Brunswick

Automatic Pinsetter

SERVICE MANUAL

BRUNSWICK CORPORATION
BOWLING SERVICE DEPARTMENT
MUSKEGON, MICHIGAN

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SECTION A

INTRODUCTION

CHAPTER 1. PURPOSE AND USE.

This service manual describes the use and maintenance of the Brunswick Automatic Pinsetter. It contains a complete description of the operation of the pinsetter as well as detailed adjustment, preventive maintenance, and trouble-shooting information.

CHAPTER 2. RULES OF BOWLING.

The Automatic Pinsetter has been 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 alley, and the bowler rolls a ball at the pins endeavoring to knock down as many as possible. If all of the pins are knocked down with the first ball, it is called a strike and the ball is returned to the bowler. The 10 pins are then set up again for the bowler.

If all of 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", or pins which were knocked down but did not fall in the pit at the rear of the pin area, are removed 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, all 10 pins are again set up on the alley whether or not any pins were left standing by the second ball. The alley is now ready for delivery of the "first ball".

At the point where the bowler releases the ball to roll down the alley, there is a black line. If the bowler's foot crosses this line while he is rolling the ball, it is considered to be 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 and all of the 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 various conditions as 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 through 3). Each assembly and function of the pinsetter will be described in detail in subsequent sections.

With 10 pins set on the alley and the bowler ready to deliver the first ball, the pinsetter is turned on, energizing a 1-horsepower electric motor. Through a combination of sheaves 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", picks up the ball and places it on rails which carry the ball back to the bowler. The other wheel, called the "pin elevator", picks up the pins and carries them up, depositing them in the "turnaround pan".

The turnaround pan receives the pins either point 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 stores the pins until it has 10 and then deposits them into the pinsetting "deck". The deck is the device that takes the 10 pins and, when necessary, lowers and sets the pins on the alley.

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 mechanism 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 (20), but only 10 pins are ever in play at any given time. The extra set of pins is utilized to speed up operations so that the bowler does not have to wait for the pins to be carried from the pit to the alley.

CHAPTER 4. PINSETTER CYCLES.

One complete cycle of the pinsetter is considered to be 360 degrees. The pinsetter is designed to be able to stop at one-quarter cycle (90 degrees), one-half cycle (180 degrees), three-quarter cycle (270 degrees), and full cycle (360 degrees). 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 left some pins standing. This process is called "detecting" and occurs at one-quarter cycle (90 degrees). 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 degrees). Deck goes back up and rake sweeps the deadwood into the pit (180 degrees). Deck comes back down and sets 10 new pins on the alley (270 degrees). Deck and rake go back up and alley is ready for the next ball (360 degrees).

FIRST BALL, STANDING PINS. Bowler rolls ball. Deck lowers and finds some pins still standing (90 degrees). Deck takes standing pins and goes back up, and the rake sweeps the deadwood into the pit (180 degrees). Deck comes down and respots standing pins (270 degrees). Deck and rake go back up and alley is ready for second ball (360 degrees). The pinsetter now cycles an additional 90 degrees, since there will be no need for the pinsetter to detect after delivery of the second ball. Immediately after delivery of the second ball, the bowler wants the deadwood swept and 10 new pins set. This extra 90 degrees is actually an idle motion because the deck and the rake are held up while the pinsetter goes through what normally would be the detecting 90 degrees. This idle cycle is utilized to speed up the game, as the bowler now will not have to wait for a second ball detecting cycle before the deck sets 10 new pins for the next first ball.

SECOND BALL. The pinsetter has already cycled the first 90 degrees. The bowler rolls the ball. Deck stays up and rake sweeps the deadwood (180 degrees). Deck comes down and sets 10 new pins (270 degrees). Deck and rake go up and alley is ready for the next ball (360 degrees).

FIRST BALL, FOUL. The bowler rolls the 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 10 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 rear 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 the second ball are no problem since 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 shuts itself off. It is then necessary for someone to remove the deadwood manually and to pull the out-of-range reset lever, which will restart the pinsetter, before the bowler may bowl. There is no problem if the out-of-range pin occurs on the second ball, since the pinsetter will automatically sweep and set 10 new pins.

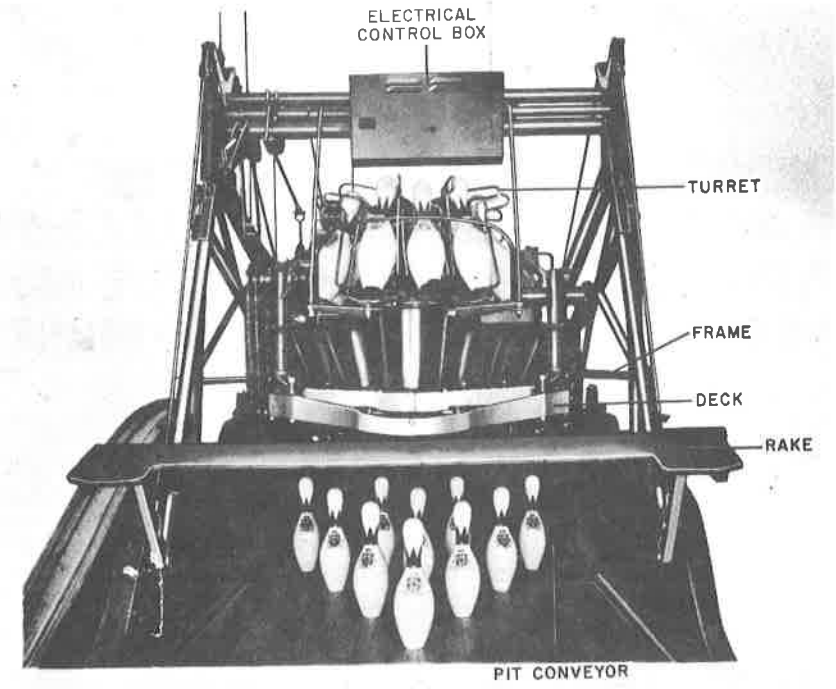


Figure 1. Pinsetter - Front View

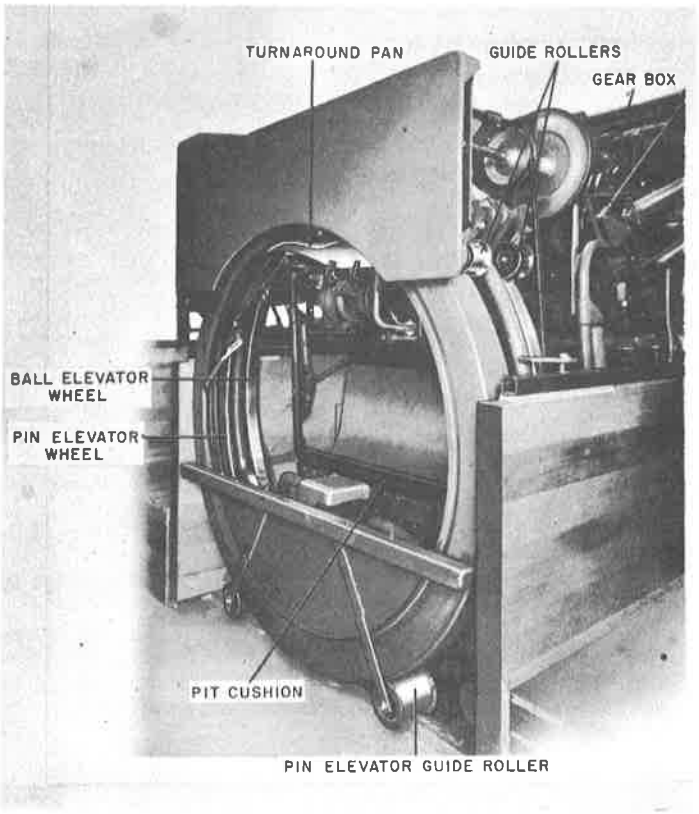


Figure 2. Pinsetter - Rear View

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 PINSETTER

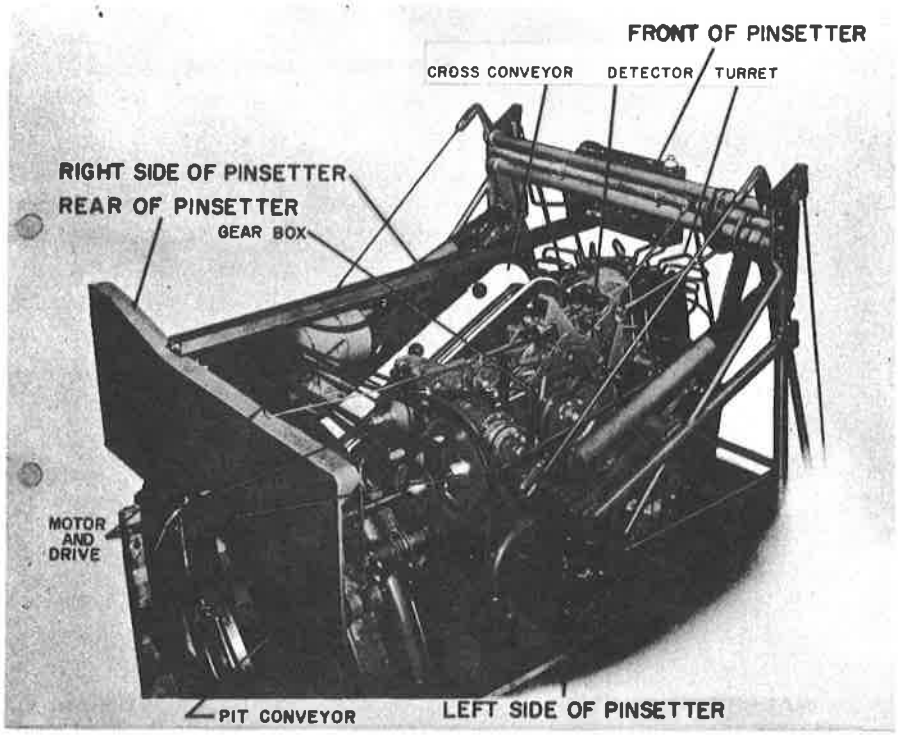


Figure 3. Pinsetter - Top View

SECTION B

DETAILED DESCRIPTION

CHAPTER 5. FRAME AND SUB-MOUNTING PLATES

Screwed to each kickback are two lengths of channel iron, or "unistruts" (figure 4), one toward the front and rear of each kickback. The side frames are composed of lengths of tubular steel pipe which are welded together and mounted on each kickback, using each unistrut as an anchor point. The rear unistruts are also used as the upper anchor points for the ball and pin elevator assembly.

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

The side frames carry between them the main cross shaft, deck shaft, rake shaft assembly, and other miscellaneous assemblies. In general, the frame provides the main support in suspending the pinsetter over the alley and pit.

Fastened to the floor of each pit are two steel, "sub-mounting plates". Protruding from the top of these plates are studs, upon which are mounted the pit conveyor frame and the ball and pin elevator assembly. (Figure 10).

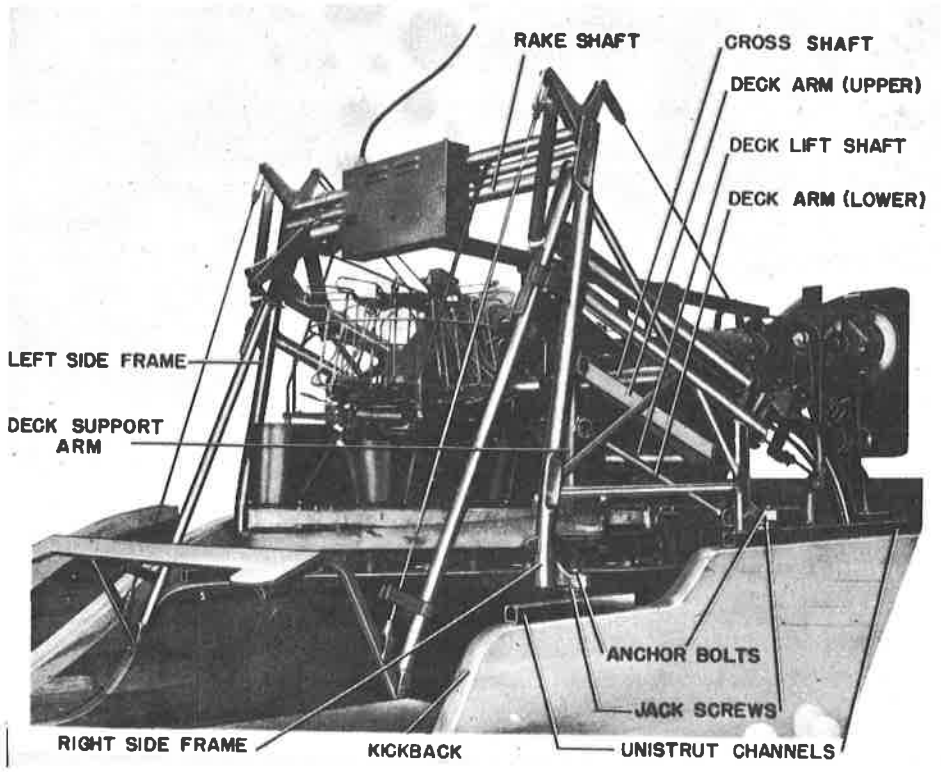


Figure 4. Frame

CHAPTER 6. GEAR BOX AND DETECTOR

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 simple gear train, shown schematically on figure 5, 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 to 1 shaft, a 2 to 1 shaft, and two 1 to 1 shafts. A complete pinsetter cycle is considered to be 360 degrees, or one complete revolution of a 1 to 1 shaft. These varying revolution-per-pinsetter-cycle shafts are required because there are operations which may occur one, twice, or four times during each cycle. Mounted on the 4 to 1 shaft is a cam which can stop the pinsetter four times in one cycle (at 90, 180, 270, and 360 degrees). Mounted on the 2 to 1 shaft is the deck lift hook assembly which can raise and lower the deck twice in one cycle; once to detect and once to respot pins. On the 1 to 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.

