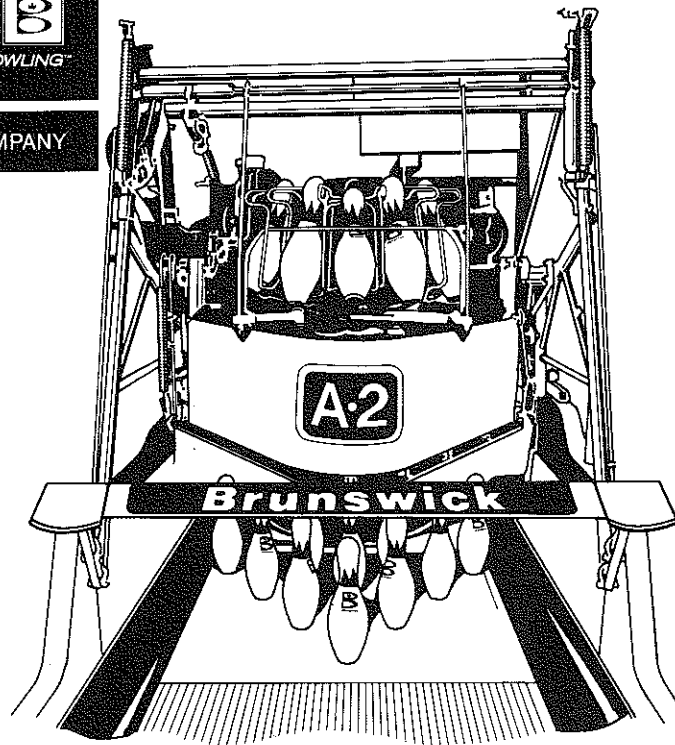


SERVICE MANUAL



Automatic Pinsetter

BRUNSWICK

SERVICE

DEPARTMENT

12-752828

A-2 Automatic Pinsetter Service Manual

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Reorder Part No. 12-752828-000

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Brunswick Bowling & Billiards Corporation
525 West Laketon Avenue
P.O. Box 329
Muskegon, MI 49443-0329
U.S.A.

231.725.3300

PINSETTER DESCRIPTION

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SECTION I

PINSETTER DESCRIPTION

INTRODUCTION

CHAPTER 1 - PURPOSE AND USE

This manual contains a complete description of the operation, maintenance and repair of the Brunswick Automatic Pinsetter, Model A-2. It also contains detailed information concerning the overall administration of an efficient pinsetter program for all bowling establishments.

CHAPTER 2 - RULES OF BOWLING

The Automatic Pinsetter was designed to replace all of the manual operations heretofore accomplished by the pinboy. A knowledge of the rules of bowling is helpful in understanding the various functions of the pinsetter; therefore, in brief, the fundamental rules of bowling are given in the following paragraphs.

Ten pins are set at the far end of the bowling lane, and the bowler rolls a ball at the pins trying to knock down as many as possible. If all the pins are knocked down with the first ball it is called a "strike". The ball is returned to the bowler and ten pins are then set up again for the bowler.

If all the pins are not knocked down by the first ball, the ball is returned to the bowler and the standing pins are left as they are. The "deadwood" (pins which were knocked down but did not fall into the pit at the rear of the pin area) are removed from the playing area so that they will not interfere with the game. The bowler then rolls the ball a second time to attempt to knock down the remaining pins. After delivery of the second ball, the ball is returned to the bowler and all ten pins are again set up on the lane whether or not any pins were left standing by the second ball. The lane is now ready for delivery of another "first ball".

At the point where the bowler releases the ball to roll down the lane, there is a black line. If the bowler's foot crosses this line while he is rolling the ball, it is considered a "foul". If the foul occurs on the first ball, all of the pins are set up again and the bowler throws a second ball, losing any possible score he made with the first ball. If the foul occurs on the second ball, he loses the points scored with the second ball only and all ten pins are set up for the next "first ball".

It is obvious then that the pinsetter was not designed merely to follow a set pattern, but must be able to respond to any condition set up by delivery of the first ball, and to operate accordingly.

CHAPTER 3 - DESCRIPTION OF PINSETTER OPERATION

The following paragraphs contain a short description of the various assemblies and operations that make up the Automatic Pinsetter (Figures 1-4). Each assembly and function of the pinsetter will be described in detail in subsequent sections of this manual.

With ten pins set on the lane and the bowler ready to deliver the first ball, the pinsetter is turned on, energizing a one-horsepower electric motor. Through a combination of pulleys and belts, the electric motor powers the pinsetter. The bowler rolls the ball which strikes the "pit cushion", thereby triggering the pinsetter. The ball knocks down some pins which fall into the "pit conveyor". The pit conveyor slopes toward the rear of the pinsetter and is constantly oscillating. The slope of the pit and the oscillation cause the pins and the ball to gravitate toward the rear of the pit.

At the rear of the pit are two large, vertically mounted, steel wheels which are constantly turning in opposite directions. One of these wheels, called the "ball elevator", lifts the ball and places it on rails which carries the ball back to the bowler. The other wheel, called the "pin elevator", receives the pins and carries them up, depositing them in the "turnaround pan".

The turnaround pan receives the pins either head first or base first, turns them, and deposits them all base first on the "cross conveyor". The cross conveyor consists, in part, of two constantly running parallel belts. These belts carry the pins across the top of the pinsetter and place them one at a time into the "turret", which in turn stores the pins until it has ten and then deposits them into the pinsetting "deck". The deck is the device that takes the ten pins and, when necessary, lowers and sets the pins on the lane.

If a bowler does not knock down all the pins with the first ball, the deadwood is removed before the second ball is delivered. This operation is accomplished by the deck and the "rake". The deck lifts the standing pins up out of the way, the rake sweeps the deadwood into the pit, and then the deck respots the standing pins in their original positions. The deck and rake are both powered by the "gear box". The gear box also contains the triggering and clutch mechanisms used to start and stop the pinsetter. One section of the gear box is the "detector", which serves to direct the various operations of the pinsetter.

The pinsetter uses two sets of pins (21), but only ten pins are ever in play at any given time. The extra set of pins is used to speed up operations so that the bowler does not have to wait for the pins to be carried from the pit to the lane.

CHAPTER 4 - PINSETTER CYCLES

One complete cycle of the pinsetter is considered to be 360°. The pinsetter is designed to be able to stop at one-quarter (90°), one-half cycle (180°), and full cycle (360°). The pinsetter must be able to respond to the varied conditions that are set up by delivery of the first ball, and it accomplishes this in the following manner: After the bowler delivers the first ball, the deck lowers toward the pin area to determine whether the bowler has thrown a strike or whether he has some pins standing. This process is called "detecting" and occurs at one-quarter cycle (90°). Determined by the conditions which the pinsetting deck detects, the pinsetter will cycle as described in the following paragraphs.

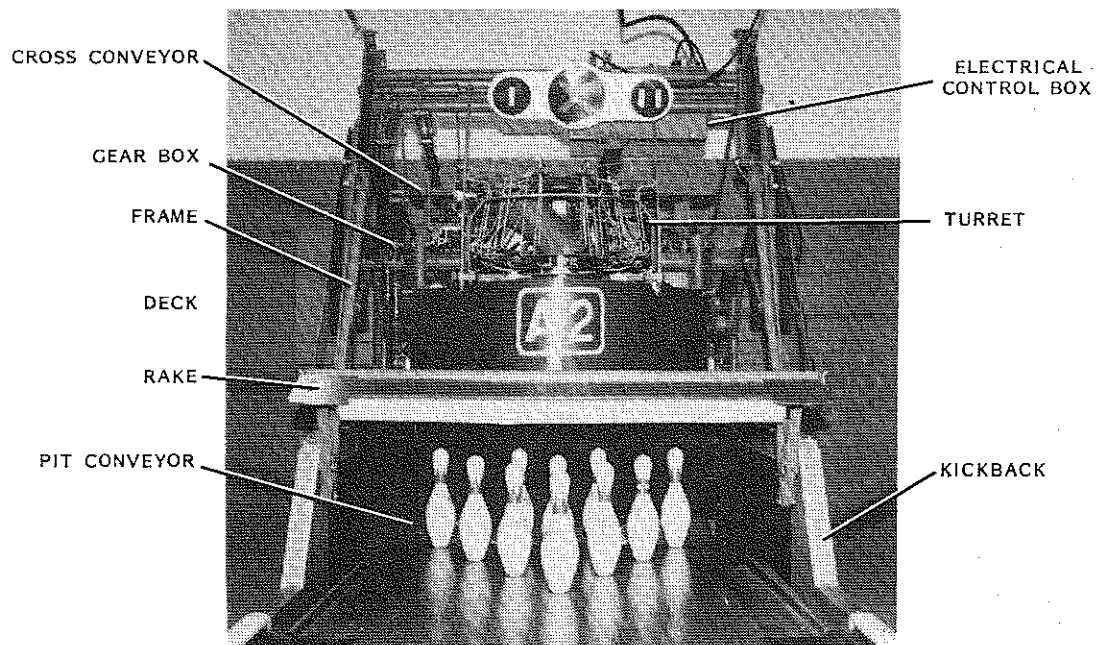
FIRST BALL, STRIKE. Bowler rolls ball. Deck lowers and finds no standing pins (90°). Deck raises and rake sweeps the deadwood into the pit (180°). Deck lowers again and sets ten new pins on the lane (270°). Deck and rake raise again and lane is ready for the next ball (360°).

FIRST BALL, STANDING PINS. Bowler rolls ball. Deck lowers and finds some pins still standing (90°). Deck takes standing pins, raises and the rake sweeps the deadwood into the pit (180°). Deck lowers and respots standing pins (270°). A second detection is made at this time. Deck and rake raise again and the lane is ready for the second ball (360°).

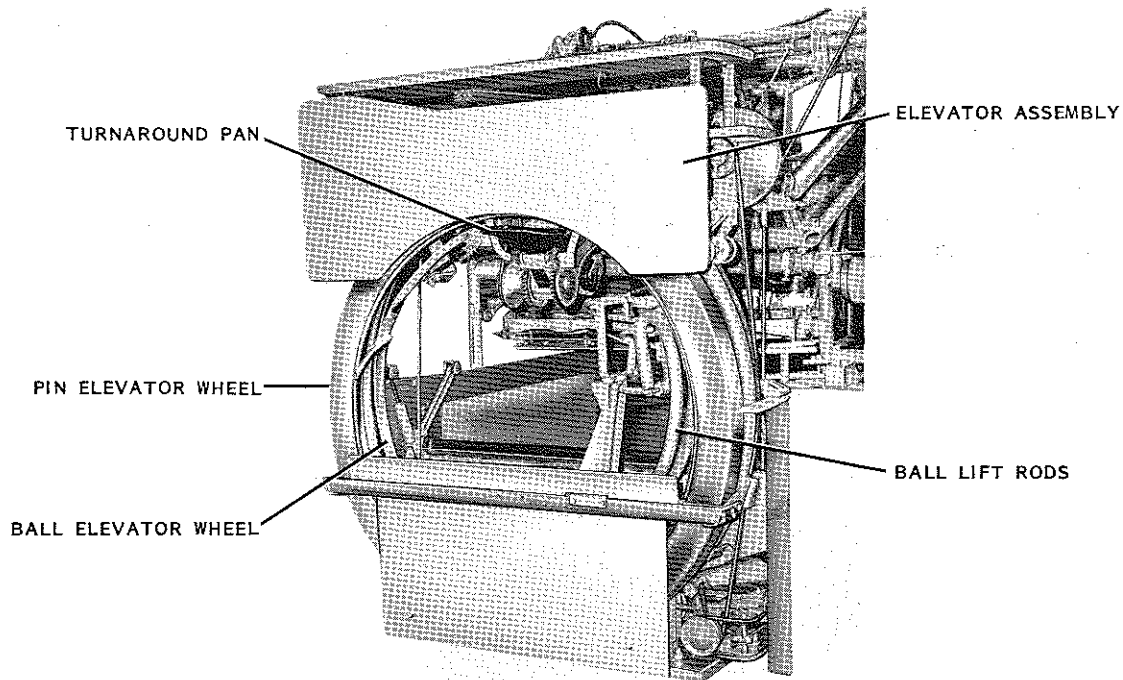
SECOND BALL. Bowler rolls ball. Deck stays up at 90° and rake sweeps the deadwood at (180°). Deck lowers and sets ten new pins (270°). Deck and rake raise and lane is ready for next ball (360°).

FIRST BALL, FOUL. Bowler rolls ball and in doing so, steps across the foul line. If all the pins were knocked down, the pinsetter will go through its normal cycle and set new pins; the bowler just loses the score of the first ball and throws a second ball. However, if standing pins were left, the pinsetter, not knowing he has fouled, will respot the standing pins. As the bowler is penalized by losing the score made on any foul ball, it is necessary for the pinsetter to sweep and set ten new pins for the bowler's second ball, even though there were pins left standing by the first ball. There is a button located at the bowler's end of the ball return which, when pushed, will cause the pinsetter to cycle. This button is called the "cycle button" and will satisfactorily handle any foul situation. Fouls which occur on second ball are no problem as the pinsetter will automatically sweep and set new pins as previously described.

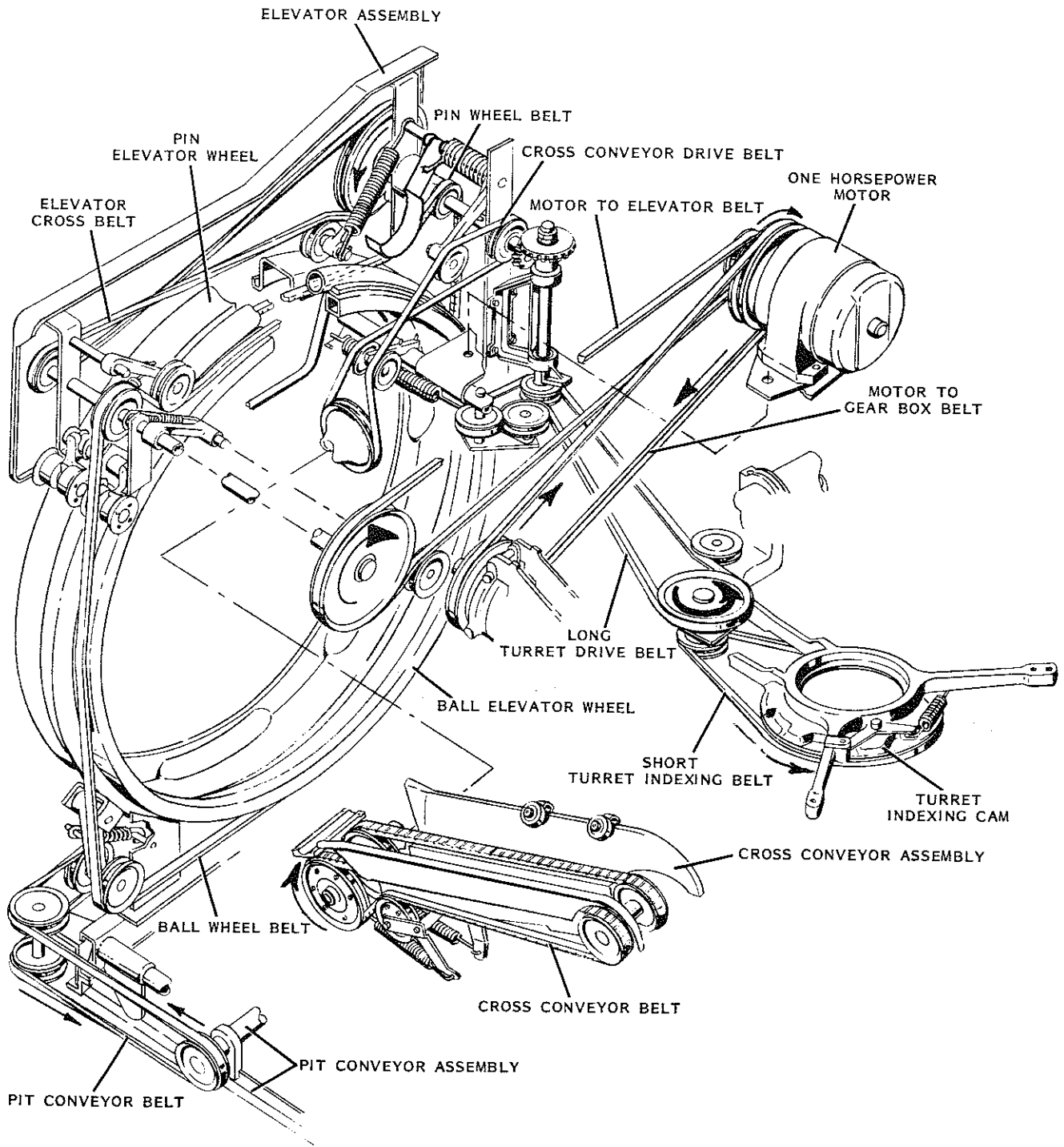
FIRST BALL, OUT-OF-RANGE PIN. There is one other condition which the pinsetter will not handle completely automatically. The ball may strike a pin in such a way that the pin moves but does not fall down. The pin may move far enough to prevent it from being lifted up by the deck while the rake sweeps. To prevent the "out-of-range" pin from being swept into the pit, the deck comes down, detects the out-of-range pin, and the pinsetter stops. Before the bowler may bowl again, it is necessary for someone to remove the deadwood manually and to pull the out-of-range reset lever, which will restart the pinsetter. There is no problem if an out-of-range pin occurs on the second ball, since the pinsetter will automatically sweep and set ten new pins.



FRONT VIEW OF PINSETTER
FIGURE 1



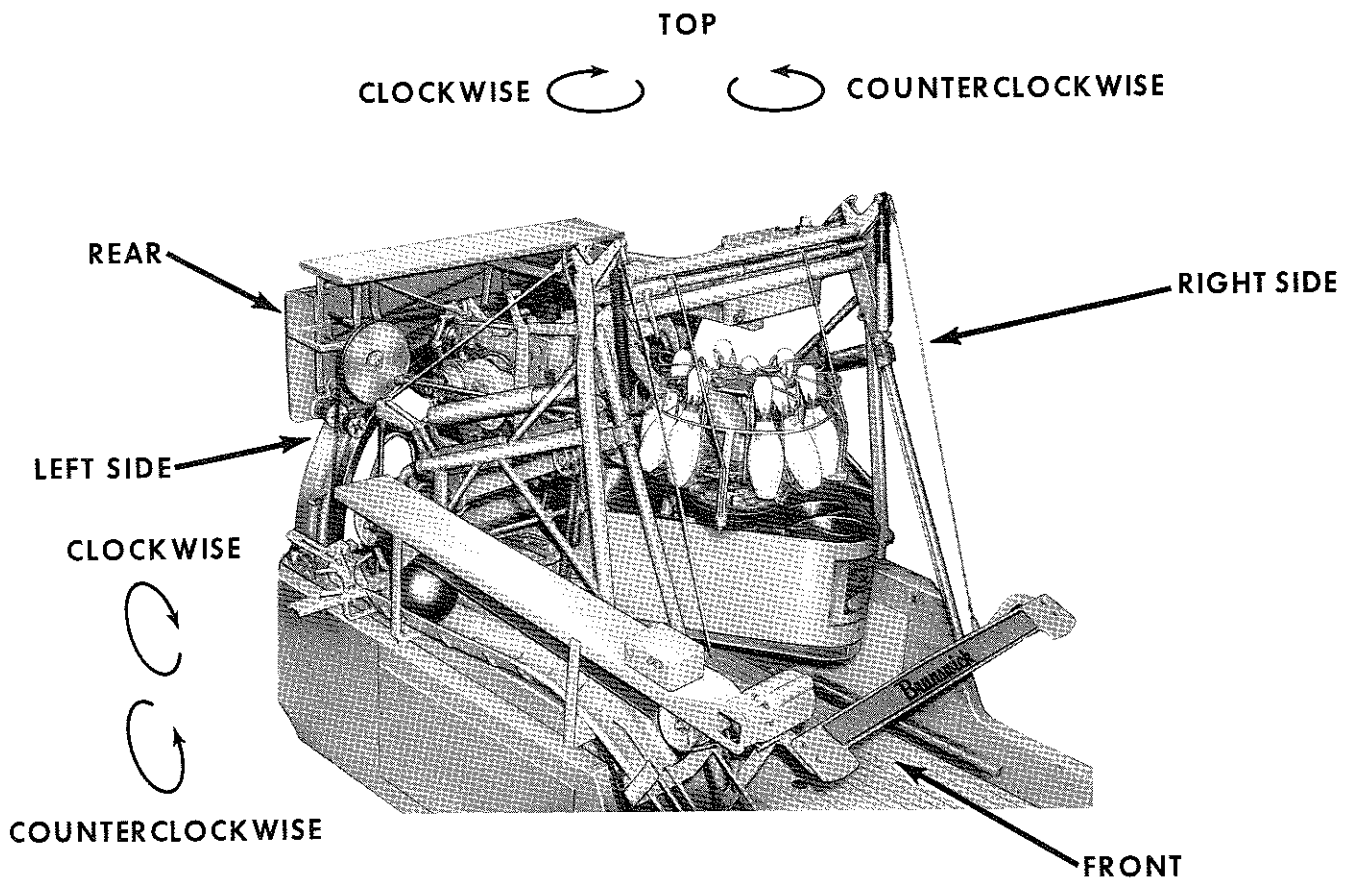
REAR VIEW OF PINSETTER
FIGURE 2



PINSETTER DRIVE BELT ARRANGEMENT

FIGURE 3

NOTE: WHENEVER ANY MOTION IS DESCRIBED IN THE TEXT SUCH AS CLOCKWISE, COUNTERCLOCKWISE, RIGHT, LEFT, FORWARD OR REARWARD, THE MOTION IS AS VIEWED FROM THE LEFT SIDE OF THE PINSETTER.



TOP VIEW OF PINSETTER

FIGURE 4

SAFETY PROCEDURES

GENERAL SAFETY REGULATIONS

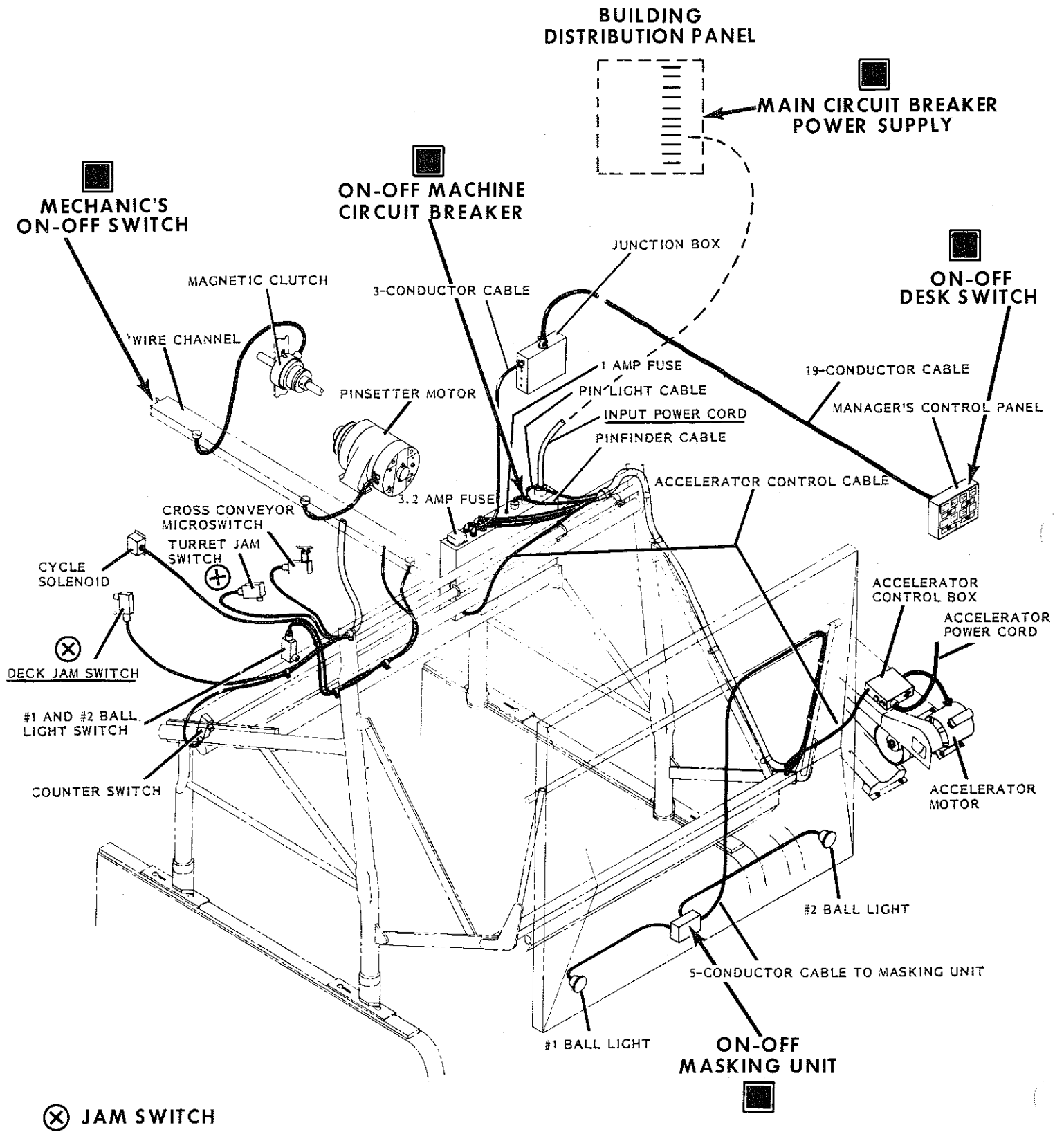
As with all machinery, there is an element of risk working on the pinsetter if the rules of safety are disregarded. Common sense, a knowledge of the machine and a knowledge of basic safety procedures will prevent injury to personnel working on the machines.

1. Wear the proper clothing when working on the pinsetter. Do not wear neckties or loose clothing that may be caught by the machine. Wear trousers without cuffs to prevent tripping. Wear shoes with safety, non-slip soles.
2. Use the right tool for each job to prevent injury to yourself and to the machine. Remove all tools from the machine before turning it on.
3. Avoid the use of cleaners which are toxic.
4. Immediately wipe up any oil or liquids that have spilled to prevent slipping.
5. Store oily rags and any other combustibles in a fireproof container.

PINSETTER SAFETY REGULATIONS

1. The mechanic must teach all personnel who will work on the pinsetters enough about the machine to prevent accidents through ignorance.
2. When the safety guards are removed from the pinsetter, be extra cautious when the machine is turned on. Replace the guards immediately when the work is completed.
3. Always open the pinsetter circuit breaker or disconnect the pinsetter power plug from the electrical box before working on the machine.
4. When the pinsetter shuts itself off electrically, be sure to open the circuit breaker or disconnect the pinsetter power plug from the electrical box before looking for, and clearing, the cause of the jam.
5. Always reach over or around the machine assemblies, never through or between the shafts, arms and levers.
6. Use the rods provided to securely lock the rake compression spring guide tube before assembling the rake or deck.
7. The desk man must never turn on a machine from the manager's control desk without first making sure that no one is working on the machine.
8. Position the rake in its down position when working on the front of the machine to prevent being hit by a bowling ball.
9. When more than one person is working on the machines, never turn on a machine without checking to see if everyone is clear of the machine.
10. Under no circumstances allow an unqualified person to work on the pinsetter.

Figure 5 details the locations of jam switches and on-off switches.



TYPICAL PINSETTER WIRING

FIGURE 5

DETAILED DESCRIPTION

CHAPTER 5 - FRAME AND SUBMOUNTING PLATES

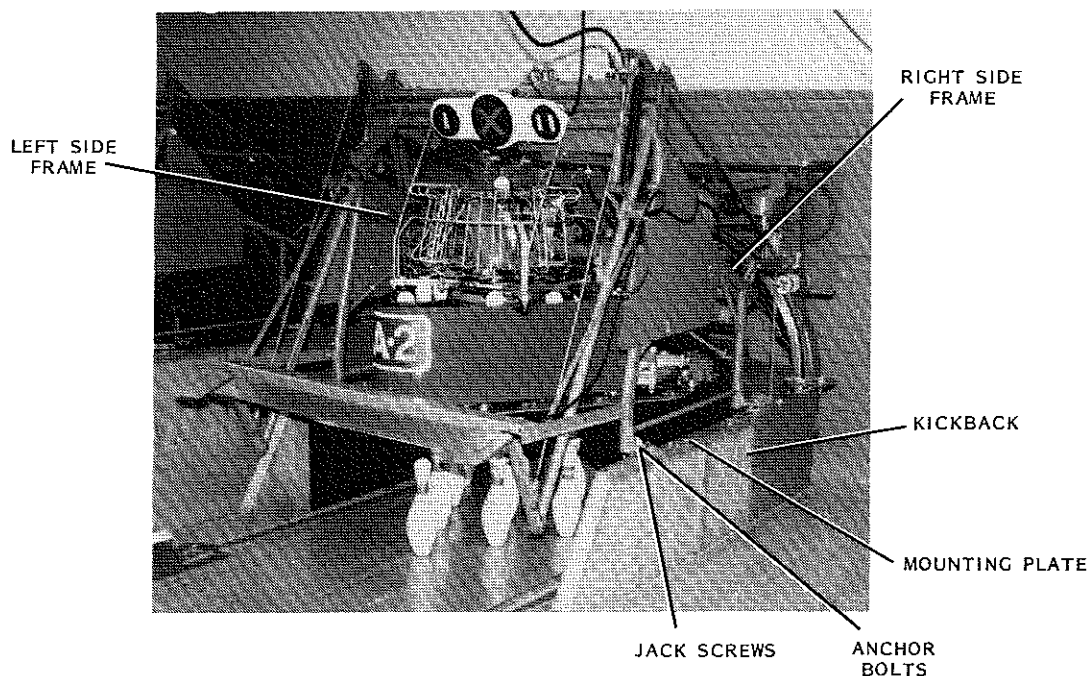
Screwed to the top of each kickback is the top mounting plate assembly. The top mounting plate runs the entire length of the kickback and consists of two steel, pinsetter mounting channels welded to a steel plate. The mounting channels have "key hole" slots to permit insertion of four anchor bolts that fasten the side frames to the kickbacks. (Figure 6)

The side frames are composed of lengths of tubular steel pipe which are welded together and mounted on each kickback using each mounting channel as an anchor point.

Flanking each of the four anchor bolts are two jack screws which can be used to level, raise or lower the side frames, thereby leveling, raising or lowering the pinsetter in relation to the lane surface.

The side frames carry between them the main cross shaft, deck lift shaft, rake sweep shaft and other miscellaneous assemblies. In general, the frame provides the main support in suspending the pinsetter above the lane and pit.

Fastened to the floor of each pit are two steel "submounting plates". Protruding from the top of these plates are six bolts, upon which are mounted the pit conveyor frame and the elevator assembly (Figure 19).



FRAME AND MOUNTING PLATES

FIGURE 6

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CHAPTER 6 - GEAR BOX AND DETECTOR

GEAR BOX INFORMATION

As of January, 1983, there are two different input worm shaft assemblies in use on automatic pinsetters. All pinsetters manufactured prior to 1983 contain a 60:1 ratio input worm shaft and a 4:1 bronze worm gear. New factory machines as of January, 1983 use a 27:1 ratio input worm shaft and a 4:1 bronze worm gear.

Each of these assemblies require a different motor to gear box belt and motor pulley. The 27:1 ratio ASSEMBLY is interchangeable with the 60:1 ratio ASSEMBLY on earlier pinsetters. It is available as a kit. Other changes have been incorporated on the 4:1 shaft assembly, the 2:1 shaft assembly, and the gear box 1:1 shaft assembly. Therefore, it is most important to read the "Service Parts Notes" added to many service replacement parts.

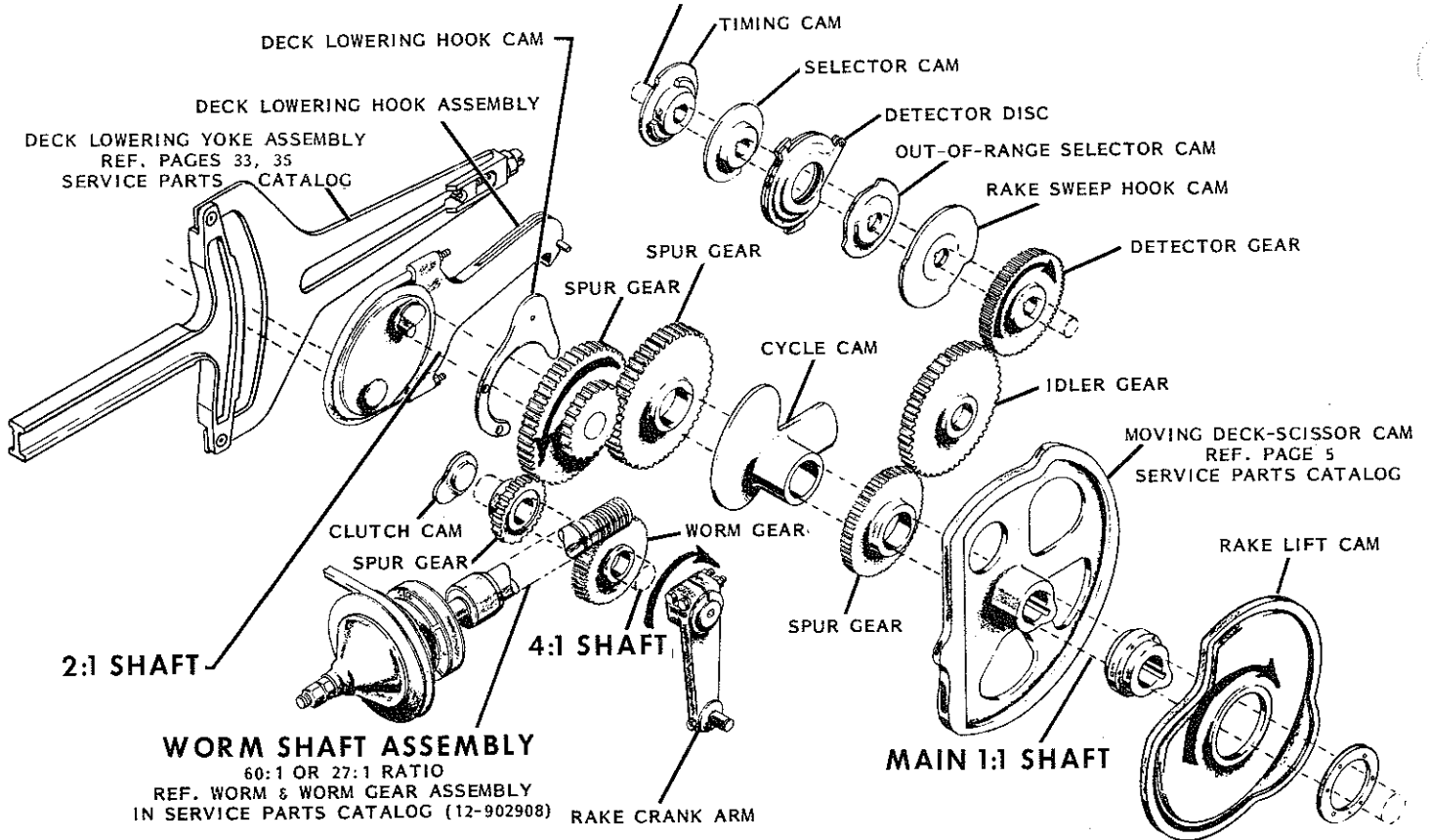
NOTE: PLEASE REFER TO YOUR SERVICE PARTS MANUAL CAREFULLY BEFORE ORDERING REPLACEMENT PARTS.

GEAR BOX CLUTCH AND DRIVE

A belt from the electric motor drives a pulley assembly mounted on the gear box power input worm shaft assembly and, through a friction clutch, drives the input shaft. By means of a gear train, shown in Figure 7, the input shaft drives the four shafts on which are mounted the cams that control the pinsetter operations.

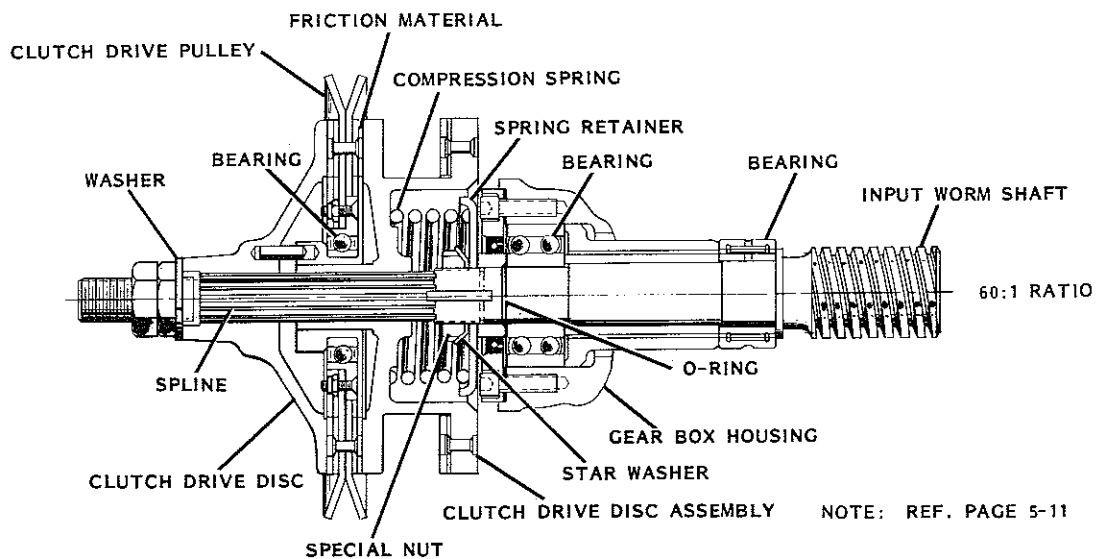
The shafts are as follows: a 4:1 shaft, a 2:1 shaft and two 1:1 shafts. A complete pinsetter cycle is considered to be 360°, or one complete revolution of a 1:1 shaft. These varying revolution-per-pinsetter-cycle shafts are required because there are operations which may occur once, twice or four times during each cycle. Mounted on the 4:1 shaft is a cam which can stop the pinsetter four times in one cycle (at 90°, 180°, 270° and 360°). Mounted on the 2:1 shaft is the deck lowering hook assembly which can raise and lower the deck twice in one cycle; once to detect and once to respot pins. On the 1:1 shafts are cams which control operations that occur only once per cycle such as the rake sweeping the deadwood. These shafts also serve other functions which will be described as they occur in the text.

DETECTOR 1:1 SHAFT



**EXPLODED VIEW OF GEAR BOX
 FIGURE 7**

Mounted on the input worm shaft assembly is a friction clutch mechanism (Figure 8) which can be engaged or disengaged to start and stop the gear box. A clutch drive disc and a clutch drive disc assembly engage splines on the worm shaft assembly. Between these discs and engaging their adjacent faces with friction material is the clutch drive pulley assembly which is driven by a belt from the motor. The pulley assembly is free to run on a bearing on the hub of the clutch drive disc assembly. A compression spring, backed up on the shaft by a spring retainer, urges the disc assembly to the rear, and unless restrained, will force the discs and pulley assembly together, thereby engaging the clutch and turning the shaft.



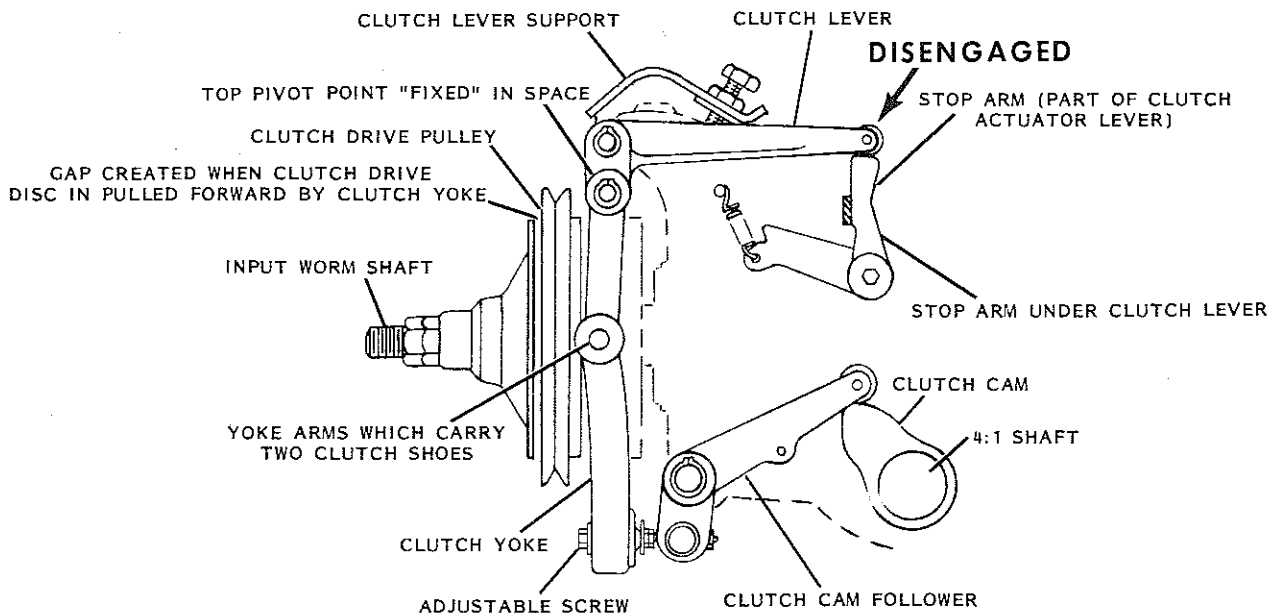
**GEAR BOX CLUTCH
 FIGURE 8**

The clutch is disengaged through a V-shaped clutch yoke assembly which straddles the clutch drive disc assembly (Figures 13 and 14). The yoke assembly is hinged at the top to an arm of the clutch lever which is pivoted on the gear box housing. About midway down on the yoke assembly and pivoted on the yoke arms, are a pair of clutch shoes which ride in a groove of the clutch drive disc assembly. The yoke assembly is connected at the bottom through an adjustable screw and spring to an arm of the clutch cam follower lever on the side of the gear box housing. The action of this clutch cam follower lever is controlled by the cam follower riding the gear box clutch cam which is mounted on the 4:1 shaft.

Four times in every cycle, as the clutch cam rotates, the lobe on the clutch cam will rotate the clutch cam follower lever. This movement of the follower lever will disengage the clutch at 90°, 180°, 270° and 360°, if desired. A stop arm can be moved under the free end of the clutch lever at 90°, 180°, 270° and 360°. When this arm is under the end of the clutch lever, the clutch will disengage as the lobe of the clutch cam rotates the clutch cam follower lever. When the stop arm is not under the clutch lever, the clutch will not disengage when the lobe of the clutch cam rotates the clutch cam follower.

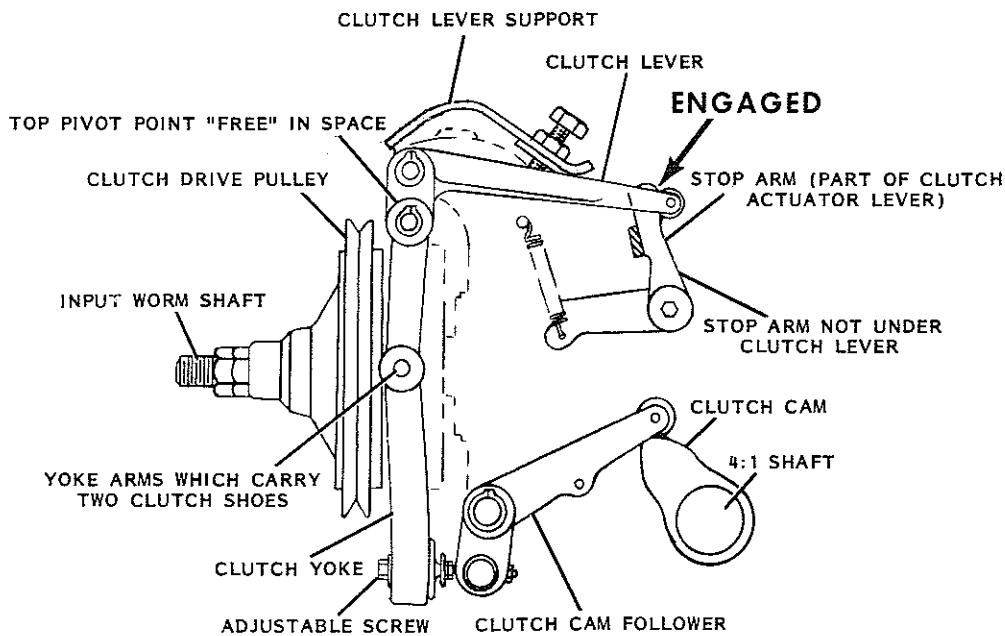
As the rising slope of the clutch cam rotates the clutch cam follower lever counter-clockwise, the lever moves the lower end of the yoke assembly forward through its adjustable connection to the yoke assembly. If the stop arm is not under the end of the clutch lever, the forward motion of the bottom of the yoke assembly will have no affect, since the top of the yoke assembly will move to the rear, the yoke assembly will pivot on the clutch shoes, and the shoes will continue to ride in the slot in the clutch drive disc assembly (Figure 10). The clutch will be "engaged".

If the stop arm is under the end of the clutch lever, the top pivot point of the yoke assembly becomes fixed in space as the clockwise motion of the clutch lever is restricted by the stop arm. The entire yoke assembly will pivot from the top pivot point as the bottom of the yoke is moved forward. As the bottom of the yoke assembly is pulled further forward, the front side of the clutch shoes will contact a friction surface in the slot of the clutch drive disc assembly and force the disc assembly forward until it actually loses contact with the drive pulley. Relieved of pressure between the clutch discs, the drive pulley is free to rotate on its bearing without driving the clutch drive disc and worm shaft (Figure 9). The clutch will be "disengaged".



GEAR BOX CLUTCH - DISENGAGED

FIGURE 9



GEAR BOX CLUTCH - ENGAGED
FIGURE 10

27:1 INPUT SHAFT

The 27:1 ratio drive is a "Energy Efficiency Drive" developed by Brunswick to aid the National Energy Conservation Program.

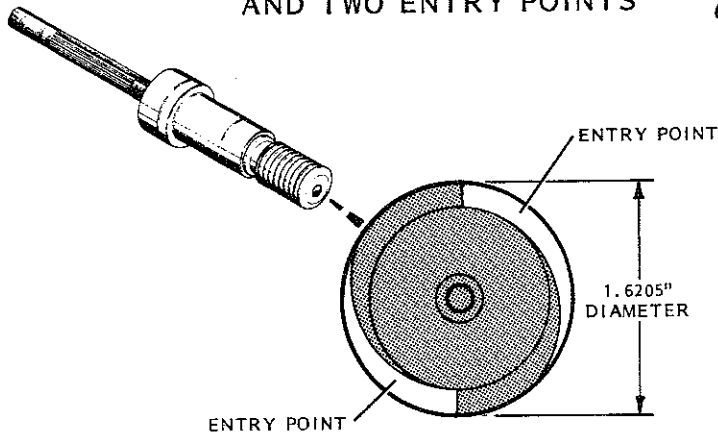
The 27:1 input shaft is not interchangeable with the 60:1 shaft individually. Both the input shaft and bronze gears on the 4:1 shaft must be changed. The motor to gear box belt and motor pulley must also be changed in a conversion.

Factory built 27:1 input shaft assemblies have a yellow identification tag attached to the top of the gear box. Customers must add this "identification" tag to converted units.

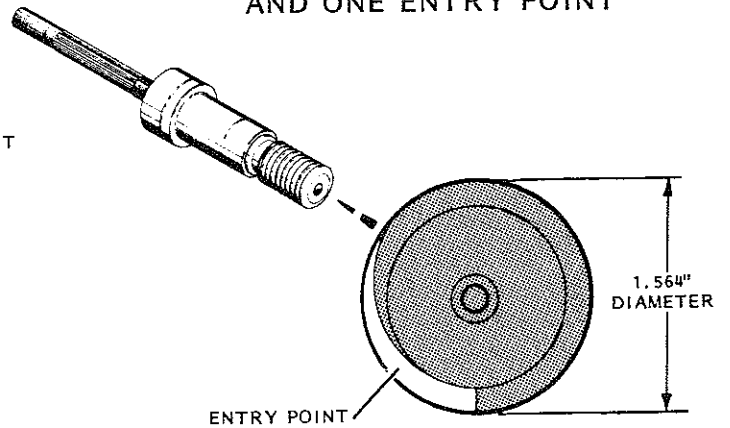
Important: The input shaft and bronze gear no longer have a locking effect on the gear box shaft assemblies. Thus, when the motor to gear box belt and the motor to elevator belts are removed, it is necessary to place a jack stand under the deck when positioning the deck at various heights. Do not rely on the holding hook for support.

Care must be exercised when working on the gear box with its related cams, shafts, and detector assemblies. Figures 11 and 12 detail the way to identify 27:1 and 60:1 worm shafts and worm gears. Later parts will have stamped identification.

27:1 - 1.6205" DIAMETER WORM
AND TWO ENTRY POINTS

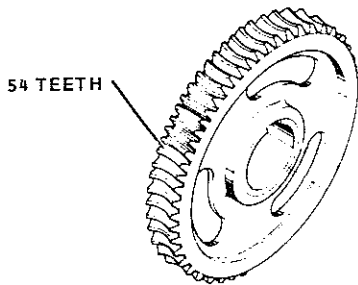


60:1 - 1.564" DIAMETER WORM
AND ONE ENTRY POINT

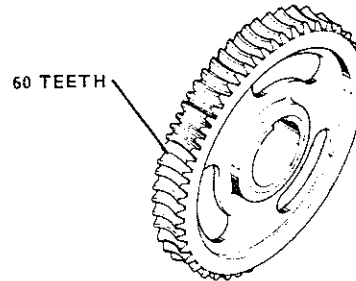


WORM SHAFT
FIGURE 11

27:1 - 54 TEETH



60:1 - 60 TEETH



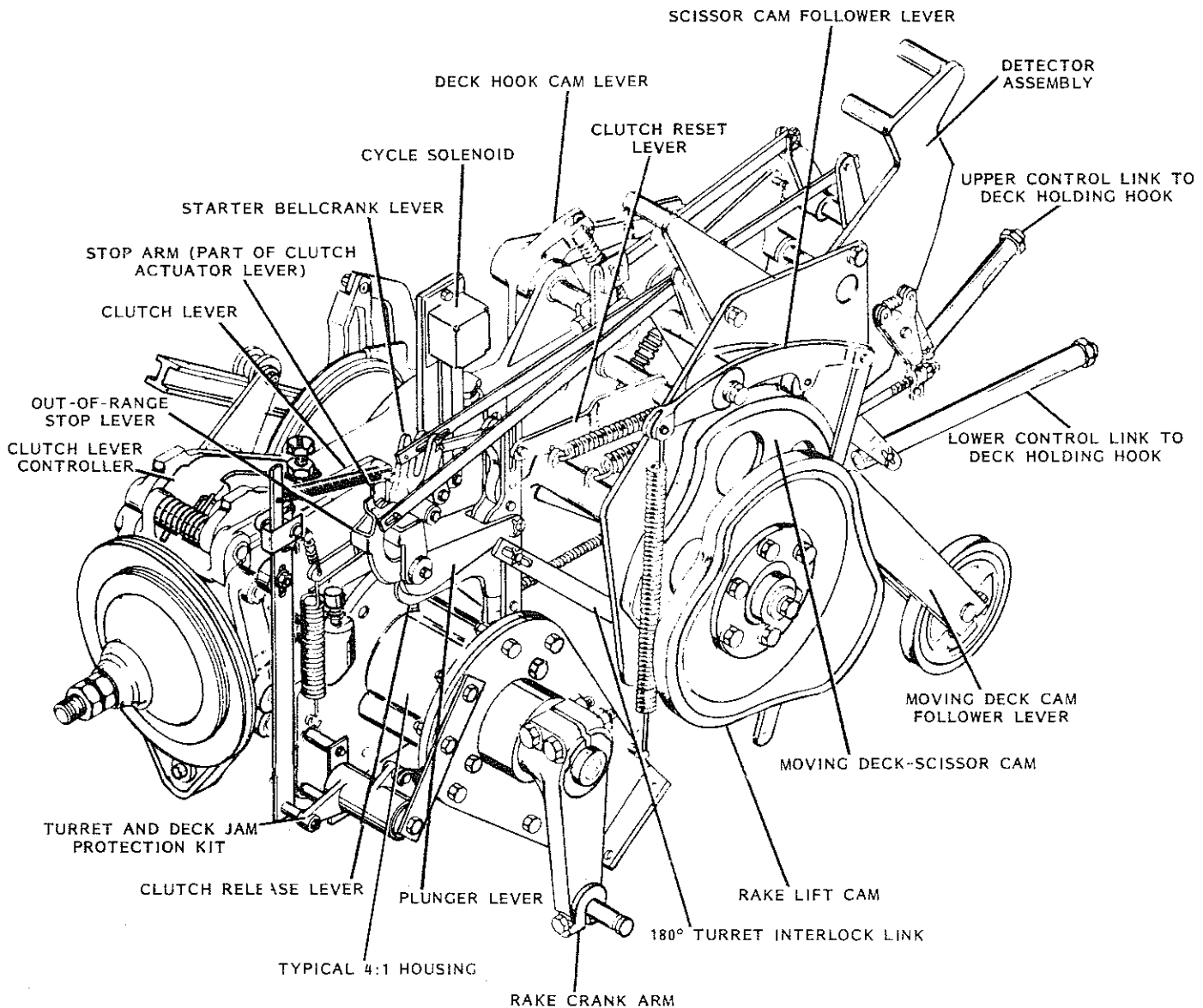
WORM GEAR
FIGURE 12

GEAR BOX START AND STOP OPERATION

The gear box requires a triggering mechanism to engage the clutch to start a machine cycle and a mechanism to control the stop arm so that it will be in the proper position to stop or not stop the pinsetter as the clutch cam rotates the yoke at 90°, 180°, 270° and 360°.

Before describing the actual mechanisms, it will be helpful to understand why it may be necessary for the pinsetter to stop at various times during a cycle. The pinsetter must be able to stop at 90° during an out-of-range cycle to permit the deadwood to be manually removed from the playing area. At 180°, when the deck is up before lowering to set new pins, the pinsetter must be able to stop if for any reason the deck does not have ten pins to deliver to the lane. The pinsetter must also be able to stop at 360° to await delivery of the next ball. There is no need to stop at 270°.

Part of the start-stop mechanism (Figures 13 and 14) consists of three levers: the "clutch actuator" lever, the "plunger" lever and the "clutch release" lever. All of these levers are pivoted on the same shaft, but are free to rotate independently of each other. The clutch actuator lever carries the stop arm which can move under the clutch lever to disengage the clutch. A spring on the stop arm urges it clockwise into its stop position. The plunger lever is pinned at one end to an enclosed slot in the clutch actuator link and is connected at the other end to the plunger of a dashpot which absorbs the shock of the rotation of the triggering mechanism. The plunger lever is spring-urged in a counter-clockwise direction. The third lever, the clutch release lever, carries a pin riding in an open slot in the clutch actuator link. The clutch release lever has a top projection which can contact the stop arm and move it backward, out from under the clutch lever, thereby engaging the clutch to start the cycle.



ISOMETRIC VIEW OF GEAR BOX

FIGURE 13

With the clutch disengaged and the triggering device latched, a spring on the plunger lever is trying to urge these two levers counterclockwise. At the same time, a reset pin in the open slot of the clutch actuator is on top of the clutch latch. The levers are prevented from moving counterclockwise and the clutch actuator link is prevented from rising by the clutch latch being held by a pin on the clutch reset lever. The reset lever is positioned by a cycle cam. The clutch latch is spring-urged in a forward, latched direction and is attached through a short connection to the starter bellcrank lever.

When a ball strikes the pit cushion, the cushion pivots slightly to the rear and through a collapsible release mechanism, lowers the rake board to its sweeping position. As the rake lowers, the rotation of the rake lift shaft mechanically activates an electrical "time delay" mechanism inside the pinsetter electrical control box. The time delay mechanism allows sufficient time for wobbling pins to fall, and then energizes the cycle solenoid.

The cycle solenoid is mounted to the gear box directly above the starter bellcrank lever and is attached to the starter bellcrank lever through a triggering link. When the cycle solenoid is energized, the triggering link is pulled upward, thus rotating the starter bellcrank counterclockwise and, through the short connection, pulls the clutch latch from under the pin on the clutch reset lever.

With the clutch latch withdrawn from under the pin, the plunger lever, being spring urged in a counterclockwise direction, rotates counterclockwise to force the actuator link upward. The actuator link then comes to a stop as the plunger lever stop collar contacts the top of the dashpot, preventing further rotation. Note: Later machines have a stop post rather than a stop collar. The upward motion of the actuator link causes the clutch release lever to rotate counterclockwise. The projection on the clutch release lever will contact and rotate the actuator lever (stop arm) from under the clutch lever to engage the clutch as previously described.

The time delay mechanism is used on a first ball cycle only, to prevent the deck from lowering too quickly and contacting wobbling pins. On a second ball cycle, the deck does not lower to detect pinfall. Therefore, the time delay mechanism is by-passed electrically which energizes the cycle solenoid immediately upon ball impact. The time lapse between ball impact and the rake sweeping the remaining pins from the lane is adequate to allow wobbling pins to fall.

The initial impulse which energizes the cycle solenoid to engage the gear box clutch can come from two sources: the ball impact as previously described and from depressing the cycle button at the rear of the pinsetter or the cycle button on the ball return rack. The latter method will be explained in a later section.

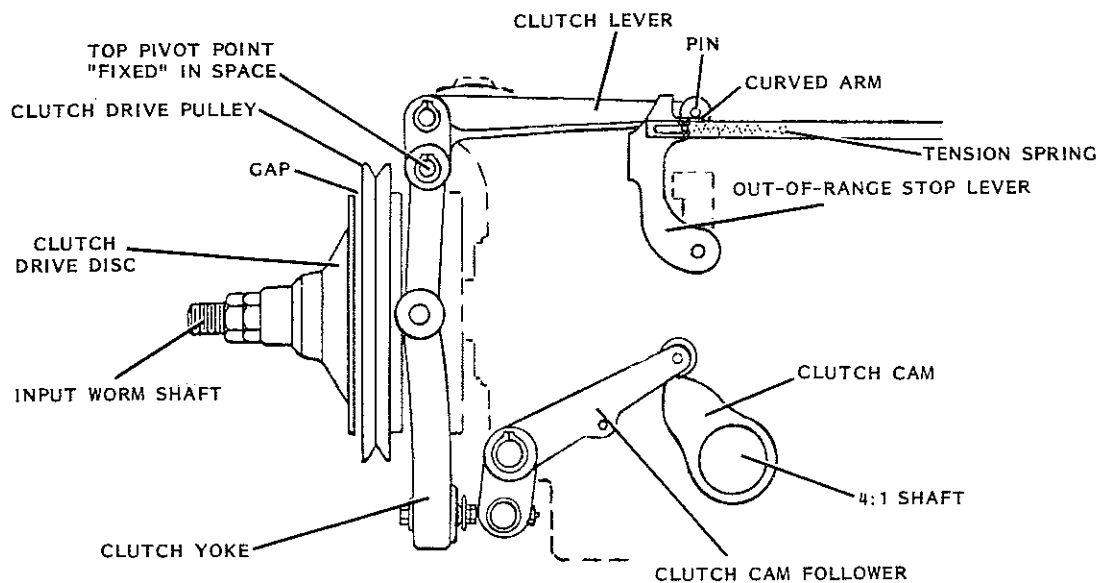
STOPPING THE MACHINE

There are two separate methods required to stop and restart the pinsetter. At the end of a strike cycle or standing pin cycle, the pinsetter is required to stop at 0° with the clutch latch under the reset lever pin and all levers in position so it requires ball impact to engage the clutch. At 180°, however, the pinsetter may have to stop if the deck does not have ten pins to deliver to the lane, and then restart without ball impact after the deck receives the ten pins. This requires a special 180° stop mechanism to be explained later.

The clutch reset lever, carrying a cam follower, is spring-urged clockwise to follow the contour of the cycle cam mounted to the 1:1 shaft. As the cam follower reaches the low point on its cam, the clutch reset lever is at its furthest clockwise position and has raised the pin in the clutch actuator link high enough for the clutch latch to snap into its latched position. A rising slope of the cycle cam then rotates the clutch reset lever counterclockwise, pushing the actuator link down, thereby rotating the clutch release lever and plunger lever clockwise. This allows the clutch actuator lever to rotate in its spring-urged, clockwise direction, bringing the stop arm under the clutch lever and the clutch will disengage at 360°.

OUT-OF-RANGE STOP

Mounted on the same pivot shaft with the clutch release lever, plunger lever and actuator lever is the C-shaped out-of-range stop lever which carries a projection and curved arm. The out-of-range stop lever is connected to a lever in the detector through a slotted link. A tension spring from the link to the lever urges the connecting pin on the lever to the forward end of the slot. The reset link is connected to the out-of-range lever and extends beyond the rear of the pinsetter. When the deck detects an out-of-range pin, the lever in the detector rotates, and through the link and tension spring, rotates the out-of-range stop lever clockwise. This positions the curved arm under a pin in the clutch lever. Then, when the clutch lever moves downward at 90°, the pin will contact the curved portion of the out-of-range stop lever, thereby preventing further rotation of the clutch lever. The gear box clutch will then disengage at 90° during an out-of-range cycle. (Figure 15)



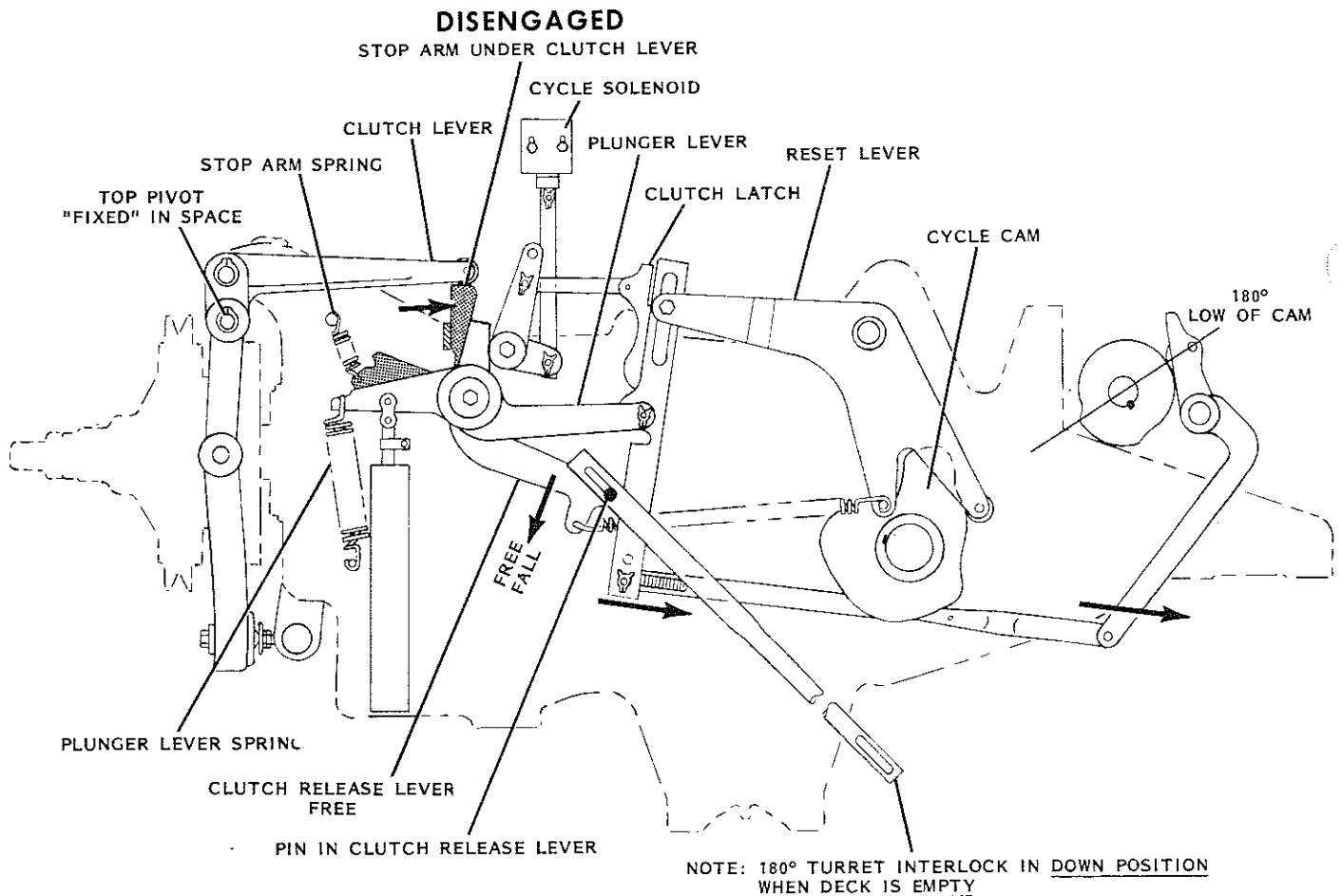
GEAR BOX CLUTCH - 90° OUT-OF-RANGE STOP

FIGURE 15

After the deadwood has been manually removed from the playing area, the operator pulls the out-of-range reset lever. This action rotates the out-of-range stop lever from under the clutch lever as the tension spring stretches and allows the connecting pin to move in the slot of the connecting link. The counterclockwise rotation of the out-of-range stop lever from under the clutch lever will re-engage the gear box clutch to permit the pinsetter to continue its cycle.

180° STOP

There is one other stop required of the pinsetter. If for any reason the deck, at 180°, does not have ten pins to deliver to the lane at 270°, the clutch must disengage. As the pinsetter cycles toward 180°, the clutch reset lever follows the down slope of the cycle cam, and the reset lever rotates clockwise and eliminates the pull on the spring which connects the reset lever with the clutch release lever. The clutch reset lever now rides on the extended low dwell of the cycle cam. Although the dwell is low enough to eliminate the pull on this spring, it is not low enough to rotate the clutch reset lever far enough clockwise to permit the clutch latch to snap under the pin. At this point the clutch actuator link, connected at its lower end to the pin detector link, is pulled forward by this link to allow the pin on the clutch release lever to drop out of the open slot in the actuator link. The clutch release lever, being freed of the control of the actuator link, will rotate clockwise by its own weight and bring the stop arm under the clutch lever to disengage the clutch at 180° (Figure 16). This provides for the 180° stop to wait for pins. The clutch is disengaged without the clutch latch being under the pin on the reset lever, but a method to re-start without a ball impact is required.



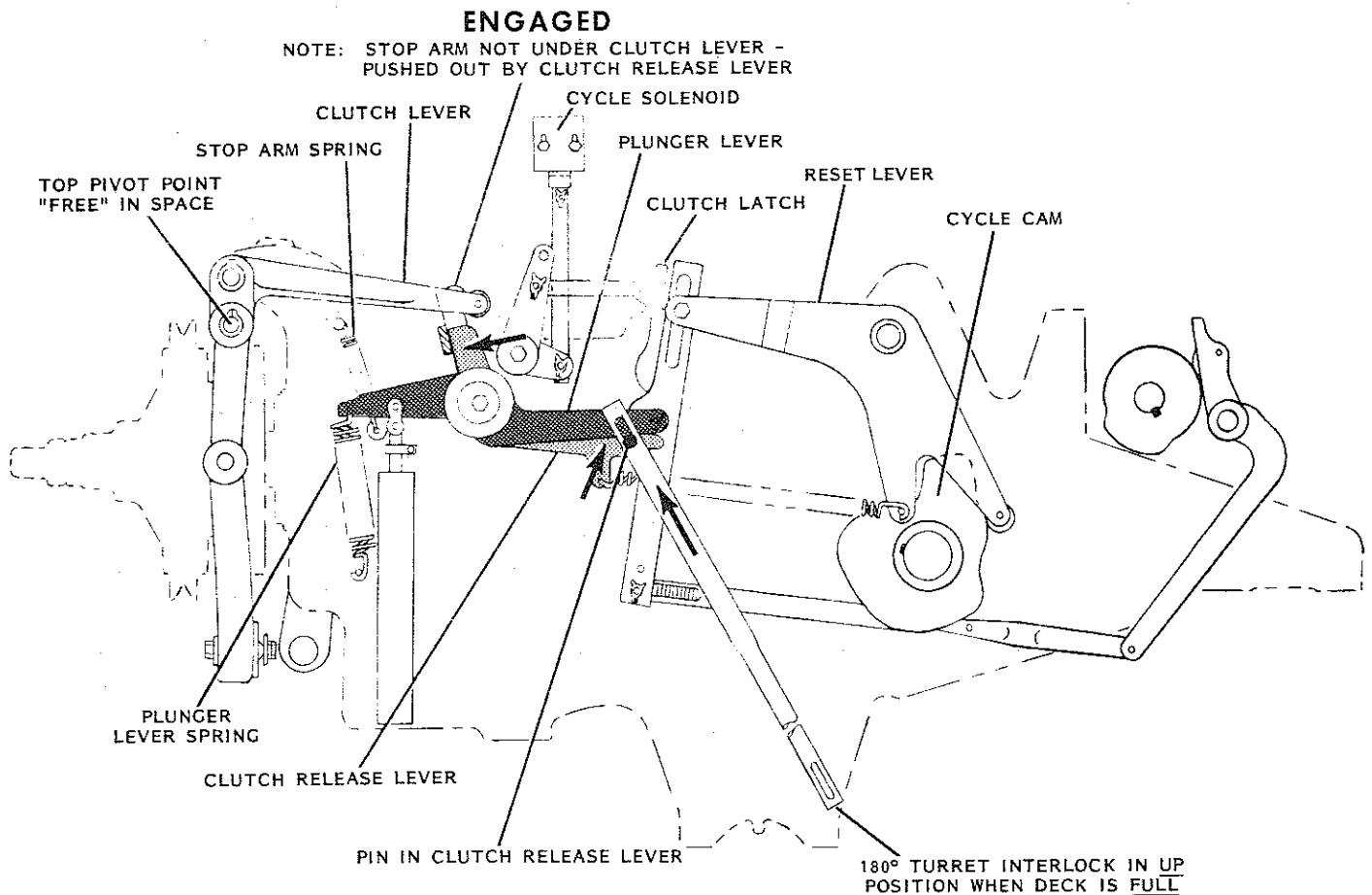
GEAR BOX - 180° STOP (DECK EMPTY)

FIGURE 16

An additional requirement is to make the 180° stop selective; to disengage the clutch if the deck does not have ten pins, and to not disengage the clutch if the deck does have ten pins at 180°. These requirements are met by bringing the clutch release lever under the complete control of the turret interlock link.

A slot in the top of the turret interlock link carries the pin on the clutch release lever which normally rides in the open slot in the clutch actuator link. The method by which this interlock link is controlled will be described in the interlock section. The turret interlock link controls the 180° start-stop in the following manner: If the deck has ten pins at 180°, as the clutch actuator link swings to the right and the pin on the clutch release lever moves out of the open slot in the clutch actuator link, the interlock link will be in an upward position. This will forcibly prevent the stop arm from rotating in its spring-urged, forward direction into its stop position, and the clutch will not disengage at 180°. (Figure 17) If the deck does not have ten pins at 180°, as the clutch actuator link is swung to the right, the interlock link will be in its downward position and the pin on the clutch release lever will be free to move downward in the slot of the interlock link. The clockwise rotation of the release lever will allow the stop arm to rotate into its stop position under the clutch lever to disengage the clutch at 180°. As the turret indexes after delivering ten pins to the deck, the interlock link will be pushed upward, and through the clutch release lever, it will rotate the stop arm out from under the clutch lever. The clutch will then engage without a ball impact.

This 180° stop completes the three stops necessary in the proper functioning of the pinsetter: 90° (out-of-range pin), 180° (waiting for pins), and 360° (end of cycle). No stop is required at 270°.



GEAR BOX - NO 180° STOP (DECK FULL)

FIGURE 17

DETECTOR ROD POSITIONING

The detector assembly can be considered the brain of the pinsetter. It stores knowledge and directs the operation of the pinsetter in handling any of the different situations that are set up by delivery of the first ball. The complete operation of the detector assembly will not be described at this time, but will be described in detail in another section of this manual.

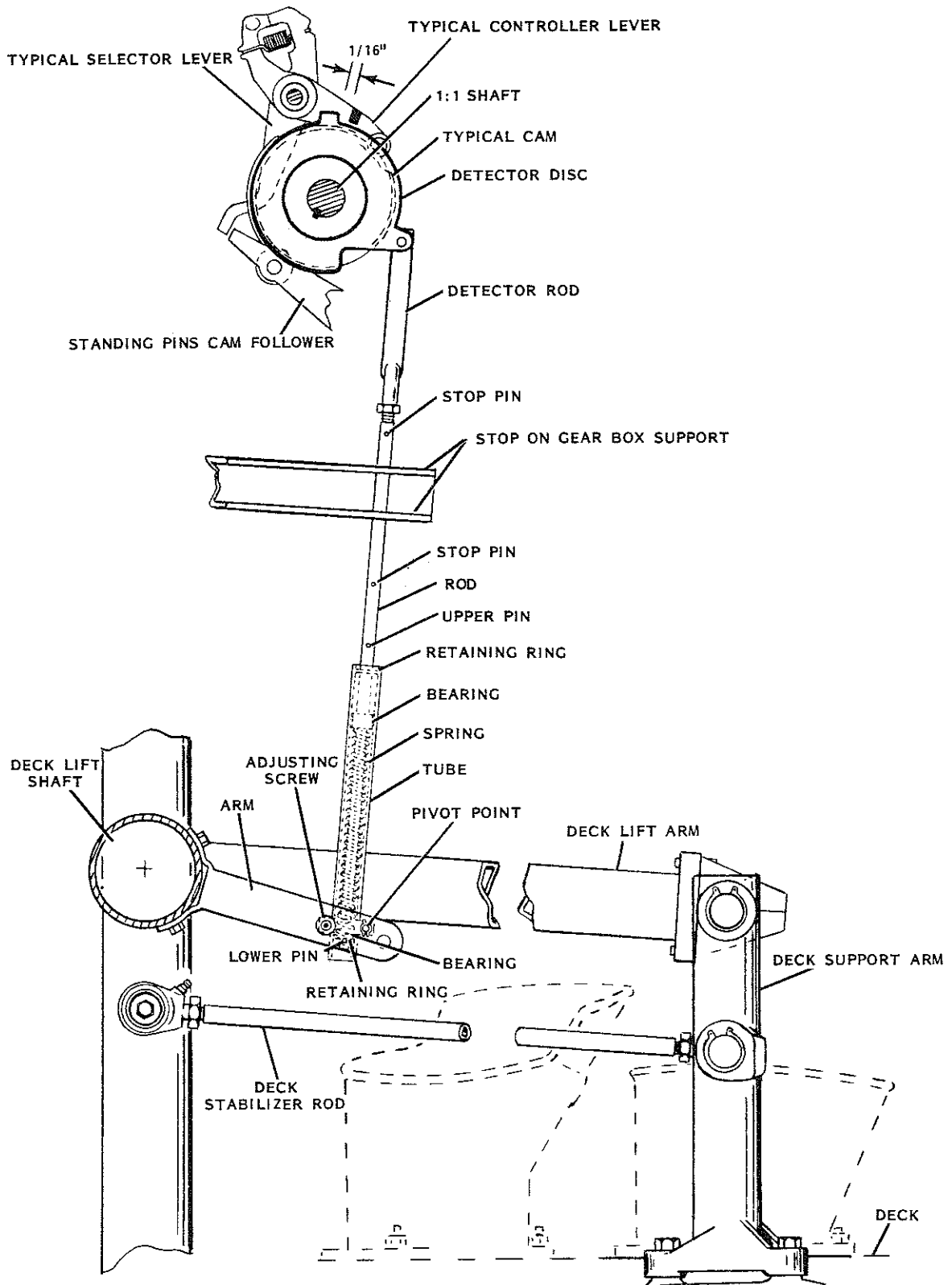
Mounted on the detector assembly 1:1 shaft are four cams (two on each side of the detector disc) in addition to appropriate cam followers, rollers, latches and linkage. The detector disc has cutouts in both faces around its outer perimeter. When positioned in the proper relation to a cam follower or latch, these cutouts will permit the cam follower to follow its cam or will raise or lower a latch.

The detector disc (Figure 18) is freely mounted on the 1:1 shaft and is connected to an arm on the deck lift shaft by the detector rod. The detector disc will rotate with the deck lift shaft so that for every position of the deck in its up and down motion, there is a corresponding position of the disc. In this manner, the cutouts on the disc are brought into position at the proper time to allow the cam followers to follow or not follow their cams and to raise and lower latches as required.

When the deck lowers to detect after first ball delivery, the deck will come down and be supported by any pins still standing. This positions the detector disc to allow the scissors to close. This is called a "no-strike" detection. If there are no standing pins, the deck will lower to the full extent of the deck lowering hook. This positions the disc to direct the pinsetter through a strike cycle.

The detector rod consists of a hollow tube pivoted at the bottom to an arm on the deck lift shaft. Inside the tube are two oilite bearings which are free to slide on a rod inside the tube between an upper and lower retaining ring. The oilite bearings are normally urged apart by a spring against pins at the top and bottom of the tube. The top of the rod is pinned to the detector disc. As the deck lift shaft rotates upward, the detector rod, through the lower retaining ring, oilite bearings, and lower pin, is moved upward until a stop pin on the exposed part of the rod is physically halted by hitting a stop on the gear box support. Any further rotation of the deck lift shaft will merely compress the spring in the tube without moving the rod and detector disc.

In the same manner, as the deck lift shaft rotates down, the rod, through the upper retaining ring, oilite bearings, and the upper pin, will come down until another stop pin on the exposed part of the rod is halted by the stop on the gear box support. Any further rotation of the deck lift shaft will merely compress the spring without further movement of the rod or disc. Except for this lost motion after the pins hit the stops going up or down, it can be seen that the detector disc has a position for every position of the deck.

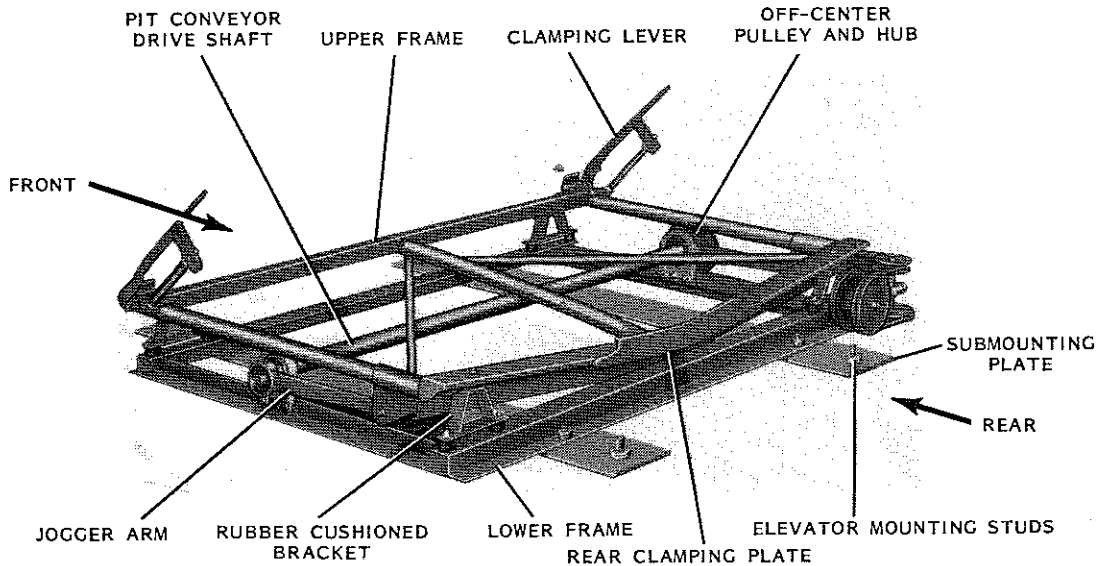


DETECTOR DISC AND DETECTOR ROD
 FIGURE 18

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CHAPTER 7 - PIT CONVEYOR

The pit conveyor assembly (Figure 19) moves the ball and pins to the ball and pin elevators at the rear of the pinsetter. The pit conveyor consists of a lower, stationary metal frame, rigidly fastened to the submounting plates at the bottom of the pit. Above this lower frame is another metal frame which is bolted to the fixed frame through four rubber-cushioned brackets so that it can wobble on its brackets in relation to the lower, fixed frame.



PIT CONVEYOR
FIGURE 19

Clamped to the upper frame between two front clamping levers and a stationary rear plate is the pit board. The pit board consists of a concave, plywood board on which is cemented a rubber backing and carpet. The board is shaped to move the ball and pins toward the rear as the pit conveyor is agitated back and forth.

The two clamping levers are pivoted to brackets mounted to the front end of the upper frame. Attached to the pivot pins are two L-shaped clamps that pivot with the motion of the clamping levers. Connected to each clamping lever is a rod and compression spring. When the clamping levers are raised, the compression springs urge the levers up, thereby rotating the "L" clamps to release the pit board for removal. When the clamping levers are lowered, the "L" clamps are positioned over the pit board and the springs hold the levers and clamps in their locked positions.

The power to agitate the pit board is supplied through a series of belts and pulleys. The same belt that turns the ball elevator also turns a pulley mounted to an arm that pivots from the bottom of the elevator frame at the left, rear corner of the pit. This pulley drives another pulley mounted on the same arm. The second pulley carries a belt which rides over two idler pulleys and drives a pulley mounted off center on an off-center hub of the pit conveyor drive shaft. The shaft runs across the middle of the pit and is bearing-mounted at each end to a bracket attached to the fixed, lower frame. Attached to the off-center hubs on each end of the shaft are two bearing-mounted jogger arms that are connected to the upper frame. Because of the eccentric relationship of the two centers of the shaft, the jogger arms constantly agitate the upper frame and pit board back and forth as the shaft is rotated, and the ball and pins move toward the rear of the pit.

CHAPTER 8 - BALL ELEVATOR

The ball elevator (Figure 20) receives the ball from the pit conveyor and carries it up to the ball return track. It consists, in part, of a large steel wheel supported by two nylon flanged guide rollers at the bottom and two at the top.

A belt from the electric motor drives a pulley mounted on the ball wheel drive shaft. Fixed to the same shaft is another pulley which drives a belt carried around the outer perimeter of the ball elevator wheel. This belt has a spring-loaded tensioning pulley. Concentric with the inside diameter of the steel wheel are the ball lift rods, which consists of a pair of curved, rubber-covered rods which are pivoted at the bottom and spring-loaded at the top. As the ball reaches the ball elevator, it wedges itself between the inner surface of the rotating ball elevator wheel and the ball lift rods and is carried up and deposited on the ball return tracks. Refer to Figure 3 for the pinsetter drive arrangement.

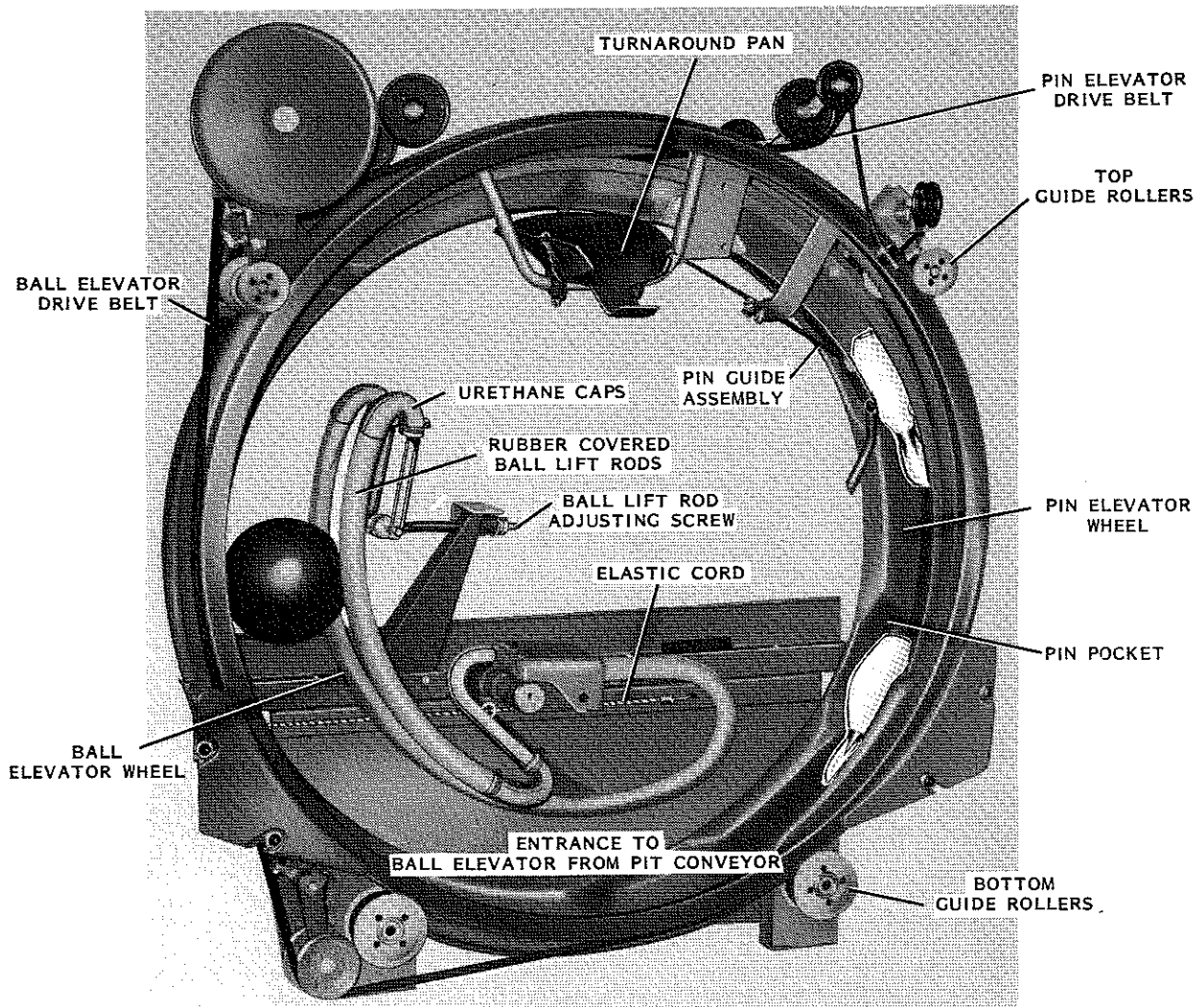
A spring-loaded, elastic cord is positioned adjacent to the path of the ball as it starts up the ball lift rods. This pin deflector cord will permit the ball to pass without interruption, but will deflect any pin being carried up by a returning ball, thus preventing pins from being placed in the ball tracks.

CHAPTER 9 - PIN ELEVATOR

The pin elevator (Figure 20) receives the pins from the pit conveyor and carries them up to the cross conveyor. The pin elevator consists, in part, of a large steel wheel at the rear of the ball elevator, and is supported by two nylon flanged guide rollers at the bottom and two guide rollers at the top. On the same jack shaft (ball wheel drive shaft) with the pulley that drives the ball elevator is another pulley carrying a belt that runs across the rear of the pinsetter to a pulley on the pin wheel drive shaft. On this shaft is an additional pulley that drives a belt which runs around the outer perimeter of the pin elevator. This belt turns the pin elevator in the opposite direction to which the ball elevator turns. The pulley that drives the pin elevator belt is powered through a magnetic clutch. Refer to Figure 3 for the details of this drive arrangement. In the event that the cross conveyor is full, the magnetic clutch will disengage and the pin elevator will stop turning. This will be described in the cross conveyor chapter.

A pin wheel brake is pivoted on the top, right side of the elevator frame and is spring-urged against the pin elevator belt. When the magnetic clutch is de-energized as just described, the brake will prevent the pin elevator from rotating backward due to the weight of pins that have been partially carried up to the turnaround pan. (Figure 48, page 3-50)

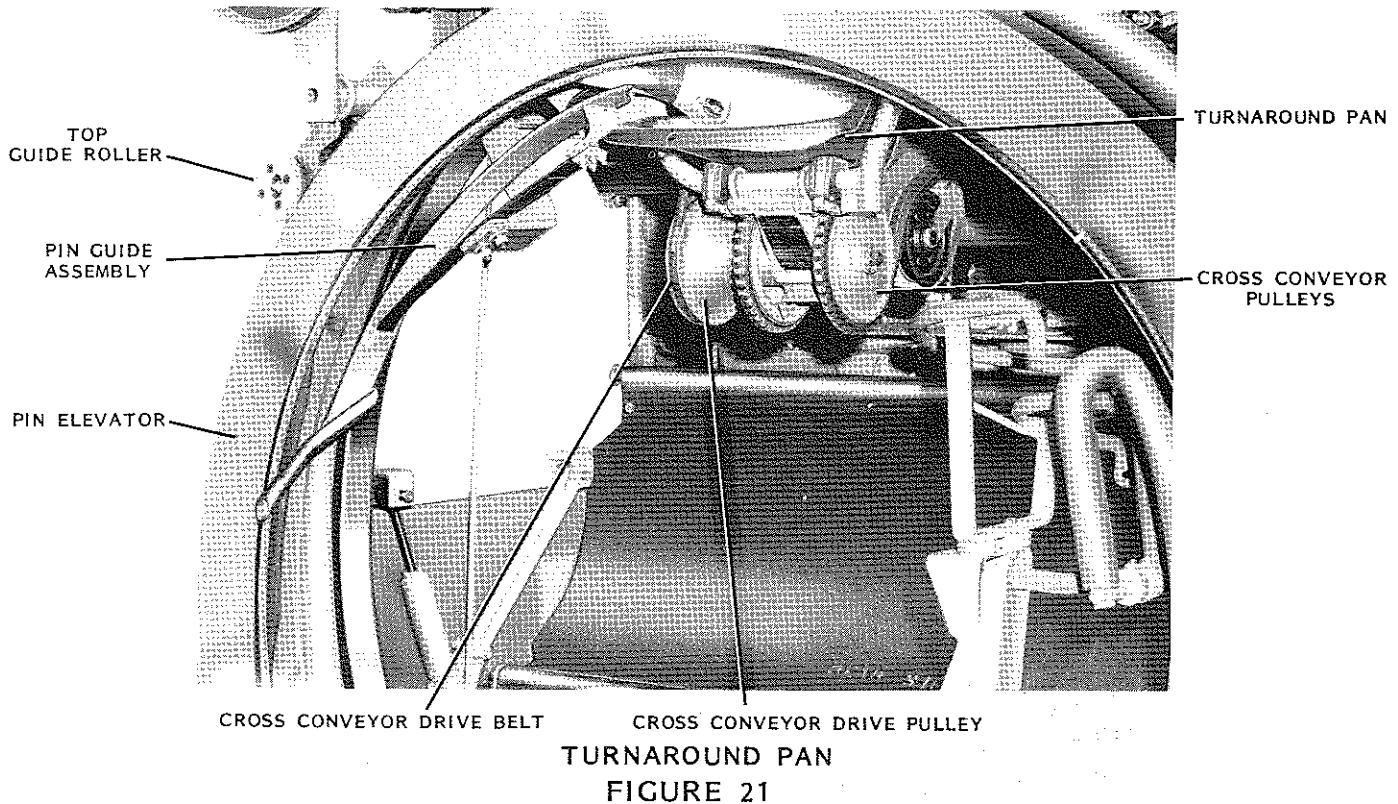
Around the inner diameter of the pin elevator are pockets into which the pins drop either base first or head first as they are carried back by the pit conveyor. A pin guide assembly holds the pins in place as they are carried up to the top. As the pins reach the top, they drop out of the pin elevator wheel into the turnaround pan.



BALL AND PIN ELEVATORS
 FIGURE 20

CHAPTER 10 - TURNAROUND PAN

The turnaround pan (Figure 21) is a concave, steel pan mounted between the top of the pin elevator and the rear of the cross conveyor. A spring holds the front of the pan firmly against the pin supporting plate of the cross conveyor. As the pins drop out of the pin elevator into the pan, the pan receives them either head first or base first and orients them all base first before they are picked up by the cross conveyor.