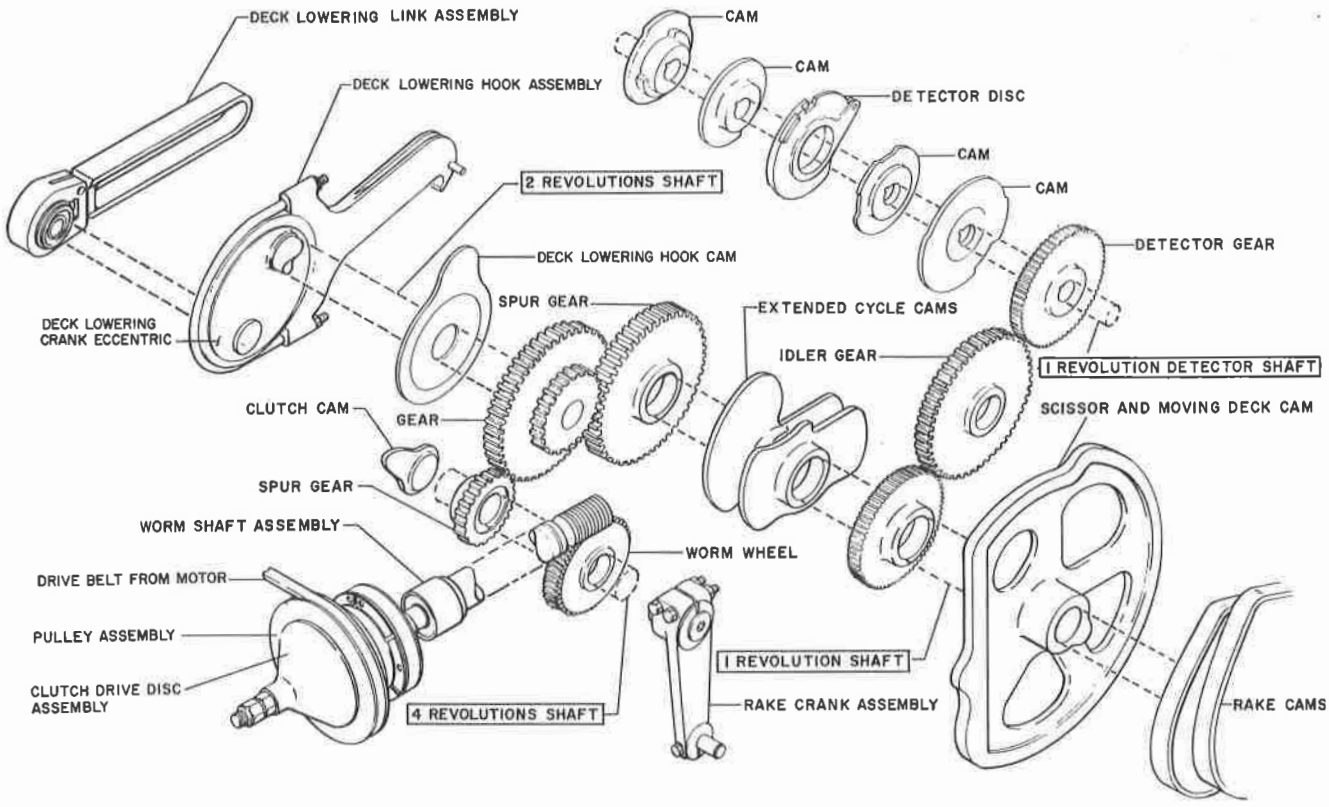


Figure 5. Gear Drive - Schematic Drawing

Mounted on the input worm shaft assembly is a friction clutch mechanism (figure 6) which can be engaged and 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 gear box 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 left and, unless restrained, will force the discs and the pulley assembly together, thereby engaging the clutch and turning the shaft.

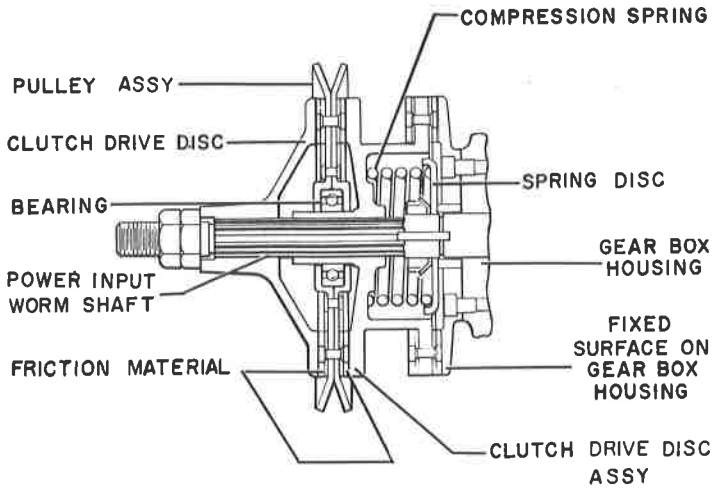


Figure 6. Clutch Mechanism

The clutch is disengaged through a "V"-shaped clutch yoke assembly which straddles the clutch drive disc assembly (figures 7 and 8). 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 link 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 to 1 shaft.

Four times in every cycle, as the gear box clutch cam rotates, the lobe on the clutch cam will move the clutch cam follower lever. This movement of the follower lever will disengage the clutch at 90, 180, 270, and 360 degrees, if desired. A stop arm on the clutch actuator lever can be moved under the free end of the clutch lever at 90, 180, 270, and 360 degrees. 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 lever.

As the rising slope of the clutch cam oscillates the clutch cam follower lever, 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. If the stop arm is under the end of the clutch lever, the top pivot point of the yoke assembly becomes fixed in space, and the entire yoke assembly will pivot from the top as the bottom of the yoke is moved forward. As the bottom of the yoke assembly is pulled further forward, the side of the clutch shoes will contact a friction surface in the slot and force the clutch drive 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 run on its bearing without driving the worm shaft. To prevent any overrun of the mechanism, as the clutch drive disc assembly is forced forward its outer surface contacts a fixed surface on the gear box housing (figure 6).

GEAR BOX START AND STOP OPERATION.

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

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 degrees. If there are standing pins after the first ball, the pinsetter goes through its 360-degree cycle plus an idle cycle of 90 degrees, and then stops at 90 degrees for the bowler to deliver the second ball. At 180 degrees, when the deck is up before coming down to set pins, the pinsetter must be able to stop if for any reason the deck does not have 10 pins to deliver to the alley. The pinsetter must also be able to stop at 360 degrees (end of strike or second ball cycle). There is no need for a stop at 270 degrees, since the deck is always down at this degree, either setting new pins or respotting standing pins.

Part of the start-stop mechanism (figures 7 and 8) consists of three levers: the "clutch actuator lever", "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 forward 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 can be adjusted to regulate the speed at which the lever can rotate. The plunger lever is spring urged in a counterclockwise direction. The third lever, the clutch release lever, carries a pin riding in an open slot in the clutch actuator link and is connected by a spring to an arm of the clutch reset lever. This lever is equipped with a 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.

The reason for using three levers, when one would function just as well to start and stop the pinsetter, is to provide for a "time delay" between the ball impact and the start of the cycle. If the clutch is engaged instantly on ball impact, the deck will come down immediately and contact any pins that are still standing. This immediate action of the deck would eliminate any chance the bowler would have for wobbling pins to fall. With the three

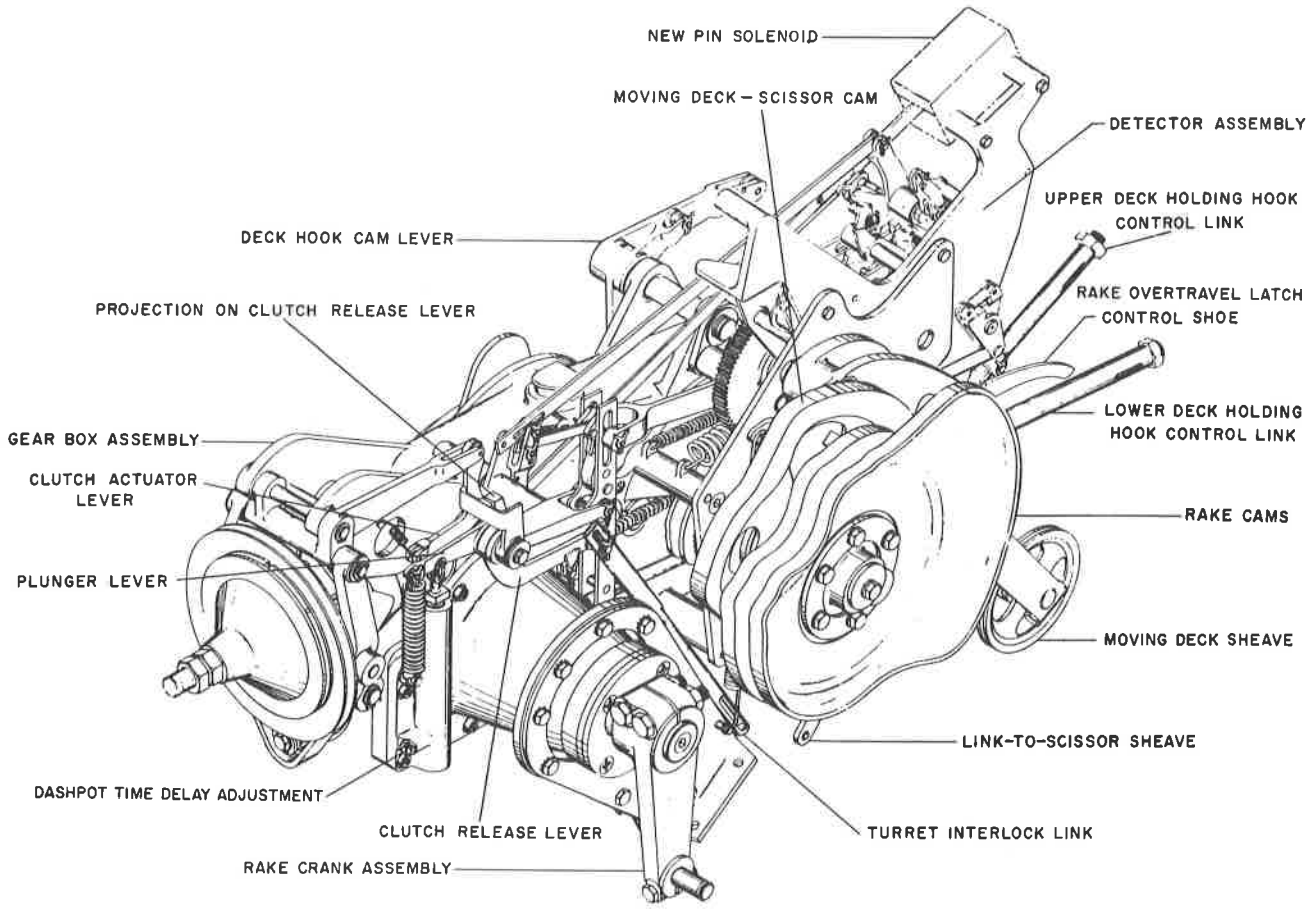


Figure 7. Gear Box - Isometric View

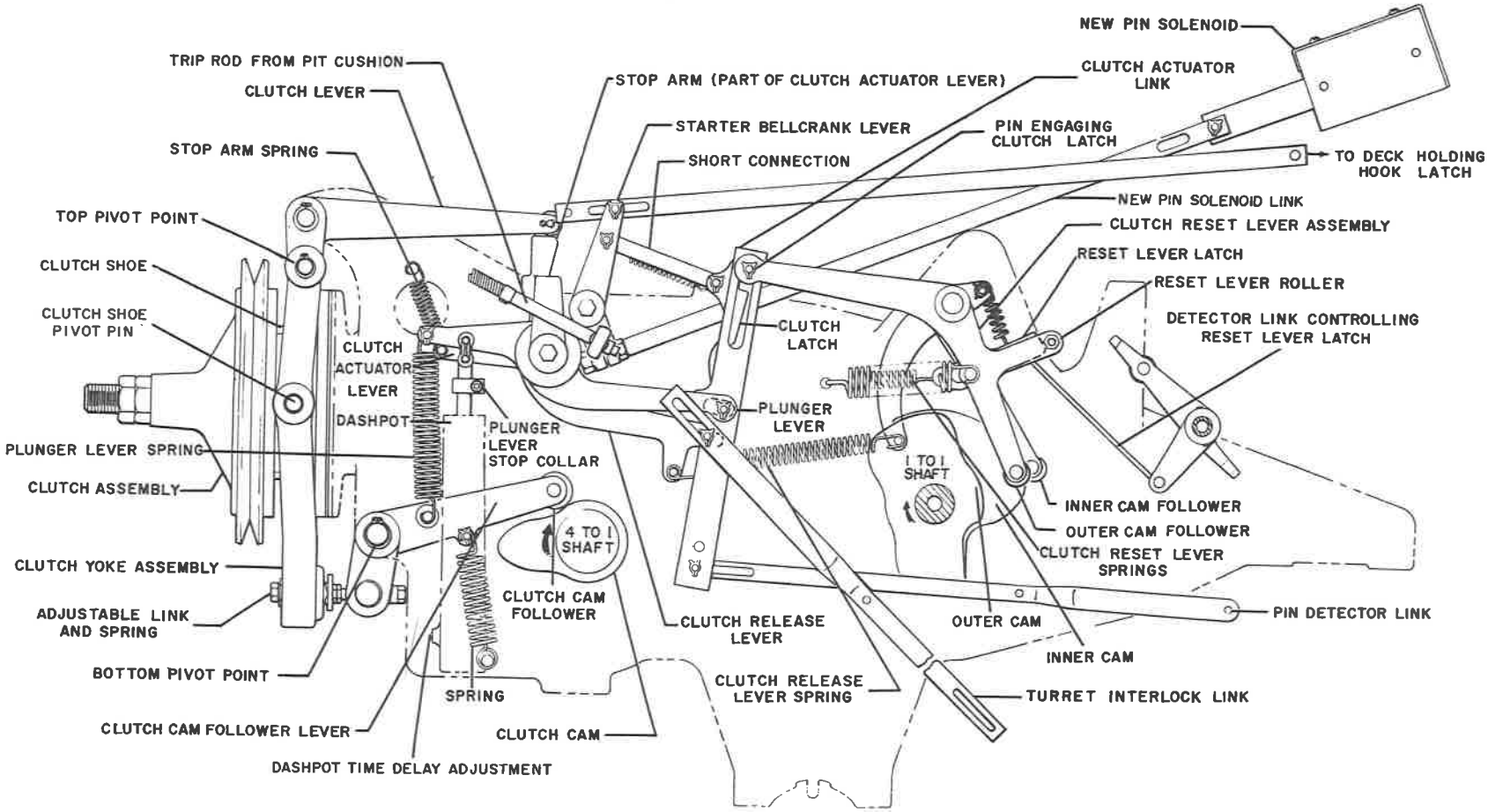


Figure 8. Gear Box - Start and Stop Mechanism

levers, the speed at which the lever equipped with the projection will rotate and move the stop arm to engage the clutch, can be regulated by adjusting the dashpot time delay adjustment. To simplify the following description of the start-stop mechanism, the three levers will be considered to be a single lever that moves slowly enough to allow the pins ample time to fall before the pinsetter starts to cycle.

With the clutch disengaged and the triggering device latched, a tension spring, extending from an arm on the clutch reset lever to an arm on the clutch release lever, and a spring on the plunger lever, are urging these two levers counterclockwise. At the same time, the pin in the open slot of the clutch actuator link and the pin in the closed slot of the clutch actuator link are urging this link upward. The levers are prevented from moving counterclockwise and the clutch actuator link is prevented from rising, by the clutch latch being held under a pin on an arm of the clutch reset lever. The pin rides in a slot at the top of the clutch actuator link. The clutch latch is spring urged in a forward or latched direction and is attached through a short connection to the starter bellcrank lever.

When a ball strikes the pit cushion, the cushion swings slightly to the rear and pushes the trigger trip rod forward. The trip rod runs from the pit cushion support arm to the starter bellcrank lever. This motion of the trip rod rotates the starter bellcrank lever counterclockwise and, through the short connection, pulls the clutch latch out from under the pin on the clutch reset lever. With the latch withdrawn from under the pin, the clutch release lever and the plunger lever, being spring urged in a counterclockwise direction, rotate counterclockwise, the clutch actuator link moves upward, and the projection on the clutch release lever moves the stop arm out from under the clutch lever, thereby engaging the clutch to start the cycle. The clutch actuator link will come to rest with the pin on the clutch reset lever riding in the bottom of the slot in the clutch actuator link. When the clutch latch is withdrawn from under the pin on the reset lever, the clutch actuator link rises and then comes to a stop as the plunger lever stop collar contacts the top of the dashpot, preventing further rotation.

The initial impulse which rotates the starter bellcrank lever to engage the clutch can come from two sources: from the ball impact as previously described and from energizing the new pin solenoid. The latter method will be explained in a later section.

There are two separate methods required to stop and restart the pinsetter. At the end of a strike cycle (360 degrees) and at the end of a standing pin cycle (90 degrees), the pinsetter is required to stop with the clutch latch under the reset lever pin and all levers in position so that it takes a ball impact to engage the clutch. At 180 degrees, however, the pinsetter may have to stop if the deck does not have 10 pins to deliver to the alley, and then restart without a ball impact after the turret receives the tenth pin. This requires a stop without the clutch latch under the reset lever pin.

The clutch reset lever, carrying a cam follower, is urged clockwise by a spring. Urged clockwise about the same pivot point by a spring is another cam follower arm carrying a latch. This latch is controlled by the detector assembly and can be moved in and out of engagement with a roll on the clutch reset lever to enable the pinsetter to stop at either 360 or 90 degrees. If the latch is engaged with the roll, the clutch reset lever is controlled by the inner cam follower (nearest to gear box) riding its extended cycle cam. As the inner 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. Then a rising slope of the cam rotates the clutch reset lever counterclockwise, pushing the 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 rotation, bringing the stop arm under the clutch lever, and the clutch will disengage at 360 degrees.

With the clutch latch disengaged from the roll on the clutch reset lever, the reset lever, through the outer cam follower arm, follows its extended cycle cam, while the inner cam follower arm follows its cam without effect. As the outer cam follower arm reaches the low point of its cam, the clutch reset lever is at its furthest clockwise position and the clutch latch snaps in under the pin. Then, as the outer cam follower arm contacts a rising surface in its cam, the clutch reset lever rotates counterclockwise. The clutch actuator link is thus pushed down, rotating the clutch release lever and plunger lever clockwise. This allows the clutch actuator lever to rotate in its spring-urged, clockwise rotation, moving the stop arm under the clutch lever, and the clutch will disengage at 90 degrees. The rising surface of the outer extended cycle cam occurs 90 degrees later than the rising surface of the inner extended cycle cam. This means the downward motion of the clutch actuator link occurs 90 degrees later when the outer cam is in control and the pinsetter cycles the extra 90 degrees.

There is one other stop required of the pinsetter. If for any reason the deck does not have 10 pins to deliver to the alley at 180 degrees, the clutch must disengage without the clutch latch under the pin on the reset lever so that the clutch can re-engage without a ball impact when the turret delivers 10 pins to the deck. As the pinsetter cycles toward 180 degrees, the clutch reset lever follows the down slope of either 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 an extended low dwell on either 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, which is connected at its lower end to the pin detector link of the detector assembly, is swung far enough to the right by this link so that the pin on

the clutch release lever drops out of the open slot in the link. This effectively frees the clutch actuator lever to rotate in its spring-urged, clockwise rotation, and brings the stop arm under the clutch lever to disengage the clutch at 180 degrees. This provides for the 180-degree 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 restart without a ball impact is required.

An additional requirement is to make the 180-degree stop selective: to disengage the clutch if the deck does not have 10 pins, and not to disengage the clutch if the deck does have 10 pins at 180 degrees. 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-degree start-stop in the following manner: If the deck has 10 pins at 180 degrees, as the clutch actuator link swings to the right and the pin on the clutch release lever drops out of the open slot in the clutch actuator link, the interlock link will be in an upward position, carrying the pin in the bottom of the slot. This will forcibly prevent the clutch actuator lever stop arm from rotating in its spring-urged, forward direction into its stop position, and the clutch will not disengage at 180 degrees. If the deck does not have 10 pins at 180 degrees, 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. This will allow the clutch actuator lever stop arm to move into its stop position under the clutch lever to disengage the clutch at 180 degrees. After the turret receives the tenth pin, 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-degree stop completes the three stops necessary in the proper functioning of the pinsetter: 90 degrees (second ball), 180 degrees (waiting for pins), and 360 degrees (end of strike and second ball cycle). No stop is required at 270 degrees, since the deck is always down at 270 degrees, either setting new pins or respotting standing pins.

DETECTOR ASSEMBLY OPERATION.

In previous references to the detector assembly (figure 9), it has been stated that a rod or a connection was pushed, pulled, or rotated by the "detector". Therefore, before the various assemblies that comprise the pinsetter are described, it will be advantageous to have some knowledge of what the detector assembly is and how it works. The complete operation of the detector assembly will not be described at this time, since an understanding of the detector assembly must come with time and familiarity with the pinsetter. The functions of the detector assembly will be described in a later chapter and are completely detailed in the detector manual.

The detector assembly can be considered the brain of the pinsetter. It stores up 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. In spite of the fact that it must direct the complex operations of the pinsetter, the physical properties of the detector assembly are relatively simple.

Mounted on the detector assembly 1 to 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 on both faces around its outer perimeter. When in the proper position in 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 is freely mounted on the 1 to 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 right 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 impact, the deck will come down and be supported by any pins still standing. This positions the detector disc to allow the "first ball, standing pins" cam followers and latches to function. If there are no standing pins (strike), the deck will lower to the full extent of the deck lowering hook. This positions the disc differently than for a standing pin cycle, and the "strike" cam followers and latches control the operations.

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.

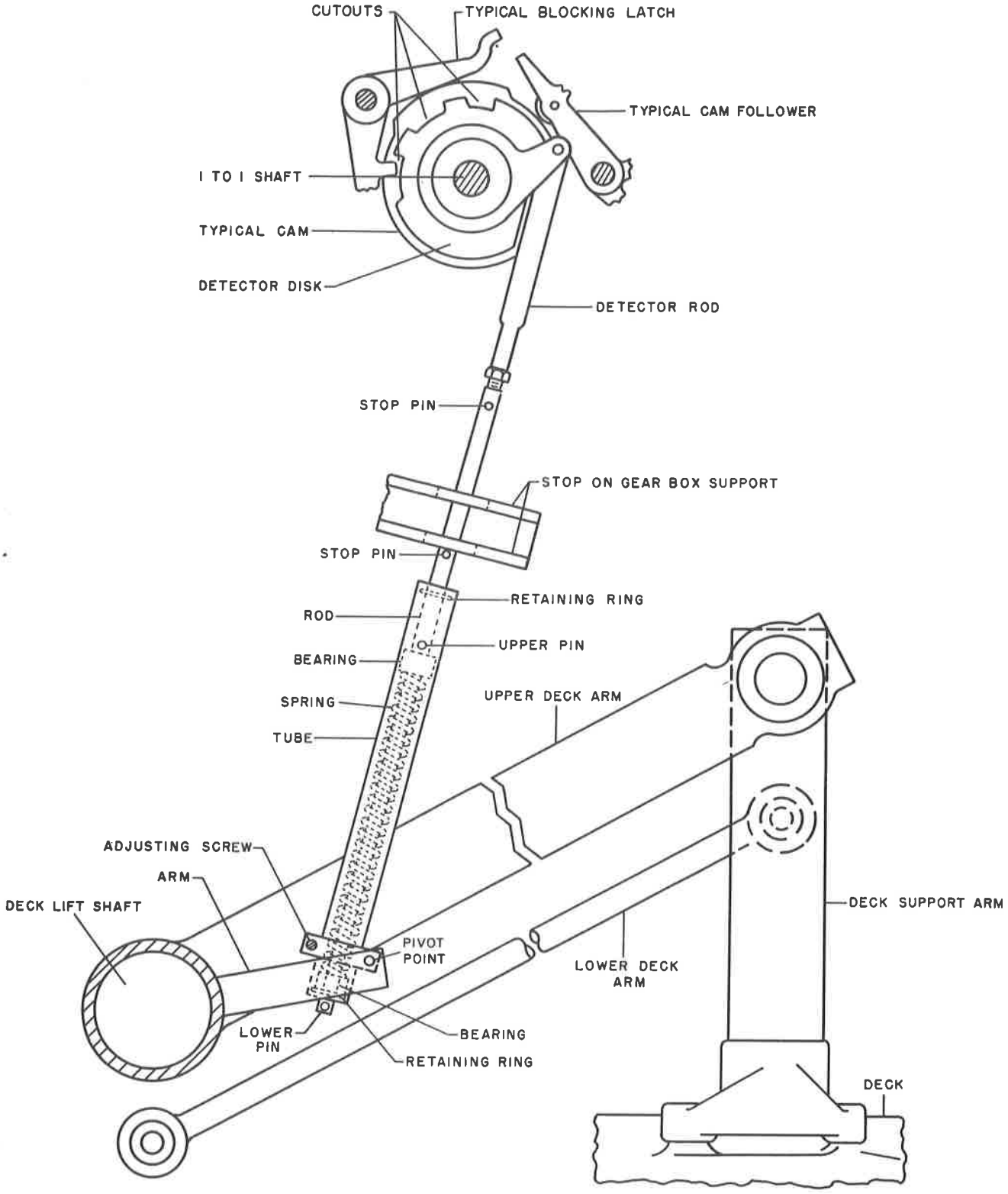


Figure 9. Detector Disc and Rod

CHAPTER 7. PIT CONVEYOR

The pit conveyor (figure 10) moves the pins and ball to the pin and ball elevators at the rear of the pit. The lower, metal frame of the pit conveyor is rigidly fastened to the submounting plates at the bottom of the pit. Above this lower frame is another 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. Clamped to the upper frame between a front and rear plate, is the pit board and the left- and right-hand deflectors. Refer to figure 14. The pit board consists of a concave plywood board on which is cemented a rubber pad covered with a carpet. The board is shaped so that the ball and pins tend to slide toward the rear as the pit conveyor is agitated back and forth.

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 on a shaft at the rear of the pit. Another pulley mounted on this shaft carries a belt which rides over two idler pulleys and drives a pulley mounted off center on an off-center hub of a shaft which runs across the middle of the pit. The shaft rotates in two bearings, one located at each end. At both ends of this shaft, a short distance inboard of these bearings, are bearing-mounted jogger arms which 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 gravitate toward the rear.

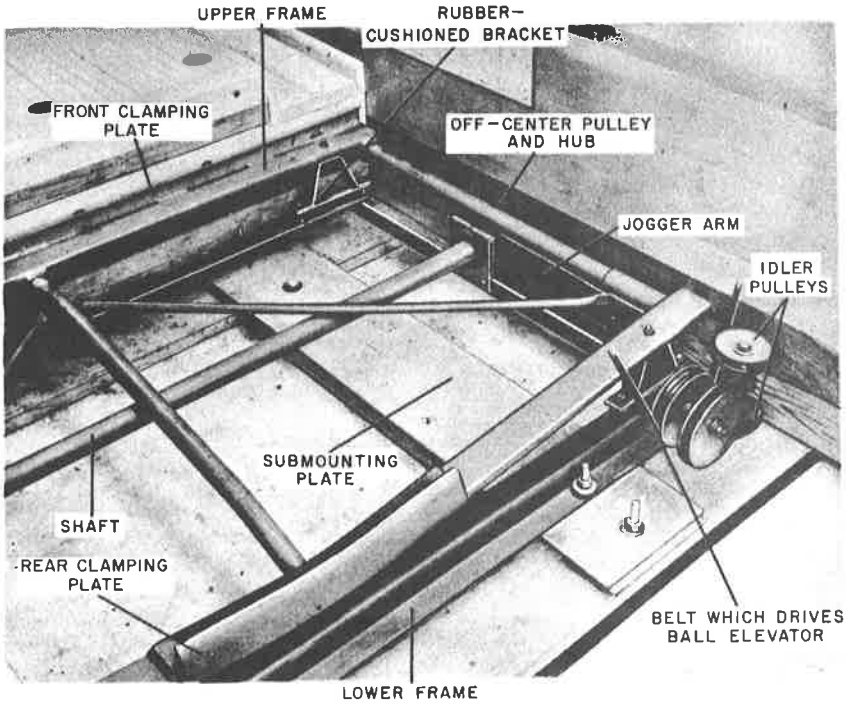


Figure 10. Pit Conveyor

CHAPTER 8. BALL ELEVATOR

The ball elevator (figure 11) picks up 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 guide rollers at the bottom and two at the top.

A belt from the electric motor drives a pulley mounted on a shaft. Fixed to the same shaft is another pulley which drives a belt carried around the outer perimeter of the steel wheel. This belt has a spring-loaded tensioning pulley. Concentric with the inside diameter of the steel wheel are the ball lift rods, which consist of a pair of curved, rubber-covered rods 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 steel wheel and the ball lift rods and is carried up and deposited on the ball return tracks. Refer to figure 15 for the pinsetter drive arrangement.