CHAPTER 11 - BALL ACCELERATOR

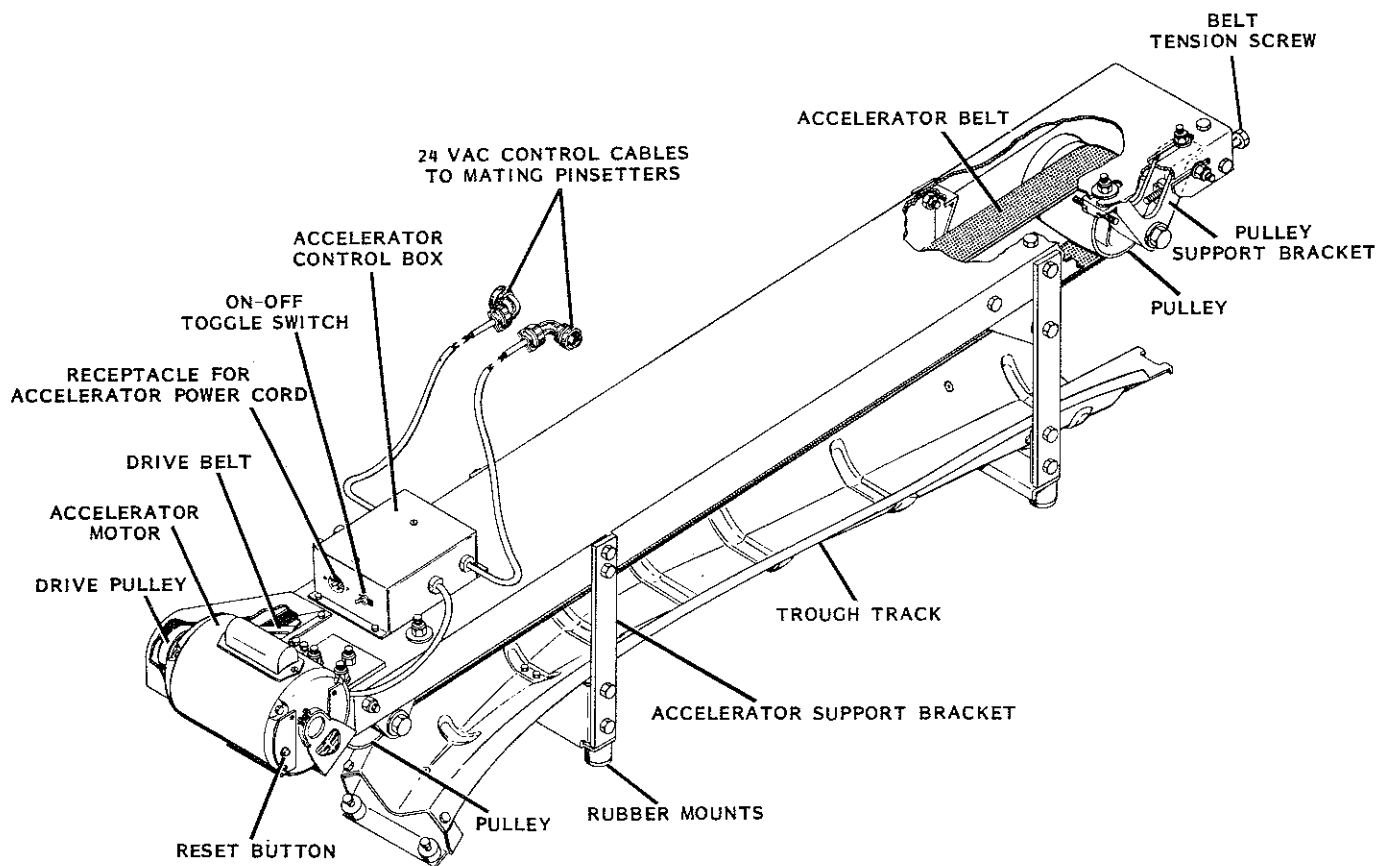
Mounted to the pair of adjacent kickbacks at the lane ball return is the ball accelerator assembly which propels the ball down the dropsweep and back to the ball return rack. (Figure 22)

Attached to the kickback mounting plates on rubber shock mounts are two U-shaped brackets that support the accelerator frame above the kickbacks. Mounted to each end of the accelerator frame is a support bracket and pulley. The front bracket is stationary while the rear support bracket is adjustable to reduce or increase the distance between the two pulleys. The two pulleys carry a long, flat accelerator belt between them.

The accelerator is powered by a one-half horsepower, capacitor start electric motor that is mounted to an adjustable bracket at the forward end of the accelerator frame. A belt from a pulley on the motor shaft drives the front pulley, and in turn, drives the accelerator belt. The motor mount bracket is adjustable to obtain constant tension on the drive belt, while the rear pulley is adjustable to provide proper tension on the accelerator belt. A metallic brush is positioned against the ball contact surface of the accelerator belt to assist in keeping the belt clean and also discharges static electricity.

Fastened to the four accelerator support brackets below the frame and belt drive mechanism is a concave, "trough-like" ball track. (Figure 22) The trough track, which is aligned with the switch track and dropsweep, has an ascending incline from the rear and a descending, curved contour on the front.

As a returning ball passes the switch track, the ball contacts the constantly rotating accelerator belt and is moved up the inclined surface of the trough track, thereby increasing the tension on the accelerator belt. As the ball reaches the highest point on the trough track, the accelerator belt is under maximum tension, thereby propelling the ball down the curved portion onto the dropsweep and back to the bowler.

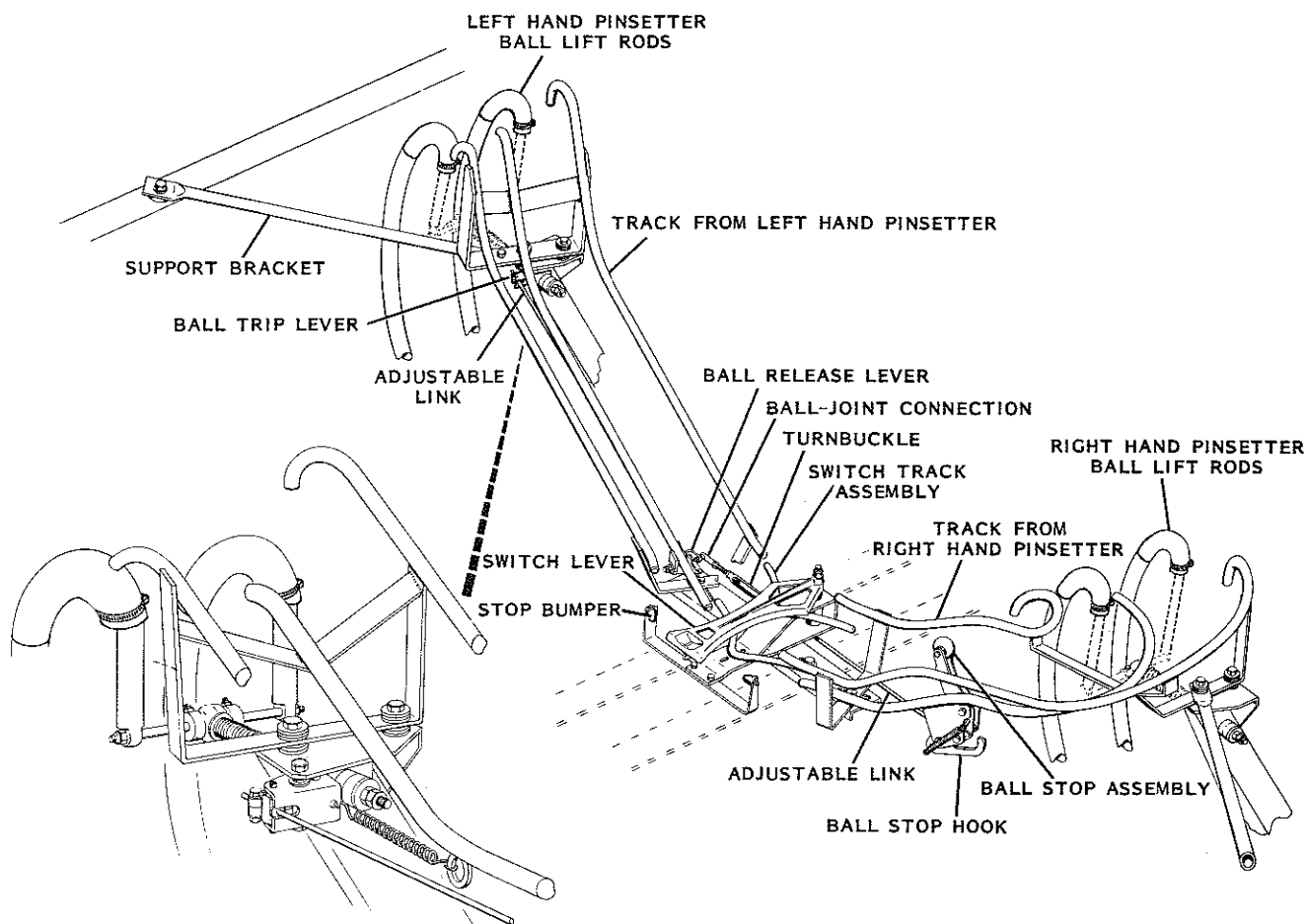


BALL ACCELERATOR
FIGURE 22

CHAPTER 12 - BALL RETURN

Various types of ball returns are in use in bowling establishments. There are center returns, by which a pair of lanes have the ball returned between them; double outside returns, by which a pair of lanes have the balls returned for both lanes on either the far left or right hand side of a pair of lanes; and single outside returns, by which the ball is returned at either the left or right side of a single lane.

In general, the pinsetter ball return consists of three parallel metal rods which form a track that receives the ball from the ball elevator, carries the ball through the pinsetter and deposits it on the common ball return switch track (Figure 23). Mounted in front of the common return switch track is a ball accelerator assembly that propels the ball down the dropsweep, along the return track, to the ball return rack. The ball accelerator assembly will be described in detail in subsequent text.



CENTRAL BALL RETURN
FIGURE 23

When the ball return services a single lane, the ball track and accelerator are the only requirements. When the ball return services two lanes, separate tracks from each pinsetter carry the ball to the common ball return switch track. The length and shape of these separate tracks will vary to meet the requirements of the type of ball returns.

PREFERENCE SYSTEM

When two pinsetters feed a single ball return, it is necessary to prevent a ball from each pinsetter from meeting at the common switch track and causing a jam. The ball return has a "ball preference" blocking mechanism to prevent such jams (Figure 23). Attached to the track from the left hand pinsetter are two levers that are rotated by the ball on the return track. The ball trip lever (nearest the elevator) and the ball release lever (nearest the switch track) are mounted on pivot bolts and are connected to each other by an adjustable rod with ball-joint connections. Mounted to the center rod of the track from the right hand pinsetter is a ball stop assembly that is spring-urged to pivot upward in the path of a returning ball. Pivoted on the same mounting bracket, directly below the ball stop, is the ball stop hook. The ball stop hook is connected to the ball release lever by an adjustable rod with ball-joint connections.

The ball preference mechanism functions in the following manner: As a ball is lifted on the ball lift rods of the left hand pinsetter, the spring-loaded adjusting rod is pushed to the right by the wedging action of the ball. This motion of the adjusting rod permits the spring-loaded ball trip lever to rotate clockwise and through the connecting link, rotates the ball release lever counterclockwise into the path of the ball. The counterclockwise rotation of the ball release lever, through the connecting link, rotates the ball stop hook counterclockwise to engage a pin in the ball stop lever. The ball stop lever is then held in the path of a ball being returned simultaneously from the right hand pinsetter.

When the ball from the left hand pinsetter nears the switch track, it contacts and rotates the ball release lever clockwise, and through the linkages, rotates the ball trip lever counterclockwise and simultaneously rotates the ball stop hook clockwise to release the ball stop lever. The ball from the right hand pinsetter is permitted to rotate the stop lever and proceed to the switch track. The stop lever will then return to its spring-urged, up position.

Mounted directly behind the switch track at the intersection point is a pivoting switch lever. The switch lever is pivoted in either direction by the balls as they enter the switch track. The switch lever is contoured to serve as a guide to prevent balls from leaving the track as they are transferred from the return track to the switch track.

CHAPTER 13 - CROSS CONVEYOR

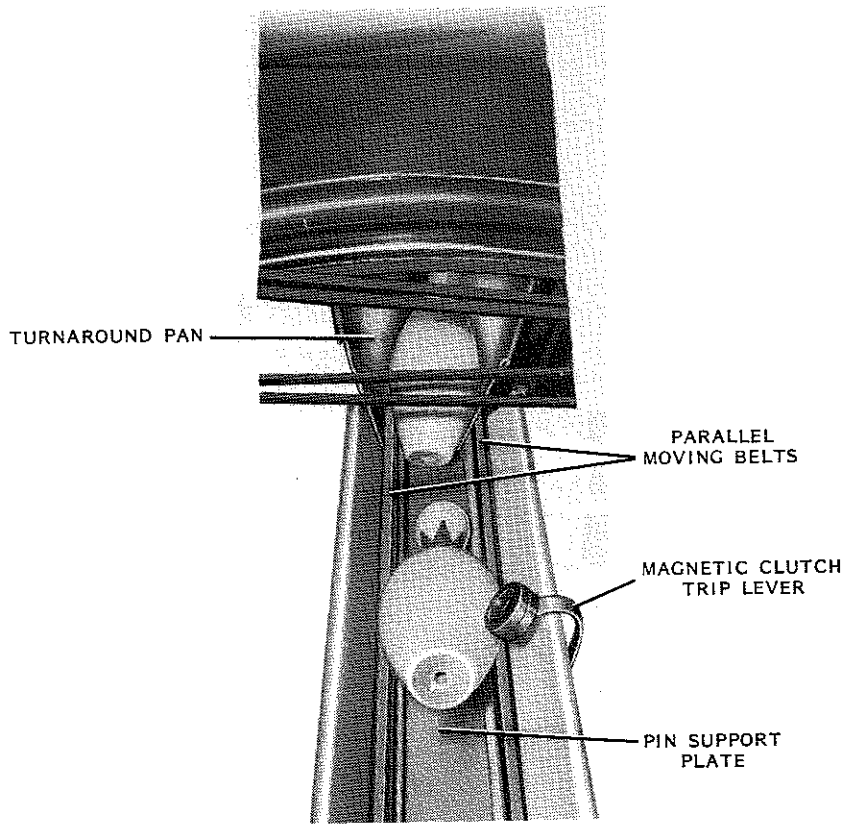
The cross conveyor (Figures 24 and 25) carries the pins from the pin elevator to the turret. A pair of parallel moving belts running between metal side plates carry the pins and deposit them one at a time into the turret. The body of the pin is supported by the belts and the head of the pin is supported by a steel plate mounted under the belts. There is a blocking device (Figure 25) at the top of the cross conveyor called the "pin gate" which prevents a second pin from being delivered to the turret until the turret has "indexed" to the next position after receiving a pin. This prevents two pins from being delivered to the same position in the turret, as well as pins from being delivered to the turret when the turret is not ready to receive them.

As the body of a pin reaches the top of the cross conveyor, it rides over and depresses the upper arm of the pin gate. As the gate is depressed, the lower arm of the pin gate swings to the rear and contacts the pin gate latch link which was holding the pin gate latch above the roller on the lower arm of the pin gate. The lower arm of the pin gate pushes the link back and the pin gate latch drops down on the lower arm of the pin gate. When the neck of the pin passes over the pin gate, the pin gate is spring-urged to return to its original position, thereby allowing the roller on the lower arm of the gate to be caught under the cross conveyor latch which is spring-urged in a downward direction. The pin gate is thus locked in position to block the passage of the next pin. As a pin contacts the pin gate in its latched position, the rising slope of the pin gate lifts the pin from the belts, thereby preventing the pin from being carried beyond the pin gate. The unlatching action will be described in the turret chapter.

Mounted on the side of the cross conveyor are two levers which hold rollers in the path of the pins as they are carried up the conveyor. The rollers are spaced far enough apart so that the body of the pin lifts one lever and then releases it before lifting the second lever. If the pin gate is latched, it will hold back one pin which will lift the front lever, and the second pin coming right behind it will be lifted on the head of the first pin and lift the second lever so that both are raised at the same time. When both levers are lifted simultaneously it is an indication that there are two pins held on the cross conveyor and that additional pins will cause a pin jam. To prevent this, there is a single microswitch mounted under the two trip levers. When both of these levers are lifted at the same time, the switch will open and de-energize the magnetic clutch, thereby stopping the pin elevator. When the pin gate opens, the levers will again be tripped one at a time, and the pin elevator will resume operation.

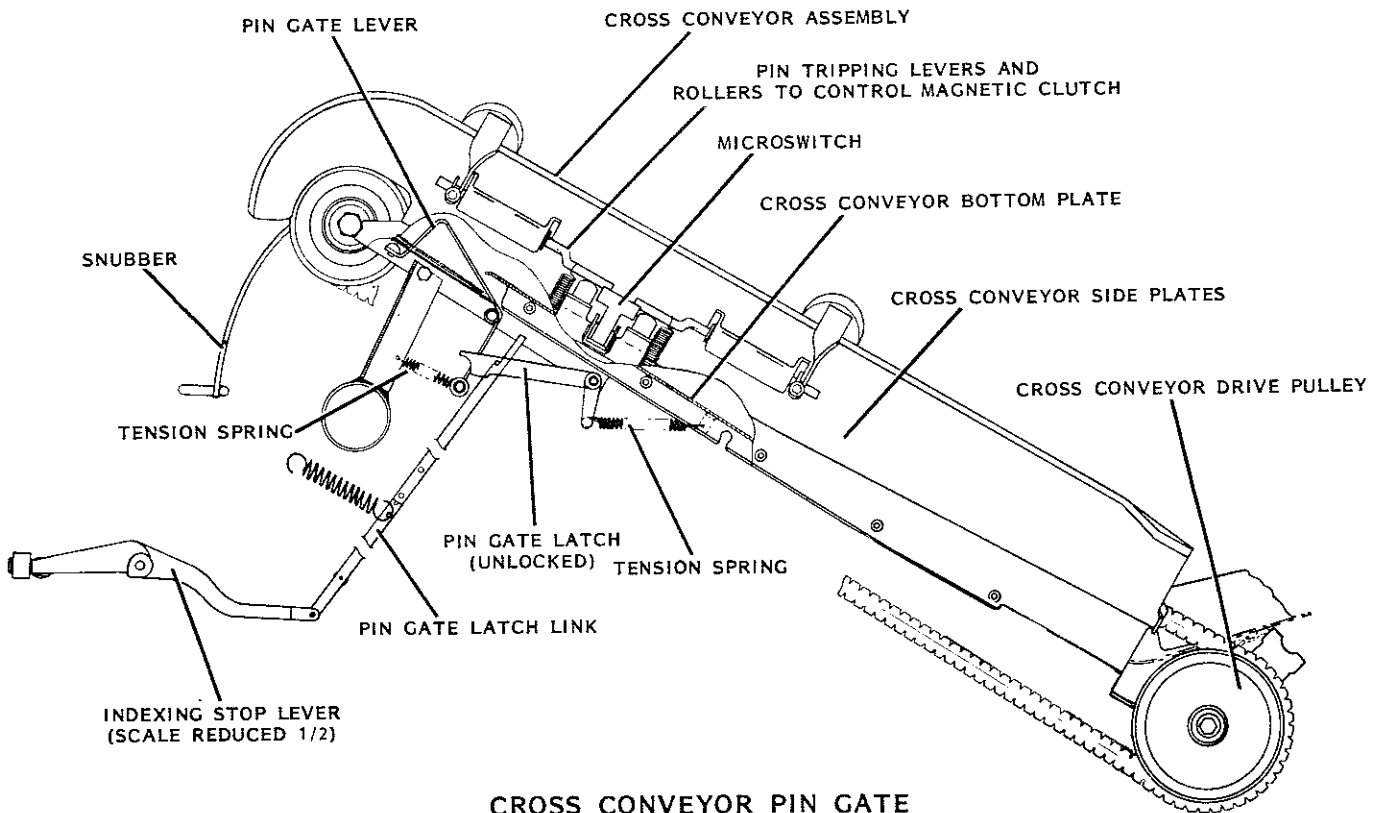
As the pins drop off the front of the cross conveyor into the turret, they contact the "snubber". The snubber is mounted to the front of the cross conveyor and its curved shape allows the pins to slide down to the turret and be properly seated in the turret baskets.

The cross conveyor is powered as follows (Figures 24 and 25): On the same jack shaft that drives the pin elevator pulley is another pulley. This pulley drives a belt across a spring-loaded idler pulley and two fixed, positioning pulleys to another pulley on a shaft at the rear of the cross conveyor assembly. Two additional pulleys on this shaft carry the parallel cross conveyor belts. Each of the two cross conveyor belts turn around another pulley at the front of the cross conveyor.



CROSS CONVEYOR ASSEMBLY

FIGURE 24



CROSS CONVEYOR PIN GATE
(VIEWED FROM RIGHT SIDE OF MACHINE)

FIGURE 25

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CHAPTER 14 - TURRET

The turret (Figure 26) receives pins from the cross conveyor and at the proper time, delivers ten pins to the deck. A bevel gear, mounted to the forward end of the pin wheel drive shaft, drives a vertical shaft mounted to the elevator assembly. A pulley, mounted on the bottom of the vertical shaft, drives a belt across a fixed, positioning pulley and a spring-loaded tensioning pulley to a pulley on top of the turret clutch assembly. Refer to Figure 3, page 1-5 for the drive arrangement.

The turret consists, in general, of nine framework pin baskets, a halo ring to hold the pins in the baskets, a chute for the tenth pin (#5 pin chute), a spider with nine spoons to support the nine pins in their framework baskets and a triggering mechanism to release the pins to the deck.

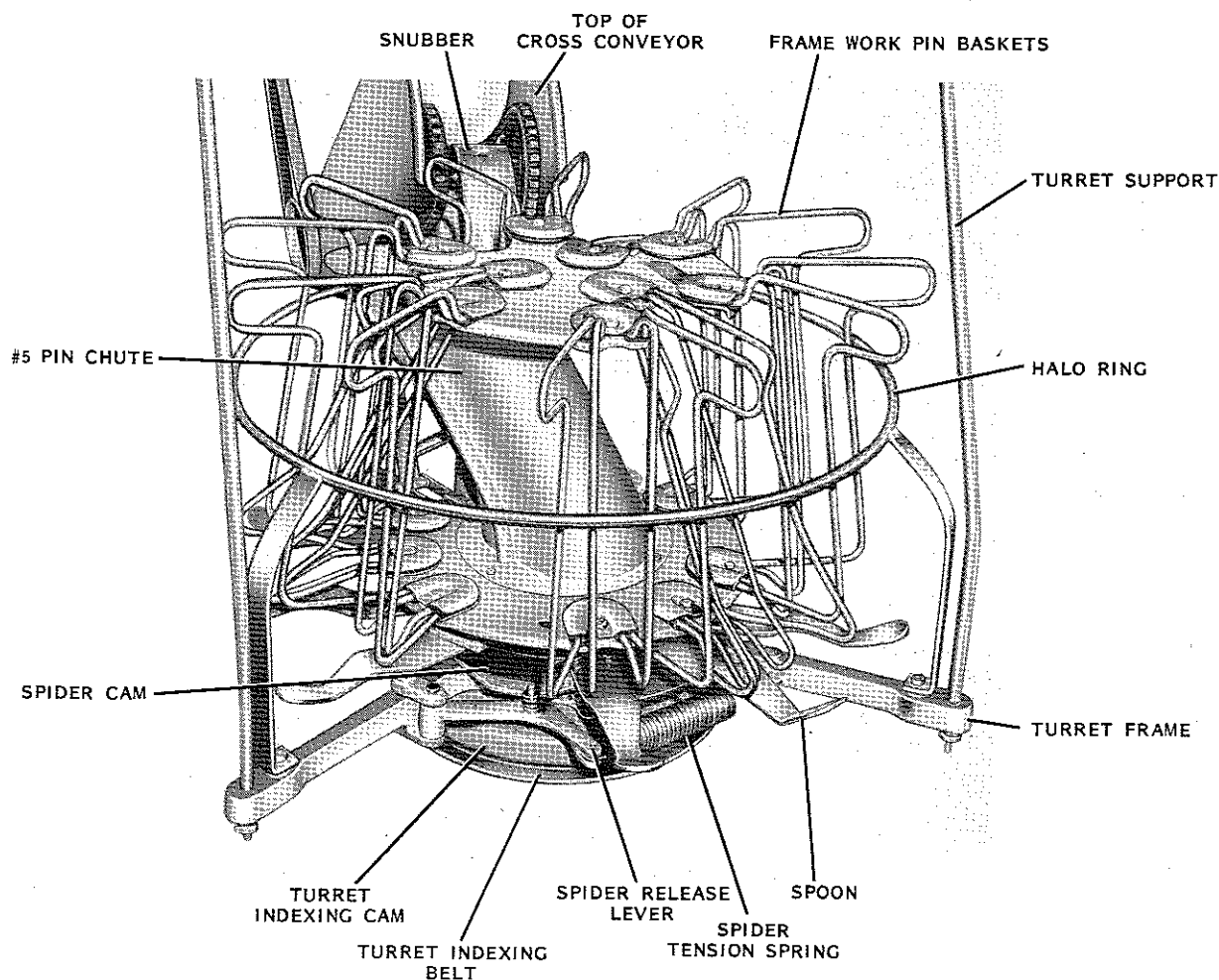
REGULAR INDEXING

The turret clutch assembly consists of an upper pulley (which is always turning) and a smaller, bottom pulley that carries the turret indexing belt to rotate the turret. Both pulleys are always engaged. The friction drag between the lower pulley and turret indexing belt permits the lower pulley to slip with the indexing belt when the turret is not free to rotate.

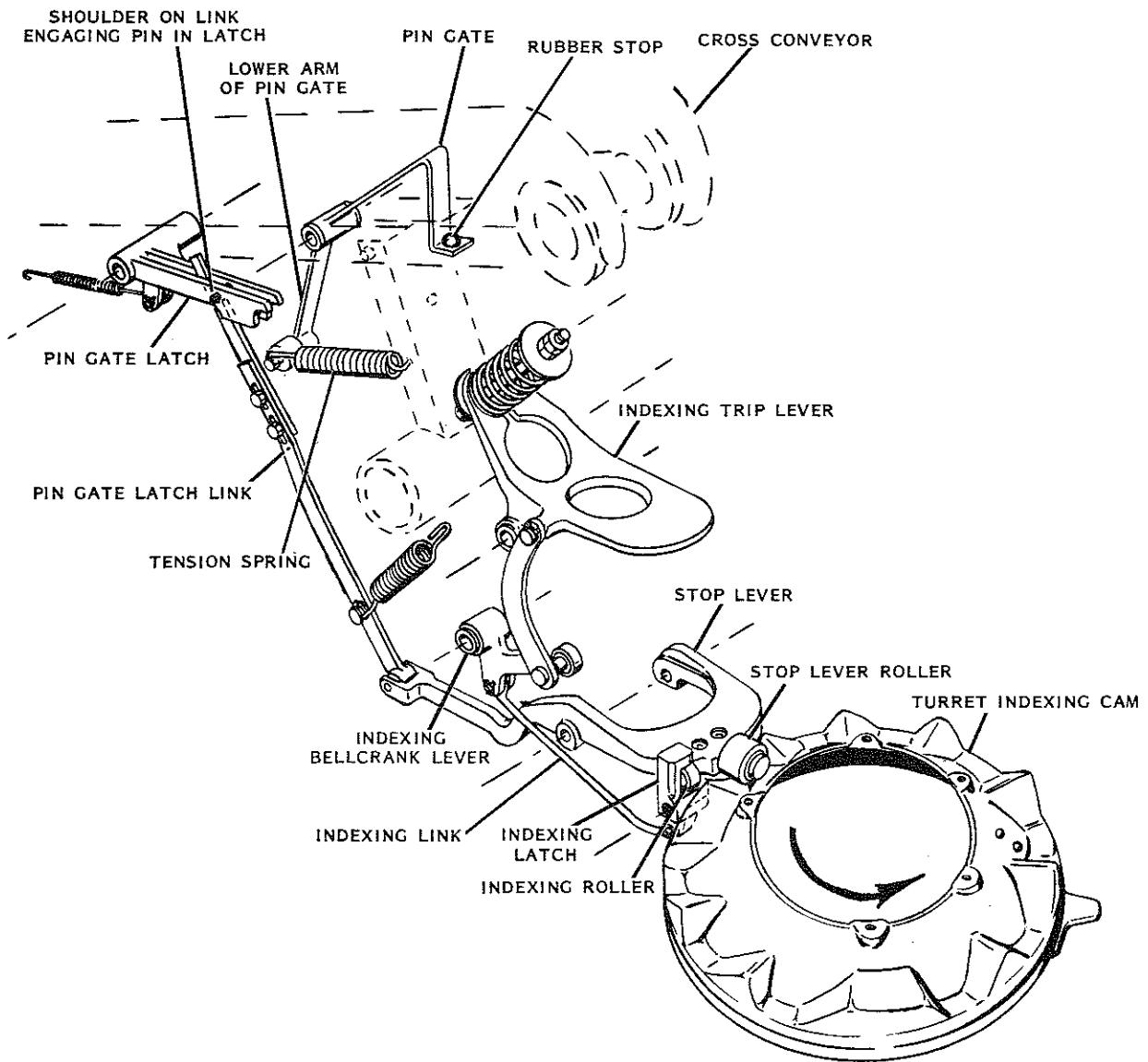
The turret, with nine framework baskets and #5 pin chute, is attached to the turret indexing ring which is bearing-mounted to the turret frame. The spider, with its pin-supporting spoons, is bearing-mounted to the turret indexing ring and carries the turret-spider latch which locks the spider to the turret. When the latch is engaged, the spider will turn with the turret. When the latch is opened, the spider is free to turn independent of turret motion.

On the top surface of the turret indexing pulley is the indexing cam (Figures 26 and 27) which has ten lobes and ten depressions. Following this cam is a roller at the forward end of the stop lever which pivots on the turret frame. Attached to the rear of the stop lever is the pin gate latch link which has a shoulder near its upper end. As the roller on the front of the stop lever rises over a lobe on the indexing cam, the latch link moves down and the shoulder of the link engages a pin in the pin gate latch. Then as the roller drops into a depression on the indexing cam, the latch link is pushed up, carrying the pin gate latch. This releases the pin gate and allows the next pin to be delivered to the turret. As the body of the next pin depresses the pin gate, the lower arm of the pin gate swings to the rear, pushes the latch link back, and the pin gate latch drops down on the lower arm of the pin gate. When the neck of the pin passes over the pin gate, the gate returns to its normal position, with the lower arm of the gate held by the pin gate latch. This prevents another pin from being delivered to the turret. Then as the turret indexes, the pin gate latch will be lifted by the turret indexing and the pin gate will allow another pin to be delivered to the turret. This alternate latching and releasing of the pin gate is repeated as each pin moves along from the cross conveyor to the turret.

The mechanism which frees the stop lever roller to rise and fall to allow the turret to index is controlled as follows: As a pin drops from the cross conveyor toward the turret, it strikes the indexing trip lever, pushing the lever down. Through a bellcrank lever and link, the trip lever rotates the indexing latch that engages the indexing roller on the stop lever. The indexing latch effectively holds the stop lever roller down in a depression on its cam, thereby preventing the turret from indexing. Since the turret clutch is always engaged and trying to turn the turret, the rotation of the latch permits the roller to rise, thereby allowing the turret to index one position to receive the next pin. The turret indexes only one position because the trip lever is spring-loaded and it immediately snaps back to relatch the indexing latch over the indexing roller to hold the stop lever roller in the low dwell of the indexing cam. The turret thus cannot index until the next pin hits the trip lever and the entire procedure is repeated. This indexing process is repeated nine times for the nine pins received.



TURRET
FIGURE 26



TURRET INDEXING MECHANISM
FIGURE 27

"5 PIN" INDEXING

The tenth pin is the "5-pin" dropped into the chute. This pin is used to trigger the release of the ten pins to the deck. Because it is not desired for the pins to be released until the deck is in position to receive them, the tenth pin is delivered to a chute containing a pin release lever control device. (Figure 28). The release lever is latched until the deck is in position to receive the pins. The tenth pin is delivered to its chute without hitting the index trip lever, thereby preventing the turret from indexing in the same manner as the first nine pins. To index the turret after the tenth pin is delivered to its chute, the 5-pin indexing mechanism is used.

The turret must not release pins to the deck unless the deck is ready to receive them. This is controlled through the pin release lever (Figure 28) which is positioned at the bottom of the #5 pin chute. The bottom of the pin release lever has an arm that the descending pin contacts. The other end of the release lever contains the turret-spider latch which engages a roller on the spider ring to lock the spider to the turret. Pivoted on the latch end of the release lever are two parallel links that are connected to the interlock probe which is pivoted on a bracket from the top of the #5 pin chute. The interlock probe is spring-urged in its latching direction and, through the linkage just described, holds the turret-spider latch in its locked position. When the turret-spider latch is engaged, the spider is locked to the turret and must, therefore, rotate with the turret as the turret indexes to receive pins from the cross conveyor.

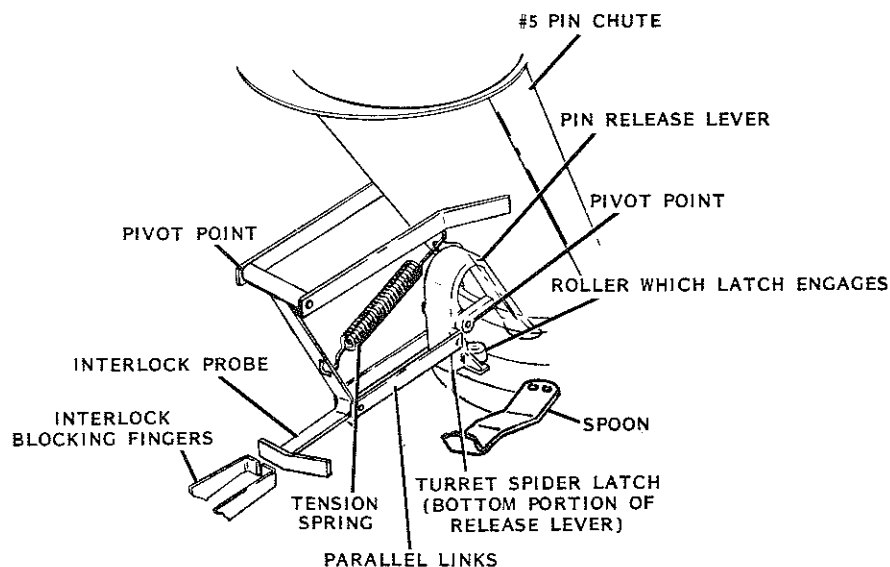


FIGURE 28. TURRET - SPIDER LATCH

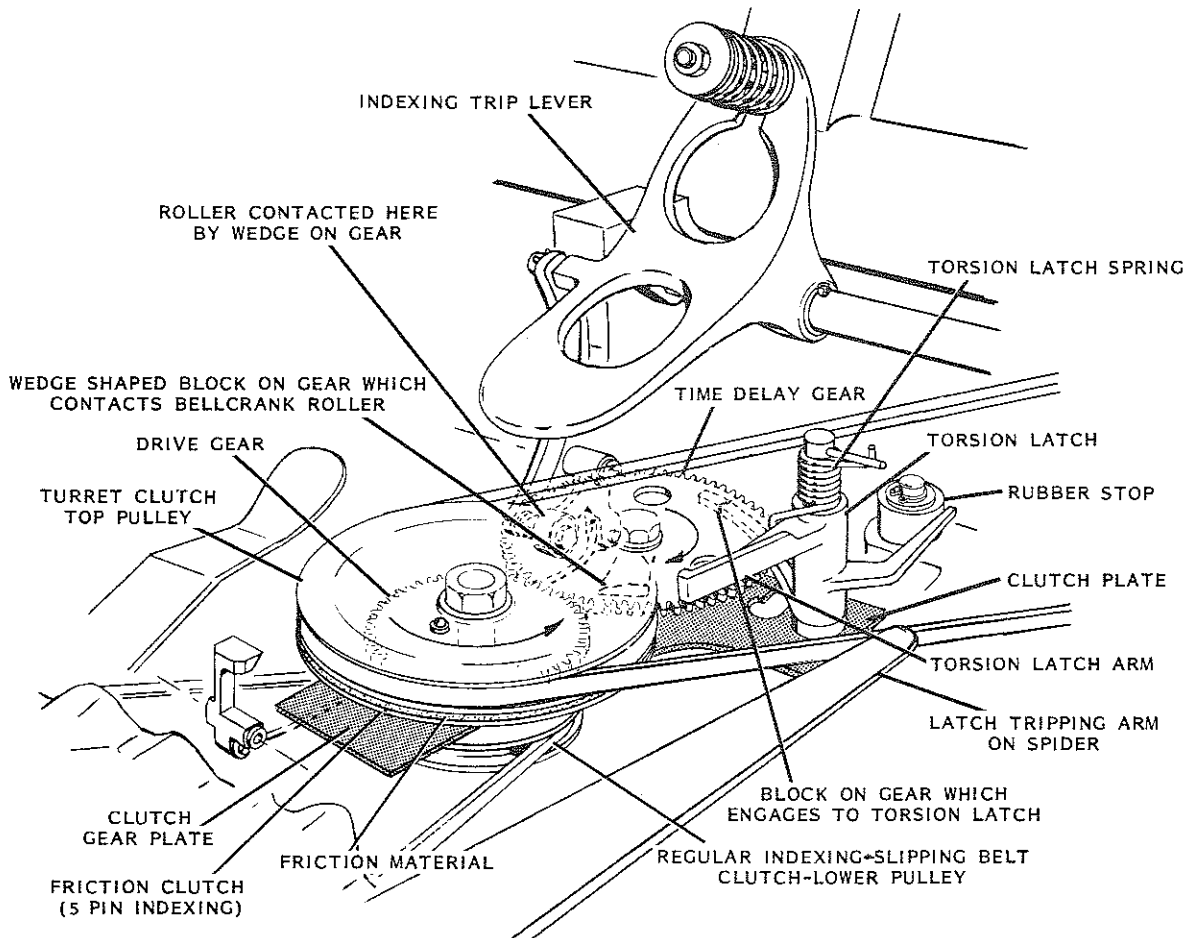
When the turret has collected nine pins, the #5 pin chute is placed under the forward end of the cross conveyor. The tenth pin (#5 pin) enters the #5 pin chute and contacts the pin release lever. When the deck is in position to receive ten pins from the turret, the two interlock blocking fingers must be up. The weight of the tenth pin will overcome the spring tension on the interlock probe, thus rotating the pin release lever. As the tenth pin rotates the pin release lever, the interlock probe is pushed rearward and simultaneously releases the turret spider latch to permit the spider to shift as previously described, and thereby, deliver pins to the deck.

The spider release lever (Figure 26) is pivoted at one end to a fixed turret support arm and is connected at its other end, through a tension spring, to another fixed turret support arm. The spider release lever carries a roller which follows the spider cam. As the turret indexes for the last few pins before receiving the tenth pin, the release lever roller encounters a rising surface on the spider cam which tensions the spring that ties the release lever to the turret support. As the tenth pin drops into the chute, it pivots the pin release lever and lifts the turret-spider latch that ties the spider to the turret. The release lever roller encounters a deep depression in the spider cam and the energy from the loaded tension spring is directed through the cam surface. The roller drops into the depression and effectively pushes the spider ahead of the turret. This removes the spoons from under the baskets, and the pins drop into the deck. The release lever roller then immediately encounters a sharp rise in the cam which prevents the spider from traveling any further than is necessary to release the pins. There is also a bumper and stop assembly mounted between the spider and the turret to absorb the shock of the sudden shift forward of the spider and to limit the amount of rotation of the spider.

If the deck is not in position to receive pins from the turret, the interlock probe is blocked by one or both interlock blocking fingers as it starts to move rearward. In this event, the pin release lever cannot be depressed and the turret-spider latch will not open to free the spider. The weight of the #5 pin will be supported by the pin release lever until the interlock blocking fingers are pivoted out of the way of the interlock probe, at which time the weight of the pin will trigger the latch as previously described (see Chapter 20, Interlocks).

Presuming all conditions were satisfactory and the ten pins were released to the deck when the spider moved ahead of the turret, the spider is now one-half position ahead of the turret and, as mentioned previously, the tenth pin does not hit the indexing trip lever to rotate the turret indexing latch. It is necessary, therefore, to index the turret after it delivers the pins to the deck to allow the turret to catch up with the spider and latch them together to repeat the indexing operation for the next set of pins.

Under the turret clutch drive pulley (which is always turning) is a drive gear which is frictionally engaged to the drive pulley. (Figure 29) Meshed with the drive gear is the time delay gear which has a blocking surface on its underside. Pivoted on the turret support, to the rear of the time delay gear, is the torsion latch which is spring-urged to engage the block on the time delay gear. When the torsion latch engages the block on the time delay gear, both gears are prevented from turning, thereby causing the friction surfaces between the drive pulley and drive gear to slip.



"5 PIN" INDEXING MECHANISM

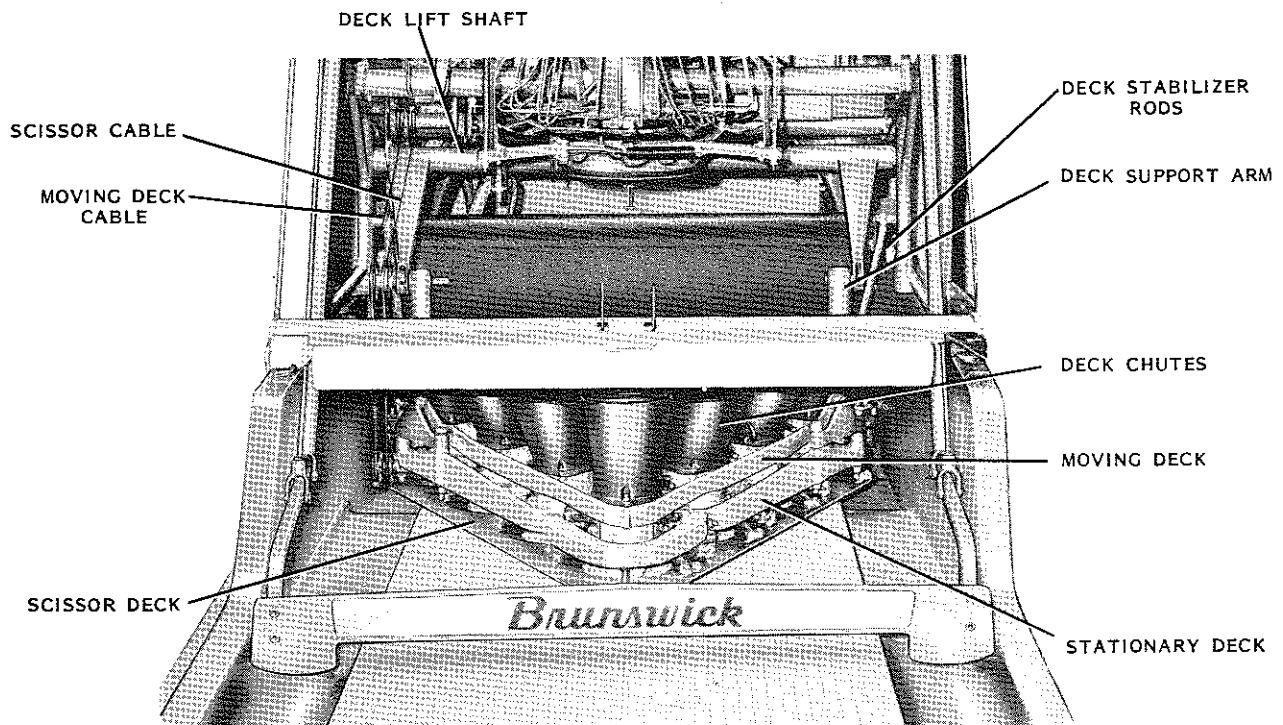
FIGURE 29

As the spider moves ahead of the turret to deliver pins to the deck, the latch tripping arm, which is mounted to the spider ring, rotates the torsion latch to permit the gears to rotate as the braking action of the time delay gear is removed. As the gears turn, another wedge-shaped block on the underside of the time delay gear depresses a roller at the bottom of the indexing bellcrank. This action depresses the bellcrank and rotates the indexing latch exactly as if a pin had depressed the trip lever. The turret is thus allowed to index, and as the spider is held stationary by the spider release lever roller in the depression of the spider cam, the turret catches up with and is relatched with the spider. Sufficient time is allowed from the time the gears start to turn until the trip lever is depressed, to insure that the pins have fallen clear of the turret before it indexes and is relatched with the spider.

CHAPTER 15 - DECK

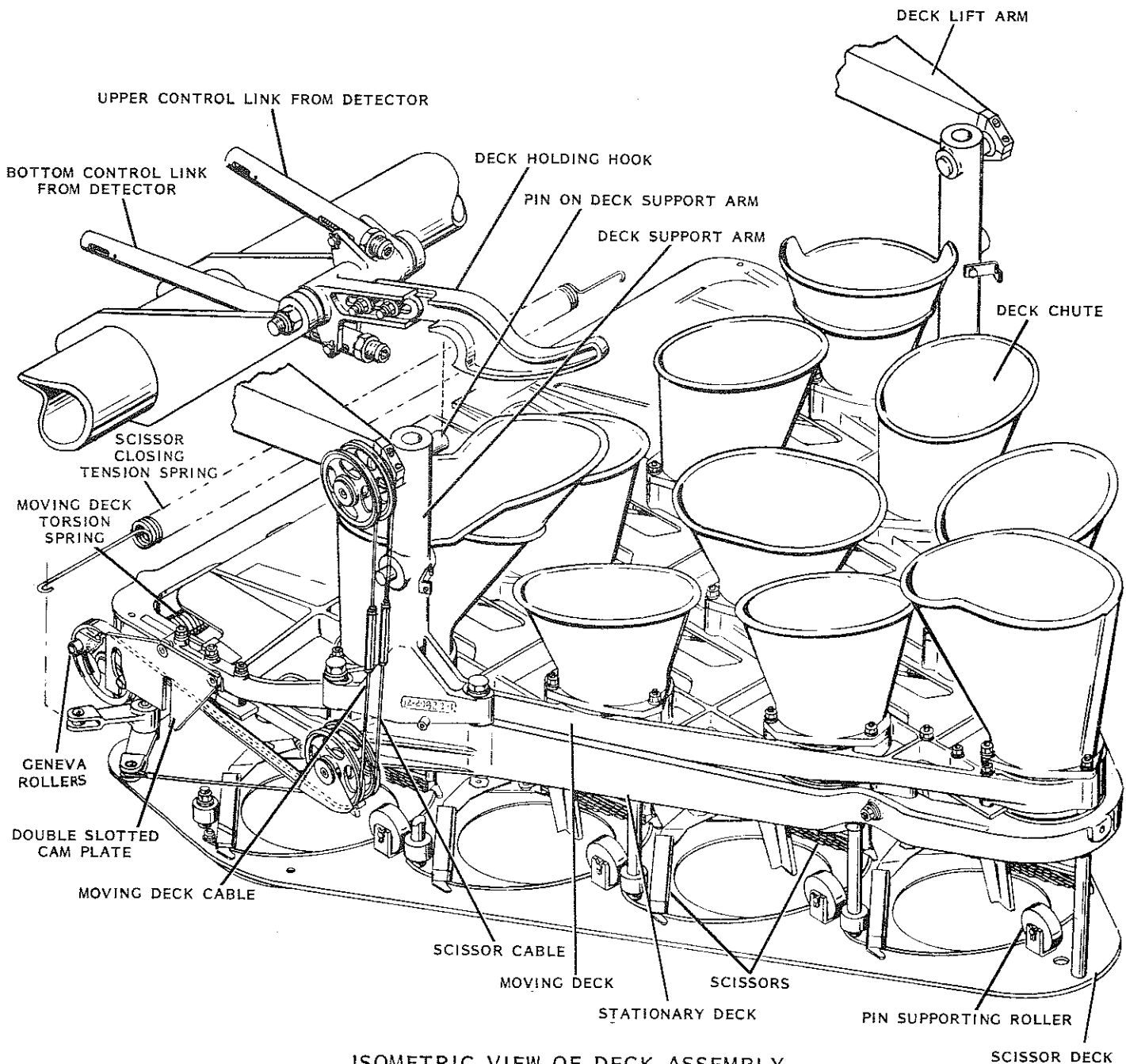
The deck (Figure 30) must serve several functions. It lowers to detect a strike or no-strike condition. If no-strike, it must pick up and then respot standing pins after the rake has swept the deadwood. It must set ten new pins on the lane for a strike detection. The deck must be able to make a short stroke for detecting, picking up and respotting standing pins, and must be able to make a longer stroke for setting new pins. First detection occurs at 90° and the second detection occurs at 270°. The second detection determines "standing pins" or "no standing pins".

The deck lift shaft is pivoted between the two side frames and carries the detector rod which moves the detector disc as previously described. The deck is fixed to the deck lift shaft by two deck lift arms which run from this shaft to the deck support arms. (Figure 30) Just below these arms is a pair of stabilizer rods which run from the main side frames to the deck support arms. The deck is raised and lowered by means of an eccentric double crank which is driven by the 2:1 shaft.



DECK ASSEMBLY
FIGURE 30

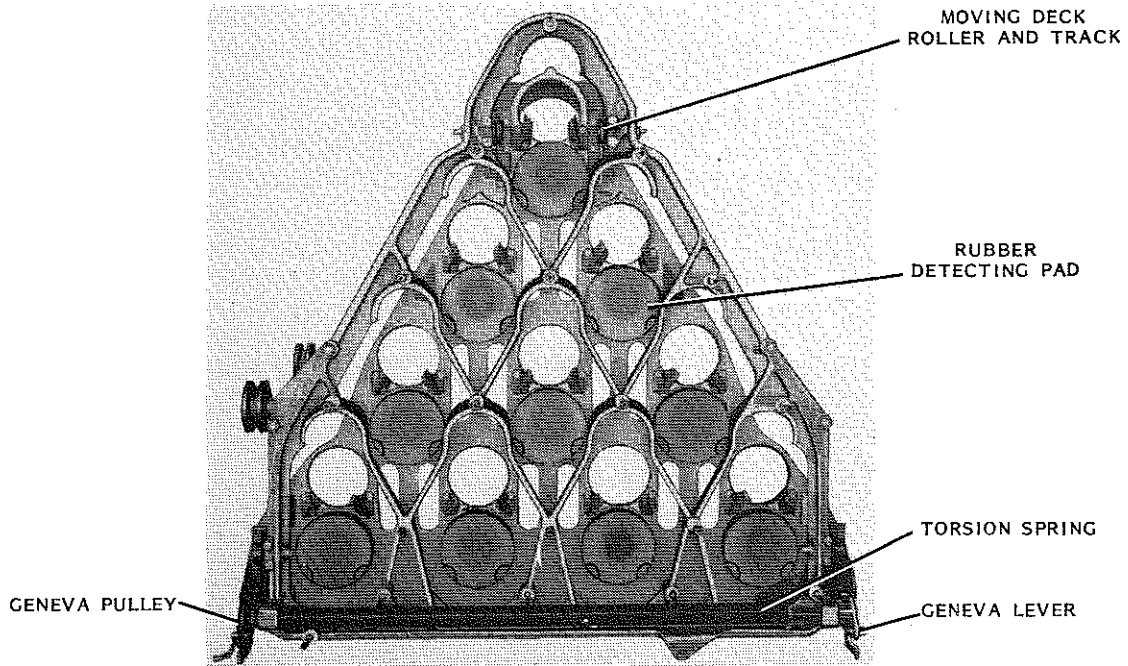
The deck (Figure 31) consists, in part, of an upper deck called the "moving deck" and a lower deck called the "scissor" or "stationary deck". The upper deck is mounted on four rollers which are carried on fixed tracks on the stationary deck. Through a cable and pulley arrangement, the upper deck can be moved back and forth on its rollers in relation to the lower, stationary deck. When the deck receives pins from the turret, the moving deck is in its forward position and each pin is supported by a roller at the bottom of each pin chute (Figure 36, page 1-46). As the deck starts down to set new pins, the upper deck is pulled back and the pins drop down until each pin is caught between the side of its roller and two metal fingers on the moving deck. When the deck reaches its full, new pin setting depth, the moving deck is pulled still further back, the pins are released to the lane and the deck goes back up.



ISOMETRIC VIEW OF DECK ASSEMBLY

FIGURE 31

When the deck comes down to detect and encounters standing pins, the weight of the deck is actually supported by the tops of the pins contacting a rubber pad on the bottom of the moving deck. (Figure 32) At this time it is desired for the pins to be picked up so that the rake can sweep the deadwood. On the top surface of the scissor deck are rubber-cushioned, steel fingers that are controlled by a cable and pulley arrangement. A pair of these fingers, or "scissors", straddle each pin. The scissors close on the necks of the pins and the pins are lifted clear of the lane as the deck goes up.



BOTTOM VIEW OF MOVING DECK (MINUS SCISSORS DECK)

FIGURE 32

Attached to the 2:1 shaft is an eccentric disc (Figure 33). Clamped around the outer perimeter of this disc is an eccentric ring, upon which is mounted the deck lowering hook. Eccentrically located on the outer surface of the disc is the crank pin which rides in a curved slot of the deck lowering yoke. When the 2:1 shaft is rotated, the eccentric rotation of the deck lowering yoke is much greater than the eccentric rotation of the deck lowering hook, and will therefore allow the deck to lower further with respect to the lane surface.

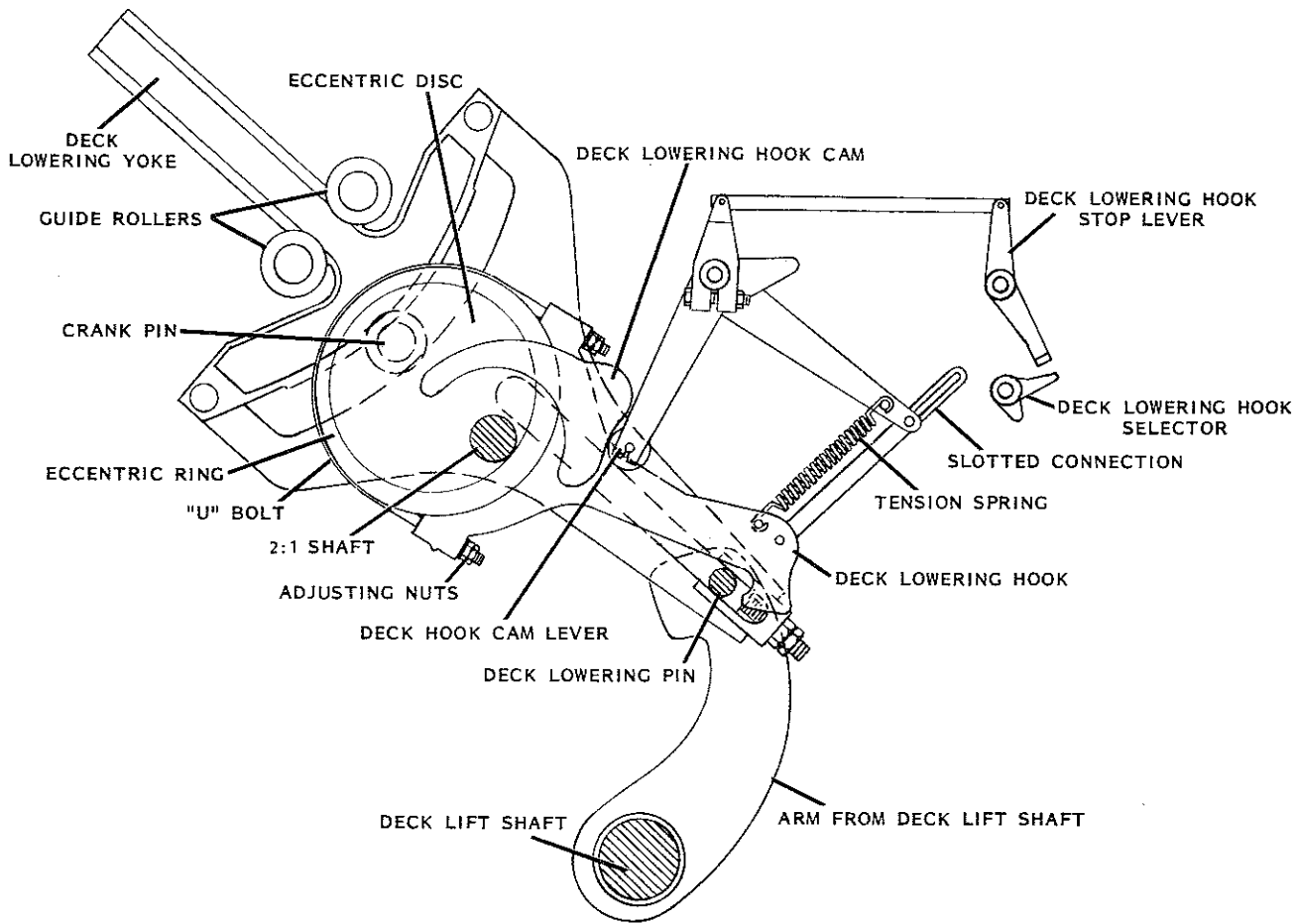
The deck lowering yoke is comprised of an upper section bolted to the lower section. The upper section contains an extended I-shaped guide that rides between two flanged rollers that are mounted to a post from the gear box. The lower section contains the contact surface of the curved slot that carries the crank pin on the eccentric disc, and an elongated, adjustable slot that engages the deck lowering pin on an arm attached to the deck lift shaft.

When it is desired for the deck to make the short stroke for detecting, the deck lowering hook is allowed to drop over the deck lowering pin at the lower end of the deck lowering yoke, and the deck goes through the shorter motion. When it is desired for the deck to make the long stroke for setting new pins, the hook is held out of engagement with the pin, and the deck goes through the longer motion. The curved slot in the yoke permits the yoke to shift laterally on the crank pin as the deck approaches its lowest level, and through the transfer of motion to the curved slot, reduces the descending speed of the deck at 270°, setting new pins. Earlier pinsetters use a deck lowering link in place of the

yoke. The link has an elongated slot that engages the deck lowering pin, while the top of the link is attached to the crank pin on the eccentric disc. The lowering motion of the deck is similar, except that the lowering speed remains constant throughout the entire new pinsetting stroke. New pinsetters built since 1983, again use a deck lowering link in place of the yoke.

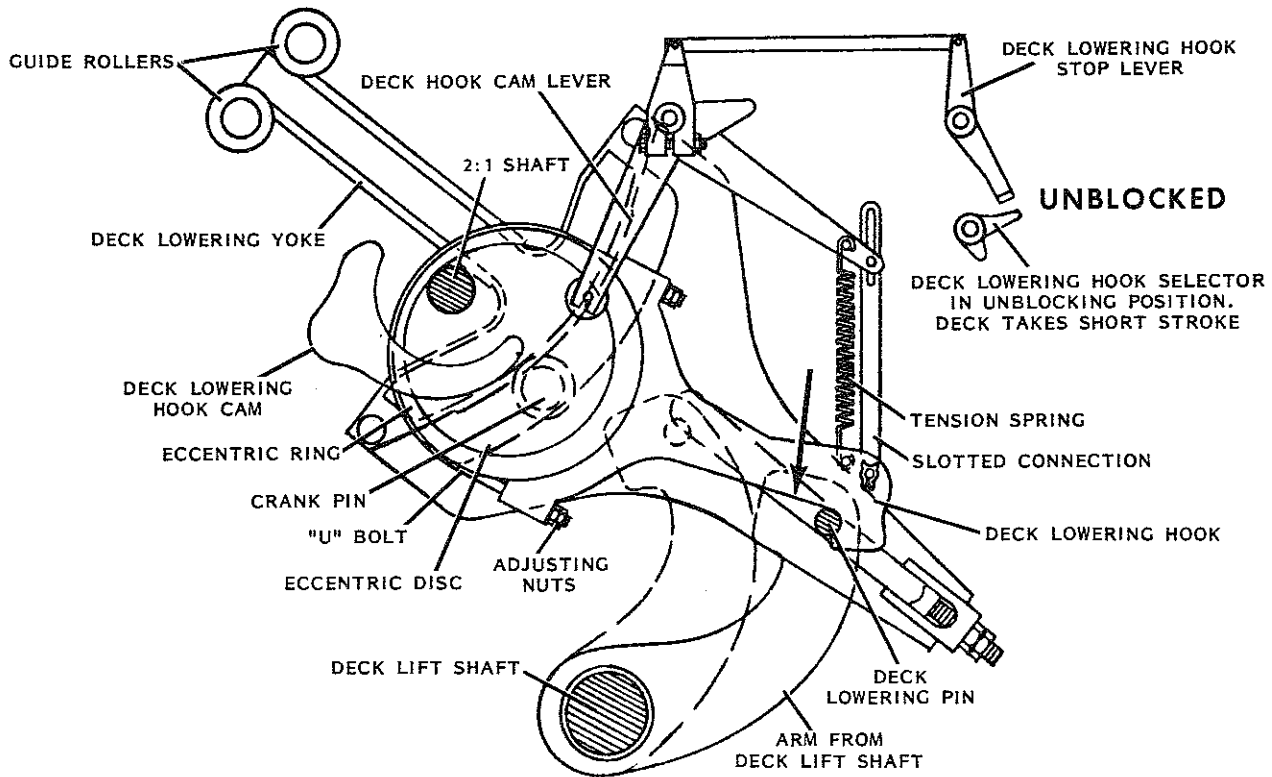
Rotated by the same 2:1 shaft as the crank, is a cam which moves the deck hook cam lever that is pivoted on the top of the gear box. One arm of the deck hook cam lever is connected to the deck lowering hook by a slotted connection. A tension spring normally holds the deck lowering hook and deck hook cam lever at the shortest distance allowed by the slotted connection. On the same pivot shaft with the deck hook cam lever, and rotating with it, is the hook latch lever which is connected by a link to the stop lever in the detector assembly. With the deck in its raised position and the deck lowering hook free of the pin, the rising slope of the cam has rotated the deck hook cam lever and the hook latch lever. This rotation, through the slotted connection and the tension spring, raises the hook above the path of the deck lowering pin. If it is desired for the deck to make the short stroke, the deck hook cam lever is allowed to follow the down slope of the cam, thereby rotating the deck hook cam lever and dropping the deck lowering hook in the path of the pin (Figure 34).

If it is desired for the deck to make the longer, new pin setting stroke, the deck lowering hook is held as follows: While the deck hook cam lever is in its position on the high level of the cam, the deck lowering hook selector in the detector assembly is rotated into the path of the deck lowering hook stop lever (Figure 35). This prevents rotation of the deck hook cam lever as it cannot follow the down slope of the cam, and the deck lowering hook cannot drop into the path of the deck lowering pin. The deck will then make the long, new pin setting stroke under control of the deck lowering yoke.



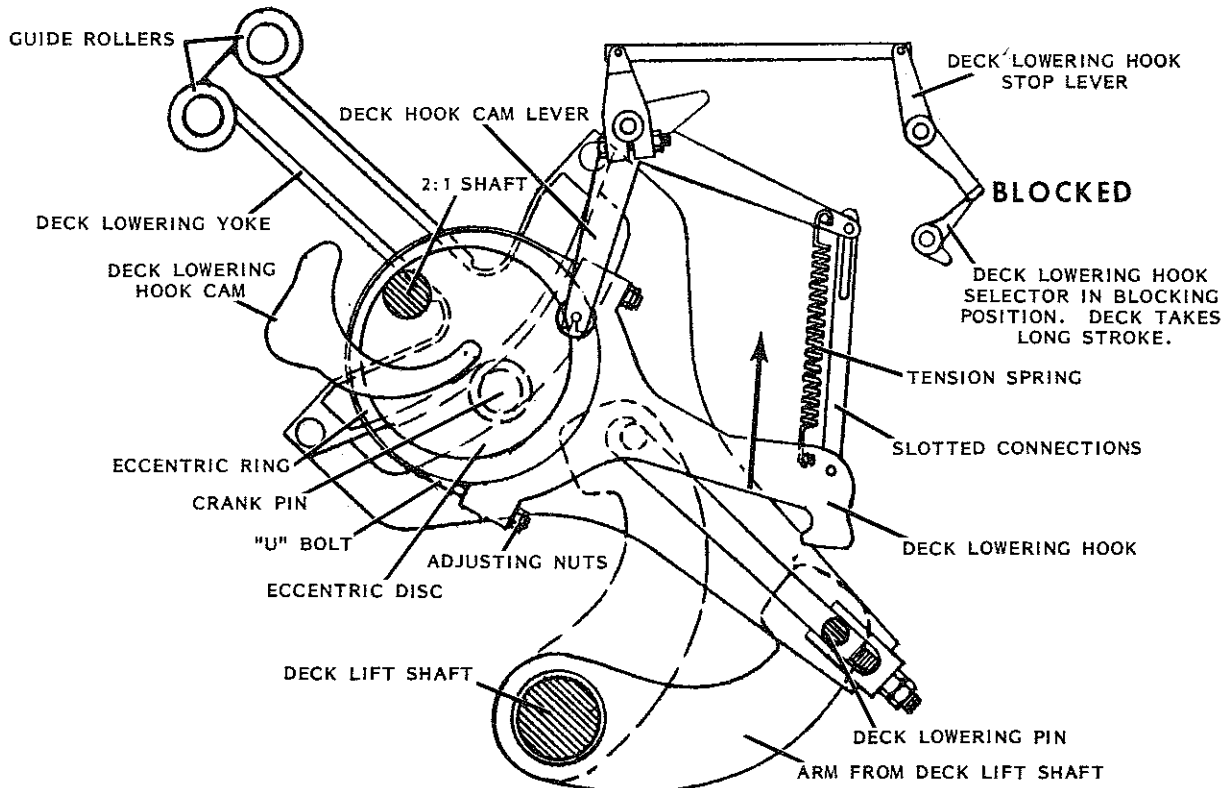
DECK LOWERING MECHANISM AT 0°

FIGURE 33



DECK LOWERING MECHANISM (SHORT STROKE)

FIGURE 34

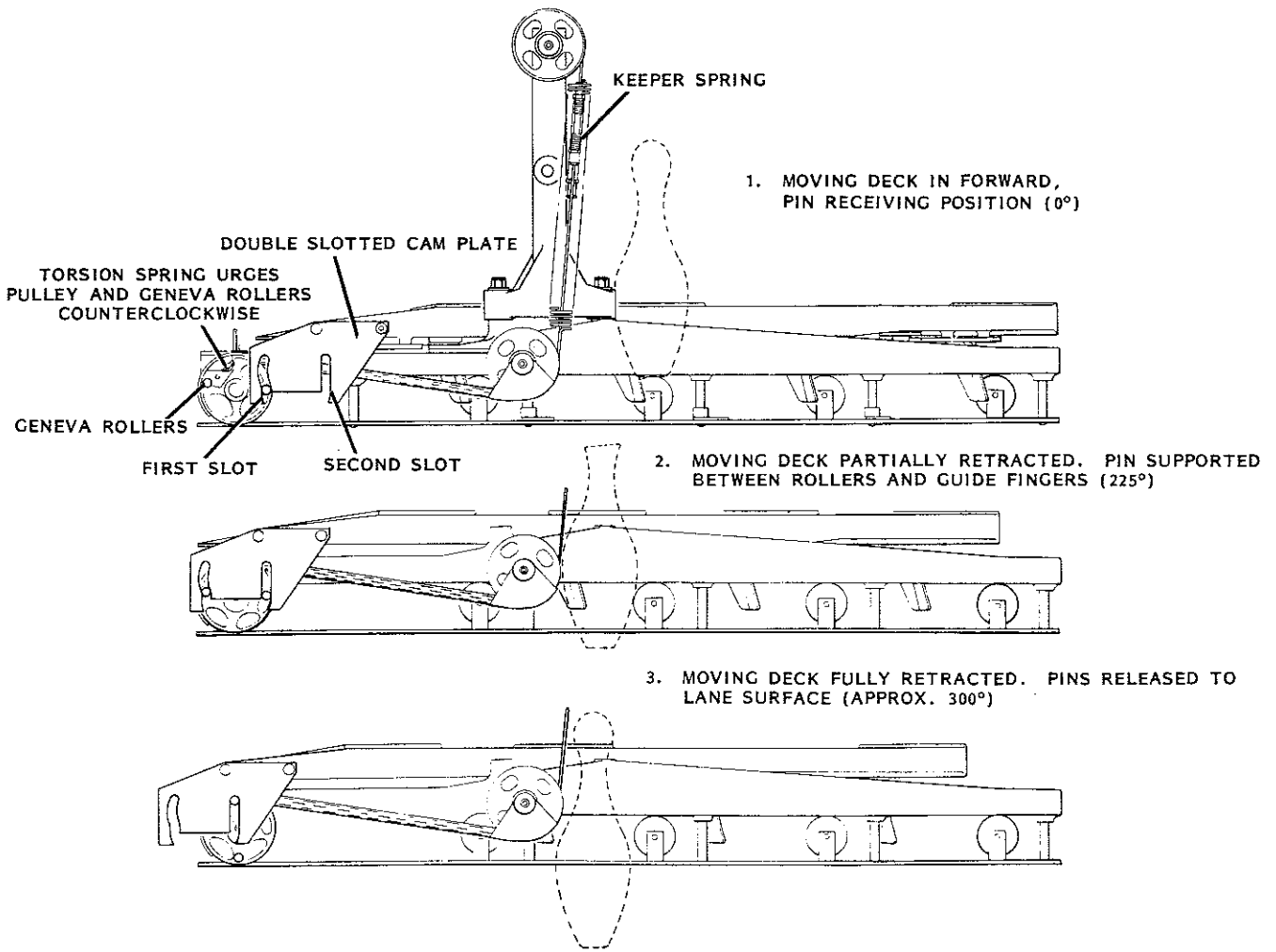


DECK LOWERING MECHANISM (LONG STROKE)

FIGURE 35

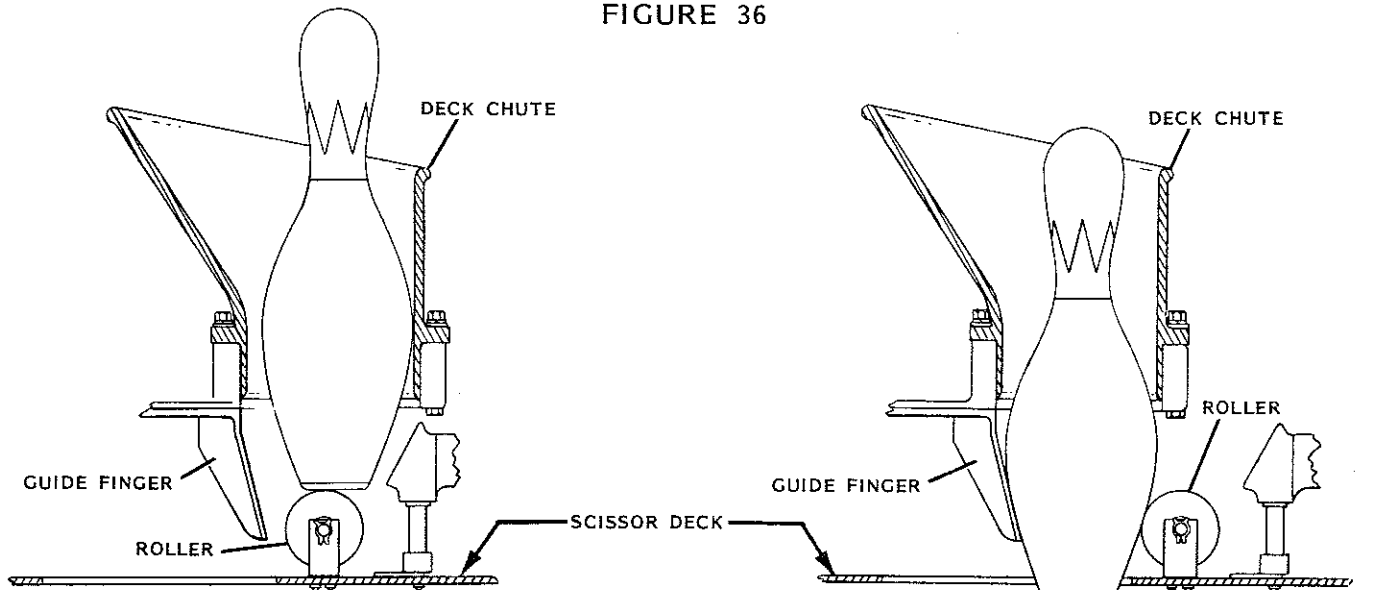
The moving deck has three positions (Figures 36 and 37):

1. Fully forward for receiving pins from the turret, for detecting, and for picking up and respotting standing pins.
2. Partially retracted for the pins to drop lower in the deck.
3. Fully retracted for releasing the pins to the lane surface.



THREE POSITIONS OF MOVING DECK

FIGURE 36

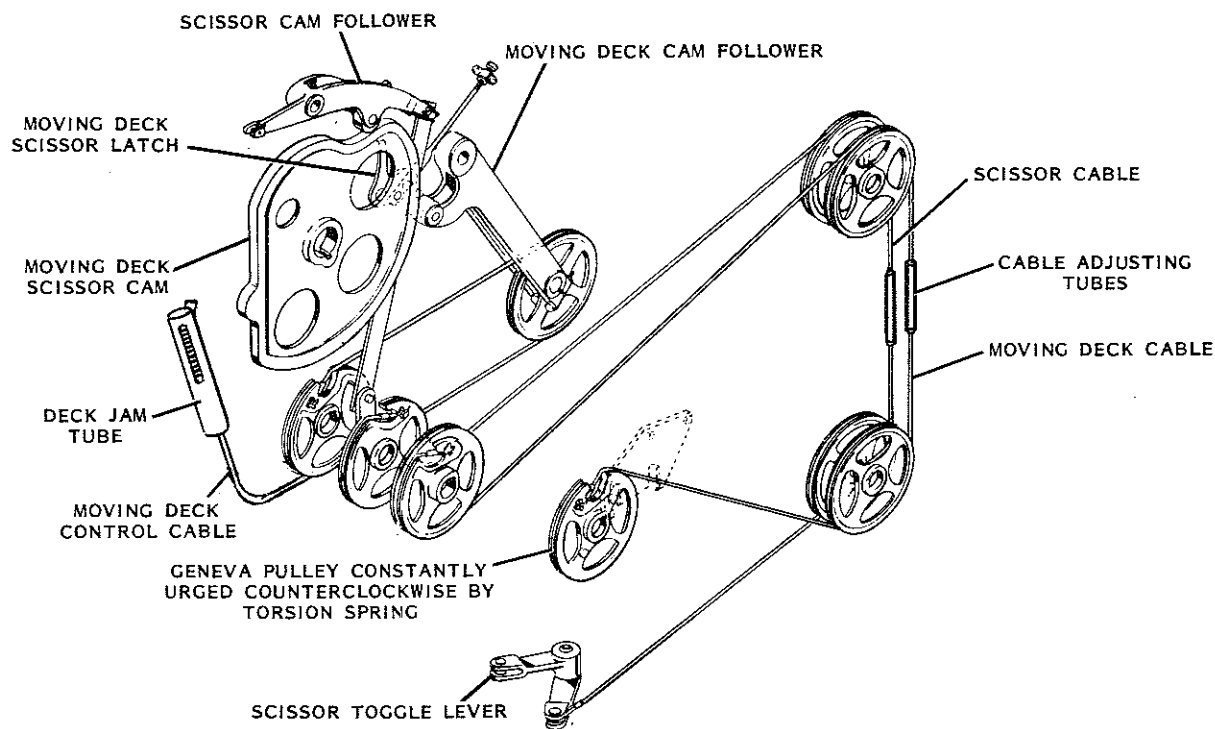


DECK IN PIN RECEIVING POSITION (0°)

DECK IN PIN SETTING POSITION (270°)

FIGURE 37

These motions are controlled through a torsion spring and a cable and pulley arrangement by the moving deck-scissor cam on the 1:1 shaft (Figure 38). A cable, which is anchored at one end to the pinsetter frame, passes over a pulley on the moving deck cam follower arm and is fixed at its other end to a pulley that is attached to a shaft. Mounted to the same shaft and rotating with it, is an additional pulley to which is attached the moving deck cable. This cable passes over a pulley mounted at the top of the deck support arm, over a pulley at the side of the deck, and is fastened to the geneva pulley at the rear of the stationary deck. The geneva pulley is fixed to a torsion spring running across the rear of the deck and carries a pair of geneva lever rollers which engage a double-slotted cam plate on the moving deck. (Figure 36) The torsion spring is wound so that the moving deck is urged in a rearward direction, but is prevented from moving by the taut cable that prevents the geneva lever pulley from rotating.



MOVING DECK AND SCISSOR CONTROL MECHANISMS

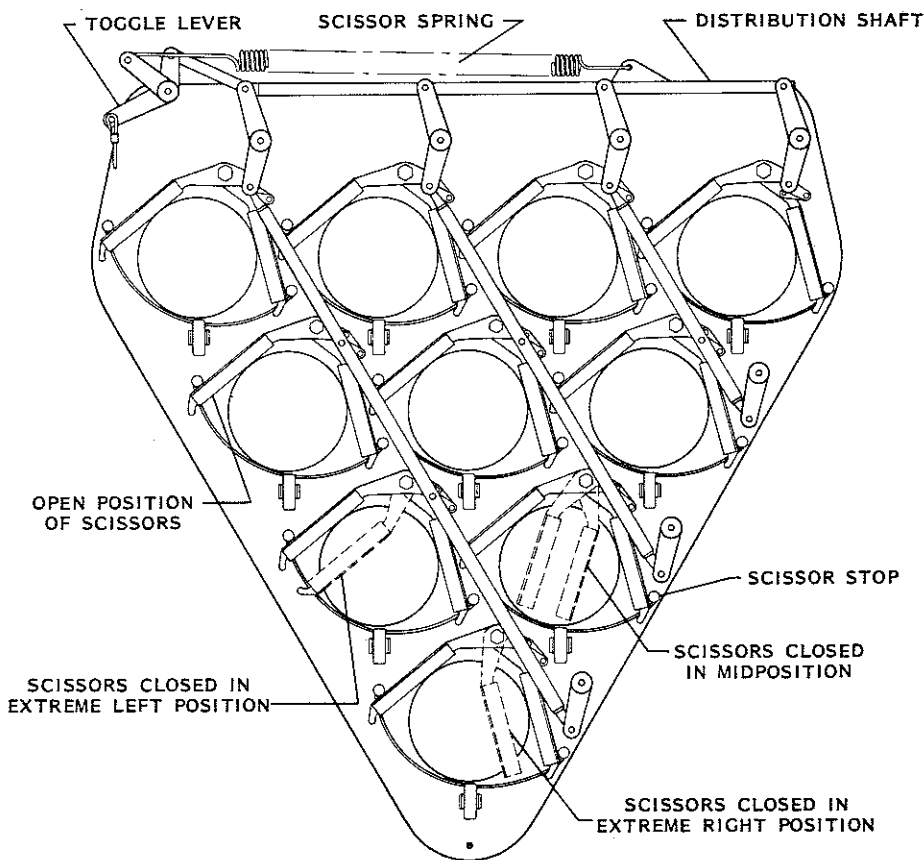
FIGURE 38

The moving deck-scissor cam has three levels. The highest level rotates the moving deck cam follower arm forward to hold the deck fully forward. The middle level of the cam allows the moving deck cam follower arm to swing to the rear, moving the deck part of the way back and allowing the pins to drop through a lower level ready for setting. The lowest level of the cam moves the moving deck cam follower arm still further to the rear, moving the deck all the way back to release the pins on the lane and to clear the pins as the deck goes back up.

The motions described above are controlled in the following manner: As stated previously, a cable passes over two pulleys, one of which is attached to the moving deck cam follower arm. As this arm moves rearward, following a lower level of the cam, the distance between the two pulleys is shortened. This slackens the moving deck control cable, allows the torsion spring-loaded geneva pulley to turn, and the first geneva rollers through the rear slots in the geneva cam plates pull the moving deck back. When the moving deck cam follower arm rotates still further rearward, the distance between the two pulleys is again decreased, and the moving deck control cable slackens again. The second geneva

rollers engage the front slots in the geneva cam plates, and the deck is pulled all the way back. Conversely, as the moving deck cam follower arm follows a rising surface on its cam, the cam follower arm rotates forward and increases the distance between the two pulleys. The moving deck control cable tightens, and the entire procedure is reversed until the deck is again in its full forward position. A keeper spring on the vertical portion of the moving deck cable serves to take up any momentary slack in the cable as the deck shifts. The machine must stop at "0°" for a full forward position.

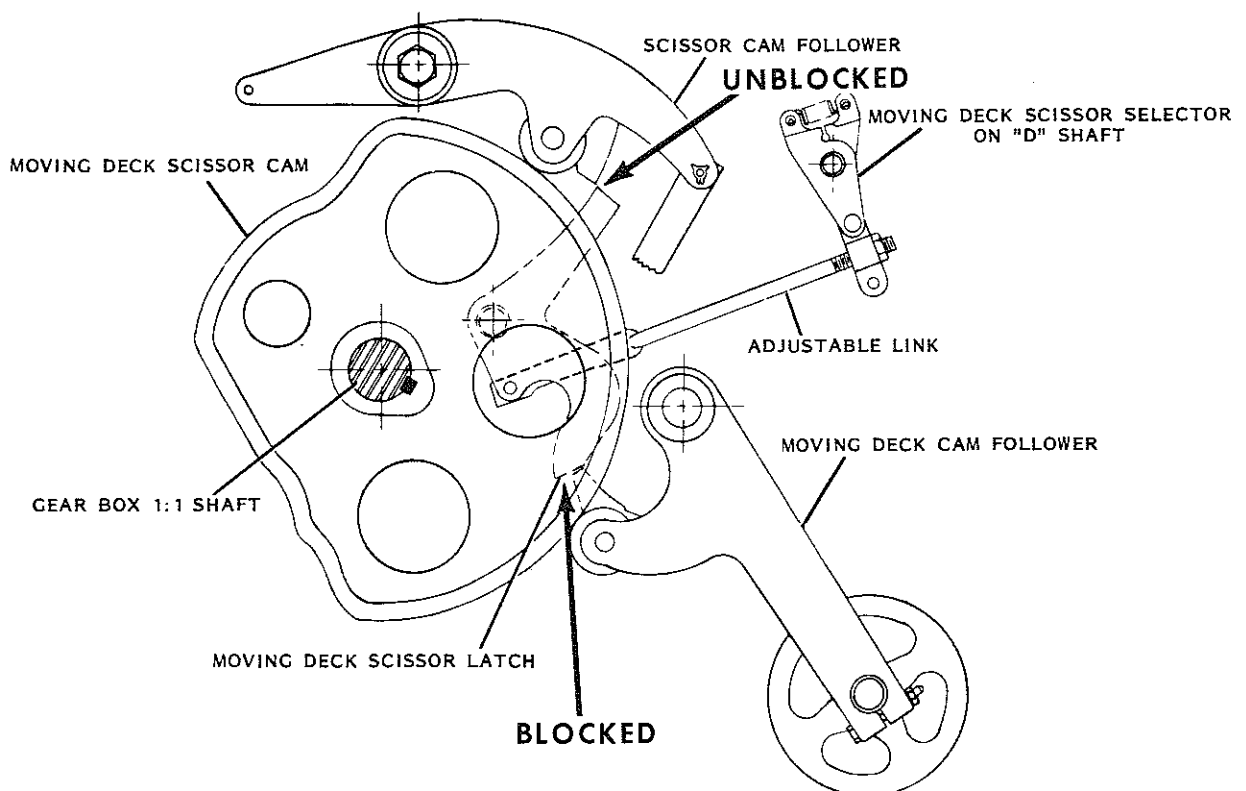
The scissors for gripping standing pins are also controlled through a spring, cable and pulley arrangement by the moving deck-scissor cam. The scissor cable is anchored to a pulley, passes over a pulley at the top of the deck support arm, then over a pulley on the deck, and is anchored to a toggle lever pivoted at the rear of the scissor deck. The other arm of the toggle lever is connected to the distribution shaft which branches out to the lever assemblies that open and close the scissors (Figure 39). Attached to this toggle lever is a strong tension spring which runs across the back of the deck. This spring urges the scissors to close and, unless the spring is overpowered by the scissor cable, the scissors will close. A no-strike detection allows the scissors to close.



SCISSOR MECHANISM
FIGURE 39

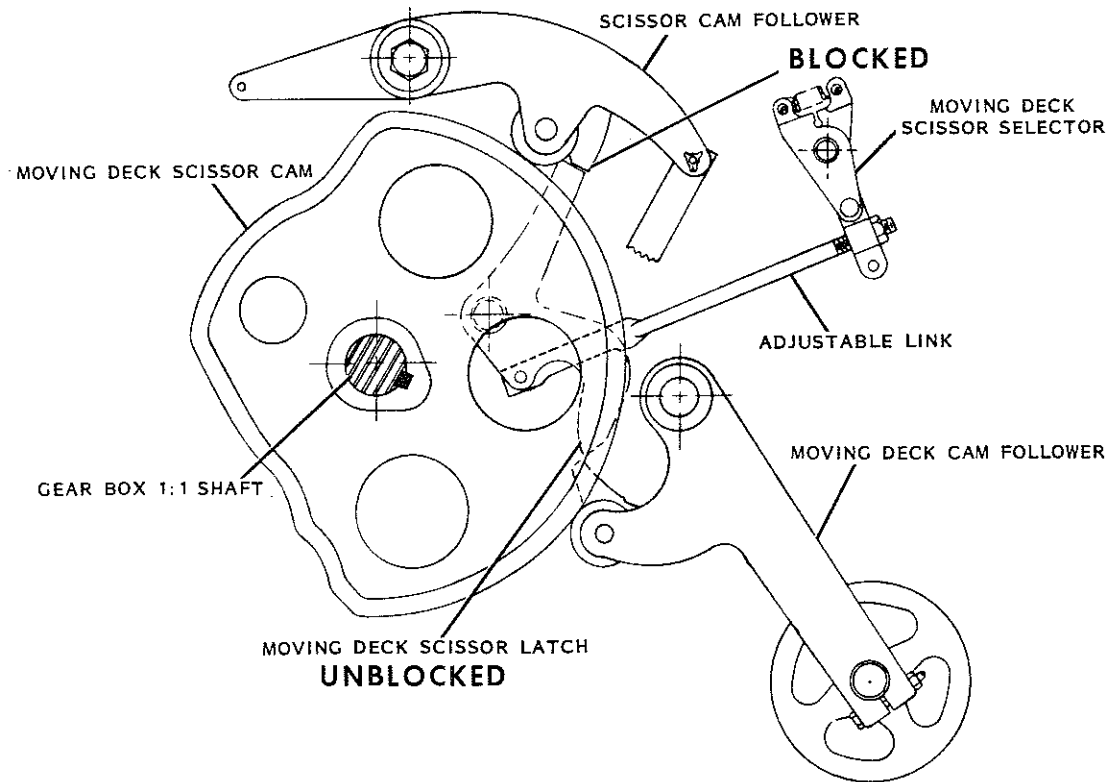
On the pulley to which the upper end of the scissor cable is fixed, is a lever connected by a link to the scissor cam follower arm. This arm follows the same cam as the moving deck cam follower arm. When the scissor cam follower arm is on the highest level of the cam, the upper pulley, through the link, holds the cable tight, and the scissor spring cannot close the scissors. When the scissor cam follower arm is on the middle level of the cam, the cam follower arm moves downward and, through the linkage, rotates the pulley to slacken the cable. The spring then closes the scissors. There is no need for the lowest level of the cam in the scissor operation, therefore, at the middle level of the cam, the cam follower arm contacts a block on the gear box housing and prevents the arm from rotating any further. As the cam follower arm contacts a rising level on the cam, the process is reversed and the scissors are opened.

The moving deck is fully forward and the scissors are open when the two cam followers are on the highest level of the moving deck-scissor cam. As it is never desired for the moving deck to operate when the scissors operate, and vice-versa, the cam is so designed that both followers are on the highest level of the cam at the same time. It is at this time that either action can be blocked out as required. The moving deck-scissor latch, pivoted on the outside of the 1:1 shaft mounting plate and controlled by a link from the detector assembly, can be rotated into the path of the moving deck cam follower arm. This prevents the follower arm from rotating, and blocks out the moving deck action, allowing the scissors to operate (Figure 40). The same latch can be rotated in the opposite direction under the scissor cam follower arm, thus blocking the scissor operation and freeing the moving deck cam follower arm (Figure 41). "First detection" controls the moving deck-scissor latch.



MOVING DECK-SCISSOR LATCH FOR A STANDING PINS CYCLE

FIGURE 40



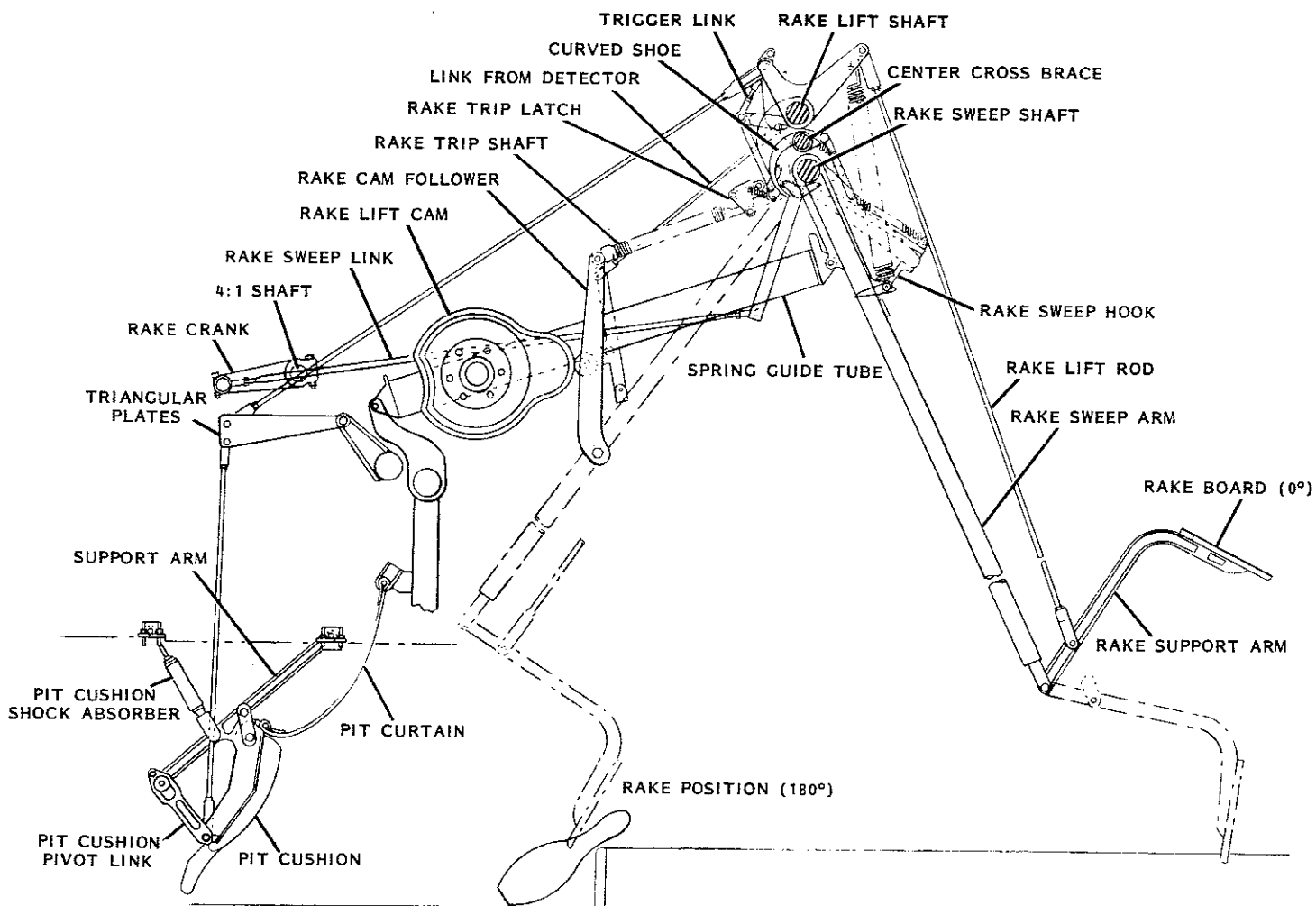
MOVING DECK-SCISSOR LATCH FOR A STRIKE OR SECOND BALL CYCLE
 FIGURE 41

Pivoted on the front cross brace is the deck holding hook (Figure 31, page 1-42) which can engage a pin at the top of the left deck support arm. This hook is raised and lowered by two control links from the detector assembly. If it is desired to hold the deck up, when the position of the deck lowering crank is such that the deck normally would be down, the hook can be lowered to engage the pin on the deck support arm. This will hold the deck up even though the deck lowering hook and deck lowering yoke are not engaging the deck lowering pin. The deck holding hook is used to hold the deck up during the second half of an out-of-range cycle and from 0° to 180° during a second ball cycle. Second detection (standing pins) lowers the deck holding hook.

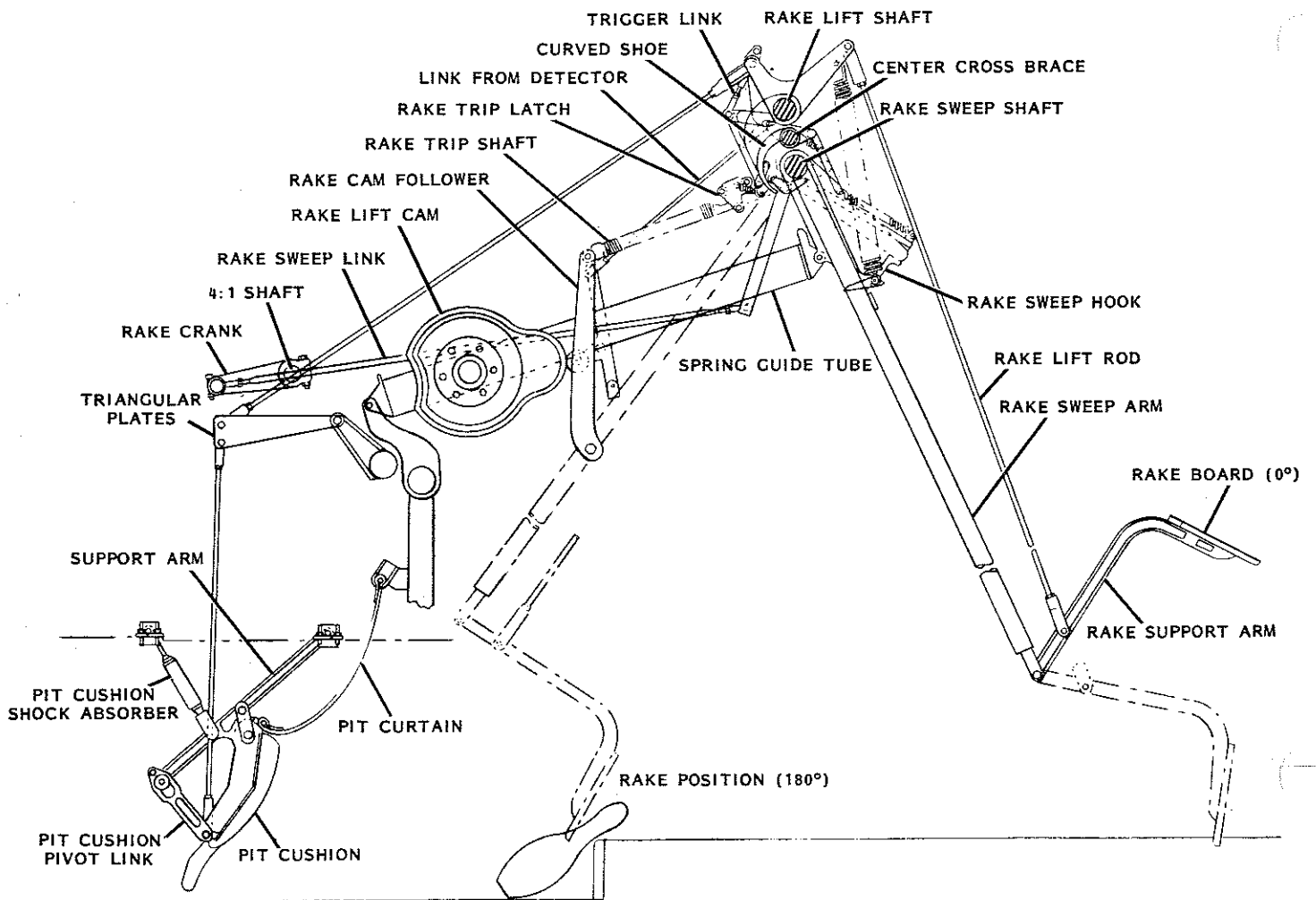
CHAPTER 16 - RAKE

The rake (Figure 42) sweeps the deadwood from the lane to the pit. It also protects the deck when it is down in the event a ball is thrown at the wrong time. The rake consists, in part, of two rake sweep arms fixed to the rake sweep shaft which is pivoted on top of the pinsetter frame. Hinged at the bottom of the rake sweep arms are two rake support arms, upon which is mounted a fiberglass rake board. When the rake board is drawn rearward by the rake sweep arms, it sweeps deadwood from the pin area.