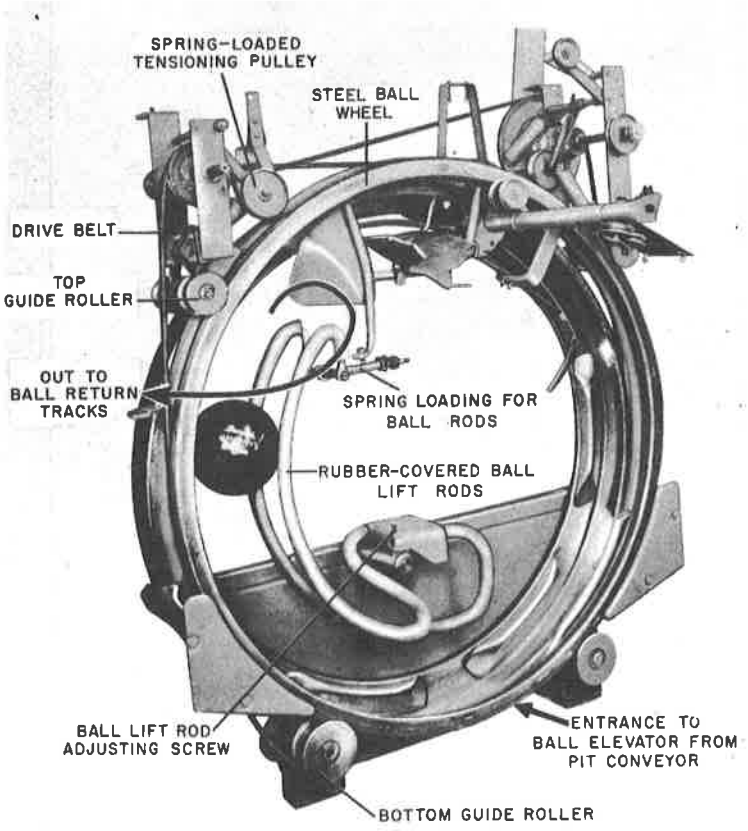


Figure 11. Ball Elevator

CHAPTER 9. BALL RETURN

Before describing the pinsetter ball return, it will be helpful to have some knowledge of the various types of ball returns in use at bowling alleys (figure 12). There are center ball returns, by which a pair of alleys have the balls returned between them; double outside returns, by which a pair of alleys have the balls returned for both alleys on either the far left or far right-hand side of the pair of alleys; and single outside returns, by which the ball is returned at either the left or right side of a single alley.

In general, the pinsetter ball return consists of a pair of parallel metal rods which form a track that receives the ball from the ball elevator (figure 13), carries the ball through the pinsetter, and deposits it on the alley ball return. The track slopes downward toward the alley ball return, and therefore gravity moves the ball. If the alley ball return is servicing just one alley, this ball track is all there is to the ball return. When the alley ball return services two alleys, the length and shape of the pinsetter ball tracks will vary to meet the requirements of the particular situation. This is due to the fact that two pinsetters are feeding one alley ball return and must have a separate track from each pinsetter converging into a common track which feeds the ball to the alley ball return.

When two pinsetters feed a common alley ball return, it is necessary to prevent two balls from the two pinsetters from meeting at the common track and causing a jam. The ball return has a "preference bar" blocking device to prevent any possible ball jam (figure 13). On one of the paired pinsetter's ball tracks, a preference bar projects above the rails and as the ball rides over it, the bar, being pivoted, is pushed down. This latches a ball stop on its companion pinsetter's ball return, blocking the ball track on the second pinsetter until the first ball is near the common track and cannot collide with a ball from the second pinsetter. At this point, the preference bar will return to its original position, and the ball stop will release on the second pinsetter.

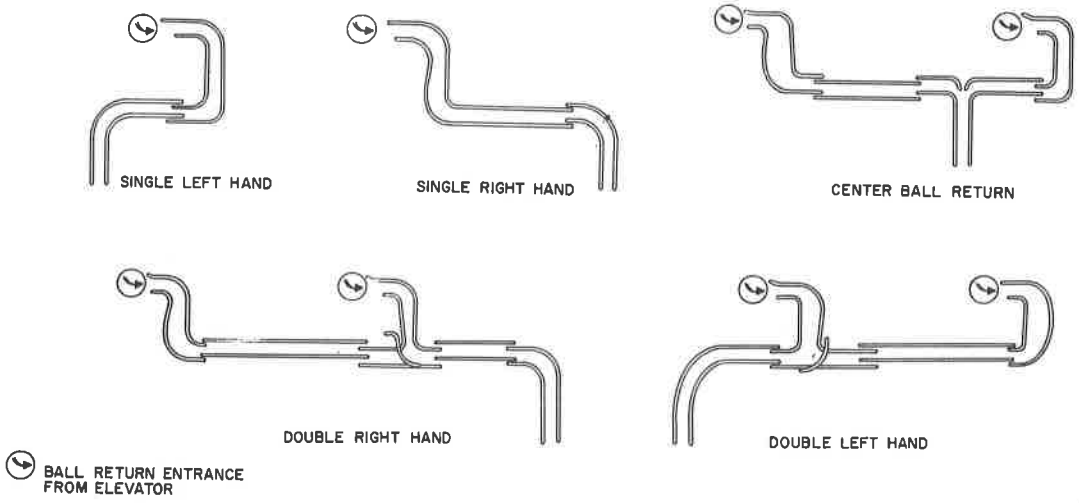


Figure 12. Types of Ball Returns

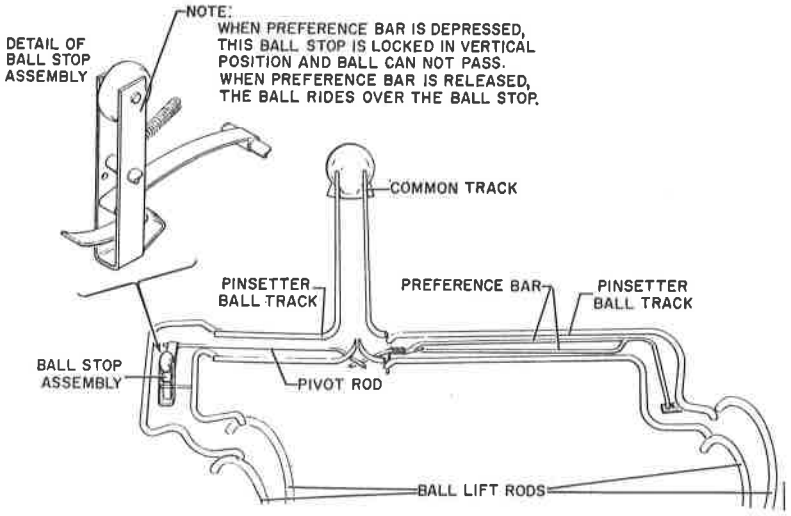


Figure 13. Typical Center Ball Return With Preference Bar

CHAPTER 10. PIN ELEVATOR

The pin elevator (figure 14) 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 guide rollers at the bottom (figure 2) and two guide rollers at the top. On the same jack shaft with the pulley that is driving the ball elevator is another pulley carrying a belt that runs across the top of the pinsetter to a pulley on a second jack 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 is turning. The pulley that drives the pin elevator belt is powered through a magnetic clutch. Refer to figure 15 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.

Around the inner diameter of the pin elevator are pockets into which the pins drop either base first or top 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 wheel into the turnaround pan.

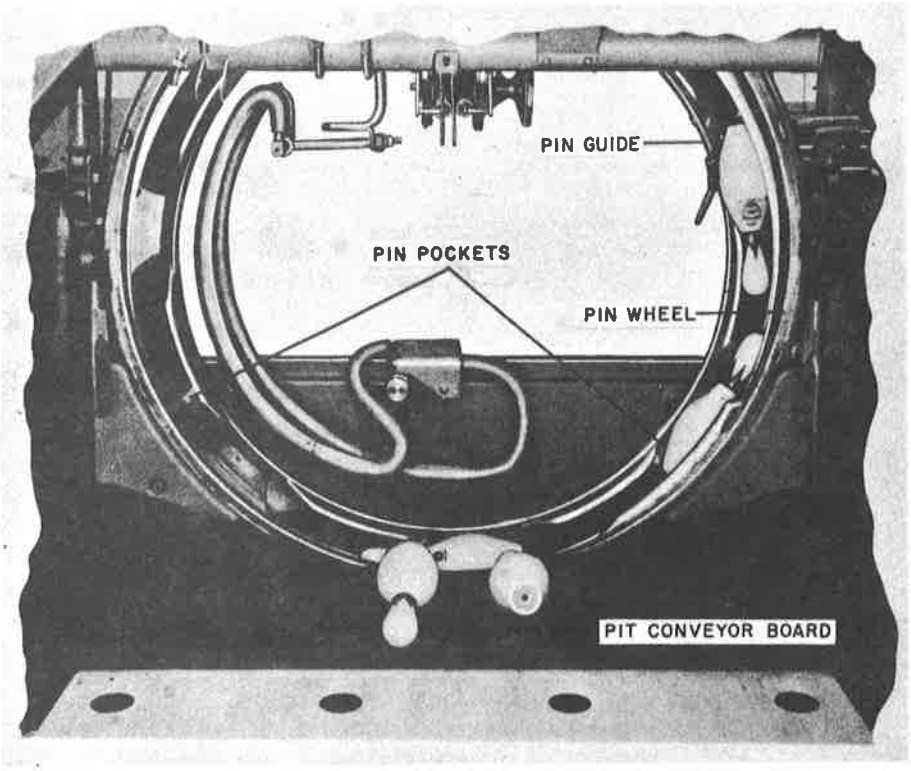


Figure 14. Pin Elevator, Lower Section

CHAPTER 11. TURNAROUND PAN

The turnaround pan (figure 16) 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 tip first or butt first and orients them all butt first before they are picked up by the cross conveyor.

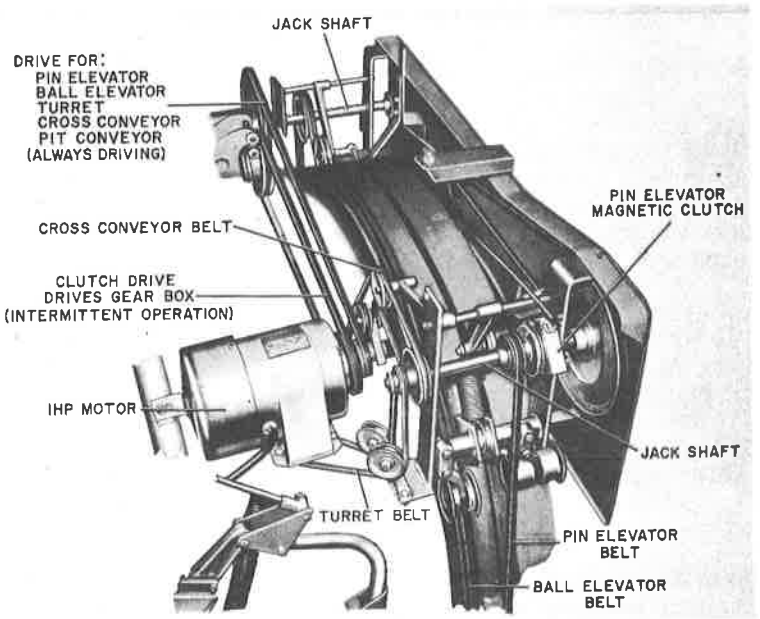


Figure 15. Pinsetter Drive Arrangement

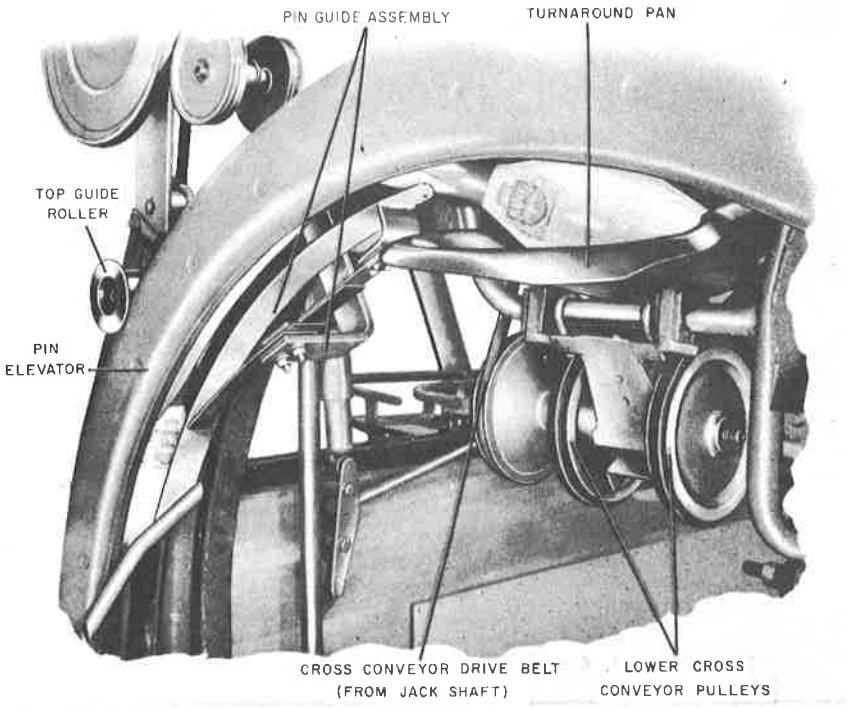


Figure 16. Pins Entering Turnaround Pan

CHAPTER 12. CROSS CONVEYOR

The cross conveyor (figures 17, 18 and 19) carries the pins from the pin elevator to the turret. A pair of parallel moving belts running between built-up metal sides 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 22) 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 basket 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 gate swings to the rear and contacts the pin gate latch link, which was holding the pin gate latch above a 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. As the neck of the pin goes over the pin gate, the gate is spring urged to move back to its original position. When the pin gate returns to its original position, the lower arm of the gate is caught under the cross conveyor latch, which is spring urged in a downward direction, and the gate is locked in position, thus blocking the passage of the next pin. 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 pin as they are carried up the conveyor. The rollers are spaced far enough apart so that the body of the pin trips one lever and then releases it before tripping the second lever. If the pin gate is latched, it will hold back one pin which will lift one lever, and the second pin coming right behind it will lift the second lever so that both are tripped at the same time. When both levers are tripped 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 microswitch mounted under the two trip levers. When both of these levers are tripped at the same time, this 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 strike the "snubber". The snubber is a spring loaded device pivoted on the front of the cross conveyor. It serves two purposes; it cushions the fall of the pins and helps to seat the pins properly in the turret baskets.

The cross conveyor is powered as follows (figures 15 and 16): 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. Two additional pulleys on this shaft carry the parallel cross conveyor belts which each turn around another pulley at the front of the cross conveyor.

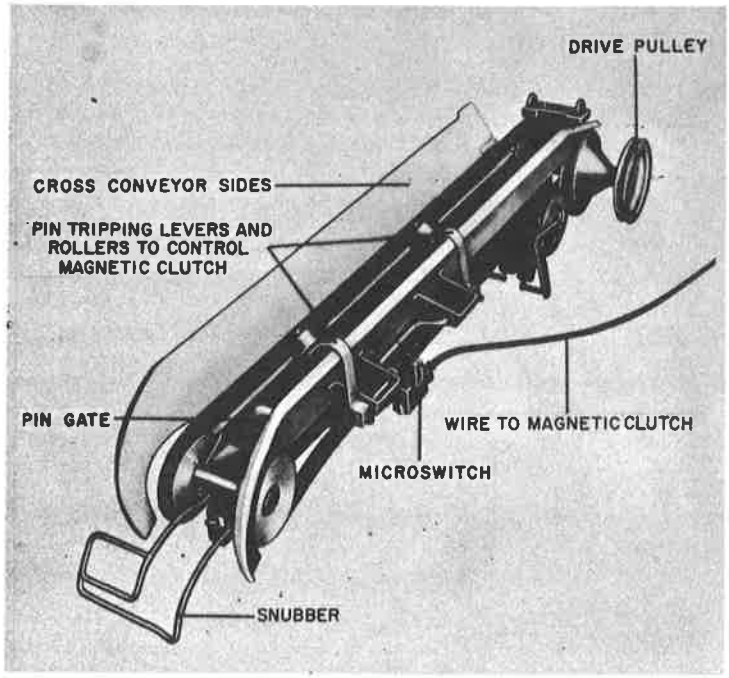


Figure 17. Cross Conveyor

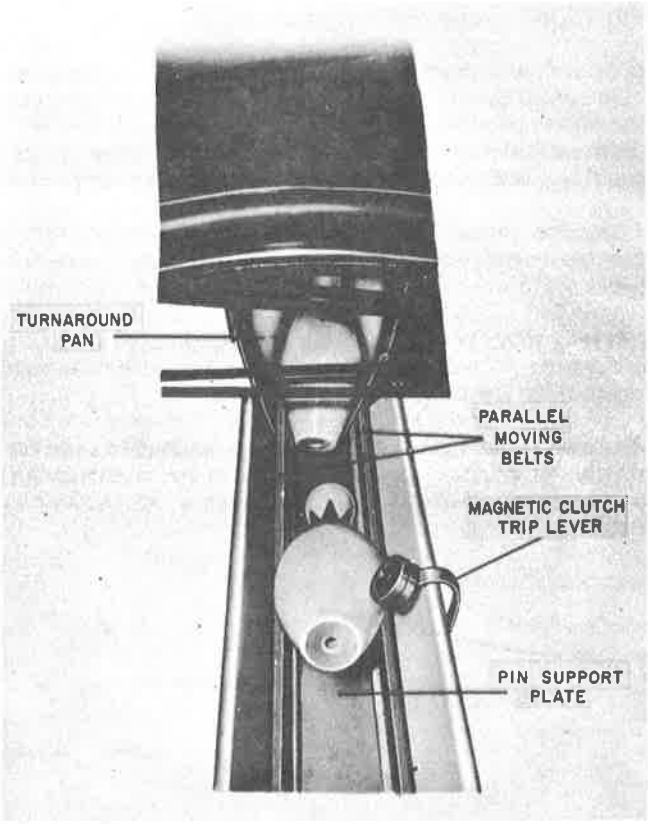


Figure 18. Cross Conveyor In Operation

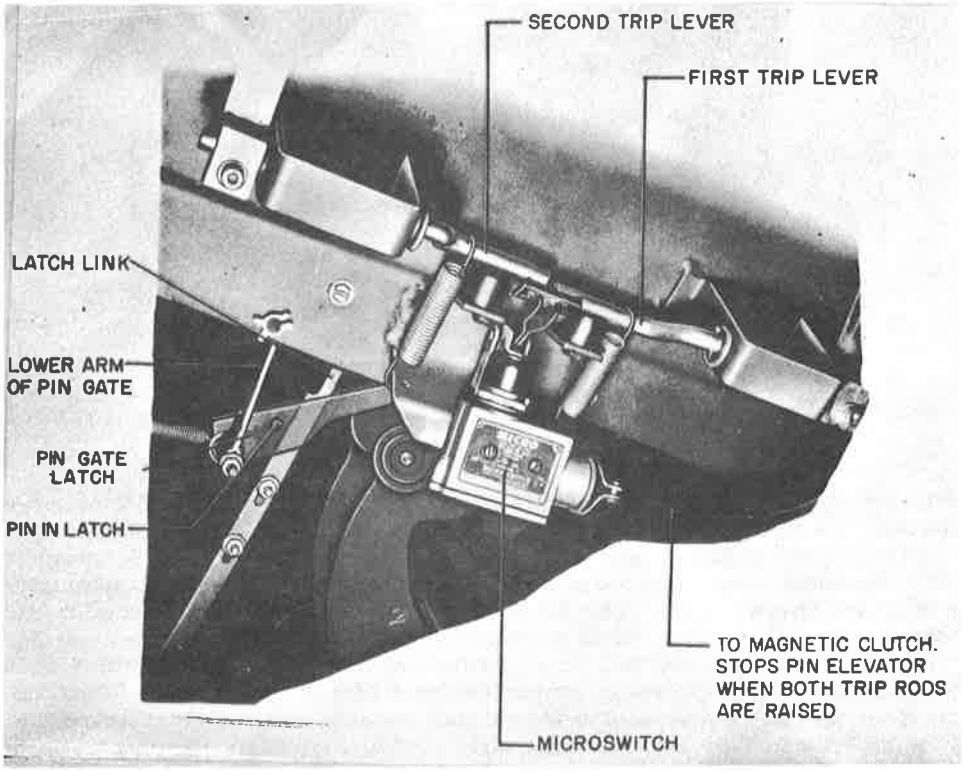


Figure 19. Cross Conveyor Microswitch Details

CHAPTER 13. TURRET

The turret (figure 20) receives the pins from the cross conveyor and at the proper time delivers 10 pins to the deck. A pulley, mounted on the jack shaft that carries the pin elevator and cross conveyor pulleys, drives a belt across two fixed, positioning idler pulleys and a spring-loaded tensioning idler pulley to a pulley on the top of the turret clutch assembly. On the bottom of the turret clutch assembly is another pulley which drives the belt that turns the pulley on the turret assembly. Refer to figures 15 and 21 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, a spider with nine spoons to support the nine pins in their framework baskets, and a triggering device to release the pins to the deck.

The turret clutch is a two pulley device, with the upper pulley (which is always turning) and the lower pulley (which drives the turret), always engaged. The friction drag of the turret belt is such, that if the turret is not free to turn, the turret belt will slip on the lower pulley.

The turret, with the framework pin baskets and the tenth pin chute, is fixed to the turret pulley so that they rotate together. The spider, with its pin-supporting spoons, is bearing mounted under the turret with a latch locking it to the turret so that they turn together. When the latch is opened, the spider is free to turn without the turret and turret pulley turning.

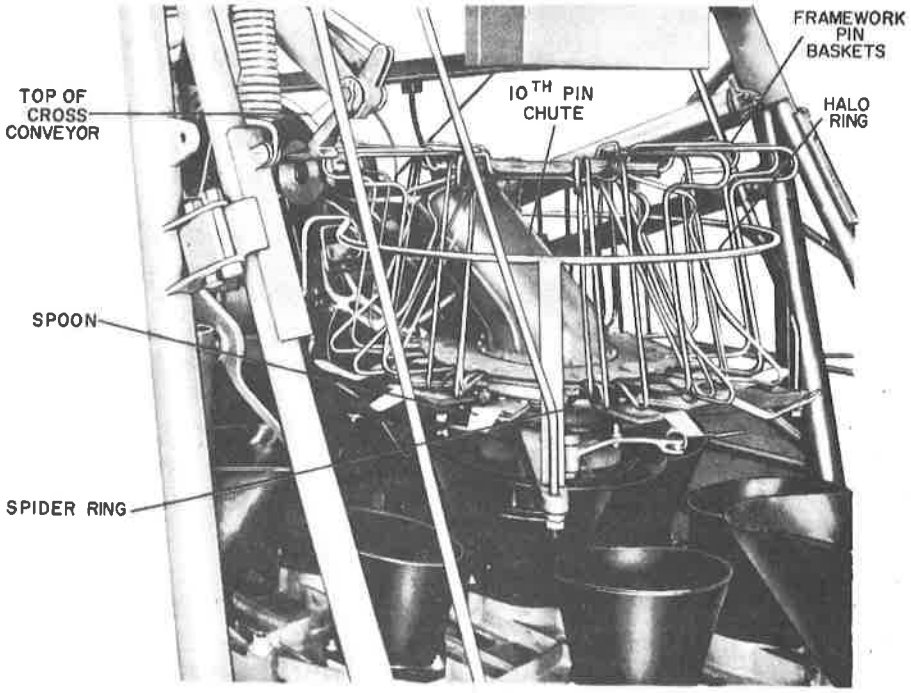


Figure 20. Turret

On the top surface of the turret pulley is the indexing cam (figures 21 and 22) which has 10 lobes and 10 depressions. Following this cam, is a roller at the front end of the stop lever which pivots on the turret clutch support. Pinned 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 link drops 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 cam, the 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 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 moves back 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 shoulder in the link 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.

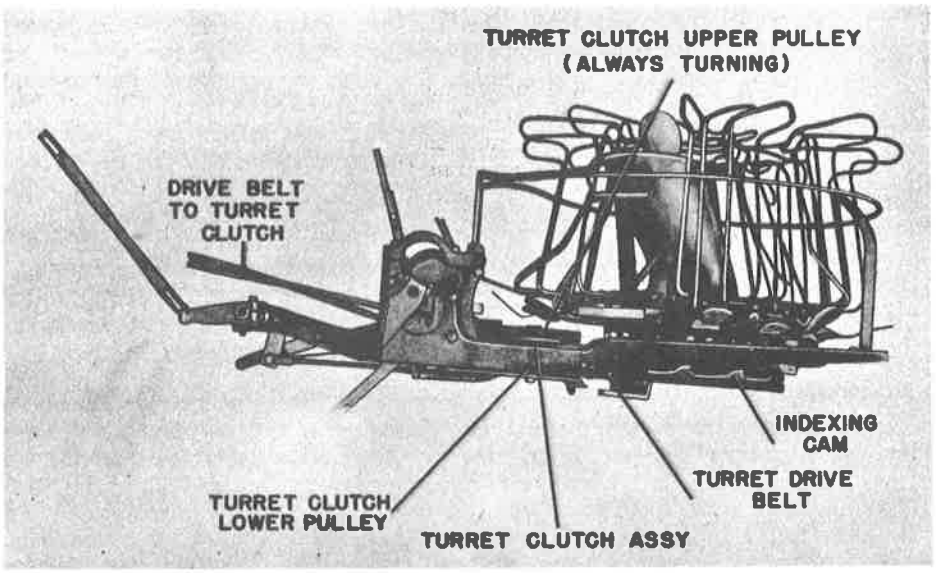


Figure 21. Turret - Side View

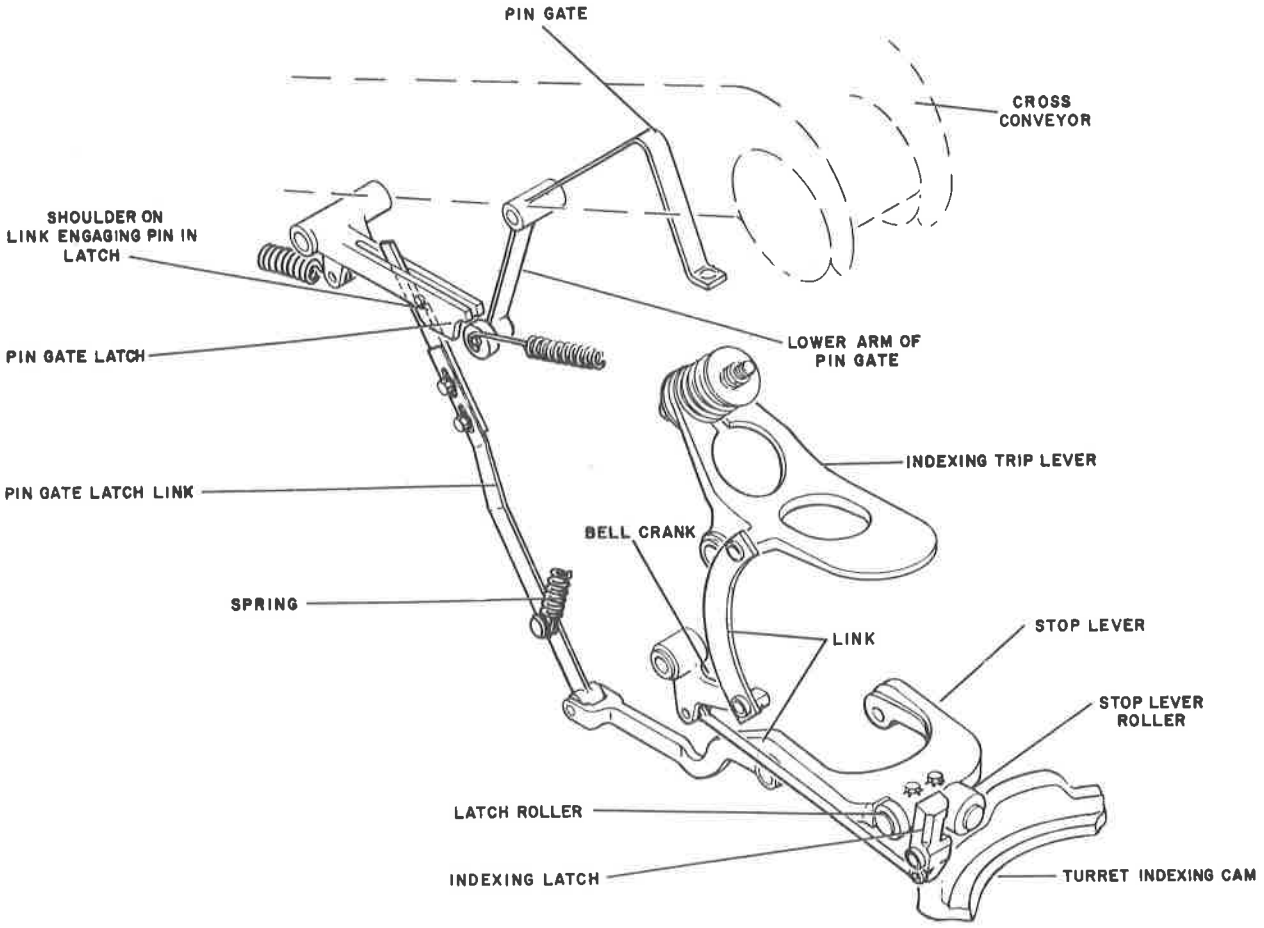


Figure 22. Turret Indexing Mechanism

The mechanism which frees the stop lever roller to rise and fall to allow the turret to index is controlled as follows: As the pin drops from the cross conveyor toward the turret, it strikes the indexing trip lever, pushing the lever down. Through a bellcrank lever and a link, the trip lever raises a latch that engaged a small roller on the stop lever. This latch effectively held 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 lifting of the latch frees the roller to rise, thereby allowing the turret to index one position to receive the next pin. The turret indexed only one position because the trip lever is spring loaded and it immediately snapped back to relatch the stop lever. 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 first nine pins. The tenth pin is used to trigger the release of the 10 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 bucket with a triggering device in the bottom (figures 23 and 24). The trigger is latched until the deck is in position to receive the pins. The tenth pin is delivered to its bucket without hitting the trip lever, thereby preventing the turret from indexing in the same manner as for the first nine pins. To index the turret after the tenth pin is delivered to its bucket, another indexing mechanism is used. The tenth pin indexing will be described a little later.