The rake board lowers to the lane immediately after delivery of a ball, and remains down during the entire pinsetter cycle, thereby protecting the deck when it is in any of its lower positions. The lowering motion of the rake, after ball delivery, also actuates the electrical triggering circuit to engage the gear box clutch to start the machine cycle.



RAKE
FIGURE 42



RAKE
FIGURE 42

Attached to the left hand rake sweep arm is a telescoping spring guide tube that contains a large compression spring. When the rake is drawn rearward to sweep, the spring compresses. When the rearward sweep motion is complete, the compression spring urges the rake forward until the sweep arms reach adjustable brackets mounted on each side frame.

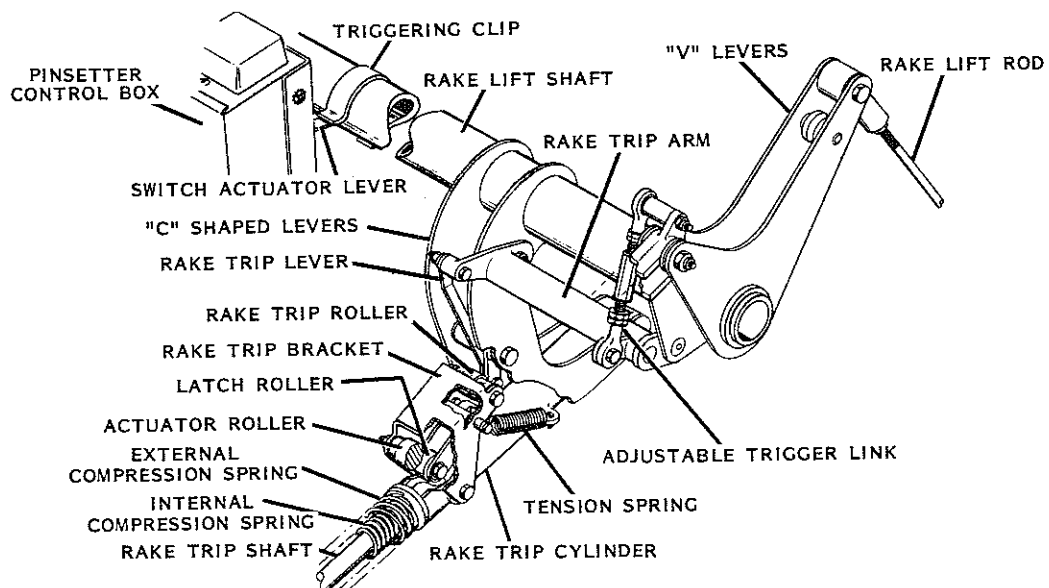
The rake has two separate motions:

1. An up and down motion for lowering to its sweep position and raising for ball delivery.
2. A rearward and forward motion for sweeping deadwood from the lane.

The up and down motion is controlled by the rake lift cam on the 1:1 shaft and a collapsible rake trip mechanism between the rake cam follower and the rake lift shaft. The rake lift shaft is mounted across the top of the pinsetter and has a pair of V-shaped levers at each end. Connected to the forward arms of each pair of "V" levers are the rake lift rods that are connected to the rake support arms. A pair of counterbalance tension springs attached from the "V" levers to the rake sweep arms urge the rake in the downward position.

RAKE TRIP MECHANISM

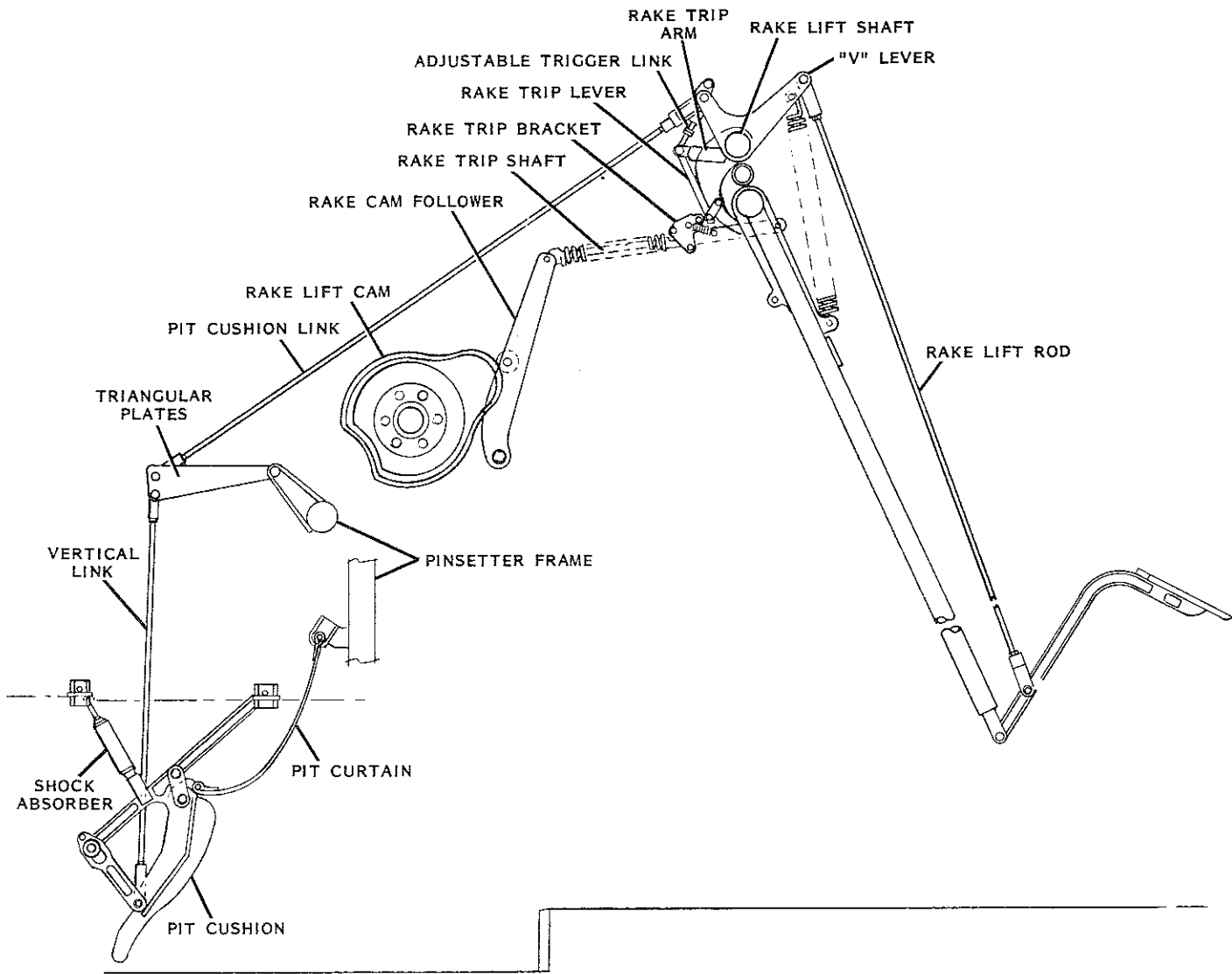
The rake trip mechanism (Figure 43) consists of a trip shaft attached to the rake cam follower lever. The trip shaft slides within the trip cylinder which is attached to the "C" lever portion of the rake lift shaft. Two compression springs urge the trip shaft and trip cylinder away from each other. Pivoted to the trip cylinder is a trip bracket assembly that contains a roller bearing at each end. A third roller bearing, the "latch roller", is mounted under the trip bracket between two parallel links that are pivoted to the top of the trip cylinder. A tension spring from the trip bracket to the trip cylinder, urges the rear, actuator roller of the bracket against the latch roller, thereby forcing the latch roller against the trip shaft.



RAKE TRIP MECHANISM
FIGURE 43

The trip shaft has a notch across its forward end. When the latch roller is held in the notch by the actuator roller of the trip bracket, the shaft is unable to slide within the cylinder, and the shaft and cylinder essentially become a rigid connection. If, however, the trip bracket is rotated counterclockwise, thus removing the pressure of the actuator roller from the latch roller, the connection becomes collapsible as the latch roller will pivot out of the notch and permit the trip shaft to slide within the trip cylinder.

Attached to the slotted link at the forward end of the left hand pit cushion link is an adjustable link that is attached to the rake trip arm (Figures 43 and 44). The rake trip arm pivots between the inner, left hand "V" lever and the C-shaped lever on the rake lift shaft. Attached to the right hand end of the rake trip arm is the rake trip lever, which is connected to the pivot link. The rake pivot link is pivoted on the C-shaped lever. The bottom portion of the rake trip lever is positioned directly in front, and slightly below the trip roller on the rake trip bracket.



RAKE LOWERING MECHANISM

FIGURE 44

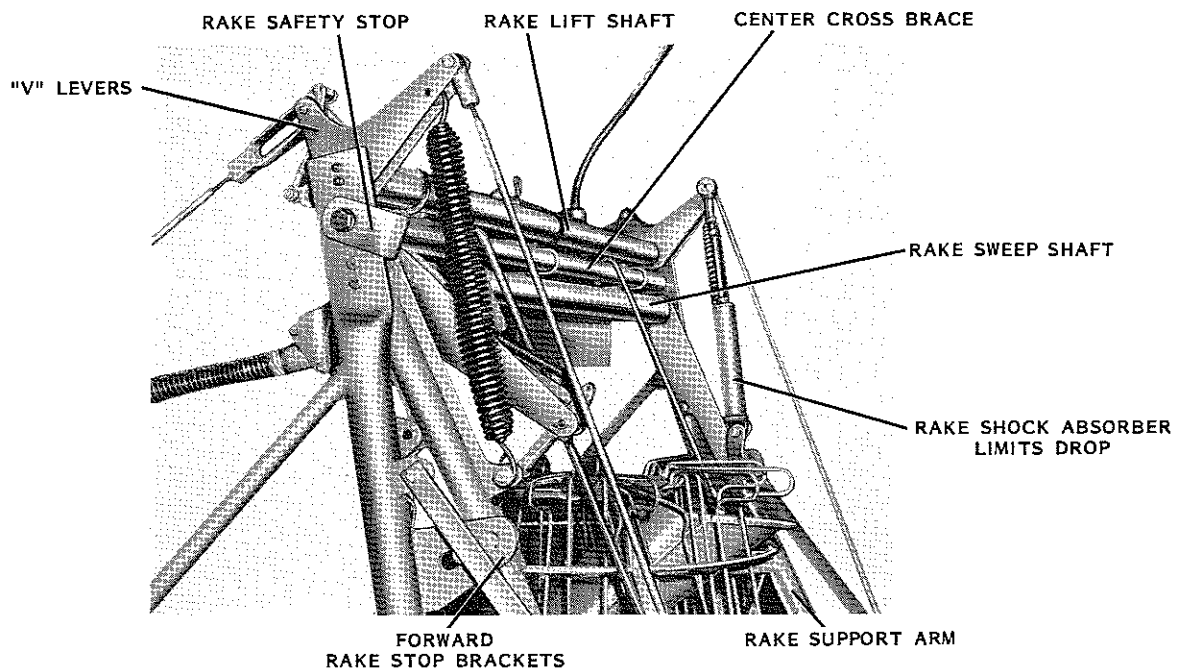
The rake is lowered and raised in the following manner: As a ball is delivered, the impact against the pit cushion will cause the pit cushion link to move forward, and through the trigger link, will rotate the rake trip arm clockwise. This clockwise rotation of the trip arm will pivot the rake trip lever rearward and thus contact the trip roller on the rake trip bracket. The trip bracket will pivot counterclockwise and remove the pressure of the actuator roller from the latch roller, thus permitting the trip cylinder to slide rearward and compress the compression spring as the rake lift shaft is rotated clockwise to lower the rake board to its sweep position. The clockwise rotation of the rake lift shaft also rotates the triggering clip that is fastened to the rake lift shaft. The switch actuator lever protrudes through a cutout on the front surface of the pinsetter control box and, when the rake lowers, the clip pivots away from the switch actuator lever, thus allowing the actuator lever to contact the triggering switch to energize the electrical triggering circuit to start the pinsetter cycle. (Figure 43)

With the rake in its lowered, sweep position, the gear box clutch becomes engaged, thereby rotating the rake lift cam on the 1:1 shaft. The rake cam follower lever immediately encounters a low dwell on the rake lift cam, thereby permitting the compression springs to push the trip shaft rearward until the latch roller again engages the notch on the shaft. The trip bracket is spring-urged clockwise, thus placing the actuator roller against the latch roller to lock the trip cylinder to the trip shaft. This essentially forms a rigid connection and, through the linkage, places the height of the rake board under complete control of the rake lift cam.

As the rake moves rearward and forward in its sweep motion, the contour of the rake lift cam controls the height of the rake board to obtain a horizontal sweep motion. As the pinsetter nears the completion of a cycle, the rake cam follower encounters a rising high level of the rake lift cam, thus pushing forward on the latched rake lift linkage to rotate the rake lift shaft counterclockwise and raise the rake board. The gear box clutch will disengage at 0° with the rake cam follower on the high level of the rake cam thus holding the rake board up to permit delivery of the next ball. The rake trip mechanism is latched and ready to repeat the entire process upon ball impact. A rake safety stop, mounted under the left hand "V" lever prevents the rake board from lowering below the lane surface at 180° in the event that the rake trip mechanism failed to relatch during the sweep motion.

If the cycle button is used to trigger the machine instead of ball impact, the cycle solenoid is immediately energized and the rake trip mechanism is not used to lower the rake. The rake cam follower finds an immediate low level of the rake lift cam, and through the linkage, lowers the rake board to its sweep position. In this case, the rake trip mechanism does not unlatch.

A shock absorber, mounted between the right hand "V" lever and the rake support arm, cushions the sudden, downward motion of the rake board when the rake trip mechanism is actuated by ball impact. A threaded collar on the plunger of the shock absorber contacts the top of the cylinder to limit the downward travel of the rake board. (Figure 45)



SHOCK ABSORBER AND LOWERING STOP

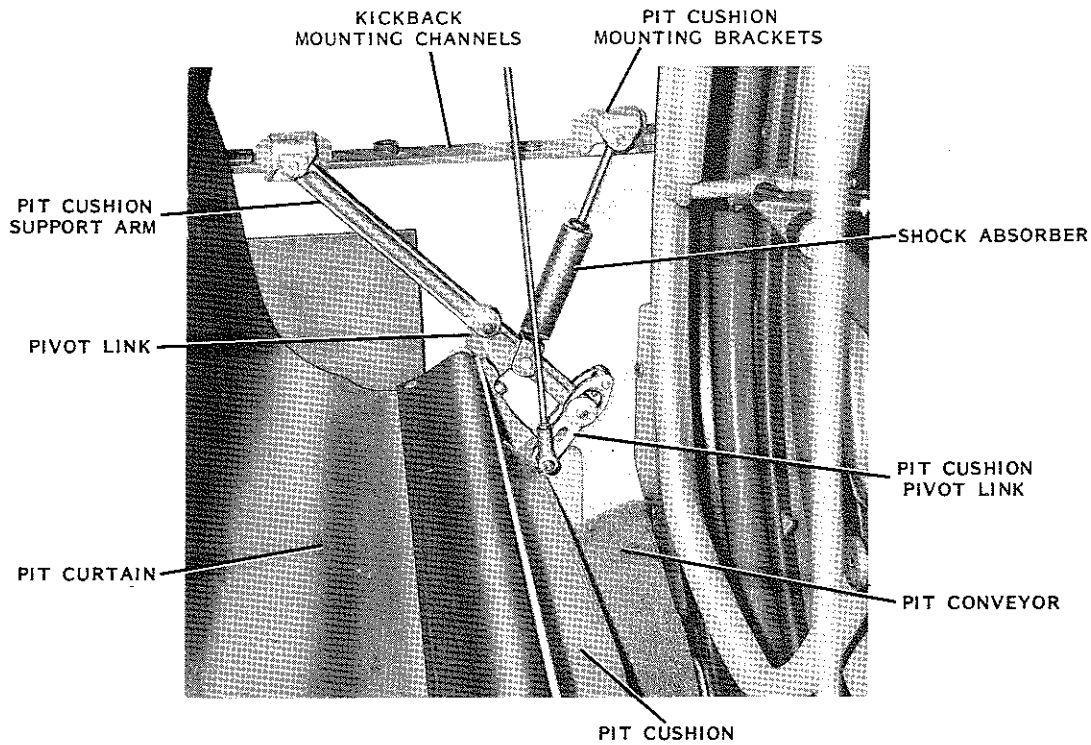
FIGURE 45

As the sweep link moves forward at 135° , the rake sweep hook cam follower encounters a low dwell in the rake sweep hook cam, which pushes the link forward to rotate the collar clockwise. The curved shoe lowers the roller, and through the bellcrank and link, lowers the sweep hook into the path of the sweep link. The rake is drawn rearward and, at 180° , reaches its rearmost position. The rake returns to its forward position at 225° , at which time the rake sweep hook cam follower encounters a high level of the cam to raise the sweep hook from the path of the link, thus completing the sweep motion until the next cycle. The rake only sweeps between 135° and 225° . It is the 1:1 shaft in the detector that controls the sweep cycle and the 4:1 shaft provides the power to sweep.

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CHAPTER 17 - PIT CUSHION

The pit cushion (Figure 47) is suspended across the pit to stop the forward motion of the ball after the ball passes the playing area of the lane. It also initiates the signal to lower the rake board and trigger the machine at the start of a cycle. It consists basically of a steel plate, suitably padded and covered with a synthetic sheet.



PIT CUSHION
FIGURE 47

Mounted to the kickback mounting plates are four pit cushion support brackets that suspend the pit cushion above the pit. Hinged to the two front brackets are two pit cushion arms. An airplane type shock absorber is attached from the bottom of each pit cushion arm to the rear support bracket on each kickback. The shock absorbers relieve the sudden rearward motion of the pit cushion upon ball impact.

The pit cushion is mounted to the bottom of the pit cushion arms through a pair of pivot links on each end. The upper pivot link has a fixed distance between its pivot points, while the bottom "follower link" has an elongated slot at its connection to the pit cushion arm. The pit cushion can, therefore, pivot rearward upon ball impact. Attached to each end of the pit cushion, on the same pivot bolt that hinges the follower link to the pit cushion, is a vertical, adjustable link that is mounted to a pair of parallel, triangular plates. The triangular plates are pivoted to brackets from the rear legs of the pinsetter frame. Another adjustable pit cushion link runs from the triangular plates to the "V" levers on the rake lift shaft. The forward end of the left hand pit cushion link is attached to the adjustable link of the rake trip mechanism as described in the previous chapter.

When a ball is thrown by the bowler, the ball impact against the cushion causes the pit cushion to rotate clockwise and thus push the vertical link upward. This action rotates the triangular plates clockwise, which pushes the pit cushion link forward and raises the adjustable rake trip link to lower the rake as described in the preceding chapter. As the rake lowers, the pit cushion link rotates the triangular plates clockwise and, through the vertical links, raises the pit cushion to allow the ball to pass under it and be returned to the bowler. The slot on the follower links permit the pit cushion to be raised by the upward motion of the vertical link.

When the pinsetter approaches 0°, the high level of the rake cam raises the rake board. The counterclockwise rotation of the "V" levers, as the rake board raises, allows the weight of the pit cushion to pull the vertical links downward, rotate the triangular plates counterclockwise and move the pit cushion links downward. The pit cushion is then in position to await delivery of the next ball. It can be seen that the pit cushion and rake board operate together. When the rake board is down, the pit cushion is up. Conversely, when the rake board is up, the pit cushion is down.

A rubber pit curtain is suspended from the rear legs of the pinsetter frame to the top of the pit cushion, thus preventing any pins from being hurtled out of the pit by ball impact.

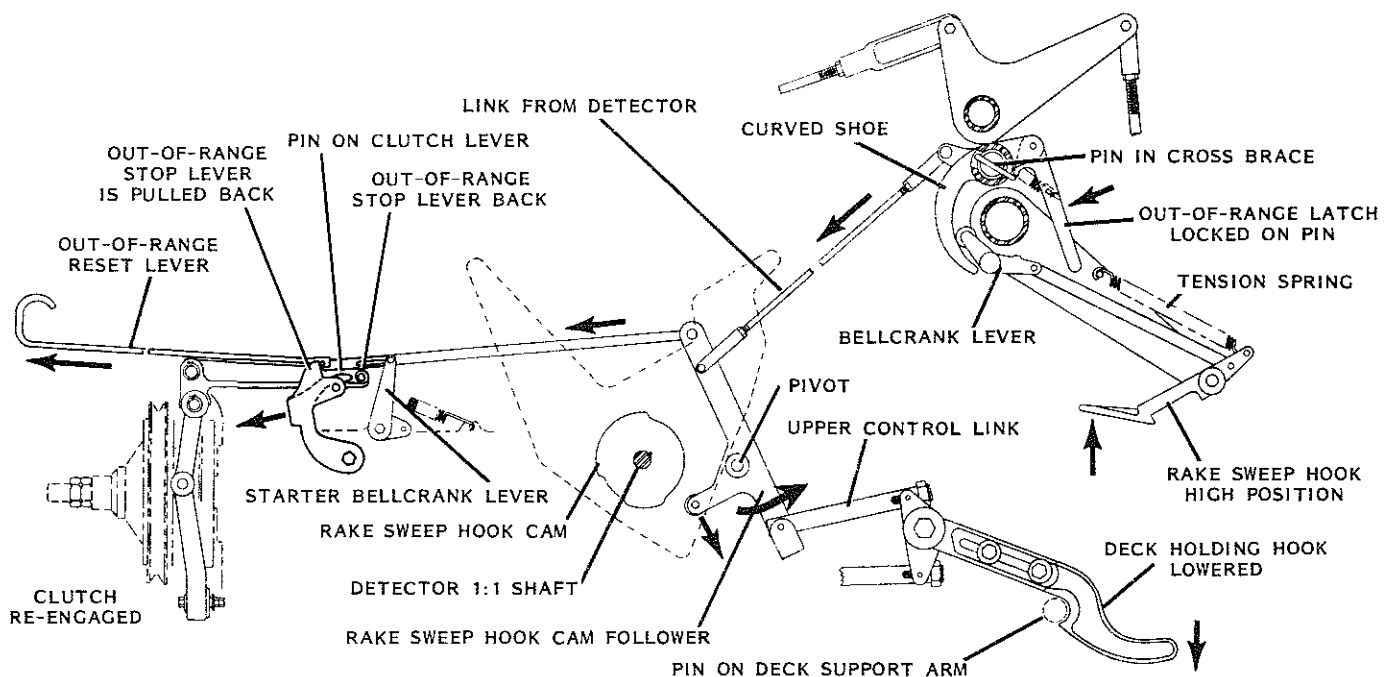
CHAPTER 18 - OUT-OF-RANGE RESET MECHANISM

Two detections are required at 90° for out-of-range; a no-strike and an out-of-range detection. In the event the deck comes down and detects an out-of-range pin, the gear box clutch will disengage and will remain disengaged until manually re-engaged. On first ball, the deck lowers to detect and the bottom of the scissor deck encounters any pin which is out of the normal pickup range of the scissors. This prevents the deck from lowering as far as it normally would. It must detect a no-strike condition. This abnormal height of the deck during the first ball, detection stroke of the deck, causes a lever in the detector to rotate. Though a link, this lever is connected to the out-of-range stop lever which is pivoted on the same shaft with the three part clutch actuating mechanism (Figure 15, page 1-19). The out-of-range stop lever carries a projection and a curved arm. When the deck encounters an out-of-range pin, the lever in the detector rotates clockwise, and through a link, rotates the out-of-range stop lever carrying the projection and curved arm clockwise. This positions the curved arm under a pin in the end of the clutch lever. Then, when the clutch lever moves downward at 90°, the pin will contact the top of the curved arm portion of the out-of-range stop lever and the clutch will disengage.

NOTE: Before clearing deadwood from the playing area during an out-of-range cycle, the operator must shut off the power to the pinsetter. After the deadwood has been removed, return the power to the pinsetter and pull the out-of-range reset lever described below.

At the rear of the pinsetter is the out-of-range reset lever which, when pulled, will accomplish three things. It will prevent the rake from sweeping, set the deck holding hook to engage the pin on the deck post and it will re-engage the gear box clutch. (Figure 48) The out-of-range reset lever carries a pin and link which is connected to the upper arm of the rake sweep hook cam follower. The rake sweep hook cam follower is connected by links to the deck holding hook and the rake sweep hook collar on the overhead cross brace. When the reset lever is manually pulled rearward, the pin contacts the projection on the out-of-range stop lever, thus rotating the curved arm from under the clutch lever to re-engage the gear box clutch. The rearward motion of the out-of-range reset lever also rotates the rake sweep hook cam follower counterclockwise. This counterclockwise rotation of the rake sweep hook cam follower rotates the collar further counterclockwise than normal, which permits the rake out-of-range latch to engage a pin on the center cross brace, thereby holding the rake sweep hook up to prevent the rake from sweeping during an out-of-range cycle. The abnormal rotation of the rake sweep hook cam follower also pushes forward on the upper control link to the deck holding hook, thereby lowering the hook to engage the pin on the deck support arm when the deck comes up. To summarize, when the reset lever is pulled, the clutch will re-engage, the deck will come up and be held up by the deck holding hook, the rake will not sweep because it is latched out and the pinsetter stops at 0° to await delivery of the second ball, since an out-of-range pin is still a standing pins cycle. The out-of-range latch will be released at 0° when the rake raises. The forward position of the "C" lever on the rake lift shaft will rotate the out-of-range latch from over the pin in the cross brace, thereby placing the rake sweep hook under the control of the rake sweep hook cam.

There is no out-of-range problem on second ball as the deck does not lower to detect. The rake will sweep and the deck will automatically set new pins after delivery of the second ball.



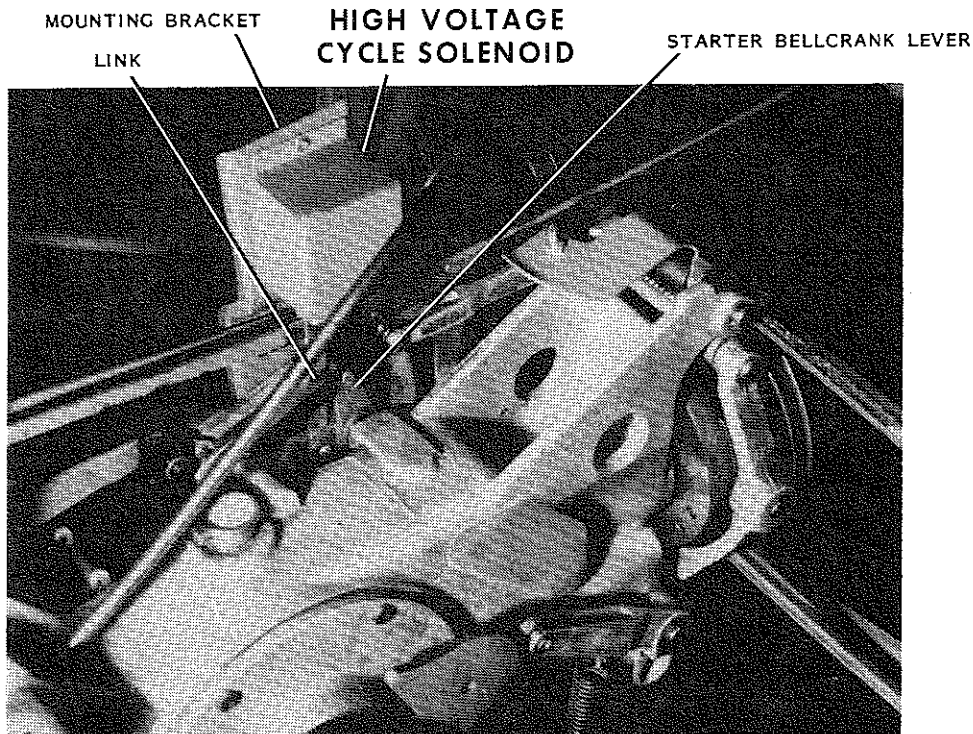
OUT-OF-RANGE RESET MECHANISM (WITH OUT-OF-RANGE HANDLE PULLED)

FIGURE 48

CHAPTER 19 - CYCLE SOLENOID

Mounted above the gear box is the cycle solenoid and linkage. (Figure 49) If the bowler wants ten new pins at a time when the pinsetter would not normally deliver them, he pushes the cycle or "trigger" button which is located on the ball return. This energizes the solenoid and, as the solenoid is connected by a link to the starter bellcrank, the bellcrank rotates and engages the clutch.

If the cycle button is pushed on first ball, the pinsetter will go through a normal first ball, standing pins operation and the button will have to be pushed a second time to obtain a new set of pins. If the button is pushed on second ball, the machine will go through a normal second ball cycle and set new pins.



CYCLE SOLENOID CONVERTED A-2 MACHINE
FIGURE 49

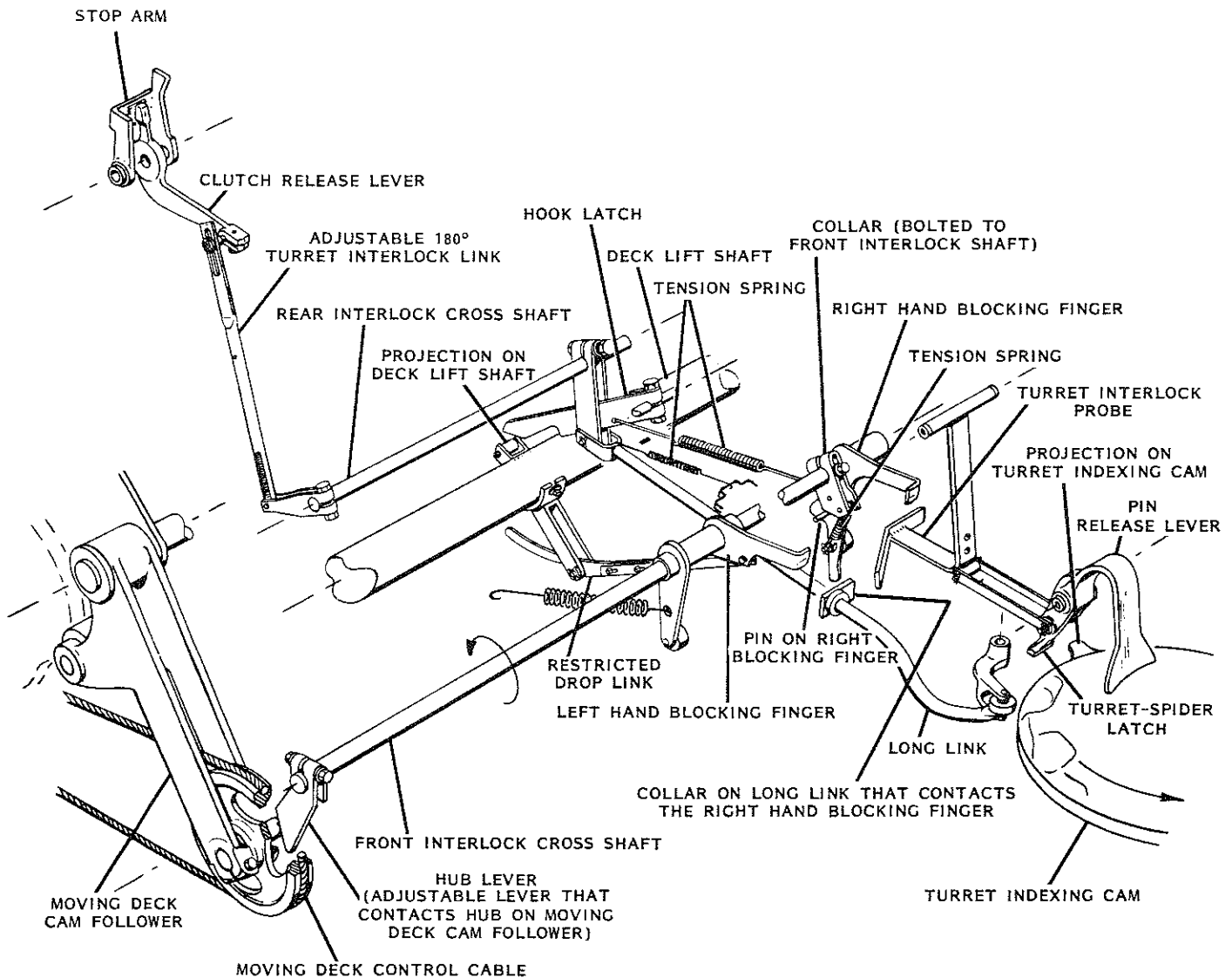
There is a second cycle button located at the rear of the pinsetter, for use by the mechanic.

The cycle button is used in the following instances:

1. When a "rerack" is desired because the new pins are off spot or one has fallen over, push the cycle button to cycle the machine to second ball. When the machine has stopped, push the cycle button again to clear the lane and set a new rack of pins.
2. If a foul is committed on the first ball and pins are left standing, push the cycle button for ten new pins. If, after the second ball is rolled, some pins remain standing, push the cycle button again so that new pins will be set for the next bowler.
3. Bowling out in the tenth frame:
 - a. Sparring in the tenth frame and not making a strike with the next ball.
 - b. Striking in the tenth frame and the 11th frame and not striking in the 12th frame.
4. When machine fails to trigger.

CHAPTER 20 - INTERLOCKS

The interlocks (Figure 50) are built into the pinsetter to insure that the turret does not dump pins into the deck when the deck is not ready to receive them. The deck must meet three requirements before it can receive pins; the deck must be in its raised position, the deck must be empty of pins, and the moving deck must be fully forward in its pin receiving position.



INTERLOCK SYSTEM

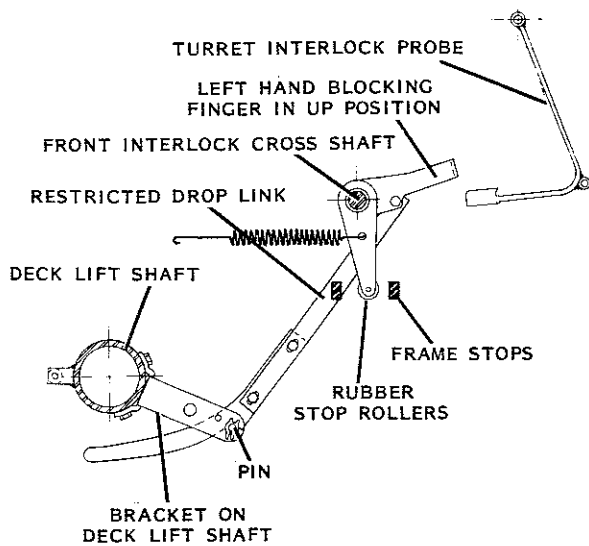
FIGURE 50

As the tenth pin drops into the turret, it depresses the pin release lever in the bottom of the #5 pin chute which moves the interlock probe rearward. If nothing blocks the rearward motion of the interlock probe, the turret-spider latch opens. The spider then rotates ahead of the turret and the pins drop into the deck. If the deck is not ready for pins, the rearward motion of the interlock probe is blocked and the spider cannot rotate to release the pins to the deck.

Located just behind the interlock probe are two blocking fingers which can pivot in an up and down motion. If either or both of the fingers are in the down position, the probe contacts the front of the finger and the probe cannot move rearward to release the pins. Both of the fingers must be up to allow motion of the interlock probe.

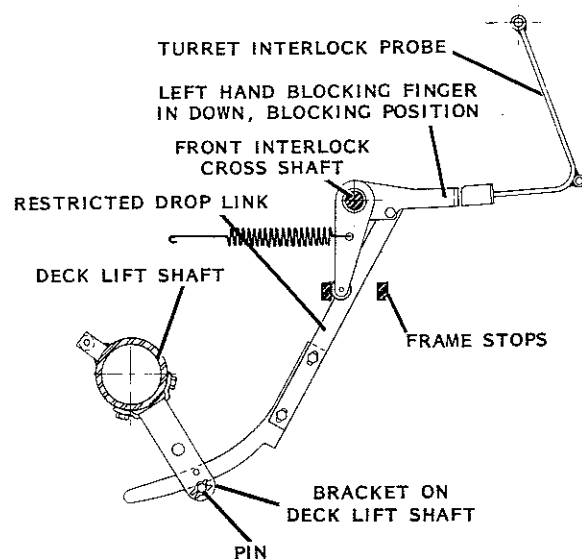
LEFT BLOCKING FINGER

The left blocking finger is controlled by the "restricted drop" linkage and is used to prevent the turret from delivering pins when the deck is not in its raised position (Figures 51 and 52). The top end of the restricted drop link is connected to the left blocking finger. The lower end of the restricted drop link is curved and has a shoulder on it. A pin mounted to a bracket which is bolted to the deck lift shaft, follows the curve of the link as the deck moves up and down. A tension spring, attached from the left blocking finger to the turret frame, urges the finger in a down, blocking position. As the deck is lowered, the pin attached to the deck lift shaft rotates away from the shoulder on the restricted drop link, permitting the left finger to lower into its spring-urged blocking position, and thus prevents the turret from delivering pins when the deck is down. Then, as the deck moves upward, the pin rotates upward and lifts the shoulder of the restricted drop link which raises the restricted drop link and pivots the left finger to its up position to indicate the deck is high enough to receive pins from the turret. Note: The 21" deck height is considered "up".



RESTRICTED DROP INTERLOCK (DECK UP)

FIGURE 51



RESTRICTED DROP INTERLOCK (DECK DOWN)

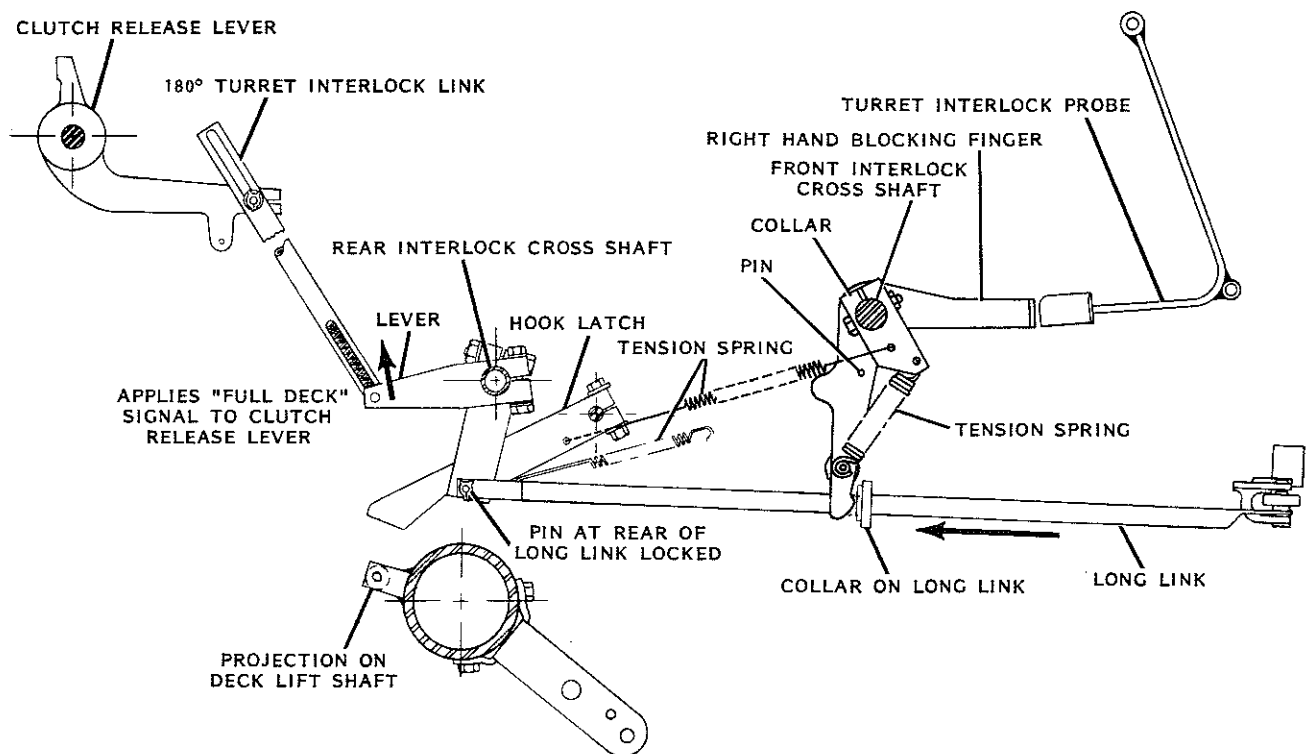
FIGURE 52

RIGHT BLOCKING FINGER

The right blocking finger is used to prevent the turret from dumping pins into the deck if the deck is full or if the moving deck is not in its forward pin receiving position. If either one of these two conditions is not satisfied, the blocking finger will be down, preventing the turret from delivering pins. Both conditions must be satisfied before the finger will lift and permit the turret to deliver pins to the deck.

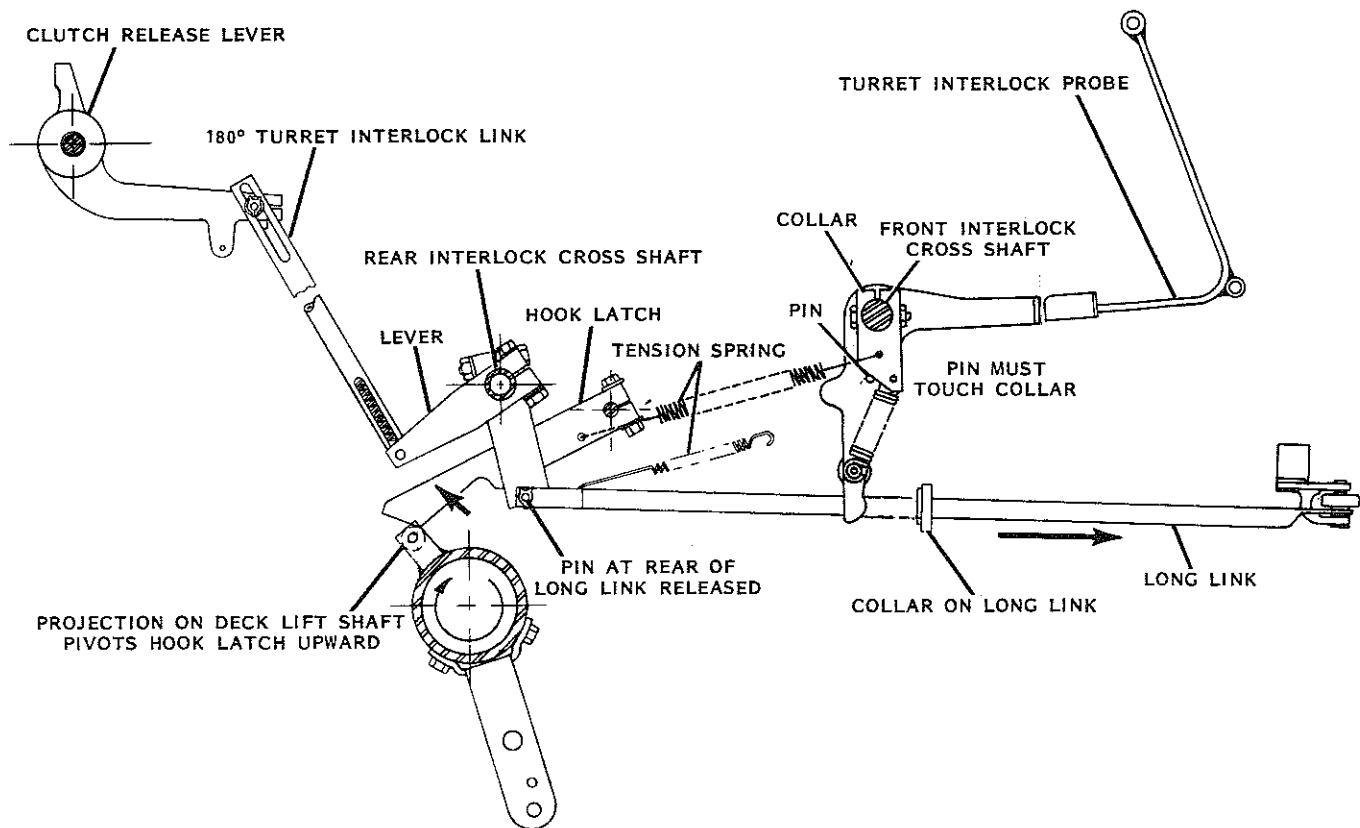
FULL DECK

There is a single rise on the bottom, outer perimeter of the turret indexing cam and, as the turret indexes after delivering ten pins to the deck, this rise contacts a roller on the long link and pushes the link rearward (Figure 53). As the link is moved rearward, a spring-loaded hook latch snaps over a pin on the end of the long link and holds it in its rearward position. As the link was pushed back, a collar on the link contacted the toe of the right blocking finger and pivoted it in its down, blocking position. The projection on the cam pushed the link rearward as the turret indexed after the #5 pin passed through. This indicates that the deck is full and that the turret should not feed the deck again until the deck has emptied. The hook latch holds the link back until the deck lowers to its new pinsetting height, at which time a projection on the rear of the deck lift shaft contacts the latch and lifts it free of the pin, allowing the long link to move forward to its original spring-urged position which moves the collar away from the toe of the right blocking finger. (Figure 54).



INTERLOCK SYSTEM (FULL DECK SIGNAL)

FIGURE 53

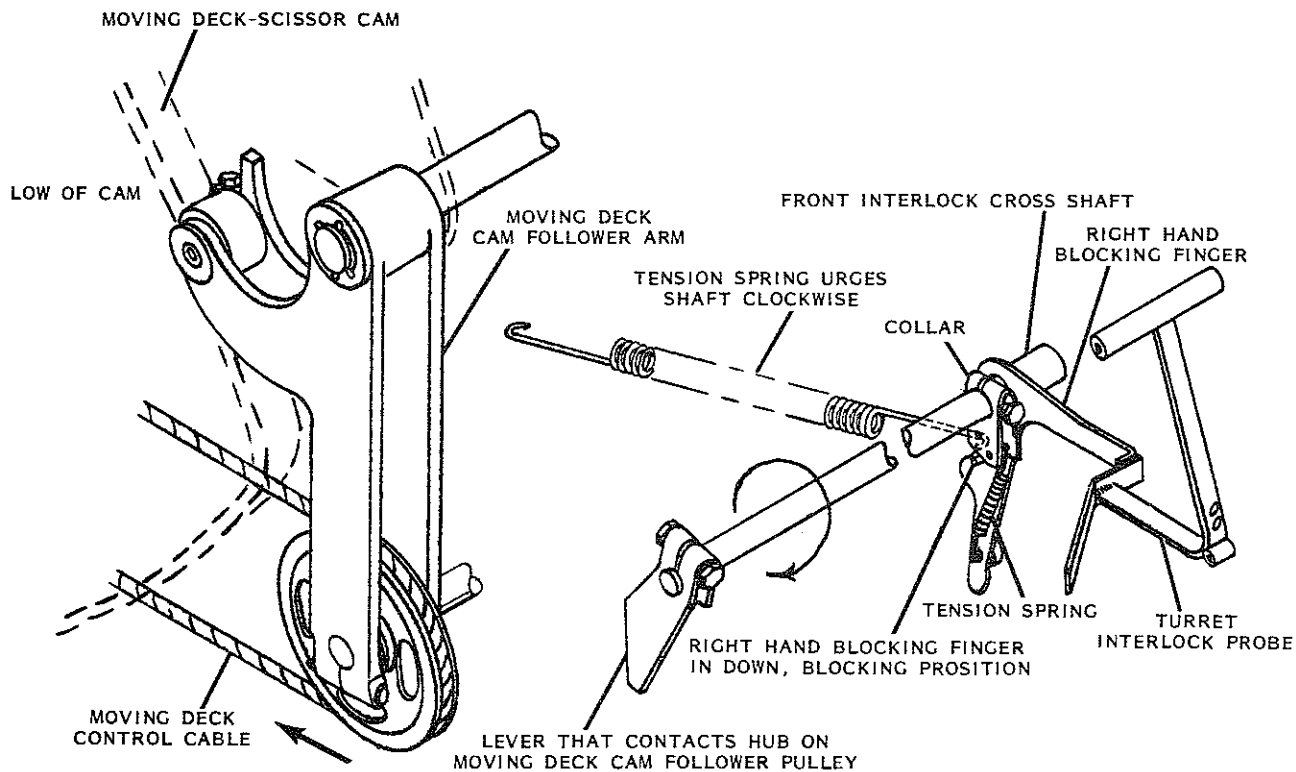


INTERLOCK SYSTEM (EMPTY DECK SIGNAL - 270°)

FIGURE 54

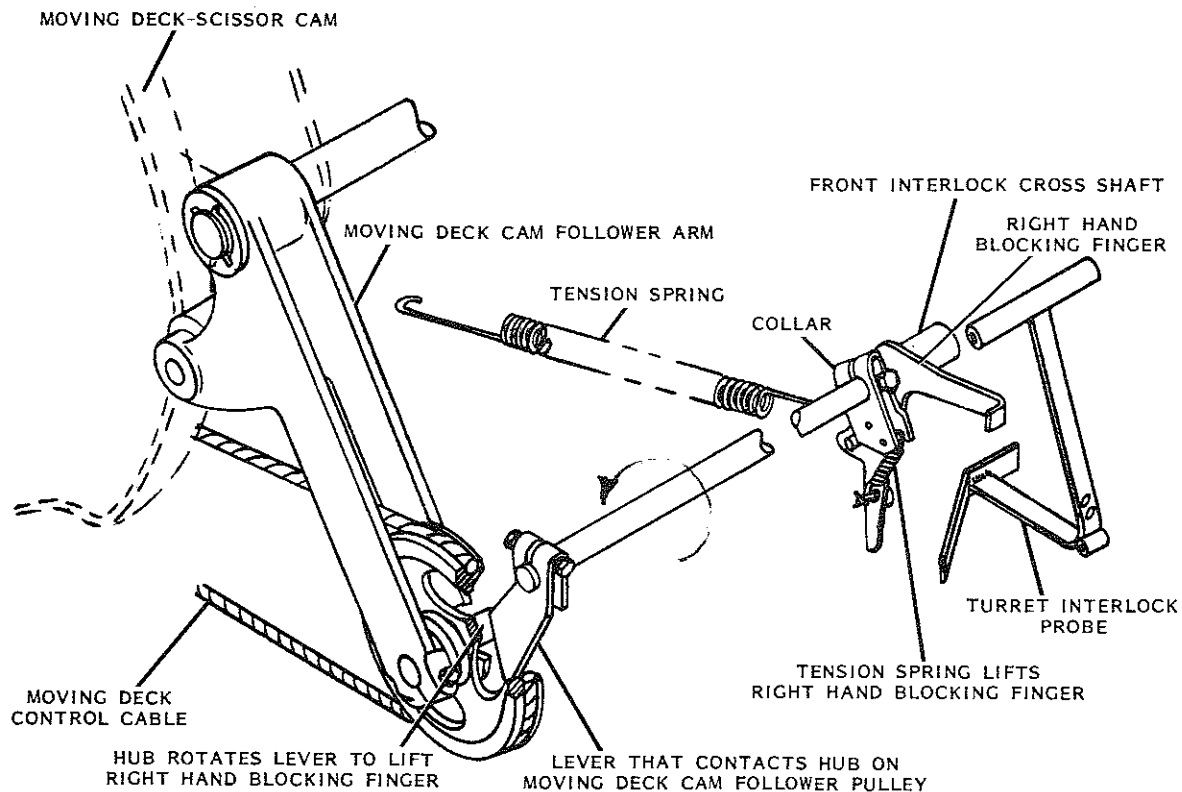
The position of the right blocking finger is also controlled by the forward or rearward position of the moving deck. Fixed to the front interlock cross shaft, upon which the two interlock blocking fingers pivot, is a collar and a hub lever. The collar is bolted between the two interlock blocking fingers and is connected to the right finger by a tension spring. The hub lever on the left end of the shaft is in line with the hub on the pulley at the lower end of the moving deck cam follower arm. Another tension spring, attached from the hook latch to the collar, urges the hub lever to follow the motion of the moving deck cam follower arm.

When the moving deck cam follower arm moves rearward to permit the deck to shift rearward, the lever rotates clockwise, thus rotating the front interlock cross shaft and collar clockwise. The bottom angle of the collar contacts a pin that protrudes from the bottom of the right blocking finger and, thereby holds the finger in its down, blocking position to prevent the turret from dumping pins when the moving deck is in a rearward position (Figure 55).



INTERLOCK SYSTEM (DECK REARWARD SIGNAL)
FIGURE 55

As the moving deck cam follower arm is moved forward by the highest level of the moving deck-scissor cam, thus positioning the moving deck in its forward position, the hub on the follower arm contacts and rotates the hub lever, front interlock cross shaft and collar counterclockwise. The collar, through the tension spring, urges the right finger to its up position to indicate that the moving deck is fully forward (Figure 56) during an empty deck.



INTERLOCK SYSTEM (DECK FORWARD SIGNAL)
FIGURE 56

Because both the full deck linkage and moving deck cam follower control the same blocking finger, either or both controls can pivot the right finger into its down, blocking position. Two conditions must be satisfied, however, to permit the right finger to be in its raised position; the deck must be empty of pins and the moving deck must be fully forward in its pin receiving position.

There is another interlock built into the pinsetter called the "180° stop interlock". When the gear box start-stop mechanism was described, it was stated that, as the pinsetter approached 180°, the clutch release lever was brought under the control of the turret interlock link to enable the clutch to disengage at 180° in the event that the deck had to wait for the pins. The clutch must then be able to re-engage when the ten pins are delivered to the deck, without a ball impact to trigger it.

The long link is also used as part of the 180° stop mechanism. Attached to the rear of the long link is a lever which rotates the rear interlock cross shaft as the long link moves rearward or forward. The shaft is pivoted on the turret frame and carries another lever at its opposite end. This lever is attached to the 180° turret interlock link which is connected at its upper end, through an elongated slot, to a pin in the clutch release lever. When the long link is in the rearward position (full deck), the rear interlock cross shaft is rotated clockwise which moves the 180° turret interlock link upward (Figure 53). Conversely, when the long link is forward (deck empty), the rear interlock cross shaft is rotated counterclockwise which lowers the 180° turret interlock link (Figure 54).

As the pinsetter approaches 180° during a first ball, strike or a second ball cycle, the clutch release lever is placed under the control of the 180° turret interlock link by the detector assembly. The pin detector link from the detector pulls the clutch actuator link forward until the pin in the clutch release lever is free of the open slot of the clutch actuator link. The pin on the clutch release lever will then ride in the bottom of the slot in the 180° turret interlock link.

If the long link is in its forward position (deck empty) at 180° during a first ball, strike or second ball cycle, the 180° turret interlock link will be in its downward position. The pin will drop to the bottom of the slot as the clutch release lever is permitted to rotate clockwise to disengage the gear box clutch, and the pinsetter will stop to wait for pins. When the turret indexes after delivering pins to the deck, the long link will be pushed rearward and, as previously described, will push the 180° turret interlock link upward. The bottom of the slot in the 180° turret interlock link will raise the pin and rotate the clutch release lever counterclockwise to rotate the stop arm from under the clutch lever. The gear box clutch re-engages and proceeds through its normal new pinsetting cycle.

The clutch actuator link remains in control of the clutch release lever during a first ball, standing pins cycle, since there is no immediate need for ten new pins as the bowler has standing pins at which to throw a second ball.

CHAPTER 21 - ELECTRICAL INFORMATION AND WIRING DIAGRAMS

The Brunswick Automatic Pinsetter, Model A-2, can be supplied to operate on any of the following line voltages: 230 volts, 60 cycles, single phase; 208 volts, 60 cycles, single phase; and 115 volts, 60 cycles, single phase. The electrical supply lines shall conform to all electrical codes. It shall be the responsibility of the proprietor for supplying power to each pinsetter.

Figure 57 shows the power wiring in a typical installation. A separate supply line is run from the Main Service Circuit Breaker Distribution Panel to a junction box mounted on the rear curtain wall, above each pinsetter. From each junction box, a three-conductor drop cord (local codes permitting), terminating in a twist lock connector, is plugged into the control box of each pinsetter to supply electrical power for the pinsetters.

Figure 58 shows the control wiring in a typical installation. For each bank of eight pinsetters, or fraction thereof, one manager's control panel is installed. (Figures 59 and 60, page 1-74) The manager's control panel contains a frame counting device and a manual on-off switch for each pinsetter. Each manager's control panel is connected to the eight or less pinsetters it controls via a 19-conductor cable. Each 19-conductor cable terminates in a junction box mounted at the center of the bank of pinsetters it serves. (Figures 61 and 62, page 1-75) A three-conductor cable runs from the junction box to each pinsetter. The three-conductor cables are connected to the pinsetter control box through a three-prong connector to complete the circuit for the counting device and a low voltage on-off switch on the manager's control panel.

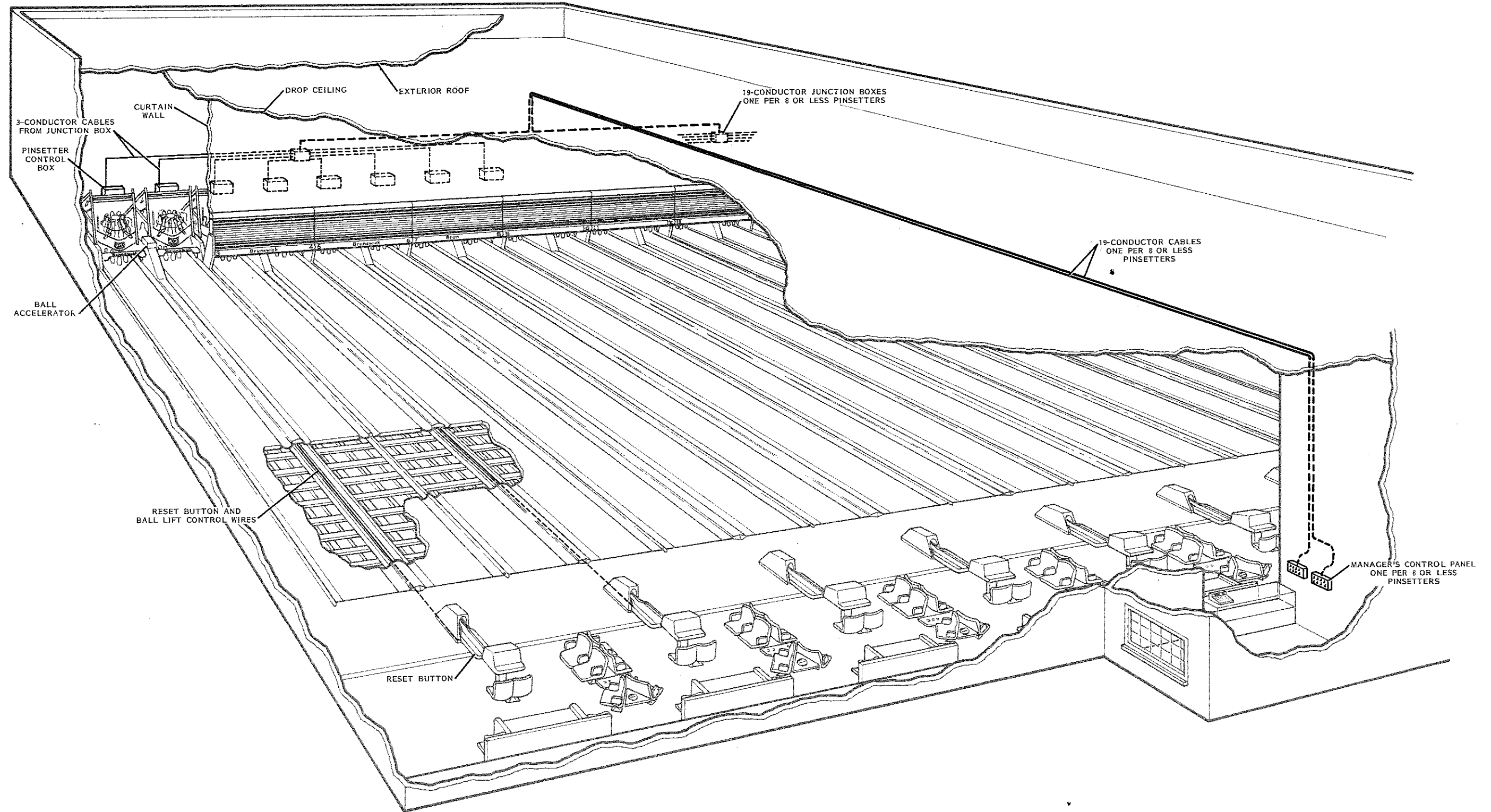
A cycle button for each pinsetter is located on the ball return racks. Each cycle button is connected to its pinsetter by means of a two-conductor cable terminating in a two-prong connector which is plugged into the pinsetter control box. A second cycle button (SW8) is located on the wire channel at the rear of each pinsetter for use by the mechanic. Both cycle buttons are arranged in a parallel circuit, and when either is depressed, the cycle solenoid will become energized to trigger the gear box clutch as previously described. A switch (TSC-2) is connected in series with the cycle buttons to prevent the solenoid from becoming energized when the cycle buttons are depressed during a pinsetter cycle. Note: This has been eliminated on late model machines.

Mounted on the masking unit for each pinsetter are the first and second ball lights and a manual, low voltage on-off switch. The lights and switch are connected to the pinsetter control box via a five-conductor cable terminating in a five-prong connector (TLR3).

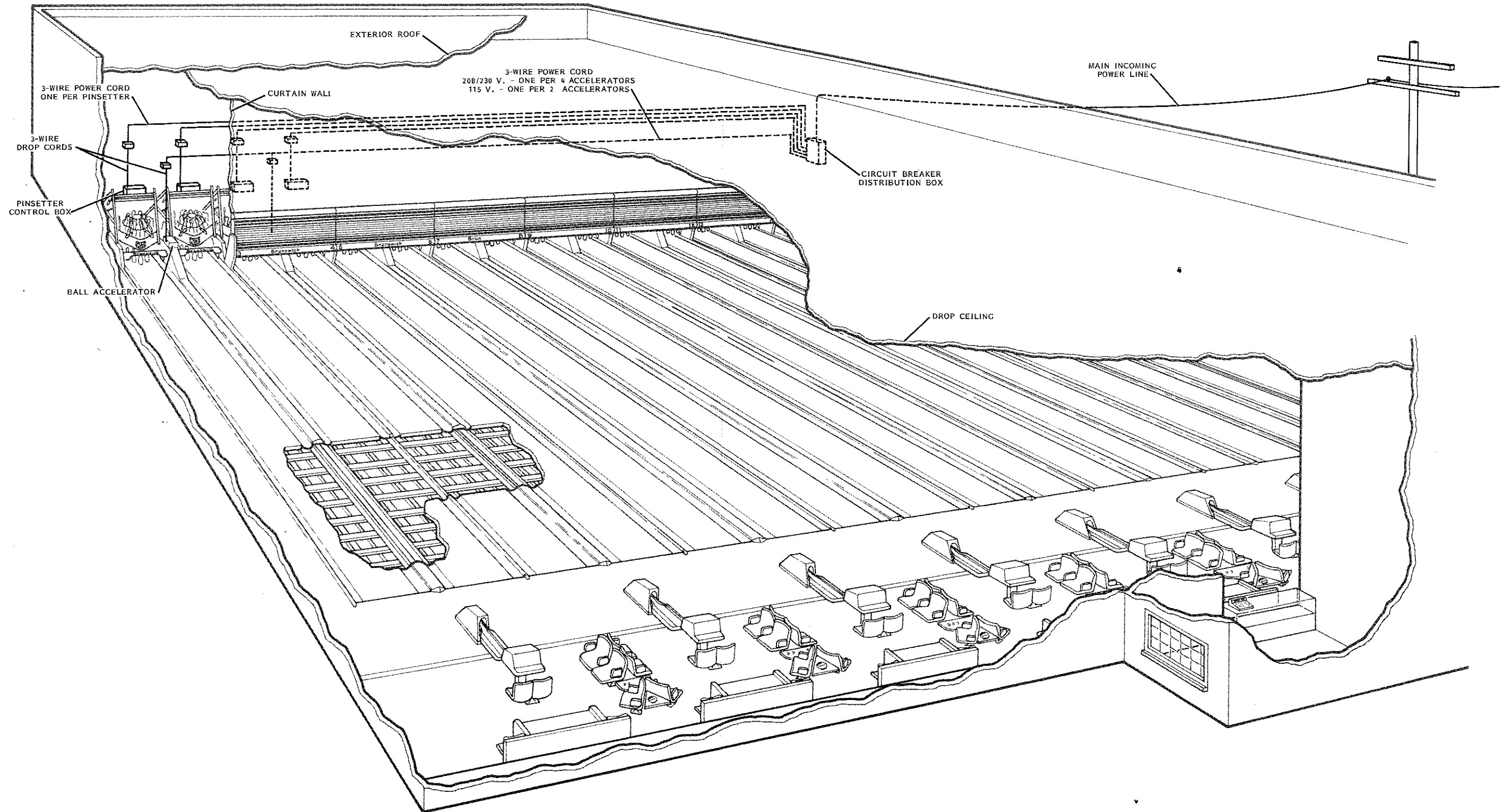
A manual, low voltage on-off switch (SW1) is also mounted at the rear of each pinsetter. A fourth manual on-off switch (CB) is located at the front of the pinsetter control box and is used to manually open and close the thermal overload circuit breaker. This circuit breaker provides additional protection for the pinsetter and is located in the pinsetter control box. A fifth manual, line voltage on-off switch may be located in the circuit breaker distribution panel on the rear wall.

All five manual switches (manager's control panel, masking unit, rear of pinsetter, pinsetter control box and circuit breaker panel) must be in the ON position before the pinsetter will operate. The pin light for each pinsetter is plugged into a receptacle (TLR6) provided on the pinsetter control box.

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POWER WIRING - TYPICAL INSTALLATION
 FIGURE 57



CONTROL WIRING - TYPICAL INSTALLATION
FIGURE 58

In series with the manual, low voltage switches are two limit microswitches. When any of these switches are open, the power to the pinsetter will be off. These switches are installed as limit switches to prevent damage to the pinsetter in the event of a jam. One limit switch, the "turret jam" microswitch (SW2), is mounted on the cross brace just above the rear turret frame. This switch is held closed against the turret frame, and, if a pin or foreign object should be on top of the deck as the deck comes up, the turret will lift at the front, causing the rear of the frame to move down from the switch. This will immediately shut off power to the pinsetter.

The other limit switch is the "moving deck jam" microswitch (SW3). This switch is mounted on the inside surface of the lower gear box support bracket and is held closed by a pin in the spring tube assembly, controlled by the moving deck control cable. If anything causes a jam in the forward motion of the moving deck, the cable will become tighter than normal and the button will pull away from the switch and shut off the power.

If the pinsetter shuts itself off, indicating that one of the limit microswitches is open, the circuit breaker on the pinsetter control box must be manually opened or the power cord disconnected from the control box before locating and clearing the cause of the jam. If the jam is corrected without opening the circuit breaker, the pinsetter will start to cycle and might result in injury to the mechanic.

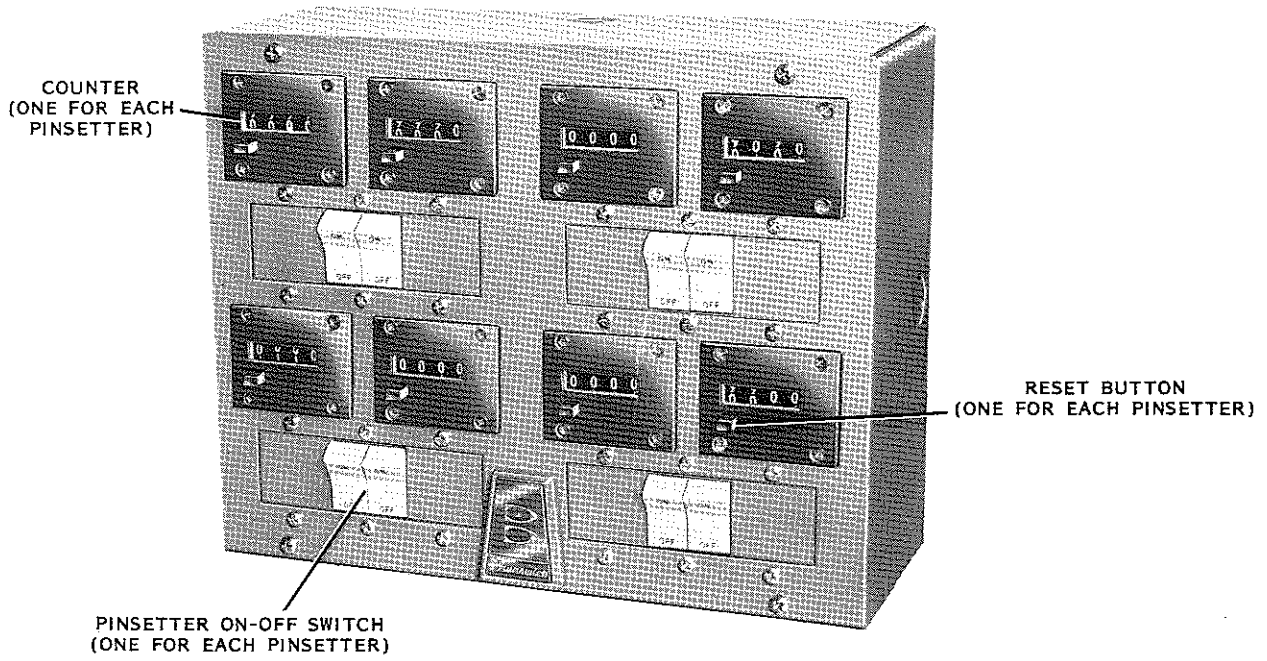
Mounted near the detector assembly is a microswitch (SW6) which is contacted by a two-position lever in the detector assembly to control the first and second ball lights. If the switch button is held in by the lever, the first ball light will be lit. When the lever moves away from the microswitch, the second ball light will light.

Mounted above the left end of the deck lift shaft is a microswitch (SW4) which is contacted by a projection on the deck lift shaft as it goes through its new pinsetting motion. This switch operates the counter on the manager's control panel to tabulate the number of frames bowled.

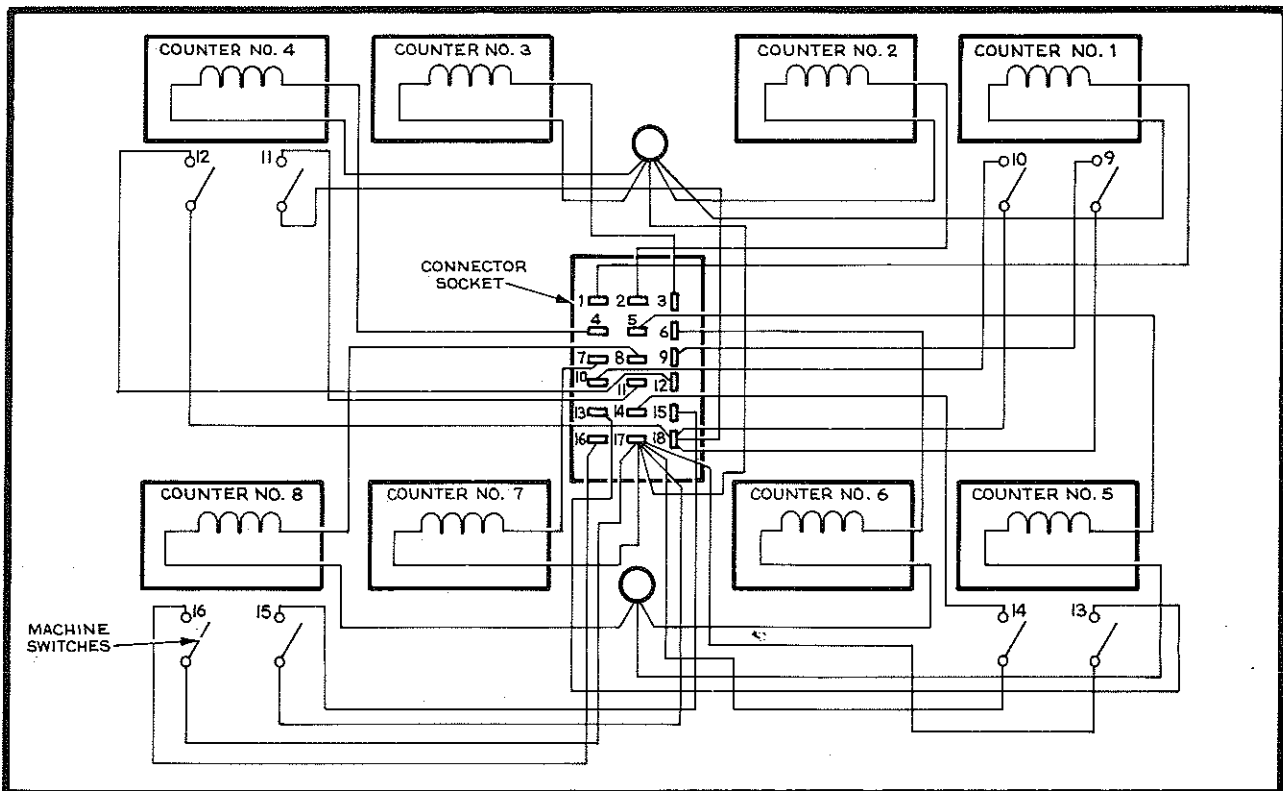
The electrical system consists, in part, of a primary power circuit (115, 208, or 230 volts) and a secondary, 24 volt control circuit. Refer to pages 1-84 to 1-91 for wiring diagrams. The primary winding of the transformer is center-tapped to provide 115 volts for the pin light, motor contactor (RL3), and selenium rectifier (SR). The cycle solenoid, pinfinder (optional) receptacle (TLR6) and the one-horsepower motor are connected to the power lines of the primary circuit. These connections, however, include contacts that must be closed to complete the electrical circuits.

The secondary low voltage, 24 volt control circuit consists of five switches; manager's control switch, masking unit switch, deck jam switch (SW3), turret jam switch (SW2), and the rear switch (SW1), in series with the coil of the motor start relay (RL2) and a 3.2 ampere fuse. When all the switches are closed, the coil of the motor start relay (RL2) is energized, thus closing contacts A & B and E & F.

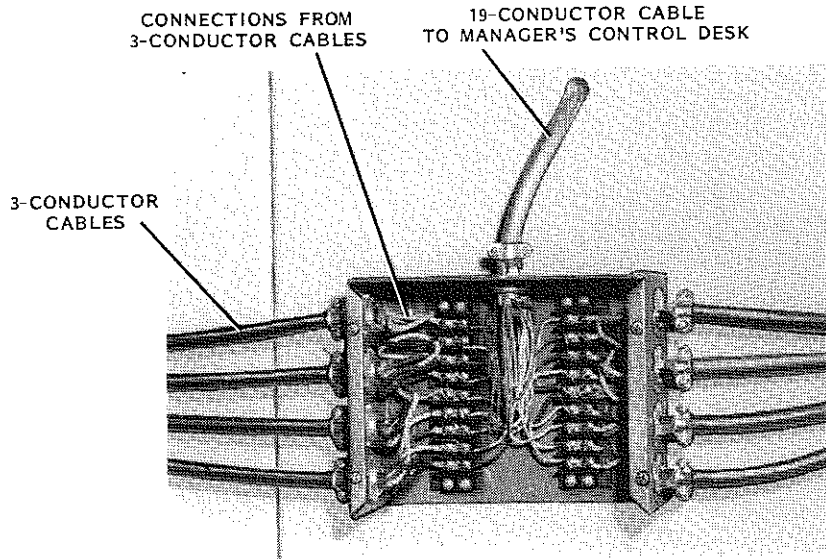
When the motor start relay contacts E & F are closed, the coil of the motor contactor (RL3) is energized, thus closing contacts 1 & 3, 2 & 4, and 7 & 8. The contacts being closed will place the pinfinder receptacle (optional) (TLR2) and motor (with integral thermal overload) or reset button across the input power line. The selenium rectifier (SR) and pin light are simultaneously energized with 115 volts. The pinsetter is thus energized.



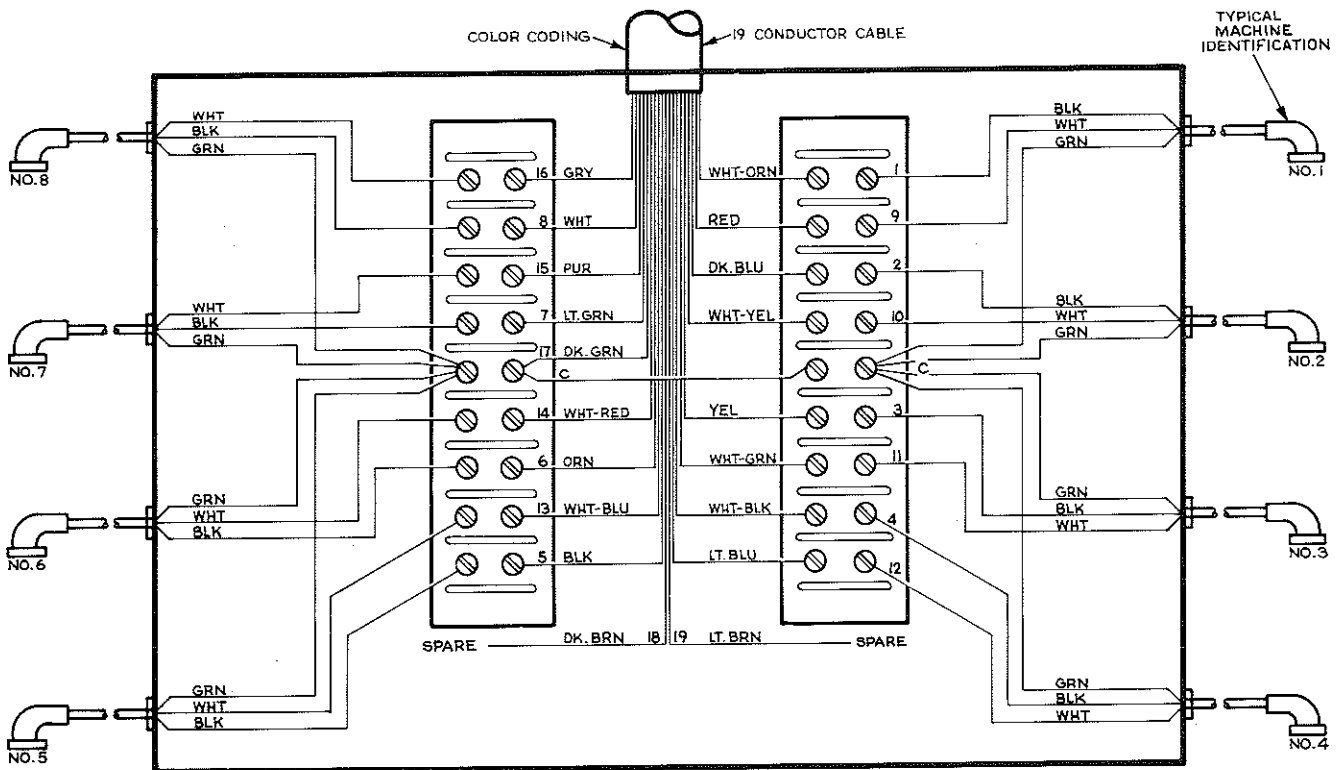
MANAGER'S CONTROL PANEL
FIGURE 59



MANAGER'S CONTROL PANEL WIRING DIAGRAM
FIGURE 60



19-CONDUCTOR JUNCTION BOX
FIGURE 61

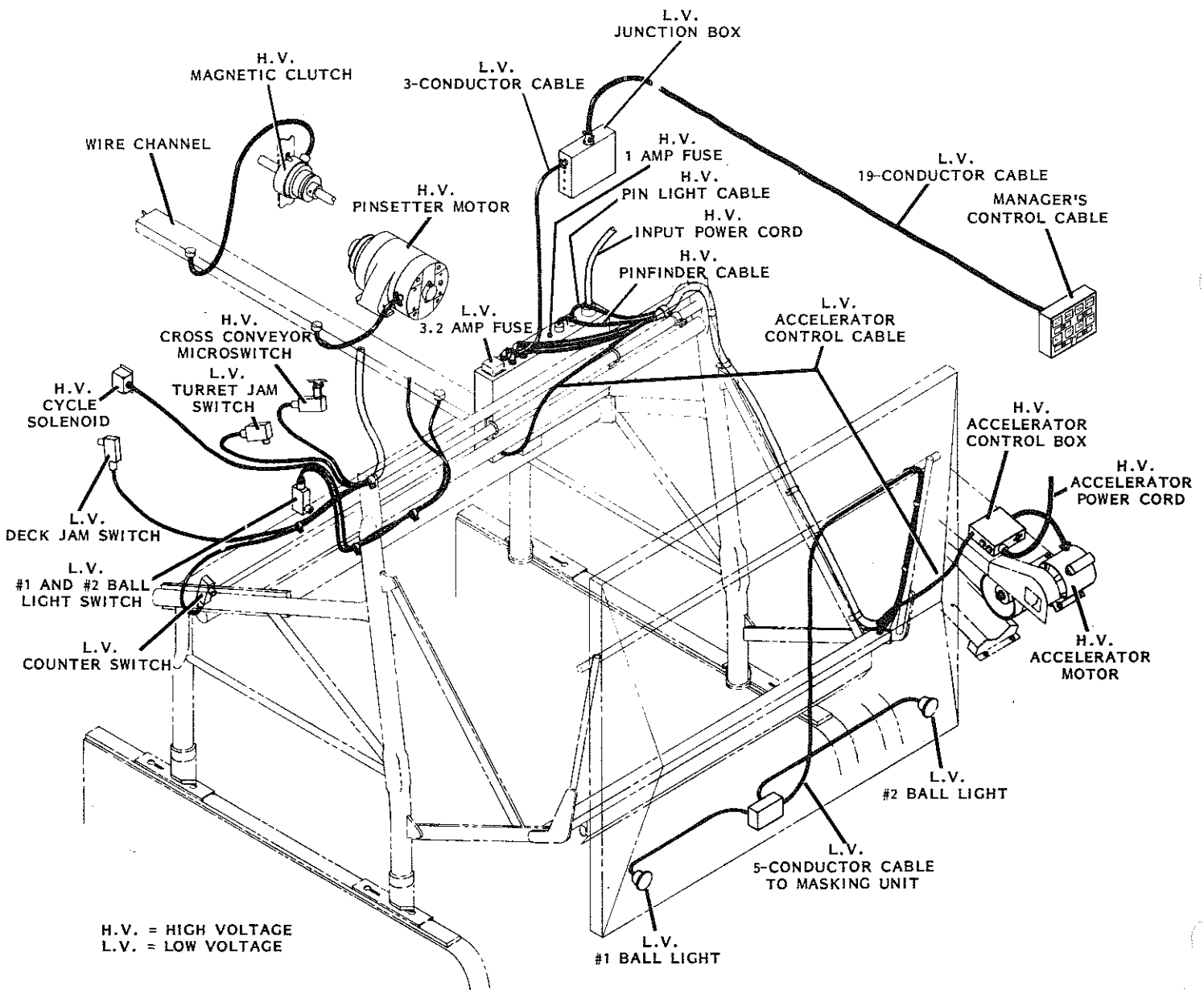


19-CONDUCTOR JUNCTION BOX WIRING DIAGRAM
FIGURE 62

When the motor start relay (RL2) was energized, contacts A & B were closed, thus closing the ball light circuit to illuminate either the first or second ball light.

The counter switch (SW4) is connected in parallel with the coil of the motor start relay (RL2), and will energize the counter coil as the deck lowers to its new pinsetting height.

When the rake lowers after delivery of the first ball, the clip on the rake lift shaft will close trigger switches TSC-1 and TSC-2 in the control box. Trigger switch TSC-1 is connected to the time delay module (TD1). This actuates an internal, electronic time delay circuit within the time delay module (TD1). When the time lapse is completed, a set of contacts within the module will close, and thus place the cycle solenoid across the power line through terminals 19 and 20. The cycle solenoid then triggers the gear box clutch as previously described. The time delay after first ball delivery provides ample time for wobbling pins to fall before the descending deck contacts the pins.



TYPICAL PINSETTER WIRING
FIGURE 63

As the rake lowers after delivery of the second ball, the trigger switch (TSC-1) is closed as previously described. However, during a second ball triggering cycle, the #2 ball light is energized and a parallel lead from the #2 light is connected to terminal #15 of the time delay module (TD1). When the #2 ball light circuit is energized, the time delay circuit is bypassed, and the cycle solenoid is energized immediately to engage the gear box clutch. There is no need for a time delay on second ball, since the deck will not lower at 90° to detect after second ball. The time lapse, from ball impact until the rake sweeps, is sufficient to permit wobbling pins to fall.

In brief, the Brunswick time delay module functions in the following manner (refer to Figure 64, page 1-79, Time Delay Schematic Diagram):

FIRST BALL CYCLE. As a first ball is delivered, the rake lowers and closes triggering switch TSC-1 which applies voltage to the time delay module through terminal 18. This voltage is applied through resistor R3, two parallel timing resistors R6 and RV, and the timing capacitor C2. The time lapse is created as capacitor C2 builds up to the firing voltage of the emitter (terminal E in the uni-junction transistor). After the required time delay, the discharge firing surge, from capacitor C2 through the transistor, energizes coils CR1-B and CR1-A of the Reed Switch CR1, thereby closing contacts CR1-1.

When contacts CR1-1 are closed, current from terminal 18 is directed through the contacts and back through coil CR1-A to essentially form a holding circuit which keeps contacts CR1-1 closed during the entire pinsetter cycle. As contacts CR1-1 are closed, voltage is applied across capacitor C3 and the coil of power relay CR2. Capacitor C3, being in a discharged state, will initially permit sufficient voltage across the coil of power relay CR2 to close contacts CR2-1, which, through output terminals 19 and 20, will place the cycle solenoid across the power line to start the pinsetter cycle. As capacitor C3 builds up voltage, the voltage is removed from the coil of the power relay, thereby opening contacts CR2-1, which de-energizes the cycle solenoid after the pinsetter has commenced to cycle.

When the rake board is raised at the completion of a cycle, triggering switch TSC-1 is again opened, which removes the voltage from the holding circuit of the Reed Relay CR1, thereby opening contacts CR1-1. The rake board being raised also closes switch TSC-2 in the pinsetter control box which allows capacitor C3 to discharge through bleeding resistor R4. The time delay module is then ready for delivery of the next ball.

SECOND BALL CYCLE. A lead from the #2 ball light circuit is connected to terminal 15 of the time delay module which impresses a voltage on the emitter of the uni-junction transistor prior to delivery of the second ball. When the rake lowers after second ball delivery, thus closing triggering switch TSC-1, voltage is applied to the base terminals (B1 and B2) of the transistor through terminal 18. The immediate discharge firing surge from capacitor C2 energizes the Reed Switch, and as previously described, will energize the cycle solenoid.

The basic difference between a second ball cycle and first ball cycle is that a first ball cycle uses the charging time of capacitor C2 as the time delay, whereas capacitor C2 is charged prior to delivery of a second ball to allow instantaneous triggering.

The cycle buttons at the ball return rack and rear of the pinsetter (SW8) are connected in parallel to terminal 17 of the time delay module, which is connected directly to the coil of power relay CR2. When the rake is up, switch TSC-2 is closed, thereby allowing the power relay coil to be energized to engage the cycle solenoid when either cycle button is depressed. When the rake is down during a machine cycle, switch TSC-2 is opened, thereby opening the circuit to terminal 15. This prevents the cycle solenoid from being energized during a cycle by the buttons being depressed.

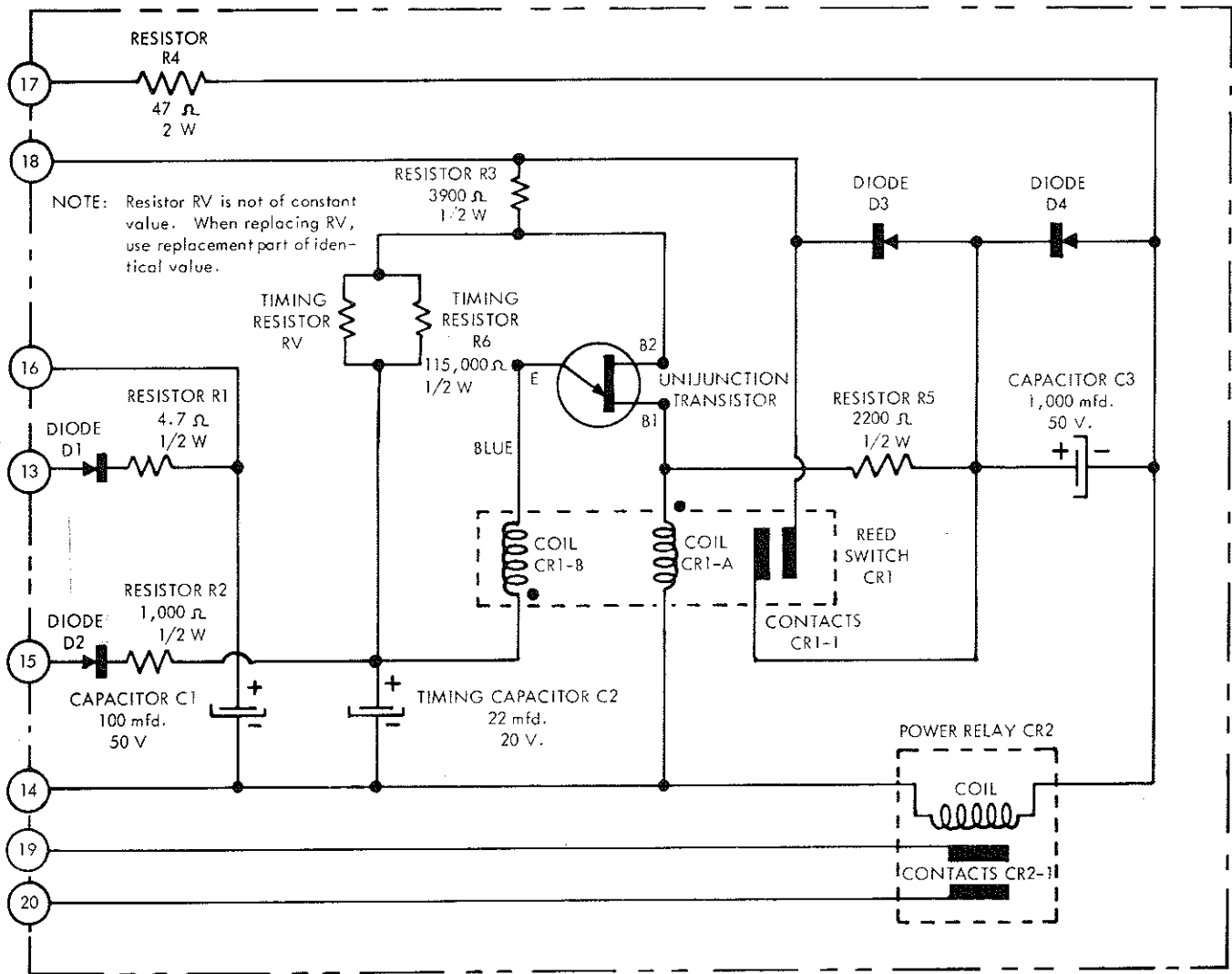
The primary circuit is protected by a 1 ampere fuse and the motor contains an integral circuit breaker and manual reset mechanism. If the motor circuit breaker should open, the button on the motor must be manually depressed to restore power to the motor. Ample cooling time must be allowed for the circuit breaker elements to cool before pressing the reset button.

The cross conveyor microswitch (SW5) is connected to the 90 volts, D.C. output of the selenium rectifier. When the switch is closed, as described in Chapter 13, Cross Conveyor, the magnetic clutch is supplied with 90 volts D.C. to drive the pin elevator wheel. When the switch is opened, the magnetic clutch loses its voltage, thereby losing its power to drive the pin elevator wheel. A capacitor is placed in parallel with the magnetic clutch to prevent the contact points of switch SW5 from pitting and burning.

NOTE: Under no circumstances should the motor starter relay (RL2) ever be bypassed with a jumper or by wedging the relay closed. Doing so would bypass the protective circuits built into the machine and severe damage to the pinsetter may result.

A two-conductor cable from each pinsetter control box on each pair of pinsetters is connected to the control box on the accelerator assembly to energize the accelerator when either or both pinsetters become operative. A pair of two-conductor cables from the accelerator control box are connected to the power ball lift to simultaneously energize the ball lift when either or both pinsetters become operative.

The accelerator control box (Figure 65) contains two relays, each connected to the 24 volt control circuit on its respective pinsetter. The contacts of both relays are connected in parallel with the accelerator motor, thereby closing the motor circuit when either relay is energized. The motor receives power (115, 208 or 230 volts) from a separate three-conductor power cord. The motor is protected by an integral overload circuit breaker. The button must be manually depressed to reset the motor circuit in the event that the circuit breaker opens. An on-off toggle switch is placed across the input power line to permit the accelerator to be turned off without disrupting the pinsetters' operation. Since the power ball lift cables are connected in parallel with the relay coils, the power lift will remain operative when the accelerator motor circuit breaker opens or the switch is opened. Additional automatic scorer cables may be involved in this area. Care must be taken in attaching the cables. Be sure cables do not interfere with any moving parts. Also, check ball travel through the accelerator and track to the ball lift.



TIME DELAY MODULE SCHEMATIC DIAGRAM

FIGURE 64

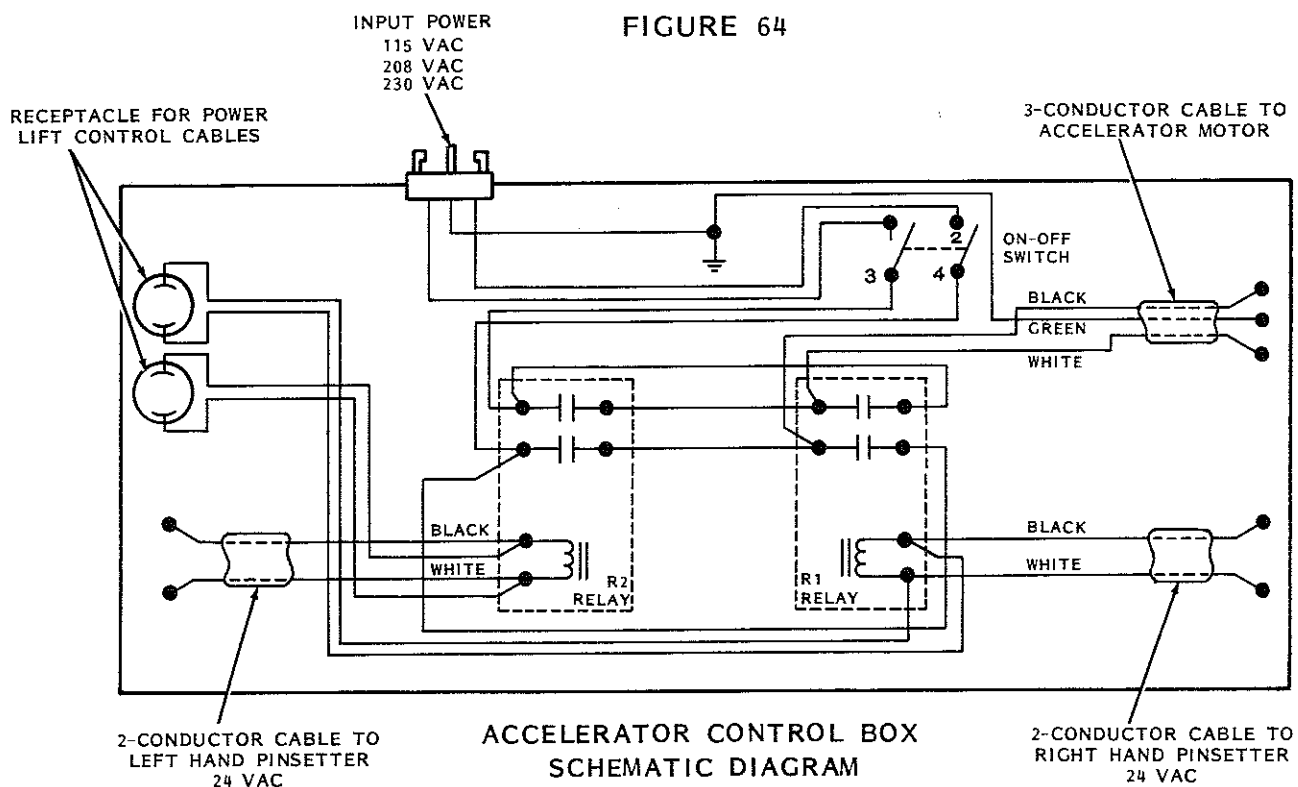


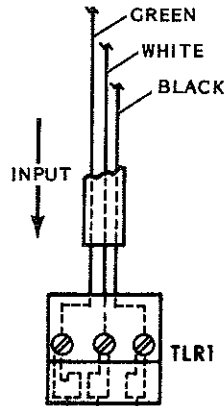
FIGURE 65

SCHEMATIC AND WIRING DIAGRAMS

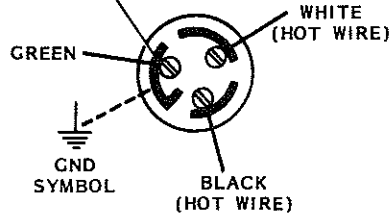
Figures 66 - 77 show symbols used on schematic and wiring diagrams. Figures 78 - 85 are pinsetter schematic and wiring diagrams for 230, 208, 115 and universal voltages.

SCHEMATIC SYMBOLS

TWIST-LOCK RECEPTACLE

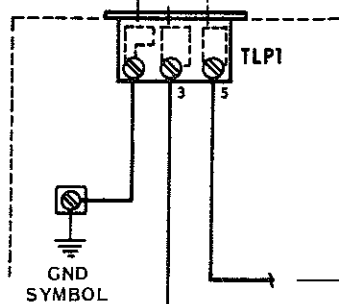


OFF-SET LEG IS ALWAYS GROUND (GREEN WIRE) CONNECTION



NOTE: THE GREEN WIRE IS NON-ELECTRICAL ON A PINSETTER. IT IS A SAFETY LEAD SHOULD A HOT WIRE SHORT OUT.

TWIST-LOCK PLUG



CIRCUIT BREAKER

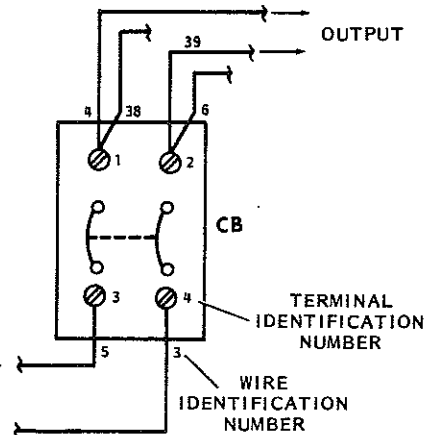


FIGURE 66

SCHEMATIC SYMBOLS

A-
"FUSTAT" - 3.2 AMP
SPECIAL "SLOW-BLOW" TYPE
FUSE PROTECTION DEVICE
FOR ALL 24 V.A.C. CIRCUITS

B-
"FUSTRON" - 125 V.A.C. - 1 AMP
"SLOW-BLOW" TYPE PROTECTS
115-120 V.A.C. VOLTAGE DIVIDER
CIRCUITS

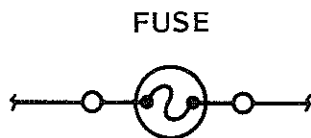
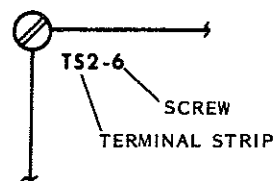


FIGURE 67

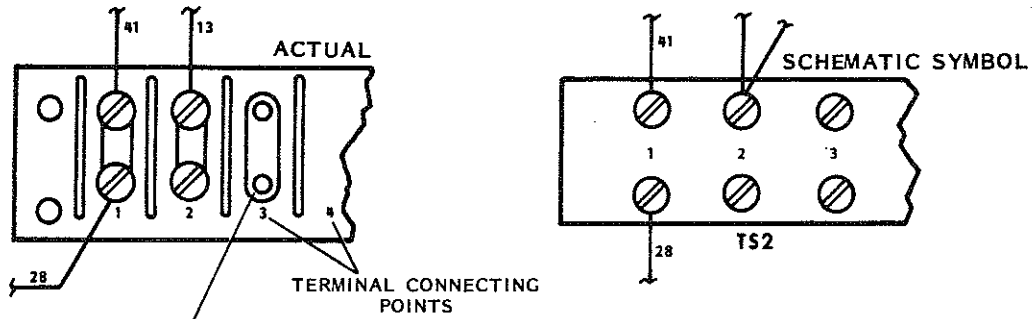
TERMINAL



TS1 - HIGH VOLTAGE
TS2 - LOW VOLTAGE

FIGURE 68

TERMINAL STRIP - TS2



NOTE: EACH TERMINAL HAS TWO WIRE MOUNTING SCREWS. THEY ARE CONNECTED TOGETHER BY A TIE-BAR NOT SHOWN ON WIRING DIAGRAMS.

FIGURE 69

RELAY CONTACT SCHEMATIC SYMBOLS

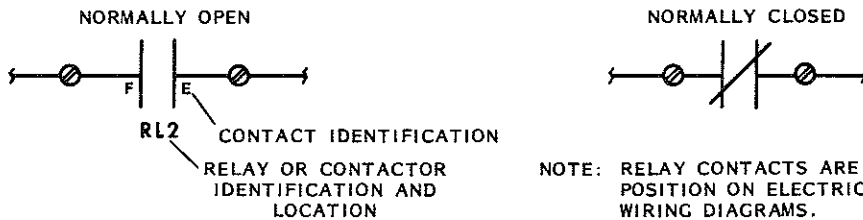
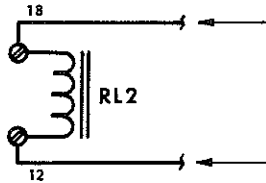


FIGURE 70

COIL (SYMBOL FOR RELAY OR CONTACTOR)

SCHEMATIC SYMBOL

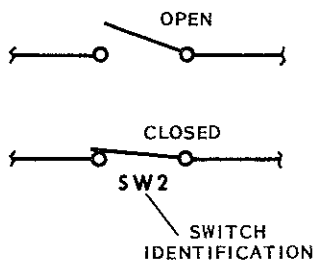


NOTE: POWER SUPPLY REQUIRES TWO (HOT) POWER SUPPLY WIRE LINES TO OPERATE COIL. THIS IS "ONE" OF THE CIRCUITS ON A RELAY OR CONTACTOR.

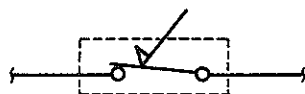
FIGURE 71

SWITCHES SCHEMATIC SYMBOLS

MANUAL TOGGLE SWITCH



2-POLE MECHANICALLY OPERATED MICRO-SWITCH



3-POLE MECHANICALLY OPERATED MICRO-SWITCH

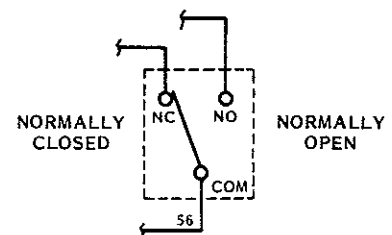
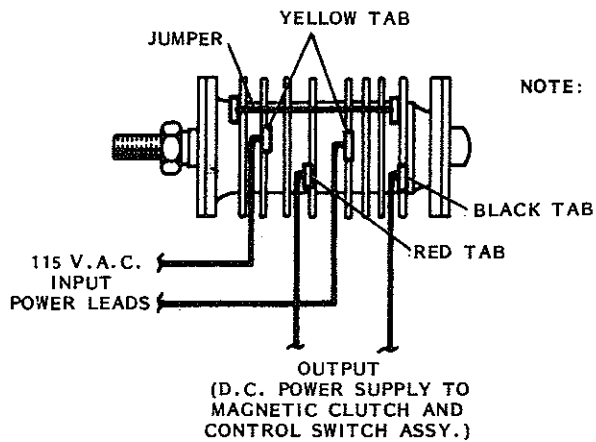


FIGURE 72

SELENIUM RECTIFIER

ACTUAL (TOP VIEW)



NOTE: NOTE THE YELLOW INPUT TABS. COLOR CODE SHOWN ON SIDE OF TABS.

FIGURE 73

TRANSFORMER SCHEMATIC SYMBOL

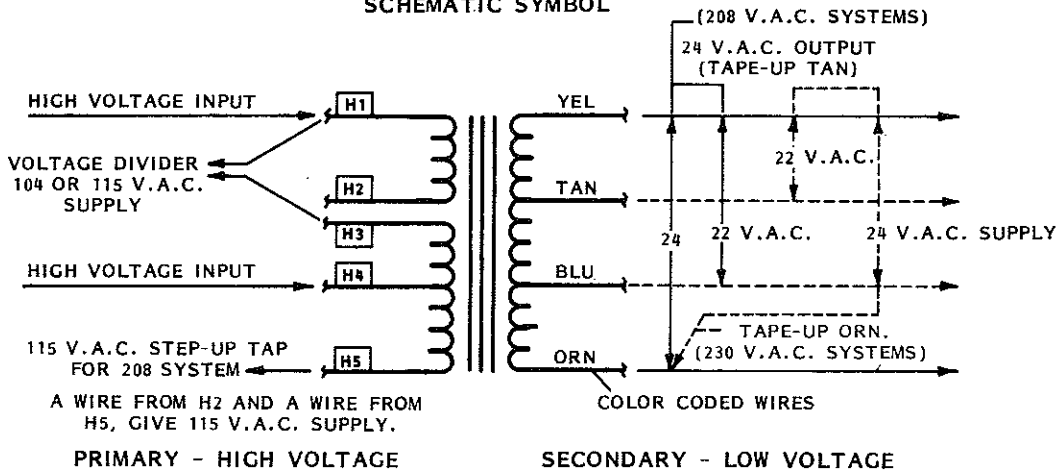
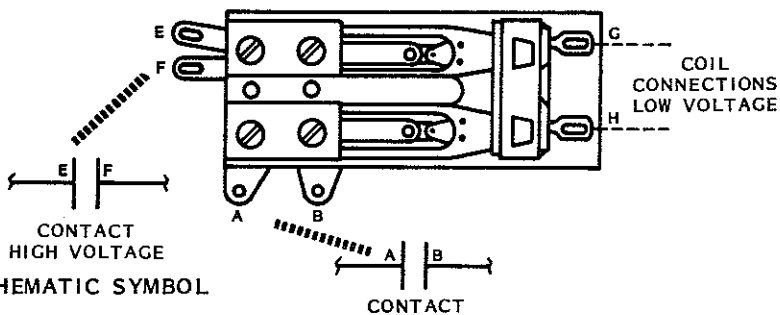


FIGURE 74

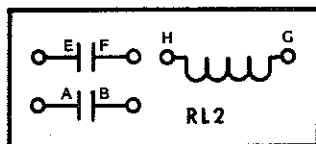
MOTOR START RELAY - RL2

ACTUAL (TOP VIEW)



CONTACT HIGH VOLTAGE SCHEMATIC SYMBOL

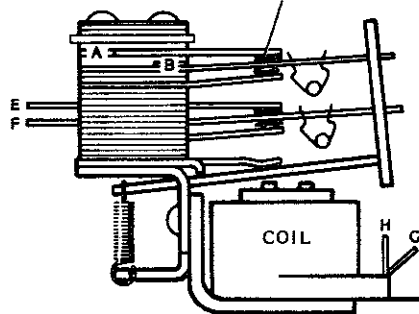
CONTACT SCHEMATIC SYMBOL



SCHEMATIC SYMBOLS

FIGURE 75

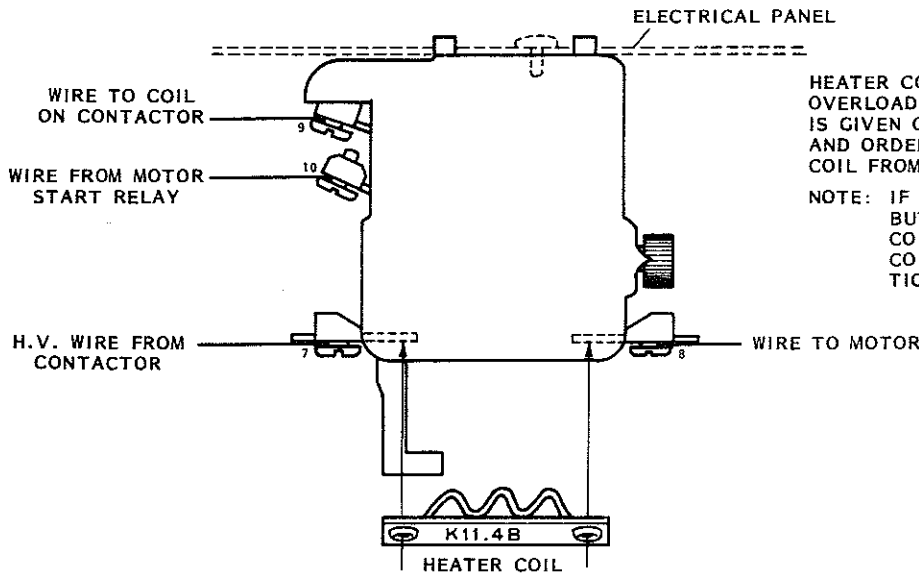
CONTACT (N.O.)



NOTE: WHEN ENERGIZED, THE COIL CLOSES THE CONTACTS.

ACTUAL (SIDE VIEW)

MOTOR OVERLOAD RELAY
ACTUAL (TOP VIEW)

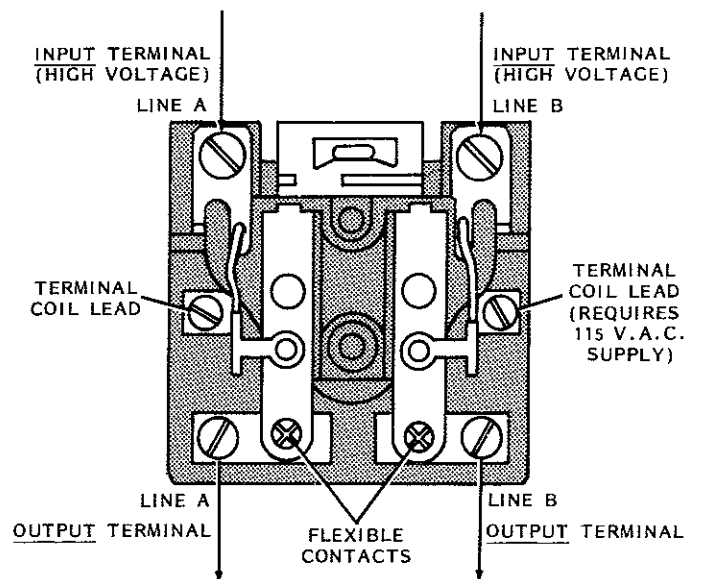


HEATER COIL IS ORDERED SEPARATELY WITH OVERLOAD RELAY. THE RUNNING AMP LOAD IS GIVEN ON THE MOTOR NAME PLATE. CHECK AND ORDER "CLOSELY MATCHED" OVERLOAD COIL FROM SERVICE PARTS CATALOG.

NOTE: IF THE MOTOR HAS BUILT-IN RESET BUTTON, THE OVERLOAD RELAY AND COIL ARE NOT REQUIRED. (REF. CONTACTOR REPLACEMENT INSTRUCTIONS MANUAL, 12-900206.)

FIGURE 76

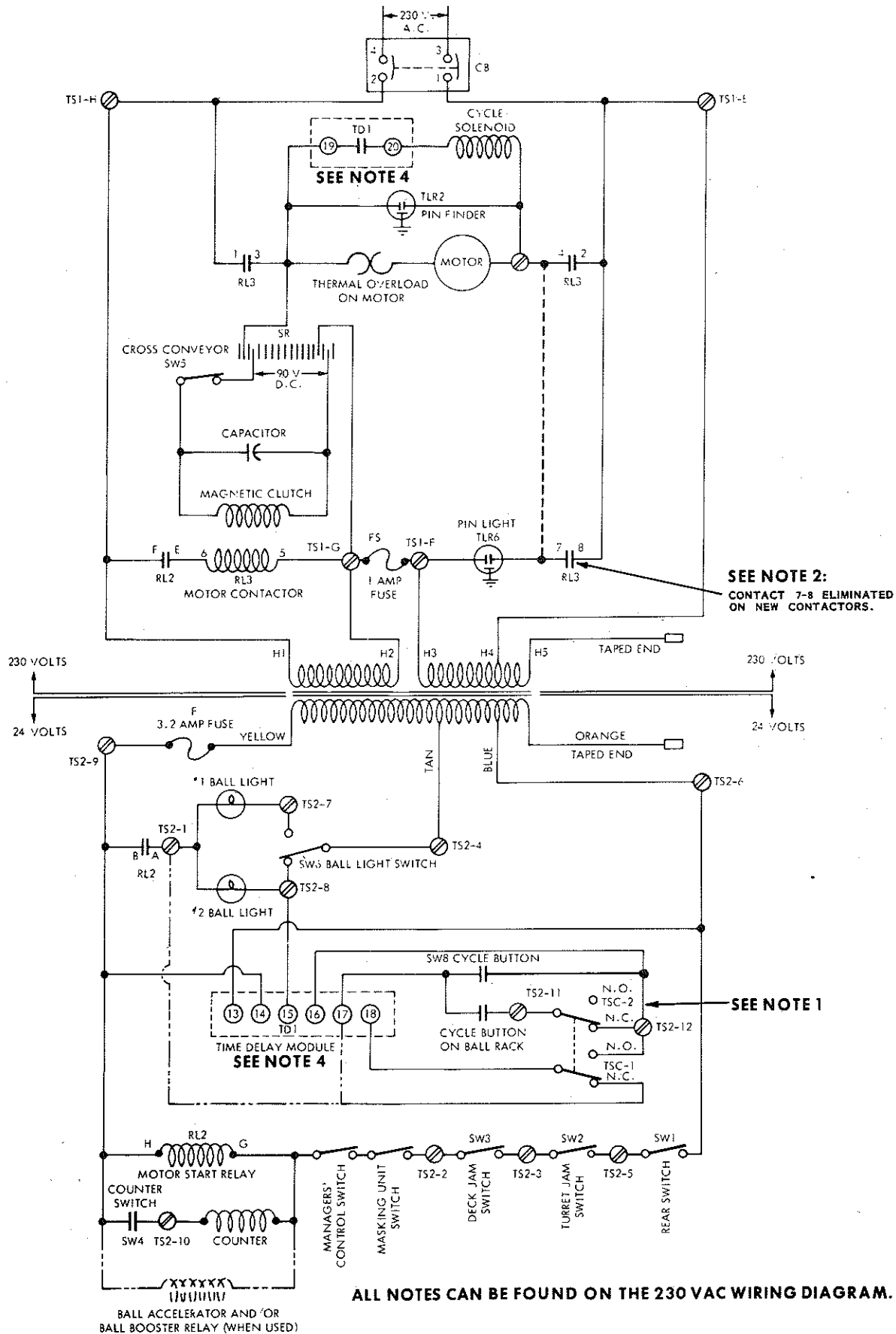
CONTACTOR - RL3
ACTUAL (TOP VIEW)



- NOTE: 1. THE CONTACTOR COIL, WHEN ENERGIZED, CLOSES THE LINE CONTACTS.
2. ALL TERMINAL SCREWS AND CONNECTING WIRES MUST BE TIGHT. LOOSE CONNECTIONS RESULT IN ELECTRICAL PART FAILURES.
3. DPST (DOUBLE POLE, SINGLE THROW) CONTACTOR HAS (2) CONTACTS, NORMALLY "OFF".
4. THIS CONTACTOR HAS NO OVERLOAD DEVICE. MOTORS WITHOUT "RESET" BUTTONS REQUIRE THE ADDITION OF AN OVERLOAD RELAY.

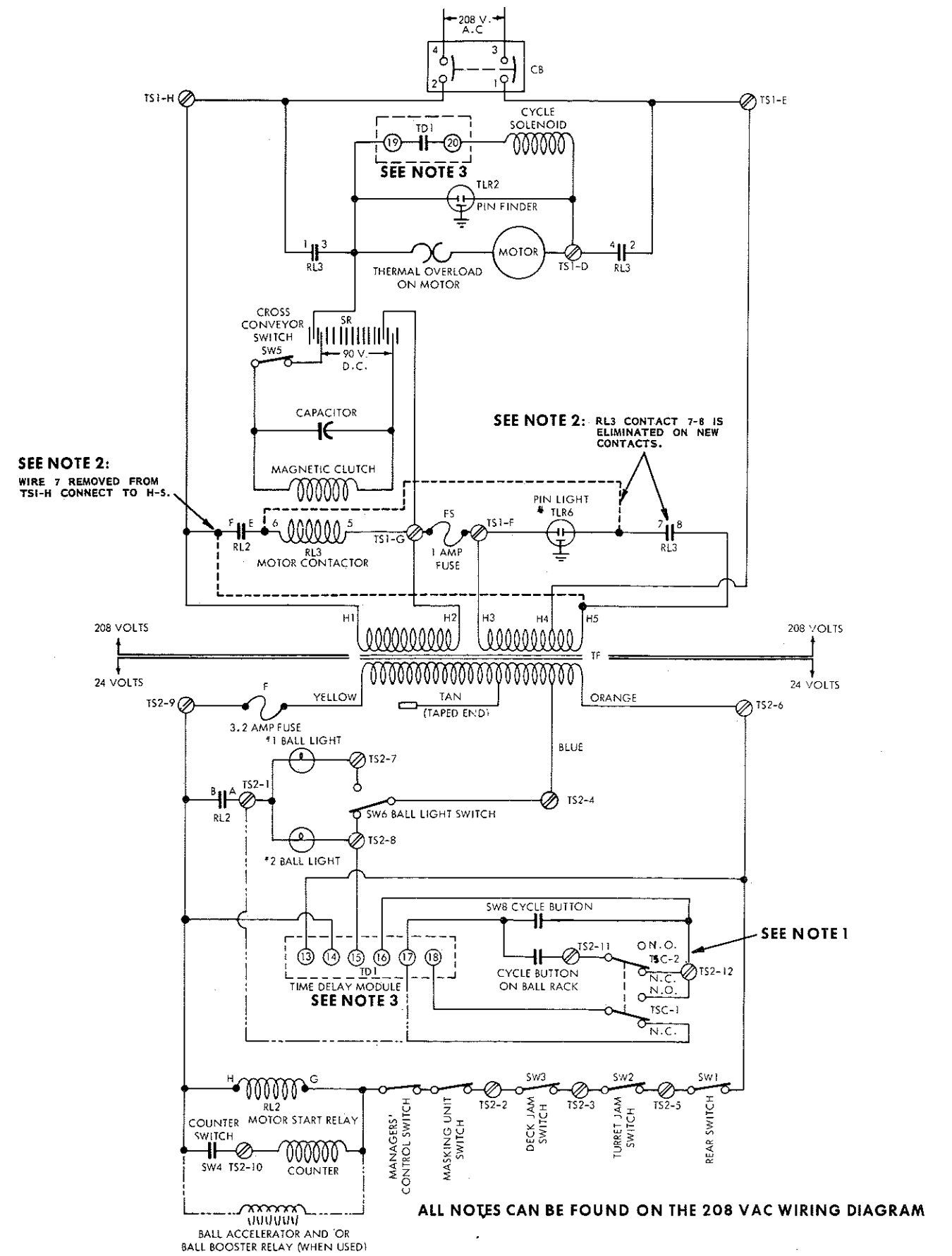
(REF. CONTACTOR REPLACEMENT INSTRUCTIONS, 12-900206 OR GUARDIAN - JAPANESE, 12-900201.)

FIGURE 77



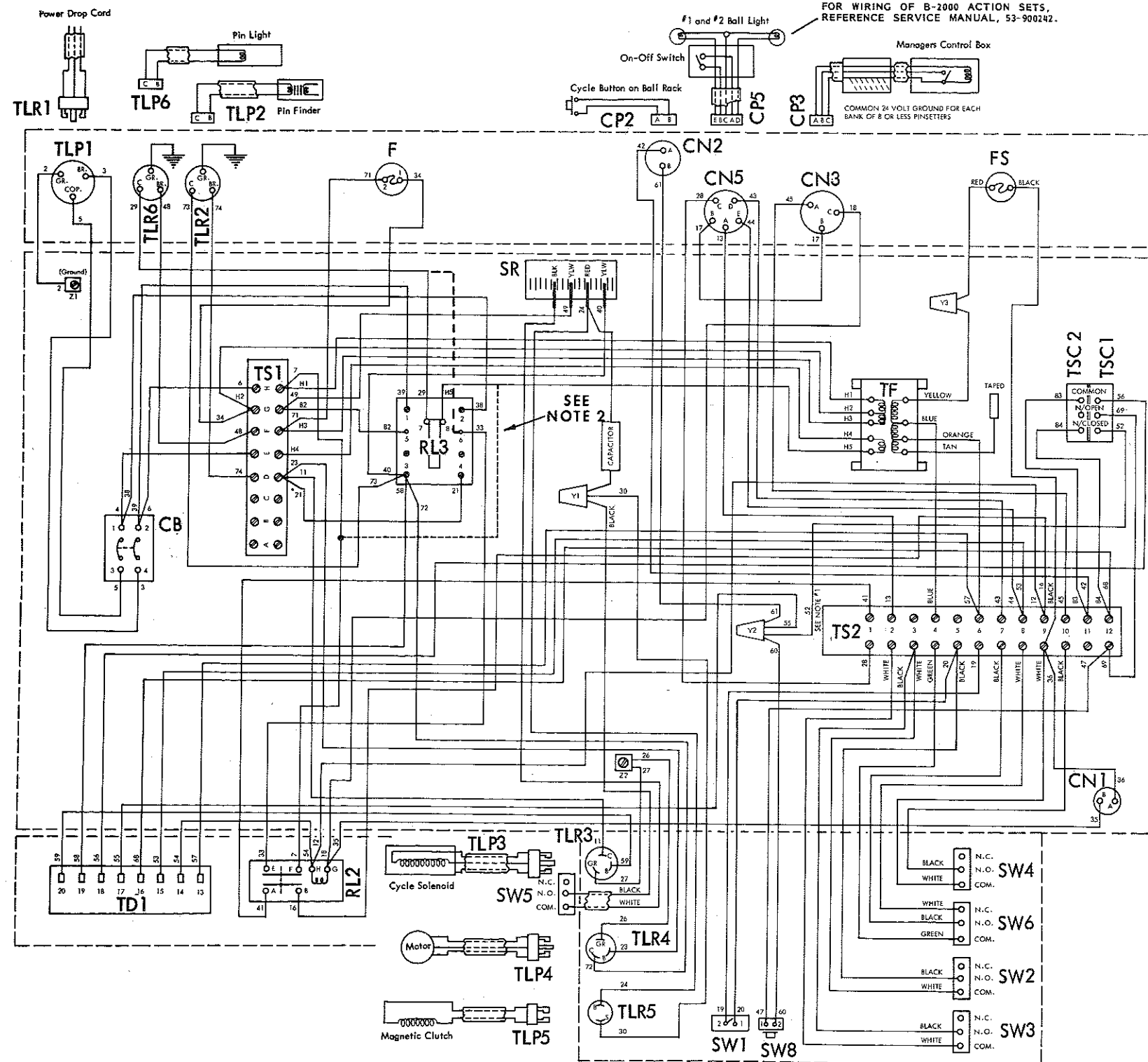
PINSETTER SCHEMATIC DIAGRAM - 230 VOLTS

FIGURE 78



PINSETTER SCHEMATIC DIAGRAM - 208 VOLTS

FIGURE 80



COMPONENT LEGEND		
SYMBOL	DESCRIPTION	LOCATION
CB	Input Circuit Breaker	Pinsetter Control Box
FS	Fusistat - 3.2 Ampere Fuse	Pinsetter Control Box
CN1	Canon Receptacle - Accelerator/Ball Lift	Pinsetter Control Box
CN2	Canon Receptacle - Cycle Button on Ball Rack	Pinsetter Control Box
CN3	Canon Receptacle - Masking Unit	Pinsetter Control Box
CN5	Canon Receptacle - Managers Control Box	Pinsetter Control Box
CP1	Canon Plug - Accelerator/Ball Lift	Control Cable - Accelerator/Ball Lift
CP2	Canon Plug - Cycle Button	Cycle Button Cable
CP3	Canon Plug - Managers Control Box	3 Conductor Cable
CP5	Canon Plug - Masking Unit	5 Conductor Cable
RL2	Motor Start Relay	Pinsetter Control Box
RL3	Motor Contactor	Pinsetter Control Box
SR	Selenium Rectifier	Pinsetter Control Box
SW1	On-Off Switch - Rear	Wire Channel
SW2	Turret Jam Switch	Turret Frame
SW3	Deck Jam Switch	Gear Box Support
SW4	Counter Switch	Pinsetter Cross Brace
SW5	Magnetic Clutch Switch	Cross Conveyor
SW6	#1 and #2 Ball Light Switch	Detector
SW8	Cycle Button - Mechanics	Wire Channel
TD1	Time Delay Module	Pinsetter Control Box
TF	Transformer	Pinsetter Control Box
TLP1	Twist Lock Plug - Input Power	Pinsetter Control Box
TLP2	Twist Lock Plug - Pin Finder	Pinsetter Control Box
TLP3	Twist Lock Plug - Cycle Solenoid	Pinsetter Control Box
TLP4	Twist Lock Plug - Motor	Pinsetter Control Box
TLP5	Twist Lock Plug - Magnetic Clutch	Solenoid Cable
TLP6	Twist Lock Plug - Pin Light	Motor Cable
TLR1	Twist Lock Receptacle - Input Power	Magnetic Clutch Cable
TLR2	Twist Lock Receptacle - Pin Finder	Pin Light Cable
TLR3	Twist Lock Receptacle - Cycle Solenoid	Power Drop Cord
TLR4	Twist Lock Receptacle - Motor	Pin Finder Cable
TLR5	Twist Lock Receptacle - Magnetic Clutch	Wire Channel
TLR6	Twist Lock Receptacle - Pin Light	Wire Channel
TS1	Terminal Strip - High Voltage	Pinsetter Control Box
TS2	Terminal Strip - Low Voltage	Pinsetter Control Box
TSC1	Trigger Switch	Pinsetter Control Box
TSC2	Solenoid Hold Out Switch	Pinsetter Control Box
Y1	Wire Connector - Low Voltage	Pinsetter Control Box
Y2	Wire Connector - Low Voltage	Pinsetter Control Box
Y3	Wire Connector - Low Voltage	Pinsetter Control Box
Z1	Ground Lug - High Voltage	Pinsetter Control Box
Z2	Ground Lug - High Voltage	Pinsetter Control Box
F	Fuse - 1 Ampere	Pinsetter Control Box

NOTES:

1. MICRO-SWITCH TSC-2 ELIMINATED ON MACHINES AFTER 1965.

2. REVISION:

CONTACTOR RL3 WAS CHANGED FROM A 3-POLE CONTACTOR TO A 2-POLE CONTACTOR IN 1977. THIS ELIMINATED CONTACT 7-8. THE FOLLOWING WIRING CHANGES MUST BE MADE FOR NEW CONTACTOR:

- A. REMOVE WIRE 29 FROM CONTACT 7.
- B. CONNECT WIRE 29 TO TERMINAL 6 ON RL3.
- C. REMOVE WIRE H-5 FROM CONTACT 8.
- D. REMOVE WIRE 7 FROM TSI-H.
- E. SPLICE WIRE 7 AND H-5 TOGETHER WITH WIRE NUT.
- F. OTHER WIRES REMAIN ON SAME CONNECTION POINTS.

NOTE:

FOR EARLY MODEL CONTACTORS, REFERENCE "CONTACTOR REPLACEMENT INSTRUCTIONS" MANUAL, 12-900206.

3. TIME DELAY MODULE CONNECTIONS 19 AND 20 ARE LOCATED NEAR THE TOP OF THE PINSETTER SCHEMATIC IN THE CYCLE SOLENOID AREA.

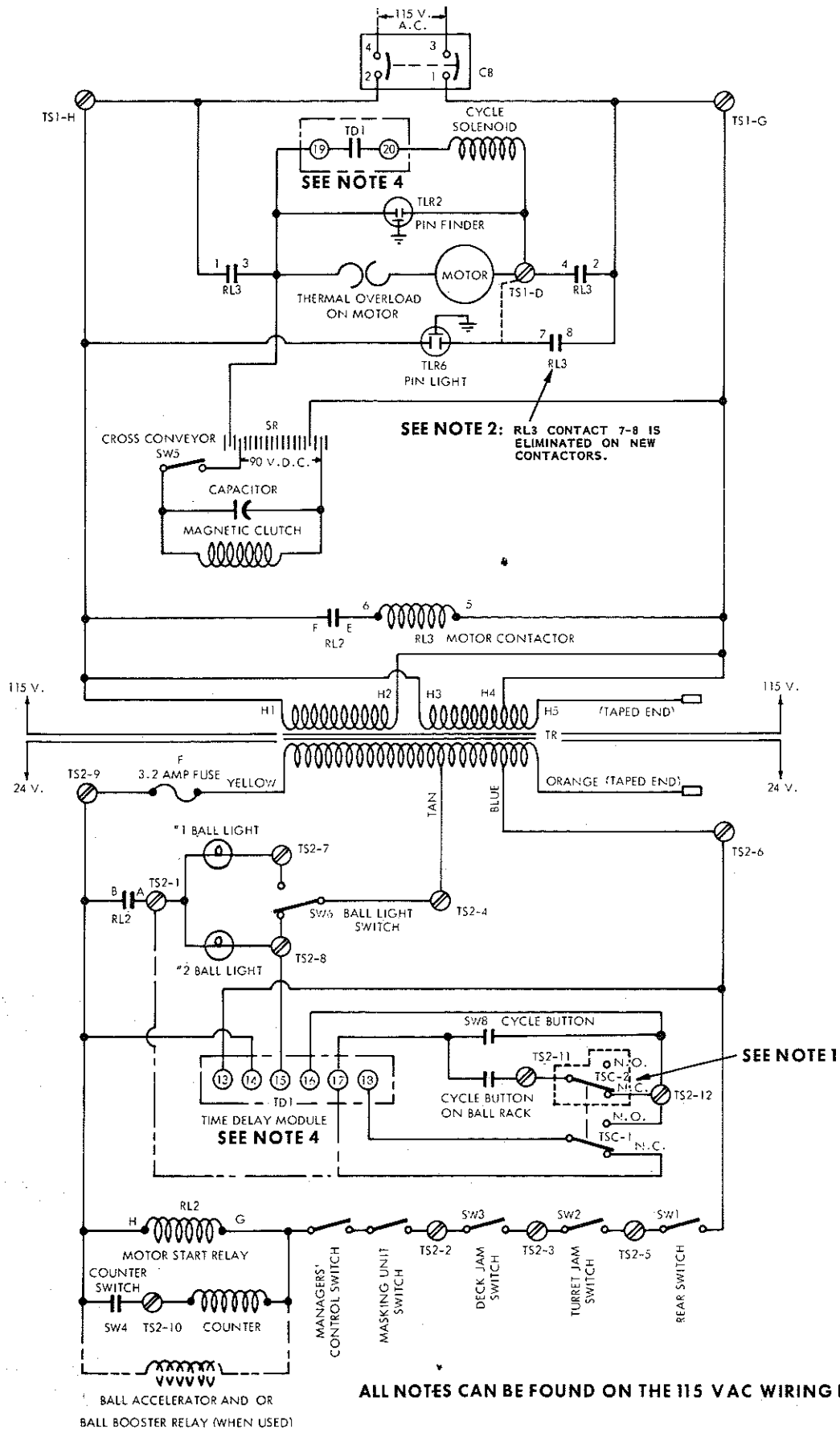
WIRE CHARTS			
SINGLE CONDUCTOR WIRES			
WIRE NO.	WIRE SPECIFICATION	TERMINALS	
2	12 Ga. Green	TLR1-GR (Ground)	Z1 (Ground)
3	12 Ga. Black	TLR1-B (Brass)	CB-4
4	12 Ga. Black	CB-1	TS1-E (Left)
5	12 Ga. Black	TLR1-C (Copper)	CB-3
6	12 Ga. Black	CB-2	TS1-H (Left)
7	16 Ga. Black	TS1-H (Right)	RL2-F
11	16 Ga. Black	TS1-D (Right)	TLR3-C
12	18 Ga. Yellow	TS2-9 (Top)	RL2-H
13	18 Ga. Yellow	TS2-2 (Top)	CN5-A
16	18 Ga. Yellow	TS2-9 (Top)	RL2-B
17	18 Ga. Yellow	CN3-B	CN5-B
18	18 Ga. Yellow	RL2-G	CN3-C
19	18 Ga. Yellow	TS2-6 (Bottom)	SW1-2
20	18 Ga. Yellow	TS2-5 (Bottom)	SW1-1
21	12 Ga. Black	TS1-D (Right)	RL3-4
23	12 Ga. Black	TS1-D (Right)	TLR4-B
24	16 Ga. Black	SR-(Red)	TLR5-B
26	12 Ga. Green	TLR4-GR	Z2 (Ground)
27	12 Ga. Green	TLR3-GR	Z2 (Ground)
28	18 Ga. Yellow	TS2-1 (Bottom)	CN5-C
29	16 Ga. Black	TLR6-C	RL3-7
30	16 Ga. Black	Y1	TLR5-5
33	16 Ga. Black	RL3-E	RL2-6
34	16 Ga. Black	F1	TS1-G (Left)
35	18 Ga. Yellow	RL2-G	CN1-B
36	18 Ga. Yellow	TS2-9 (Bottom)	CN1-A
38	12 Ga. Black	RL3-2	CB-1
39	12 Ga. Black	CB-2	RL3-1
40	16 Ga. Black	RL3-3	SR-(Yellow)
41	18 Ga. Yellow	TS2-1 (Top)	RL2-A
42	18 Ga. Yellow	TS2-11 (Top)	CN2-A
43	18 Ga. Yellow	TS2-7 (Top)	CN5-D
44	18 Ga. Yellow	TS2-8 (Top)	CN5-E
45	18 Ga. Yellow	TS2-10 (Top)	CN3-A
47	18 Ga. Yellow	TS2-12 (Bottom)	SWB-1
48	16 Ga. Black	TLR6-B	TS1-F (Left)
49	16 Ga. Black	SR-(Yellow)	TS1-G (Right)
52	18 Ga. Yellow	See Note #1	TS1-N/Closed
53	18 Ga. Yellow	TD1-15	TS2-8 (Top)
54	18 Ga. Yellow	TD1-14	RL2-H
55	18 Ga. Yellow	TD1-17	Y2
56	18 Ga. Yellow	TD1-18	TS1-Common
57	18 Ga. Yellow	TD1-13	TS2-6 (Top)
58	16 Ga. Black	TD1-19	RL3-3
59	16 Ga. Black	TD1-20	TLR3-B
60	18 Ga. Yellow	Y2	SWB-2
61	18 Ga. Yellow	Y2	CN2-B
68	18 Ga. Yellow	TD1-16	TS2-12 (Top)
69	18 Ga. Yellow	TS2-12 (Bottom)	TS2-3 (Bottom)
71	16 Ga. Black	F2	TS2-3 (Bottom)
72	12 Ga. Black	RL3-3	TS1-F (Right)
73	16 Ga. Black	TLR2-C	TLR4-C
74	16 Ga. Black	TLR2-B	RL3-C
82	16 Ga. Black	RL3-5	TS1-D (Left)
83	18 Ga. Yellow	TS2-11 (Top)	TS1-G (Right)
84	18 Ga. Yellow	TS2-12 (Top)	TS2-Common

TWO CONDUCTOR CABLES			
SW3	White Black	SW3-Common SW3-N/Open	TS2-2 (Bottom) TS2-3 (Bottom)
SW2	White Black	SW2-Common SW2-N/Open	TS2-3 (Bottom) TS2-5 (Bottom)
SW4	White Black	SW4-Common SW4-N/Open	TS2-9 (Bottom) TS2-10 (Bottom)
SW5	White Black	SW5-Common SW5-N/Open	SR-Red Y1

THREE CONDUCTOR CABLE			
SW6	White Black Green	SW6-N/Closed SW6-N/Open SW6-Common	TS2-8 (Bottom) TS2-7 (Bottom) TS2-4 (Bottom)

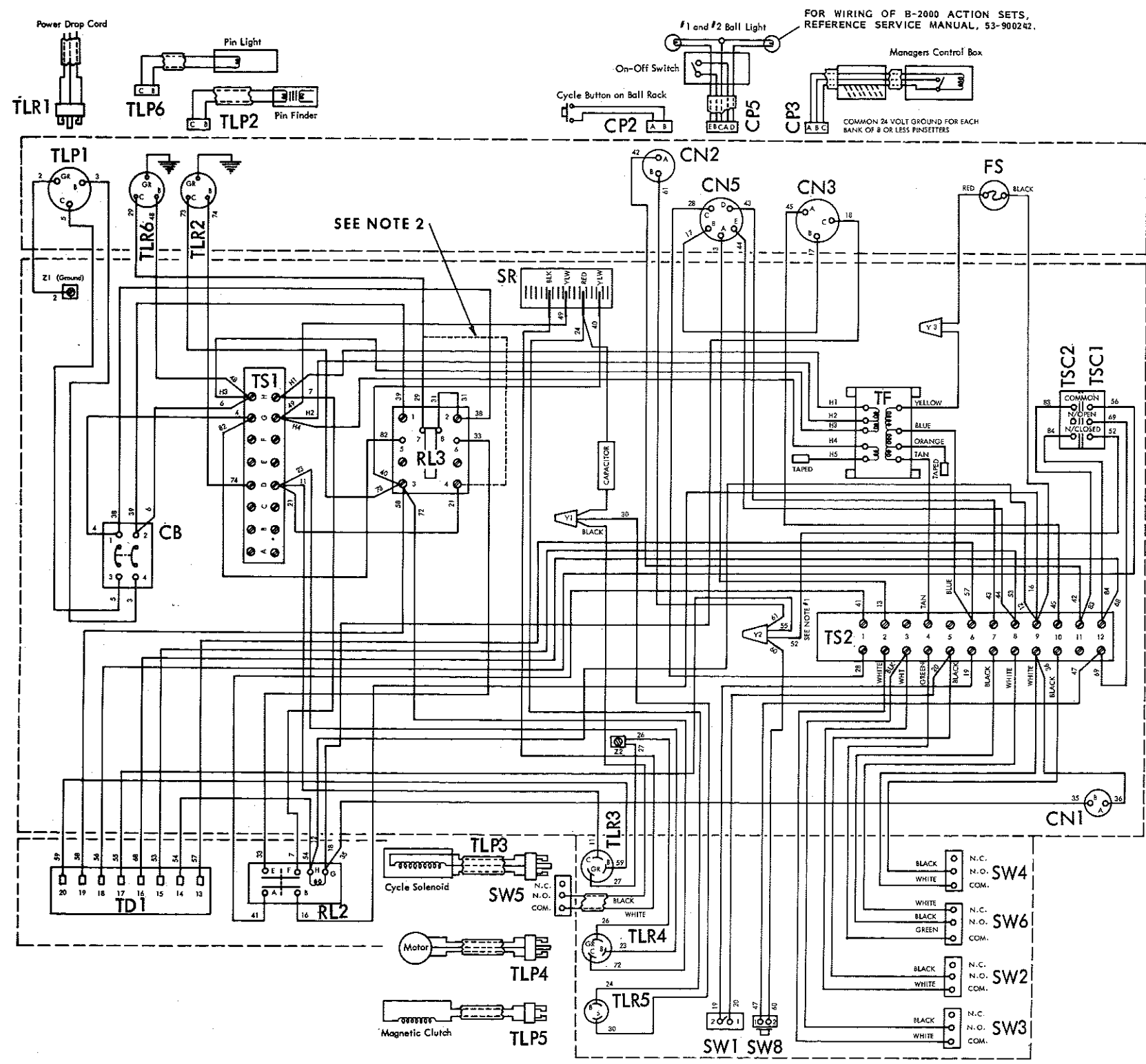
TRANSFORMER (TR)	
LEAD	TERMINAL
Yellow	Y3
Blue	TS2-4 (Top)
Orange	TS2-6 (Top)
Tan	TS2-6 (Top)
H1	TS1-H (Right)
H2	TS1-G (Left)
H3	TS1-F (Right)
H4	TS1-E (Right)
H5	RL3-B

PINSETTER WIRING DIAGRAM - 208 VOLTS
FIGURE 81



PINSETTER SCHEMATIC DIAGRAM - 115 VOLTS

FIGURE 82



COMPONENT LEGEND

SYMBOL	DESCRIPTION	LOCATION
CB	Input Circuit Breaker	Pinsetter Control Box
FS	Fusist - 3.2 Ampere Fuse	Pinsetter Control Box
CN1	Canon Receptacle - Accelerator/Ball Lift	Pinsetter Control Box
CN2	Canon Receptacle - Cycle Button on Ball Rack	Pinsetter Control Box
CN3	Canon Receptacle - Managers Control Box	Pinsetter Control Box
CN5	Canon Receptacle - Masking Unit	Pinsetter Control Box
CP1	Canon Plug - Accelerator/Ball Lift	Control Cable - Accelerator/Ball Lift
CP2	Canon Plug - Cycle Button	Cycle Button Cable
CP3	Canon Plug - Managers Control Box	3 Conductor Cable
CP5	Canon Plug - Masking Unit	5 Conductor Cable
RL2	Motor Start Relay	Pinsetter Control Box
RL3	Motor Contactor	Pinsetter Control Box
SR	Selenium Rectifier	Pinsetter Control Box
SW1	On-Off Switch - Rear	Pinsetter Control Box
SW2	Turret Jam Switch	Wire Channel
SW3	Deck Jam Switch	Turret Frame
SW4	Counter Switch	Gear Box Support
SW5	Magnetic Clutch Switch	Pinsetter Cross Brace
SW6	#1 and #2 Ball Light Switch	Cross Conveyor
SW8	Cycle Button - Mechanics	Detector
TD1	Time Delay Module	Wire Channel
TF	Transformer	Pinsetter Control Box
TLP1	Twist Lock Plug - Input Power	Pinsetter Control Box
TLP2	Twist Lock Plug - Pin Finder	Pinsetter Control Box
TLP3	Twist Lock Plug - Cycle Solenoid	Pinsetter Control Box
TLP4	Twist Lock Plug - Motor	Solenoid Cable
TLP5	Twist Lock Plug - Magnetic Clutch	Motor Cable
TLP6	Twist Lock Plug - Pin Light	Magnetic Clutch Cable
TLR1	Twist Lock Receptacle - Input Power	Pin Light Cable
TLR2	Twist Lock Receptacle - Pin Finder	Power Drop Cord
TLR3	Twist Lock Receptacle - Cycle Solenoid	Pin Finder Cable
TLR4	Twist Lock Receptacle - Motor	Wire Channel
TLR5	Twist Lock Receptacle - Magnetic Clutch	Wire Channel
TLR6	Twist Lock Receptacle - Pin Light	Pinsetter Control Box
TS1	Terminal Strip - High Voltage	Pinsetter Control Box
TS2	Terminal Strip - Low Voltage	Pinsetter Control Box
TSC1	Trigger Switch	Pinsetter Control Box
TSC2	Solenoid Hold Out Switch	Pinsetter Control Box
Y1	Wire Connector - Low Voltage	Pinsetter Control Box
Y2	Wire Connector - Low Voltage	Pinsetter Control Box
Y3	Wire Connector - Low Voltage	Pinsetter Control Box
Z1	Ground Lug - High Voltage	Pinsetter Control Box
Z2	Ground Lug - High Voltage	Pinsetter Control Box

WIRE CHARTS

SINGLE CONDUCTOR WIRES

WIRE NO.	WIRE SPECIFICATION	TERMINALS
2	12 Ga. Green	TLR1-GR (Ground)
3	12 Ga. Black	TLR1-B (Brass)
4	12 Ga. Black	CB-1
5	12 Ga. Yellow	TLR1-C (Copper)
6	12 Ga. Black	CB-2
7	16 Ga. Black	TS1-H (Right)
11	16 Ga. Black	TS1-D (Right)
12	18 Ga. Yellow	TS2-9 (Top)
13	18 Ga. Yellow	TS2-2 (Top)
16	18 Ga. Yellow	TS2-9 (Top)
17	18 Ga. Yellow	CN3-B
18	18 Ga. Yellow	RL2-G
19	18 Ga. Yellow	TS2-6 (Bottom)
20	18 Ga. Yellow	TS2-5 (Bottom)
21	12 Ga. Black	TS1-D (Right)
23	12 Ga. Black	TS1-D (Right)
24	16 Ga. Black	SR-(Red)
26	12 Ga. Green	TLR4-GR
27	12 Ga. Green	TLR3-GR
28	18 Ga. Yellow	TS2-1 (Bottom)
29	16 Ga. Black	TLR6-C
30	16 Ga. Black	Y1
31	16 Ga. Black	RL3-2
33	16 Ga. Black	RL2-E
35	18 Ga. Yellow	RL2-G
36	18 Ga. Yellow	TS2-9 (Bottom)
38	12 Ga. Black	RL3-2
39	12 Ga. Black	CB-2
40	16 Ga. Black	RL3-3
41	18 Ga. Yellow	TS2-1 (Top)
42	18 Ga. Yellow	TS2-11 (Top)
43	18 Ga. Yellow	TS2-7 (Top)
44	18 Ga. Yellow	TS2-8 (Top)
45	18 Ga. Yellow	TS2-10 (Top)
47	18 Ga. Yellow	TS2-12 (Bottom)
48	16 Ga. Black	TLR6-B
49	16 Ga. Black	SR-(Yellow)
52	18 Ga. Yellow	See Note #1
53	18 Ga. Yellow	TD1-15
54	18 Ga. Yellow	TD1-14
55	18 Ga. Yellow	TD1-17
56	18 Ga. Yellow	TD1-18
57	18 Ga. Yellow	TD1-13
58	16 Ga. Black	TD1-19
59	16 Ga. Black	TD1-20
60	18 Ga. Yellow	Y2
61	18 Ga. Yellow	Y2
68	18 Ga. Yellow	TD1-16
69	18 Ga. Yellow	TS2-12 (Bottom)
72	12 Ga. Black	RL3-3
73	16 Ga. Black	TLR2-C
74	16 Ga. Black	TLR2-8
82	16 Ga. Black	RL3-5
83	18 Ga. Yellow	TS2-11 (Top)
84	18 Ga. Yellow	TS2-12 (Top)

- #### NOTES:
- MICRO-SWITCH TSC-2 ELIMINATED ON MACHINES AFTER 1965.
 - REVISION:
CONTACTOR RL3 WAS CHANGED FROM A 3-POLE CONTACTOR TO A 2-POLE CONTACTOR IN 1977. THIS ELIMINATED CONTACT 7-8. THE FOLLOWING WIRING CHANGES MUST BE MADE FOR A NEW CONTACTOR.
A. REMOVE WIRE 29 FROM CONTACT 7. CONNECT TO TERMINAL 4-RL3.
B. REMOVE WIRE 31 FROM CONTACT 8 AND TERMINAL 2. DISCARD WIRE 31.
 - FOR EARLIER CONTACTORS, REFERENCE "CONTACTOR REPLACEMENT INSTRUCTIONS" MANUAL, 12-900206.
 - TIME DELAY MODULE CONNECTIONS 19 AND 20 ARE LOCATED NEAR THE TOP OF THE PINSETTER SCHEMATIC IN THE CYCLE SOLENOID AREA.

TWO CONDUCTOR CABLES

SW3	White Black	SW3-Common SW3-N/Open	TS2-2 (Bottom) TS2-3 (Bottom)
SW2	White Black	SW2-Common SW2-N/Open	TS2-3 (Bottom) TS2-5 (Bottom)
SW4	White Black	SW4-Common SW4-N/Open	TS2-9 (Bottom) TS2-10 (Bottom)
SW5	White Black	SW5-Common SW5-N/Open	SR-Black Y1

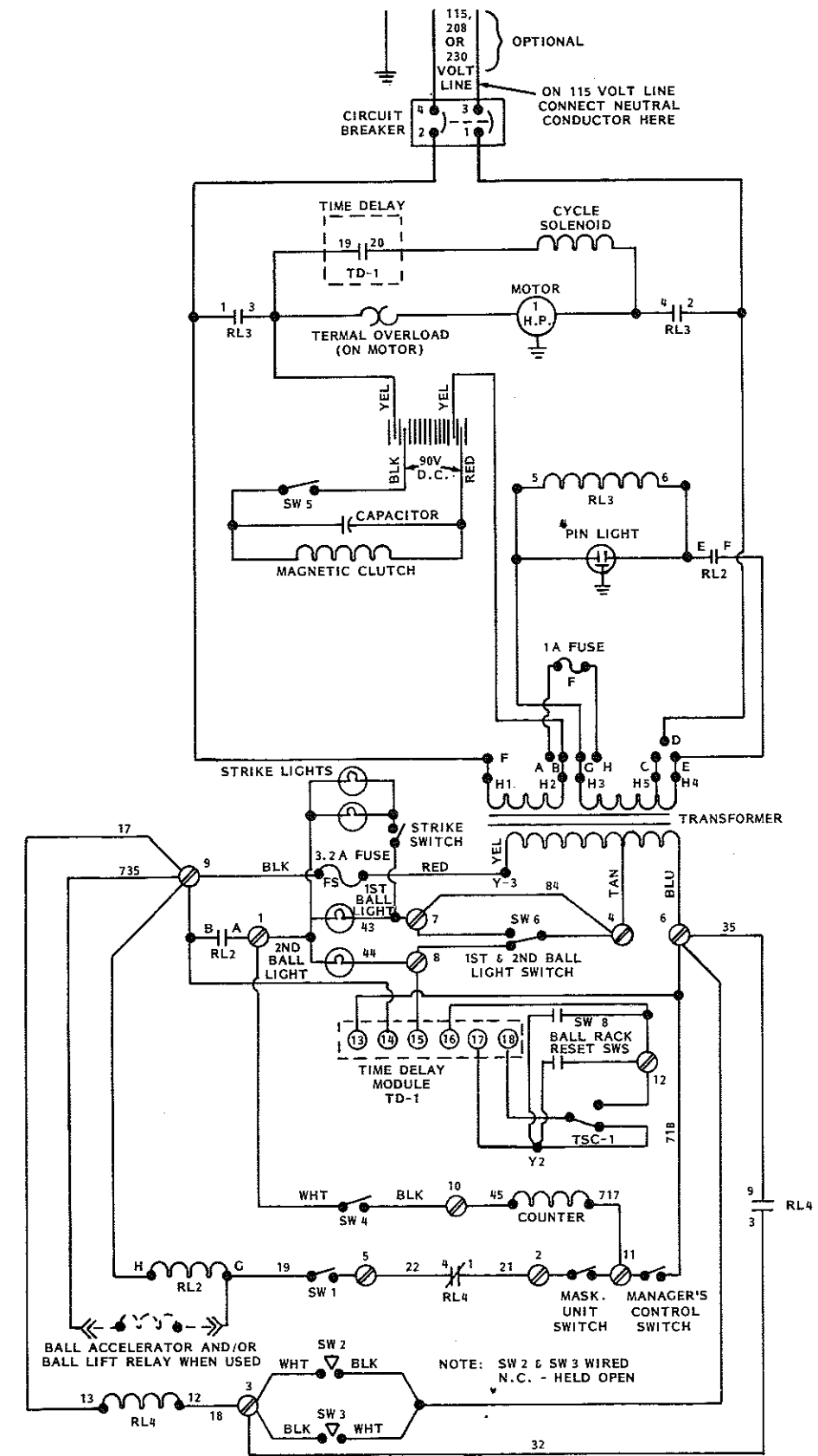
THREE CONDUCTOR CABLE

SW6	White Black Green	SW6-N/Closed SW6-N/Open SW6-Common	TS2-8 (Bottom) TS2-7 (Bottom) TS2-4 (Bottom)
-----	-------------------------	--	--

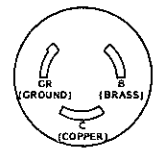
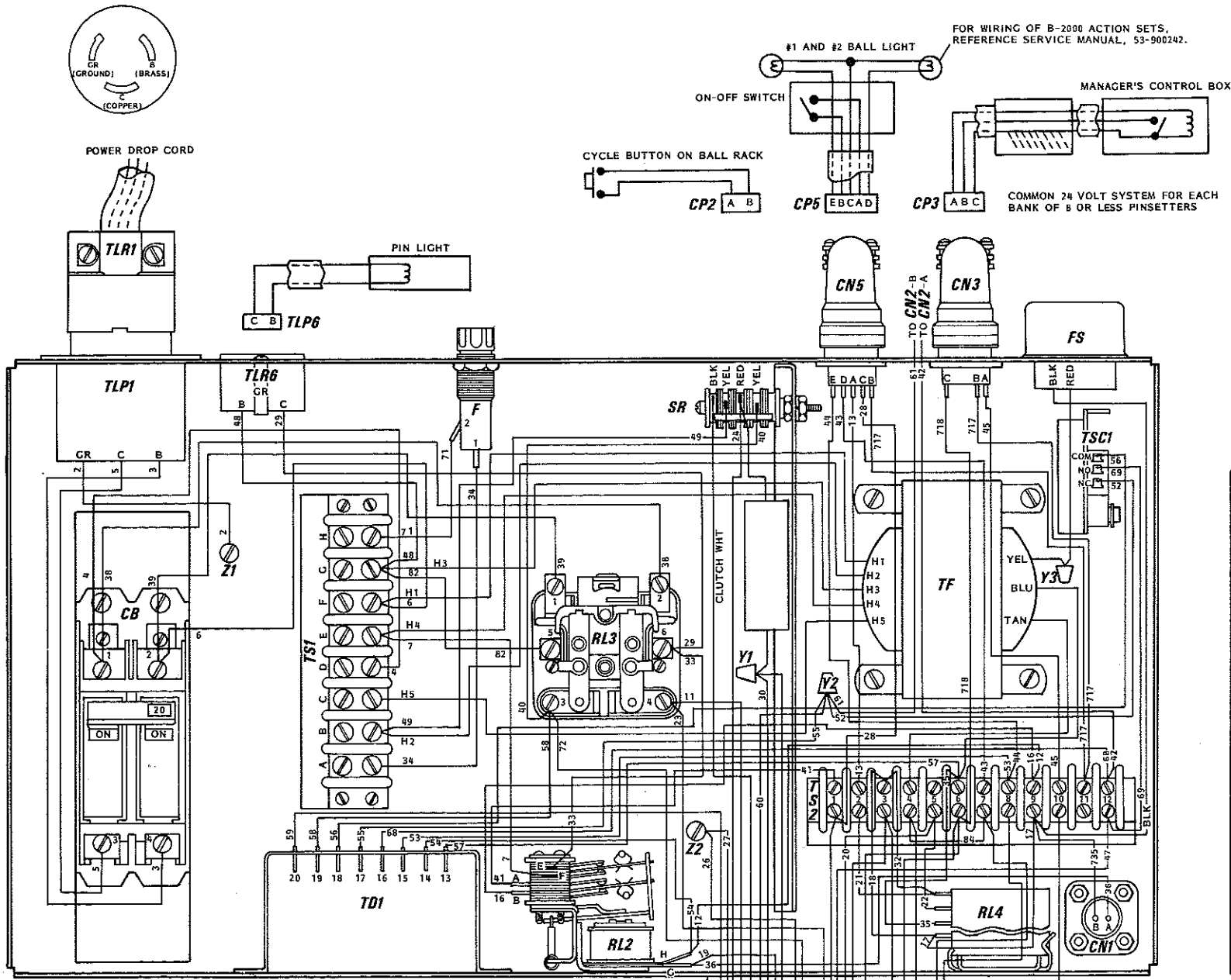
TRANSFORMER (TR)

LEAD	TERMINAL
Yellow	Y3
Blue	TS2-6 (Top)
Orange	Taped
Tan	TS2-4 (Top)
H1	TS1-H (Right)
H2	TS1-G (Right)
H3	TS1-H (Left)
H4	TS1-G (Left)
H5	Taped

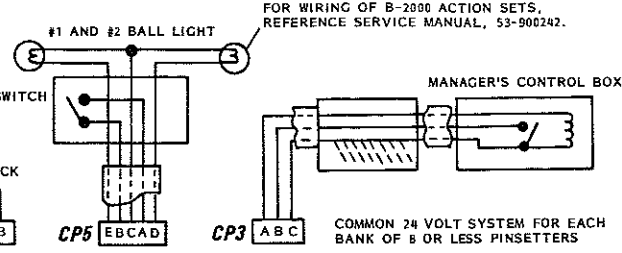
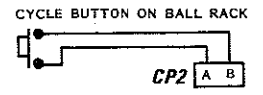
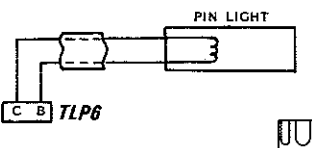
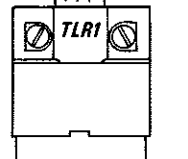
PINSETTER WIRING DIAGRAM - 115 VOLTS
FIGURE 83



PINSETTER SCHEMATIC DIAGRAM - UNIVERSAL VOLTAGE
FIGURE 84



POWER DROP CORD



FOR WIRING OF B-2000 ACTION SETS, REFERENCE SERVICE MANUAL, 53-900242.

COMMON 24 VOLT SYSTEM FOR EACH BANK OF 8 OR LESS PINSETTERS

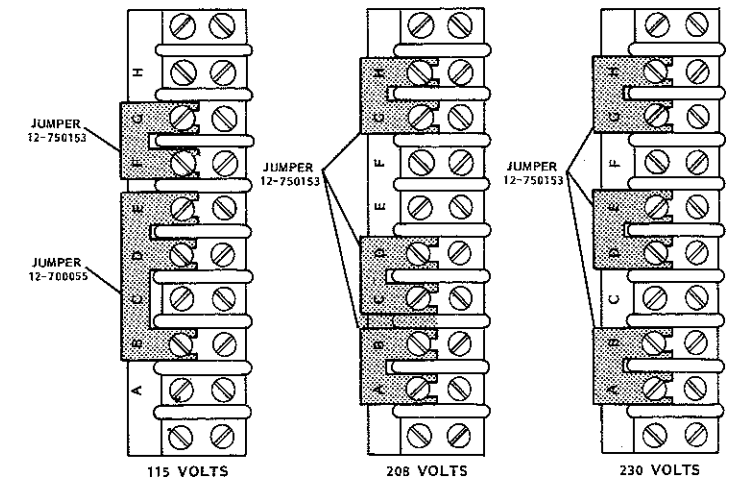
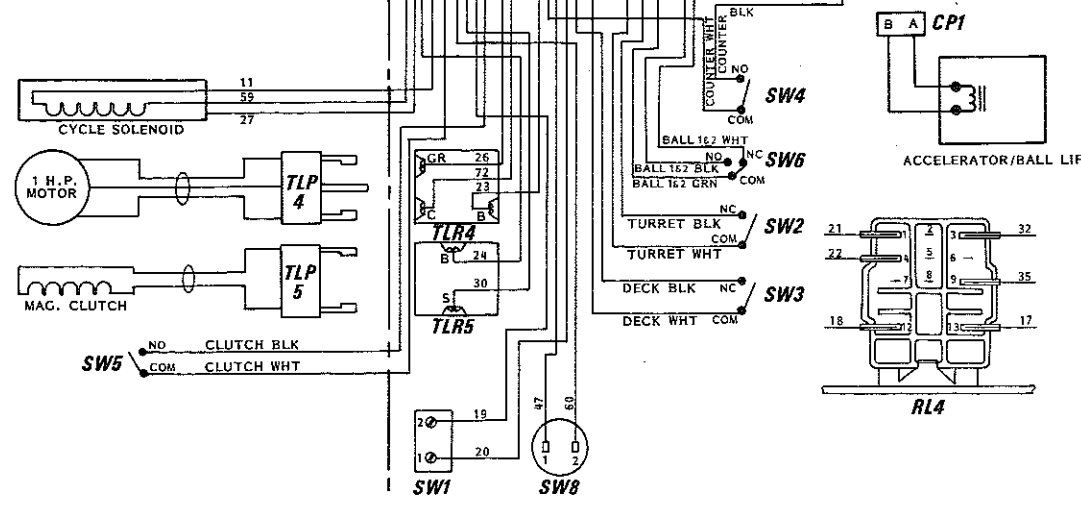
TRANSFORMER	
LEAD	TERMINAL
YEL	Y3
BLU	TS2-6 (TOP)
TAN	TS2-4 (TOP)
H1	TS1-F (RIGHT)
H2	TS1-B (RIGHT)
H3	TS1-C (RIGHT)
H4	TS1-E (RIGHT)
H5	TS1-C (RIGHT)

COMPONENT LEGEND		
DESCRIPTION	LOCATION	
CB	INPUT CIRCUIT BREAKER	PINSETTER CONTROL BOX
FS	FUSTAT (3.2 AMP FUSE)	PINSETTER CONTROL BOX
CN1	CANNON RECEPTACLE (ACCELERATOR/BALL LIFT)	PINSETTER CONTROL BOX
CN2	CANNON RECEPTACLE (BALL RACK CYCLE BUTTON)	PINSETTER CONTROL BOX
CN3	CANNON RECEPTACLE (MANAGER'S CONTROL BOX)	PINSETTER CONTROL BOX
CN5	CANNON RECEPTACLE (MASKING UNIT)	PINSETTER CONTROL BOX
CP1	CANNON PLUG (ACCELERATOR/BALL LIFT)	CONTROL CABLE (ACC./BALL LIFT)
CP2	CANNON PLUG (CYCLE BUTTON)	CYCLE BUTTON CABLE
CP3	CANNON PLUG (MANAGER'S CONTROL BOX)	3-CONDUCTOR CABLE
CP5	CANNON PLUG (MASKING UNIT)	5-CONDUCTOR CABLE
RL2	MOTOR START RELAY	PINSETTER CONTROL BOX
RL3	MOTOR CONTACTOR	PINSETTER CONTROL BOX
SR	SELENIUM RECTIFIER	PINSETTER CONTROL BOX
SW1	ON-OFF SWITCH (REAR)	WIRE CHANNEL
SW2	TURRET JAM SWITCH	TURRET FRAME
SW3	DECK JAM SWITCH	GEAR BOX SUPPORT
SW4	COUNTER SWITCH	PINSETTER CROSS BRACE
SW5	MAGNETIC CLUTCH SWITCH	CROSS CONVEYOR DETECTOR
SW6	#1 AND #2 BALL LIGHT SWITCH	WIRE CHANNEL
SW8	CYCLE BUTTON (MECHANICS)	PINSETTER CONTROL BOX
TD1	TIME DELAY MODULE	PINSETTER CONTROL BOX
TF	TRANSFORMER	PINSETTER CONTROL BOX
TLP1	TWIST LOCK PLUG (INPUT POWER)	SOLENOID CABLE
TLP3	TWIST LOCK PLUG (CYCLE SOLENOID)	MOTOR CABLE
TLP4	TWIST LOCK PLUG (MOTOR)	MAGNETIC CLUTCH CABLE
TLP6	TWIST LOCK PLUG (MAGNETIC CLUTCH)	PIN LIGHT CABLE
TLR1	TWIST LOCK RECEPTACLE (INPUT POWER)	POWER DROP CORD
TLR3	TWIST LOCK RECEPTACLE (CYCLE SOLENOID)	WIRE CHANNEL
TLR4	TWIST LOCK RECEPTACLE (MOTOR)	WIRE CHANNEL
TLR5	TWIST LOCK RECEPTACLE (MAGNETIC CLUTCH)	PINSETTER CONTROL BOX
TLR6	TWIST LOCK RECEPTACLE (PIN LIGHT)	PINSETTER CONTROL BOX
TS1	TERMINAL STRIP (HIGH VOLTAGE)	PINSETTER CONTROL BOX
TS2	TERMINAL STRIP (LOW VOLTAGE)	PINSETTER CONTROL BOX
TSC1	TRIGGER SWITCH	PINSETTER CONTROL BOX
TSC2	SOLENOID HOLD OUT SWITCH	PINSETTER CONTROL BOX
Y1	WIRE CONNECTOR (LOW VOLTAGE)	PINSETTER CONTROL BOX
Y2	WIRE CONNECTOR (LOW VOLTAGE)	PINSETTER CONTROL BOX
Y3	WIRE CONNECTOR (LOW VOLTAGE)	PINSETTER CONTROL BOX
Z1	GROUND LUG (HIGH VOLTAGE)	PINSETTER CONTROL BOX
Z2	GROUND LUG (HIGH VOLTAGE)	PINSETTER CONTROL BOX
F	FUSE (1 AMP)	PINSETTER CONTROL BOX

WIRE CHARTS			
SINGLE CONDUCTOR WIRES			
WIRE NO.	WIRE SPEC.	TERMINALS	TERMINALS
2	12 GA. GRN	Z1 (GROUND)	TLP1-GR (GROUND)
3	12 GA. BLK	TLP1-B (BRASS)	CB-4
4	12 GA. BLK	CB-1	CB-3 (RIGHT)
5	12 GA. BLK	TLP1-C (COPPER)	CB-3
6	12 GA. BLK	CS 2	TS1 F (RIGHT)
7	12 GA. BLK	TS1-E (RIGHT)	RL2-F
12	18 GA. YEL	TS2-9 (TOP)	RL2-H
13	18 GA. YEL	TS2-2 (TOP)	CN5-A
16	18 GA. YEL	TS2-9 (TOP)	RL2-B
17	18 GA. YEL	TS2-9 (BOTTOM)	RL4-13
18	18 GA. YEL	TS2-3 (TOP)	RL4-12
19	18 GA. YEL	TS2-G	SW1-2
20	18 GA. YEL	TS2-5 (BOTTOM)	SW1-1
21	18 GA. YEL	TS2-2 (BOTTOM)	RL4-1
22	18 GA. YEL	TS2-5 (BOTTOM)	RL4-4
23	12 GA. BLK	RL3-4	TLR4-B
24	15 GA. BLK	SR-RED	TLR5-B
26	12 GA. BLK	TLR4-CR	Z2 (GROUND)
28	18 GA. YEL	TS2-1 (BOTTOM)	CN5-C
29	16 GA. BLK	TLR6-C	RL3-6
30	16 GA. BLK	Y1	TLR5-5
32	18 GA. YEL	TS2-3 (TOP)	RL4-3
33	16 GA. BLK	RL2-E	RL3-6
34	16 GA. BLK	F-1	TS1-A (RIGHT)
35	18 GA. YEL	TS2-6 (TOP)	RL4-9
36	18 GA. YEL	RL2-G	CN1-A
38	12 GA. BLK	RL3-2	CB-1
39	12 GA. BLK	CB-2	RL3-1
40	16 GA. BLK	RL3-3	SR-YELLOW
41	18 GA. YEL	TS2-1 (TOP)	RL2-A
42	18 GA. YEL	TS2-12 (TOP)	CN2-A
43	18 GA. YEL	TS2-7 (TOP)	CN5-D
44	18 GA. YEL	TS2-8 (TOP)	CN5-E
45	18 GA. YEL	TS2-10 (TOP)	CN5-A
47	18 GA. YEL	TS2-12 (BOTTOM)	SW8-1
48	16 GA. BLK	TLR6-B	TS1-C (RIGHT)
49	16 GA. BLK	SR-YELLOW	TS1-B (RIGHT)
52	18 GA. YEL	Y2	TSC-1 (N.C.)
53	18 GA. YEL	TD1-15	TS2-8 (TOP)
54	18 GA. YEL	TD1-14	RL2-H
55	18 GA. YEL	TD1-17	Y2
56	18 GA. YEL	TD1-18	TSC-1 (COMM)
57	18 GA. YEL	TD1-13	TS2-6 (TOP)
58	16 GA. BLK	Y1	TD1-19
60	18 GA. YEL	Y2	SW8-2
61	18 GA. YEL	Y2	CN2-B
68	18 GA. YEL	TD1-16	TS2-12 (TOP)
69	12 GA. BLK	TS2-12 (BOTTOM)	TSC-1 (N.O.)
71	12 GA. BLK	F-2	TSC-1 (N.C.)
72	12 GA. BLK	RL3-3	TLR4-C
82	16 GA. BLK	RL3-5	TS1-C (RIGHT)
84	18 GA. BLK	TS2-4 (BOTTOM)	TS2-7 (BOTTOM)
717	18 GA. YEL	TS2-11 (TOP)	CN5-B
718	18 GA. YEL	TS2-11 (TOP)	CN3-B
735	18 GA. YEL	TS2-9 (BOTTOM)	CN3-C
			CN1-B

TWO CONDUCTOR CABLES			
WIRE NO.	WIRE SPEC.	TERMINALS	TERMINALS
SW3	BLK WHT	SW3 (N.C.)	TS2-3 (BOTTOM)
		SW3 (COMM)	TS2-6 (BOTTOM)
SW2	BLK WHT	SW2 (N.C.)	TS2-6 (BOTTOM)
		SW2 (COMM)	TS2-3 (BOTTOM)
SW4	BLK WHT	SW4 (N.O.)	TS2-10 (BOTTOM)
		SW4 (COMM)	TS2-1 (BOTTOM)
SW5	BLK WHT	SW5 (N.O.)	Y1
		SW5 (COMM)	SR-BLACK

THREE CONDUCTOR CABLES			
WIRE NO.	WIRE SPEC.	TERMINALS	TERMINALS
SW6	WHT BLK GRN	SW6 (N.C.)	TS2-8 (BOTTOM)
		SW6 (N.O.)	TS2-7 (BOTTOM)
		SW6 (COMM)	TS2-4 (BOTTOM)
CYC. SOL.	WHT BLK GRN	WIRE #11	RL3-4
		WIRE #59	TD1-20
		WIRE #27	Z2



PINSETTER WIRING DIAGRAM - UNIVERSAL VOLTAGE
FIGURE 85

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DETECTOR ASSEMBLY

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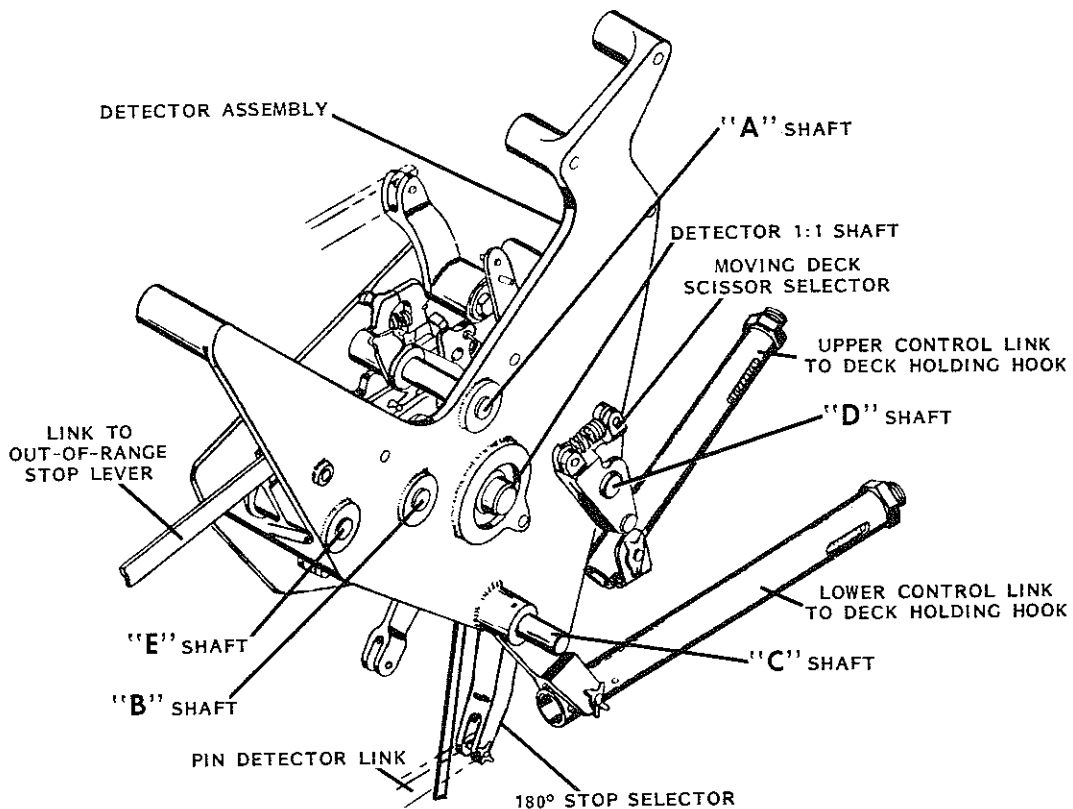
SECTION II

DETECTOR ASSEMBLY

CHAPTER 22 - DETECTOR THEORY

The automatic pinsetter must be able to perform several different operations by responding to the varied conditions set up by delivery of the first ball. The mechanism that selects the proper sequence of operations is the detector assembly. The detector is the brains of the pinsetter since it accepts intelligence, then places the various selective mechanisms in their proper positions to direct the pinsetter through its cycles.

The detector is 100% mechanical with various shafts, cams and levers that are positioned to direct the operations of the pinsetter. The detector assembly is bolted to the front, left side of the gear box and contains six (6) shafts, upon which are mounted the selective mechanisms. These shafts are positioned between the two detector mounting plates and identified as follows (Figure 1): 1:1 shaft, "A" shaft, "B" shaft, "C" shaft, "D" shaft and "E" shaft. The detector 1:1 shaft is driven, through an idler gear, by the gear box 1:1 shaft, and completes one revolution per pinsetter cycle. The "A", "B" and "E" shafts are stationary pivot shafts while the "C" and "D" shafts are bearing-mounted to pivot freely.



DETECTOR ASSEMBLY

FIGURE 1

The detector has four basic selective mechanisms; strike mechanism, standing pins mechanism, out-of-range mechanism and a rake sweep hook mechanism.

The rake sweep hook mechanism operates constantly through a strike or standing pins cycle. It requires manual effort to change its normal operation during an out-of-range cycle.

The basic theory of the detector's operation can be condensed into the following paragraphs:

FIRST DETECTION, NO-STRIKE OR STRIKE. As the deck lowers at 90° to determine the result of the bowler's first ball delivery, the strike mechanism must react to the pinfall. If the deck assembly encounters standing pins at 90°, no-strike detection, the scissors must close to pick up the standing pins, the deck must take the short respotting stroke and a 180° stop will not be requested since the deck will be respotting standing pins at 270°. If a strike detection has been detected at 90°, the moving deck would operate, the deck would take the long, new pinsetting stroke, and a 180° stop would be requested in the event the deck was empty of pins at 180°.

SECOND DETECTION. This occurs at 270° and will be no-standing pins detection or standing pins detection. The height of the deck assembly at 270°, either setting new pins (long stroke) or respotting standing pins (short stroke), will permit the standing pins mechanism to prepare the pinsetter for delivery of the next ball. If the deck is at 270°, setting new pins, the standing pins mechanism will prepare the pinsetter for a first ball delivery by lighting the #1 ball light. If the deck is respotting standing pins at 270° (short stroke), the standing pins mechanism will prepare the pinsetter for a second ball delivery by energizing the #2 ball light and pivoting the deck holding hook down to engage the pin on the deck support arm when the deck raises at 0°. When the second ball is thrown, the gear box clutch engages, but the deck does not lower at 90° to detect, since it is held up by the deck holding hook. When the deck is held on the holding hook at 90°, the strike mechanism is given an automatic strike signal, thereby directing the pinsetter to set new pins identical to a first ball strike situation. The pinsetter then proceeds through its cycle and stops at 0° to await delivery of the next first ball.

The out-of-range mechanism will disengage the gear box clutch at 90° when the deck encounters an out-of-range pin at 90° as described in Chapter 18, Out-of-Range Pin. The only function of the out-of-range mechanism within the detector is to stop the machine. The strike mechanism and standing pin mechanism function identically during an out-of-range cycle as they would during a normal standing pins cycle.

The method of accepting intelligence from the heights of the deck at 90° and 270°, with detailed descriptions of the strike mechanism, standing pins mechanism, out-of-range mechanism and rake sweep hook mechanism are contained in the following text.

CHAPTER 23 - DETECTOR ROD AND DETECTOR DISC

Freely mounted to the detector 1:1 shaft is the detector disc, which is connected to the deck lift shaft by the detector rod as described on page 1-21. It was stated that:

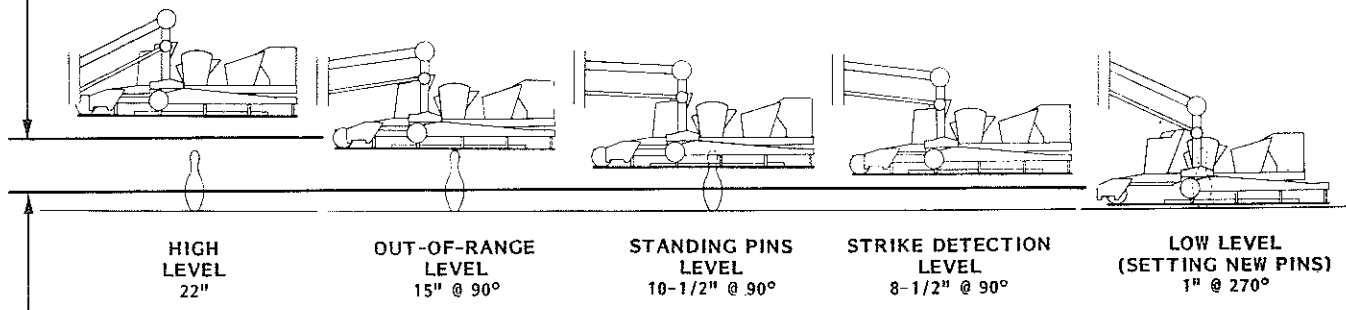
"The detector rod consists of a hollow tube pivoted at the bottom to an arm on the deck lift shaft. Inside the tube are two oilite bearings which are free to slide on a rod inside the tube between an upper and lower retaining ring. The oilite bearings are normally urged apart by a spring against pins at the top and bottom of the tube. The top of the rod is pinned to the detector disc. As the deck lift shaft rotates upward, the detector rod, through the lower retaining ring, oilite bearings and the lower pin, is moved upward until a stop pin on the exposed part of the rod is physically halted by hitting a stop on the gear box support. Any further rotation of the deck lift shaft will merely compress the spring in the tube without moving the rod and detector disc.

"In the same manner, as the deck lift shaft rotates down, the rod, through the upper retaining ring, oilite bearings, and the upper pin, will come down until another stop pin on the exposed part of the rod is halted by the stop on the gear box support. Any further rotation of the deck lift shaft will merely compress the spring without further movement of the rod or disc. Except for this lost motion after the pins hit the stops going up or down, it can be seen that the detector disc has a position for every position of the deck."

The detector disc is thereby positioned differently for the five possible positions of the deck at 90° or 270° (Figure 2).

1. High Level - Second Ball - Deck assembly held in up position at approximately 21 inches by the deck holding hook. This will occur at 90° during a second ball cycle and 270° during a first ball, out-of-range cycle.
2. Out-of-Range Level - Deck assembly resting on an out-of-range pin at approximately 15 inches above the lane surface. This will occur only at 90° during a first ball, out-of-range cycle.
3. Standing Pins Level - Deck assembly resting on normal standing pins at approximately 10 inches above the lane surface. This will occur at 90°, detecting no-strike and at 270°, respotting standing pins during a first ball, standing pins cycle.
4. Strike Detection Level - Deck assembly at lowest level permitted by the deck lowering hook; approximately 8-1/2 inches above the lane surface. This will only occur at 90° detecting a strike after first ball delivery.
5. Low Level (Long Stroke) - Deck assembly at lowest level permitted by the deck lowering yoke when setting new pins at approximately 7/8 inches above the lane surface. This will occur at 270° during a first ball strike cycle or at 270° during a second ball cycle.

THE DETECTOR ROD MOVES ONLY WHEN THE DECK MOVES BETWEEN THE LIMITS ILLUSTRATED. WHEN THE DECK IS ABOVE OR BELOW THE HEIGHTS INDICATED, THE STOP PINS ON THE DETECTOR ROD CONTACT THE STOP BRACKET TO HALT THE MOVEMENT OF THE DETECTOR ROD AND DISC.



LEVELS OF DECK AT 90° OR 270°

FIGURE 2

As the deck assembly lowers at 90° to detect pinfall, only three positions of the deck are required to accept first ball intelligence, since the bowler can leave only one of three possible situations; strike, standing pins, or an out-of-range pin. As the deck approaches the out-of-range level, the stop pin on the detector rod moves away from the stop bracket and permits the disc to rotate.

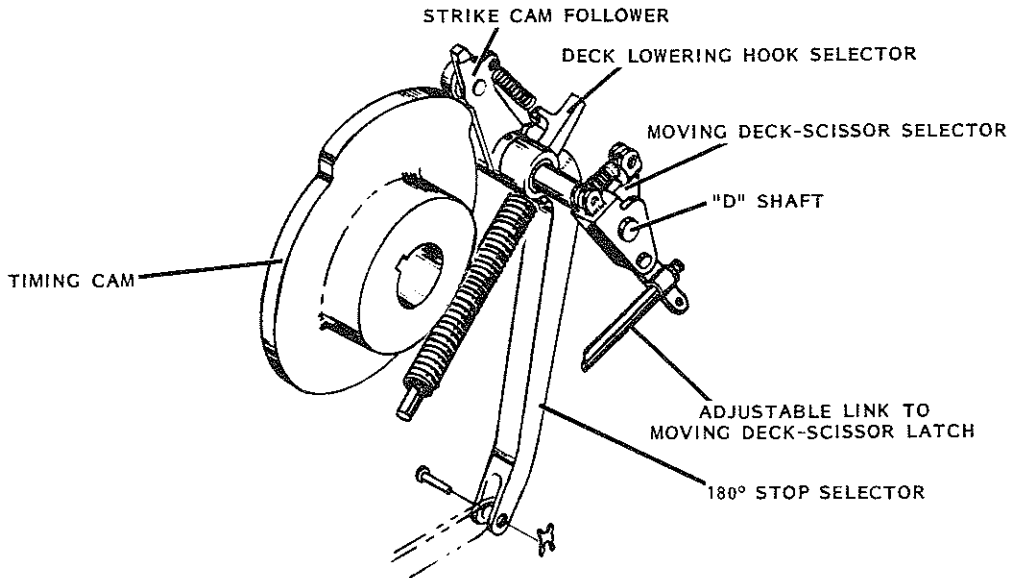
At 270° there are also three positions of the deck assembly that will transmit intelligence to the detector. The deck will be held up on the holding hook during an out-of-range cycle, or at the standing pins level during the first ball, standing pins cycle or it will be at the low level, setting new pins. At 270°, during a first ball, out-of-range cycle, the deck is held up on the deck holding hook. The disc is positioned to permit the standing pin mechanism to function identically to a normal standing pins cycle, and thus prepare the pinsetter for a second ball situation.

CHAPTER 24 - STRIKE MECHANISM

Mounted on the detector 1:1 shaft is the timing cam which controls the motion and timing of the strike cam follower. The timing cam has only two levels; a high level that extends for 90° of the cam's circumference, and a low level that extends for the remaining 270° of the circumference. Spring-urged to follow the contour of the timing cam is the strike cam follower which is pinned to the "D" shaft (Figure 3). As the 1:1 shaft rotates, the strike cam follower will be in one of two possible positions; on the high level of the timing cam, or the low level of the timing cam. The "D" shaft, therefore, has only two possible positions; counterclockwise when the strike cam follower is on the low level of the timing cam, and clockwise when the strike cam follower is on the high level of the timing cam.