Pivoted at one end to a fixed turret support arm is the spider release lever, which is connected at its other end, through a spring, to another fixed turret support arm. The spider release lever carries a roller which follows the spider release 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 release cam which tensions the spring that ties the release lever to the turret support. Then as the tenth pin drops into the bucket and lifts the latch that ties the spider to the turret, the release lever roller encounters a deep depression in the spider release 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 travelling any further than is necessary to release the pins. There is also a simple air-actuated dashpot recoil mechanism between the spider and the turret, designed to alleviate some of the shock of the sudden shift forward of the spider and to limit the amount of rotation of the spider.

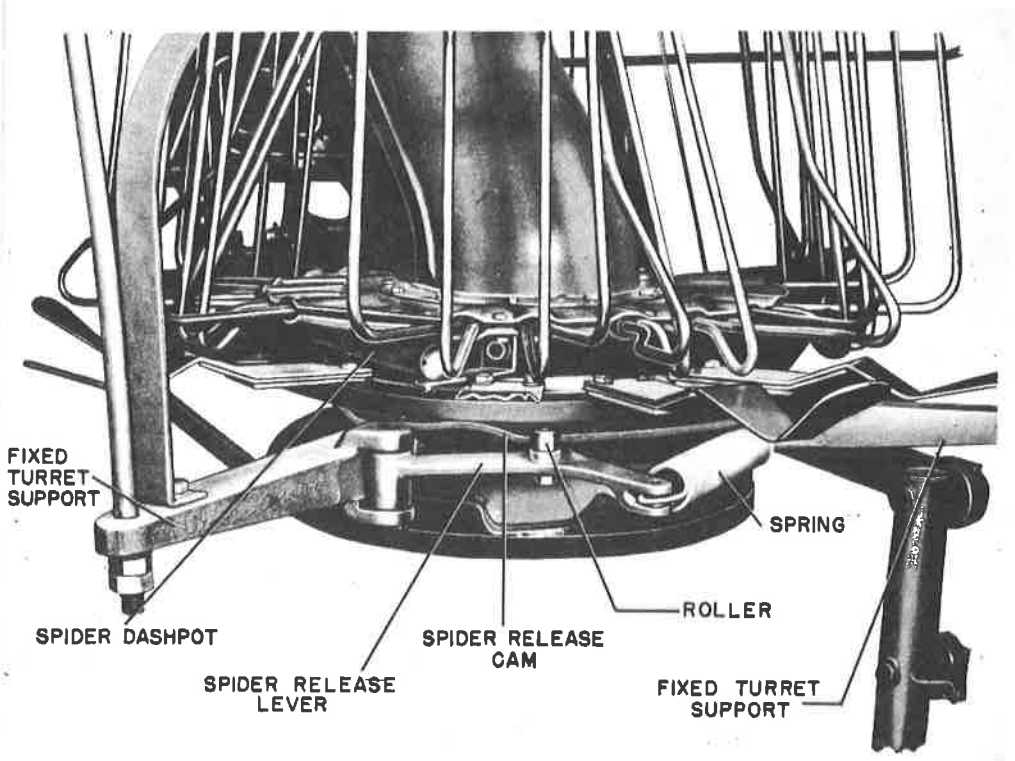


Figure 23. Spider Release Mechanism

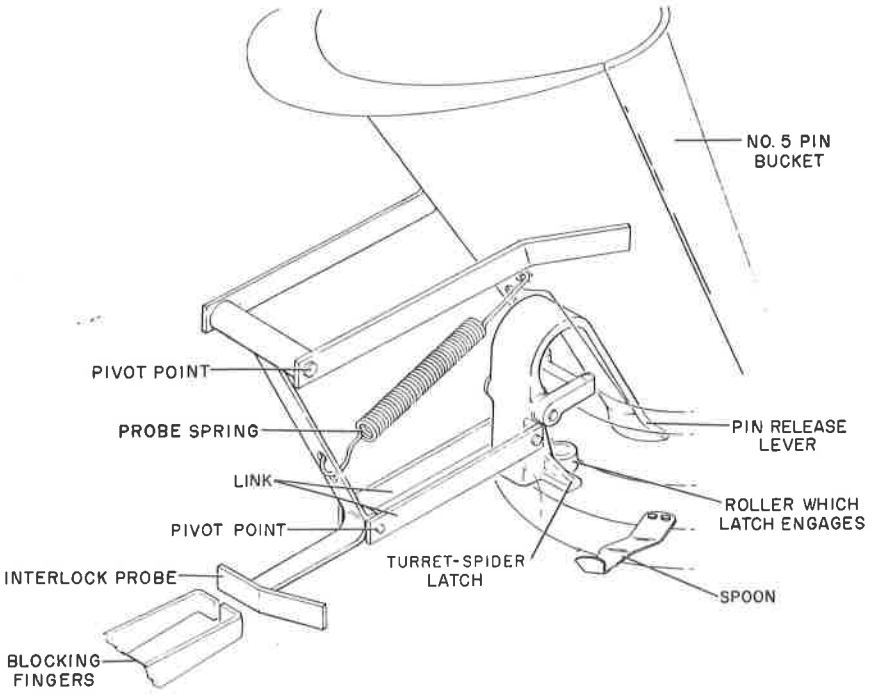


Figure 24. Turret No. 5 Pin Triggering Device

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 24) which is positioned at the bottom of the tenth pin bucket. At the bottom of this bucket, the pin release lever has an arm which the descending pin meets. At the other end of the release lever is the latch which ties the spider to the turret. Pivoted on the latch end of the pin release lever is the interlock link, and pivoted on the other end of this link is the interlock probe which is also pivoted at its top on the 5 pin bucket. The interlock probe is spring urged in its latching direction and, through the linkage just described, holds the turret-spider latch in its latched position. As the descending pin hits the pin release lever, the weight of the pin overcomes the spring tension of the interlock probe, the pin release lever is depressed, the latch swings out, and the interlock link pushes the probe outward. If the deck is in position to receive pins, the interlock probe encounters no opposition, the spider makes its forward move, and the pins drop into the deck. If the deck is not in position to receive pins, the interlock probe is blocked by one or both of the interlock blocking fingers as it starts to move outward. In this event, the pin release lever cannot be depressed, and the latch will not lift to free the spider. The weight of the tenth pin will be supported by the pin release lever until the interlock blocking fingers are lifted out of the way of the interlock probe, at which time the weight of the pin will trigger the latch as previously described. The interlock blocking fingers and the method by which they determine the time to release the pins to the deck will be fully described in the interlock chapter.

Presuming all conditions were satisfactory and the 10 pins were released to the deck when the spider moved ahead of the turret, the spider is now one position ahead of the turret and, as mentioned previously, the tenth pin does not hit the trip lever which lifts 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 gear (figures 25 and 26) which is frictionally engaged to the pulley. Engaging this gear is a latch gear which, when latched, prevents the gears from turning and causes the friction surfaces between the gear and pulley to slip. Pivoted on the turret support is a latch which is torsion-spring urged in urged in engagement with a block on the underside of the latch gear. As the spider moves ahead of the turret to release pins to the deck, an arm on the spider trips this latch, and the gears start turning as the braking action of the latch gear is removed. As the gears turn, another block on the underside of the latch gear contacts the trip lever where it joins the bellcrank lever. This trips the lever and lifts the indexing latch exactly as if a pin had hit 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 release 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 contacted, to insure that the pins are clear of the turret before it indexes and is relatched with the spider.

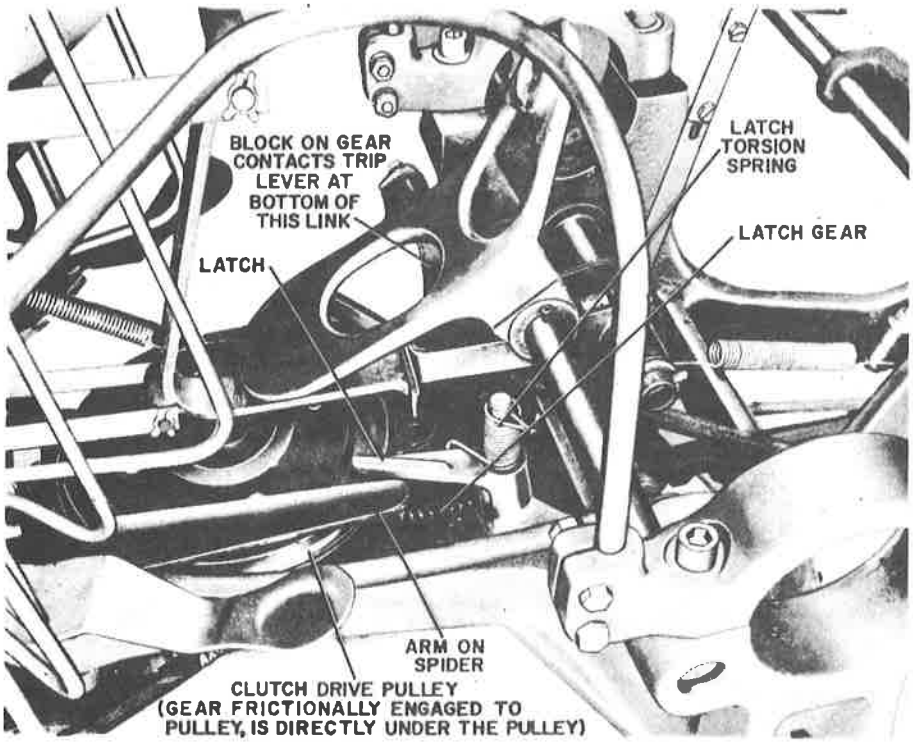


Figure 25. Turret No. 5 Pin Indexing Device

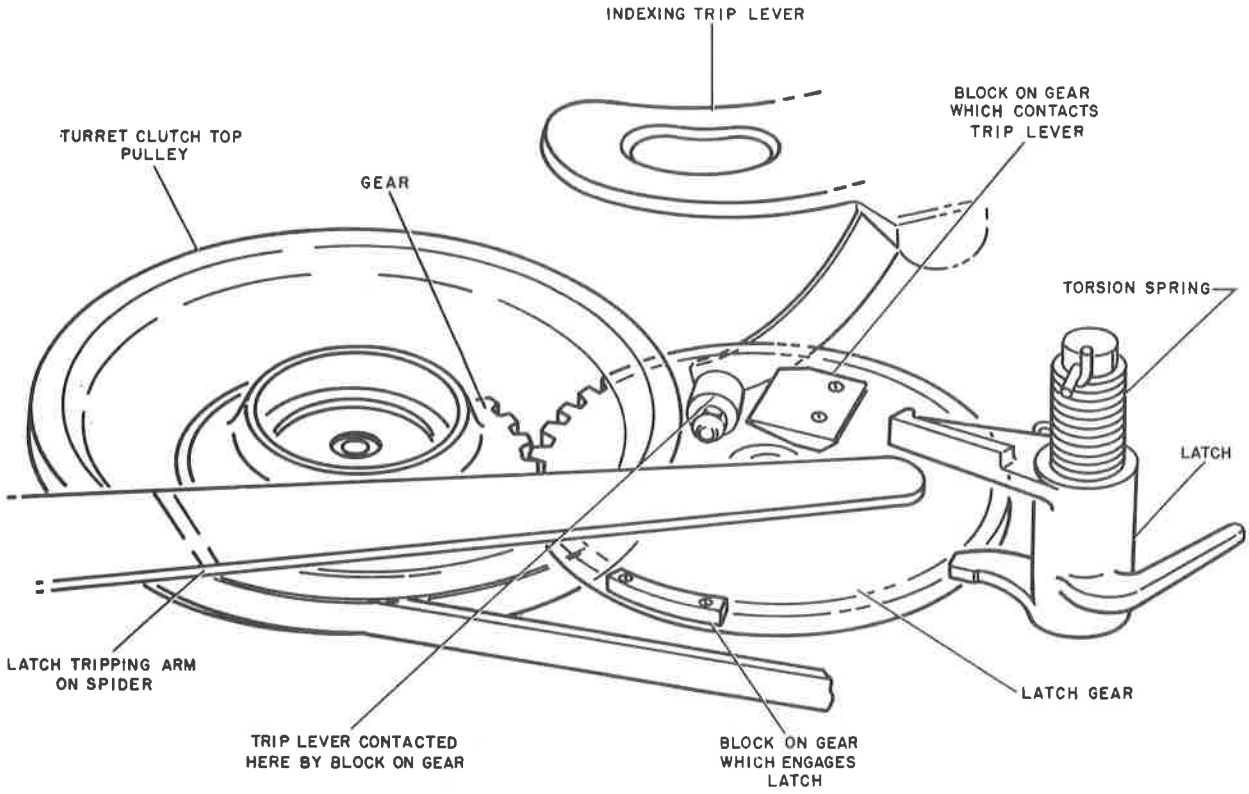


Figure 26. Turret No. 5 Pin Indexing Device

CHAPTER 14. DECK.

The deck (figure 27) must serve several functions. It lowers to detect a strike or standing pins condition, it must pick up and then respot standing pins after the rake has swept the deadwood, and it must set 10 new pins on the alley when needed. The deck must be able to make a short stroke for detecting, picking up, and respotting of standing pins, and must be able to make a longer stroke for setting new pins (figure 28).

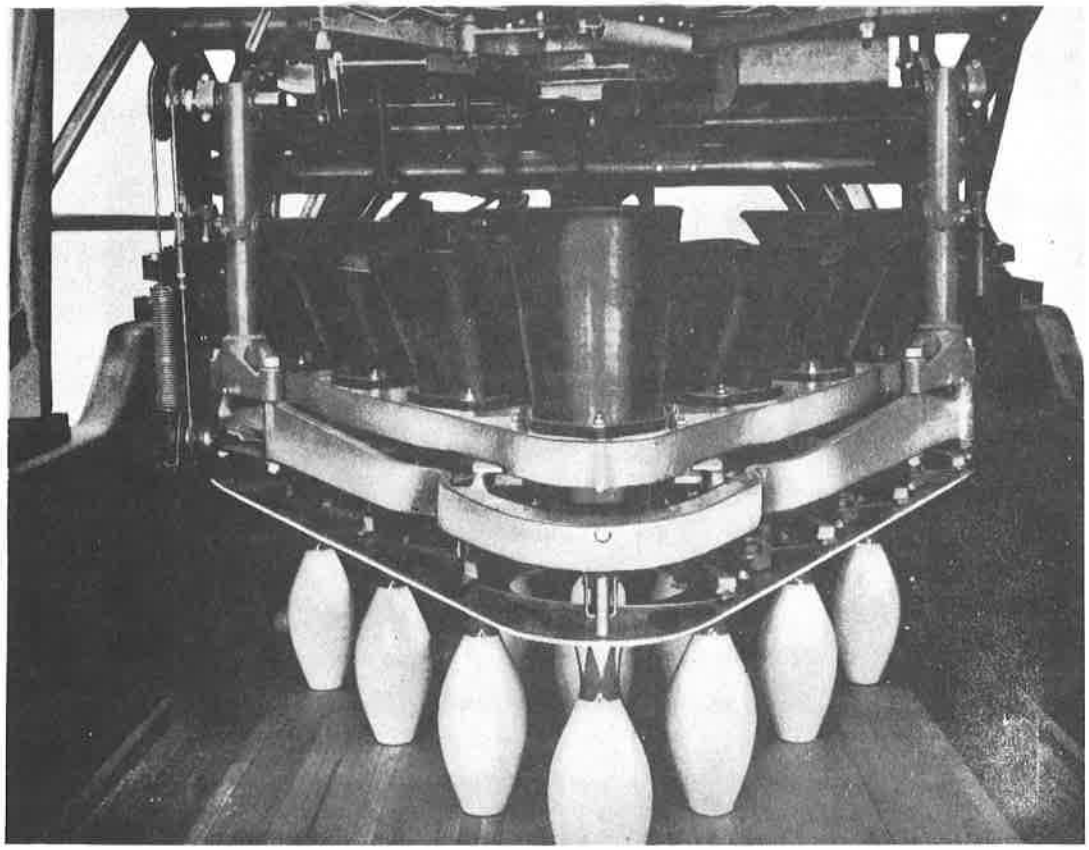


Figure 27. Deck

The deck lift shaft 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 4). Just below these arms is another pair of arms 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 to 1 shaft. The 2 to 1 shaft is used because the deck must lower and raise twice per cycle.

The deck (figure 29) itself 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 (figure 30) which are carried in fixed tracks on the stationary deck. Through a cable and sheave 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 31). 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 pinsetting depth, the upper deck is pulled still further back, the pins are released, and the deck goes back up. Just underneath each roller is a pin stabilizing plate which insures that the deck will release undersized pins perpendicular to the alley surface.

When the deck comes down to detect and encounters standing pins, the weight of the deck is actually supported by the top of the pins contacting a rubber-covered steel plate in the deck (figure 30). 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 which are controlled by a cable and sheave 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 alley as the deck goes up.

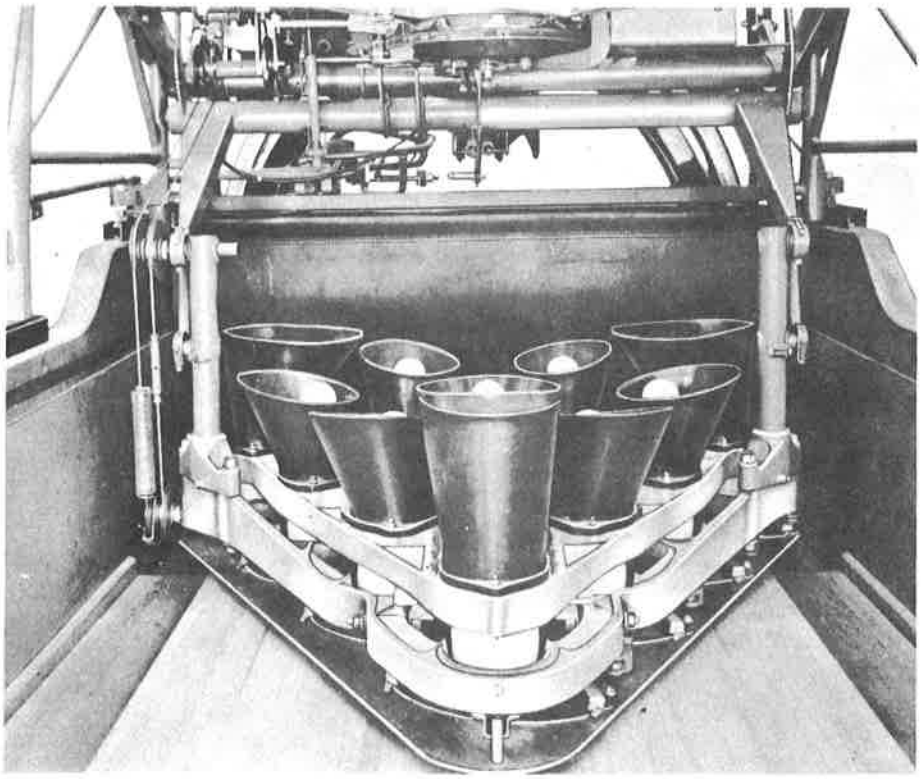


Figure 28. Deck In New Pinsetting Position

Attached to the 2 to 1 shaft is an eccentric disc (figure 32). Clamped around the outer perimeter of this disc is the deck lowering hook. Eccentrically located on the outer surface of the disc is the crank pin which carries the long, slotted, deck lowering link. When the 2 to 1 shaft is rotated, the eccentric rotation of the deck lowering link is much greater than the eccentric rotation of the hook. The lower end of the deck lowering link 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, and for picking up and respotting standing pins, the deck lowering hook is allowed to drop over the deck lowering pin at the lower end of the deck lowering link, and the deck goes through the shorter motion of the hook. 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 of the link.

Rotated by the same 2 to 1 shaft as the crank, is a cam which moves the deck hook cam lever, which 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 engaged 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 a stop lever in the detector assembly. With the deck in its top position and the deck lowering hook free of the pin, the rising slope of the cam rotates the deck hook cam lever and the hook latch lever. This rotation, through the slotted connection and the tension spring, raises the hook out of the path of the 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.

If it is desired for the deck to make the longer, new pinsetting stroke, the deck lowering hook is held out as follows: While the deck hook cam lever is in its position on the high spot of the cam, the deck hook latch in the detector assembly is put in the path of the detector stop lever. This prevents the 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 pin. The deck will then make the longer stroke under control of the link.

The moving deck has three positions (figure 31): fully forward for receiving pins from the turret, for detecting, and for picking up and respotting standing pins; partially retracted for the pins to drop lower in the deck; and fully retracted for releasing the pins on the alley.

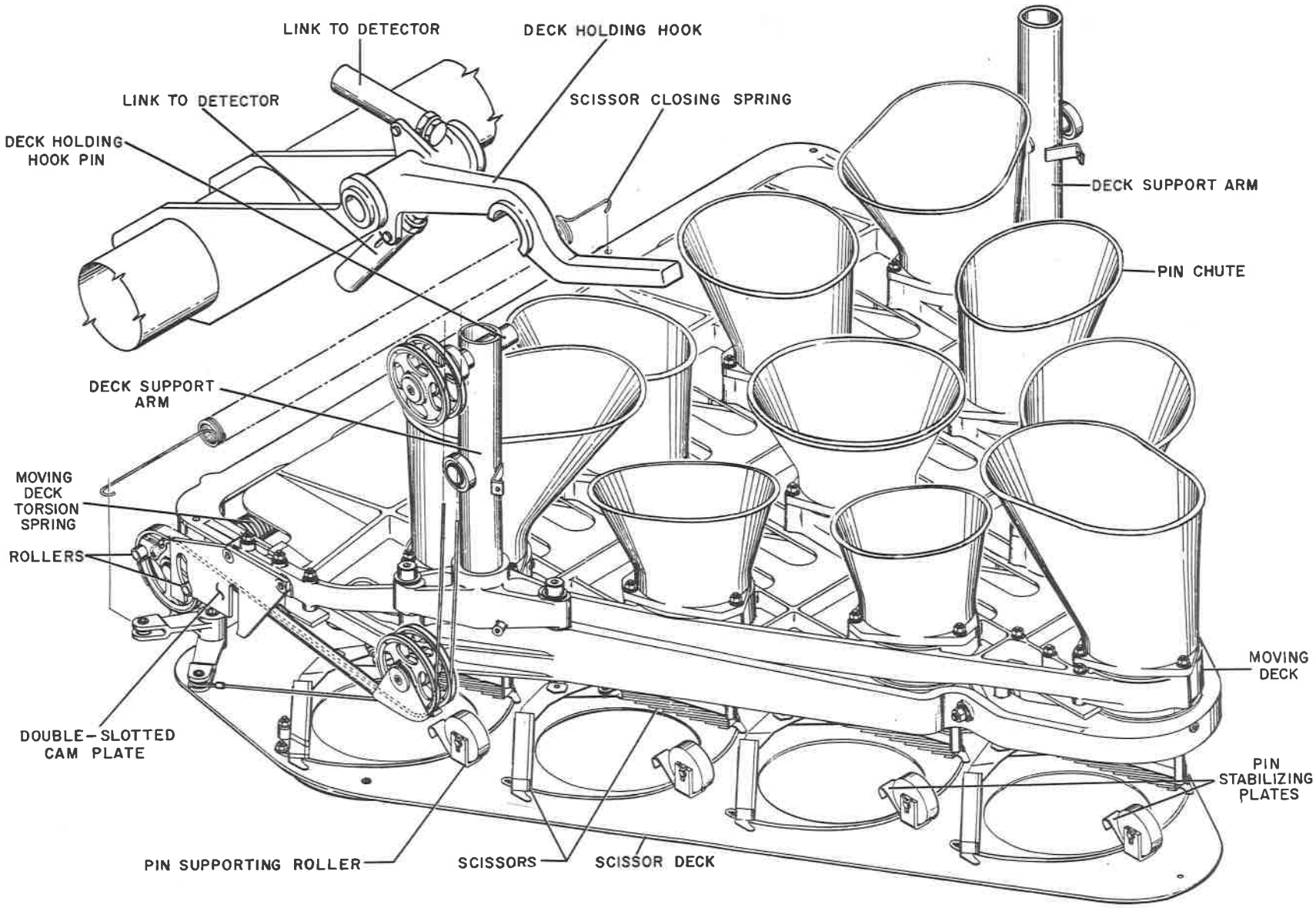


Figure 29. Deck Showing Major Subassemblies

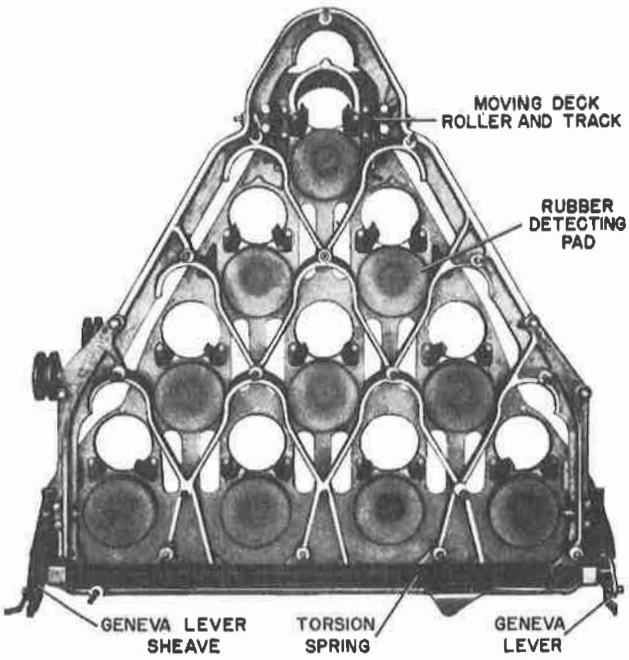


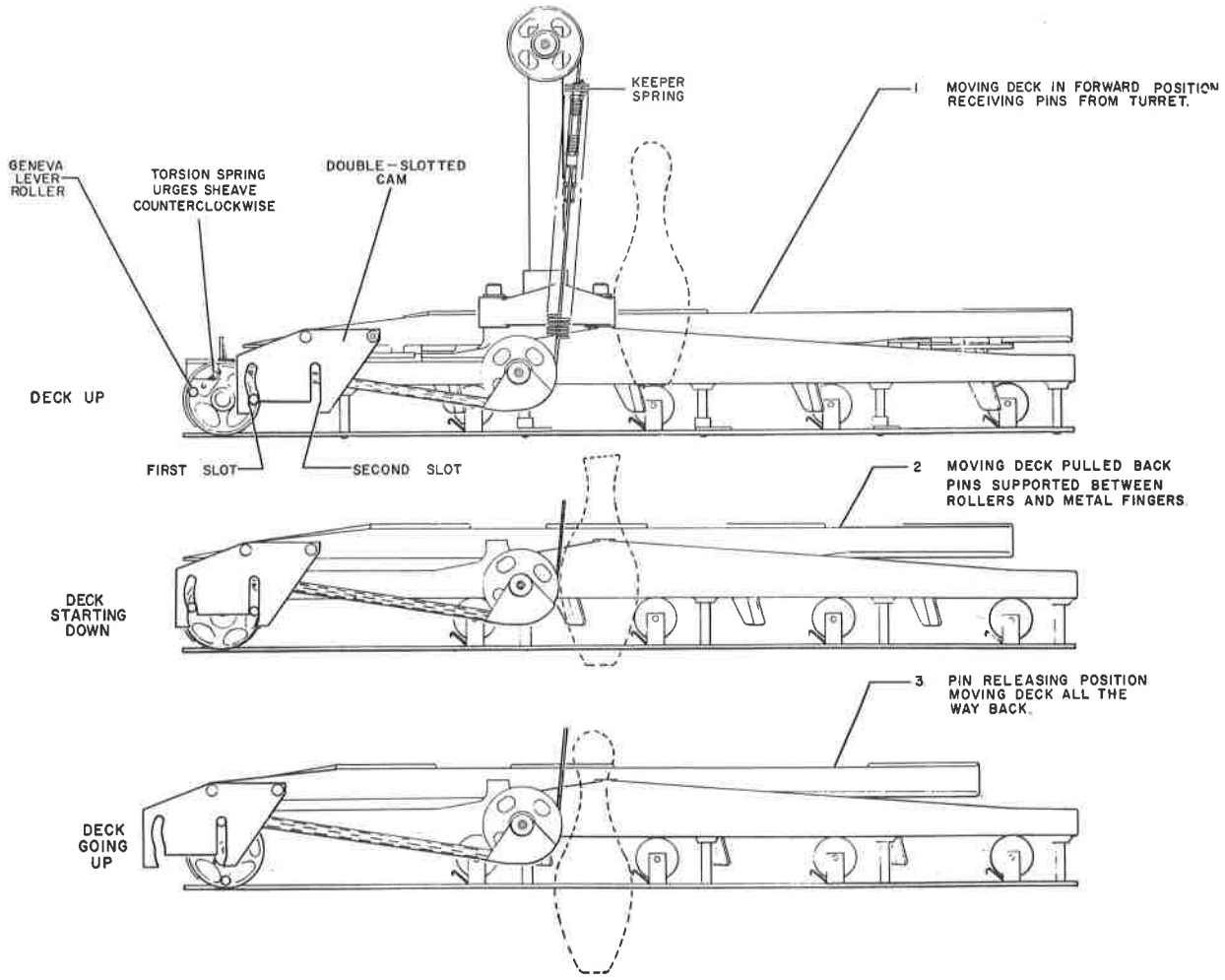
Figure 30. Underside of Moving Deck

These motions are controlled through a torsion spring and cable-sheave arrangement by the moving deck-scissor cam on the 1 to 1 shaft (figure 33). A cable, which is anchored at one end to the pinsetter frame, passes over a sheave on the moving deck cam follower arm and is fixed at its other end to another sheave on a shaft. On this shaft and rotating with it, is an additional sheave to which is attached the moving deck cable. This cable passes over a sheave mounted on an arm above the deck, over a sheave on the deck, and is fastened to a sheave at the rear of the stationary deck. The latter sheave is fixed to a torsion spring running across the rear of the deck and carries a pair of geneva levers which can engage a double-slotted cam plate on the moving deck (figure 29). The torsion spring is wound so that the moving deck is urged in a backward direction, but is prevented from moving by the taut cable preventing the geneva lever sheave from rotating.