Connected to the "D" shaft are three selectors that control three separate mechanisms of the pinsetter (Figure 3):

1. 180° Stop Selector
2. Deck Lowering Hook Selector
3. Moving Deck-Scissor Selector



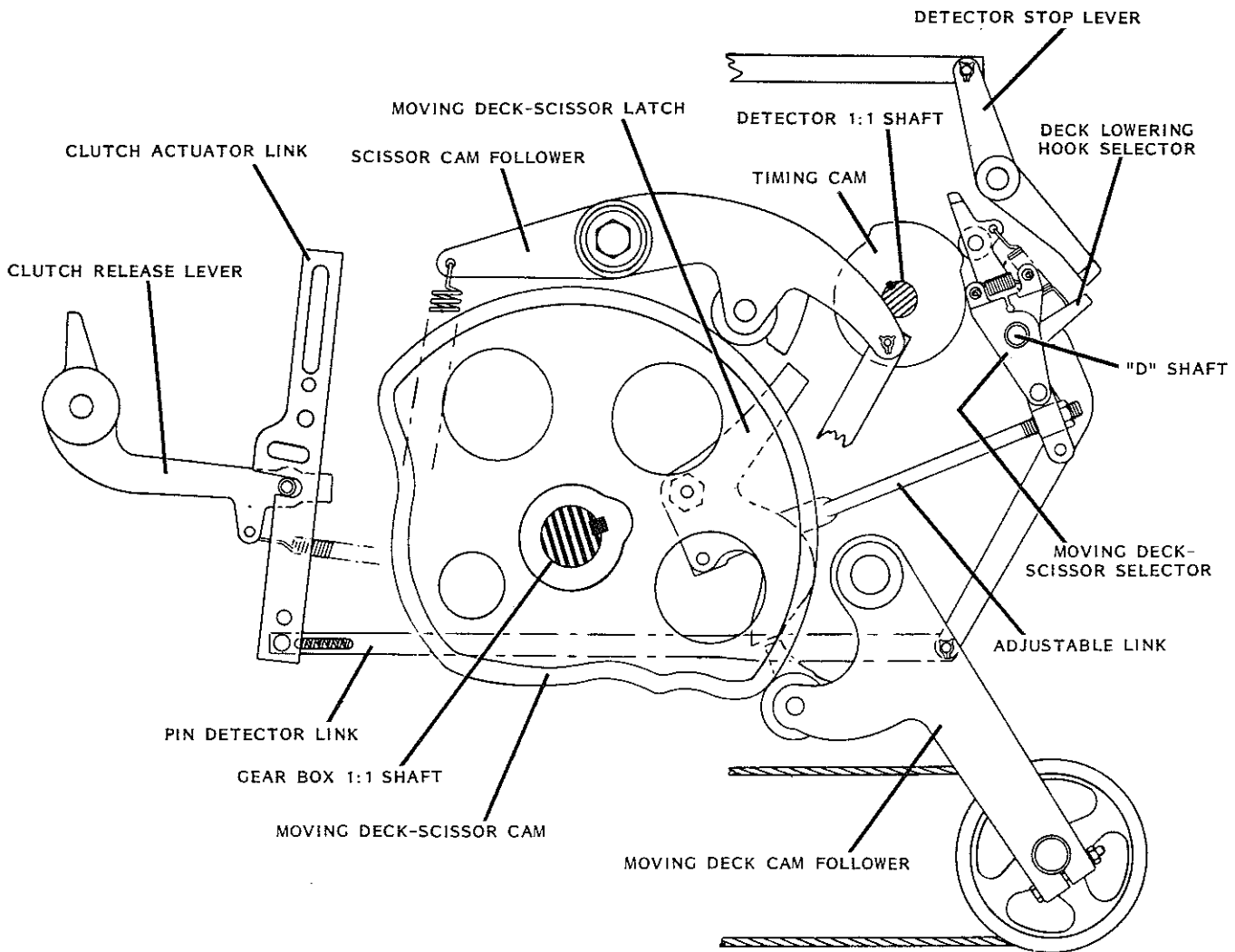
"D" SHAFT ASSEMBLY

FIGURE 3

Each of these selectors are positioned by the clockwise or counterclockwise position of the "D" shaft. Since the "D" shaft has only two possible positions, the selectors have only two possible positions. There is no neutral position of the "D" shaft or the selectors. Each of the pinsetter mechanisms controlled by these three selectors have only two choices of operation. The deck lowering mechanism will allow the long, new pinsetting stroke or the short, detecting or respotting stroke. (Figure 35, page 1-41 and Figure 4, page 2-6.) The moving deck-scissor mechanism permits the moving deck to shift rearward to set new pins or the scissors to close to pick up and respot standing pins. The 180° stop is requested during a first ball strike or second ball cycle, and not requested during a first ball standing pins cycle. The following table will associate the individual selections created by the position of the "D" shaft and the position of the strike cam follower in relation to the levels of the timing cam.

STRIKE (90°)	NO-STRIKE (90°)
"D" SHAFT IN COUNTERCLOCKWISE POSITION AND STRIKE CAM FOLLOWER ON LOW LEVEL OF TIMING CAM	"D" SHAFT IN CLOCKWISE POSITION AND STRIKE CAM FOLLOWER AT EQUIVALENT HIGH LEVEL OF TIMING CAM
<ol style="list-style-type: none"> 1. 180° STOP REQUEST 2. LONG STROKE OF DECK 3. MOVING DECK 	<ol style="list-style-type: none"> 1. NO 180° STOP REQUEST 2. SHORT STROKE OF DECK 3. SCISSORS

It will be observed that when the strike cam follower is on the low of the timing cam, thus rotating the "D" shaft in its counterclockwise position, the three selectors are placed in position to direct the pinsetter through a strike cycle. Conversely, when the strike cam follower is on the high level of the timing cam, placing the "D" shaft in its clockwise position, the three selectors are positioned to direct the pinsetter through a no-strike cycle. The type of pinsetter cycle, strike or no-strike, is entirely dependent on the position of the strike cam follower with respect to the timing cam, and the resultant position of the "D" shaft.



MECHANISMS CONTROLLED BY "D" SHAFT
FIGURE 4

The strike cam follower and timing cam are physically positioned to cause the strike cam follower to rise to the high level of the timing cam at exactly 0° (Figure 5). As the pinsetter cycles from 0° toward 90° , the strike cam follower is riding on the high level of the timing cam which holds the "D" shaft in its clockwise position. This situation occurs every cycle due to the shape of the timing cam.

STRIKE

As the pinsetter cycles to 90° , the deck has lowered to detect pinfall. If the deck assembly lowers to its strike detection level ($8\frac{1}{2}$ "), the bowler has a strike and the detector must direct the pinsetter through a strike cycle. At approximately 90° , the strike cam follower will be permitted to fall to the low level of the timing cam, rotate the "D" shaft counterclockwise and place the three selectors in position to direct the pinsetter through a strike cycle.

NO-STRIKE

If the deck had encountered standing pins at 90° , the detector would retain the original position of the strike cam follower by preventing it from following the low level of the timing cam from 90° to 0° . By keeping the strike cam follower at the equivalent high level of the timing cam, the "D" shaft will remain in its clockwise position with the three selectors in position for scissors operation, "no" 180° stop, and a short stroke of deck.

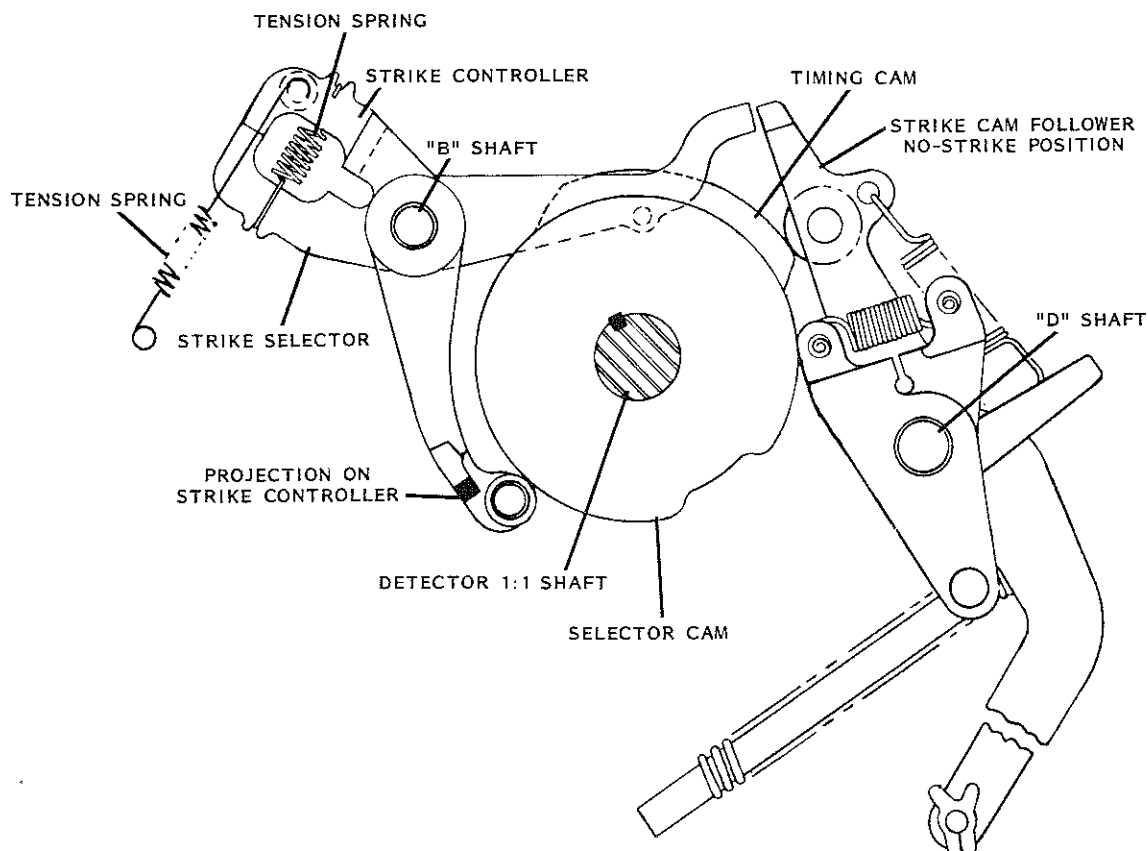
SELECTOR CAM

Keyed to the detector 1:1 shaft, adjacent to the timing cam, is the selector cam. The selector cam has a hub upon which the detector disc is freely mounted. The selector cam has two levels; a high level that extends for approximately 345° of the cam's circumference, and a single low level for the remaining 15°.

STRIKE CONTROLLER AND STRIKE SELECTOR

Pivoted on the "B" shaft is the strike controller which is spring-urged to follow the contour of the selector cam. Also pivoted on the "B" shaft, next to the strike controller, is the strike selector. The strike selector receives positive motion from the strike controller in a counterclockwise direction only and is spring-urged in the opposite direction. When the strike controller is on the high level of the selector cam, the strike selector is spring-urged into the path of the strike cam follower. (Figure 5)

The selector cam and strike controller are physically positioned to align the roller of the strike controller with the low level of the selector cam at 90°. The strike controller has a square projection on its left side that is in line with the right hand face of the detector disc.

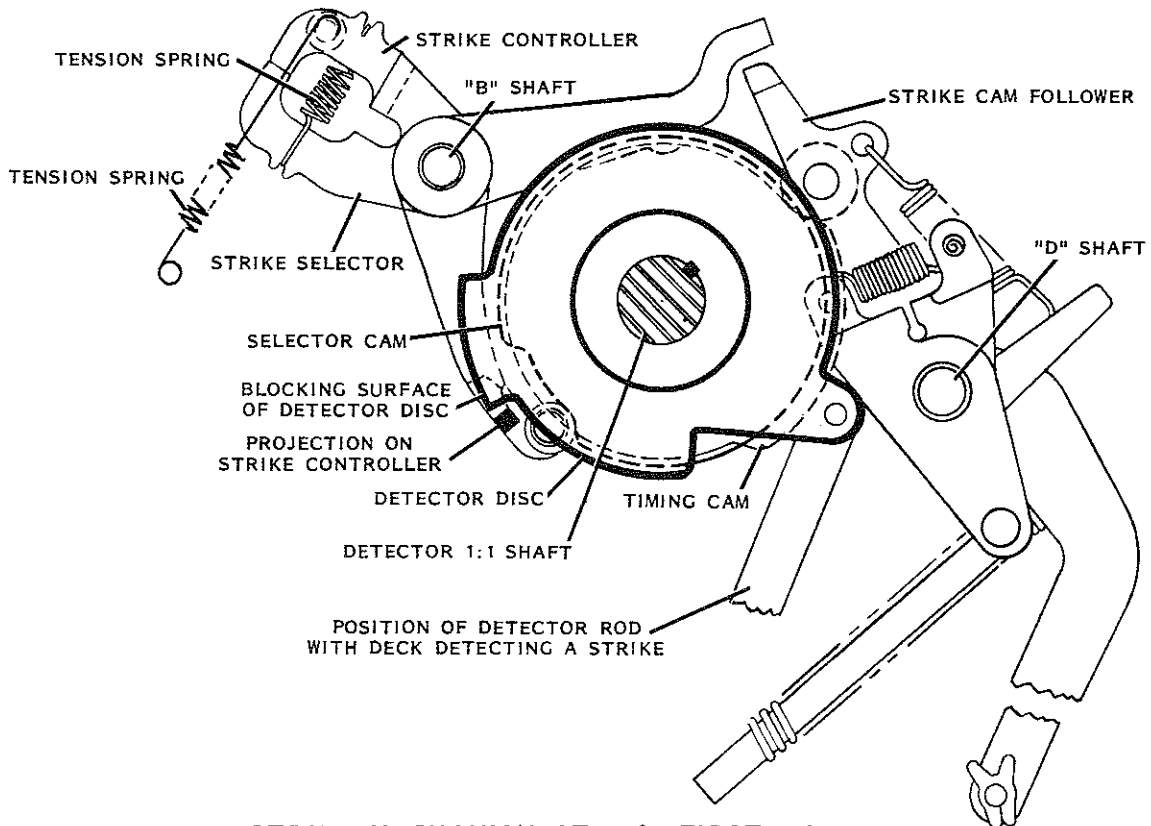


STRIKE CONTROLLER AND STRIKE SELECTOR (0°)

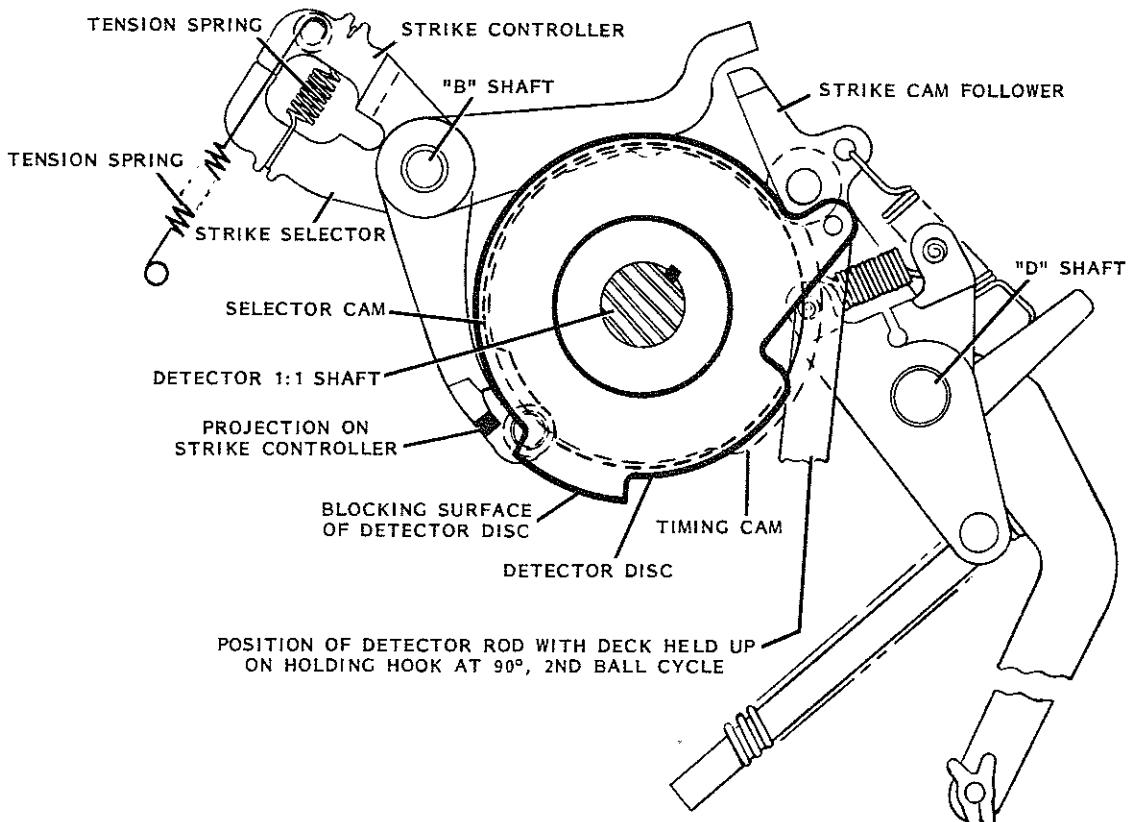
FIGURE 5

Each time the pinsetter cycles to 90°, the roller on the strike controller will be in line with, and spring-urged toward the low level of the selector cam. The position of the detector disc at 90° will allow or not allow the strike controller to follow the low level of the selector cam. If the deck, at 90°, is at the strike detection level (8-1/2" above the lane surface) or held up on the deck holding hook (90°, second ball cycle), the detector disc will be positioned unblocking the projection on the strike controller. This will permit the strike controller to rotate into the low level of the selector cam, pivot on the "B" shaft, and thus pivot the

strike selector above the path of the strike cam follower. The strike cam follower will then rotate to the low level of the timing cam, which rotates the "D" shaft counterclockwise to position the three selectors to direct the pinsetter through a strike cycle (Figures 6 and 7).

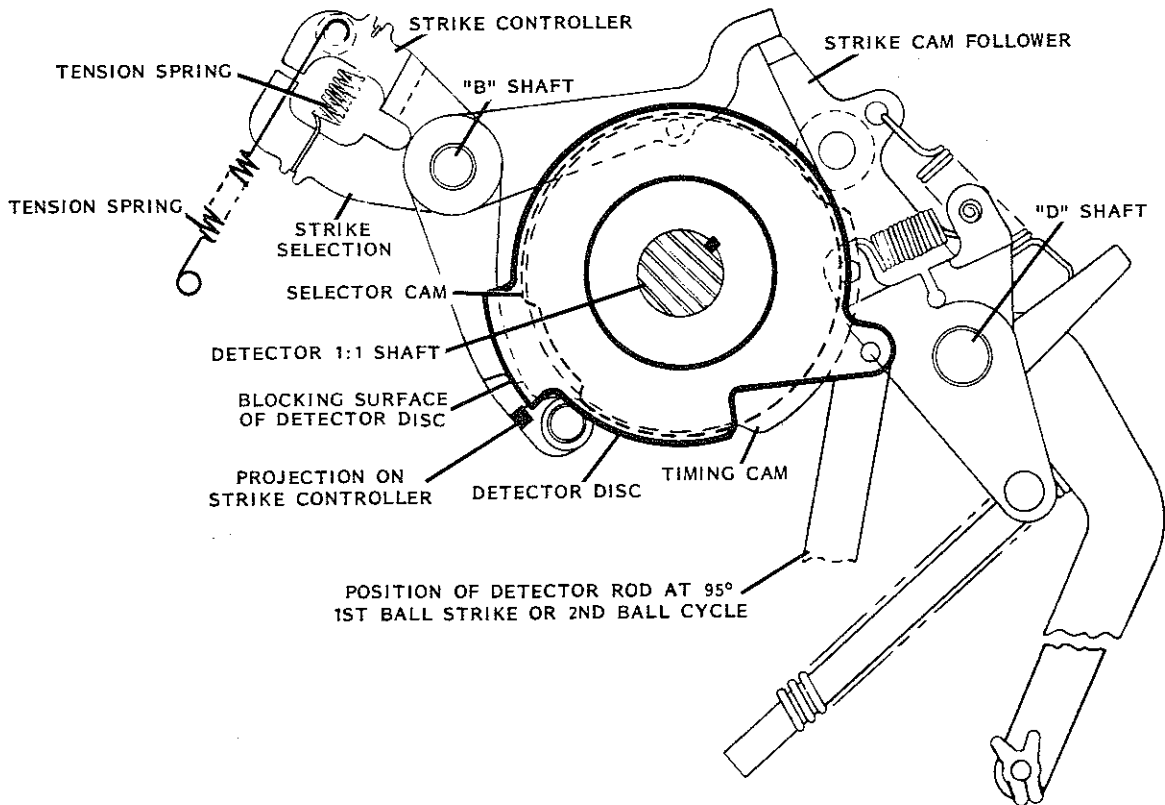


STRIKE MECHANISM AT 90°, FIRST BALL STRIKE
FIGURE 6



STRIKE MECHANISM AT 90°, SECOND BALL CYCLE
FIGURE 7

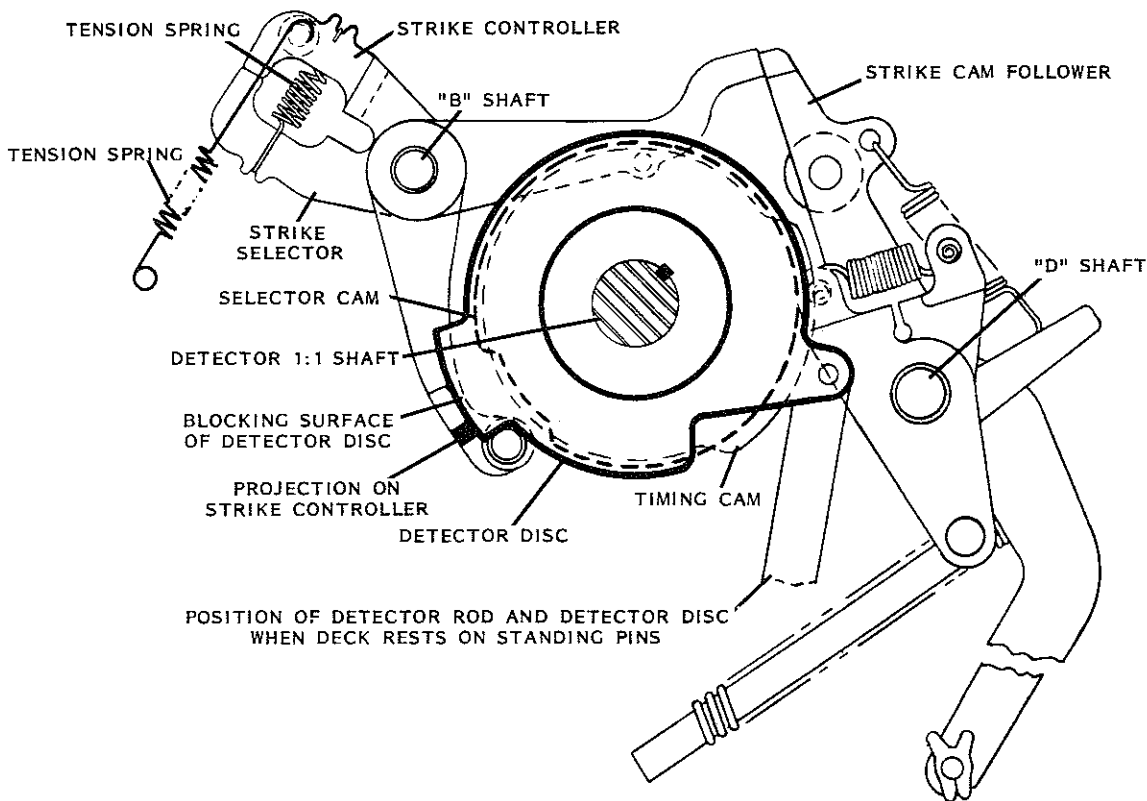
Immediately after the detector receives a strike signal at 90°, the high level of the selector cam will rotate the strike controller clockwise to position the projection clear of the detector disc. The strike selector will be spring-urged to rotate clockwise to its original blocking position until it physically contacts the top of the strike cam follower. The tension spring between the controller and selector will stretch as a gap is formed between them (Figure 8). The gap will close when the high level of the timing cam pivots the strike cam follower clockwise, thereby allowing the strike selector to pivot to its blocking position.



STRIKE MECHANISM AT 95°,
FIRST BALL STRIKE OR SECOND BALL CYCLE

FIGURE 8

If the deck, however, at 90° detecting, is resting on top of normal standing pins or an out-of-range pin, the detector disc is positioned with a blocking surface under the projection on the strike controller. The projection contacts the blocking surface of the detector disc and the strike controller is prevented from following the low level of the selector cam. The strike selector remains in its blocking position which holds the strike cam follower at the equivalent high level of the timing cam. The "D" shaft does not rotate at 90°, and the three selectors remain in position to help direct the pinsetter during standing pins. (Figure 9) The strike cam follower will remain in its blocked position until 0°, when the high level of the timing cam will again control its position.



STRIKE MECHANISM AT 90°, DETECTING NO-STRIKE
FIGURE 9

In order to obtain a strike signal, two conditions must be satisfied:

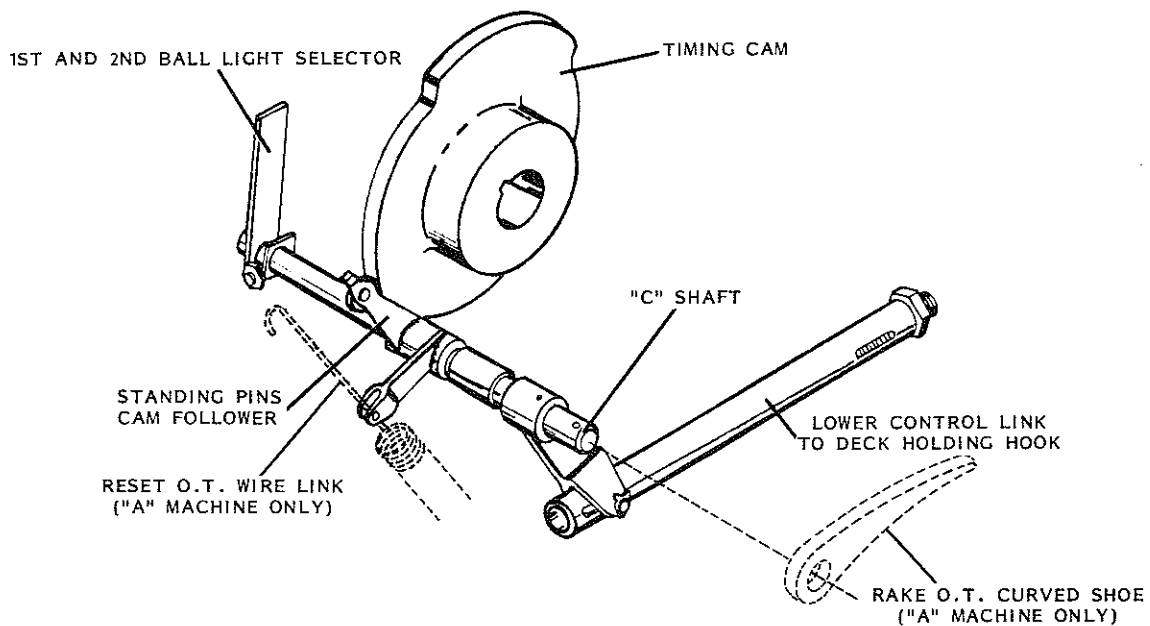
1. The detector disc must be unblocking the projection on the strike controller (deck at 8-1/2" detecting a strike after first ball delivery, or held up on the deck holding hook at 90° during a second ball cycle).
2. The pinsetter must be at 90° to align the roller on the striker controller with the low level of the selector cam.

CHAPTER 25 - STANDING PINS MECHANISM

Spring-urged to follow the contour of the timing cam is the standing pins cam follower which is pinned to the detector "C" shaft. The roller on the standing pins cam follower is physically located 180° opposite the roller on the strike cam follower. The two levels of the timing cam thus position the standing pins cam follower and "C" shaft in either of two possible positions. When the standing pins cam follower is on the high level of the timing cam, the "C" shaft is in a counterclockwise position and when the standing pins cam follower is in the low level of the timing cam, the "C" shaft is in its clockwise position.

Connected to the "C" shaft (Figure 10) are two selectors that control two separate mechanisms of the pinsetter:

1. First and Second Ball Light Selector
2. Deck Holding Hook Selector



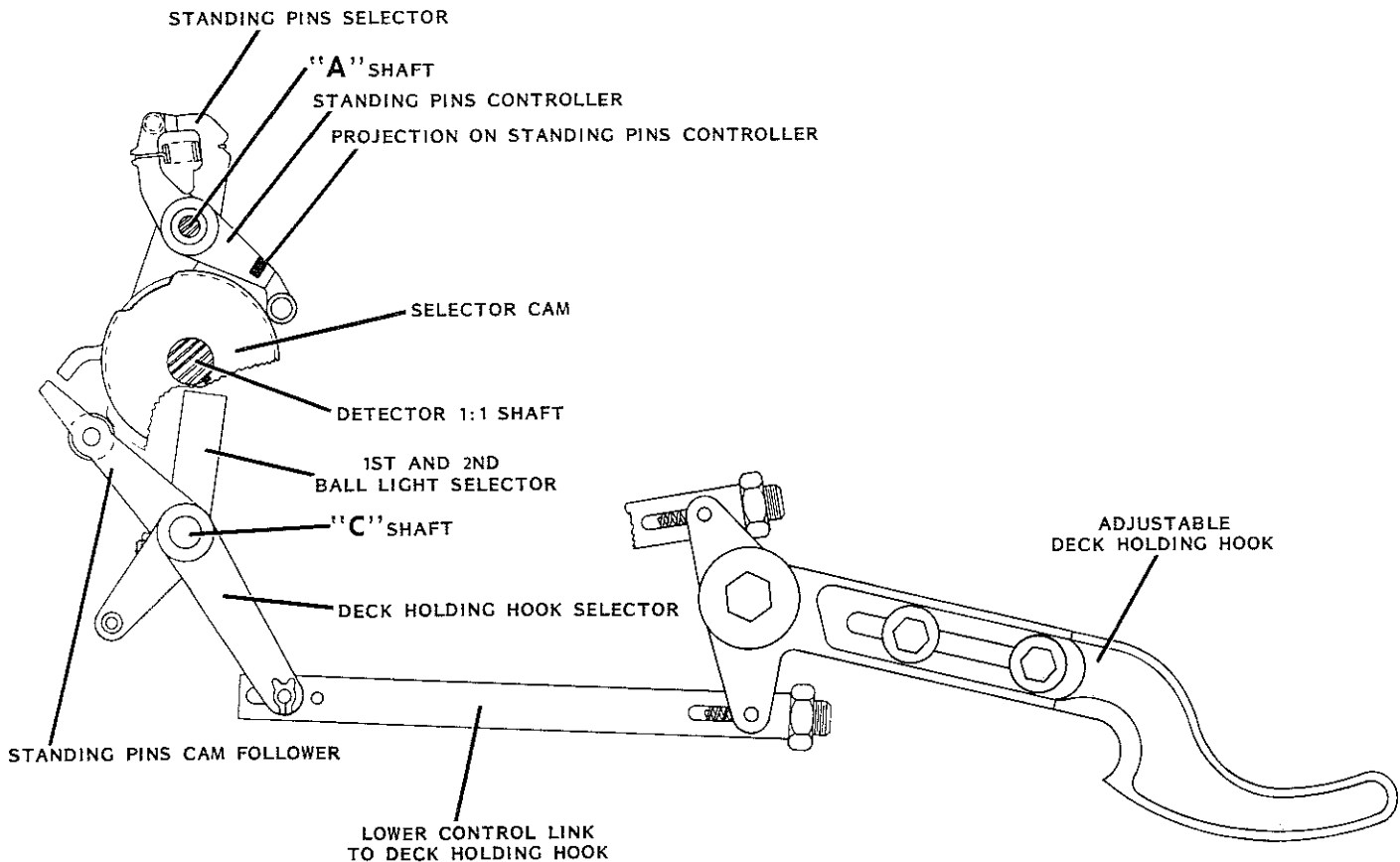
"C" SHAFT ASSEMBLY

FIGURE 10

Both of these selectors are positioned by the clockwise or counterclockwise position of the "C" shaft. Since the "C" shaft has only two possible positions, the selectors have only two possible positions. There is no neutral position of the "C" shaft or the selectors. Both of these pinsetter mechanisms have only two choices of operation. The #1 ball light will be energized when awaiting a first ball delivery and the #2 ball light will be energized when awaiting a second ball delivery. The deck holding hook will not hold the deck up at 90° during a first ball cycle, but the deck holding hook will hold the deck up at 90° during a second ball cycle. The following table will associate the individual selections created by the position of the "C" shaft and the position of the standing pins cam follower in relation to the levels of the timing cam.

It will be observed that when the standing pins cam follower is on the high level of the timing cam, thus rotating the "C" shaft in its counterclockwise position, the two selectors are placed in position to prepare the pinsetter for a first ball delivery. Conversely, when the standing pins cam follower is in the low level of the timing cam, placing the "C" shaft in its clockwise position, both selectors are placed in position to prepare the pinsetter for a second ball cycle.

The standing pins cam follower, being positioned directly opposite the strike cam follower, will rise to the high level of the timing cam at 180°. (Figure 11) As the pinsetter cycles from 180° toward 270°, the standing pins cam follower rides to the high level of the timing cam which rotates the "C" shaft in its counterclockwise, first ball position. This situation occurs during every standing pins cycle due to the shape of the timing cam.



MECHANISMS CONTROLLED BY "C" SHAFT

FIGURE 11

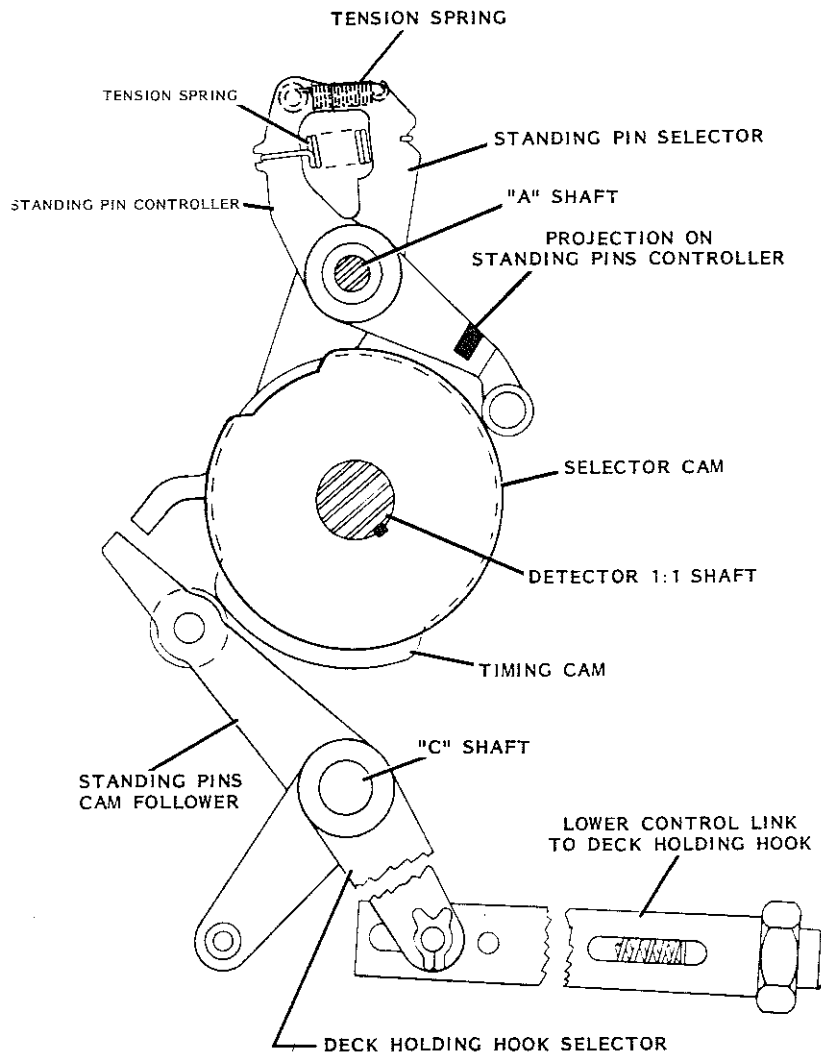
SECOND DETECTION - FIRST BALL

As the pinsetter cycles to 270°, the deck has lowered to set new pins or respot standing pins. If the deck is respotting standing pins, the bowler is entitled to a second ball, and the detector must prepare the pinsetter for a second ball delivery. At exactly 270°, the standing pins cam follower will be permitted to rotate to the low level of the timing cam, rotate the "C" shaft clockwise and place both selectors in position to prepare the pinsetter for a second ball delivery.

SECOND DETECTION - STRIKE OR SECOND BALL

If the deck was setting new pins at 270° , the detector would retain the original position of the standing pins cam follower by preventing it from following the low level of the timing cam from 270° to 180° . By keeping the standing pins cam follower at the equivalent high level of the timing cam, the "C" shaft will remain in its counterclockwise position with both selectors in position to prepare the pinsetter for a first ball delivery.

Pivoted on the "A" shaft is the standing pins controller that is spring-urged to follow the contour of the selector cam on the detector 1:1 shaft. The roller on the standing pins controller is physically positioned 180° opposite the roller on the strike controller. Also pivoted on the "A" shaft, next to the standing pins controller, is the standing pins selector. The standing pins selector receives positive motion from the standing pins controller in a clockwise direction only and is spring-urged in the opposite direction. When the standing pins controller is on the high level of the selector cam, the standing pins selector is spring-urged into the path of the standing pins cam follower (Figure 12).



STANDING PINS CONTROLLER AND SELECTOR (180°)

FIGURE 12

The selector cam and standing pins controller are physically positioned to align the roller of the standing pins controller with the low level of the selector cam at 270°. The standing pins controller has a square projection on its left side that is in line with the right hand face of the detector disc.

Each time the pinsetter cycles to 270°, the roller on the standing pins controller will be in line with, and spring-urged toward the low level of the selector cam. The position of the detector disc at 270° will allow or not allow the standing pins controller to follow the low level of the selector cam. If the deck, at 270°, is at its respotting height (approximately 10" above the lane surface) or held up on the deck holding hook (270°, during a first ball, out-of-range cycle), the detector disc will be positioned to unblock the projection on the standing pins controller. This will permit the standing pins controller to rotate to the low level of the selector cam, pivot on the "A" shaft, and thus pivot the standing pins selector above the path of the standing pins cam follower. The standing pins cam follower will then rotate to the low level of the timing cam, which rotates the "C" shaft clockwise to position the two selectors in position to prepare the pinsetter for a second ball situation. (Figures 13 and 14)

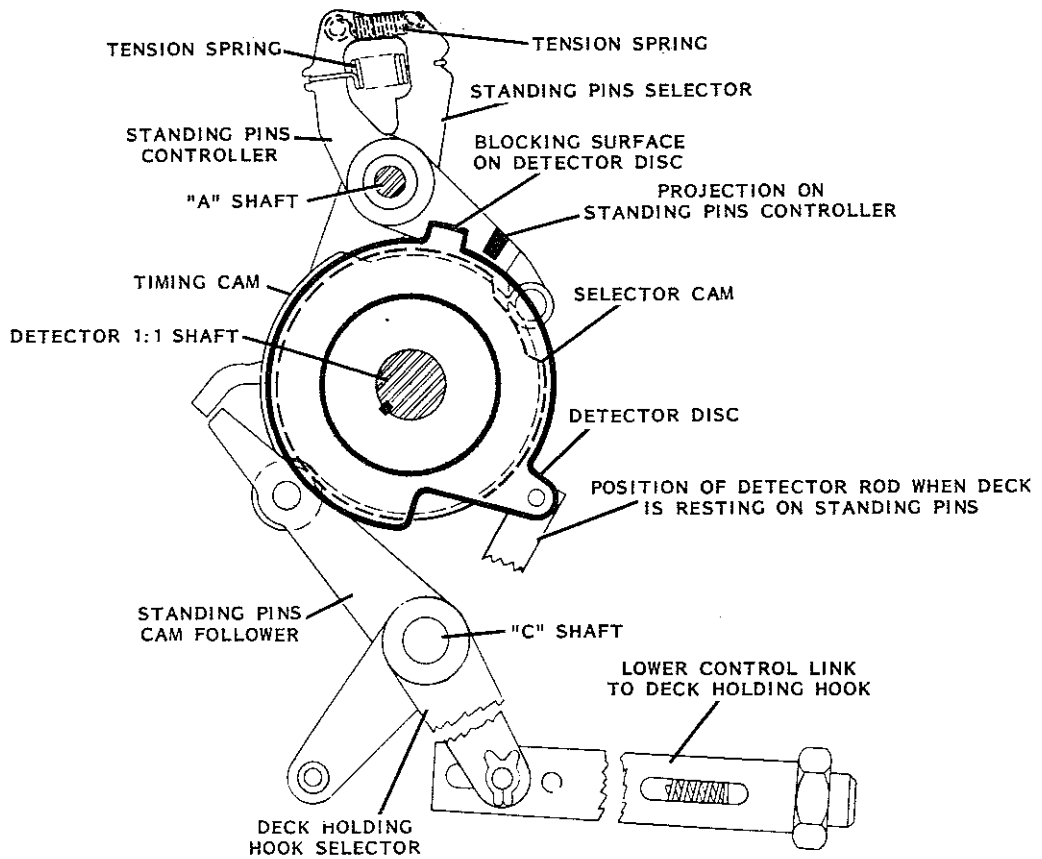
Immediately following the signal at 270°, the high level of the selector cam will rotate the standing pins controller counterclockwise to position the projection clear of the detector disc. The standing pins selector will be spring-urged to rotate counterclockwise to its original blocking position until it physically contacts the top of the standing pins cam follower. The tension spring between the controller and selector will stretch as a gap is formed between them (Figure 15). The gap will close when the high level of the timing cam pivots the standing pins cam follower counterclockwise, thereby allowing the standing pins selector to pivot to its blocking position at 180° second ball. (Figure 12, page 2-13)

If the deck, however, at 270° is at its lowest level (setting new pins), the detector disc will be positioned with a blocking surface under the projection on the standing pins controller. The projection contacts the blocking surface of the detector disc which prevents the standing pins controller from rotating to the low level of the selector cam. The standing pins selector remains in its blocking position which holds the standing pins cam follower at the equivalent high level of the timing cam. The "C" shaft does not rotate at 270°, and the two selectors remain in position to prepare the pinsetter for a first ball delivery (Figure 16). The standing pins cam follower will remain in its blocked position until 180°, when the high level of the timing cam will again control its position.

In order to obtain a second ball signal, two conditions must be satisfied:

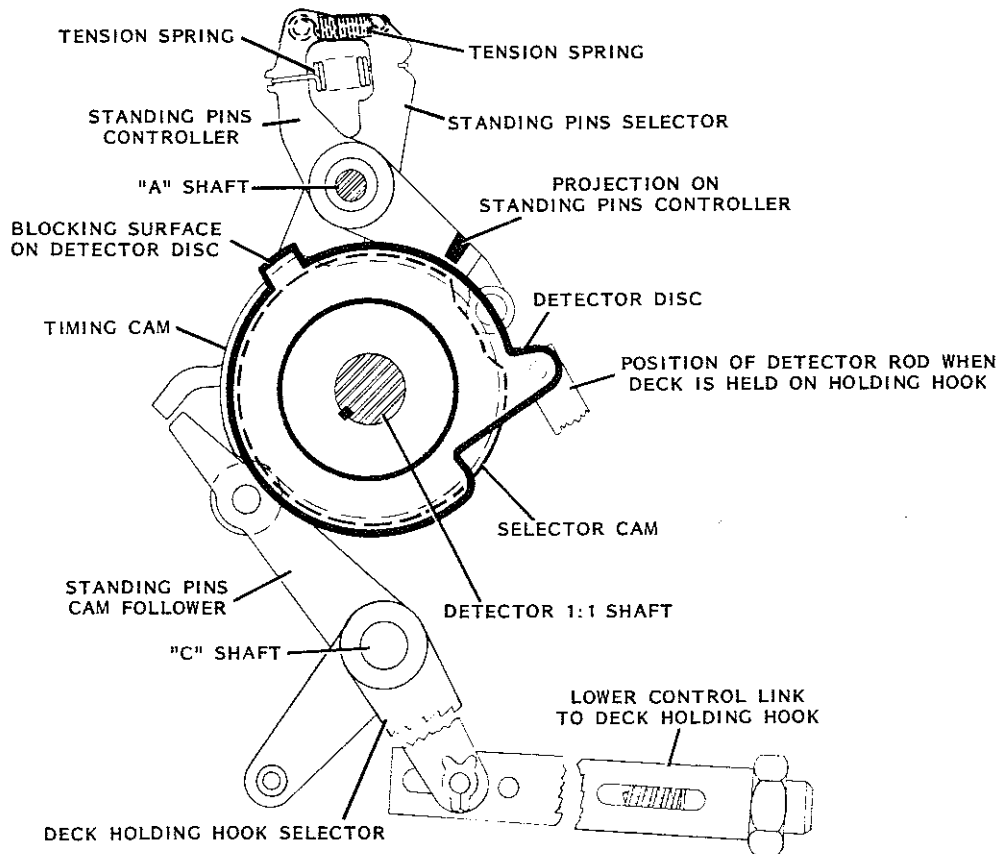
1. The detector disc must be positioned to unblock the projection on the standing pins controller (deck at respotting height, approximately 10", or held up on the deck holding hook at 270° during a first ball, out-of-range cycle).
2. The pinsetter must be at 270° to align the roller on the standing pins controller with the low level of the selector cam for second detection.

Although the strike mechanism, Chapter 24, and the standing pins mechanism, Chapter 25, are similar, and in fact use the same timing cam, detector disc and selector cam, it must be noted that they operate at different times and are completely independent from each other. The strike mechanism decides the type of pinsetter cycle to be taken, strike or no-strike, while the standing pins mechanism prepares the pinsetter for delivery of the next ball at 270°, first ball.



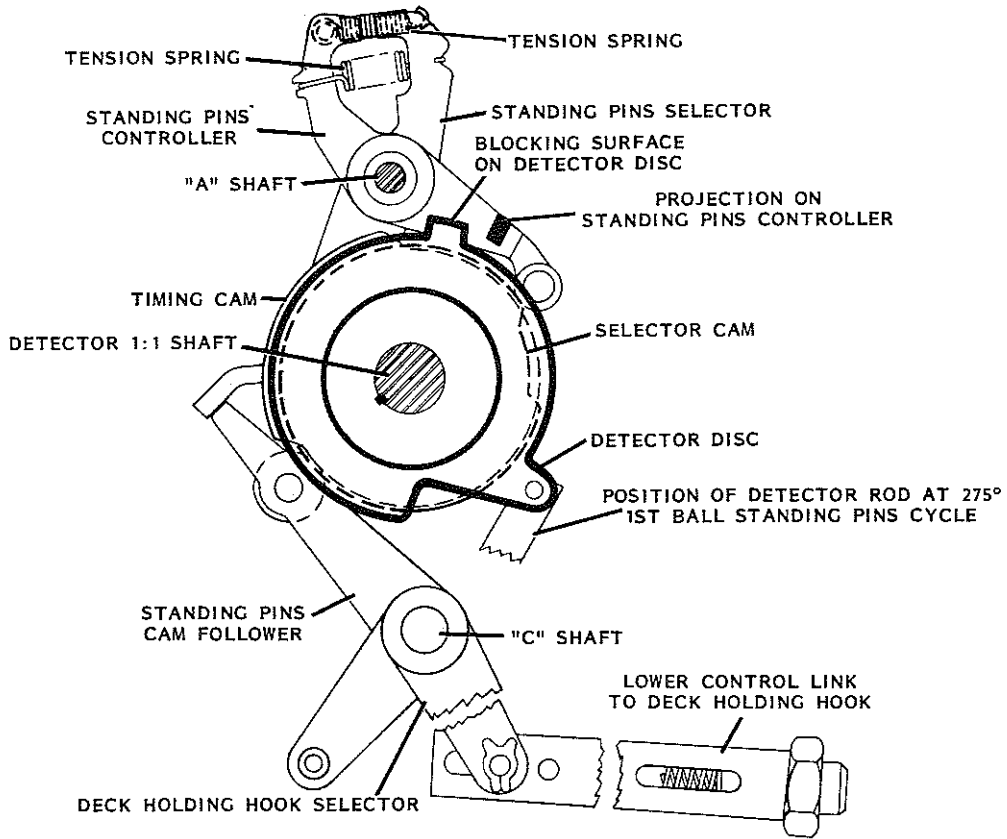
STANDING PINS MECHANISM AT 270°, RESPOTTING STANDING PINS

FIGURE 13

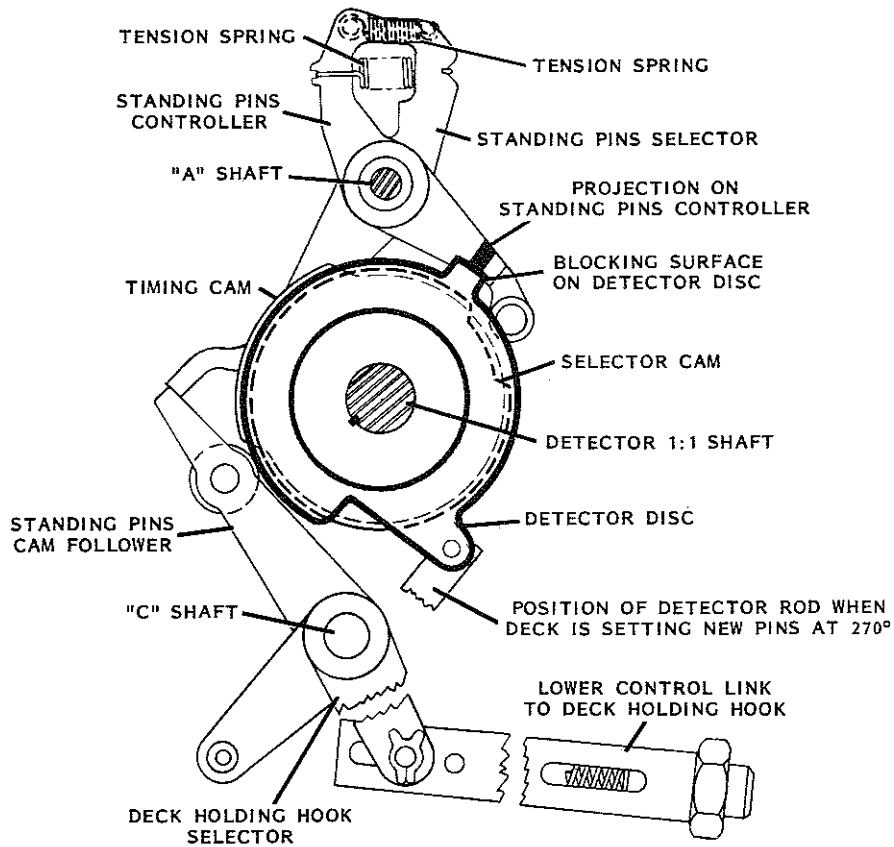


STANDING PINS MECHANISM AT 270°, FIRST BALL OUT-OF-RANGE

FIGURE 14



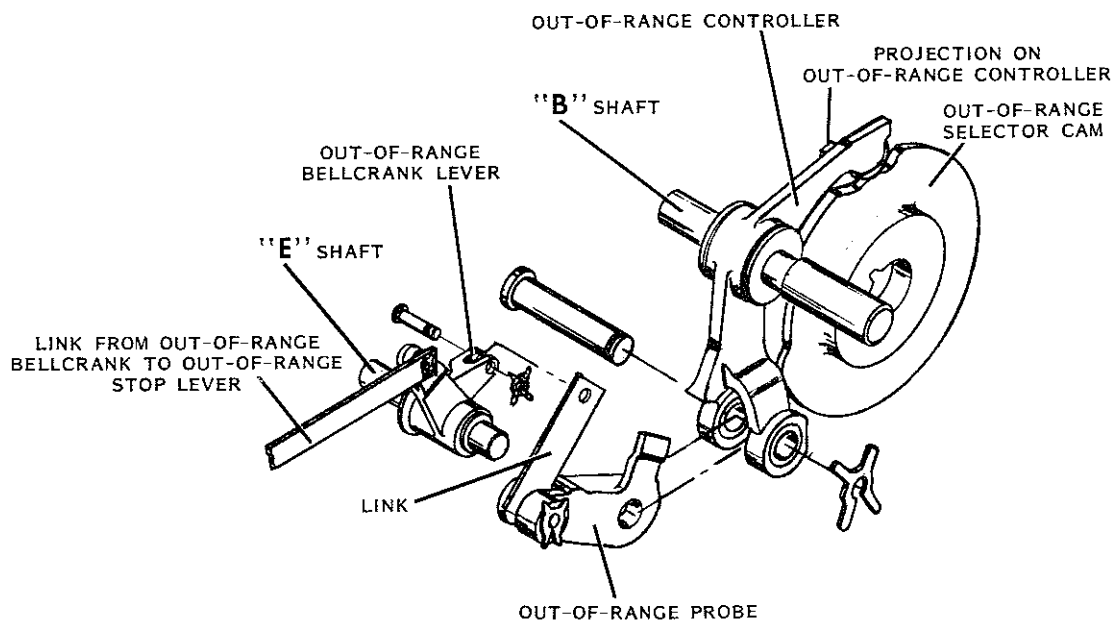
STANDING PINS MECHANISM AT 275°, FIRST BALL STANDING PINS
FIGURE 15



STANDING PINS MECHANISM AT 270°, SETTING NEW PINS
FIGURE 16

CHAPTER 26 - OUT-OF-RANGE MECHANISM

Mounted on the detector 1:1 shaft, next to the detector disc, is the out-of-range selector cam. The out-of-range controller is pivoted on the "B" shaft and is spring-urged to follow the contour of the out-of-range selector cam. (Figure 17) Pivoted on a pin at the bottom of the out-of-range controller is the out-of-range probe. The toe of the out-of-range probe extends between the out-of-range selector cam and the rake sweep hook cam. The rake sweep hook cam is mounted on the 1:1 shaft adjacent to the out-of-range selector cam. The rake sweep hook cam has a knob on its inside surface, near its outer perimeter, that will contact the out-of-range probe once per cycle as the 1:1 shaft rotates.



OUT-OF-RANGE MECHANISM

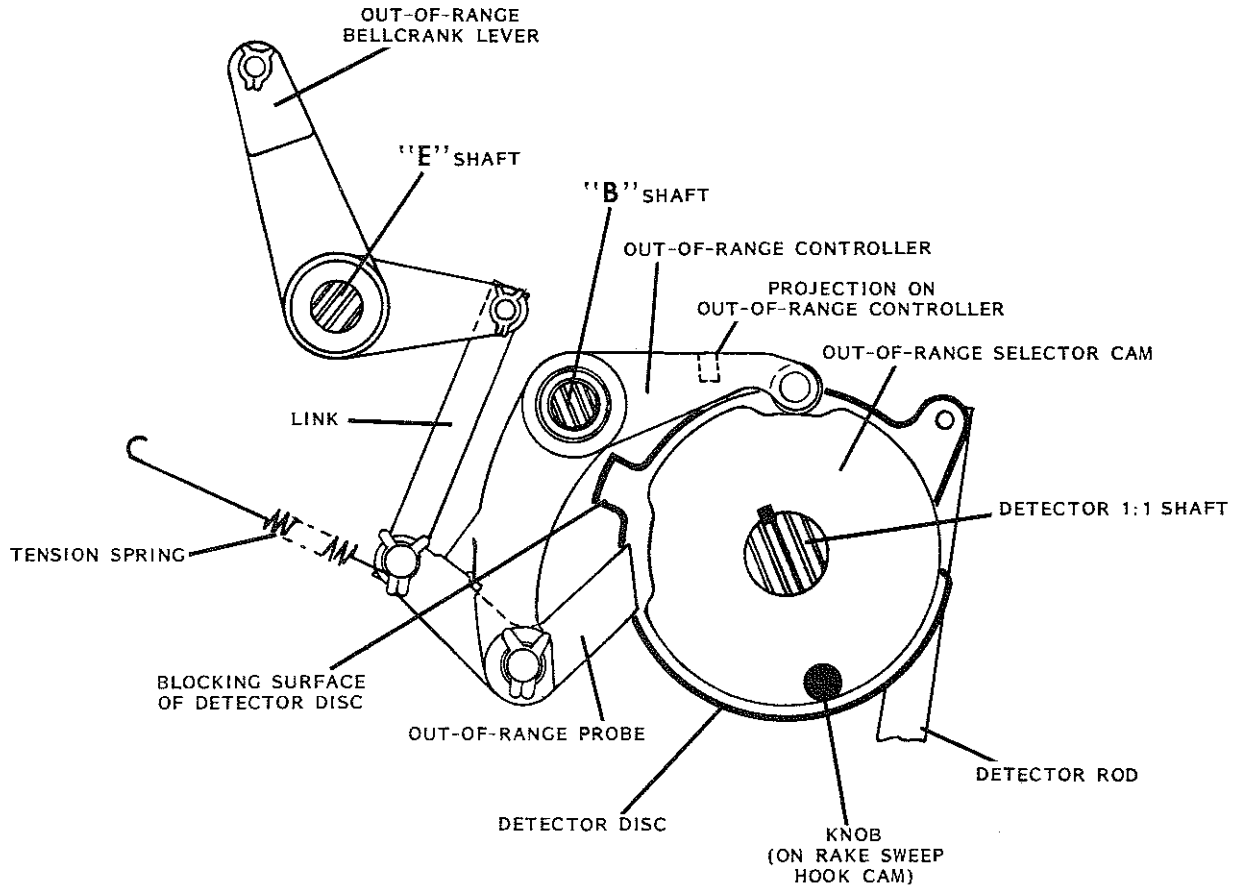
FIGURE 17

Attached to the rear portion of the out-of-range probe is a vertical link that is attached at its upper end to the out-of-range bellcrank lever that is pivoted on the detector "E" shaft. Another link from the out-of-range bellcrank lever is connected to the out-of-range stop lever on the gear box, as described in Chapters 6 and 18.

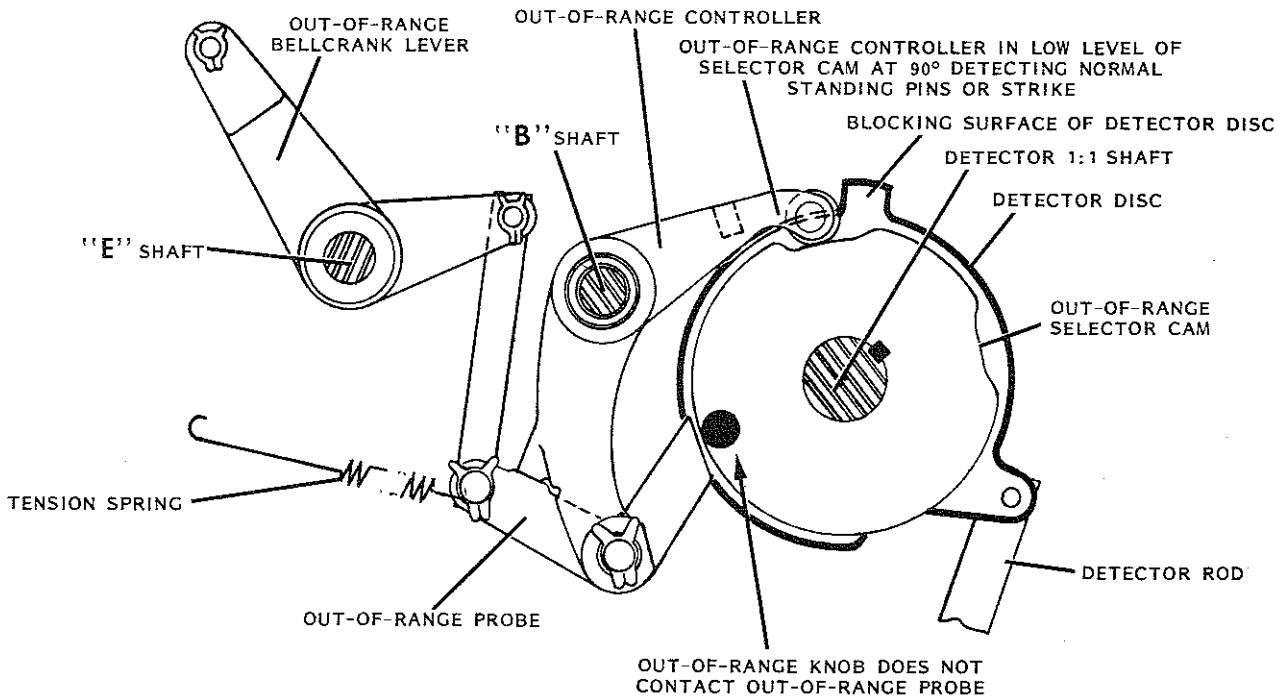
The out-of-range selector cam has two low levels, one in line with the roller on the out-of-range controller at 0°, and the other in line with the roller at 90°. Located on the right hand side of the out-of-range controller is a square projection that is in the same plane with the left hand face of the detector disc (Figure 18).

As the deck assembly lowers at 90° to detect pinfall, the detector disc will be positioned relative to the position of the deck. If the deck detects a strike or no-strike, the detector disc will be positioned with a cutout in line with the projection on the out-of-range controller. The out-of-range controller will rotate to the low level of the out-of-range selector cam at 90°, thus rotating clockwise. The clockwise motion of the out-of-range controller will move the out-of-range probe rearward, out of the path of the out-of-range knob (Figure 19). The out-of-range knob will not contact the out-of-range probe and the pinsetter will continue through its normal strike or standing pin cycle as described in the preceding chapters. When the deck is held up on the deck holding hook at 90°

during a second ball cycle, the detector disc is positioned with the cutout in line with the projection on the out-of-range controller and, as just described, will permit the pinsetter to complete its automatic strike, second ball cycle. (Figure 19)

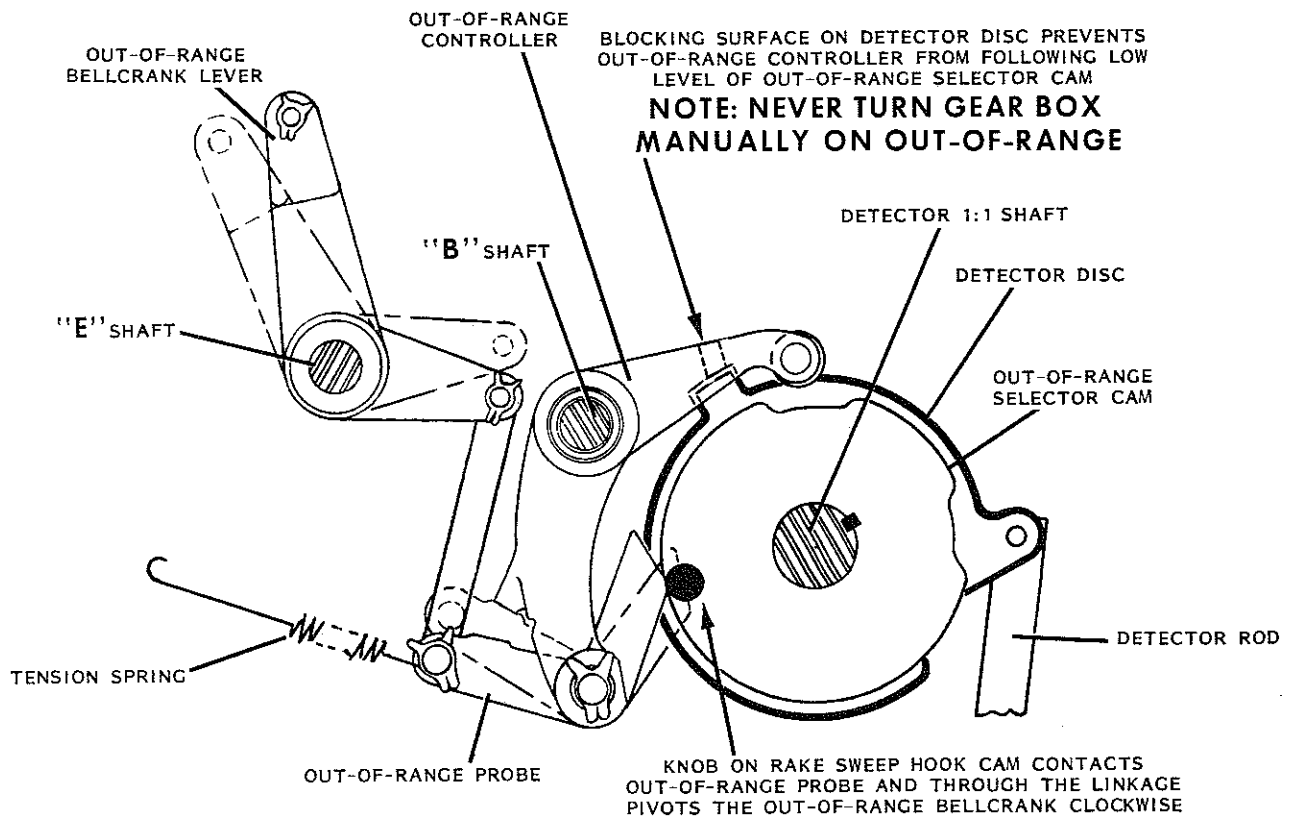


OUT-OF-RANGE MECHANISM AT 0°
FIGURE 18



OUT-OF-RANGE MECHANISM AT 90°, STRIKE OR STANDING PINS
FIGURE 19

If, however, the deck lowers at 90° to detect and encounters an out-of-range pin, the detector disc will be positioned with a blocking surface under the projection on the out-of-range controller. This will prevent the out-of-range controller from following the low level of the out-of-range selector cam at 90°. The out-of-range controller will not pivot on the "B" shaft, and the out-of-range probe will be kept in the path of the out-of-range knob. The out-of-range knob will contact the toe of the out-of-range probe, thus rotating the probe counter-clockwise which, through the vertical link, rotates the out-of-range bellcrank lever clockwise. (Figure 20) The clockwise rotation of the out-of-range bellcrank lever, through the connecting linkage, pulls the out-of-range stop lever under the gear box clutch lever to disengage the clutch at 90°.



OUT-OF-RANGE MECHANISM AT 90°, OUT-OF-RANGE PIN

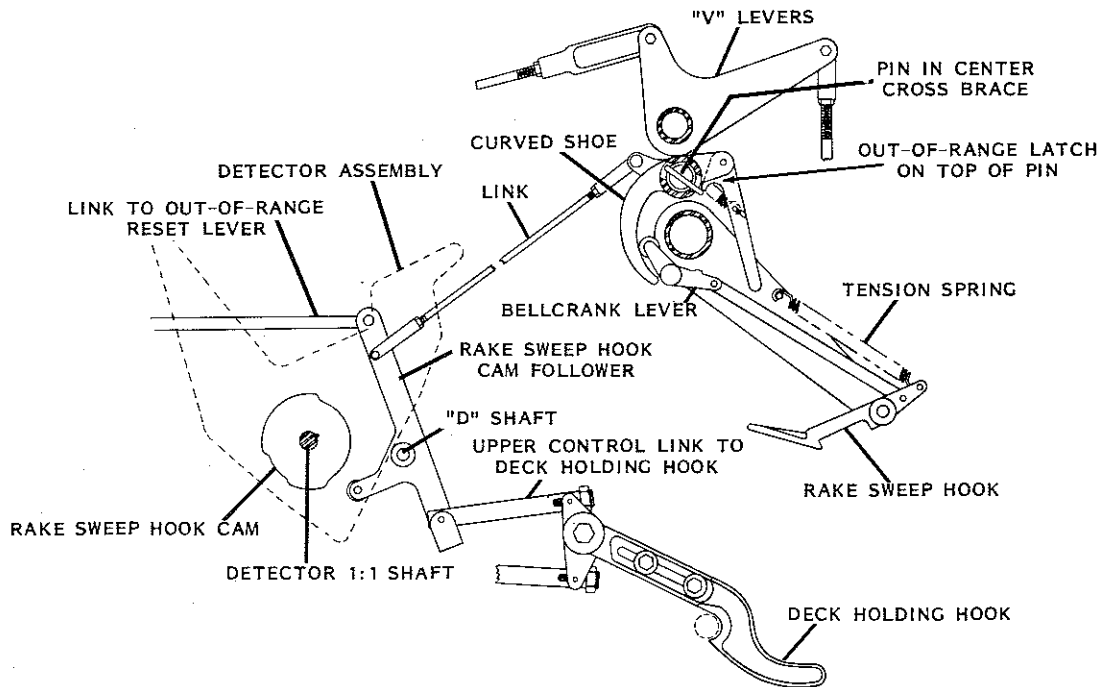
FIGURE 20

After the deadwood has been manually removed from the playing area of the lane, the out-of-range reset lever must be manually pulled rearward to re-engage the gear box clutch as previously described in Chapter 18, Out-of-Range Reset Mechanism. The rake will be prevented from sweeping and the deck will be held on the deck holding hook at 270° during an out-of-range cycle.

The sole function of the out-of-range mechanism in the detector is to disengage the gear box clutch at 90° in the event of an out-of-range pin left by the bowlers first ball.

CHAPTER 27 - RAKE SWEEP HOOK MECHANISM

The rake sweep hook cam is mounted on the detector 1:1 shaft. Freely mounted on the "D" shaft is the rake sweep hook cam follower which is spring-urged to follow the contour of the rake sweep hook cam. Attached to the lower end of the rake sweep hook cam follower, through an elongated slot, is the upper control link to the deck holding hook. (Figure 21) A link from the out-of-range reset lever is connected to the upper arm of the rake sweep hook cam follower. A third link, as described in Chapter 16, is connected from the upper arm of the rake sweep hook cam follower to the collar on the center cross brace which controls the position of the rake sweep hook.



RAKE SWEEP HOOK MECHANISM DURING OUT-OF-RANGE

FIGURE 21

As the pinsetter cycles through its normal strike and standing pins cycles, the rake sweep hook cam follower follows the contour of the rake sweep hook cam. When the cam follower is in the low level of the rake sweep hook cam, the rake sweep hook is lowered to engage the block on the rake sweep link. When the cam follower is on the high level of the rake sweep hook cam, the rake sweep hook is pivoted above the path of the rake sweep link.

During an out-of-range cycle, when the out-of-range reset lever is manually pulled rearward, the rake sweep hook cam follower is rotated further counterclockwise than normal. The out-of-range latch on the overhead collar latches. This latching action holds the rake sweep hook cam follower away from the cam during the out-of-range cycle. This abnormal counterclockwise rotation of the cam follower causes the pin to push the deck holding hook link forward, thus pivoting the deck holding hook down to engage the pin on the deck support arm. The rake is thus prevented from sweeping and the deck is held up from 180° to 360° during an out-of-range cycle.

When the rake board raises at 0°, the out-of-range latch will be released to permit the cam follower to again follow the contour of the rake sweep hook cam.

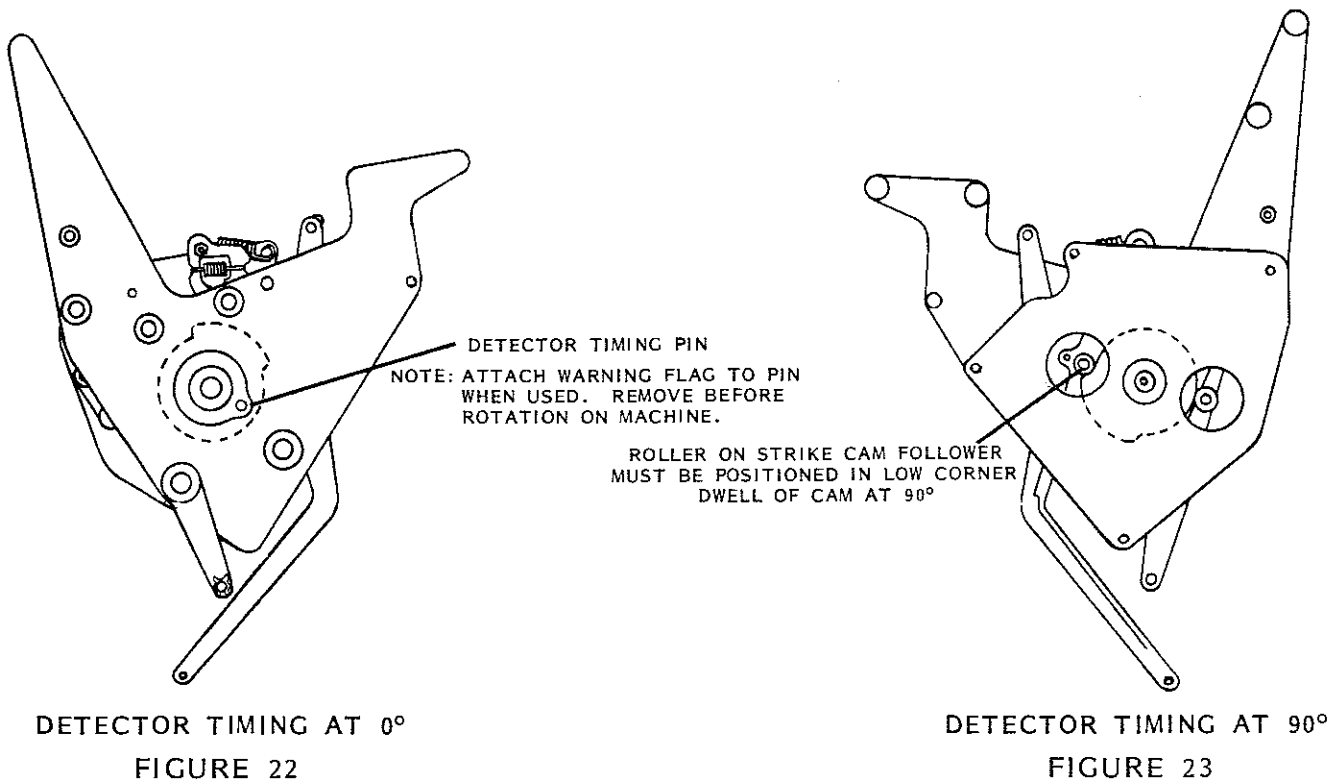
CHAPTER 28 - DETECTOR TIMING

The detector is powered through three external gears; a drive gear on the gear box 1:1 shaft, an idler gear that is mounted to a plate that supports the 1:1 shaft, and the driven gear on the detector 1:1 shaft. When the detector assembly is removed from the gear box for any reason, it is absolutely essential that the detector be reinstalled correctly to insure proper timing between the gear box and detector.

Proper timing between the gear box and detector is established by the engagement of the detector gear with the idler gear. If the gears are meshed improperly, one or more gear teeth out of time, the pinsetter will perform in an erratic manner. There are two methods of checking the timed relationship between the gear box and detector.

At 0° , a hole in the detector plate is in line with the timing hole in the detector drive gear. When the "timing pin" is inserted through both holes, the detector is locked at its 0° position. If the detector is located at 0° , and the gear box is positioned at 0° , the detector may be replaced without danger of the detector being "out-of-time" (Figure 22).

The second method is a result of the detector being easily removed from the pinsetter at 90° . When the detector is reinstalled at 90° , the roller on the strike cam follower must be positioned against the descending slope of the timing cam. The roller and timing cam are visible through an opening on the right hand side of the detector assembly (Figure 23).



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ADJUSTMENTS

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SECTION III

ADJUSTMENTS

The following pages describe the recommended procedures in making functional adjustments on the automatic pinsetter. The adjustments are listed in sequences that are directly related to each other and, as will be noted in the text, the adjustments should be performed in their proper sequence.

All measurements in the adjustments are described in inches and carry their respective dimensional tolerances. A tolerance is an allowable variation in the adjustment which will permit the mechanism to function properly. Each tolerance is enclosed by parenthesis and follows the nominal dimension for each adjustment.

Example 1: $3-1/4'' (\pm 1/8)$

NOMINAL
DIMENSION

TOLERANCE

In this example, the measurement is $3-1/4''$ with an allowable tolerance of plus $1/8''$ or minus $1/8''$. The measurement is then permissible to be between $3-1/8''$ and $3-3/8''$.

Example 2: $3-1/4'' (+1/8 - 0)$

In this example, the measurement is $3-1/4''$ with an allowable tolerance of plus $1/8''$ or minus 0. The measurement is then permissible to be between $3-1/4''$ and $3-3/8''$.

Example 3: $3-1/4'' (+0 - 1/8)$

In this example, the measurement is $3-1/4''$ with an allowable tolerance of plus 0 and minus $1/8''$. The measurement is then permissible to be between $3-1/8''$ and $3-1/4''$.

NOTE: In checking rake sweep hook adjustments, it is wise to "jog" the machine through the first cycle. Be alert for interferences.

1. DETECTOR ROD ADJUSTMENT

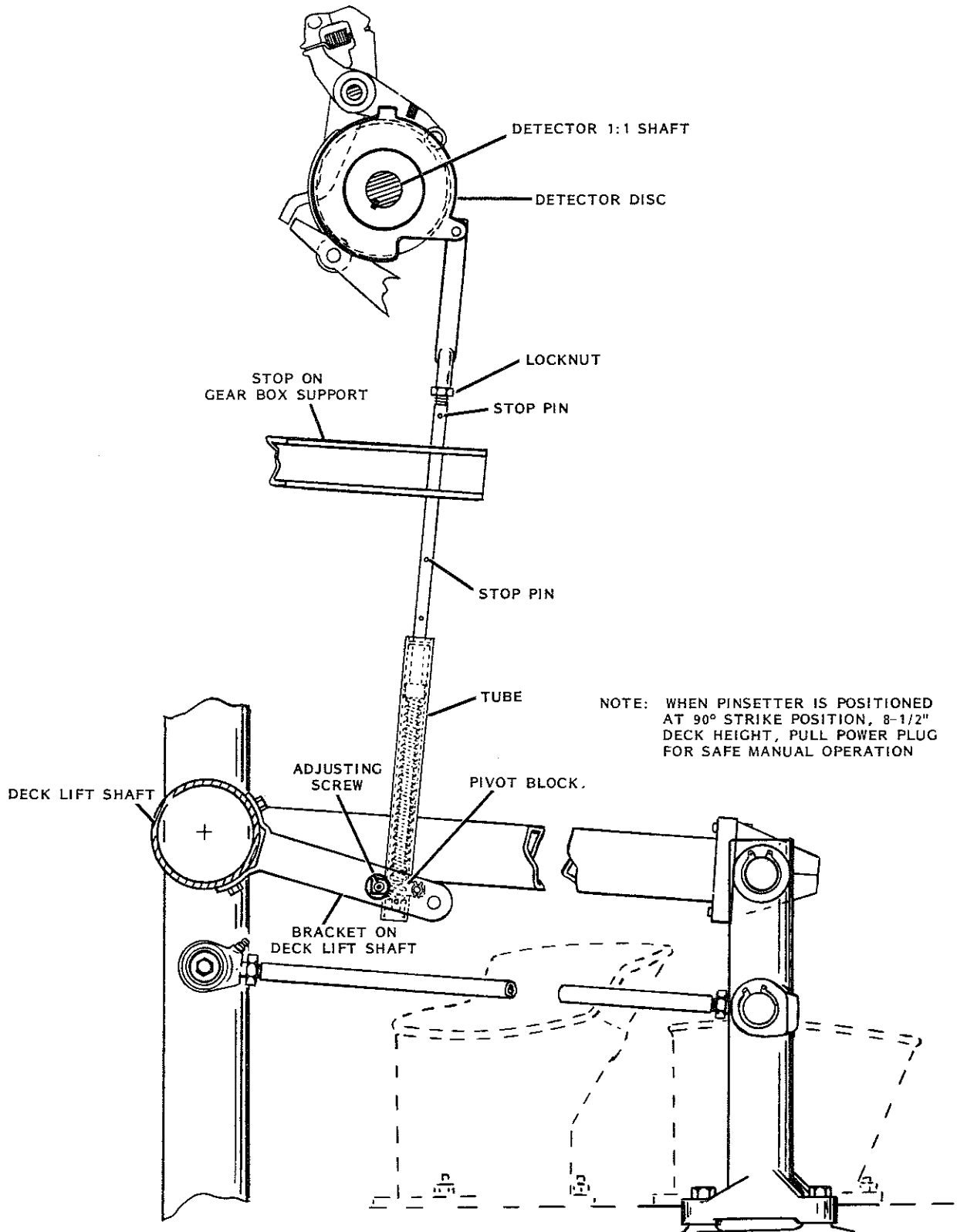
The purpose of the detector rod adjustment is to insure that the pinsetter accurately detects:

1. Strikes
2. Any number of standing pins, with maximum deck weight
3. Out-of-range pins

This is a combined adjustment, normally only Part B needs to be made, Part A is necessary when the detector rod has been removed and replaced.

NOTE: After installation of the rod, make sure the exposed stop pins on the rod are perpendicular to the slots in the stop bracket with one pin above and one pin below the stop bracket. (Figure 1)

- A.
 1. With the deck in the fully up position at 0° , measure the distance between the rear face of the projection on the out-of-range controller and its blocking surface on the detector disc. The distance must not be less than $1/16''$. It is preferable to maintain the $1/16''$ dimension as close as possible.
 2. To obtain this measurement, the detector rod will have to be threaded in or out of the part of the rod which is attached to the detector disc.
 3. If the rod cannot be threaded in far enough, it should be removed and about $1/8''$ cut off the threaded end. When this is done, make sure the jam nut is left on the rod, as it can be used to clear the threads for easy replacement.
 4. Repeat steps 1 and 2.
 5. The distance between the lower top pin on the detector rod and the point of connection at the disc is now correct. The deck down position of the disc can now be adjusted.
- B.
 1. Cycle the pinsetter to exactly 90° first ball strike.
 2. Check the position of the strike cam follower roller and see if it is nested in the low level of the timing cam. If not, manually lift the strike selector out of its blocking position, permitting the strike cam follower roller to enter the low level of the timing cam. Loosen the pivot block screw and lower the detector rod until the upper stop pin on the rod hits the stop bracket. (Figure 1)
 3. Carefully push the detector rod and tube assembly upward until the motion of the rod stops. Be careful not to compress the spring in the tube.
 4. Carefully work the tube and rod down $1/16''$ to $1/8''$, then tighten the pivot block screw. Check now if the rod can be pushed up against the spring this $1/16''$.
 5. As a check, cycle the pinsetter through all cycle and combination of standing pins.
 6. If detection is incorrect, return to 90° strike position.
 7. Mark tube assembly at top of block. Lower additional $1/16''$ (total $1/8''$). Lock adjusting screw and repeat test of detection. Maximum tolerance $3/8''$. If still failing detections, return to step B1 and repeat adjustment.



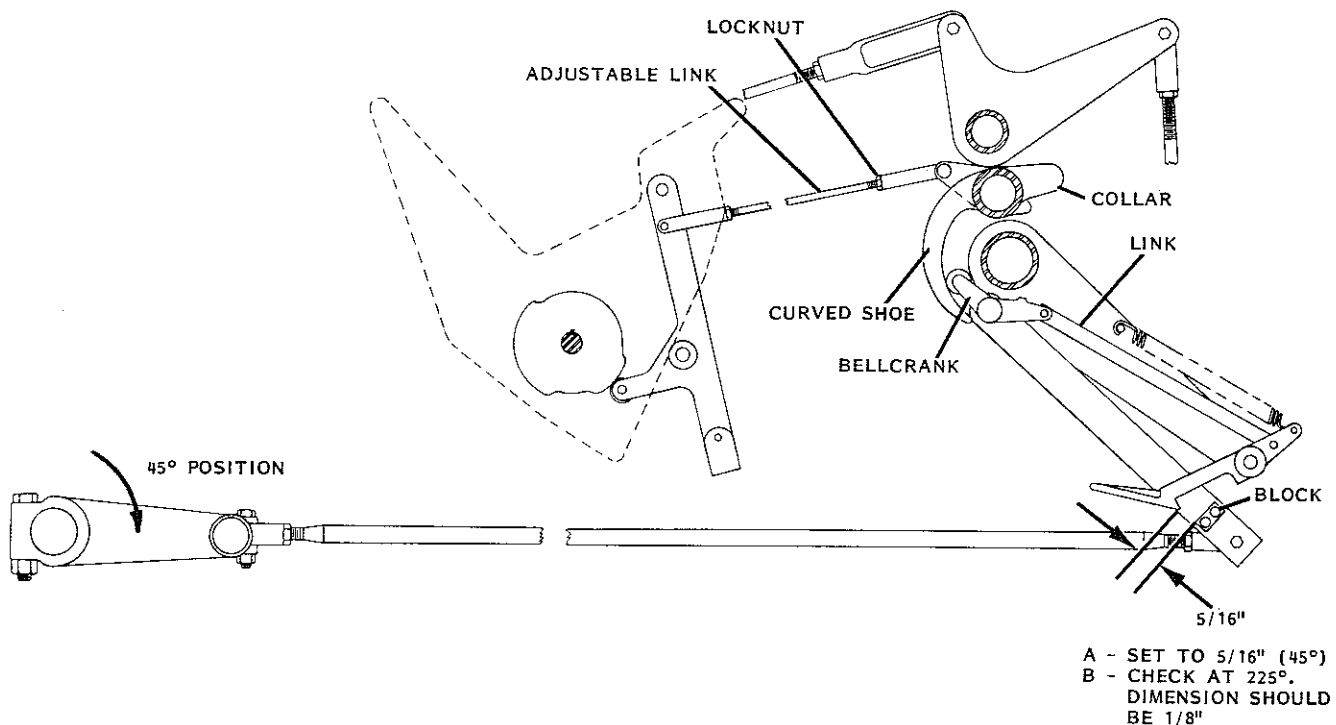
DETECTOR ROD ADJUSTMENT AT 90°

FIGURE 1

2. RAKE SWEEP HOOK ADJUSTMENT

The rake sweep hook adjustment is made to insure that the sweep hook makes a positive engagement with the block when the rake sweeps, and that the sweep hook is lifted clear of the block when the rake must not sweep. The rake motion is obtained from the rake sweep link on the 4:1 shaft, and a large compression spring urges the rake in its forward motion. It is extremely important, therefore, that this adjustment be made carefully to avoid injury to personnel working around the pinsetter.

1. Cycle the pinsetter until the rake crank link is a direct continuation of the main rake crank on the 4:1 shaft (this will occur at 45°).
2. Loosen the locknuts on both ends of the link which runs from the detector assembly to the collar on the overhead cross brace, and turn the rod until the lower edge of the vertical surface of the rake sweep hook is $5/16'' (+1/16'' - 0)$ above the latch block that the hook engages (Figure 2). Tighten the locknuts. As a check, jog the pinsetter and make sure the hook fully engages the block during the sweep motion, and that the hook lifts at least $1/8''$ above the block when the hook disengages at 225°.



RAKE SWEEP HOOK ADJUSTMENT AT 45°

FIGURE 2

- Cycle the pinsetter to exactly 135° until the rake sweep link is a direct continuation of the rake crank. Loosen the locknuts on both ends of the rake sweep link and turn the rake sweep link until the vertical surface of the rake sweep hook is $1/16"$ ($+1/32 -0$) behind the latch block that the sweep hook engages (Figure 3). Tighten the locknuts.

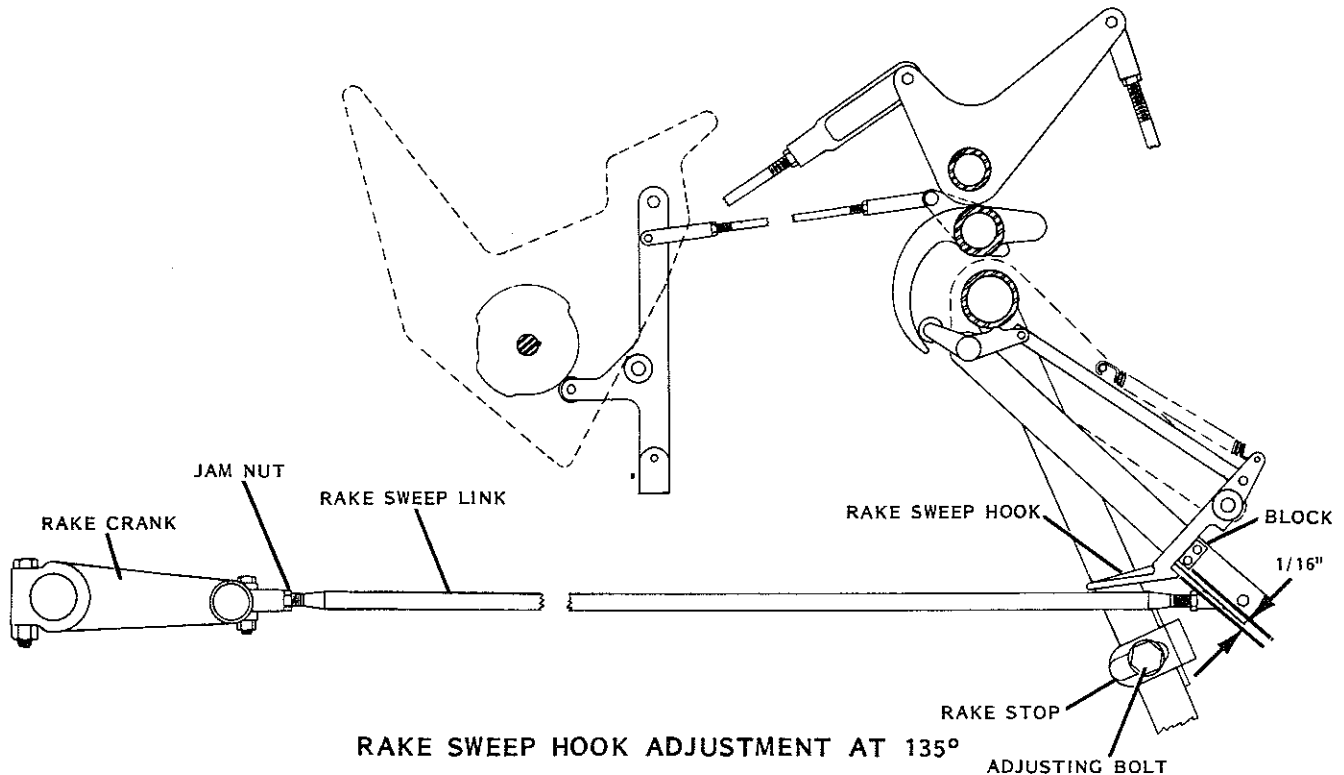
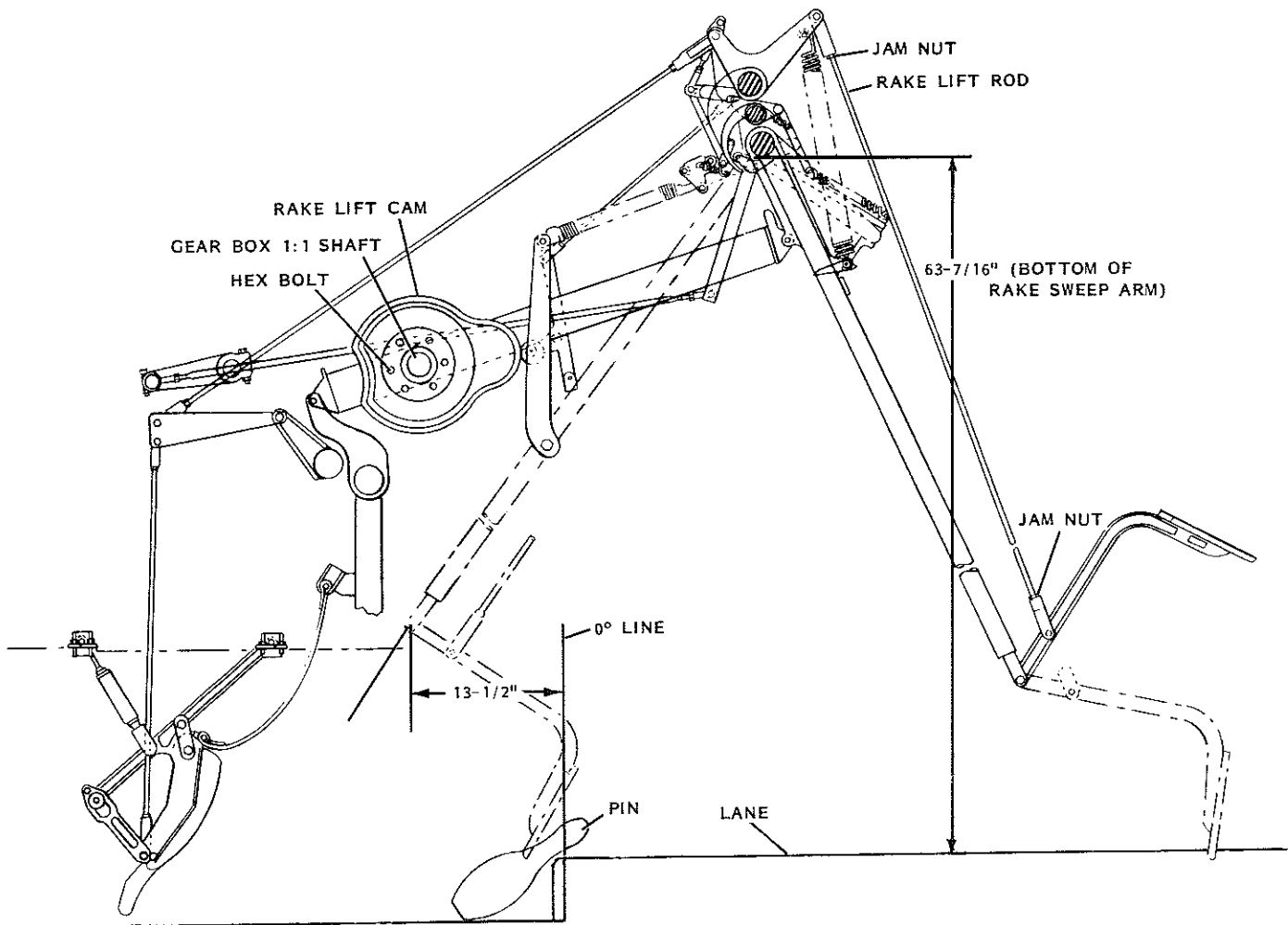


FIGURE 3

- Cycle the pinsetter to exactly 180° , with the rake in its rearmost position.
- Measure the horizontal distance from the zero line of the lane to the lower hinge pin on the bottom of the rake support arm (Figure 4). This dimension must be $13\text{-}1/2"$ ($\pm 1/8$), and may be obtained by readjusting the rake sweep link which was previously adjusted in step 2c.
- Manually cycle the pinsetter to exactly 225° , where the rake sweep link will again be a direct continuation of the rake crank arm on the 4:1 shaft.
- Loosen the hex nut that mounts the left hand rake stop bracket to the left hand side of the pinsetter frame. Adjust the left hand rake stop bracket so that the vertical surface of the rake sweep hook is again $1/16"$ ($+1/32 -0$) behind the rear surface of the block. Tighten the nut securely.
- Loosen the bolt that mounts the right hand stop bracket to the right hand side of the pinsetter frame. Push the right hand rake support arm rearward until the left hand support arm starts to lose contact with the left hand rake stop bracket. While holding the rake support arm in this position, snug the right hand rake stop bracket against the rake support arm. Tighten the nut securely.



RAKE BOARD HEIGHT ADJUSTMENT

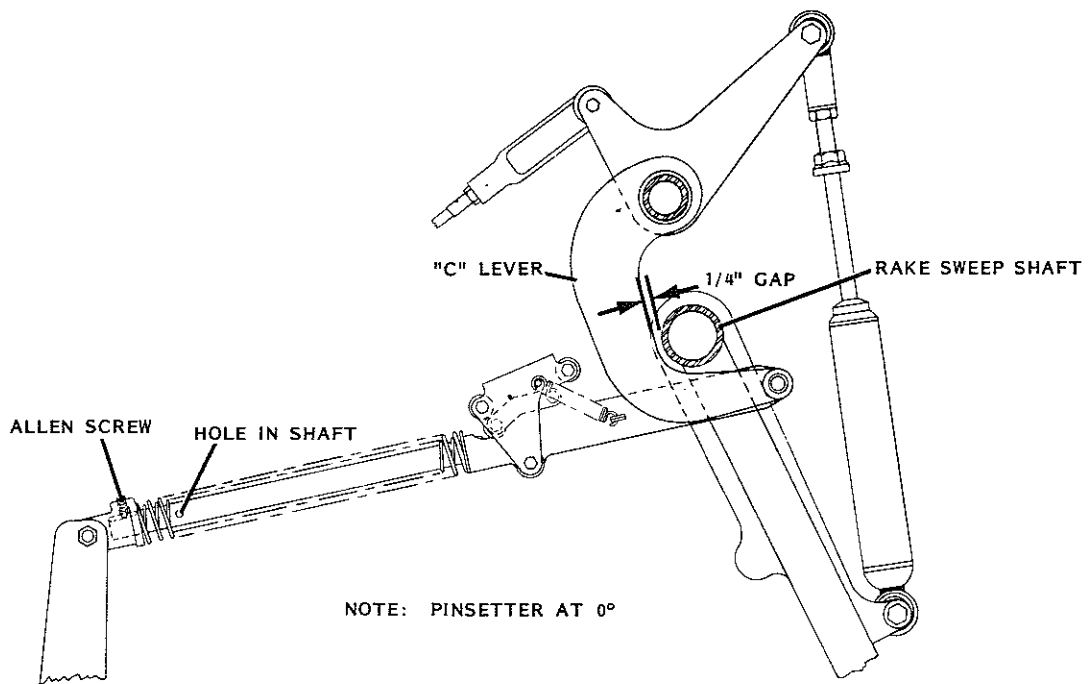
FIGURE 4

3. RAKE BOARD HEIGHT ADJUSTMENT

This adjustment is made to insure that the rake board stays at the correct height above the lane surface during the entire sweep motion.

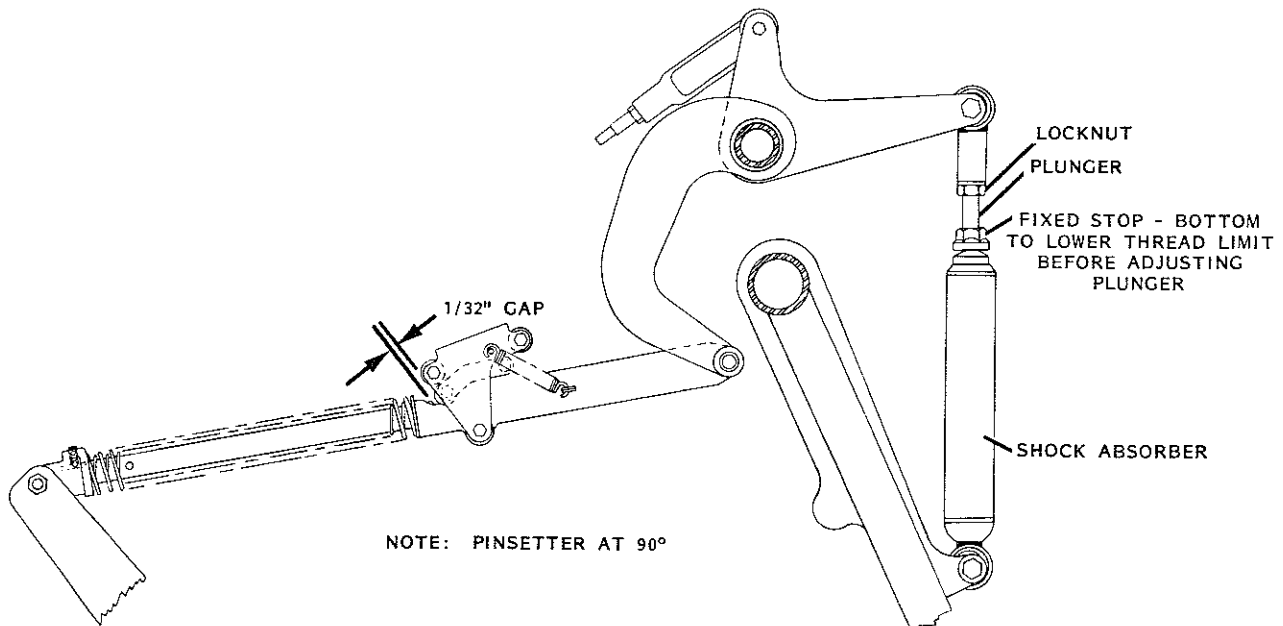
1. Cycle the pinsetter to 0°.
2. Measure the horizontal distance from the rear edge of the rake sweep shaft to the forward edge of the C-shaped lever on the rake lift shaft. This dimension must be $1/4"$ ($+1/8 - 0$) and can be obtained in the following manner: Cycle the pinsetter to 45° and shut off the power to the pinsetter. Loosen the allen screw on the rear, upper rake trip shaft connection to the rake cam follower (Figure 5). Insert a pin through the hole provided in the rake trip shaft and rotate the shaft one full revolution counterclockwise to decrease the gap $1/32"$, or one full revolution clockwise to increase the gap by $1/32"$. Tighten the set screw.

NOTE: The rake trip shaft has an axial "V" groove on its rear end that must face upward to receive the allen screw. The shaft adjustments must therefore be made in increments of a full rotation. One full revolution of the rake trip shaft will increase or decrease the gap by $1/32"$.



RAKE BOARD HEIGHT ADJUSTMENT
FIGURE 5

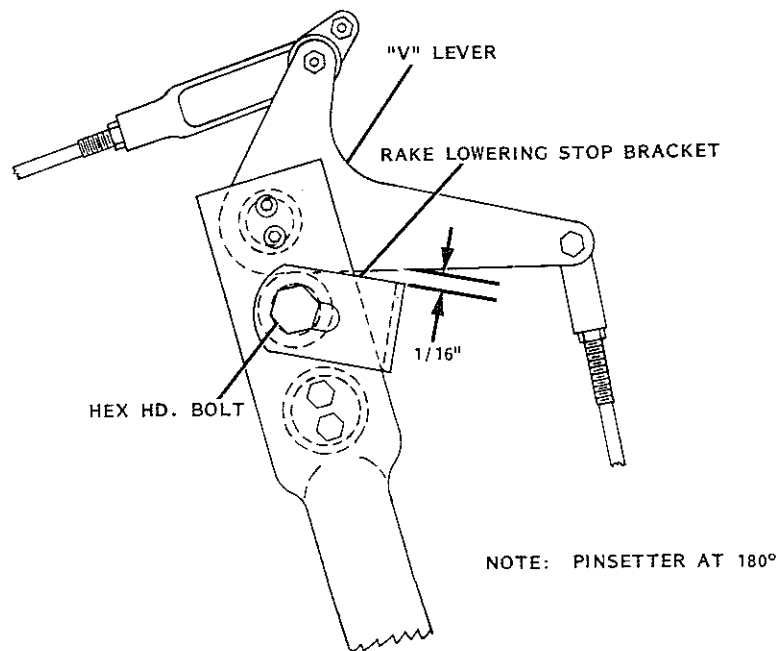
3. Cycle the pinsetter to 90° and shut off the power. Tighten the fixed stop nut against the bottom thread limits of the plunger. Loosen the locknut at the top of the shock absorber plunger. Turn the plunger to obtain a 1/32" (+1/32 -0) gap between the rear surface of the latch roller and the rear edge of the notch in the rake trip shaft (Figure 6).



RAKE BOARD DASHPOT ADJUSTMENT
FIGURE 6

4. If the plunger is adjusted too low, the gap will decrease, and if the plunger is adjusted too high, the gap will increase. Tighten the locknut.

5. Cycle the pinsetter to exactly 180° , with the rake in its rearmost position. Shut off the power. Manually engage the gear box clutch and rotate the input worm shaft two full revolutions in the reverse direction (clockwise when viewed from the rear of the pinsetter). Loosen the six bolts around the hub of the rake lift cam and allow the pressure of the rake cam follower to rotate the cam as the follower seeks the low level of the cam. This action will place the rake lift cam "in time" with the gear box. Tighten the six mounting bolts.
6. With the rake still at 180° , loosen the bolt that mounts the rake lowering stop bracket to the top, left hand side of the pinsetter frame (Figure 7). Rotate the stop bracket until its upper surface is $1/16"$ below the bottom of the "V" lever. Tighten the bolt. This adjustment is made to insure that the rake board will not jam against the header plank in event the rake trip latch should fail to re-engage.



RAKE LOWERING STOP ADJUSTMENT

FIGURE 7

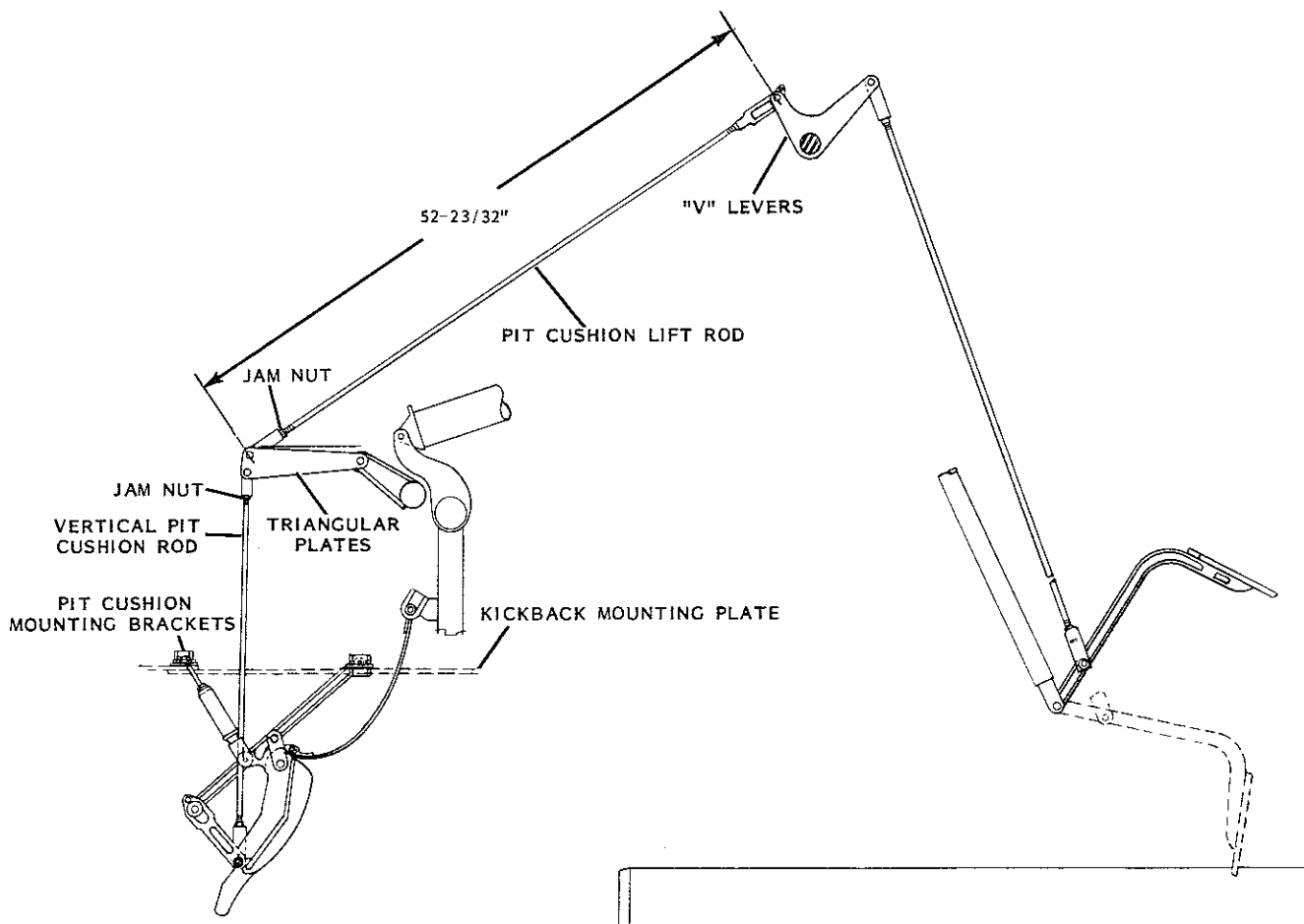
7. Manually reverse the pinsetter until the rake board is positioned between the 2, 3 and 4, 5 and 6 spots. Loosen the jam nuts on both ends of the rake lift rods and adjust the rods until the bottom of the rake board is $5/8"$ ($\pm 1/8$) above the lane surface and parallel to the lane surface within $1/32"$ from one end of the rake board to the other. Tighten the jam nuts.
8. After making this adjustment, check the Out-of-Range Latch Adjustment, Adjustment 21, page 3-25.

NOTE: The following series of adjustments, numbers 4-12, while seemingly unrelated, all affect triggering efficiency. To obtain maximum triggering efficiency, all of these adjustments must be correct.

4. PIT CUSHION LIFT ROD ADJUSTMENT

This adjustment is made to insure that the pit cushion is positioned properly to trigger the pinsetter and provide adequate clearance for the ball to return to the bowler.

1. Cycle the pinsetter to 0° and shut off the power.
2. Loosen the jam nuts on both ends of the pit cushion lift rods from the triangular plates to the "V" levers on the rake lift shaft.
3. Turn the rods until the center of the pin on the triangular plates is 52-23/32" ($\pm 1/16$) from the pivot pin on the "V" lever (Figure 8). Tighten the jam nuts. Be certain the vertical links from the triangular plates are not supporting the pit cushion when making this adjustment.



PIT CUSHION LIFT ROD ADJUSTMENT

FIGURE 8

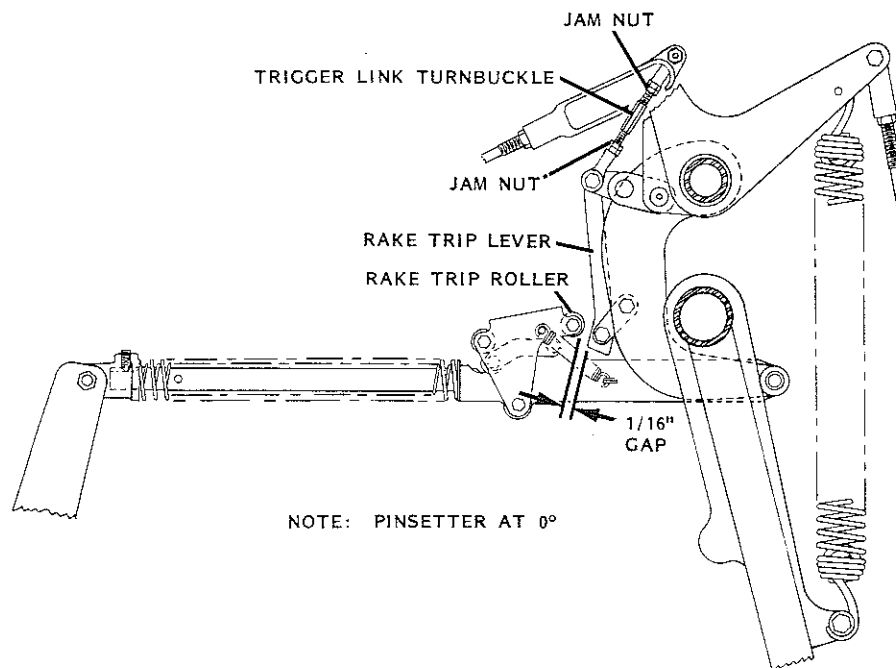
4. Check the motion of the pit cushion to insure that there is no restriction or binding in the pit cushion linkages.
5. With the pinsetter still shut off, and the rake board in its raised position, loosen the jam nuts at both ends of the vertical pit cushion rods and turn the rods in until the pit cushion lifts. Screw the rods out until a downward motion of the pit cushion stops, then continue 1/2 turn to insure that the rods are not supporting the weight of the cushion. Tighten the jam nuts.
6. Manually trip the rake mechanism and place a standard size ball between the pit cushion and pit conveyor. A minimum clearance of 1/8" must be obtained between the bottom of the cushion and the top of the ball. If this clearance is less than 1/8" check the position of the pit conveyor, Adjustment 23, page 3-28. If the pit conveyor is positioned properly, shims may be added between the kickback mounting plates and pit cushion mounting brackets to obtain the required clearance. DO NOT use the pit cushion rods to lift the pit cushion for ball clearance.

NOTE: Any change in this adjustment will affect the pit cushion trigger link adjustment, Adjustment 5, below.

5. PIT CUSHION TRIGGER LINK ADJUSTMENT

This adjustment is made to insure that ball impact against the pit cushion will effectively trip the rake lowering mechanism to lower the rake.

1. Cycle the pinsetter to 0° and shut off the power to the pinsetter.
2. Loosen the jam nut on the trigger link turnbuckle. Rotate the turnbuckle until a 1/16" (+1/64 -0) gap is obtained between the front surface of the rake trip roller and the rear surface of the rake trip lever. Tighten the jam nuts. (Figure 9)

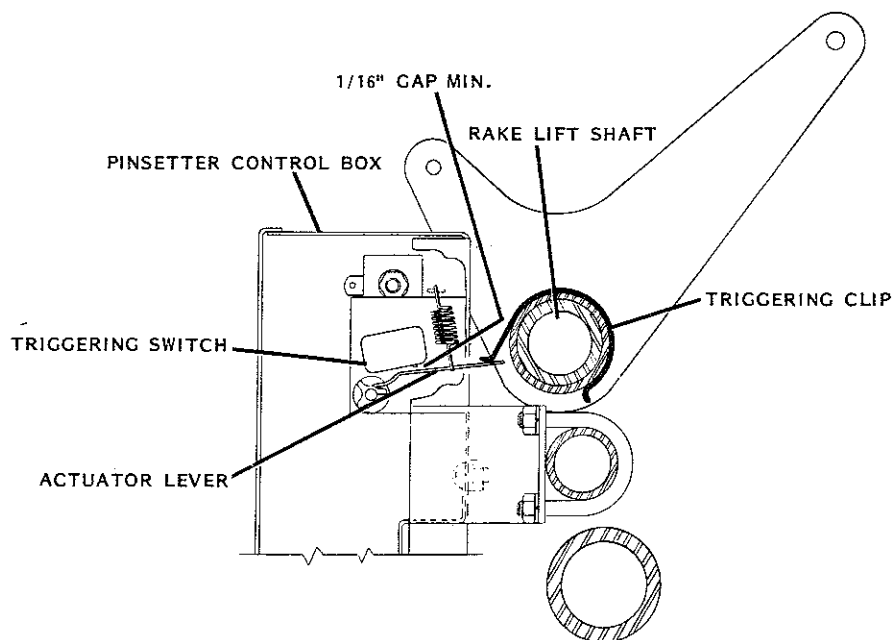


PIT CUSHION TRIGGER LINK ADJUSTMENT
FIGURE 9

6. TRIGGER SWITCH ADJUSTMENT

This adjustment is made to insure that the triggering circuit is energized by the lowering motion of the rake.

1. Cycle the pinsetter to 0° with the rake in its raised position. Shut off the power to the pinsetter.
2. Rotate the triggering clip on the rake lift shaft clockwise until the spring-loaded actuator lever closes the switch. (Figure 10)
3. Rotate the clip counterclockwise until it depresses the actuator lever far enough to open the switch (an audible click can be heard when the switch opens). Carefully rotate the clip to depress the lever an additional $1/16''$ ($+1/16 - 0$).



TRIGGER SWITCH ADJUSTMENT

FIGURE 10

7. GEAR BOX CLUTCH ADJUSTMENT

This adjustment is made to insure that the clutch is not too loose, causing noisy operation, or too tight, causing overheating of the friction surfaces.

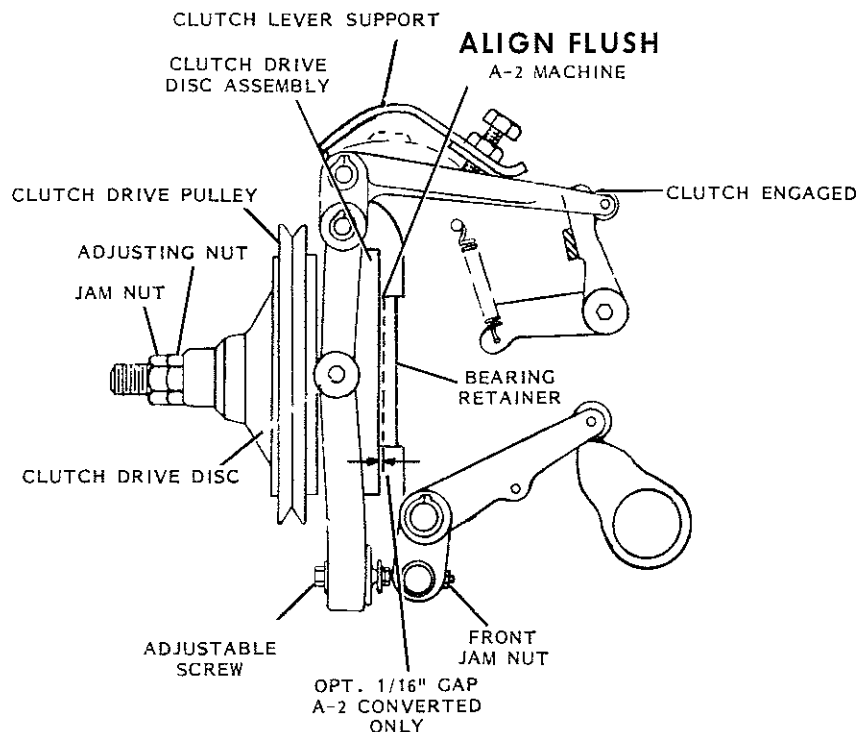
PINSETTERS WITHOUT GEAR BOX STOP SURFACE (FACTORY EQUIPPED)

1. Cycle the pinsetter to 0° and shut off the power.
2. With the gear box clutch engaged, loosen the jam nut on the end of the input worm shaft. (Figure 11)
3. Turn the front adjusting nut until the front surface of the clutch drive disc assembly is even with the rear surface of the bearing retainer. Holding the front nut, tighten the rear jam nut.

PINSETTERS WITH GEAR BOX STOP SURFACE (CONVERTED)

1. Cycle the pinsetter to 0° and shut off the power.
2. Engage the gear box clutch and loosen the jam nut on the end of the input worm shaft. (Figure 11)
3. Turn the inner nut until a gap of 1/16" ($\pm 1/64$) is obtained between the front surface of the clutch drive disc assembly and the bearing retainer disc. Tighten rear jam nut.

NOTE: Whenever the gear box clutch is readjusted, Adjustments 8 and 9, Gear Box Clutch Cam Follower and Gear Box Clutch Lever, will require readjustment.



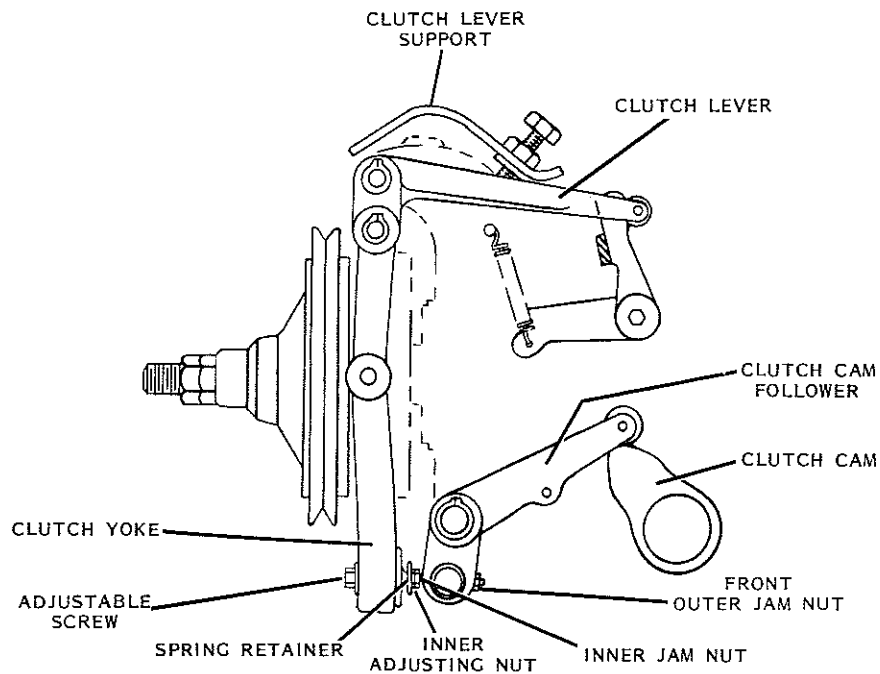
GEAR BOX CLUTCH ADJUSTMENT

FIGURE 11

8. GEAR BOX CLUTCH CAM FOLLOWER ADJUSTMENT

This adjustment is made to insure that the clutch cam follower is urged to follow the contour of the clutch cam to properly control the motion of the clutch lever.

1. Cycle the pinsetter to 0° and shut off the power.
2. Engage the gear box clutch, with the power off, and loosen the inner jam nut on the threaded connection between the clutch cam follower and the clutch yoke. (Figure 12)
3. Turn the inner adjusting nut in until the spring retainer is pressed lightly against the clutch yoke.
4. Tighten the forward jam nut against the inner adjusting nut.



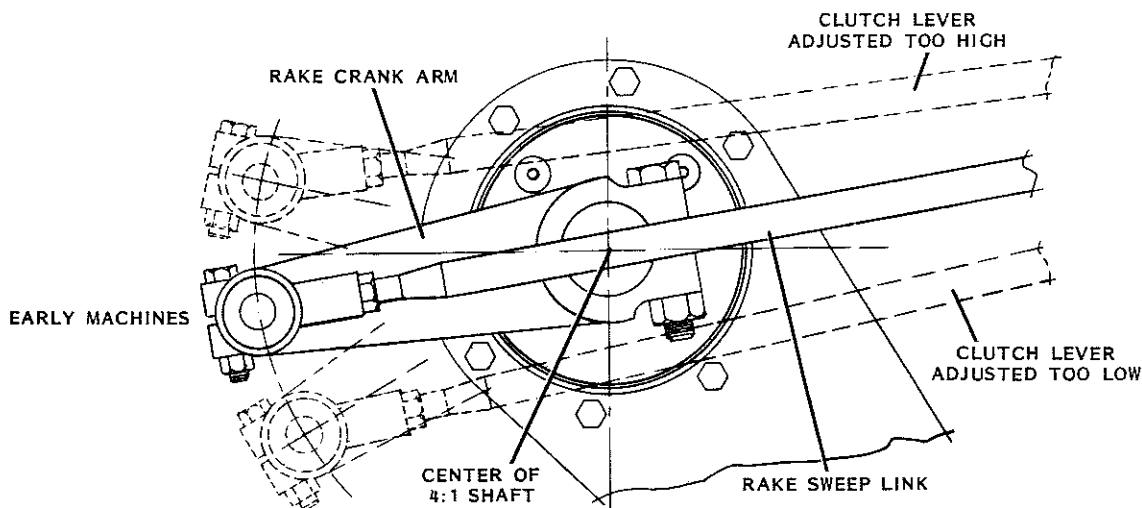
CLUTCH CAM FOLLOWER ADJUSTMENT

FIGURE 12

9. GEAR BOX CLUTCH LEVER ADJUSTMENT

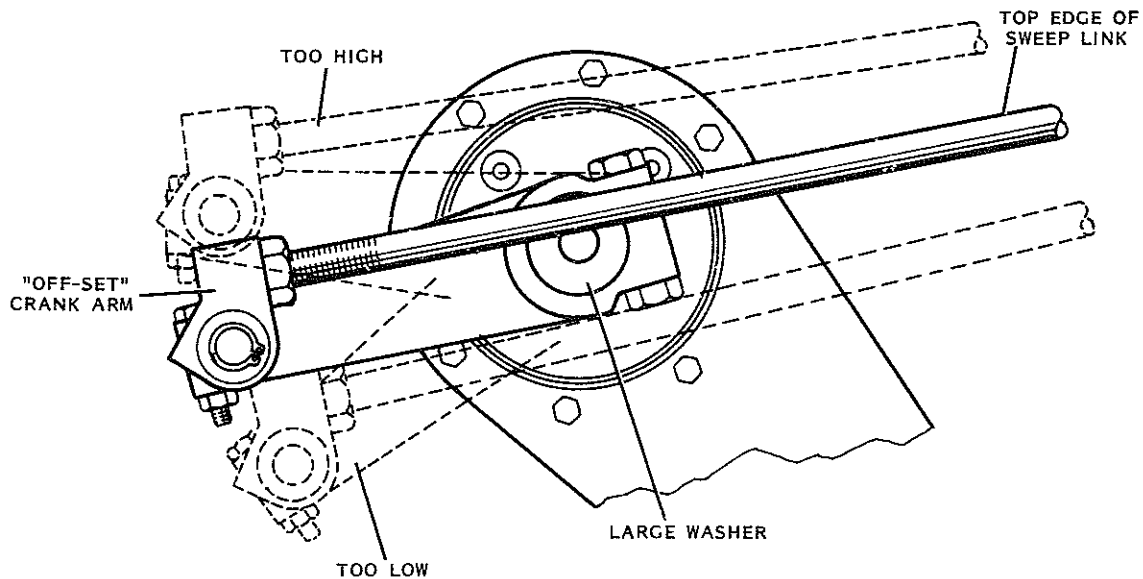
This adjustment is made to insure that the roller on the clutch lever engages the stop arm to disengage the gear box clutch at exactly 0°.

1. Cycle the pinsetter and allow it to come to a normal 0° stop, first ball cycle.
2. Check the position of the rake crank arm and the rake sweep link. The sweep link and crank arm should be in the same horizontal plane, with the sweep link bisecting the center of the 4:1 shaft on A-2 converted machines (Figure 13). On factory A-2 machines, the sweep link will be even with the top of the large washers (Figure 14).



GEAR BOX CLUTCH LEVER ADJUSTMENT (A-2 CONVERTED)

FIGURE 13



GEAR BOX CLUTCH LEVER ADJUSTMENT (A-2 MACHINES)

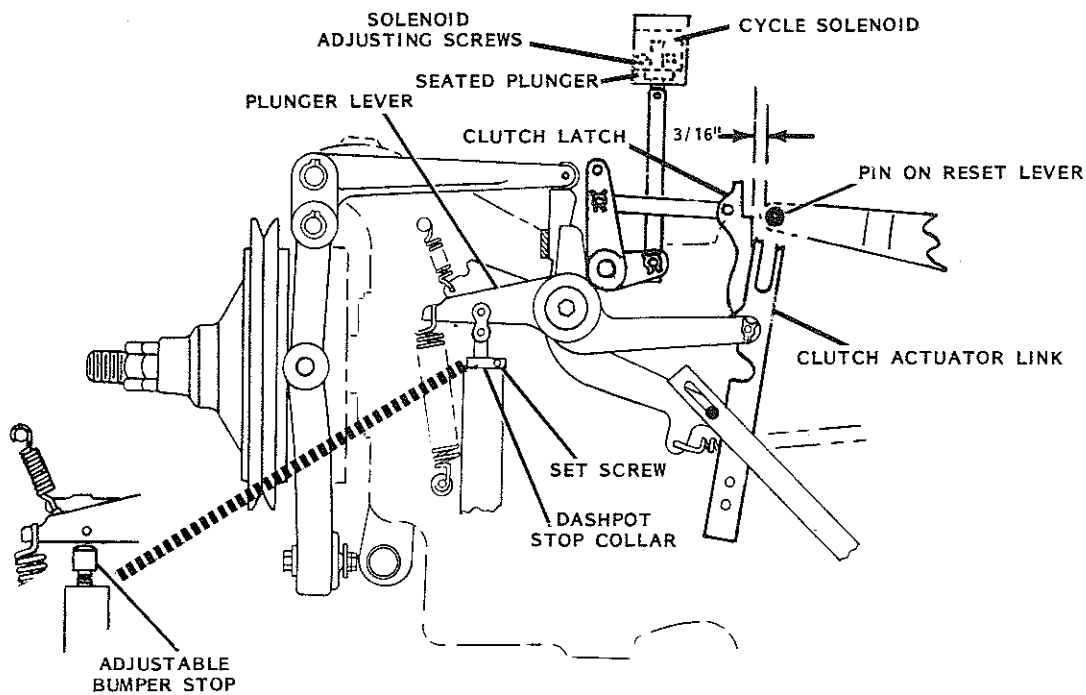
FIGURE 14

3. If the sweep link is higher than the crank arm, the clutch lever must be lowered. If the sweep link is lower than the crank arm, the clutch lever must be raised.
4. To adjust the clutch lever, loosen the most forward jam nut on the forward end of the adjustable connection at the lower end of the yoke. To raise the clutch lever, screw the adjustable connection out; to lower the clutch lever, screw the adjustable connection in. Tighten the most forward jam nut (ref. page 5-11) after checking for 0° stop.
5. Cycle the pinsetter and observe whether the crank and link stop in the same plane. Repeat adjustment if necessary.

10. GEAR BOX STOP COLLAR ADJUSTMENT

This adjustment is made to insure that the triggering and reset mechanism will function properly to disengage the gear box clutch as required.

1. Cycle the pinsetter to a normal 180° stop, waiting for pins. Shut off power to the pinsetter.
2. Loosen the set screw on the dashpot stop collar, or loosen jam nut on bumper stop. (Figure 15)
3. Position the clutch actuator link so that the shoulder of the clutch latch is opposite the center of the pin in the end of the clutch reset lever.
4. Hold the clutch actuator link in this position and slide the stop collar down against the top of the dashpot and tighten the set screw.
5. As a check, if the stop collar is set too high, the pinsetter will recycle; if set too low, the gear box clutch will disengage at 270°.



GEAR BOX STOP COLLAR AND CYCLE SOLENOID ADJUSTMENTS

FIGURE 15

11. CYCLE SOLENOID ADJUSTMENT

This adjustment is made to insure that the solenoid plunger is fully seated when the solenoid becomes energized to trigger the pinsetter.

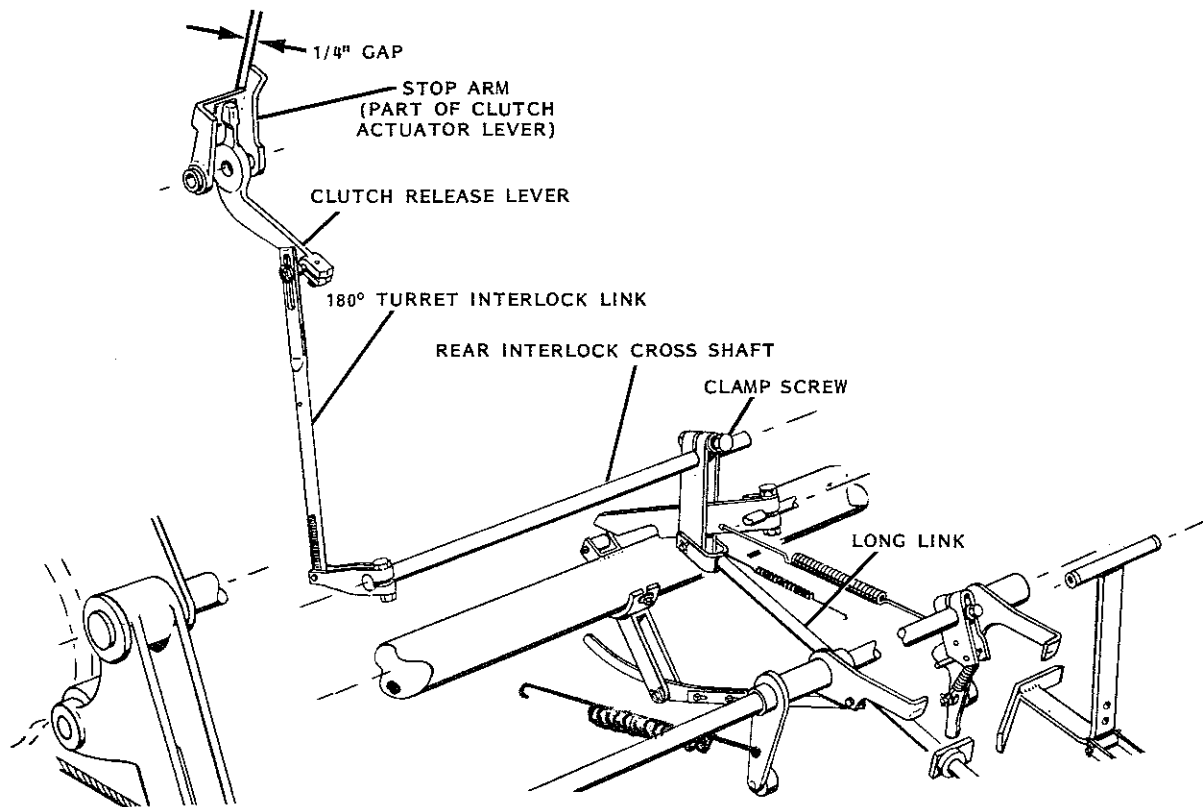
1. Cycle the pinsetter to a normal 180° stop. Shut off the power.
2. With the gear box clutch disengaged, loosen the two screws that mount the solenoid to the support bracket.
3. Rotate the clutch latch counterclockwise until a 3/16" (+1/8 - 0) gap is obtained between the front surface of the latch and the rear surface of the pin in the clutch reset lever. (Figure 15)
4. While holding the clutch latch in this position, slide the solenoid down until the solenoid is fully seated on the plunger. The mounting holes are slotted for vertical adjustment. Tighten the hex head adjusting screws. Check plunger clearance through box cover when energized after assembly.

12. GEAR BOX 180° TURRET INTERLOCK ADJUSTMENT

This adjustment is made to insure that the clutch will disengage at 180° when the deck must wait for pins to deliver to the lane, and that the clutch will then automatically re-engage when the turret delivers ten pins to the deck.

1. Allow the pinsetter to come to a normal 180° stop, waiting for pins. Be certain that the long link is in its forward position (empty deck signal).
2. Loosen the clamp screw on the lever at the right hand end of the rear interlock cross shaft. (Figure 16)

3. Rotate the rear interlock cross shaft until a gap of $1/4''$ ($\pm 1/64$) is obtained between the rear face of the projection on the clutch release lever and the contact surface of the stop arm. Tighten the clamp screw.



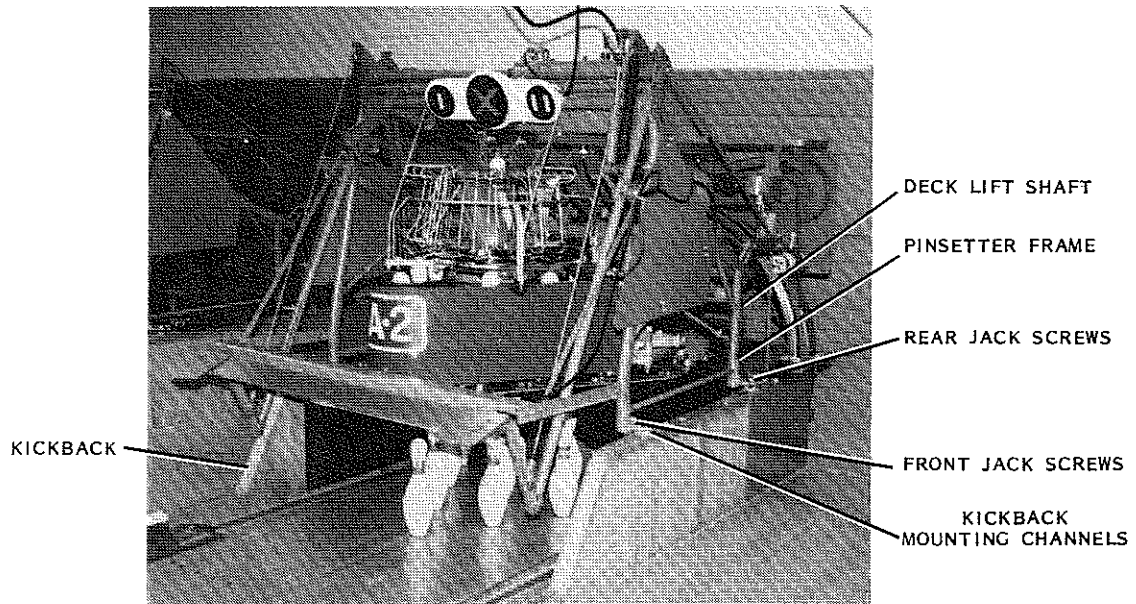
180° TURRET INTERLOCK ADJUSTMENT
FIGURE 16

4. As a check, cycle the pinsetter and observe if the clutch disengages at 180° when it must wait for pins and then re-engages automatically when the turret indexes after delivering ten pins to the deck. If the pinsetter stops at 180°, and then fails to restart automatically, the link is set too low. If the pinsetter fails to stop at 180° to wait for pins, the link is set too high.
5. As a further check, let the pinsetter run at 0° without engaging the clutch. Allow the cross conveyor to deliver ten pins to the turret and observe if the pinsetter triggers itself, when the turret indexes after delivering ten pins to the deck. If it does trigger itself, the link is set too high.

13. DECK LIFT SHAFT ADJUSTMENT

This adjustment is made to insure that the deck shaft is correctly positioned with relation to the lane surface.

1. Set the deck lift shaft at $15-13/16''$ ($+0 -1/8$) from the rear of the deck lift shaft to the center of the 7, 8, 9 and 10 spots. To move the pinsetter forward or backward, loosen the bolts at the four anchor points on the top of the kickbacks. (Figure 17)



DECK LIFT SHAFT ADJUSTMENT
FIGURE 17

2. Set the deck lift shaft at $32 \frac{5}{8}$ " ($\pm 1/16$) from the bottom of the deck lift shaft to the playing surface of the lane, at both ends of the deck lift shaft. The shaft may be raised or lowered by means of the REAR jack screws on both side frames.
3. Position the front of the pinsetter frame $63-7/16$ " ($\pm 1/8$) from the bottom of the rake sweep shaft to the lane surface. This dimension is obtained with the jack screws at the front legs of the side frame.

NOTE: When using the jack screws in making any adjustment, always use the jack screws in pairs so that the weight of the machine is never supported by a single screw.

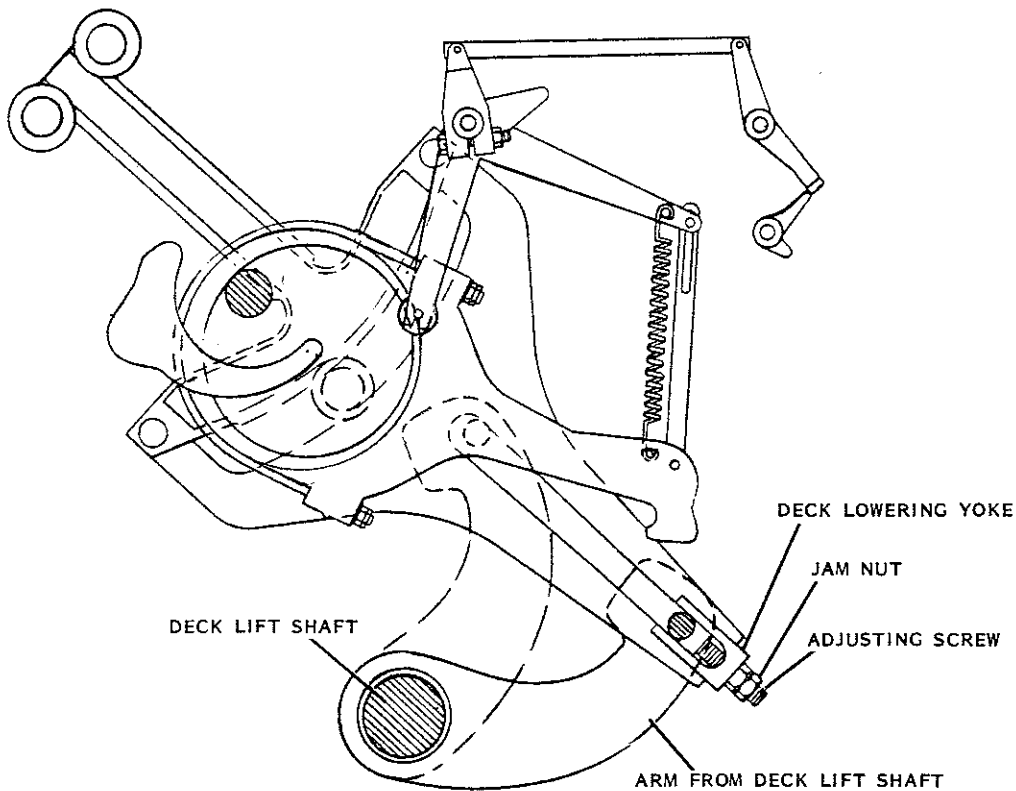
14. DECK HEIGHT AND LEVEL ADJUSTMENT

This adjustment is made to insure that the deck is level with the lane surface and the correct height above the lane surface.

1. With the pinsetter at exactly 270° , setting new pins, level the deck to the lane surface. If the apex or rear of the deck requires adjustment, loosen the jam nuts on the stabilizer rods. Length or shorten to make the deck an equal height at the front and the rear corners. Lock the jam nuts.
2. With the pinsetter still at 270° , set the height of the deck as follows:

PINSETTERS WITH DECK LOWERING YOKE (FACTORY EQUIPPED)

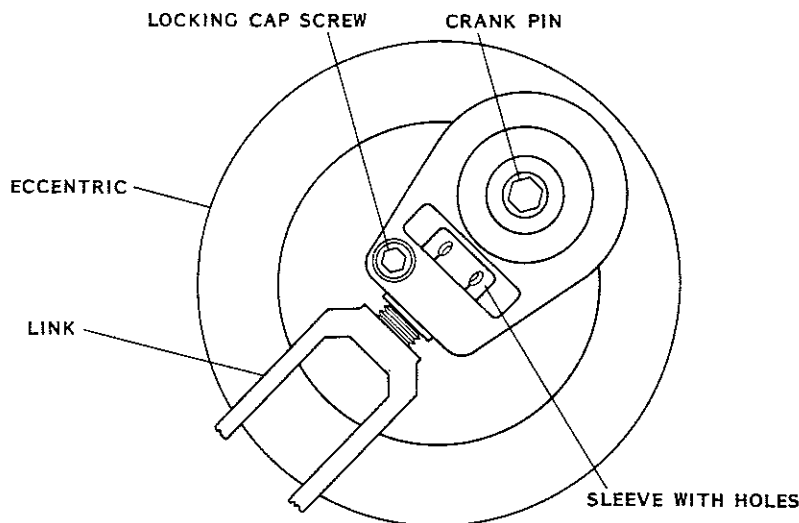
To raise or lower the deck, loosen the jam nut at the bottom of the deck lowering yoke and turn the adjusting screw until the bottom of the scissor deck is $15/16$ " ($\pm 1/32$) above the lane surface. (Figure 18)



DECK HEIGHT ADJUSTMENT (FACTORY EQUIPPED PINSETTERS ONLY)
 FIGURE 18

PINSETTERS WITH DECK LOWERING LINK (CONVERTED)

To raise or lower the deck, loosen the locking cap screw where the deck lowering link is threaded into the pin on the 2:1 shaft. Rotate the adjusting sleeve until the deck is 1" ($\pm 1/32$) above the lane surface. The sleeve may be rotated by means of a pin punch placed in the holes of the sleeve. (Figure 19). Tighten the cap screw. The sleeve is easily rotated if the deck is blocked up to take the weight off the lowering link.



DECK HEIGHT ADJUSTMENT (CONVERTED PINSETTERS ONLY)
 FIGURE 19

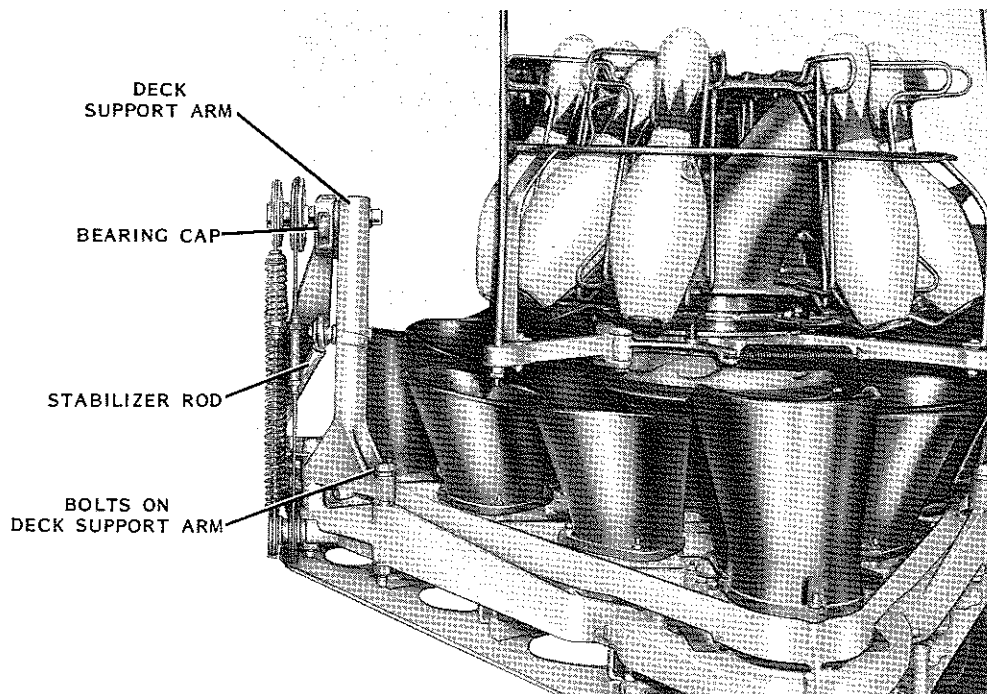
NOTE: 1. If the deck has to be lowered beyond the limits obtainable with both the jack screws and lowering adjustments, shims may be added between the top of the deck and the deck support arms.

2. Whenever the deck height is changed by means of the deck lowering adjustments, be sure to readjust the restricted drop interlock (Adjustment 43, page 3-46) and the deck holding hook (Adjustment 22, page 3-26).

15. DECK PINSPOTTING ADJUSTMENT

This adjustment is made to insure that the deck accurately sets new pins on the spots.

1. Cycle the pinsetter through several new pinsetting cycles and observe whether the pins are accurately placed on the spots.
2. If pins are spotted too far to the left or right, it must be determined whether the pinsetter must be shifted on the kickbacks to obtain proper pinspotting, or if the deck assembly must be shifted to obtain proper pinspotting. If the side frames and rake board are positioned to the right or left of the lane, the frame must be shifted. If the frames and rake board are centered with the lane, the deck assembly must be shifted.
3. To shift the frame, loosen the four mounting bolts that secure the side frames to the kickback mounting plates. Shift the pinsetter as required, then tighten the mounting bolts.
4. To shift the deck, cycle the pinsetter until the deck is all the way down (270°) with the weight of the deck supported on blocks. Loosen the bearing caps on the front of the deck support arms, and move the deck right or left as required. Tighten the bearing caps. (Figure 20)



DECK PINSPOTTING ADJUSTMENT

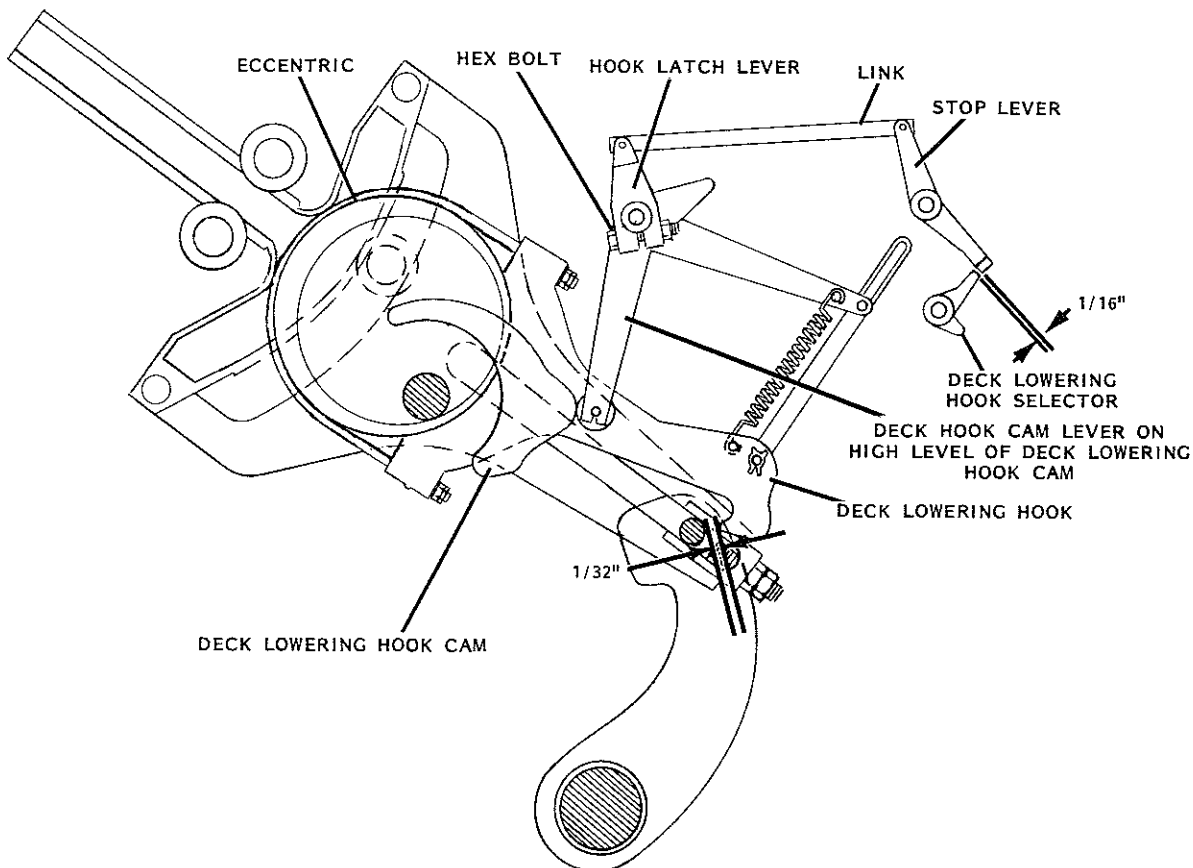
FIGURE 20

5. After making these adjustments, cycle the pinsetter and observe if there is interference between the rake board and edge of the lanes, or interference between the rake arms and the deck assembly. If interference exists, readjust as required.
6. If the pins are spotted too far forward or to the rear, loosen the two bolts on the lower end of each deck support arm and slide the deck forward or rearward. Tighten the four bolts.

16. DECK LOWERING HOOK LATCH ADJUSTMENT

This adjustment is made to insure that the deck lowering hook will engage the pin when the deck is detecting or respotting, and that the hook will be held out when the deck sets new pins.

1. Cycle the pinsetter until the roller on the deck hook cam lever is on the highest level of the deck lowering hook cam during a first ball strike or second ball cycle. Shut off the power. (Figure 21)
2. Loosen the bolt on the hook latch lever and set the gap between the rear of the deck lowering hook stop lever and the front of the deck lowering hook selector at $1/16''$ ($\pm 1/64$). (The stop lever and deck lowering hook selector are in the front end of the detector assembly.) Tighten the bolt.



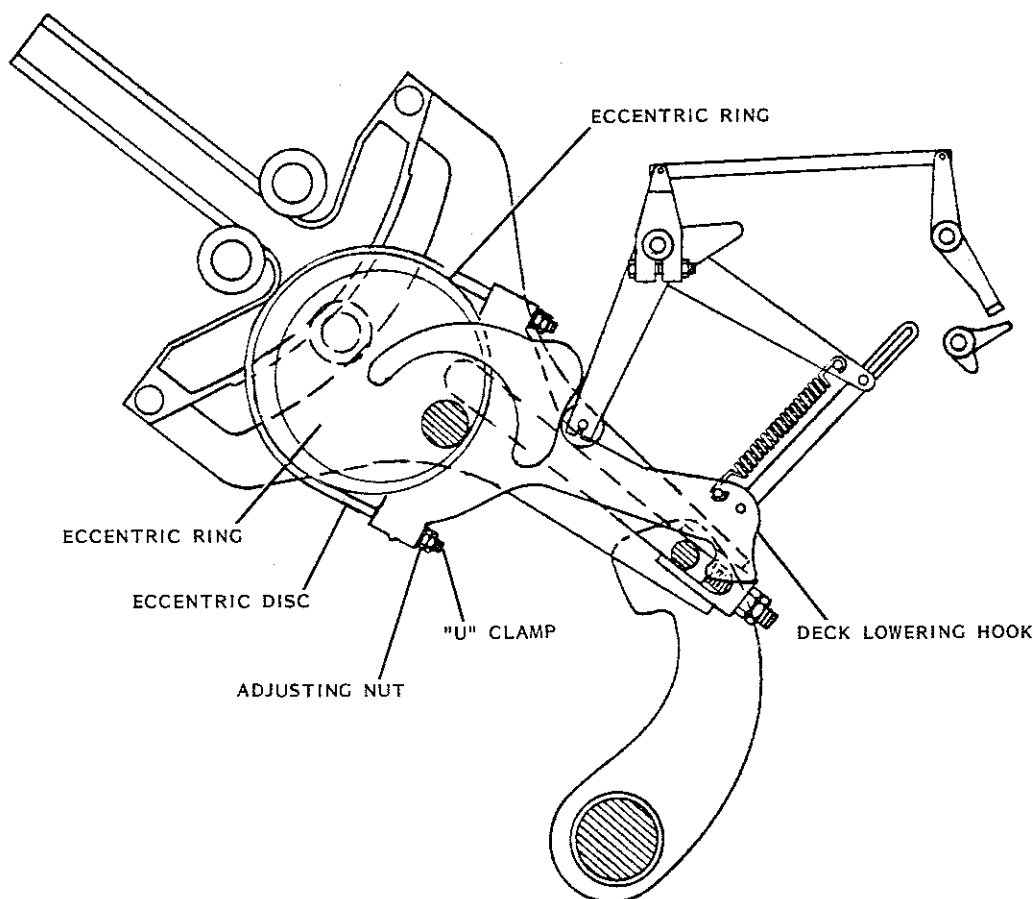
DECK LOWERING HOOK LATCH ADJUSTMENT
FIGURE 21

17. DECK ECCENTRIC ADJUSTMENT

This adjustment is made to insure that the deck lowers far enough beyond the standing pins detection level at 90°, first ball strike cycle, to permit proper functioning of the detector assembly and deck lowering mechanism.

PINSETTERS WITH DECK LOWERING YOKE (FACTORY EQUIPPED)

1. Cycle the pinsetter to 0° and shut off the power.
2. Loosen the two nuts on the deck lowering hook "U" clamp and rotate the eccentric ring until the edge of the deck lowering hook just clears the deck lowering pin by 1/32" (Figure 22). Tighten the nuts. Be careful not to overtighten the "U" clamp as the eccentric ring may become deformed.



DECK ECCENTRIC ADJUSTMENT (FACTORY EQUIPPED PINSETTERS ONLY)
FIGURE 22

PINSETTER WITH DECK LOWERING LINK (CONVERTED)

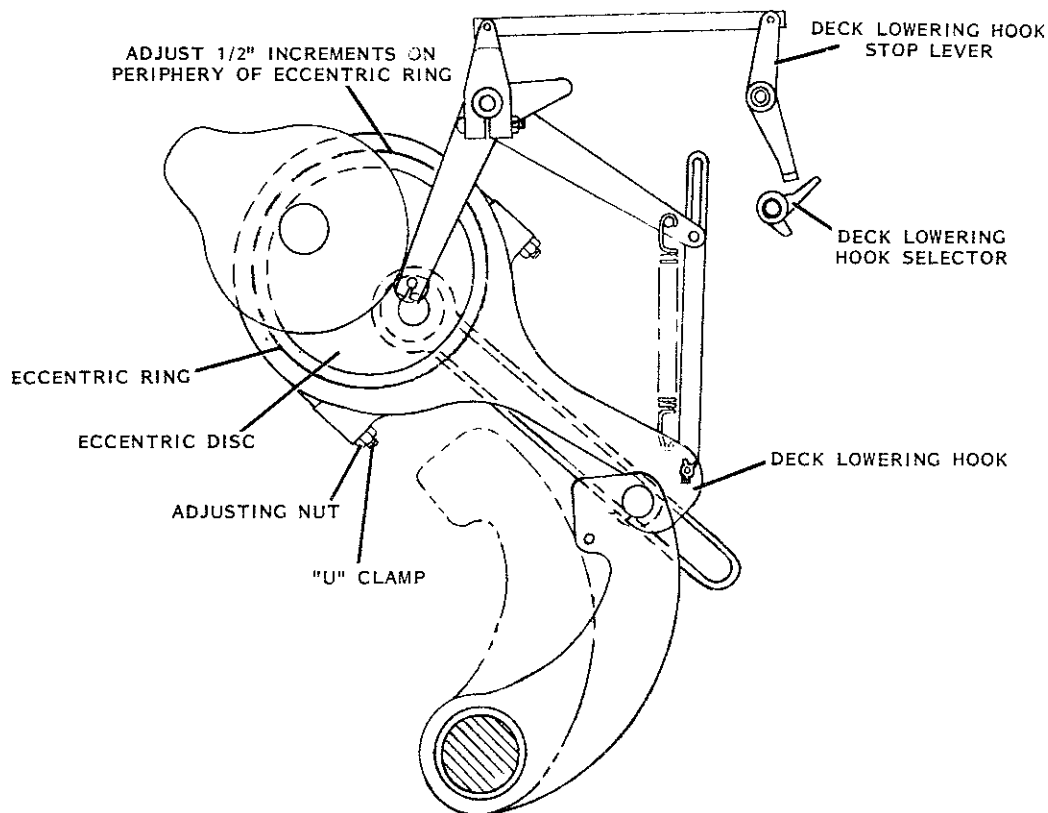
1. Allow the pinsetter to run until the deck receives ten pins.
2. Place a pin on the #5 pin spot only, and cycle the pinsetter to 90° with the weight of the full deck resting on the #5 pin.
3. Measure the vertical distance from the bottom of the scissor deck to the top of the lane surface.

4. Cycle the pinsetter to exactly 90°, first ball strike cycle (no pins on the lane).
5. Measure the vertical distance from the bottom of the scissor deck to the top of the lane surface.
6. The deck must be 1-1/4" lower when detecting a strike than when detecting a single standing pin with a full deck.
7. Loosen the two nuts on the deck lowering hook "U" clamp (Figure 23) and rotate the eccentric ring until the bottom of the scissor deck is positioned 1-1/4" lower than the dimension obtained in Adjustment 17, step 3. Tighten the nuts. Be careful not to overtighten the "U" clamp as the eccentric ring may become deformed. The eccentric ring may be rotated by placing a pin punch in the hole provided on the eccentric ring. Rotate the ring in 1/2" increments until the proper height of the deck is obtained.

NOTE: 1. Check deck lowering hook at 90° and 270°, standing pins for overtravel clearance between bottom end of hook and frame cross member.

2. In making the above adjustment, it is helpful to scribe a mark on the eccentric ring and eccentric disc so that the amount of rotation will be readily visible.

3. Whenever the deck height is changed by means of the eccentric ring, it will be necessary to readjust the detector rod. (Adjustment 1.)



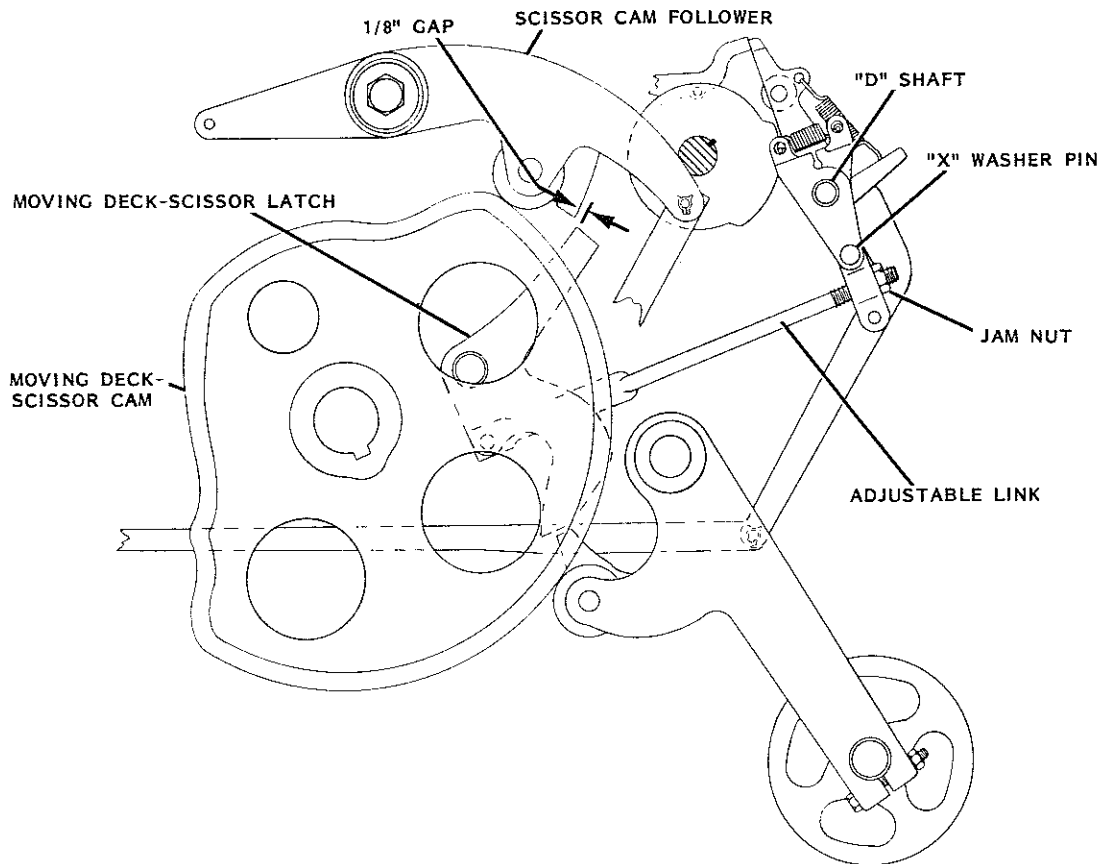
DECK ECCENTRIC ADJUSTMENT (CONVERTED PINSETTERS ONLY)

FIGURE 23

18. MOVING DECK-SCISSOR LATCH ADJUSTMENT

This adjustment is made to insure that the moving deck cam follower and scissor cam follower are blocked out as required.

1. With the pinsetter at 90° detecting no-strike, measure the gap between the rear of the latch and the front surface of the scissor cam follower arm. This gap should be 1/8" ($\pm 1/32$). (Figure 24)



MOVING DECK-SCISSOR LATCH ADJUSTMENT

FIGURE 24

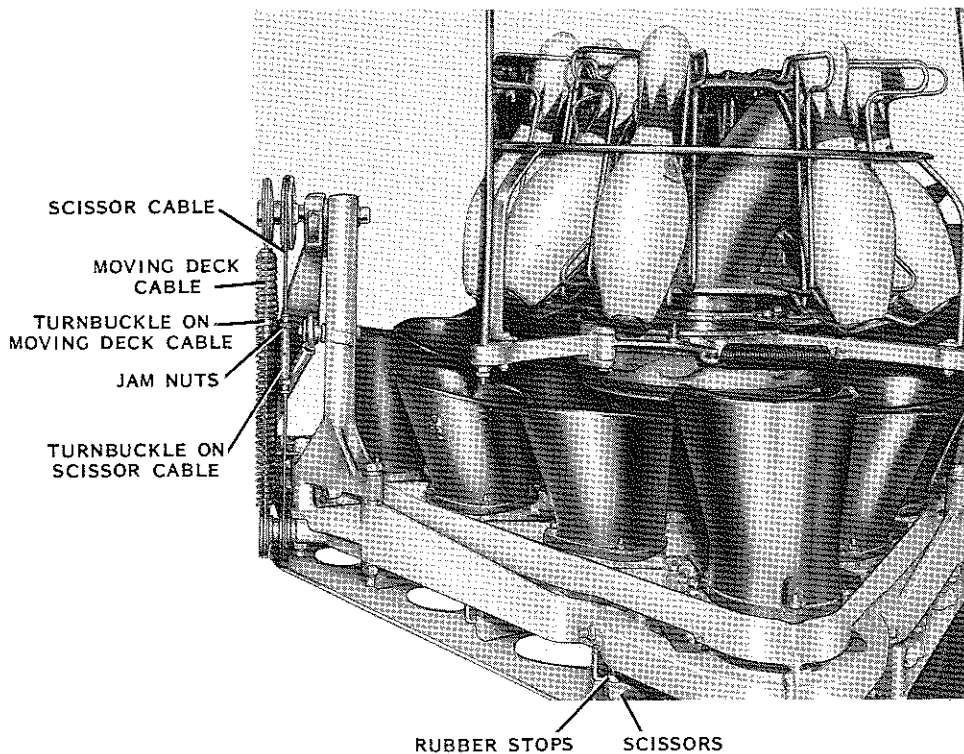
2. If the gap must be changed, the link connecting the latch to the detector is adjustable and may be lengthened or shortened, as required.
3. As a check, cycle the pinsetter to 90° detecting a strike. A minimum of 3/16" of the blocking surface of the latch should contact the lower surface of the scissor cam follower arm. If it is less than 3/16", adjust accordingly.

19. SCISSOR CABLE ADJUSTMENT

This adjustment is made to insure that the scissors open fully and do not interfere with the setting of new pins by the moving deck.

1. Cycle the pinsetter to 0° with the scissor cam follower on the high level of the moving deck-scissor cam.
2. Loosen the locknuts on the cable turnbuckle and adjust the scissor cable until the first pair of scissors are fully open, resting firmly against their rubber stops. The remaining pairs of scissors may not touch their rubber stops at this time, however, they will not interfere with the new pinsetting action. Tighten the locknuts. Do NOT attempt to tighten the cable until all scissors touch their rubber stops. (Figure 25)

NOTE: When adjusting the turnbuckle, hold the threaded studs and rotate the barrel with a pin punch to avoid twisting and fraying the cable.



SCISSOR CABLE ADJUSTMENT

FIGURE 25

20. MOVING DECK CABLE ADJUSTMENT

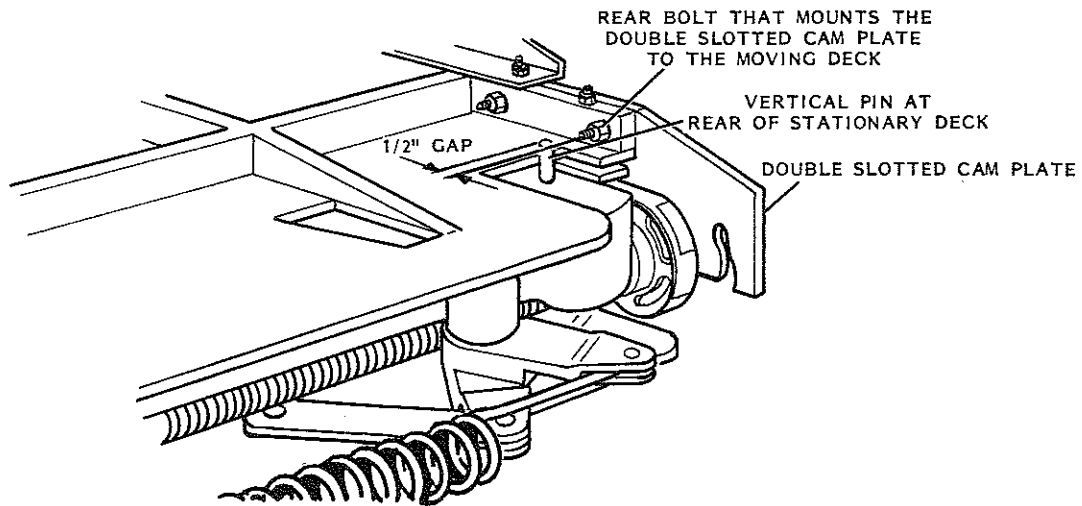
This adjustment is made to insure that the pins do not wobble when set by the deck.

1. Cycle the pinsetter until the moving deck is in its extreme rearward position (approximately 290°, first ball strike or second ball cycle).

2. Loosen the locknuts on the cable turnbuckle and adjust the moving deck cable until the center of the rear bolt that mounts the left hand geneva cam plate is $1/2''$ ($\pm 1/16$) from the center of the vertical roll pin at the rear of the stationary deck. Tightening the cable will increase the gap and loosening the cable will decrease the gap. Tighten both locknuts. (Figure 26)

NOTE: When adjusting the turnbuckle, hold the threaded studs and rotate the barrel with a pin punch to avoid twisting and fraying the cable.

3. Run the pinsetter through several strike cycles and observe if pins wobble when placed on the lane. If the pins wobble, cycle the pinsetter manually and observe if the guide fingers or the lower, front edges of the deck chutes contact the pins as the deck goes up.



MOVING DECK CABLE ADJUSTMENT

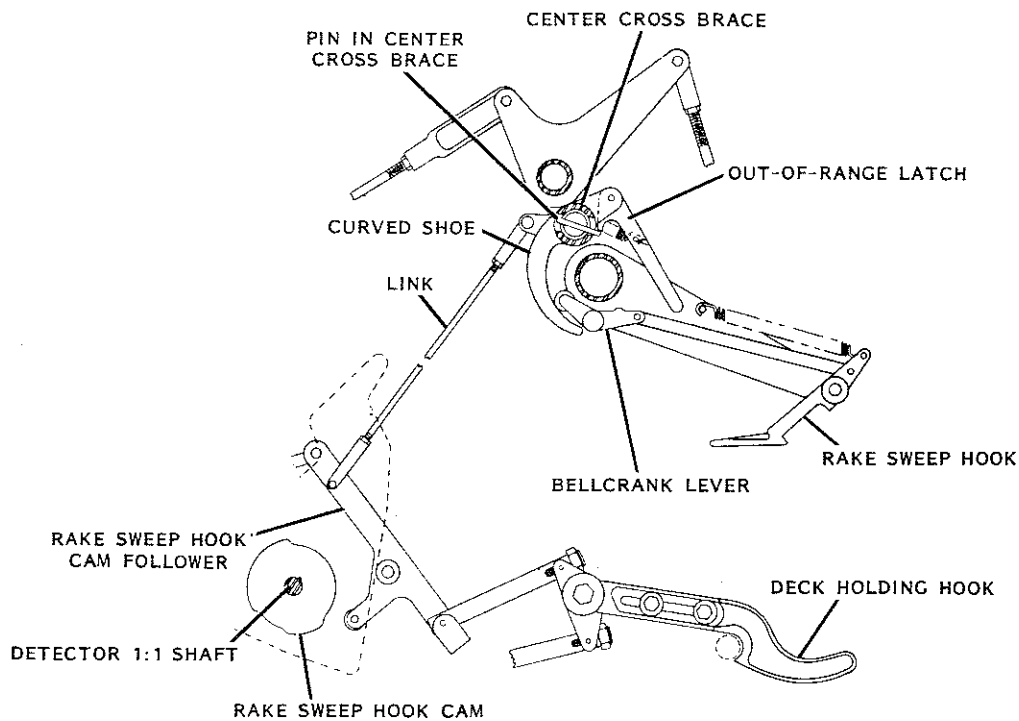
FIGURE 26

4. If the guide fingers contact the pins as the deck goes up, the cable must be slackened. If the lower, front edges of the deck chutes contact the pins as the deck goes up, the cable must be tightened. The clearances to the pin should be equal at the front and rear as the deck raises.

21. OUT-OF-RANGE LATCH ADJUSTMENT

This adjustment is made to insure that the rake does not sweep during an out-of-range cycle.

1. Set a pin out-of-range and cycle the pinsetter until the clutch automatically disengages. Then turn off the power by opening the circuit breaker.
2. Loosen the large bolts which mount the center cross brace to the overhead frame and the "U" bolts which mount the control box to the center cross brace.



OUT-OF-RANGE LATCH ADJUSTMENT

FIGURE 27

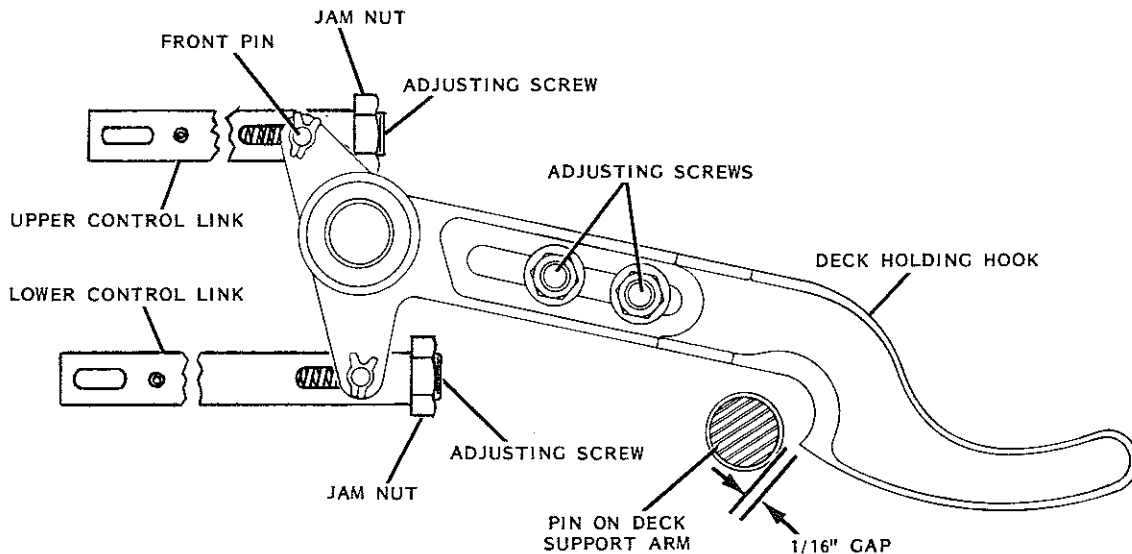
3. Pull the out-of-range reset lever at the rear of the pinsetter and while holding it in its rearmost position, rotate the middle cross brace until the short inner arm on the out-of-range blocking latch just drops over the pin in the cross brace. Tighten the bolts. The cross brace may be rotated by placing a pin punch through one of the roll pins in the center cross brace. (Figure 27)
4. At the end of the out-of-range cycle, the front end of the link from the inner rake cam follower arm must come forward far enough to push the out-of-range blocking latch off the pin in the cross brace. If the latch does not come off the pin, the pin may be carefully driven further into the cross brace.
5. Tighten the mounting bolts.
6. After rotating the center cross brace, check the Trigger Switch Adjustment (Adjustment 6, page 3-11) and the Rake Lowering Stop Adjustment (Adjustment 3, page 3-8).

22. DECK HOLDING HOOK ADJUSTMENT

This adjustment is made to insure that the deck holding hook fully engages the pin on the deck support arm to hold the deck up from 180° to 360° during a first ball, out-of-range cycle and from 0° to 180° during a second ball cycle; and that it clears the pin when the deck lowers.

- NOTE: 1. Before making this adjustment make sure Adjustment 21, Out-of-Range Latch, is correct.
2. Make this adjustment carefully, as the hook is the only support for the deck when it engages the pin.

1. Cycle the pinsetter to 0° , waiting for the first ball delivery, and allow the pinsetter to run until the turret delivers ten pins to the deck. Remove the jam nuts and allen head adjusting screws from both the upper and lower control links. (Figure 28)
2. Replace the adjusting screw in the upper link and turn it in until the sharp edge of the hook is opposite the horizontal center of the pin in the deck support arm. Tighten the locknut.



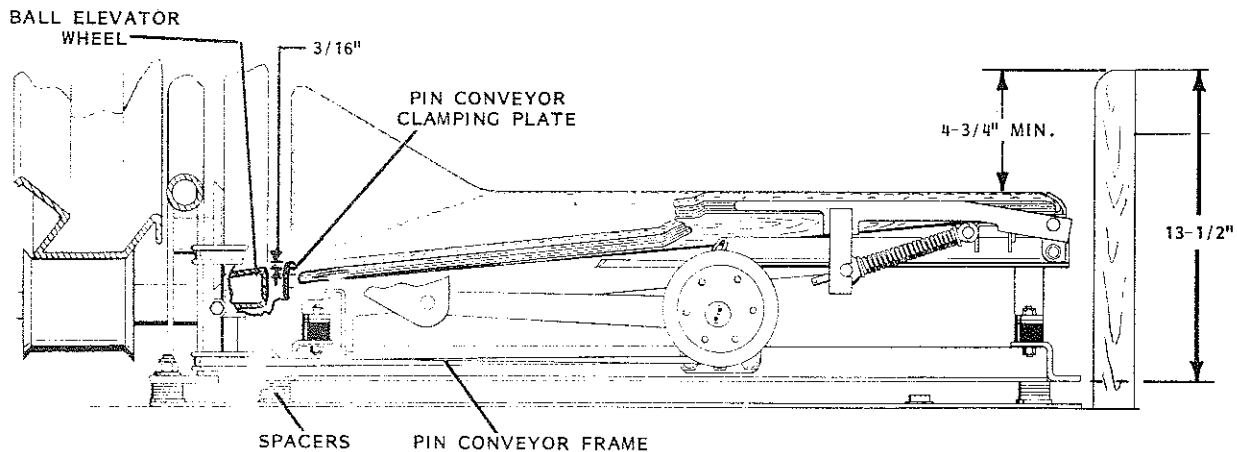
DECK HOLDING HOOK ADJUSTMENT
FIGURE 28

3. Replace the adjusting screw in the lower link and carefully turn it in until the screw just touches the front pin in the link. This should result in NO FREEPLAY in the hook. Tighten the jam nut.
4. With the pinsetter still at 0° , waiting for the first ball delivery with the deck full, loosen the two clamping screws that connect the rear and forward sections of the deck holding hook.
5. Pivot the hook up and down, and adjust the forward section of the hook to obtain a $1/16''$ ($\pm 1/64$) gap between the sharp edge of the hook and the pin at their closest point. Tighten the clamping screws.
6. As a check, jog the pinsetter through a second ball cycle and observe if the hook fully engages the pin and if it clears the pin when the deck lowers after 180° , second ball. As a second check, first ball, out-of-range after an out-of-range stop, pull the out-of-range handle and jog the pinsetter. Observe if the hook fully engages the pin for the remainder of the first ball cycle.

23. PIT CONVEYOR ADJUSTMENT

This adjustment is made to insure that the pit conveyor is the A.B.C. required distance below the lane surface to prevent pins rebounding from the pit to the lane. The adjustment is also made to insure that the ball and pins will easily transfer from the pit to the elevator.

1. Remove the pit board from the pit conveyor and measure the distance from the lane surface to the bottom of the pit conveyor frame. This dimension should be $13\text{-}1/2''$ ($\pm 1/16$) and can be obtained by adding or removing shims between the submounting plates and the pit conveyor frame. (Figure 29)
2. Check the pit conveyor frame at all four corners to insure that the frame is level. Shims can be added or removed between the submounting plates and pit conveyor frame to level the pit conveyor. Replace the pit board.



PIT CONVEYOR AND ELEVATOR FRAME ADJUSTMENTS

FIGURE 29

24. ELEVATOR FRAME ADJUSTMENT

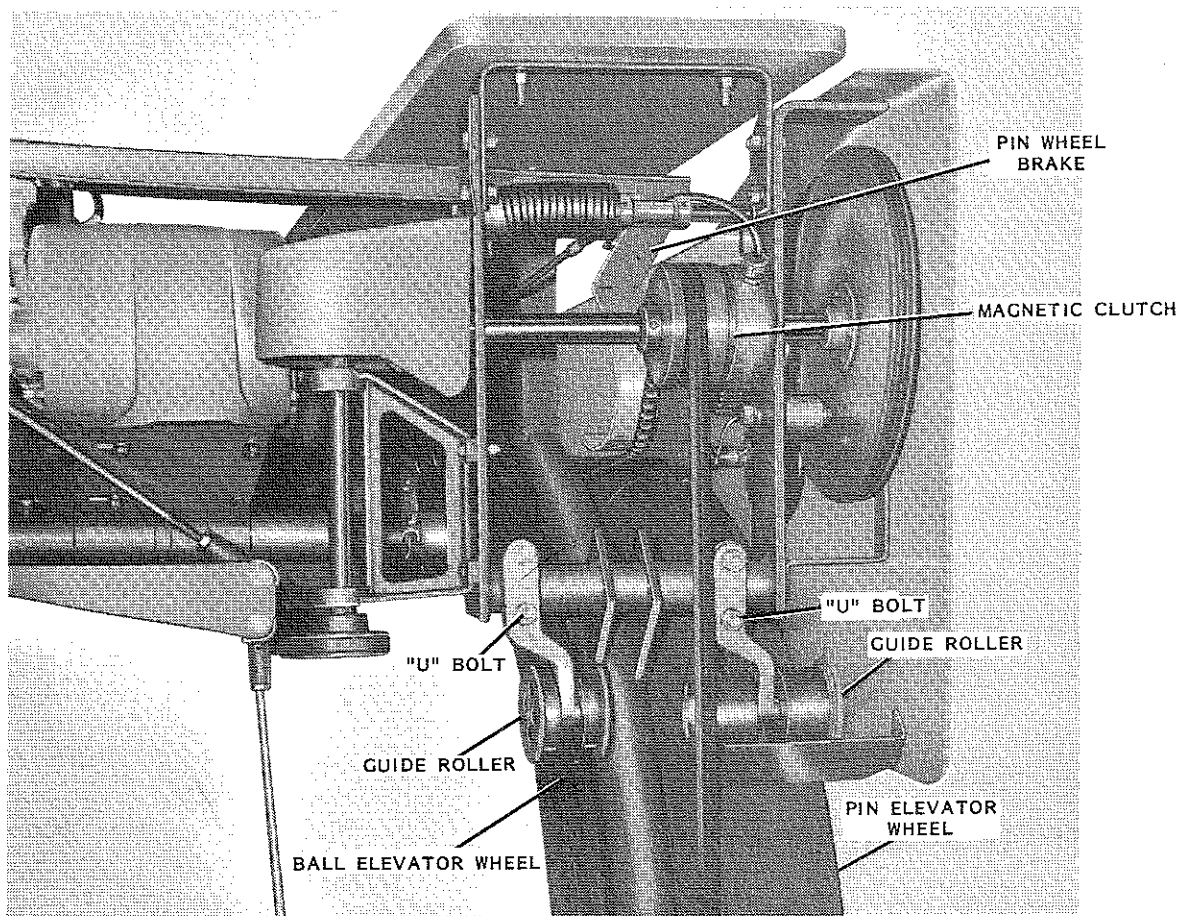
This adjustment is made to insure that the elevator frame is positioned correctly.

1. Place a vertical level or plumb line on the elevator frame and loosen the mounting bolt in the slot of the motor mount shaft, both mounting bolts to the kickback mounting plates and both "J" bolts at the rear of the cross conveyor.
2. Tilt the elevator frame forward or rearward until the frame is plumb. Tighten all bolts.
3. Position the elevator frame assembly so that the front edge of the ball elevator wheel is $3/16''$ ($+0\text{-}1/16$) below the rear clamping plate of the pit conveyor. This dimension can be obtained by adding or removing shims between the submounting plates and the elevator mounting feet. (Figure 29)

25. ELEVATOR GUIDE ROLLER ADJUSTMENT

This adjustment is made to prevent undue wear to the guide rollers or to the ball and pin wheels.

1. Release the spring-loaded belt tension pulleys on each wheel's drive belt.
2. Loosen the "U" bolts on all four upper guide rollers (two each wheel) and move them upward until they lose contact with the wheels. (Figure 30)



ELEVATOR GUIDE ROLLER ADJUSTMENT

FIGURE 30

PIN WHEEL

3. Check to insure that the elevator pin wheel is properly seated on both the lower guide rollers.
4. Lower the two upper guide rollers on the pin wheel until they just contact the wheel and tighten the "U" bolts.

NOTE: Slowly rotate the wheel by hand and observe if an out-of-round condition exists, causing binding in the rollers at the high spots of the wheel. If such high spots exist, loosen the "U" bolts and set the guide rollers so that the rubber in the rollers contacts the wheel at the high spots.

BALL WHEEL

5. To adjust the ball wheel, loosen set screws on the collars on both sides of the idler pulley arm that provides spring tension for the ball wheel belt. Slide the idler pulley arm forward or rearward to align the idler pulley with the ball wheel drive pulley. Snug the collars against both sides of the idler arm and tighten the set screws.
6. Check to insure that the ball wheel is properly seated on both the lower guide rollers.
7. Lower the two upper guide rollers until they just contact the wheel and tighten the "U" bolts. (Figure 30)

NOTE: Slowly rotate the wheel by hand and observe if an out-of-round condition exists, causing binding in the rollers at the high spots of the wheel. If such high spots exist, loosen the "U" bolts and set the guide rollers so that the rubber in the rollers contacts the wheel at the high spots.

NOTE: Check jack shaft pulley for centering with belt. Note also, that the rollers should be checked periodically for proper adjustment.

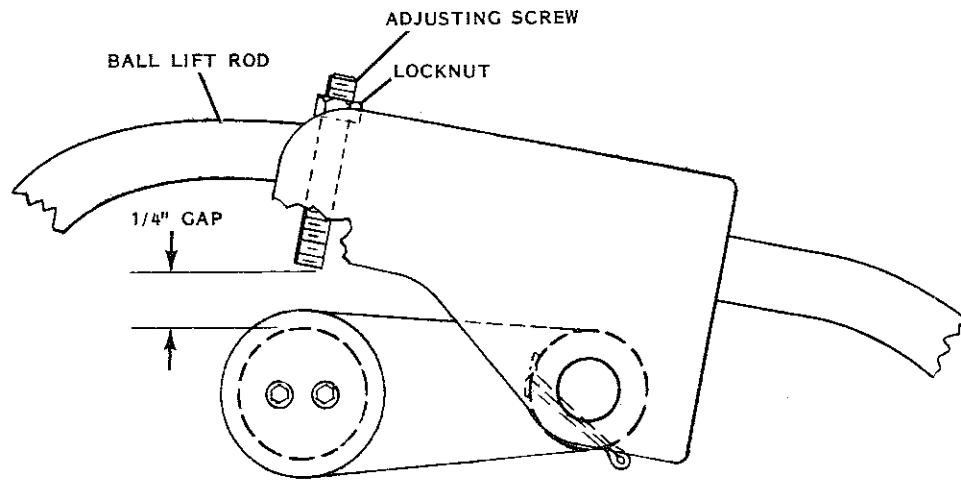
NOTE: Check pin wheel brake for centering on pin wheel belt. Lock set screws in collars on each side of pin wheel brake.

The following adjustments, numbers 26-29, are closely related and changing one will affect the others. For efficient ball pickup, ball transfer and preference bar operation, care must be taken when changing one adjustment, to make compensating adjustments as required. These adjustments should be made in the sequence indicated.

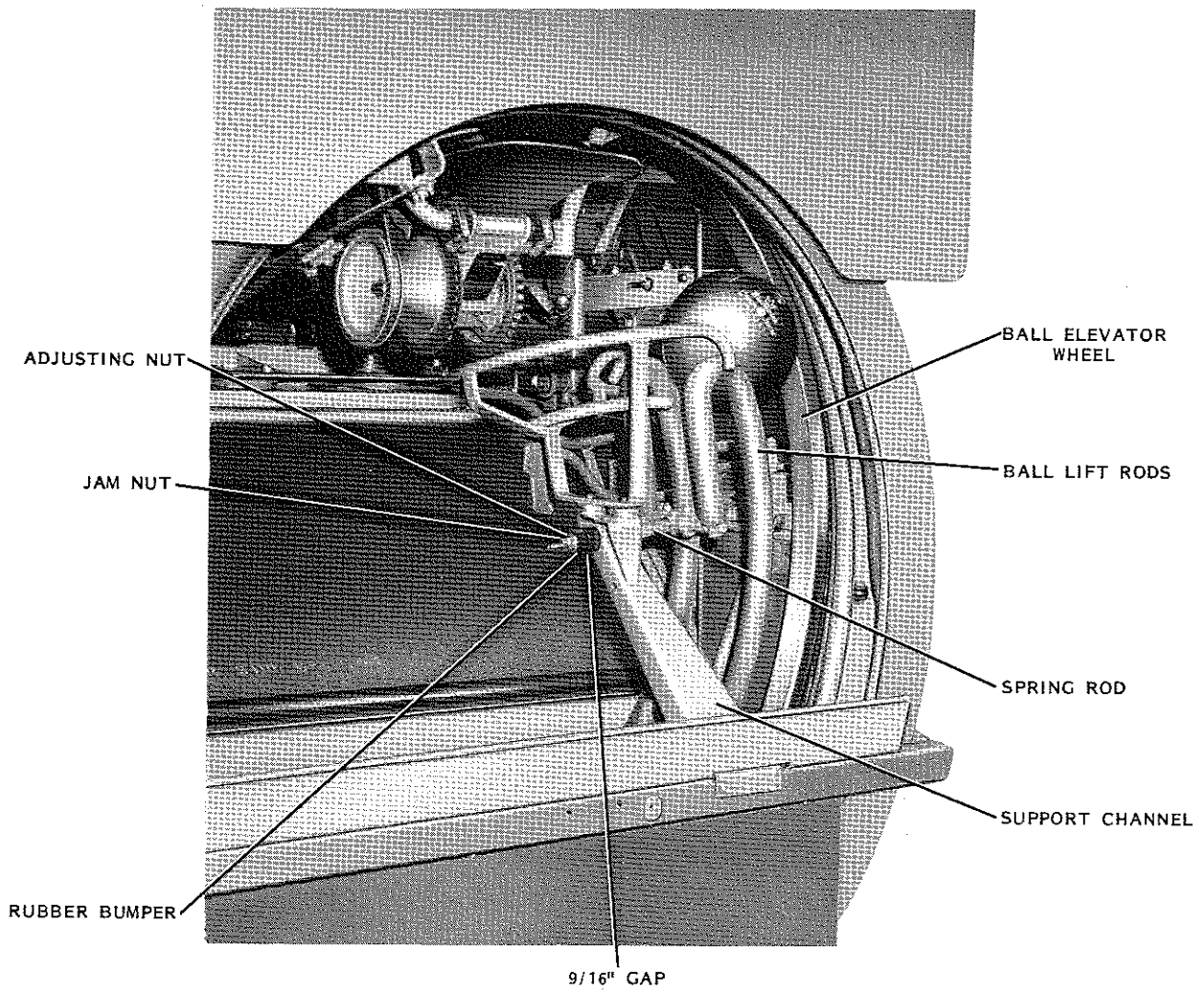
26. BALL LIFT ROD ADJUSTMENT

This adjustment is made to obtain maximum ball pickup efficiency.

1. Make sure the elevator frame (Adjustment 24) and the elevator guide rollers (Adjustment 25) are correct.
2. Place a standard size ball between the lift rods and ball elevator wheel, and manually rotate the ball elevator wheel until the ball wedges itself, thus lifting the ball lift rods. Loosen the jam nut and turn the adjusting screw on the clapper block until the bottom of the screw is $1/4''$ ($\pm 1/16$) from the surface of the lower clapper block (Figure 31).
3. Place a standard size ball between the ball lift rods and ball elevator wheel near the top of the lift rods. Loosen the jam nut and turn the adjusting nut on the spring rod until a $9/16''$ ($+1/16 - 0$) gap is obtained between the rubber bumper and the ball trip bracket. Tighten the jam nut against the adjusting nut. (Figure 32)



BALL LIFT ROD ADJUSTMENT
FIGURE 31



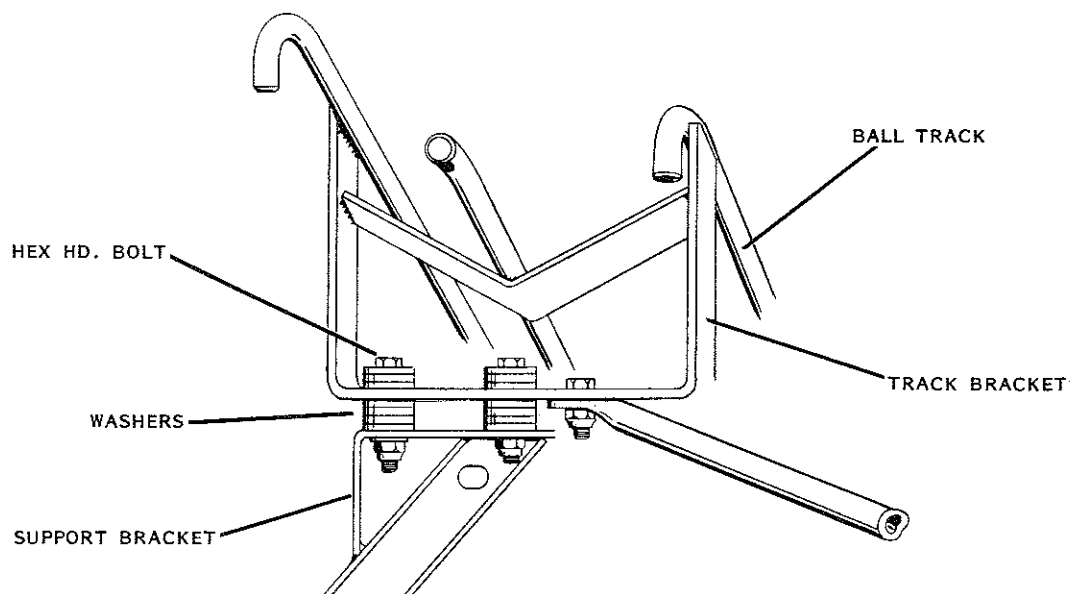
BALL LIFT ROD ADJUSTMENT
FIGURE 32

4. Place a standard size ball at the lower center of the ball wheel so that it is resting against the rear ball lift rod. With the pit conveyor in its rearmost position, there should be 1/16" minimum clearance between the lower portion of the ball and the rear edge of the pit conveyor clamping plate.
5. If the clearance is less than 1/16", check the Elevator Guide Roller Adjustment (Adjustment 25), Pit Conveyor Adjustment (Adjustment 23) and Elevator Frame Adjustment (Adjustment 24). If all adjustments are correct, the ball lift rods must be raised to increase the dimension. To raise the ball lift rods, loosen the locknut on the upper clapper block and turn the adjusting screw until the 1/16" dimension is obtained. Tighten the jam nut.
6. Check the ball lift rods to assure they are parallel with the ball lift wheel.

27. BALL TRANSFER ADJUSTMENT

This adjustment is made to obtain smooth ball transfer from the ball lift rods to return tracks, and from the return tracks to the switch track and accelerator track.

1. If rough transfer is observed as the ball transfers from the lift rods to the return tracks, the return tracks must be adjusted at the junction with the ball lift rods.
2. Remove the two bolts that secure the ball track to the support channel. Add or remove shim washers between the support channel and ball track bracket to obtain the proper height of the tracks. (Figure 33)



BALL TRANSFER ADJUSTMENT

FIGURE 33

NOTE: Extra shim washers are placed between the bolt head and track bracket. If the track must be raised, move the required amount of shim washers from the top of the track bracket and insert them between the bracket and support channel. Conversely, if the track must be lowered, transfer the proper amount of shim washers from under the bracket to the top of the bracket.

3. Replace and tighten both mounting bolts.
4. When the tracks have been raised, a careful check must be made to insure that the ends of the tracks do not contact the ball, thereby causing possible damage to the ball.
5. Place a ball in the pit and slowly jog the pinsetter until the ball is at the top of the ball lift rods. At this point, check the position of the track ends with relation to the ball. If the track ends can contact the ball, the track must be carefully bent down to avoid any possible ball contact. Extreme care must be taken to avoid distorting the rest of the track or the mounting brackets, when bending the track ends down.
6. Loosen both hex bolts that mount the switch track assembly to the kickback mounting plates and center the switch track assembly with the accelerator. Shims must be added under the low side of the switch track to assure that it is level from side to side within 1/16".
7. Slide the switch track assembly forward or rearward to obtain smooth transfer between the return tracks, switch track and accelerator track. Tighten the hex bolts. Check the switch lever stops for alignment to accelerator track.

28. BALL PREFERENCE ADJUSTMENT - CENTER RETURNS

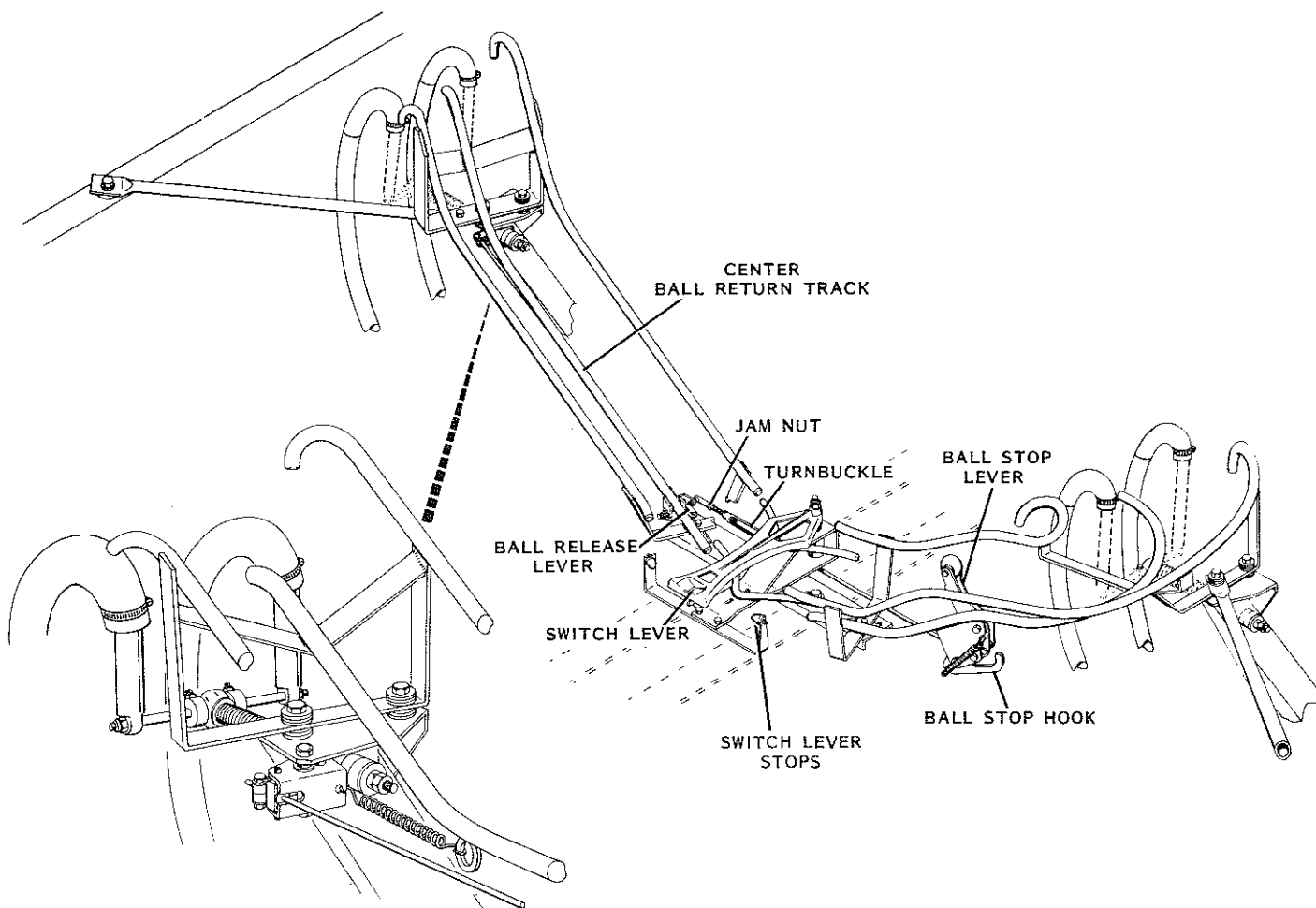
This adjustment is made to prevent two balls from adjacent pinsetters from meeting at the common switch track assembly.

1. Loosen the jam nuts at both ends of the turnbuckle on the rod that connects the ball stop hook to the ball release lever. (Figure 34)
2. While holding the ball stop hook in its unlatched position, turn the turnbuckle until the extreme end of the ball release lever is at the same height as the top of the center track. Tighten both jam nuts.
3. With the ball stop hook still in its unlatched position, place a standard size ball between the ball lift rods and the ball elevator wheel of the left hand pinsetter. Stop the machine as the ball nears the top of the lift rods.
4. Check the gap between the ball trip bracket and the rubber bumper on the spring rod. This dimension must be 3/8" (+1/16 -0). Readjust if required.
5. Remove the ball and unlatch the ball stop hook. Loosen the locknut on the stop clamp. Position the clamp to obtain a 1/32" ($\pm 1/64$) gap between the clamp and the block. Tighten the locknut.

6. As a check, allow a standard size ball to be lifted and placed on the return track which rotates the ball trip lever, thus rotating the ball stop hook in its latching position. At this time, allow a second ball to roll against the ball stop lever on the mating return track. The latching action of the hook should prevent rotation of the ball stop lever, thereby stopping the second ball.

As the first ball continues to roll and approaches the switch track assembly, it will depress the ball release lever and pivot the ball stop hook to its unlatching position. The weight of the second ball should rotate the ball stop lever and proceed to the switch track. Readjust if necessary.

7. Check all pivot points of the ball preference mechanism to insure that all components have freedom of motion.



BALL PREFERENCE ADJUSTMENT

FIGURE 34

29. BALL ACCELERATOR ADJUSTMENT

This adjustment is made to insure that the accelerator belt is properly tensioned and positioned to effectively return balls to the ball return rack. The accelerator must be properly mounted on the kickbacks prior to making belt adjustments. The mounting surface on each kickback must be level across the two kickbacks to within 1/32". Shim washers can be added or removed to obtain level condition. Set accelerator on kickback mounts. Shim as required. Do not draw accelerator frame down when tightening belts.

1. Loosen the three nuts holding the rear pulley assembly. Two nuts are located on top and one nut on side of the top frame.
2. Loosen the rear belt tension screw. (Figure 35)
3. Remove old belt and install new belt.

NOTE: The belt is marked on the inside surface. Place this surface on the pulleys.

4. Viewing the accelerator from the rear of the machines, locate the belt 1" from the edge of the pulley facing the right machine side.

NOTE: The motor drive belt is located on the left machine side.

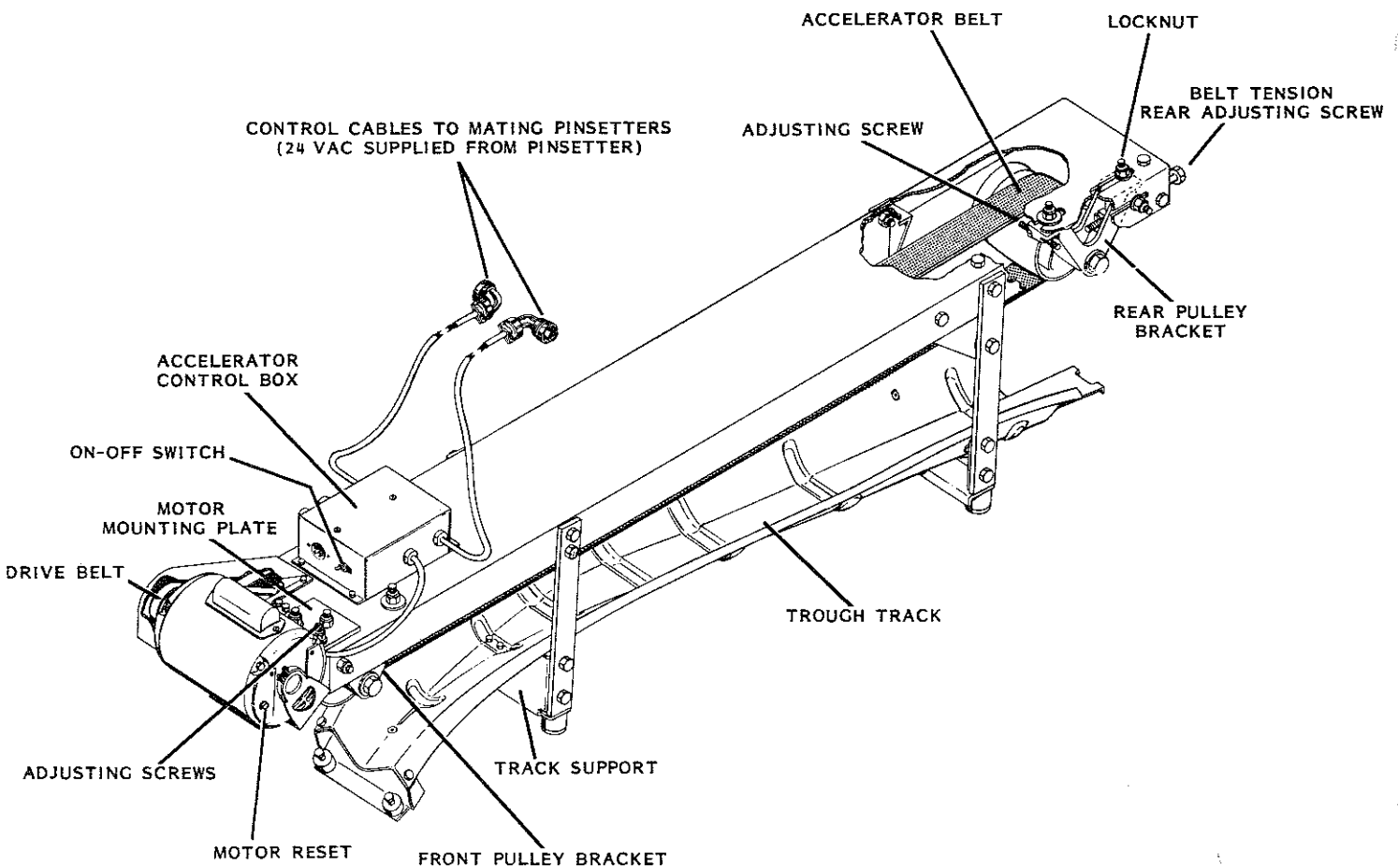
5. Manually rotate the pulley to position the belt on the front pulley in a like manner.
6. Manually pull the rear pulley assembly rearward and hand tighten the rear belt tensioning screw. Snug the three nuts holding the bearing bracket assembly to the frame.

NOTE: There is an adjustable set screw through the side of the pulley brackets. This adjustment screw moves the belt left or right for proper tracking operation. Turn this screw in until it touches the frame side. Lock the jam nut.

Continue tightening the rear tension screw until the belt is level between the pulleys. Tighten the tension screw four additional turns. Then tighten the two top locknuts and the side locknut.

7. Start the accelerator and run idle (no ball). Check the belt tracking. Maximum permissible belt wobble is 1/8". Belt should run 1" from the edge of the pulley. If not, loosen the locknuts holding the rear bearing assembly. Loosen the jam nut on the adjustable screw and move set screw one turn "in" to move belt toward right machine. Back set screw "out" one turn to move belt toward left machine. Retighten adjusting screw jam nut and the three locknuts on the bearing assembly before testing.

NOTE: One-half turn of the adjusting screw moves the belt 1/8".



BALL ACCELERATOR ADJUSTMENT

FIGURE 35

MOTOR BELT ADJUSTMENT

The motor is to be mounted with the mounting bolts located centrally in the elongated motor base slots. Adjust the motor belt by moving the motor or adding shims under the motor base as required to make the motor belt track $3/16''$ ($\pm 1/16$) from the edge of the motor pulley and $3/16''$ ($+1/8-1/16$) from the edge of the accelerator pulley.

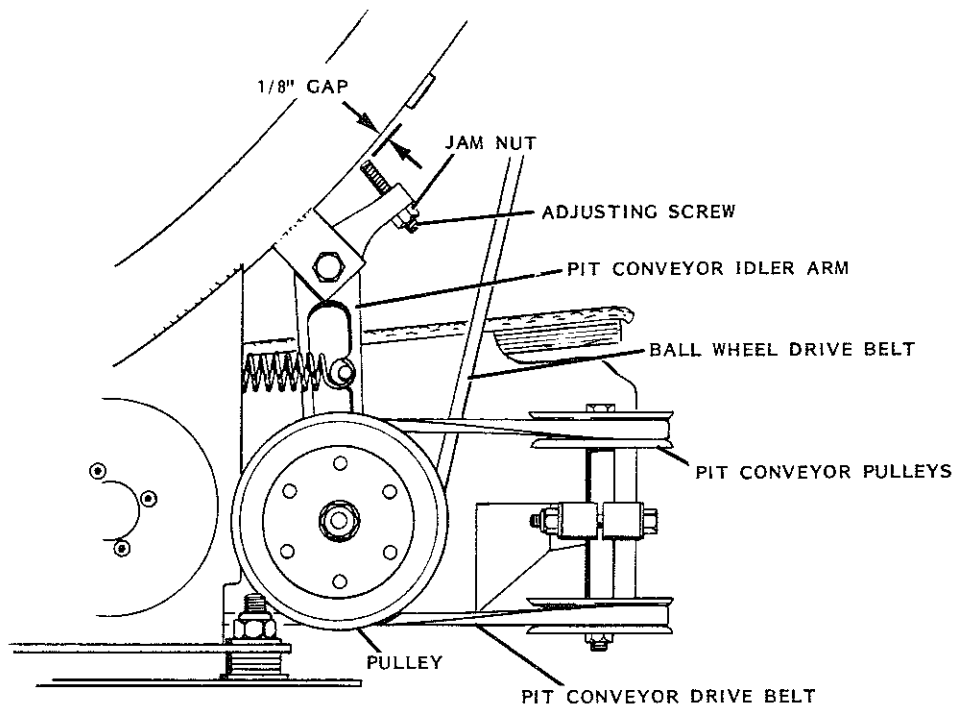
BALL TEST

1. Run a drilled ball through the accelerator and observe belt movement. Allowable belt movement:
 - Used belt - $1/4''$
 - New belt - $1/16''$ to $1/4''$ toward motor belt.
2. Adjust if necessary. Check set screws, making sure they sit against frame with tightened jam nuts. Check all bearing locknuts. Recheck accelerator mounting on kickbacks.

30. PIT CONVEYOR IDLER ARM ADJUSTMENT

This adjustment is made to limit the travel of the pit conveyor idler pulley arm to prevent the pit conveyor belt from slipping off the pulley when installing a new belt.

1. Shut off the machine and loosen the adjusting screw jam nut on the pit conveyor idler pulley arm. (Figure 36)
2. Turn the adjusting screw until a clearance of $1/8''$ is obtained between the point of the set screw and the elevator frame. This $1/8''$ is measured with the machine turned off. Tighten the locknut.



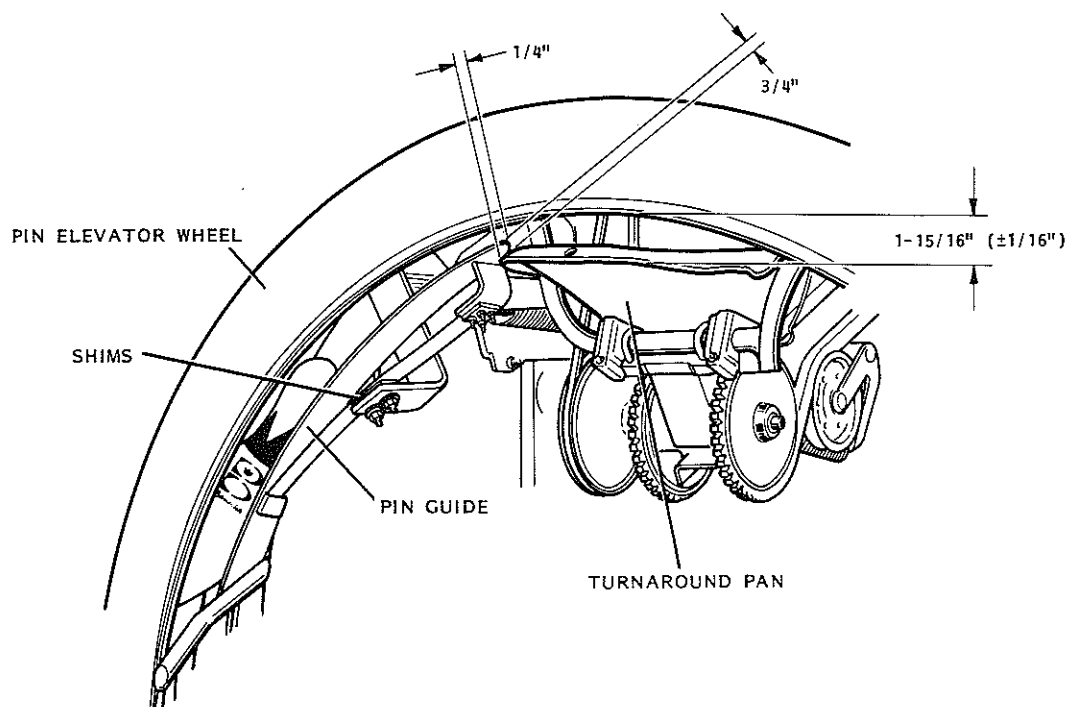
PIT CONVEYOR IDLER ARM ADJUSTMENT

FIGURE 36

31. TURNAROUND PAN ADJUSTMENT

This adjustment is made to insure that the turnaround pan orients pins base first on the cross conveyor whether they are received head first or base first from the pin elevator.

1. With the turnaround pan in its normal, spring-urged position, measure the vertical distance from the bottom, rear edge of the turnaround pan to the rear inside edge of the pin elevator wheel. This dimension must be $1-15/16''$ ($\pm 1/16$). (Figure 37)
2. Carefully bend the tongue of the turnaround pan to obtain the desired dimension.



TURNAROUND PAN ADJUSTMENT
FIGURE 37

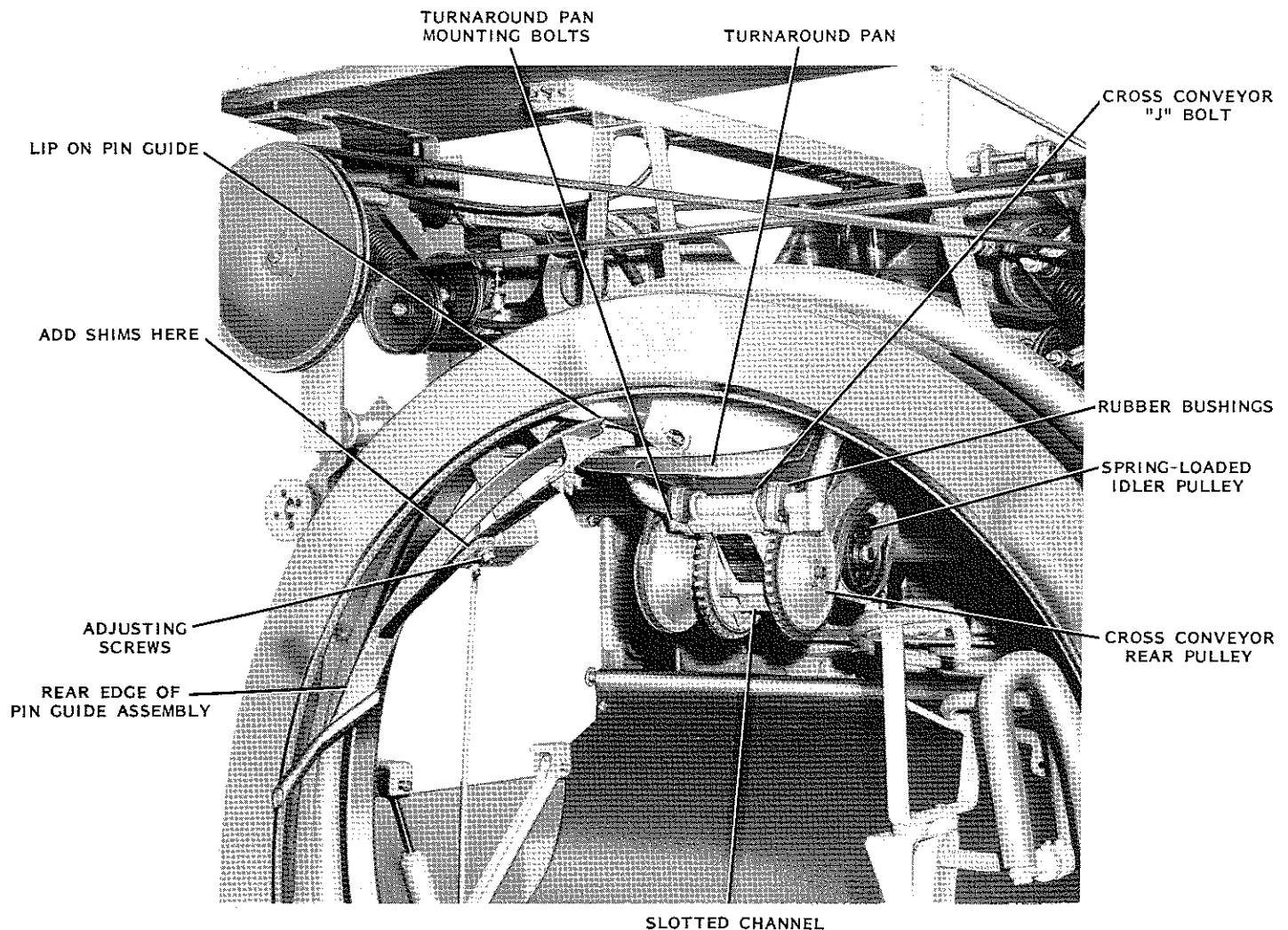
32. PIN GUIDE ADJUSTMENT

This adjustment is made to insure that the pins are held securely in the pin elevator and that they are properly released to the turnaround pan for head first orientation.

NOTE: Adjustments 31 and 32, Turnaround Pan and Pin Guide Adjustments, are directly related to each other, and changing one will affect the other.

1. Center the cross conveyor and turnaround pan between the elevator frame prior to pin guide adjustment. Loosen the "J" bolts to center the cross conveyor and turnaround pan.
2. The pin guide must be positioned with the lip of the pin guide $3/4"$ ($\pm 1/16$) above the top edge of the turnaround pan. This dimension may be obtained by adding or removing shims between the steel spring and mounting bracket.
3. Loosen the two pin guide mounting bolts and position as follows: The mounting holes are oversized for adjustments. Pivot the top of the pin guide forward until the top end of the pin guide is $1/4"$ ($\pm 1/16$) beyond the top edge of the turnaround pan. (Figure 37)
4. As a check, observe the action of pins being delivered head first and base first to the turnaround pan. Pins delivered base first should be properly oriented to ride half way up the side of the turnaround pan.
5. The pin guide assembly may require readjustment to compensate for proper orientation of base first and head first pins by the turnaround pan. Moving the pin guide forward at the top will cause the pins to be delivered later on

the turnaround pan, while moving the pin guide rearward will cause the pins to be delivered earlier to the turnaround pan. The pin guide should be positioned to obtain optimum performance of base first and head first pins.



PIN GUIDE AND CROSS CONVEYOR ADJUSTMENTS
FIGURE 38

33. CROSS CONVEYOR BELT ADJUSTMENT

This adjustment is made to insure that the belts are properly tensioned to carry the pins up the cross conveyor to the turret.

1. Remove the spring-loaded idler pulleys from the cross conveyor belts and loosen the rear pulley assembly "J" bolts and the lower bolts in the slotted channel. (Figure 38)
2. Swing the rear pulley assembly to the rear until the belts are tensioned. Tighten the bolts and replace the spring-loaded idler pulleys. Make certain that the belts do not rub against the idler pulley arms. A-2 converted machines may have idler pulleys. Factory A-2 machines have no idlers.

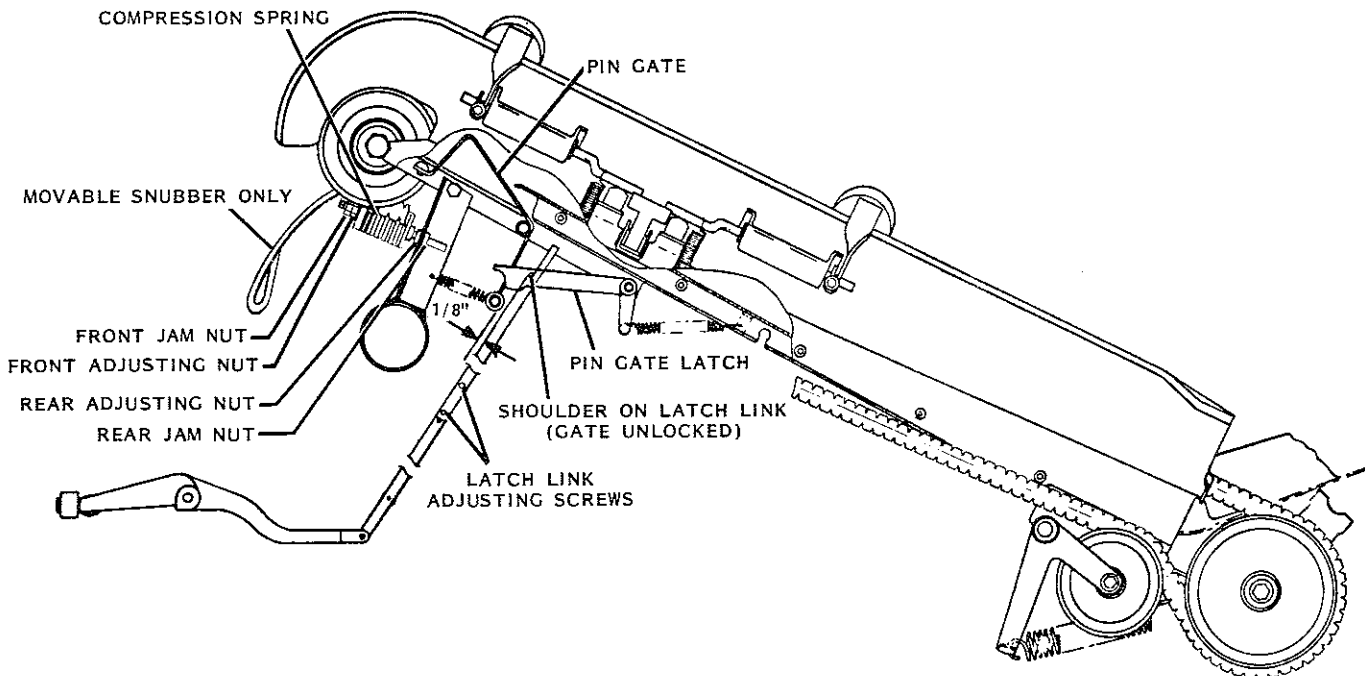
NOTE: The following series of adjustments, Numbers 34-44, are closely related and changing one may affect the others. All adjustments in this series must be correct to insure proper pin transfer from cross conveyor to turret, proper turret operation and proper pin transfer from turret to deck.

34. PIN GATE ADJUSTMENT

This adjustment is made to insure that the pin gate latches after a pin passes over it and that the gate is released as the turret indexes after receiving that pin.

NOTE: Before proceeding with the adjustment, a preliminary check must be made of the components. Check the up and down motion of the latch to insure there is no binding on the latch link. Check the shoulder on the latch link to insure there is no wear on the step. If worn, replace. Check side play of latch link through pin gate latch.

1. Index the turret by hand until the stop lever roller is on a high level of the turret indexing cam. This will locate the latch link in its lowest position.
2. Loosen the two screws which fasten the upper and lower parts of the latch link together. Move the upper part of the link up or down until the shoulder on the link is $1/8''$ to $3/16''$ below the bottom of the pin in the pin gate latch. Tighten the two screws. (Figure 39)



PIN GATE AND SNUBBER ADJUSTMENTS

FIGURE 39

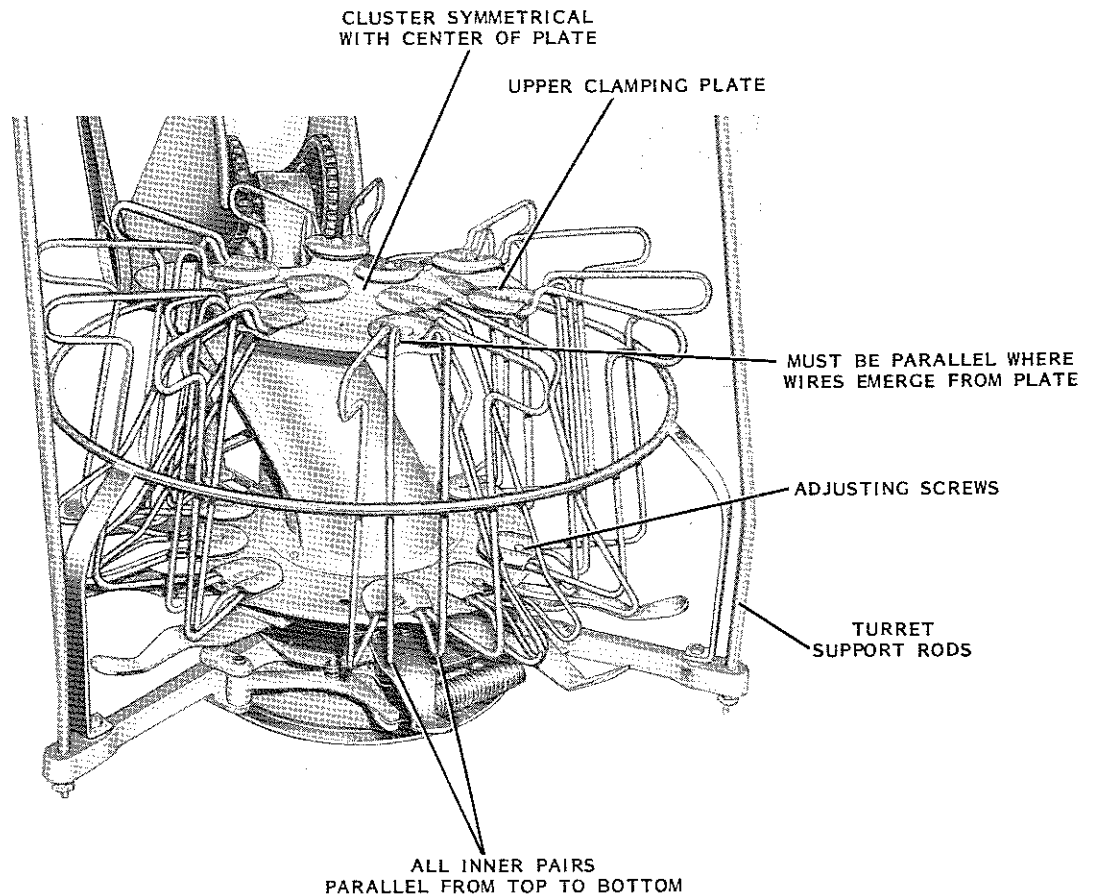
3. Index the turret by hand until the stop lever roller is on a low level of the turret indexing cam. This will unlock the pin gate.
4. Slowly move a pin up the cross conveyor until the body of the pin depresses the pin gate. The pin gate latch must drop on top of the roller. Then move the pin up until the neck of the pin is over the pin gate. At this point, the gate must come up in the neck of the pin and become locked as the head of the pin passes over the pin gate. If the pin gate cannot come up high enough in the neck of the pin to automatically lock the gate, check the tension spring and pivot point of the pin gate. Also check the $1/8''$ dimension with the pin gate unlocked (Figure 39). Recheck steps 1, 2 and 3.

5. As a final pin gate test, lock the pin gate and allow three pins to line up on the cross conveyor. Release the pin gate and observe the pin gate action as the three pins are delivered to the turret. The pin gate should latch as the neck of each pin passes over and release after the turret has indexed after receiving that pin.

35. TURRET LEVEL ADJUSTMENT

This adjustment is made to insure that the turret is level with the lane surface, thereby preventing any interference with the turret by pins in the deck when the deck is in its up position.

1. Loosen the jam nuts on the two front turret supports and place a level under the main turret pulley, front to rear.
2. Turn the adjusting nuts until the turret is level front to rear. Tighten the jam nuts. Check each rod for equal support. (Figure 40)



TURRET LEVEL AND TURRET WIRE ADJUSTMENTS

FIGURE 40

36. TURRET WIRE ADJUSTMENT

This adjustment is made to insure that the turret properly seats the pins and that the turret accurately delivers the pins to the deck chutes.

1. Make sure each cluster of four wires is symmetrical with the center of the turret at the top and bottom of the turret.
2. Make sure that the outer pair of wires on the 1, 7 and 10 baskets extend from the upper clamping plate parallel with each other to obtain sufficient pin inclination for accurate delivery of these pins to their respective pin chutes.
3. Make sure the inner wires of all nine baskets are parallel with each other from top to bottom. (Figure 40)
4. Fill the turret with nine pins. Adjust the lower ends of all the outside wires to obtain $1/16''$ ($-0+1/16$) clearance between the wires and the pin bodies.
5. With the turret empty, position the spider in its open, pin releasing position. Slide a pin down through each pin basket and observe if there is any binding or restriction of the passage, caused by tight turret wires. Adjust as required.
6. Be certain that all upper and lower clamping plate bolts are tight.
7. As the pins are being delivered from the cross conveyor to the turret, to the deck, check the operation of the pin gate, trip lever, turret and interlocks, for proper operation. Readjust as required.

37. TURRET SPIDER ADJUSTMENT

This adjustment is made to insure that the spider rotates to release the pins to the deck, that the pins clear the spoons completely and that the spider is re-attached after releasing the pins.

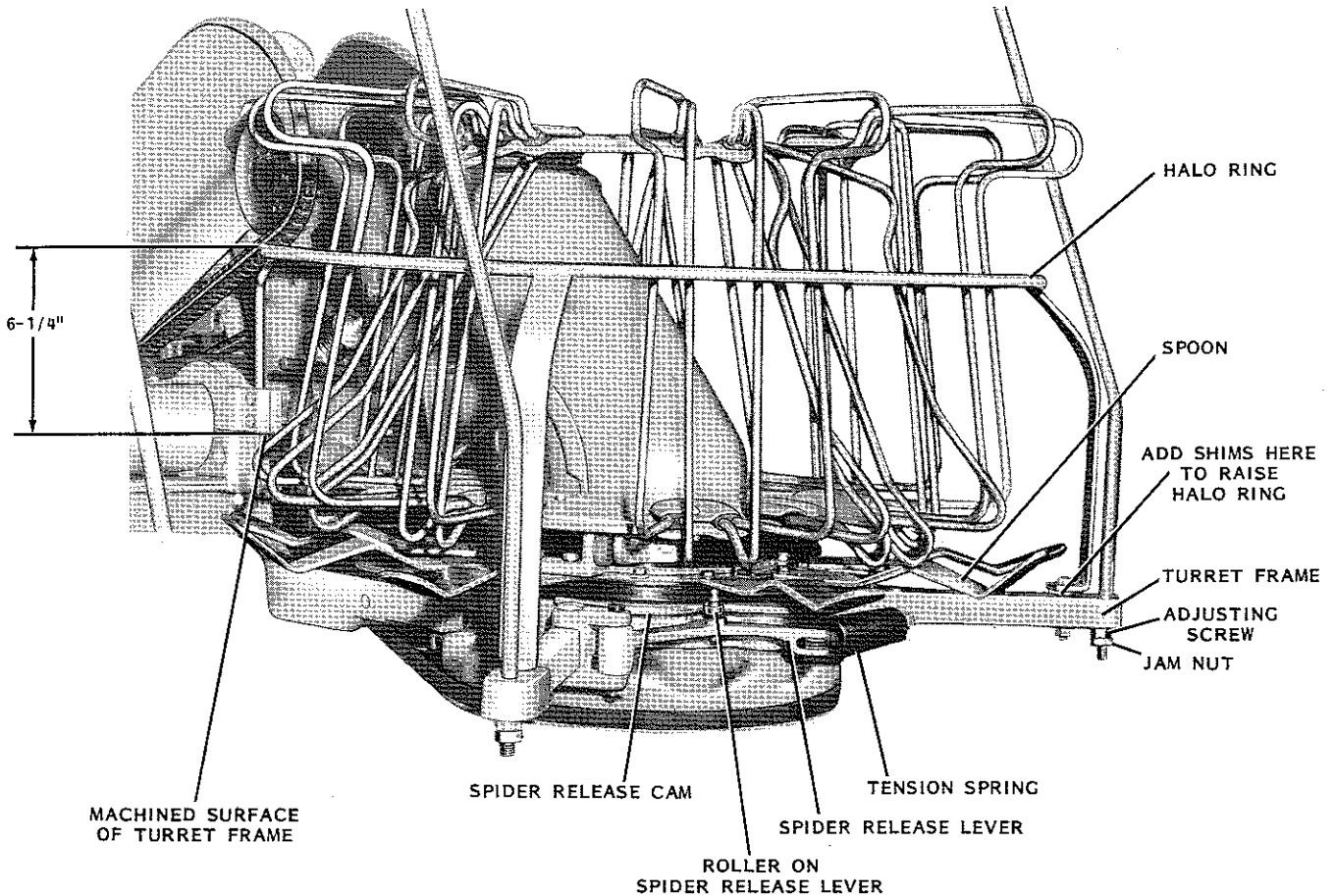
1. Position the #5 pin chute under the cross conveyor and release the spider to its open, pin release position. (Figure 41)
2. Check the roller of the spider release lever when it is in the low dwell of the spider cam. The roller should be tight enough to resist spinning by the fingers. If the roller can be rotated freely, it indicates that the inner stop on the spider release lever is pressed against the turret frame instead of being slightly away from the frame. File the inner stop until the roller is tight in the low dwell of the spider cam.
3. Position the spider in its open, pin releasing position. Slide a pin down through each turret basket and observe if the pin touches any spoon as the pin moves down to the deck. If the pin touches any spoon, loosen the two bolts which fasten the spoon to the spider ring and position the spoon until it clears the pin. Tighten the bolts.

38. TURRET HALO RING ADJUSTMENT

This adjustment is made to insure that the halo ring does not contact the pins in the turret or the #5 pin chute as the turret indexes.

1. Loosen the clamps supporting the two rear legs of the halo ring.

2. Move the halo ring up or down until the top of the halo ring is 6-1/4" (+0 -1/16) above the machined surfaces on which the clamps are mounted. Tighten the clamps. (Figure 41)
3. As a check, observe if the halo ring rubs the #5 pin chute or pins in the turret as the turret indexes. Adjust as required. If the front of the ring must be raised, shims may be added under the two front legs of the halo ring.



TURRET SPIDER AND HALO RING ADJUSTMENTS
FIGURE 41

39. SNUBBER ADJUSTMENT

This adjustment is made to insure that the snubber assists the pins into the turret wires.

PINSETTERS WITH MOVABLE SNUBBERS ONLY

1. Position the #2, #3, #4, #6, #8 or #9 basket under the cross conveyor and fully seat a pin in the basket.
2. Loosen the jam nut at the rear end of the snubber spring and turn the adjusting nut until depressing the snubber 3/16" ($\pm 1/16$) will fully compress the snubber spring. Tighten the locknut. (Figure 39)
3. Loosen the locknut at the front of the snubber spring. Turn the adjusting nut until the snubber can move 5/8" forward from the position established in step 2. Tighten the lock nut.

PINSETTERS WITH FIXED SNUBBERS

1. Loosen the two mounting bolts that mount the snubber to the cross conveyor.
2. Position the turret with the #8 or #9 pin basket in front of the cross conveyor.
3. Place a pin in the #8 or #9 pin basket with a pin in a vertical position.
4. Adjust the snubber until there is a $3/16"$ ($\pm 1/16$) gap between the snubber and the pin. Tighten the mounting bolts.

40. TURRET INTERLOCK PROBE ADJUSTMENT

This adjustment is made to insure that there is no interference with the motion of the probe.

1. Rotate the turret until the interlock probe is over the torsion latch. The clearance between the bottom of the probe and the top of the latch must be at least $1/32"$. (Figure 42)
2. Position the #5 pin chute under the cross conveyor and release the spider by pulling the probe to its rearmost position. The clearance between the top of the probe and the bottom of the two interlock blocking fingers (in their up position) must be at least $1/16"$.
3. These two dimensions may be obtained by carefully bending the probe in the required direction.

41. TURRET INDEX TRIP LEVER ADJUSTMENT

This adjustment is made to insure that the turret indexes one position after each pin is delivered from the cross conveyor.

1. Position the turret so that the stop roller on the stop lever assembly is in a low dwell of the indexing cam. Loosen the locknut at the rear of the trip lever spring and turn the rear adjusting nut until the front face of the indexing latch is vertical. Tighten the lock nut.
2. Position the turret so that the stop roller on the stop lever assembly is on a high level of the indexing cam. Loosen the locknut at the front of the trip lever spring and turn the front adjusting nut until depressing the trip lever $1/8"$ will solidly compress the spring. Tighten the locknut. (Figure 42)
3. Position the #5 pin chute under the cross conveyor. Check the index trip lever in its down position to insure that it does not contact the interlock probe. Check the trip lever in its up position to insure that it does not contact any of the turret wires as the turret indexes. If any turret wires contact the trip lever, carefully bend the wires upward to provide clearance. Do not disturb the trip lever adjustment at this point.

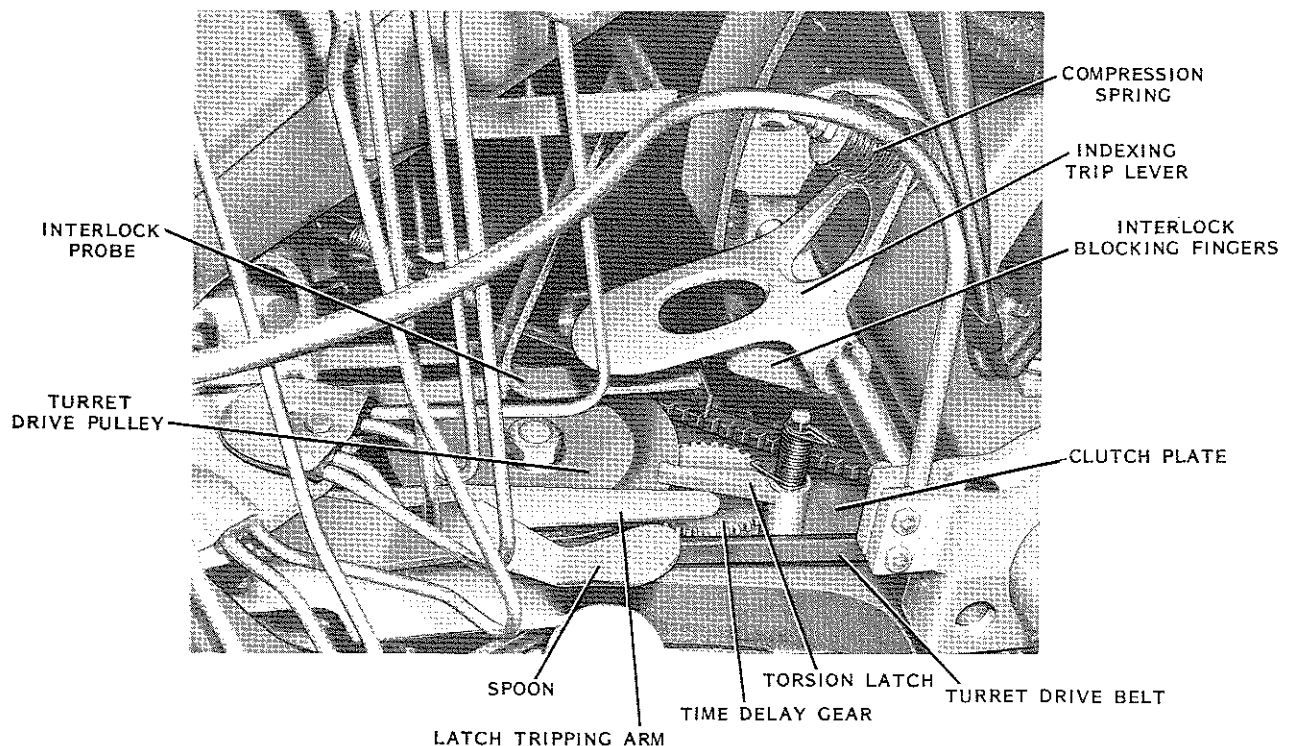
4. Allow the turret to collect nine pins, then shut off the power when the #5 pin chute is in front of the cross conveyor. Try to manually force the turret beyond the #5 pin position with the power off. If the turret can be manually forced beyond the #5 pin position, the indexing trip lever must be readjusted to bring the indexing latch further rearward to provide a more positive latching action. Check each pin position in this manner.

42. TURRET TIME DELAY GEAR ADJUSTMENT

This adjustment is made to insure that the turret indexes once, after delivering ten pins to the deck.

NOTE: Check lower left finger of torsion latch for blocking of time delay gear. Position for blocking by trimming rubber stop, if necessary.

1. Position the #5 pin chute under the cross conveyor. Check the position of the latch tripping arm with relation to the torsion latch. The latch tripping arm should be in a horizontal plane with the center of the arm of the torsion latch. The latch tripping arm may be carefully bent to insure that it will properly contact the torsion latch. (Figure 42)
2. Position an empty pin basket in front of the cross conveyor and trip the torsion latch by hand. If the delay gear is working correctly, the index trip lever will dip once and the turret will index one position. If the trip lever dips twice and the turret indexes two positions, it indicates the torsion latch did not return to its latching position to arrest the rotation of the delay gear. If the trip lever does not dip at all, and the turret does not index, check for binding of the delay gear or torsion latch. Also check to insure the two gears are properly meshed. Check clutch plate for flatness and proper positioning in slide bolts.



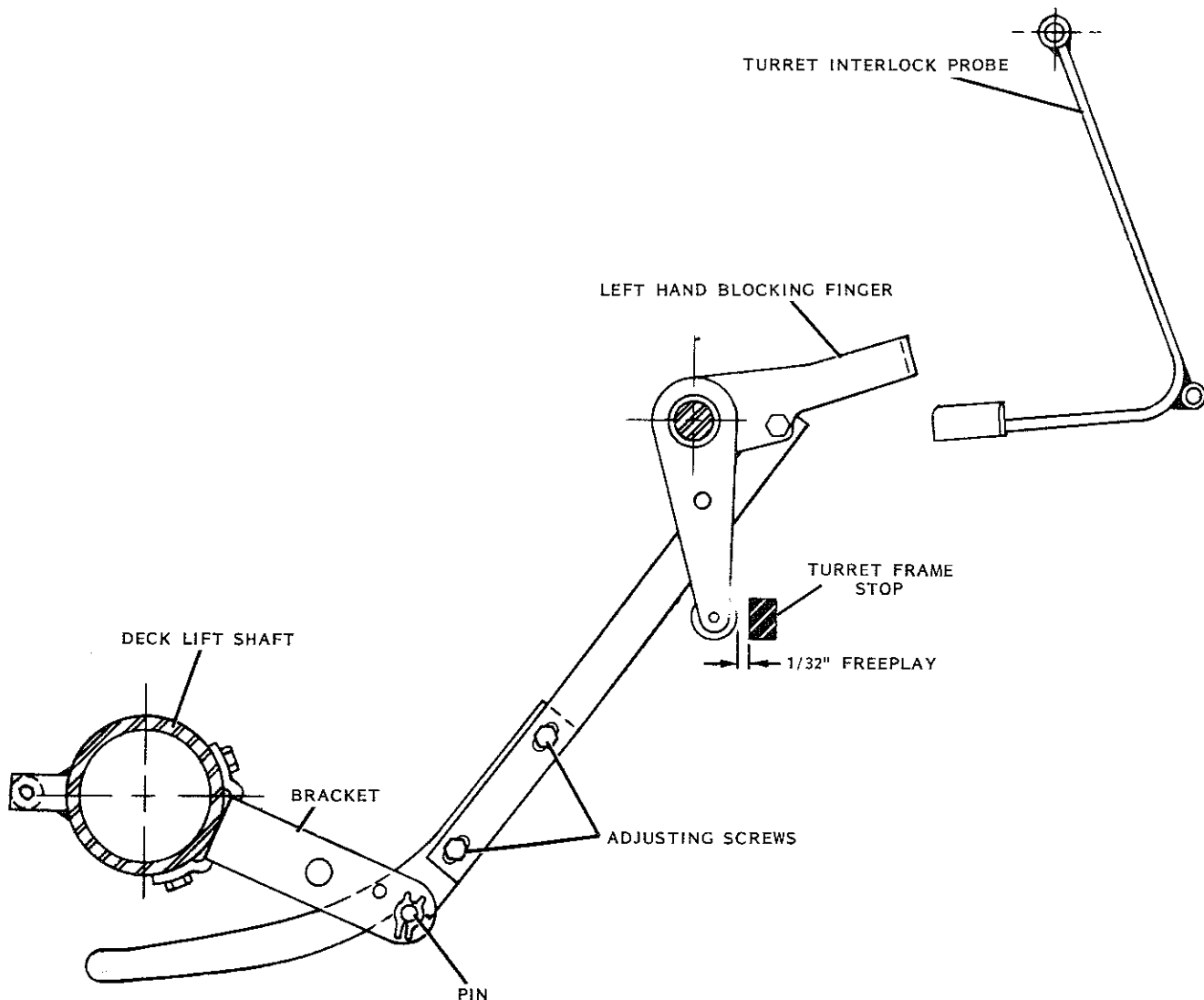
TURRET INTERLOCK PROBE, INDEX TRIP LEVER,
AND TIME DELAY GEAR ADJUSTMENTS

FIGURE 42

43. RESTRICTED DROP INTERLOCK ADJUSTMENT

This adjustment is made to insure that the turret does not release pins to the deck, when the deck is not in its up position.

1. With the pinsetter at 0°, disconnect the tension spring to the left blocking finger and loosen the two bolts which connect the upper and lower parts of the restricted drop link.
2. Move the upper part of the link upward, until the blocking finger is in its full up position.
3. Carefully work the upper part of the link down, until there is a 1/32" freeplay in the blocking finger. This is very important, as no freeplay can result in severe damage to the restricted drop mechanism. (Figure 43)
4. Make sure the 1/32" freeplay is maintained. Tighten the two bolts and replace the tension spring.

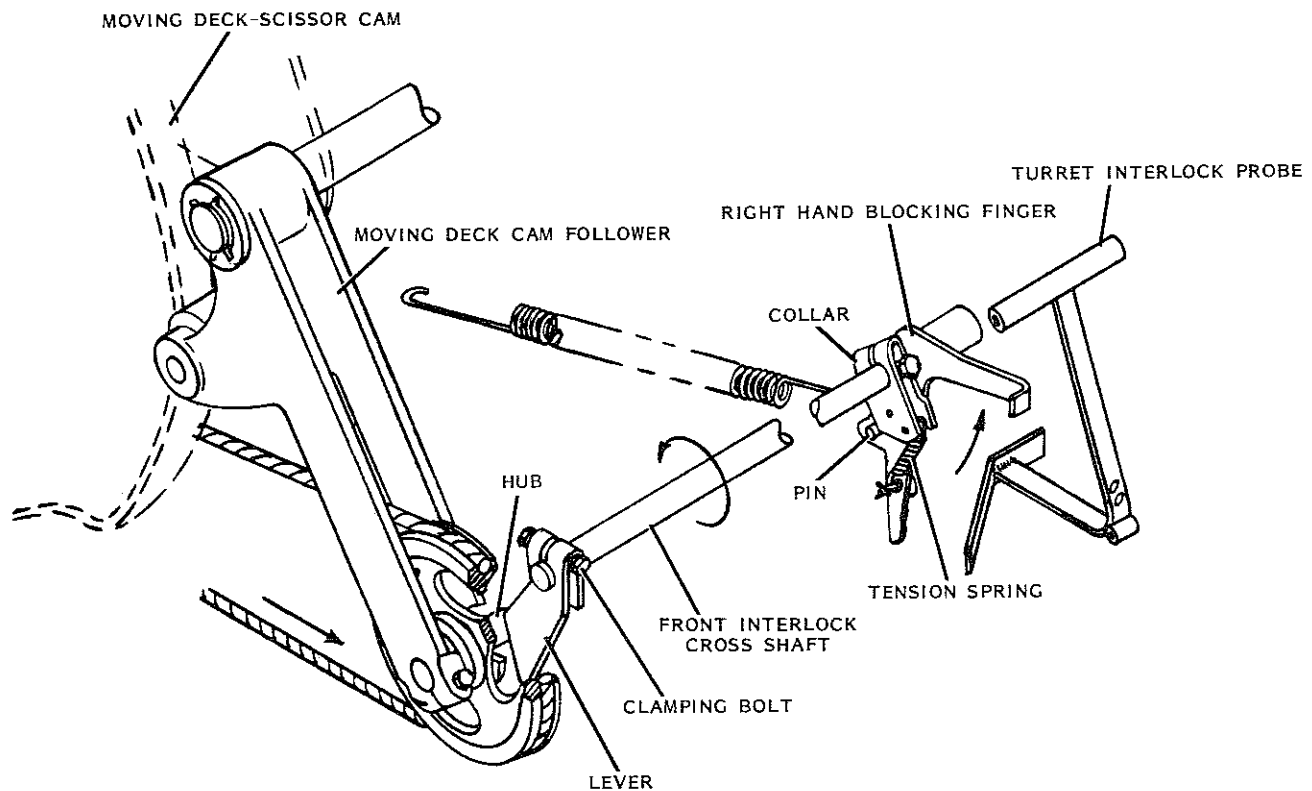


RESTRICTED DROP INTERLOCK ADJUSTMENT
FIGURE 43

44. FULL DECK-MOVING DECK INTERLOCK ADJUSTMENT

This adjustment is made to insure that the right blocking finger is in its down, blocking position, when either the moving deck is rearward or when the deck is full; and to insure that the right blocking finger is up when the moving deck is fully forward and when the deck is empty.

1. The long link is not adjustable. To check the operation of the full deck interlock, allow the turret to receive ten pins and deliver them to the deck. As the turret indexes after delivering the pins to the deck, the single rise on the outer perimeter of the turret indexing cam should push the long link back until the link is caught by the latch and held back. Then cycle the pinsetter and observe if the projection on the deck shaft frees the latch as it should when the deck reaches its full, new pinsetting depth at 270°. The latch must not release when the deck is at detecting height.
2. To adjust the moving deck interlock, cycle the pinsetter to exactly 0° and position the #5 pin chute under the cross conveyor, waiting for a pin. Make sure the hook latch is not holding the long link in its rear position.
3. Loosen the clamping bolt on the lever which contacts the hub of the moving deck pulley. Rotate the front interlock cross shaft counterclockwise until the upward motion of the right hand blocking finger stops. Stretch the tension spring slightly. (Figure 44)
4. While holding the shaft in this position, rotate the lever against the hub on the moving deck pulley. Tighten the clamping bolt.



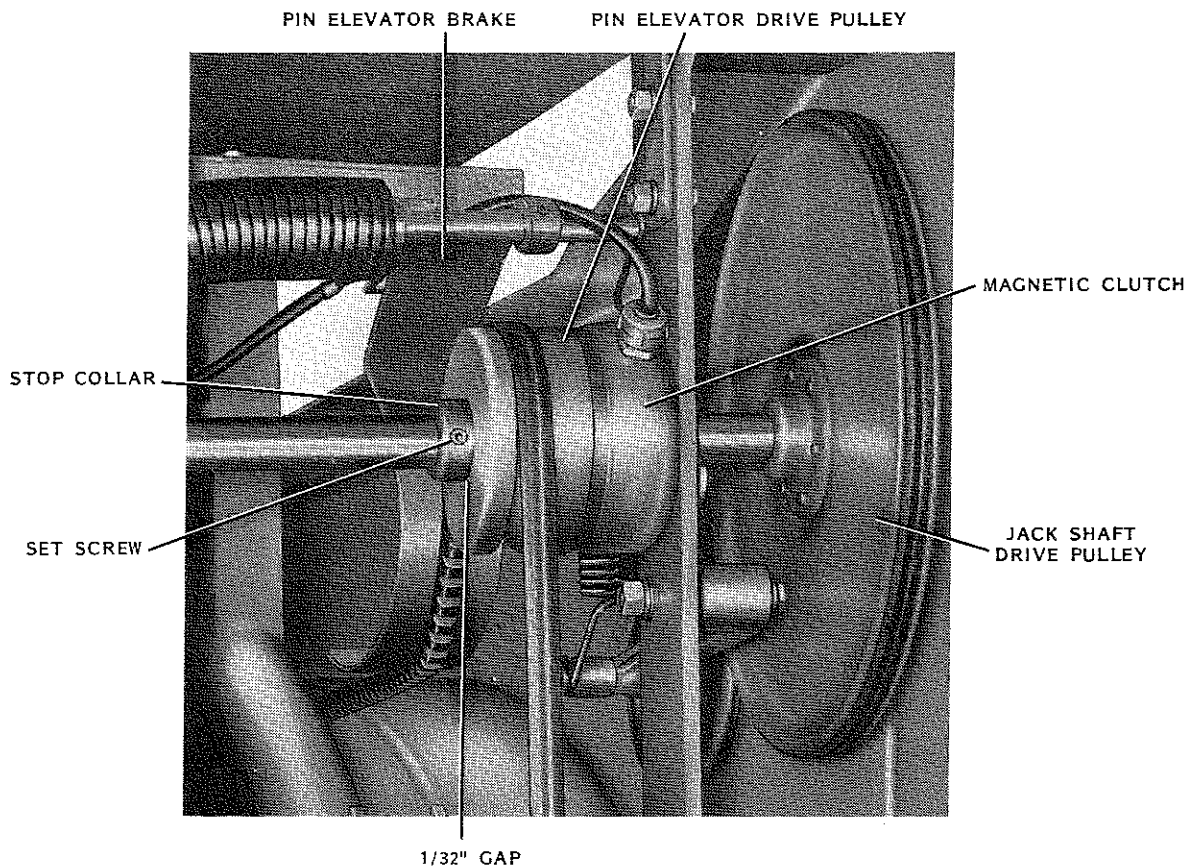
FULL DECK -MOVING DECK INTERLOCK ADJUSTMENT

FIGURE 44

45. MAGNETIC CLUTCH ADJUSTMENT

This adjustment is made to insure that the magnetic clutch has sufficient clearance to disengage and to insure that the magnetic clutch will be de-energized when both levers on the cross conveyor are raised at the same time.

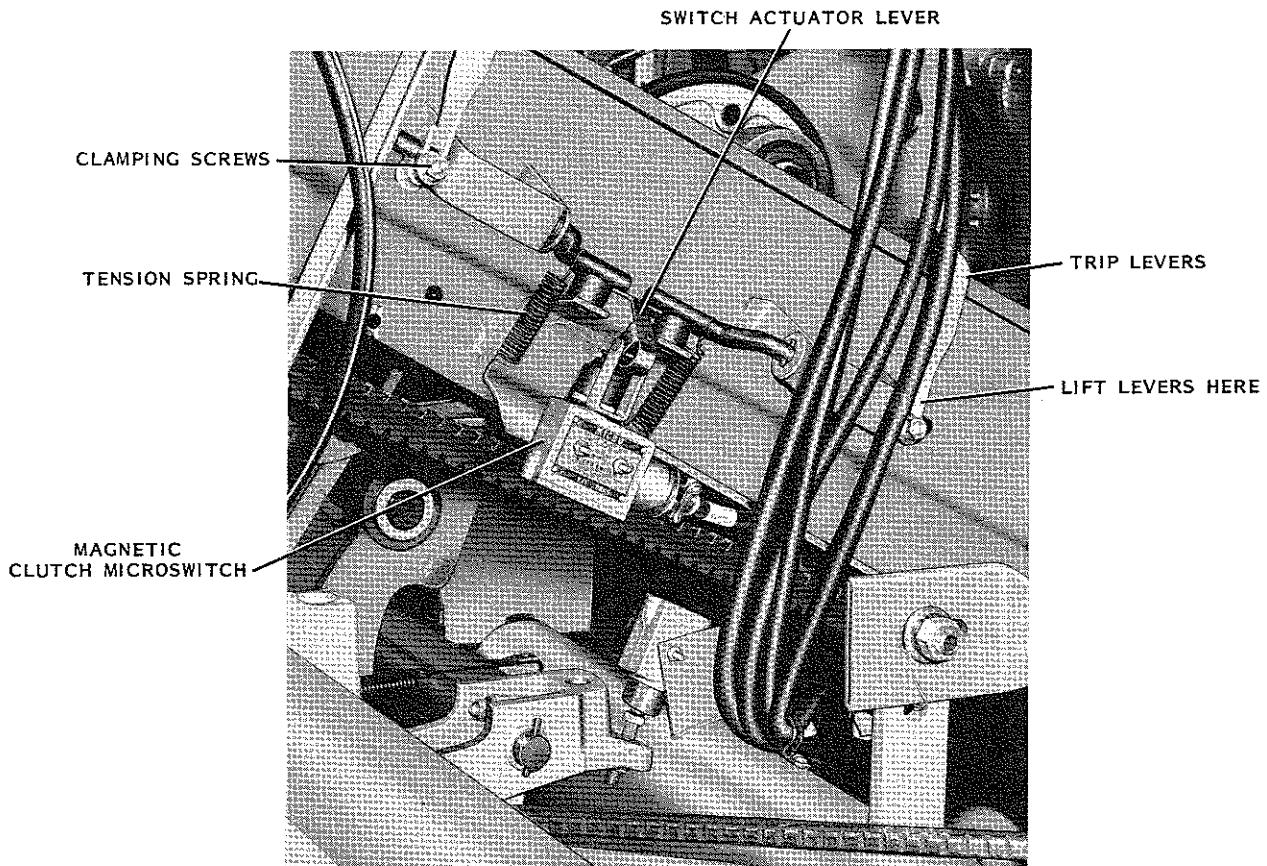
1. With the clutch de-energized (power shut off), loosen the set screw on the stop collar which positions the pin elevator drive pulley. (Figure 45)
2. Push the pulley firmly against the magnetic clutch.
3. Set the gap between the pulley and the stop collar at $1/32"$. Tighten the set screw.
4. Latch the pin gate so that no pins can be delivered to the turret and allow two pins to be delivered to the cross conveyor and be stopped by the latched pin gate.



MAGNETIC CLUTCH ADJUSTMENT

FIGURE 45

5. Loosen the two clamping screws at the ends of the trip levers. While holding the rollers firmly against the pins on the cross conveyor, push the lower ends of both levers down against the microswitch. While holding the rollers on the pins, slowly lift the lower ends of both trip levers, until the microswitch just clicks, indicating the switch has opened. Tighten the clamping screws to hold the levers in this position. (Figure 46)



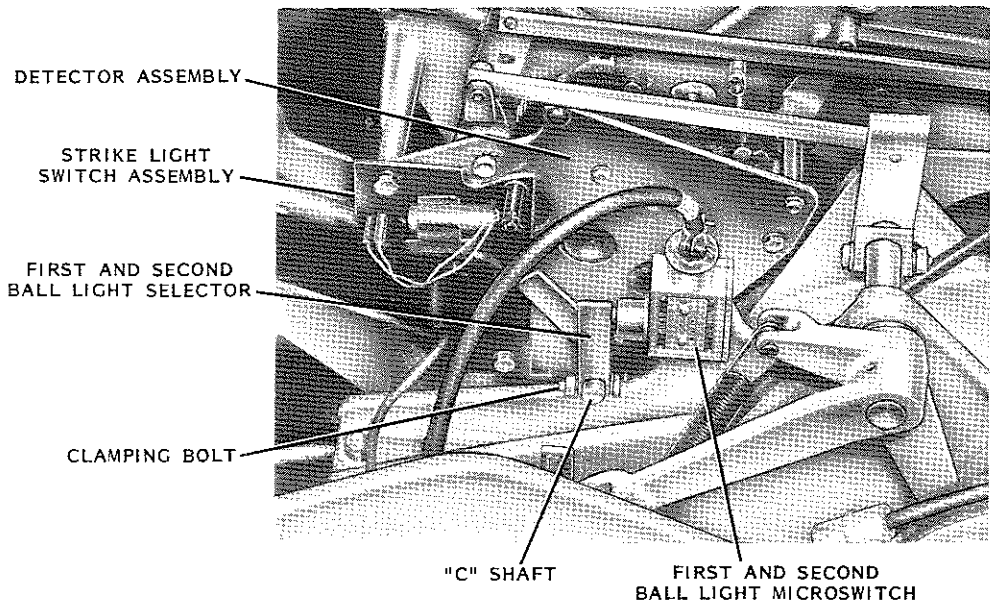
CROSS CONVEYOR MICROSWITCH ADJUSTMENT

FIGURE 46

46. FIRST AND SECOND BALL LIGHT MICROSWITCH ADJUSTMENT

This adjustment is made to insure that the first ball light is lit during the first ball cycle and then changes to the second ball light in the event that standing pins are left:

1. With the pinsetter at 0°, first ball, loosen the clamping bolt on the lever from the detector assembly that contacts the first and second ball light microswitch. (Figure 47)
2. Slowly push the lever against the button on the microswitch until the first ball light goes on and then carefully push the lever in another 1/16". Tighten the bolt.
3. As a check, cycle the pinsetter and observe whether the first and second ball lights operate at the proper time.

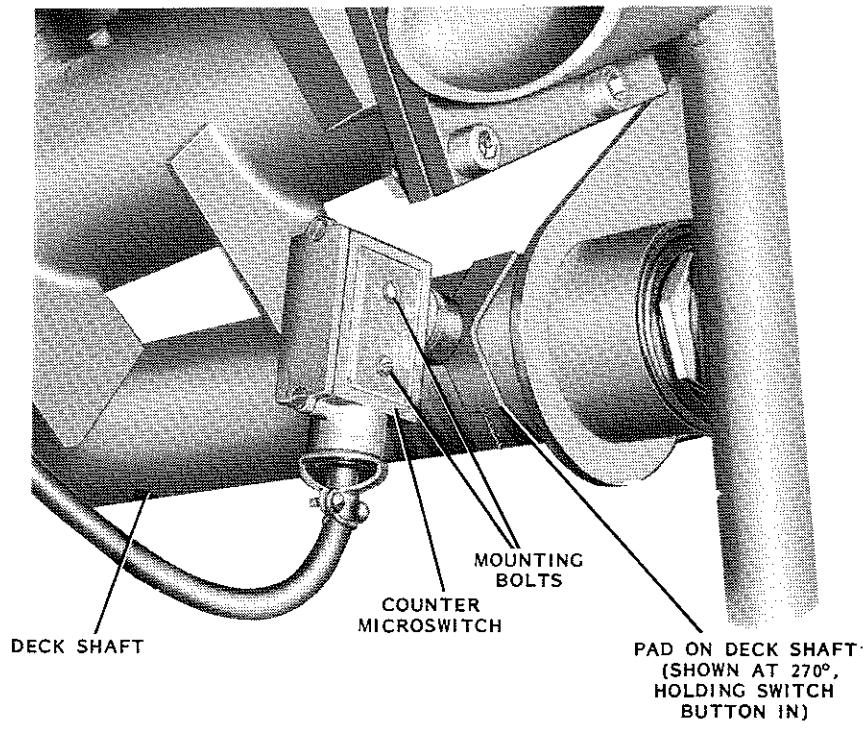


FIRST AND SECOND BALL LIGHT MICROSWITCH ADJUSTMENT
 FIGURE 47

47. COUNTER MICROSWITCH ADJUSTMENT

This adjustment is made to insure that the frame counter counts once, each time the deck sets ten new pins.

1. Cycle the pinsetter to exactly 270°, setting new pins.



COUNTER MICROSWITCH ADJUSTMENT
 FIGURE 48

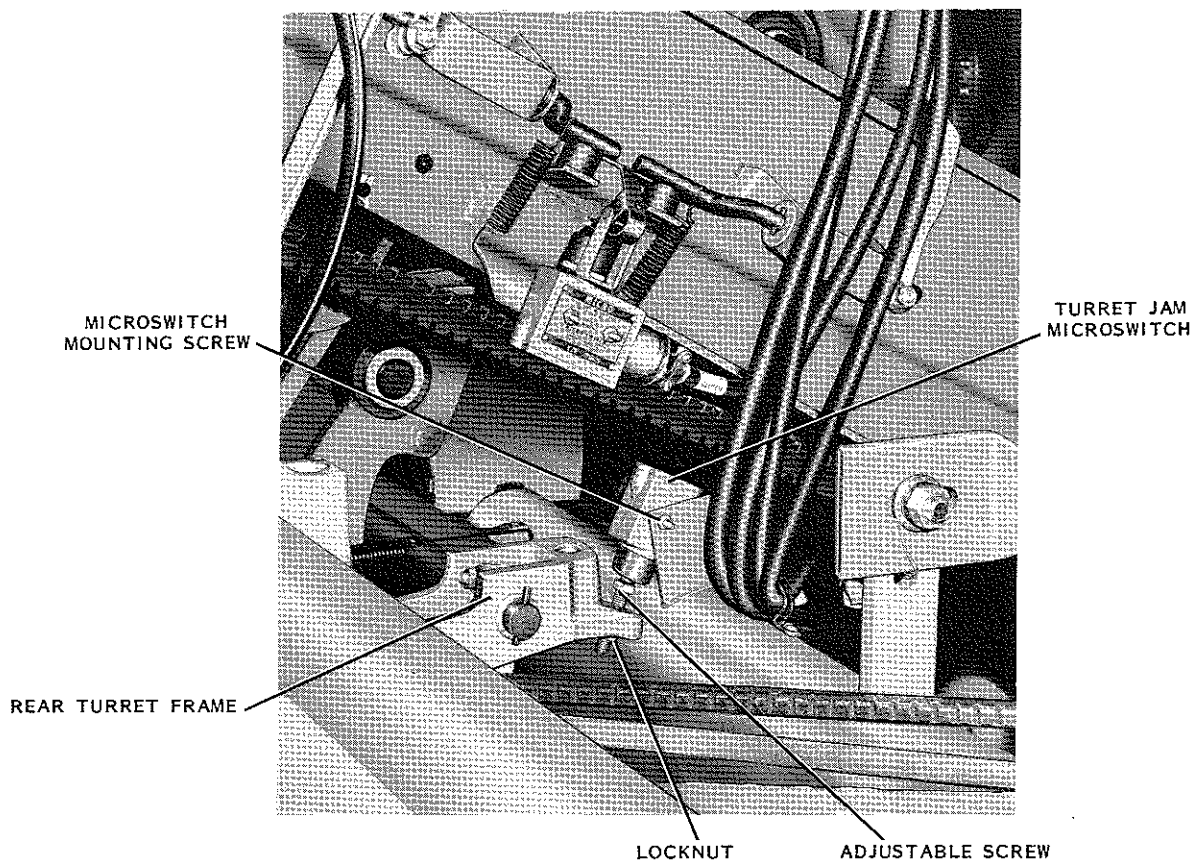
2. Loosen the counter microswitch mounting bolts and position the switch so that the pad on the deck shaft is holding the switch button in. Tighten the mounting bolts. Care should be taken to prevent the switch from being positioned to permit the pad to hit the microswitch twice, once going down and again on the way up. (Figure 48)

NOTE: If the deck must remain in its lowered position for any length of time with the power on, raise the deck enough to prevent the pad on the deck shaft from depressing the counter. The solenoids controlling the counters are not rated for continuous duty and they will burn out, if left on for any length of time.

48. TURRET JAM MICROSWITCH ADJUSTMENT

This adjustment is made to insure that the turret jam microswitch will open, thereby shutting off the pinsetter, in the event a pin or other foreign object on top of the deck contacts the turret.

1. Loosen the locknut on the adjustable screw located under the turret jam microswitch. (Figure 49)
2. Be certain that the turret is level per Adjustment 35.
3. With the turret frame resting on the turret leveling nuts, turn the microswitch adjusting screw down until the switch opens. Turn the adjusting screw out until the switch just closes. Then turn the adjusting screw one additional full turn. Tighten the locknut.



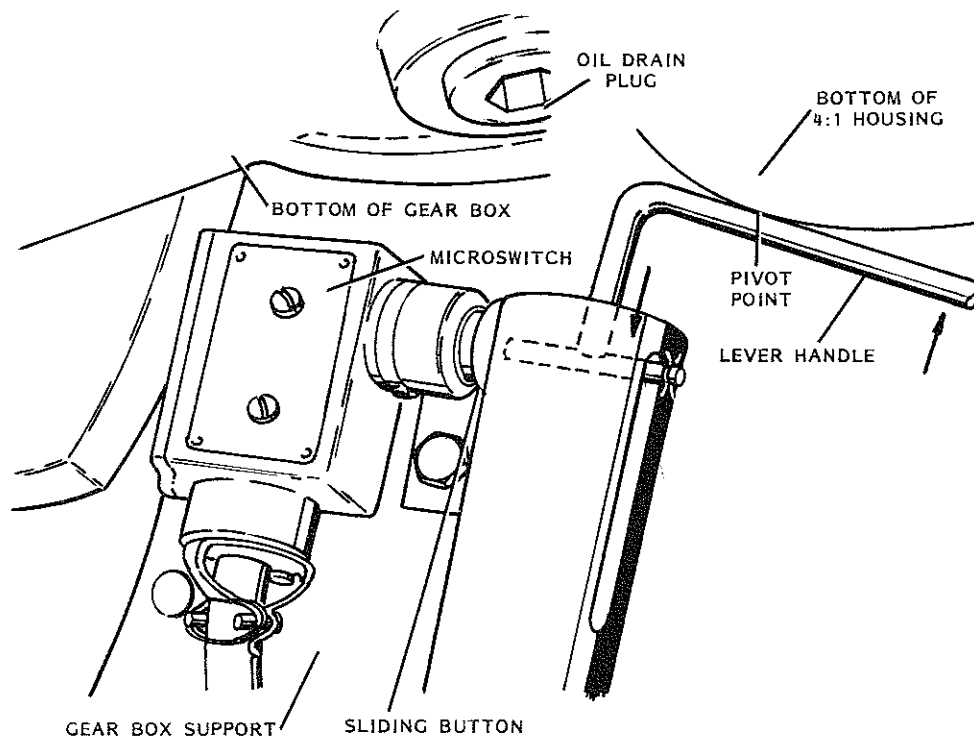
TURRET JAM MICROSWITCH ADJUSTMENT

FIGURE 49

49. MOVING DECK JAM MICROSWITCH ADJUSTMENT

This adjustment is made to insure that the microswitch remains closed during normal operation, and to insure that the switch will open to shut off the machine in the event a deck jam occurs.

1. At 0°, check the position of the microswitch button, with relation to the sliding button which holds the microswitch closed. (Figure 50)



MOVING DECK JAM MICROSWITCH ADJUSTMENT
FIGURE 50

2. If the microswitch button is not in contact with the center of the sliding button, reposition the microswitch until this center contact is obtained. The microswitch can be moved by adding spacers between the switch and the gear box support and also by elongating the mounting holes in the gear box support.
3. As a check, lever the button down and observe if the sliding button moves away from the switch, thereby shutting off the power.

If the center contact of step 2 is not obtained, the pin lights will tend to blink off and on when the deck is setting new pins.

CAUTION: The moving deck jam microswitch, when properly adjusted, will adequately protect the pinsetter from damage due to deck jams. If the purpose of the switch is ever nullified, severe damage to the gear box may result.

1. Under no circumstances should the machine ever be placed under power by bypassing the deck jam microswitch.
2. Under no circumstances should the machine ever be forced to rotate forward manually if a deck jam has opened the microswitch.

TO PROPERLY CLEAR A DECK JAM, PROCEED AS FOLLOWS:

1. Shut off the power by opening the control box circuit breaker.
2. Rotate the gear box drive pulley backward (clockwise when observed from the rear of the machine). This will cause the moving deck to shift to the rear, releasing the jammed pin or pins. It may be necessary to rotate the moving deck-scissor latch to unblock the moving deck cam follower when manually reversing the pinsetter.
3. Remove the pins from the deck and resume normal operation.

NOTE: Newer machines contain a deck jam protection kit (Figure 51).

50. DECK JAM CLUTCH RELEASE MECHANISM ADJUSTMENT

This adjustment is made to insure that the pinsetter will not be damaged by deck jams. With the deck jam clutch release mechanism installed, the pinsetter clutch is disengaged when a deck jam occurs, assuring that no abnormal stresses are placed on any of the deck or gear box parts.

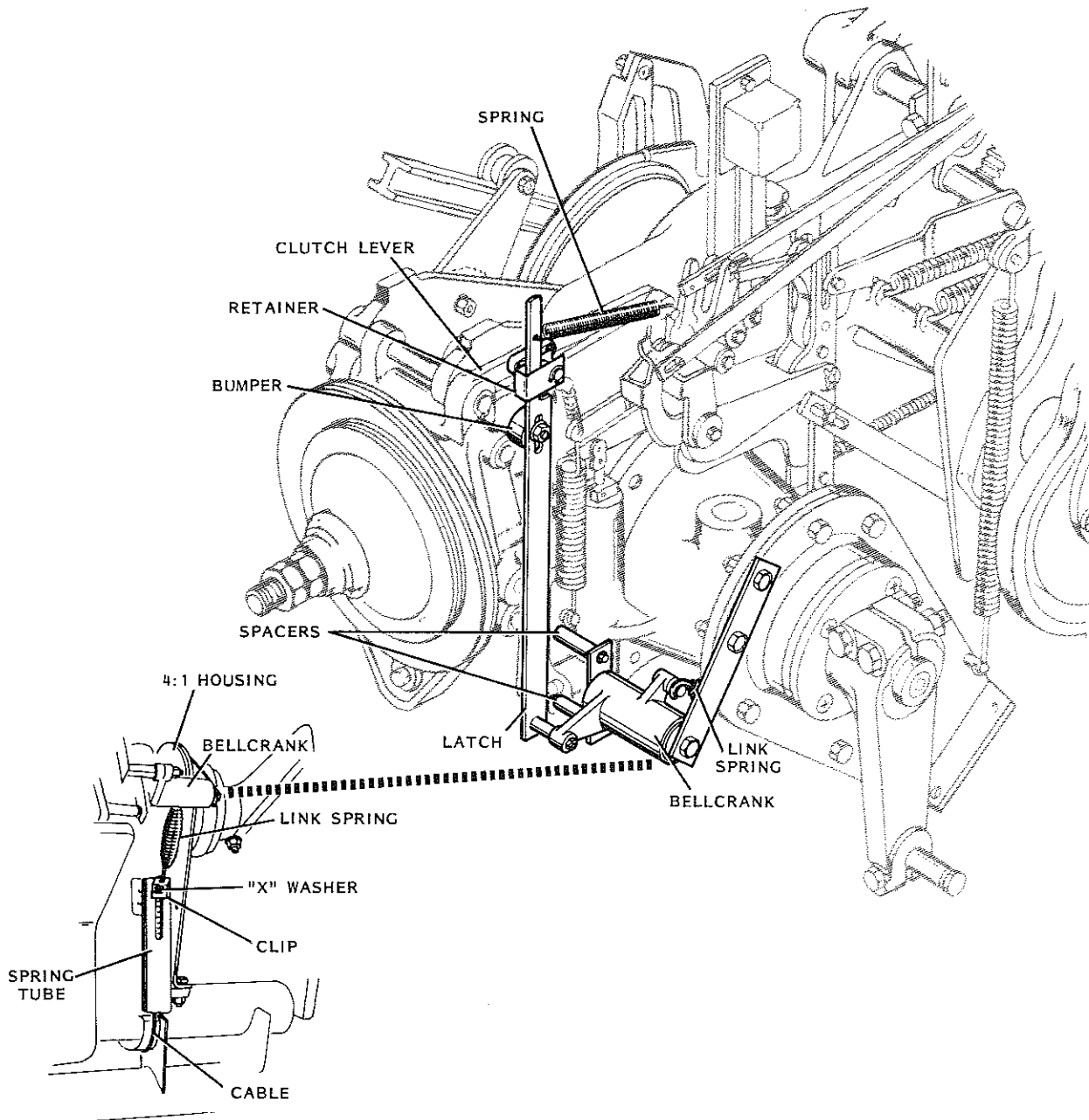
This system also incorporates an electrical shutoff device which prevents the pinsetter from restarting until the circuit breaker is turned off and then on. This greatly reduces the possibility that inexperienced personnel will be injured by clearing a deck or turret jam with the pinsetter power on.

DECK JAM

1. A deck jam occurs when the moving deck is prevented from moving forward by some obstruction after setting new pins. (Usually a pin has failed to drop from the deck.)
2. As the moving deck cam follower continues up the moving deck-scissors cam, increased tension is applied to the moving deck cable.
3. The increased tension on the cable causes the spring in the spring tube mounted on the 4:1 housing to compress. (Figure 51)
4. As the spring is compressed, the pin in the spring tube moves downward pulling the link spring with it. The spring in turn causes the bellcrank to rotate, moving the latch upward.
5. The latch raises the clutch lever, disengaging the clutch, stopping the pinsetter.
6. At the same time, the pin in the spring tube moves off the deck jam switch actuator. The normally closed contacts of the switch close, energizing relay RL4. RL4's normally closed contacts open, de-energizing the motor start relay which de-energizes the motor contactor, turning off the pinsetter motor.
7. The normally open contacts of RL4 close, electrically latching RL4 in the energized state. RL4 will remain energized until the circuit breaker is turned off. Therefore, the motor can only be restarted by clearing the jam and turning the breaker off, then on.

NOTE: Some machines may not include the electrical relay system. This requires turning off the electrical power to clear the jam.

8. To clear a jam, the clutch can be re-engaged by moving the top of the latch rearward. This allows the pin on the clutch lever to disengage from the latch, re-engaging the clutch. The gear box can now be manually reversed with the belts to clear the jam.



DECK JAM CLUTCH RELEASE MECHANISM ADJUSTMENT

FIGURE 51

TURRET JAM

1. When a turret jam occurs, the turret frame moves away from the turret jam switch causing its normally closed contacts to close. RL4 energizes, de-energizing the motor start relay RL2 and the motor contactor RL3, turning off the motor. As with a deck jam, the normally closed contacts of RL4 close, latching RL4 in its energized position. Again, RL4 can only be de-energized by clearing the jam and turning the breaker off, then on.

CLEARING A DECK JAM

1. Turn off the pinsetter circuit breaker.
2. Move the top of the new latch rearward. This will release the clutch lever and re-engage the clutch.
3. Using the motor to gear box belt, manually reverse the gear box until the pin or pins causing the jam can be removed.
4. Remove the pins and turn the circuit breaker on. The pinsetter will restart.
5. On pinsetters with electrical triggering, the trigger solenoid will energize shortly after the circuit breaker is turned on.
6. This will cause the pinsetter to continue to cycle past 0° and stop at 180° with pins in the scissors. The pinsetter is restarted by raising 180° turret interlock link. The pinsetter will then cycle to 0°, waiting for second ball. If a full set of pins are on the playing surface, switch the pinsetter to first ball by raising the deck holding hook. If a full set of pins is not present, recycle the pinsetter to set new pins.

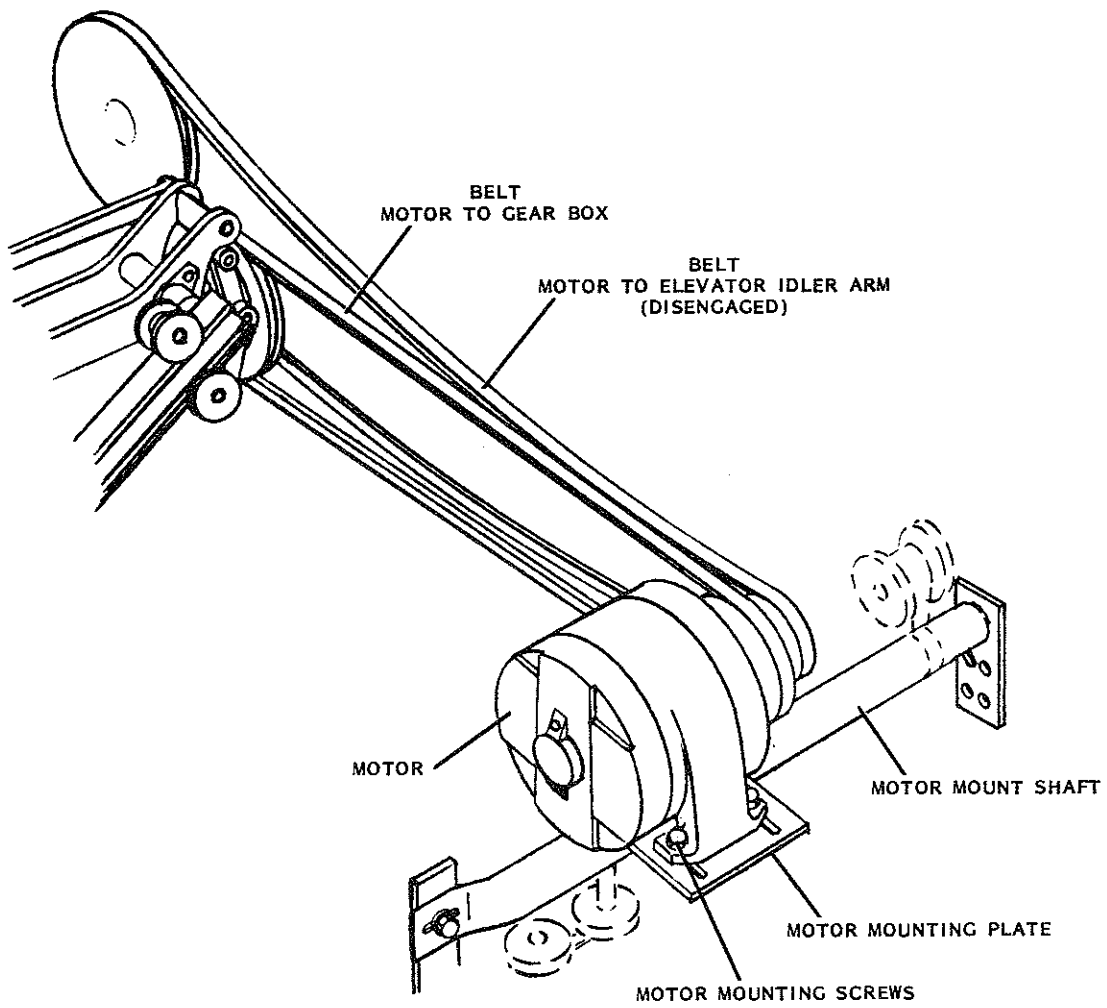
CLEARING A TURRET JAM

1. Turn off the circuit breaker.
2. Using the motor to gear box belt, manually reverse the gear box, lowering the deck until the pins causing the jam can be removed.
3. Turn the circuit breaker on.

51. MOTOR MOUNT ADJUSTMENT

This adjustment is made to insure that the motor is positioned properly to provide adequate tensions on the motor to gear box belt and motor to elevator belt.

1. Remove the spring-tensioned idler pulley from the motor to elevator belt.
2. Loosen the four bolts that mount the motor to the plate on the motor mount shaft. The four mounting holes are elongated for adjustment. (Figure 52)
3. Move the motor to the right until adequate tension is placed on the motor to gear box belt. Tighten the four mounting bolts.
4. Replace the idler pulley on the motor to elevator belt.
5. Improper motor to gear box belt tension can cause belt slippage and overloading of motor while lifting deck.
6. Check belt lengths carefully. Measure around motor pulley and gear box pulley with 1/2" wide measuring tape for closest belt length.



MOTOR MOUNT ADJUSTMENT
 FIGURE 52

TROUBLESHOOTING INDEX

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SECTION IV

TROUBLESHOOTING

COMPLAINT 1: RAKE FAILS TO SWEEP

- Cause A: Rake sweep hook fails to engage block on rake crank link.
Remedy A: Check rake sweep hook adjustment (Adjustment #2, page 3-4).
- Cause B: Out-of-range latch engages pin on overhead shaft.
Remedy B: Check out-of-range latch adjustment (Adjustment #21, page 3-25).
- Cause C: Bind in rake sweep hook cam follower or rake sweep hook mechanism.
Remedy C: Check the rake sweep hook cam follower, adjusting link, rotating collar and sweep hook assembly for possible binds. Correct as required.

COMPLAINT 2: RAKE RELEASES DURING SWEEP MOTION

- Cause A: Rake sweep hook does not fully engage block on rake crank link assembly.
Remedy A: Check rake sweep hook adjustment (Adjustment #2, page 3-4).
- Cause B: Rake board contacts lane surface during sweep motion, thereby allowing rake sweep hook to release.
Remedy B: See Complaint No. 4.
- Cause C: Rake board contacts pins held in scissors.
Remedy C: Check rake board height adjustment (Adjustment #3, page 3-6) and deck eccentric adjustment (Adjustment #17, page 3-21).
- Cause D: Block on rake sweep link reversed with tapered edge engaging rake sweep hook.
Remedy D: Reassemble block in correct position.
- Cause E: Out-of-range latch engages pin on overhead cross shaft.
Remedy E: Check out-of-range latch adjustment (Adjustment #21, page 3-25).

COMPLAINT 3: RAKE SWEEPS OUT OF TIME

- Cause A: Rake sweep hook engaged at improper time.
Remedy A: Check rake sweep hook adjustment (Adjustment #2, page 3-4).
- Cause B: Detector out-of-time.
Remedy B: Check detector timing with respect to the gear box. Refer to page 2-21.

COMPLAINT 4: RAKE CONTACTS LANE SURFACE DURING SWEEP MOTION

- Cause A: Rake board set too low.
Remedy A: Check rake board height adjustment (Adjustment #3, page 3-6).
- Cause B: Rake trip mechanism not relatching before sweep motion.
Remedy B: Check rake board height adjustment (Adjustment #3, page 3-6). Check for binding or restriction of motion in the latching mechanism.

COMPLAINT 5: RAKE BOARD CONTACTS EDGE OF LANE DURING SWEEP MOTION

- Cause A: Pinsetter frame shifted on kickback. As a clue, it may be noted that the deck does not accurately spot pins.
Remedy A: Shift pinsetter on kickbacks. Refer to deck pinspotting adjustment (Adjustment #15, page 3-19).

COMPLAINT 6: PINS PASS UNDER RAKE BOARD DURING SWEEP MOTION

- Cause A: Rake board set too high.
Remedy A: Check rake board height adjustment (Adjustment #3, page 3-6).

COMPLAINT 7: RAKE BOARD DOES NOT RAISE AT 0 DEGREES

- Cause A: Rake trip latch does not re-engage during sweep motion.
Remedy A: Check the rake board height adjustment (Adjustment #3, page 3-6).
Cause B: Weak spring or bind on rake trip mechanism.
Remedy B: Inspect and correct as required.

COMPLAINT 8: RAKE BOARD RAISES AT 0 DEGREES BUT DOES NOT STAY UP. RAKE BOARD IMMEDIATELY LOWERS AND PINSETTER RECYCLES.

- Cause A: Rake trip mechanism not fully engaged.
Remedy A: Check rake board height adjustment (Adjustment #3, page 3-6).
Cause B: Pit cushion trigger link out of adjustment. Trigger gap too small.
Remedy B: Check pit cushion trigger link adjustment (Adjustment #5, page 3-10).
Cause C: Bind in pit cushion linkage.
Remedy C: Check pit cushion linkages for possible binds or restriction of motion. Correct as required.
Cause D: Ball held under pit cushion by pins.
Remedy D: Check pit conveyor, pin elevator, turnaround pan, cross conveyor, pin gate and turret for possible malfunction. Correct as required.

COMPLAINT 9: RAKE SWEEPS DURING AN OUT-OF-RANGE CYCLE

- Cause A: Out-of-range latch did not engage pin on overhead cross brace.
Remedy A: Check out-of-range latch adjustment (Adjustment #21, page 3-25).
Check the rake sweep hook adjustment (Adjustment #2, page 3-4) and the out-of-range reset linkage. Correct as required.

COMPLAINT 10: PINS WOBBLE OR FALL WHEN SET BY THE MOVING DECK.

- Cause A: Pins touched by deck chutes or guide fingers as the deck rises.
Remedy A: Check moving deck cable adjustment (Adjustment #20, page 3-24).
Cause B: Scissors not fully open, thereby touching the pins.
Remedy B: Check scissor cable adjustment (Adjustment #19, page 3-24).

Cause C: Pins sticking in deck chutes.
Remedy C: Clean the deck chutes with Brunswick Pinsetter Cleaner, as prescribed in the Preventive Maintenance Section of this manual. Also check the condition of the pins for cleanliness. Correct as required.

Cause D: Worn, round bottoms on pins.
Remedy D: Replace pins.

Cause E: Deck assembly not level or not at correct height above lane surface.
Remedy E: Check deck height and level adjustment (Adjustment #14, page 3-17).

Cause F: Interference between the moving deck and stationary deck.
Remedy F: Check entire moving deck assembly and stationary deck assembly for possible binds or interference. Check the rubber roller to make certain that the pins roll freely and check for loose or broken guide fingers.

COMPLAINT 11: PINS WOBBLE WHEN RESPOTTED AT 270°

Cause A: Moving deck cable adjusted too loose.
Remedy A: Check moving deck cable adjustment (Adjustment #20, page 3-24). If the moving deck cable is adjusted too loose, the moving deck will make a slight rearward shift at 180 degrees with pins held in the scissors. Consequently, the pins will be tilted and thus wobble when placed on the lane surface.

Cause B: Worn, round bottoms on pins.
Remedy B: Replace pins.

Cause C: Defective scissor link, loose or missing pivot screw, or defective rubber pad.
Remedy C: Inspect the entire scissors and respotting mechanism. Correct as required.

COMPLAINT 12: DECK SETS PINS TOO FAR OFF SPOT

Cause A: Deck not centered over pin area.
Remedy A: Check deck pinspotting adjustment (Adjustment #15, page 3-19).

Cause B: Motion of pins restricted by faulty roller or guide fingers.
Remedy B: Check the roller for freedom of motion and the guide fingers. Repair or replace as required.

COMPLAINT 13: NEW PINS SET FROM RESPOTTING HEIGHT

Cause A: Deck lowering hook not prevented from engaging deck lowering pin.
Remedy A: Check deck lowering hook latch adjustment (Adjustment #16, page 3-20).

Cause B: Moving deck-scissor latch not adjusted properly. The scissors remain blocked out during a normal standing pins cycle which allows the moving deck to shift rearward and deposit pins to the lane surface from respotting height.

Remedy B: Check the moving deck-scissor latch adjustment (Adjustment #18, page 3-23).

Cause C: Strike cam follower in the detector assembly does not properly seat against the low level of the timing cam.

Remedy C: Check the entire strike mechanism, and "B" shaft assembly for binds or interference. Correct as required.

COMPLAINT 14: SCISSORS FAIL TO OPEN OR CLOSE PROPERLY

- Cause A: Scissor cable misadjusted.
Remedy A: Check scissor cable adjustment (Adjustment #19, page 3-24).
- Cause B: Scissor mechanisms on stationary deck inoperative.
Remedy B: Check each pair of scissors for mechanical failure and correct as required.
- Cause C: Moving deck-scissor latch not adjusted properly.
Remedy C: Check moving deck-scissor latch adjustment (Adjustment #18, page 3-23).
- Cause D: Restriction in scissor cable or pulleys.
Remedy D: Check scissor cable and all scissor pulleys. Repair or replace as required.

COMPLAINT 15: MOVING DECK WILL NOT SHIFT TO SET NEW PINS

- Cause A: Jam in moving deck or moving deck cable.
Remedy A: Check the moving deck cable to make sure that the cable is on all of its pulleys and that the rear geneva rollers are free to rotate the moving deck rearward. Check the moving deck for possible rearward binding or interference.
- Cause B: Moving deck-scissor latch not adjusted properly.
Remedy B: Check the moving deck-scissor latch adjustment (Adjustment #18, page 3-23).
- Cause C: Roller on strike cam follower does not seat against low level of timing cam.
Remedy C: Check the entire strike mechanism and the "D" shaft assembly in the detector for possible binding or interference. Correct as required.

COMPLAINT 16: PINS SET OR RESPOTTED WITH DECK HELD UP ON DECK HOLDING HOOK

- Cause A: Out-of-range latch engages pin on overhead cross brace when it should not. As a clue to this malfunction, it will be observed that the rake may not sweep.
Remedy A: Check out-of-range latch adjustment (Adjustment #21, page 3-25).
- Cause B: Deck holding hook adjusted improperly.
Remedy B: Check deck holding hook adjustment (Adjustment #22, page 3-26).

COMPLAINT 17: DECK DOES NOT MAKE SHORT DETECTING OR RESPOTTING STROKE

- Cause A: Deck lowering hook prevented from engaging the deck lowering pin.
Remedy A: Deck lowering hook latch not adjusted properly.
Check deck lowering hook latch adjustment (Adjustment #16, page 3-20).
- Cause B: Deck held up on deck holding hook.
Remedy B: Check deck holding hook adjustment (Adjustment #22, page 3-26).

COMPLAINT 18: DECK LOWERS AT 90° DURING A SECOND BALL CYCLE

- Cause A: Deck holding hook failed to engage pin on deck support arm.
Remedy A: Check deck holding hook adjustment (Adjustment #22, page 3-26).

COMPLAINT 19 CONSTANT MOVING DECK JAMS

NOTE: This is a very difficult malfunction to track down. There are many factors which can cause a deck jam and unfortunately the mechanic sees only the end result - the deck jam. If possible, observe the machine while it is operating and endeavor to locate the basic cause of the deck jam.

Cause A: Pin gate failure - pins feed to turret while turret is full or indexing.
Remedy A: Check pin gate adjustment (Adjustment #34, page 3-40).

Cause B: Pins do not seat properly in turret - pins fall in or on deck. This is the most common cause of deck jams and can result from any of the following:

1. Turret wires misadjusted.
2. Turret spider misadjusted.
3. Turret halo ring misadjusted.
4. Turret-spider latch fails to relock.
5. Snubber misadjusted.

Remedy B: Check turret wire adjustment (Adjustment #36, page 3-42).
Check spider adjustment (Adjustment #37, page 3-42).
Check halo ring adjustment (Adjustment #38, page 3-42).
Check snubber adjustment (Adjustment #39, page 3-43).

Cause C: Restricted drop interlock failure - pins dropping too great a distance and missing the deck chutes.
Remedy C: Check restricted drop interlock adjustment (Adjustment #43, page 3-46).

Cause D: Pins delivered from turret into full deck.
Remedy D: Check full deck-moving deck interlock adjustment (Adjustment #44, page 3-47).

Cause E: Turret double indexes - causes pin to miss turret basket and fall on or in deck.
Remedy E: Check turret index trip lever adjustment (Adjustment #41, page 3-44).
Check interlock probe adjustment to make sure probe does not trip the torsion latch (Adjustment #40, page 3-44).

Cause F: Scissors do not open completely, causing pins to hang up in deck chutes.
Remedy F: (See Complaint 14).

Cause G: Pins not released to lane because moving deck did not fully retract.
Remedy G: (See Complaint 15).

Cause H: Pins hang up in deck chutes because chutes are cracked or split.
Remedy H: (See Complaint 10).

COMPLAINT 20: DECK DROPS OFF DECK HOLDING HOOK AT 270° DURING A FIRST BALL OUT-OF-RANGE CYCLE.

Cause A: Deck holding hook adjusted too high. Deck holding hook not adjusted properly in relation to the rake sweep hook adjustment and the out-of-range latch adjustment.

Remedy A: Check the rake sweep hook adjustment (Adjustment #2, page 3-4), the out-of-range latch adjustment (Adjustment #21, page 3-25), and the deck holding hook adjustment (Adjustment #22, page 3-26).

COMPLAINT 21: BALLS NICKED OR DAMAGED

Cause A: Ball strikes end of track or machine part enroute from pit to bowler.
Remedy A: Check ball transfer adjustment (Adjustment #27, page 3-32). Also check entire return system for sharp edge which can contact ball.

COMPLAINT 22: BALL DOES NOT RETURN OR RETURN TIME TOO LONG

Cause A: Ball lodged in pin elevator - ball lift rods adjusted too high.
Remedy A: Check ball lift rod adjustment (Adjustment #26, page 3-30).

Cause B: Ball jam at switch track - balls from two pinsetters reach switch track simultaneously due to failure of the ball preference mechanism.
Remedy B: Check ball preference adjustment (Adjustment #28, page 3-33).

Cause C: Ball falls off track due to rough transfer from lift rods to track.
Remedy C: Check ball transfer adjustment (Adjustment #27, page 3-32).

Cause D: Ball stays at rear edge of pit conveyor due to edge of pit conveyor being lower than the ball elevator.
Remedy D: Check elevator frame adjustment (Adjustment #24, page 3-28).

Cause E: Ball spinning in normal pickup position due to oil or lane dressing on ball or elevator wheel.
Remedy E: Clean ball and elevator wheel per the Preventive Maintenance Section of this manual.

Cause F: Ball contacts front edge of ball elevator only, due to misadjusted ball lift rods.
Remedy F: Check ball lift rod adjustment (Adjustment #26, page 3-30).

Cause G: Ball cannot pass front ball lift rod due to misadjusted ball lift rods.
Remedy G: Check ball lift rod adjustment (Adjustment #26, page 3-30).

Cause H: Ball spins near top of ball lift rods due to oil on the ball elevator wheel or misadjusted ball lift rods.
Remedy H: Clean ball and ball elevator wheel. Check ball lift rod adjustment (Adjustment #26, page 3-30).

Cause I: Ball accelerator assembly not adjusted properly.
Remedy I: Check ball accelerator adjustment (Adjustment #29, page 3-35).

Cause J: Ball retarder assembly not adjusted properly.
Remedy J: Refer to the ball retarder manual for proper adjustment.

Cause K: Power lift mechanism at ball return rack not functioning properly.
Remedy K: Refer to the ball lift manual for proper adjustment.

Cause L: Ball slowed down due to poor ball track alignment and ball transfer.
Remedy L: Check ball transfer adjustment (Adjustment #27, page 3-32) and ball preference adjustment (Adjustment #28, page 3-33).

Cause M: Ball elevator wheel improperly aligned or adjusted.
Remedy M: Check elevator frame adjustment (Adjustment #24, page 3-28) and elevator guide roller adjustment (Adjustment #25, page 3-29).

Cause N: Thermal circuit breaker on ball accelerator motor open.
Remedy N: Press reset button on ball accelerator motor. If thermal overload continues to open, check the ball accelerator adjustments (Adjustment #29, page 3-35) and the electrical circuit to the ball accelerator.

COMPLAINT 23: PINS DROP FROM TURRET WHEN DECK IS DOWN TOO FAR

Cause A: Restricted drop interlock failure.
Remedy A: Check restricted drop interlock adjustment (Adjustment #43, page 3-46).

Cause B: Turret interlock probe misaligned.
Remedy B: Check turret interlock probe adjustment (Adjustment #40, page 3-44).

COMPLAINT 24: PINS DROP FROM TURRET WHEN DECK IS FULL OR WHEN MOVING DECK IS RETRACTED

Cause A: Full deck-moving deck interlock mechanism improperly adjusted.
Remedy A: Check full deck-moving deck interlock adjustment (Adjustment #44, page 3-47).

Cause B: Hook latch does not hold long link rearward when deck is full.
Remedy B: Check action of the hook latch. Make sure the hook latch is not being released when deck is only at detecting height. Latch must not release until deck reaches new pinsetting depth at 270 degrees.

Cause C: Moving deck-scissor latch improperly adjusted. Prevents deck from retracting on pinsetting stroke, resulting in full deck with an empty deck interlock condition.
Remedy C: Check moving deck-scissor latch adjustment (Adjustment #18, page 3-23).

Cause D: Turret interlock probe improperly adjusted.
Remedy D: Check turret interlock probe adjustment (Adjustment #40, page 3-44).

COMPLAINT 25: PINS DO NOT RELEASE FROM TURRET WHEN THE DECK IS UP, EMPTY AND FORWARD

Cause A: If left hand blocking finger is down, there is a restricted drop interlock malfunction.
Remedy A: Check restricted drop interlock adjustment (Adjustment #43, page 3-46).

Cause B: If the right hand blocking finger is down, there is a full deck-moving deck interlock malfunction.
Remedy B: Check the full deck-moving deck interlock adjustment (Adjustment #44, page 3-47).

Cause C: Turret interlock probe too high - cannot get under raised blocking fingers.
Remedy C: Check interlock probe adjustment (Adjustment #40, page 3-44).

Cause D: Bottom of pin jammed between turret wire and side of spoon, thus preventing spider from releasing pins.
Remedy D: Check turret wire adjustment (Adjustment #36, page 3-42), and the spider adjustment (Adjustment #37, page 3-42).

- Cause E: The #5 pin slips through the #5 pin chute without releasing spider, due to too much clearance between the pin release lever and the front of the #5 pin chute.
- Remedy E: Carefully bend the portion of the pin release lever that the #5 pin contacts in an upward position inside the chute.

COMPLAINT 26: TURRET FAILED TO INDEX

- Cause A: Turret index trip lever not functioning correctly.
Remedy A: Check index trip lever adjustment (Adjustment #41, page 3-44).
- Cause B: Pin does not contact index trip lever due to tight turret wires.
Remedy B: Check turret wire adjustment (Adjustment #36, page 3-42).
- Cause C: The latch tripping arm on the spider binds on the front halo mounting bolt.
Remedy C: Carefully bend the trip arm to clear the halo support.
- Cause D: Pins or #5 pin chute binding against halo ring.
Remedy D: Check halo ring adjustment (Adjustment #8, page 3-12).
- Cause E: The stop roller on the stop lever assembly cannot move out of low dwell of indexing cam due to burr on cam.
Remedy E: Carefully file cam surface to remove burr.
- Cause F: Lubricant from indexing cam flows into belt pulley, causing belt to slip.
Remedy F: Clean belt and pulley. Use light film of oil on indexing cam.
- Cause G: Stop roller on stop lever assembly not free to turn on roller stud.
Remedy G: Check roller for ease of rotation. Repair or replace as required.
- Cause H: Turret clutch assembly does not freely slide back and forth due to lack of lubrication or misalignment.
Remedy H: Apply oil to clutch slides per the Preventive Maintenance Section of this manual.
- Cause I: Loose linkage between index trip lever and the indexing latch.
Remedy I: Tighten connecting linkage.
- Cause J: Lack of lubrication in turret ring assembly causing bind in turret rotation.
Remedy J: Lubricate turret ring assembly per the Preventive Maintenance Section of this manual.
- Cause K: Indexing trip lever spring stud bent, causing index trip lever to bind against stud.
Remedy K: Correct or replace stud.

COMPLAINT 27: TURRET FAILED TO INDEX AFTER NO. 5 PIN ONLY

- Cause A: Latch tripping arm on spider too high. Fails to release torsion latch.
Remedy A: Check time delay gear adjustment (Adjustment #42, page 3-45).
- Cause B: Indexing trip lever contacts interlock probe, preventing full stroke of trip lever.
Remedy B: Check interlock probe adjustment (Adjustment #40, page 3-44).

- Cause C: Bind in rotation of time delay gear.
Remedy C: Check for cause and correct as required.
- Cause D: Time delay gear loose on stud. Gear moves upward instead of depressing index trip lever.
Remedy D: Check for loose stud and correct.
- Cause E: Teeth on time delay gear do not mesh properly with teeth on drive gear.
Remedy E: Check for burr on teeth or misalignment of gear. Correct as required.
- Cause F: Clutch does not turn drive gear.
Remedy F: Check clutch for misalignment of roll pins and spring guide assembly or anything that prevents internal clutch compression spring from exerting enough pressure to drive the gear. Also check for loose rivets on friction drive plate.
- Cause G: Mounting screws for latch tripping arm too loose, allowing latch tripping arm to miss torsion latch.
Remedy G: Adjust the latch tripping arm and tighten the mounting screws.

COMPLAINT 28: TURRET MULTIPLE INDEXES

- Cause A: Turret index trip lever out of adjustment.
Remedy A: Check index trip lever adjustment (Adjustment #41, page 3-44).
- Cause B: Bind in motion of index trip lever.
Remedy B: Check for binding in linkage between the index trip lever and index latch.
- Cause C: Torsion latch remains in open position, causing time delay gear to keep rotating.
Remedy C: Check for loose or broken torsion spring or bind in rotation of latch.
- Cause D: Interlock probe too low, thereby contacting torsion latch.
Remedy D: Check interlock probe adjustment (Adjustment #40, page 3-44).
- Cause E: Stretched turret indexing belt. This is an easy malfunction to recognize, as the turret will index normally for the first nine pins and double index after the #5 pin only.
Remedy E: Replace turret indexing belt.
- Cause F: Loose turret indexing pulley prevents indexing latch from moving over the indexing roller.
Remedy F: Tighten the pulley mounting bolts.

COMPLAINT 29: TURRET-SPIDER LATCH FAILS TO RELOCK AFTER NO. 5 PIN INDEXING

- Cause A: Bind in turret-spider latch pivot point.
Remedy A: Check for bind and correct as required.

- Cause B: Weak or broken interlock probe tension spring.
 Remedy B: Correct or replace as required.
- Cause C: #5 pin fails to seat properly in the #5 pin deck chute.
 Remedy C: Inspect and correct as required.
- Cause D: Dirty or sticky deck chutes.
 Remedy D: Clean deck chutes as described in the Preventive Maintenance Section of this manual.
- Cause E: Spider release lever not holding spider cam in low dwell.
 Remedy E: Check turret spider adjustment (Adjustment #37, page 3-42).

COMPLAINT 30: GEAR BOX CLUTCH CHATTERS

- Cause A: Gap in clutch too large (converted pinsetters only).
 Remedy A: Check gear box clutch adjustment (Adjustment #7, page 3-11).
- Cause B: Loose clutch facings on gear box clutch drive pulley.
 Remedy B: Tighten mounting screws as required.
- Cause C: Clutch cam follower out of adjustment.
 Remedy C: Check gear box clutch cam follower adjustment (Adjustment #8, page 3-12).
- Cause D: Worn clutch shoes.
 Remedy D: Replace as required.

COMPLAINT 31: GEAR BOX CLUTCH OVERHEATS

- Cause A: Gap in clutch too small (converted pinsetters only).
 Remedy A: Check gear box clutch adjustment (Adjustment #7, page 3-11).

COMPLAINT 32: PINSETTER RECYCLES

- Cause A: Gear box clutch lever out of adjustment
 Remedy A: Check clutch lever adjustment (Adjustment #9, page 3-13).
- Cause B: Gear box dashpot stopcollar adjusted too high.
 Remedy B: Check gear box stopcollar adjustment (Adjustment #10, page 3-14).
- Cause C: 180 degree turret interlock link adjusted too high.
 Remedy C: Check 180 degree turret interlock adjustment (Adjustment #12, page 3-15).
- Cause D: Trigger switch out of adjustment.
 Remedy D: Check trigger switch adjustment (Adjustment #6, page 3-11).
- Cause E: Bind in gear box triggering assembly.
 Remedy E: Make sure gear box triggering assembly moves freely.
- Cause F: Weak or broken spring on gear box triggering assembly.
 Remedy F: Check springs on gear box triggering assembly. Repair or replace as required.

Cause G: Defective time delay module or short circuit in electrical triggering system.
Remedy G: Repair or replace as required.

COMPLAINT 33: PINSETTER FAILS TO CYCLE

Cause A: Rake trip mechanism not unlatching upon ball impact.
Remedy A: Check rake board height adjustment (Adjustment #3, page 3-6).
Cause B: Pit cushion lift rod out of adjustment.
Remedy B: Check pit cushion lift rod adjustment (Adjustment #4, page 3-9).
Cause C: Pit cushion trigger link adjusted with gap too wide.
Remedy C: Check pit cushion trigger link adjustment (Adjustment #5, page 3-10).
Cause D: Trigger switch out of adjustment.
Remedy D: Check trigger switch adjustment (Adjustment #6, page 3-11).
Cause E: Bind in gear box triggering mechanism.
Remedy E: Check gear box triggering mechanism for possible bind or restriction of motion. Repair or replace as required.
Cause F: Defective components or open connection in electrical triggering circuit.
Remedy F: Inspect and correct as required.

COMPLAINT 34: GEAR BOX CLUTCH DOES NOT DISENGAGE AT EXACTLY 0, 90 OR 180 DEGREES

Cause A: Clutch lever out of adjustment.
Remedy A: Check clutch lever adjustment (Adjustment #9, page 3-13).

COMPLAINT 35: PINSETTER USES TIME DELAY ON SECOND BALL DELIVERY

Cause A: First and second ball light microswitch not adjusted properly.
Remedy A: Check first and second ball light microswitch adjustment (Adjustment #46, page 3-49).
Cause B: Defective time delay module.
Remedy B: Inspect and correct as required.

COMPLAINT 36: PINSETTER HAS NO TIME DELAY ON FIRST BALL DELIVERY

Cause A: First and second ball light microswitch not adjusted properly.
Remedy A: Check first and second ball light microswitch adjustment (Adjustment #46, page 3-49).
Cause B: Defective time delay module.
Remedy B: Inspect and correct as required.

COMPLAINT 37: GEAR BOX CLUTCH DISENGAGES AT 180° TO WAIT FOR PINS WHEN DECK IS FULL

Cause A: 180 degree turret interlock link adjusted too low.
Remedy A: Check 180 degree turret interlock adjustment (Adjustment #12, page 3-15).

Cause B: Latch which holds long link rearward when deck is full, not functioning properly.
Remedy B: Observe action of latch to make certain the long link is not released before the deck sets new pins at 270 degrees. Correct as required.

COMPLAINT 38: CLUTCH DOES NOT DISENGAGE AT 180° WHEN DECK IS EMPTY

Cause A: 180 degree turret interlock link adjusted too high.
Remedy A: Check 180 degree turret interlock adjustment (Adjustment #12, page 3-15).

Cause B: Latch which holds long link rearward when deck is full, not releasing when deck sets new pins.
Remedy B: Observe action of the latch and make certain latch releases the long link at 270 degrees when the deck is setting new pins.

COMPLAINT 39: PINSETTER DOES NOT RESTART AFTER A 180° STOP

Cause A: 180 degree turret interlock link adjusted too low.
Remedy A: Check 180 degree turret interlock link (Adjustment #12, page 3-15).

Cause B: Turret does not index to #9 pin position after delivering pins to the deck.
Remedy B: Check the full deck-moving deck interlock adjustment (Adjustment #44, page 3-47) and turret time delay gear adjustment (Adjustment #42, page 3-45).

COMPLAINT 40: GEAR BOX CLUTCH DISENGAGES AT 270 DEGREES

Cause A: 180 degree turret interlock link adjusted too low.
Remedy A: Check 180 degree turret interlock adjustment (Adjustment #12, page 3-15).

Cause B: Gear box dashpot stopcollar too low.
Remedy B: Check gear box stopcollar adjustment (Adjustment #10, page 3-14).

Cause C: Bind in motion of clutch actuator link.
Remedy C: Check the motion of the clutch actuator link for possible binding or restrictions. Correct or replace as required.

COMPLAINT 41: DOES NOT DETECT STRIKE - SCISSORS CLOSE AS ON STANDING PINS AND NEW PINS ARE NOT SET

Cause A: Detector rod adjusted too high.
Remedy A: Check detector rod adjustment (Adjustment #1, page 3-2).

COMPLAINT 42: DETECTS AN OUT-OF-RANGE PIN ON STRIKE OR STANDING PIN CYCLE.

Cause A: Detector rod adjusted too high.
Remedy A: Check detector rod adjustment (Adjustment #1, page 3-2).

COMPLAINT 43: DOES NOT DETECT STANDING PINS - SCISSORS DO NOT CLOSE AND DECK SETS NEW PINS

Cause A: Detector rod adjusted too low.
Remedy A: Check detector rod adjustment (Adjustment #1, page 3-2).

COMPLAINT 44: OUT-OF-RANGE PIN DOES NOT DISENGAGE CLUTCH

Cause A: Detector rod misadjusted.
Remedy A: Check detector rod adjustment (Adjustment #1, page 3-2).

Cause B: Loose or broken spring between out-of-range stop lever and link from detector.
Remedy B: Correct or replace as required.

Cause C: Gear box clutch lever adjusted too low, thereby not permitting out-of-range stop arm to move under clutch lever.
Remedy C: Check gear box clutch lever adjustment (Adjustment #9, page 3-13).

COMPLAINT 45: PINSETTER DOES NOT MAKE SECOND BALL CYCLE

Cause A: Detector rod installed too high. Detector disc interferes with motion of standing pin selector, thereby not allowing the standing pin mechanisms to direct the pinsetter to a second ball situation.
Remedy A: Check the detector rod adjustment (Adjustment #1, page 3-2). Be certain the rod is installed properly to permit motion of the pins mechanism.

COMPLAINT 46: PINS DAMAGED BY PINSETTER

Cause A: Pin strikes edge of turret clutch pulley as it drops from the turret to the #8 or #9 deck chutes, causing damage just below belly of pin. This occurs when the #8 or #9 pin turret spoon deflects the pins as the pins drop toward the deck or the turret wires are misadjusted.

Remedy A: Position the #8 and #9 pin turret spoon as far clockwise (when viewed from above) as possible in keeping the proper turret operation. Check the turret wire adjustment (Adjustment #36, page 3-42).

Cause B: Pin strikes edge of turret drive belt idler pulley as it is delivered to the #9 deck chute, causing nicks around the head of the pin.

Remedy B: Check turret wire adjustment (Adjustment #36, page 3-42).

Cause C: Burr on top of the top cross conveyor pulley shaft housing causes small nicks in the neck of the pin.

Remedy C: File smooth.

Cause D: Burr on snubber or crack in snubber nicks pins.

Remedy D: Repair or replace snubber.

Cause E: Pins nicked around top of head by hitting upper turret wire clamping plates as the pins drop into the 1, 7, and 10 baskets.
Remedy E: Correctly position turret wires to prevent pins from contacting and clamping plates.

Cause F: Pins nicked by sharp edge or burr on pin guide assembly.
Remedy F: File smooth.

Cause G: Vertical cuts on plastic bottom rings caused by pins striking the edge of the #5 pin chute as the pins are delivered from the cross conveyor to the #8 and #9 turret baskets.
Remedy G: Correctly position turret wires and grind or file the protruding edge of the #5 pin chute.

Cause H: Pins marked by gear box drive belt. This is created when the magnetic clutch does not disengage and the pins stop on the cross conveyor under the belt.
Remedy H: Check the magnetic clutch adjustment (Adjustment #45, page 3-48).

Cause I: Pins marked by halo ring. This is caused when turret wires are too tight at the top of the pins.
Remedy I: Check turret halo ring adjustment (Adjustment #38, page 3-42).

COMPLAINT 47: PINS STAY IN PIT

Cause A: Ball wheel higher than rear clamping plate.
Remedy A: Check elevator frame adjustment (Adjustment #24, page 3-28) and elevator guide roller adjustment (Adjustment #25, page 3-29).

COMPLAINT 48: PINS NOT CARRIED UP BY CROSS CONVEYOR

Cause A: Pins slipping on cross conveyor belts.
Remedy A-1: Check cross conveyor belt adjustment (Adjustment #33, page 3-39).
Remedy A-2: Check for badly worn belts. Replace as required.
Remedy A-3: Check for dirty or oily belts. Clean or replace as required.
Remedy A-4: Check for oil covered pins. Clean pins and assembly.

COMPLAINT 49: PIN ELEVATOR DELIVERS PINS WHEN CROSS CONVEYOR IS FULL

Cause A: Magnetic clutch not disengaged.
Remedy A: Check magnetic clutch adjustment (Adjustment #45, page 3-48).

COMPLAINT 50: PIN JAM IN PIN GUIDE ASSEMBLY

Cause A: Pin guide out of adjustment.
Remedy A: Check pin guide adjustment (Adjustment #32, page 3-37).

Cause B: Pin elevator wheel misaligned.
Remedy B: Check elevator guide roller adjustment (Adjustment #25, page 3-29).

COMPLAINT 51: PIN JAM IN TURNAROUND PAN OR HEAD FIRST ON CROSS CONVEYOR

Cause A: Turnaround pan not functioning correctly.
Remedy A: Check turnaround pan adjustment (Adjustment #31, page 3-37).

- Cause B: Pin wheel brake not functioning properly - allows pin elevator to rotate backwards and cause jam in turnaround pan.
 Remedy B: Check the operation and tension of the pin wheel brake. The brake should apply adequate tension on the belt to prevent the elevator from rotating backwards when the magnetic clutch is de-energized.
- Cause C: Turnaround pan located incorrectly.
 Remedy C: Check turnaround pan adjustment (Adjustment #31, page 3-37).
- Cause D: Rough or dirty turnaround pan.
 Remedy D: Clean turnaround pan per the Preventive Maintenance Section of this manual.
- Cause E: Pin guide not holding pins properly.
 Remedy E: Check pin guide adjustment (Adjustment #32, page 3-37).
- Cause F: Magnetic clutch not disengaged when cross conveyor is full.
 Remedy F: Check magnetic clutch adjustment (Adjustment #45, page 3-48).
- Cause G: Cross conveyor does not carry pins up to the turret.
 Remedy G: Check and correct dirty, worn, twisted, or misadjusted cross conveyor belts.
- Cause H: Pins stick in pin elevator wheel and are not released at the proper time.
 Remedy H: Clean pin elevator wheel per the Preventive Maintenance Section of this manual. If trouble persists, mark the pinpockets which are responsible and check for abnormality.

COMPLAINT 52: PIN GATE FAILS TO RELEASE

- Cause A: Pin gate latch slips from shoulder of latch link.
 Remedy A: First, as a test, with the latch link in its up position, lift the latch as high as possible and allow it to drop. The shoulder on the link must catch the latch and prevent it from latching the pin gate. If it slips off, replace it with a new link.
- Cause B: Latch and latch link motion is binding.
 Remedy B: Move the latch up and down and observe if it moves freely. When lifted and released, it should drop down by itself. If there is any binding, check and correct as required.
- Cause C: Latch link not lifting latch high enough.
 Remedy C: Check pin gate adjustment (Adjustment #34, page 3-40).
- Cause D: Oil or grease on shoulder of latch link.
 Remedy D: Remove lubricant from shoulder of pin gate latch link.

COMPLAINT 53: PIN GATE FAILS TO LATCH - PINS DELIVERED TO TURRET BEFORE TURRET INDEXES

NOTE: This is a difficult malfunction to recognize, since the end result usually observed is a deck jam or pins scattered on top of the deck or lane. As a pin gate operational check, latch the pin gate and allow three pins to line up on the cross conveyor. Then, with the pinsetter running, lift the latch and observe if the pin gate latches rapidly enough to stop each succeeding pin until the turret indexes.

- Cause A: - 1 Pin gate failure.
Remedy A: Check pin gate adjustment (Adjustment #34, page 3-40).
- Cause A: - 2 Pin gate failure.
Remedy B: Free pin gate latch and latch link from any binding or restriction of motion.

COMPLAINT 54: PINSETTER SHUTS ITSELF OFF

- Cause A: Blown or faulty fuse.
Remedy A: Replace fuse; if it blows again, check for short and correct as required.
- Cause B: Open circuit breaker.
Remedy B: Close circuit breaker; if it opens again, check for short or overload and correct as required.
- Cause C: Manual switch opened accidentally.
Remedy C: Check manual switches on managers control panel, masking unit, pinsetter control box, and rear of wire channel.
- Cause D: Turret jam microswitch open, incorrect adjustment or actual turret jam.
Remedy D: Check turret jam microswitch adjustment (Adjustment #48, page 3-51) or clear actual turret jam.
- Cause E: Moving deck jam microswitch open.
Remedy E: Check moving deck jam microswitch adjustment (Adjustment #49, page 3-52) or check for actual moving deck jam.
- Cause F: Open circuit breaker in power distribution panel.
Remedy F: Check circuit breaker in power distribution panel to pinsetters.
- Cause G: Loose electrical connection or defective electrical component.
Remedy G: Repair or replace as required.

COMPLAINT 55: PINSETTER MOTOR INOPERATIVE

- Cause A: Thermal overload circuit breaker open on motor.
Remedy A: Press thermal overload reset button on motor. Allow sufficient time for overload elements to cool.

COMPLAINT 56: FIRST AND SECOND BALL LIGHT BLINKS

- Cause A: First and second ball light microswitch improperly adjusted.
Remedy A: Check first and second ball light microswitch adjustment (Adjustment #46, page 3-49).

COMPLAINT 57: PIN LIGHT BLINKS WHEN DECK SETS NEW PINS

- Cause A: Moving deck jam microswitch incorrectly positioned.
Remedy A: Check moving deck jam microswitch adjustment (Adjustment #49, page 3-52).

COMPLAINT 58: MANAGERS COUNTER DOES NOT REGISTER OR COUNTS INACCURATELY

- Cause A: Counter microswitch incorrectly positioned.
Remedy A: Check counter switch adjustment (Adjustment #47, page 3-50).
Cause B: Faulty counter in managers control box.
Remedy B: Repair or replace as required.

COMPLAINT 59: MANUAL SWITCHES IN 24 VOLT CIRCUIT DO NOT SHUT OFF PINSETTER

- Cause A: Motor start relay fails to open.
Remedy A: Check operation of motor start relay.
Cause B: Shorted leads on the switches.
Remedy B: Check switch leads for short circuit. Replace or correct as required.

COMPLAINT 60: PIN ELEVATOR STOPS TURNING - MAGNETIC CLUTCH NOT OPERATING

- Cause A: Magnetic clutch out of adjustment.
Remedy A: Check magnetic clutch adjustment (Adjustment #45, page 3-48).
Cause B: Magnetic clutch defective.
Remedy B: Take ohm meter reading of clutch coil at the clutch plug. The coil resistance should be between 580 and 760 ohms. Replace if required.
Cause C: Incorrect clutch voltage.
Remedy C: Check clutch voltage with clutch plugged in. Connect meter leads to red and black connections on the selenium rectifier. The voltage should be 90 volts ($\pm 15\%$) D. C. If this voltage is incorrect, check selenium rectifier and wiring to determine the cause. Replace rectifier if necessary.

COMPLAINT 61: LOUD NOISE OR CLATTER FROM PIT AREA

- Cause A: Pit board loose in clamping plates.
Remedy A: Check rear of pit board to insure that it is under the clamping plate and make sure the front clamping plates are over the board.
Cause B: Pit frame to submounting plate bolts are loose.
Remedy B: Tighten mounting bolts.
Cause C: Submounting plates to pit floor bolts are loose.
Remedy C: Make sure submounting plates are securely tightened to the pit floor.
Cause D: Jogging corner mounts damaged, worn or broken.
Remedy D: Replace bad parts.

COMPLAINT 62: PIT CONVEYOR BELT CONSISTENTLY WEARS, BREAKS OR COMES OFF PULLEY

- Cause A: Pit conveyor idler arm misadjusted.
Remedy A: Check pit conveyor idler arm adjustment (Adjustment #30, page 3-37).
Cause B: Stretched ball wheel belt.
Remedy B: Shorten spliced belts only and splice with alligator fastener.

Cause C: Stretched pit conveyor belt.
Remedy C: Replace pit conveyor drive belt.

Cause D: Loose or broken spring from pit conveyor idler arm to elevator frame.
Remedy D: Repair or replace tension spring as required.

COMPLAINT 63: BELT JUMPS OFF MOTOR OR GEAR BOX WHEN MACHINE IS STARTED

Cause A: Motor mount roll pin missing or too far down.
Remedy A: Set roll pin on motor mount plate at least 1/8 inch above the motor mount.

Cause B: Stretched gear box drive belt.
Remedy B: Replace gear box drive belt.

Cause C: Motor mount adjusted with inadequate tension on gear belt.
Remedy C: Check motor mount adjustment (Adjustment #51, page 3-55).

COMPLAINT 64: OIL LEAK AROUND GEAR BOX WORM SHAFT

Cause A: Defective worm shaft oil seal, spacer and o-ring.
Remedy A: Replace oil seal, spacer and o-ring. The following is a detailed procedure used when performing subject operation. Refer to Figure 5, page 5-11.

1. Stop the machine at 270 degrees with the deck at its full, new pinsetting depth.
2. Remove Nut GB124 and Spacer GB125.
3. Remove Bolt GB117 and Pin GB126. It is not necessary to loosen the two Jam Nuts GB115.
4. Remove Retaining Ring GB154A, Washer GB119, and Pin GB154.
5. Remove Hex Nuts GB130, Clutch Drive Disc GB131, Pulley Assembly GB132A, Clutch Drive Disc Assembly GB133 with Yoke Assembly GB120, and Spring GB134.
6. Unlock Washer GB136 and remove Locknut GB 135, Washer GB136, and Spring Disc GB137.
7. Remove four (4) Flat Head Socket Screws GB160D and Bearing Retainer GB138. Caution should be exercised in sliding the Bearing Retainer over the Worm Shaft to prevent possible damage to the Oil Seals GB138A. Inspect the Oil Seal to be sure that the sealing surface of the lip has not been damaged. A seal lip that is turned back, cut, or otherwise damaged will cause leakage and should be replaced.

To replace the seal, place the Bearing Retainer GB138 face down on two blocks of wood, force the old seal out by using light taps on a wooden block to prevent possible damage to the bore. Check the bore for burrs and/or sharp edges that could damage the new seal. Pre-lubrication of the new seal is required. This consists of lubricating (by dipping or wiping) the sealing member in a suitable lubricant immediately before installation. Gear Box oil can be used as the pre-lubricant. Soaking or dipping in hot oil is not required. Application of a light coat of shellac or Permatex No. 1372 gasket cement on the outside diameter of the seal just before assembly into the bore will provide a margin of safety against seepage through the pressfit joint. Care must be exercised to avoid getting gasket material on the sealing member. The seal must be installed with its part number facing the rear of the machine.

8. Remove Spacer GB139 and deformed o-ring.
9. Clean the mating surfaces of the Bearing Retainer and the Gear Box Housing thoroughly.
10. Reinstall the Bearing Retainer and the (4) Flat Head Socket Screws. Exercise caution when sliding the Bearing Retainer over the Worm Shaft to prevent damage to the Oil Seal.
11. Install the new Spacer GB139 and the new o-ring. The new Spacer must be installed with its leading edge toward the front of the machine. Do not install backward or damage to the o-ring seal may result.
12. Reinstall Spring Disc GB137, Lockwasher GB136, and Locknut GB135. Tighten Locknut securely and lock in place by bending an ear of the Lockwasher.
13. Reinstall Spring GB134, Clutch Drive Disc Assembly GB133 with Yoke Assembly GB120, Pulley Assembly GB132, Clutch Drive Disc GB131, and the Hex Nuts GB130.
14. Reinstall Pin GB154, Washer GB119, and Retaining Ring GB154A. Lubricate the Pin prior to installation to assure freedom of movement.
15. Adjust Gear Box Clutch (Adjustment #7, page 3-11).
16. Adjust the Clutch Lever (Adjustment #9, page 3-13).

NOTE: The o-ring seats on the shaft between the front side of Spacer GB139 and rear of shaft ball bearing assembly. Always replace with new o-ring.

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SECTION V

PREVENTIVE MAINTENANCE

The performance of scheduled preventive maintenance is the most important responsibility of the pinsetter mechanic. Properly performed preventive maintenance will decrease the malfunction rate, prevent major breakdowns and lengthen the life of the pinsetter.

Scheduled preventive maintenance should be instituted as soon as the pinsetters are installed. Do not wait until the pinsetters are dirty and operating poorly to start the program. The job is simple if done correctly, but if the work is neglected and allowed to get ahead of the mechanic, the situation will very shortly become untenable.

It is very poor practice to rely on memory in servicing any machinery. Brunswick, therefore, has made available a printed form entitled "Preventive Maintenance Work Schedule". This schedule gives a step-by-step procedure for maintaining the pinsetters. Careful study of the contents of this section and proper use of the work schedule will result in clean, well-operating machines and in addition, will greatly lengthen their useful life.

MATERIALS REQUIRED FOR PREVENTIVE MAINTENANCE

1. "Preventive Maintenance Work Schedule" forms. (Available from Brunswick.)
2. Standard pinsetter tool kit, including metered oil can and grease gun with needle attachment. (Now available from Brunswick.)
3. Vacuum cleaner.
4. Cleaning cloths.
5. Wire brush - medium, fine bristles.
6. Gear box oil (for refilling gear box only). Four commercially available gear box oils are listed below and are available nationwide at auto service stations and supply stores.

For A-2 pinsetters (prior to 1980 use 1-1/5 qts. and after 1980, 24 oz.):

- Mobiloil EP 80-90 (Socony Mobil Oil Co.)
- Shell Spirax EP 90 (Shell Oil Co.)
- Texaco Universal Gear Lubricant EP 90 (Texas Oil Co.)

For "A" pinsetters (use 1-1/5 qts.)

- 10W30 Oil

7. General lubrication oil. Used on all general lubrications such as oilites, pivots, external gear teeth, sliding surfaces and cam surfaces. Three commercially available general lubrication oils are listed below.
 - Mobil DTE Heavy Medium Oil (Socony Mobil Oil Co.)
 - Shell Tellus #33 (Shell Oil Co.)
 - Texaco Regal Oil PC (R & O) (Texas Oil Co.)
8. Grease for all pinsetter greasing. Three commercially available greases are listed below.
 - Mobilux Grease #2
 - Shell Alvania #2
 - Texaco Marfax #2
9. Brake fluid. Available from all auto service stations and supply stores.
10. Loctite Service Kit No. 3-2. A nut and bolt cleaner and sealant available from American Sealants Company, 103 Woodbine Street, Hartford, CT.
11. "Tide" household detergent, a 5 gallon bucket and a scrub brush.
12. Brunswick All-Purpose Pinsetter Cleaner. Used for all pinsetter cleaning.

NOTE: Brunswick All-Purpose Cleaner is the best cleaner presently available for cleaning the pinsetter. Pressurized spray-on cleaners are not recommended as the excess fluid can wash dirt and other foreign matter into pinsetter parts. The overspray can penetrate prepacked bearings and contaminate the lubricant, thus reducing their service life. Cleaners containing naphtha, benzine, acetone, carbon tetrachloride and many other synthetic solvents can leave harmful deposits and cause rapid deterioration of many rubber and metal parts. Silicone aerosol sprays can cause belt slippage.

HOW TO USE THE WORK SCHEDULE

The work schedule (Figure 1) contains a list of all items which require scheduled maintenance. These items are divided into five groups: Tri-Weekly Service, Weekly Service, Monthly Service, Quarterly Service and Annual Service.

One work schedule sheet is sufficient to record the maintenance performed on all pinsetters in a center for a four week period. When performing one of the maintenance items listed on the sheet, do not check it off as completed until the number of pinsetters designated in the instructions have all received that service. For example, the instructions for "Weekly Service" state that 1/4 of the machines are to be done on Monday, 1/4 on Tuesday, 1/4 on Wednesday and 1/4 on Thursday. One of the items under "Weekly Service" is "Deck Chutes (Wipe)". On Monday, do not check this item as completed until the deck chutes have been wiped on the first 1/4 of the machines. On Tuesday, do not check it as completed until the deck chutes have been wiped on the second 1/4 of the pinsetters, etc.

To simplify its use, and as a valuable aid in properly scheduling maintenance, the work schedule has been coded. To use the code, divide the machines into four groups as nearly equal as possible. For example, a 12 lane center would be divided into four groups of three machines each. A 14 lane center would be divided into four groups of three, three, four and four machines. A 30 lane center would be divided into four groups of seven, seven, eight and eight machines.

At the top of the work schedule are four coded blocks with spaces to enter the group of machines assigned to each block. For example, a 12 lane center would enter machines 1-3 at the first coded block, machines 4-6 at the second coded block, machines 7-9 at the third coded block and machines 10-12 at the fourth coded block. By assigning a different coded block to each of the four groups of machines, the workload is automatically scheduled in advance. Wherever the code in the first block appears under Tri-Weekly, Weekly and Monthly Service, the group of machines assigned to that code are scheduled for maintenance. For example, in a 12 lane center, machines 1-3 are assigned to the first coded block. This same code appears on Monday, Wednesday and Friday under Tri-Weekly Service. This means machines 1-3 would receive the designated service on those days. The check marks which signify completion of each service will be easily visible over the coded blocks on the work schedule.

As a further aid in scheduling maintenance, there is a column on the work schedule entitled "Assign To". Use this column to enter the initials of the individuals to whom the various services are assigned. When a four week work schedule is completed, the chief mechanic should sign in the designated place. In addition, the proprietor should sign the work schedule, thus acknowledging his satisfaction with the current status of the maintenance program.

MACHINES

THRU



MACHINES

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PREVENTIVE MAINTENANCE WORK SCHEDULE
BRUNSWICK AUTOMATIC PINSETTER (MODEL A-2)

FOUR WEEK PERIOD ENDING

1	CHECK STOP SHEET (ALL MACHINES DAILY)	ASSIGN TO	TRI - WEEKLY SERVICE (1/2 OF PINSETTERS PER DAY)																											
			M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
CLEANING																														
2	BALL & PIN ELEVATORS & PIN GUIDE (WIPE)																													
3	TURNAROUND PAN (WIPE)																													
4	BALL LIFT RODS & RETURN TRACKS (WIPE)																													
5	PIT CUSHION & PIT CURTAIN (WIPE)																													
6	CROSS CONVEYOR BELTS, SIDES & PLATE (WIPE)																													
7	TURRET 5 PIN CHUTE, SPOONS & SNUBBER (WIPE)																													
8	PIT CARPET (VACUUM CLEAN)																													
9	WORK AREA (BENCH, ROOM & AISLE)																													

CLEANING			WEEKLY SERVICE (1/4 OF PINSETTERS PER DAY)																											
10	ALL BELTS (WIPE)		M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
11	DECK CHUTES (WIPE)																													
LUBRICATION																														
12	GEAR BOX OIL LEVEL (CHECK)																													
13	DETECTOR (CLEAN & OIL)																													
14	LUBRICATION CHARTS (WEEKLY ITEMS)																													

INSPECT AND CORRECT			MONTHLY SERVICE (1/4 OF PINSETTERS PER WEEK)																											
15	CHECK JAM SWITCHES (ALL MACHINES)		M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
CLEANING																														
16	ACCELERATOR BELTS (CLEAN)																													
17	FRAMES & CROSS MEMBERS (WIPE)																													
18	GEAR BOX (WIPE)																													
19	DECK (WIPE)																													
20	PIT CARPET (CLEAN)																													
LUBRICATION																														
21	CAM SURFACES (CLEAN & OIL)																													
22	LUBRICATION CHARTS (MONTHLY ITEMS)																													

MACHINE NUMBER			QUARTERLY SERVICE (1/3 OF PINSETTERS PER MONTH)																											
LUBRICATION																														
23	LUBRICATION CHARTS (QUARTERLY ITEMS)																													
TIGHTEN																														
24	KICKBACK CHANNELS & SIDE FRAMES																													
25	ALL PULLEY BOLTS & NUTS																													
26	GEAR BOX SUPPORTS																													
27	MOTOR SUPPORTS																													
28	DETECTOR MOUNTING BOLTS																													
29	SCISSOR CAM FOLLOWER MOUNTING BOLT																													
30	DECK SHAFT BOLTS																													
31	ELEVATOR GUIDE ROLLER BOLTS & NUTS																													
32	PIT CUSHION BOLTS																													
33	PIT CUSHION ARM TRIANGULAR PLATES																													
34	FIXED RAKE ARM STOPS																													
35	SCISSOR DECK SCREWS																													
36	TURRET INDEX PULLEY SCREWS																													
37	SUB PLATE & PIT CONVEYOR BOLTS																													
38	BALL TRACK & PREFERENCE BAR																													

MACHINE NUMBER			ANNUAL SERVICE (1/2 OF PINSETTERS PER MONTH)																											
LUBRICATION			M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
39	GEAR BOX OIL (CHANGE)																													
40	GEAR BOX CLUTCH																													
41	ELECTRIC MOTOR (GREASE)																													
42	LUBRICATION CHARTS (ANNUAL ITEMS)																													
INSPECT & CORRECT																														
43	BALL LIFT ROD COVERS																													
44	SHOCK ABSORBERS																													
45	MOVING DECK & SCISSOR CABLES																													
46	ELECTRICAL CONTACT POINTS																													
47	WELDED ASSEMBLIES																													
48	PIVOT & WEAR POINTS																													

REMARKS:

CHIEF MECHANIC'S SIGNATURE

PROPRIETOR'S SIGNATURE

PREVENTIVE MAINTENANCE WORK SCHEDULE
FIGURE 1

NOTE: The following detailed instructions completely explain each item on the work schedule. These items are listed in the identical order in which they appear on the work schedule.

TRI-WEEKLY SERVICE

1. CHECK STOP SHEETS (ALL MACHINES). Six days a week, from Monday through Saturday, check all stops recorded on the "Daily Malfunction Sheets" for the previous day and correct the causes. This item should average approximately 25 minutes per day per each 12 machines over an extended period of time.

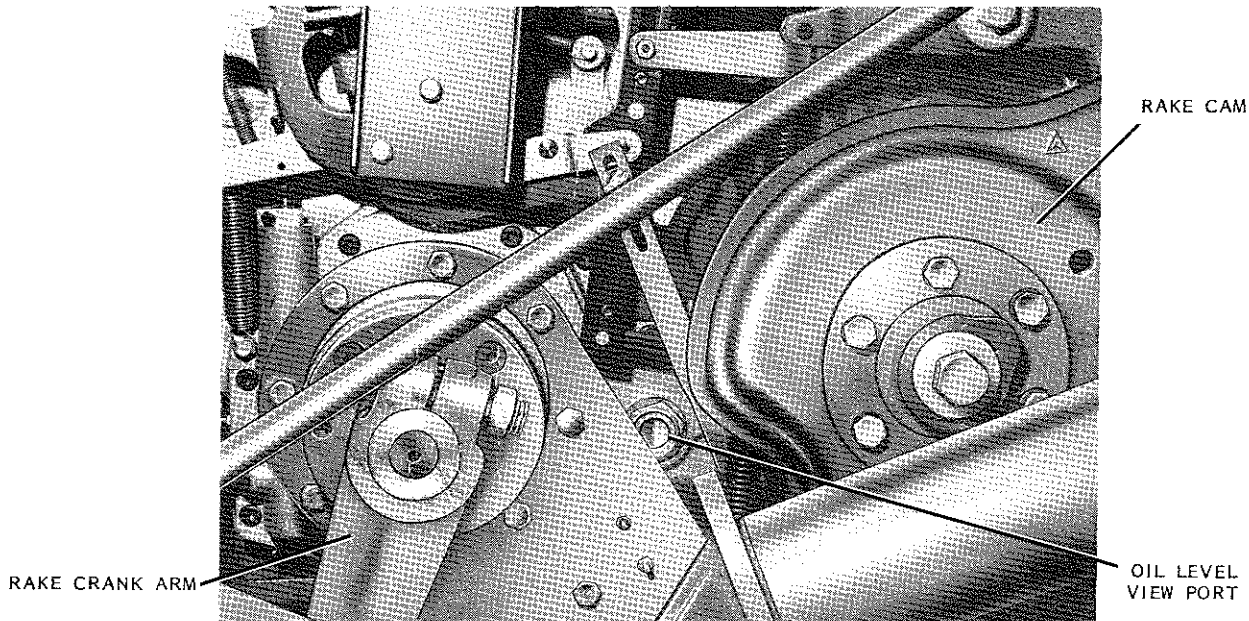
The following items, 2-9, should be accomplished three times per week per machine. Do the first half of the machines on Monday, the second half of the machines on Tuesday, the first half on Wednesday, etc., from Monday through Saturday, thereby doing each machine three times per week. Items 2-9 should take approximately six minutes per machine.

2. BALL AND PIN ELEVATORS AND PIN GUIDE (WIPE). Wipe the inside surfaces of the ball elevator wheel, pin elevator wheel and pin guide with a dry cloth. If any oil or grease has accumulated on the surfaces, wipe with a cloth moistened with Pinsetter Cleaner.
3. TURNAROUND PAN (WIPE). Wipe the turnaround pan with a dry cloth. If any oil or grease has accumulated on the surface, wipe with a cloth moistened with Pinsetter Cleaner.
4. BALL LIFT RODS AND RETURN TRACKS (WIPE). Wipe the lift rods and ball return tracks with a dry cloth. If any oil or grease has accumulated on the surface, wipe with a cloth moistened with Pinsetter Cleaner.
5. PIT CUSHION AND PIT CURTAIN (WIPE). Wipe the faces of the pit cushion and pit curtain with a dry cloth. If any oil or grease has accumulated on the surface, wipe with a cloth moistened with Pinsetter Cleaner.
6. CROSS CONVEYOR BELTS, SIDES AND PLATE (WIPE). Wipe the belts, sides and bottom plate with a dry cloth. If any oil or grease has accumulated on the surfaces, wipe with a cloth moistened with Pinsetter Cleaner.
7. TURRET, 5-PIN CHUTE, SPOONS AND SNUBBER (WIPE). Wipe the turret, the inside of the 5-pin chute, snubber, the spider spoons and top of the turret clutch with a dry cloth. If any oil or grease has accumulated on the surfaces, wipe with a cloth moistened with Pinsetter Cleaner.
8. PIT CARPET (VACUUM CLEAN). Thoroughly vacuum the pit carpet.
9. WORK AREA (BENCH, ROOM AND AISLE). Keep the work area, work bench, parts room and service aisle clean and orderly at all times.

WEEKLY SERVICE

The following items, 10-14, should be accomplished once per week per machine. Do the first 1/4 of the machines on Monday, the second 1/4 on Tuesday, the third 1/4 on Wednesday and the final 1/4 on Thursday, thereby completing all of the machines once every week. Items 10-11 should take approximately four minutes per machine and Items 12-14 should take approximately 15 minutes per machine.

10. ALL BELTS (WIPE). Wipe all belts with a dry cloth.
11. DECK CHUTES (WIPE). Wipe the interior of the deck chutes with a cloth moistened with Pinsetter Cleaner. Be sure to remove all deposits that have built up on the interior surfaces.
12. GEAR BOX OIL LEVEL (CHECK). Check the oil level through the view port in the side of the gear box. (Figure 2) The oil should show halfway up on the port. Add an approved gear box oil if necessary.



GEAR BOX OIL LEVEL

FIGURE 2

13. DETECTOR (CLEAN AND OIL). Lubricate roller bearings, cam surfaces and bearings with the metered oil can. Put a light film on the cam surfaces and three or four drops on bearings and pivot points.
14. LUBRICATION CHARTS (WEEKLY ITEMS). Carefully check the lubrication charts and accomplish all the items marked with the weekly symbol. (Figures 8-12.)

MONTHLY SERVICE

The following items, 15-22, should be accomplished once every four weeks per machine. On the first Friday, do the first 1/8 of the machines, on the first Saturday do the second 1/8 of the machines. On the second Friday, do the third 1/8 of the machine, on the second Saturday do the fourth 1/8 of the machines. On the third Friday, do the fifth 1/8 of the machines and on the third Saturday do the sixth 1/8 of the machines. On the fourth Friday, do the seventh 1/8 of the machines and on the fourth Saturday, do the last 1/8 of the machines, thereby completing all of the machines once in each four week period. Items 15-20 should take approximately 50 minutes per machine and Items 21 and 22 should take approximately 12 minutes per machine.

15. **JAM SWITCHES (ALL MACHINES).** Check the adjustment and operation of the turret jam microswitch and the deck jam microswitch on all pinsetters each month. Damage to the pinsetter may result if these switches do not function properly. Refer to Adjustment Section, Numbers 48 and 49. Do NOT bypass the electrical control circuit by inserting the motor plug into the power cord to check a pinsetter jam or malfunction. Severe damage to the pinsetter or personnel can result from such practices. Lubricate the rubber dust covers with brake fluid.
16. **ACCELERATOR BELT (CLEAN).** Shut off the power to the ball accelerator. Use a wire brush to clean the contact surface of the belt. Brush the belt sideways to remove dirt and residue.
17. **FRAMES AND CROSS MEMBERS (WIPE).** Wipe all frames and cross members with a dry cloth. If any oil or grease has accumulated on the surface, wipe with a cloth moistened with Pinsetter Cleaner.
18. **GEAR BOX (WIPE).** Wipe the gear box with a dry cloth. If any oil or grease has accumulated on the surfaces, wipe with a cloth moistened with Pinsetter Cleaner.
19. **DECK (WIPE).** Wipe the scissor deck and moving deck with a dry cloth. If any oil or grease has accumulated on the surfaces, wipe with a cloth moistened with Pinsetter Cleaner.
20. **PIT CARPET (CLEAN).** The dirt and dust can most easily be removed from the pit carpet with an air compressor. Remove the pit board from the machine and take it outside the building for cleaning. Blow all the dirt and dust out of the carpet with the compressor. If an air compressor is not available, a vacuum cleaner reversed for blowing may be used. Never attempt to blow the dirt out of the carpet while inside the building.

After blowing the dirt and dust out of the carpet, any oil or grease that has accumulated on the carpet may be cleaned as follows:

- a. Mix a solution of 1/2 cup of "Tide" detergent per gallon of water.
- b. Lightly scrub the carpet with an ordinary scrub brush, using enough solution to just wet the pile.
- c. Use a clean rag to wipe the carpet as dry as possible.
- d. When the carpet is thoroughly dry, vacuum it to pick up any dirt which remains in the pile.
- e. For heavy concentrations of grease or oil, sprinkle dry "Tide" powder into the spots and work it into the pile with a brush. Then follow the wetting, scrubbing, drying and vacuuming as detailed in Steps a-d.

21. CAM SURFACES (CLEAN AND OIL). Clean all gear box cam and cam follower contact surfaces with a cloth moistened with Pinsetter Cleaner. Then apply a light film of oil to the cleaned surfaces.
22. LUBRICATION CHARTS (MONTHLY ITEMS). Carefully check the lubrication charts and accomplish all the items marked with the monthly symbol. (Figures 8-12.)

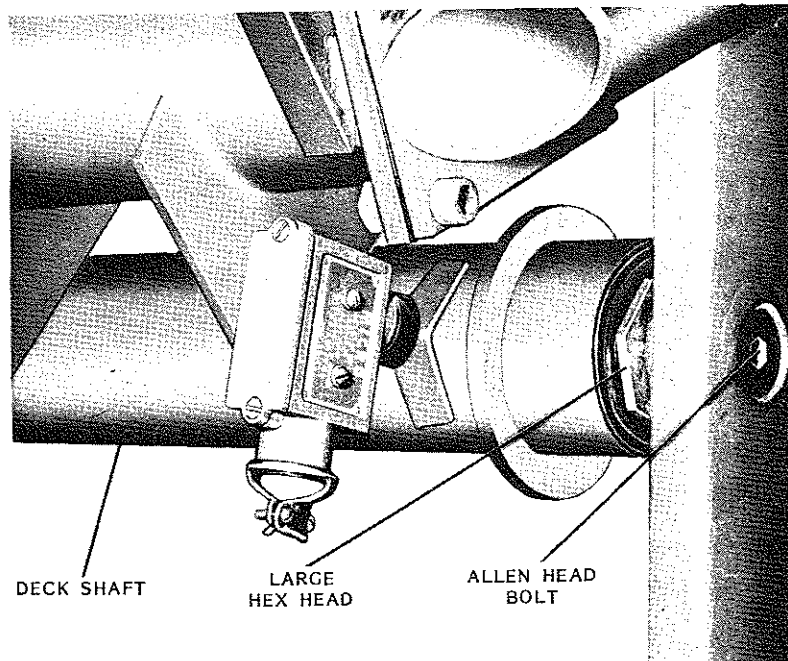
QUARTERLY SERVICE

The following items, 23-38, should be accomplished once every three months per machine. Do 1/3 of the machines in every four week period, thereby completing all of the machines once every three months. Enter the machine number in the designated space on the work schedule as each machine receives the quarterly service. In this way, a permanent record is maintained and no machine will be accidentally overlooked during the three month period. Item 23 should take approximately 18 minutes per machine. Items 24-38 should take approximately 45 minutes per machine.

23. LUBRICATION CHARTS (QUARTERLY ITEMS). Carefully check the lubrication charts and accomplish all the items marked with the quarterly symbol. (Figures 8-12.)

NOTE: The following 16 items require periodic checking to insure that they have not become loose. In addition to these 16 specific items, other loose nuts, bolts, etc., may be found. Liquid "Loctite" may be applied to all troublesome items as a preventive measure, thereby reducing the possibility of a recurrence.

24. KICKBACK CHANNELS AND SIDE FRAMES. Tighten the mounting channels to the kickbacks and the side frames to the mounting channels.
25. ALL PULLEY NUTS AND BOLTS. Tighten all the bolts on which the pulleys turn.
26. GEAR BOX SUPPORTS. Tighten all bolts which connect the gear box to the frame.
27. MOTOR SUPPORTS. Tighten the motor mount shaft bolts and the bolts connecting the motor to the mounting plate.
28. DETECTOR MOUNTING BOLTS. Carefully tighten the three bolts which attach the detector to the gear box.
29. SCISSOR CAM FOLLOWER ARM MOUNTING BOLT AND MOVING DECK BOLTS. Tighten the bolt that the scissor cam follower arm pivots on. Also check the moving deck cam follower shaft bolt and the moving deck and scissors latch bolt.
30. DECK SHAFT BOLTS. Hold the large hex heads at the ends of the deck shaft while tightening the allen head bolts. (Figure 3)



DECK SHAFT BOLTS

FIGURE 3

31. ELEVATOR GUIDE ROLLER BOLTS. Tighten the bolts on which the ball and pin wheel guide rollers turn. Tighten the "U" bolts on the upper guide roller arms.
32. PIT CUSHION BOLTS. Tighten the bolts connecting the pit cushion to the pit cushion support arms.
33. PIT CUSHION ARM TRIANGULAR PLATES. Tighten the bolts on the triangular plates which connect the pit cushion links and the link to the "V" levers. Do this very carefully to prevent any possible binding in the three pivot points.
34. FIXED RAKE ARM STOPS. Tighten the bolts on the two fixed rake arm stops which are mounted on the side frames. (Figure 4)

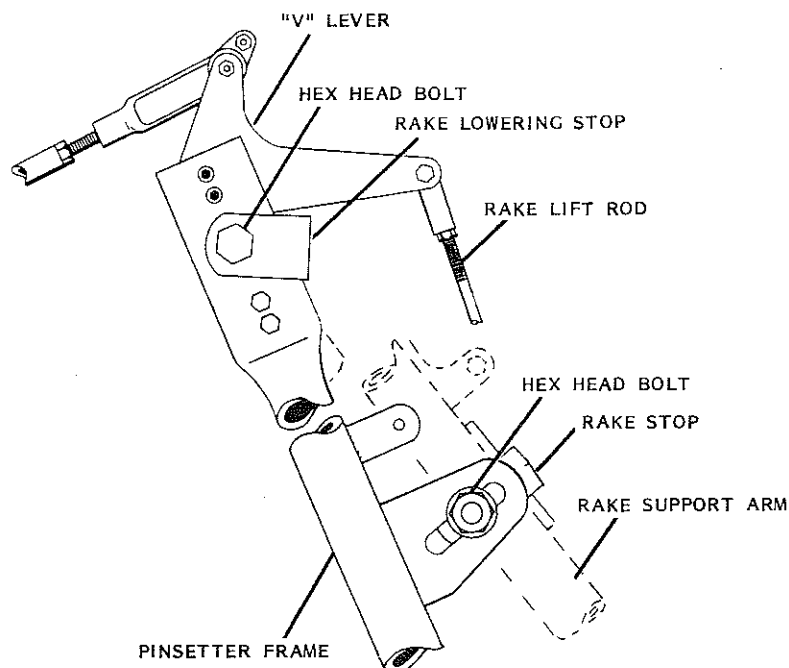


FIGURE 4. RAKE ARM STOPS AND LOWERING STOP

35. SCISSOR DECK SCREWS. Tighten the flat head screws on the underside of the scissor deck.
36. TURRET INDEX PULLEY SCREWS. Tighten the button head screws connecting the index pulley to the bottom of the turret.
37. SUB-PLATE AND PIT CONVEYOR BOLTS. Remove the pit board and carefully tighten the sub-plate to pit floor screws and the pit conveyor to sub-plate bolts.
38. BALL TRACK AND PREFERENCE BAR. Tighten all ball track and ball preference mounting bolts.

ANNUAL SERVICE

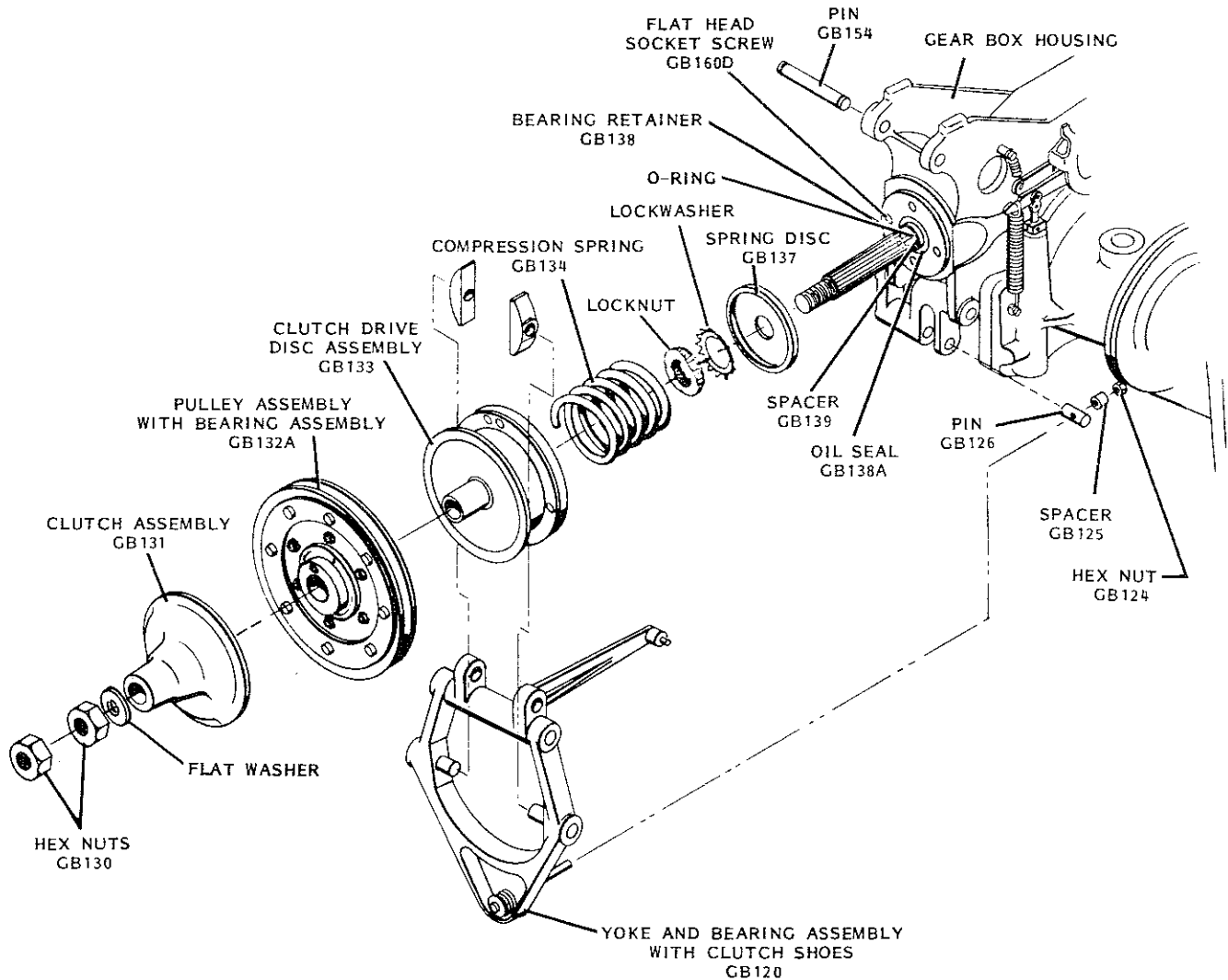
The following items, 39-48, should be accomplished once per year per machine. Do 1/12 of the machines in every four week period, thereby completing all of the machines once every year. Enter the machine number in the designated space on the work schedule as each machine receives the annual service. In this way a permanent record is maintained and no machine will be accidentally overlooked during the one year period. Items 39 -42 should take approximately 60 minutes per machine. Items 43-48 cannot be times as the workload is contingent upon the number of defective items the inspection reveals. The inspection should take approximately 20 minutes per machine.

39. GEAR BOX OIL - NEW MACHINES (CHANGE).
 - a. At the end of the first month of pinsetter operation, drain the gear box oil by removing the drain plug in the bottom of the gear box. Replace the drain plug.
 - b. Flush the gear box by pouring one quart of Pinsetter Cleaner through the oil filter cap in the top of the gear box.
 - c. Drain the gear box by removing the drain plug. Replace the drain plug.
 - d. Fill the gear box with 1-1/5 quarts of recommended gear box oil. The oil should show half way up on the view port.
 - e. At the end of the six months, drain and refill the gear box and thereafter drain and refill the gear box annually.
40. GEAR BOX CLUTCH (FIGURE 5).
 - a. Expose the splined section of the worm shaft by removing the following parts:
 - Hex Nuts GB130
 - Clutch Drive Disc
 - Pulley Assembly with Bearing Assembly GB132A
 - Yoke and Bearing Assembly with Clutch Shoes GB120

NOTE: To remove the yoke and bearing assembly, it is necessary to remove the hex nut GB124, spacer GB125 and pin GB126 from the hex head bolt GB117. Remove either pivot pin from the top of the yoke.

 - Clutch Drive Disc Assembly GB133
 - Compression Spring GB134

- b. Carefully inspect all clutch components and replace as required. Particular attention should be given to the clutch facings, shoes, the bearing in the pulley assembly and the hub of the clutch drive disc assembly which carries the pulley bearing.



GEAR BOX CLUTCH LUBRICATION

FIGURE 5

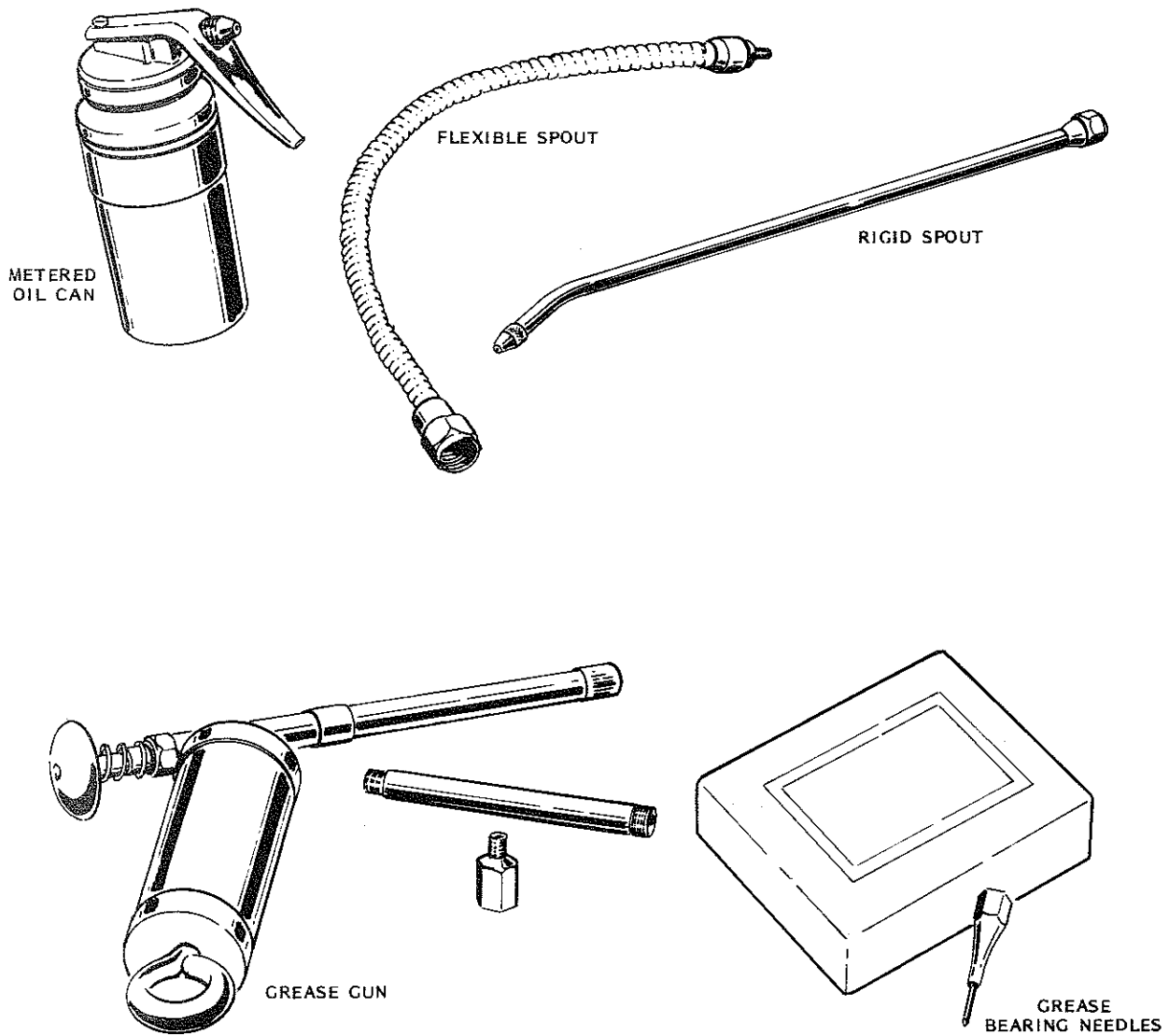
- c. Using Brunswick All-Purpose Pinsetter Cleaner, thoroughly clean the worm shaft, the splined bore in the clutch drive disc, the I.D. of the pulley bearing, the pivot pins for the clutch shoes, the bore in the clutch shoes, the splined bore in the clutch disc assembly and the hub of the clutch disc assembly that carries the pulley bearing.
- d. Using a cloth, carefully apply a light film of the recommended general lubricating oil on all surfaces just cleaned. Extreme care must be taken to avoid overlubrication and getting oil on any of the clutch facings.
- e. Reassemble and adjust the clutch as shown in a previous section.

41. ELECTRIC MOTOR - EARLY MACHINES (GREASE).
 - a. Remove the upper and lower grease plugs in both end shields.
 - b. Insert standard 1/8" grease fittings in both upper holes.
 - c. Pump in grease until fresh grease appears at the lower grease hole. Do this at both end shields. (Place a can or cup under the lower holes to prevent grease from spilling onto the machine.)
 - d. After greasing, run the motor for ten minutes. Replace the lower grease plugs.
 - e. Remove the grease fittings and replace the upper grease plugs.
42. LUBRICATION CHARTS (ANNUAL ITEMS). Carefully check the lubrication charts and accomplish all the items marked with the annual symbol. (Figures 8-12.)
43. BALL LIFT ROD COVERS. Check rubber covers for wear on the ball contact surface. The rod covers may be turned slightly to bring new surface to the ball contact area. Urethane caps should also be checked.
44. SHOCK ABSORBERS. Disconnect one end of the shock absorbers on the pit cushion and rake lift shaft. Check for proper shock resisting action by rapidly working up and down. Replace as required.
45. MOVING DECK AND SCISSOR CABLES. Check for frayed or worn cables. Replace as required.
46. MOTOR CONTACTORS. Badly pitted motor contactors should be replaced.
47. WELDED ASSEMBLIES. Check all welded assemblies for cracks or breaks. Replace or repair as required.
48. PIVOT AND WEAR POINTS. Check all pivot and wear points, oilites, bearings, roll pins and all metal-to-metal contact points for wear. Repair or replace as required.
49. DETECTOR (CLEAN AND OIL). Proper lubrication is important for maintaining the life of the cam rollers and bearings. Place a large drop cloth and pan under the detector to catch cleaning material. Wash the detector down using a 1" paint brush.

Lubricate roller bearings, cam surfaces and bearings with the metered oil can. Put a light film on cam surfaces and three or four drops on bearings and pivot points.

GENERAL INFORMATION

The majority of the lubrication is performed with two tools. One is a metered oil can with two spouts, rigid and flexible, and the other is a grease gun with two tips. The oil can has an adjustable flow that can be regulated to deliver one drop, two drops, etc. The grease gun has a standard tip to accommodate the regular grease fittings on the pinsetter. In addition, it has a hollow needle tip which is used to relubricate the shielded bearings in the idler pulleys. The needle is used to pierce the bearing shields so that grease may be pumped into the bearings. (Figure 6)



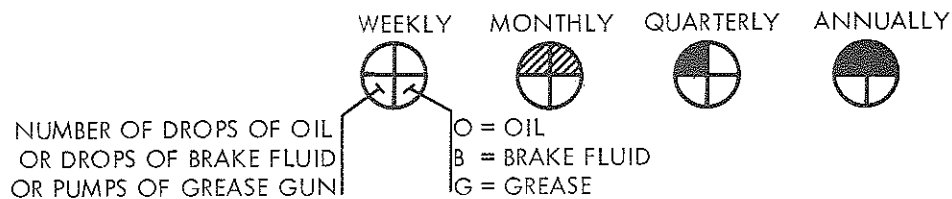
LUBRICATION TOOLS

FIGURE 6

EXPLANATION OF SYMBOLS

All items on the charts requiring lubrication are marked with one of the symbols shown in Figure 7. The upper half of the symbol indicates the frequency of lubrication. If the upper half of the symbol is blank, the item should be lubricated weekly; if it is marked with diagonal lines, the item should be lubricated monthly; if the left side of the upper half is blocked in, the item should be lubricated quarterly; if the entire upper half is blocked in, the item should be lubricated annually.

The lower half of the symbol indicates the type and quantity of lubrication. The lower left side indicates the quantity and the lower right side indicates the type. For example, a symbol marked 2-0 requires two drops of oil; a symbol marked 2-B requires two drops of brake fluid; a symbol marked 3-G requires three pumps of grease.

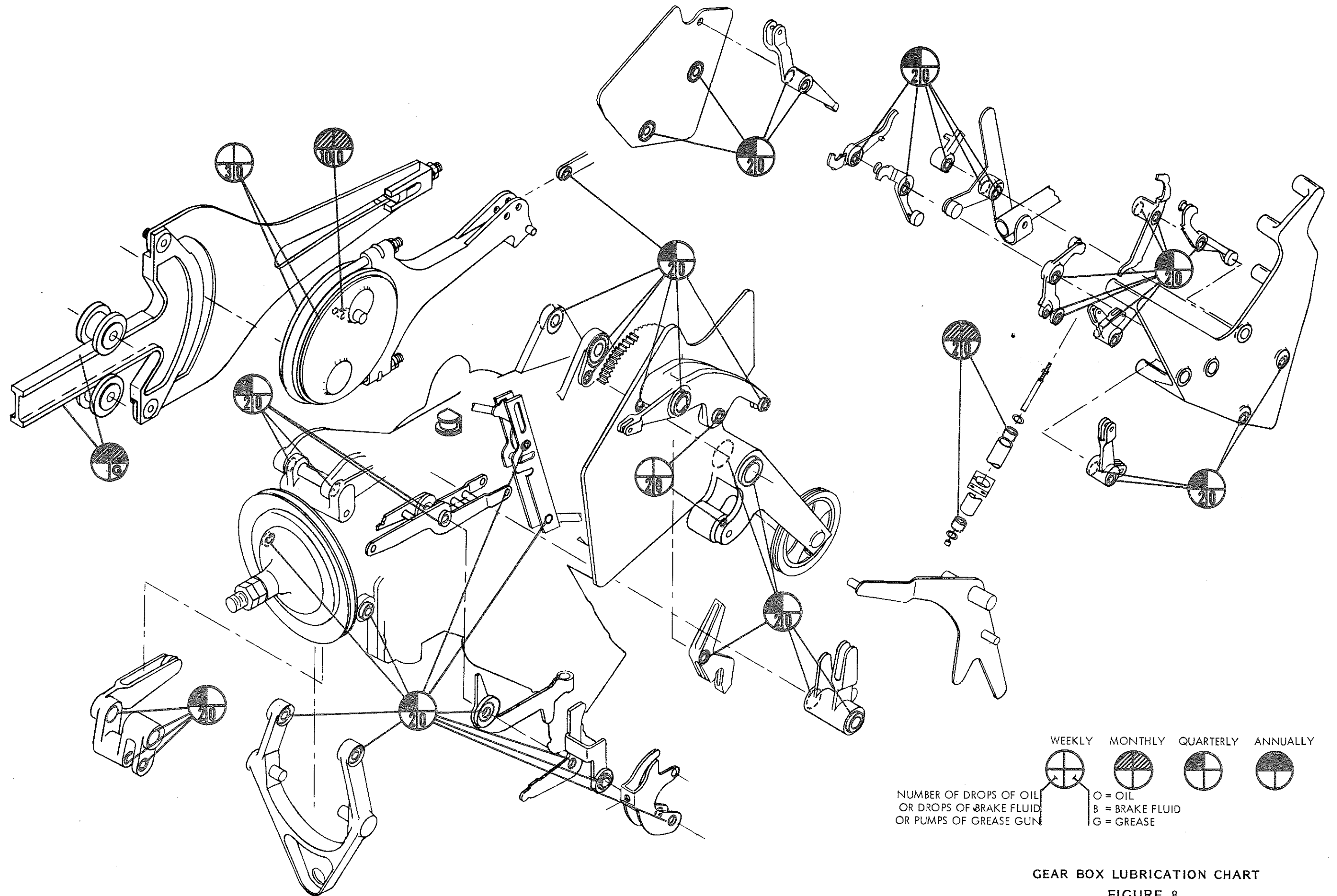


LUBRICATION CHART LEGEND

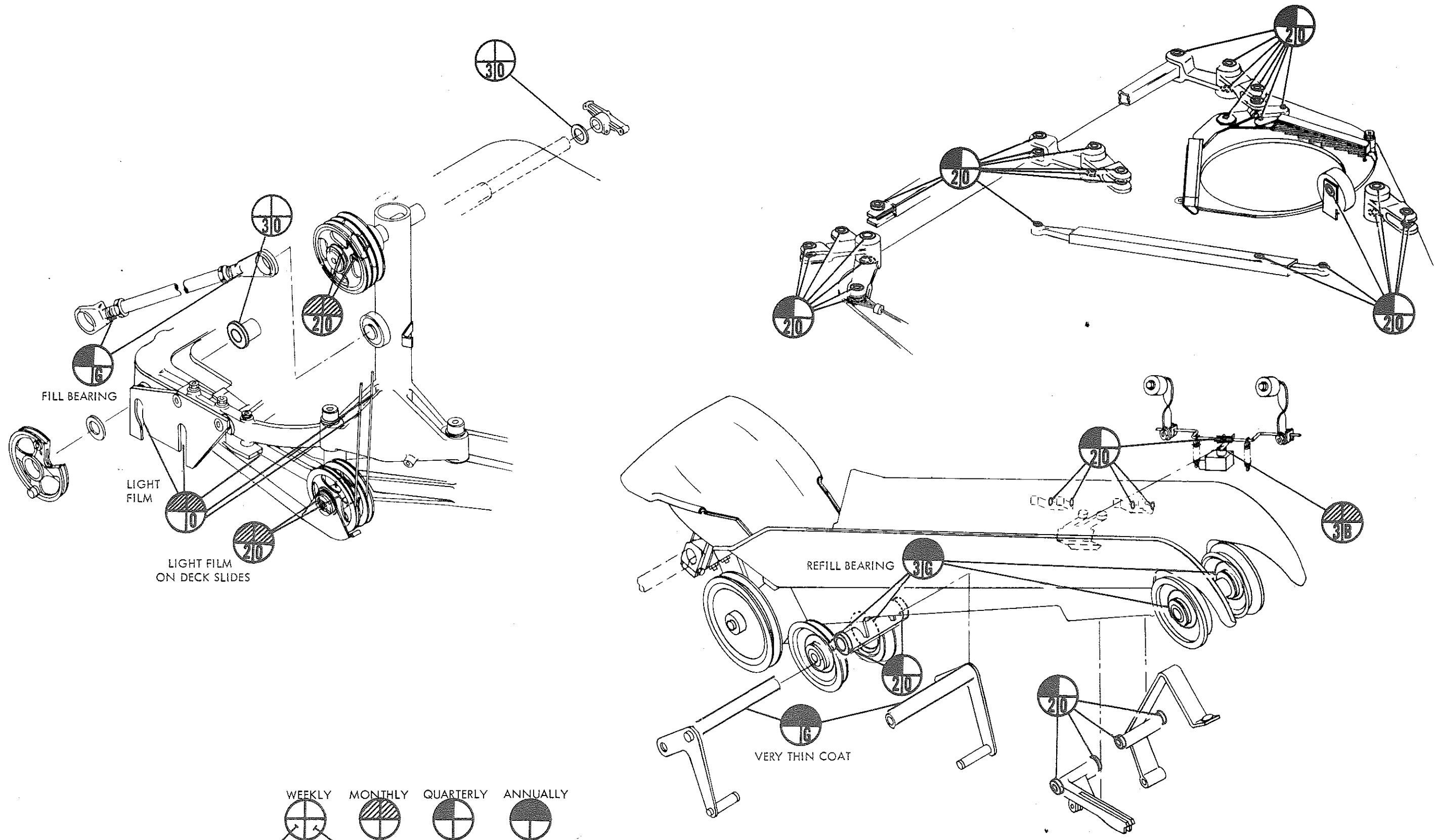
FIGURE 7

Whenever these symbols cannot completely identify the required lubrication, special instructions will be noted directly on the lubrication charts.

If there are more than one of the same item, the item will only be shown once on the charts. For example, there are two side frames, but only one is illustrated. There are ten pairs of scissors with their connecting linkage, but only one pair is illustrated.

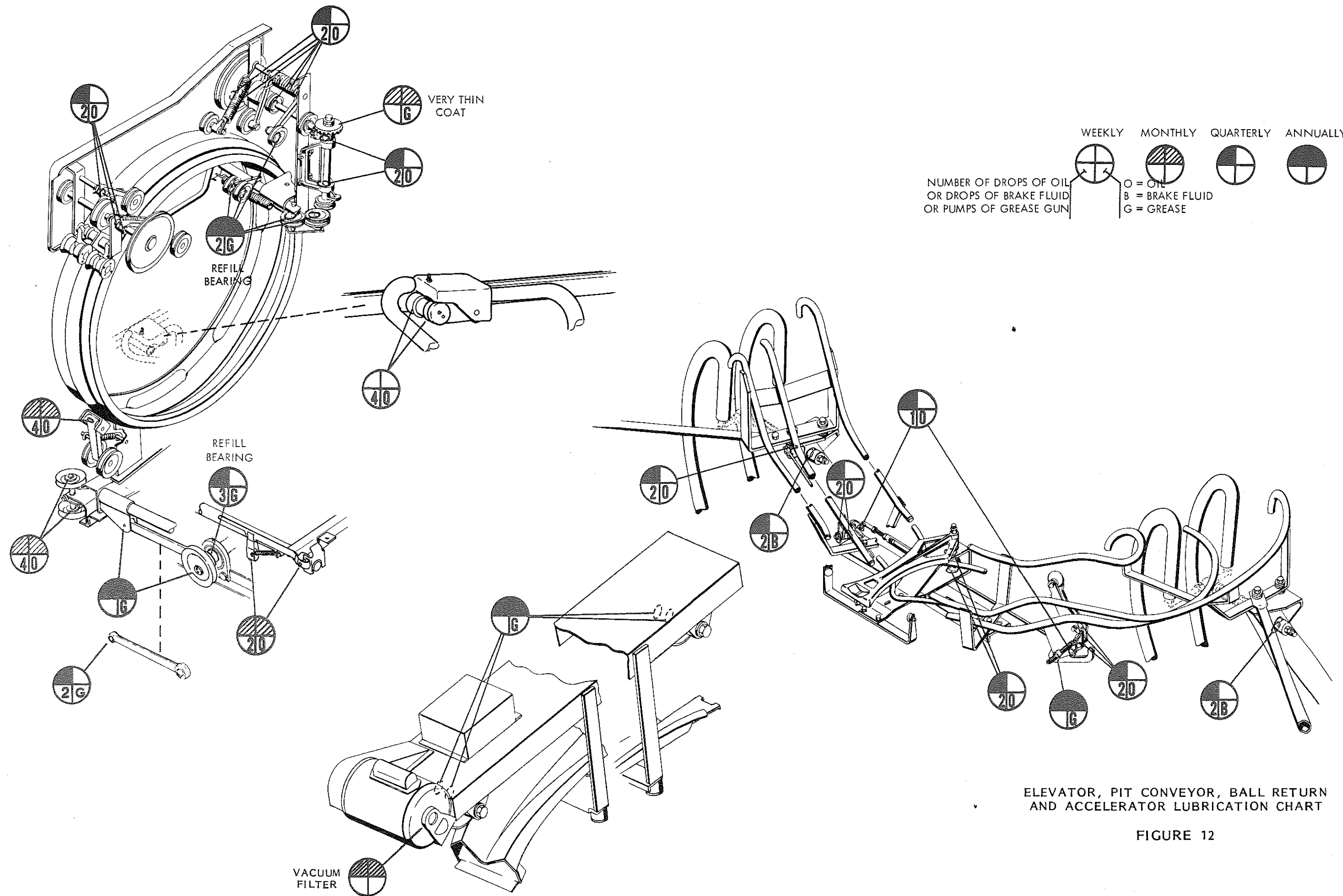


GEAR BOX LUBRICATION CHART
FIGURE 8



DECK AND CROSS CONVEYOR
LUBRICATION CHART

FIGURE 10



ELEVATOR, PIT CONVEYOR, BALL RETURN AND ACCELERATOR LUBRICATION CHART

FIGURE 12