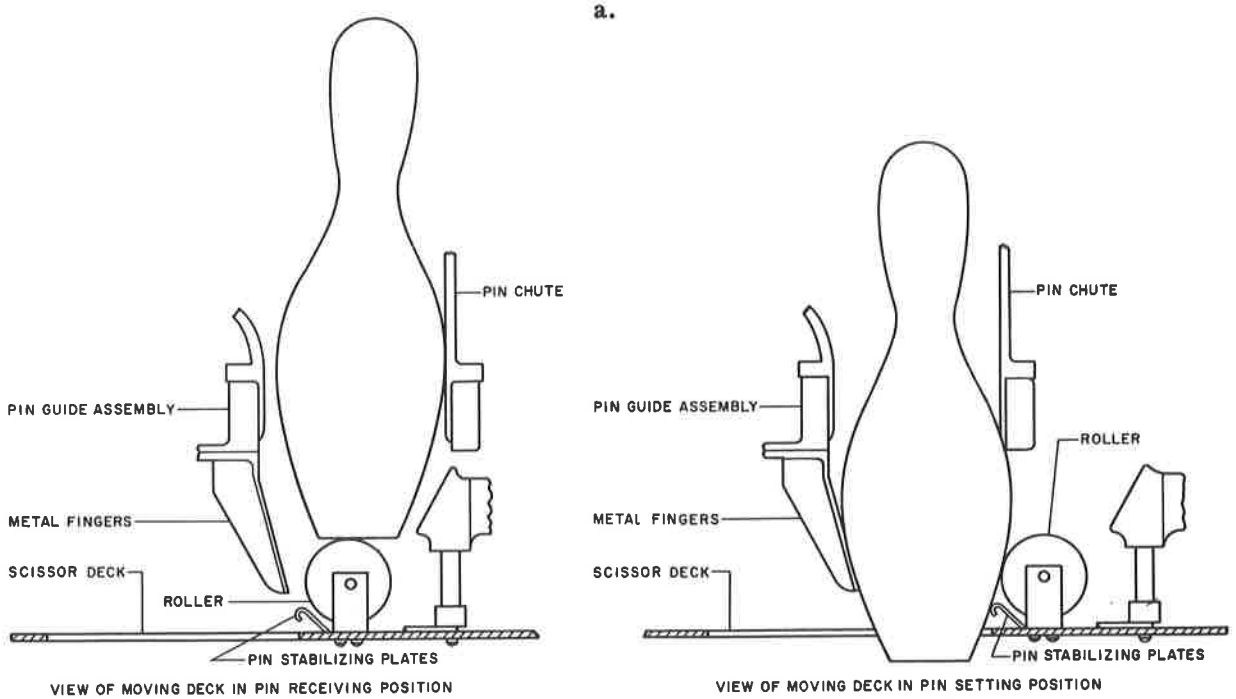
The moving deck-scissor cam has three levels. The highest level rotates the moving deck cam follower arm the farthest forward to hold the deck fully forward. The middle level of the cam allows the moving deck cam follower arm to swing to the rear, moving the deck part of the way back and allowing the pins to drop through to 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 alley 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 sheaves, one of which is attached to the moving deck cam follower arm. As this arm moves rearward, following a lower height of the cam, the distance between the two sheaves is shortened. This slackens the moving deck control cable, allows the torsion spring-loaded sheave to turn, and the first geneva lever through the rear slot in the cam plate pulls the moving deck back. When the moving deck cam follower arm rotates still farther rearward, the distance between the two sheaves is again decreased, and the moving deck control cable slackens again. The second geneva lever engages the front slot in the cam plate, 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 sheaves. 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 control cable serves to take up any momentary slack in the cable as the deck shifts.

The scissors for gripping standing pins are also controlled through a spring and cable-sheave arrangement by the moving deck-scissor cam. The scissor cable is anchored to a sheave, passes over a sheave on an arm above the deck, then over a sheave on the deck, and is anchored to a toggle lever pivoted on 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 34). Attached to this toggle lever is a strong tension spring which runs across the back of the deck. This spring normally urges the scissors to close and, unless the spring is overpowered by the scissor cable, the scissors will close. Refer to figure 35 for the range of scissor operation.



a.



b.

Figure 31. Various Positions of Moving Deck

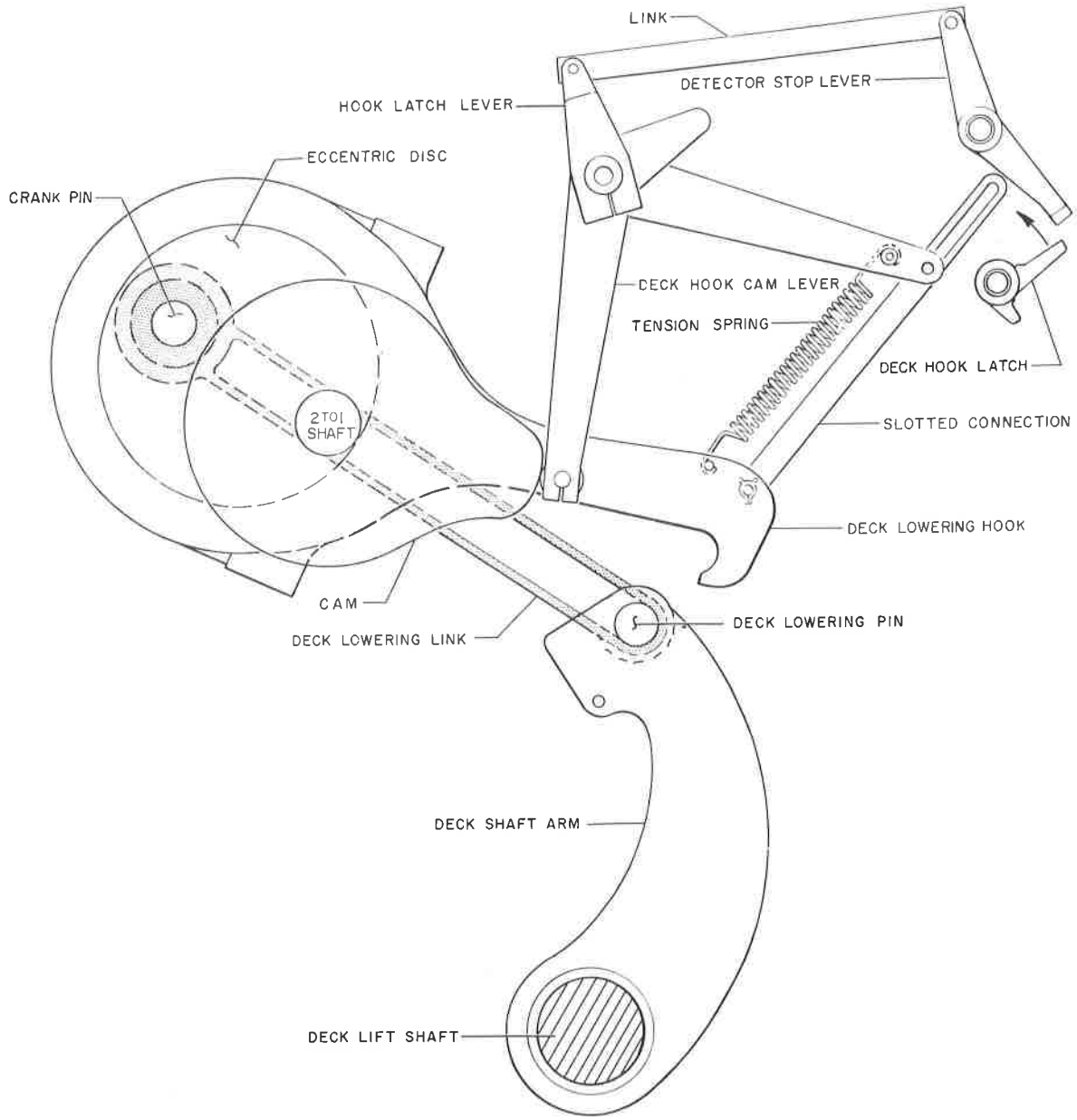


Figure 32. Deck Raising and Lowering Mechanism

On the sheave 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 dwell of the cam, the upper sheave, through the link and lever, 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 sheave to slacken the cable. The spring then closes the scissors. There is no need for the lower 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 machine housing and prevents the arm from rotating any further. As the cam follower arm contacts a rising dwell 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 detector mounting plate and controlled by a link from the detector assembly, can be rotated to contact 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. The same latch can be rotated in the opposite direction under the scissor cam follower arm, thus blocking the scissor action and freeing the moving deck cam follower arm.

Pivoted on the front cross brace is the deck holding hook (figure 29) 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 link 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 during the 0 to 90-degree overtravel.

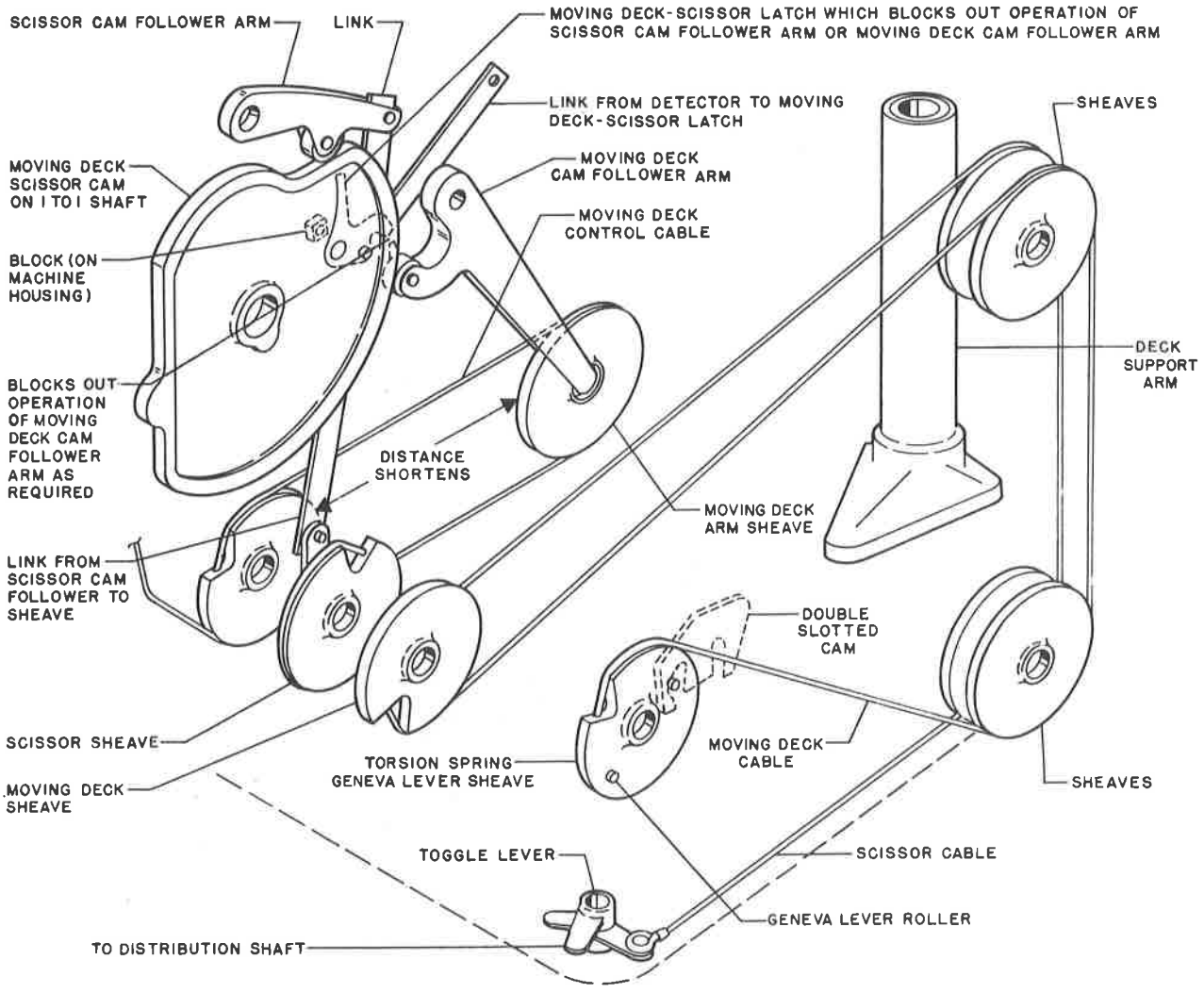


Figure 33. Moving Deck & Scissor Control Mechanisms

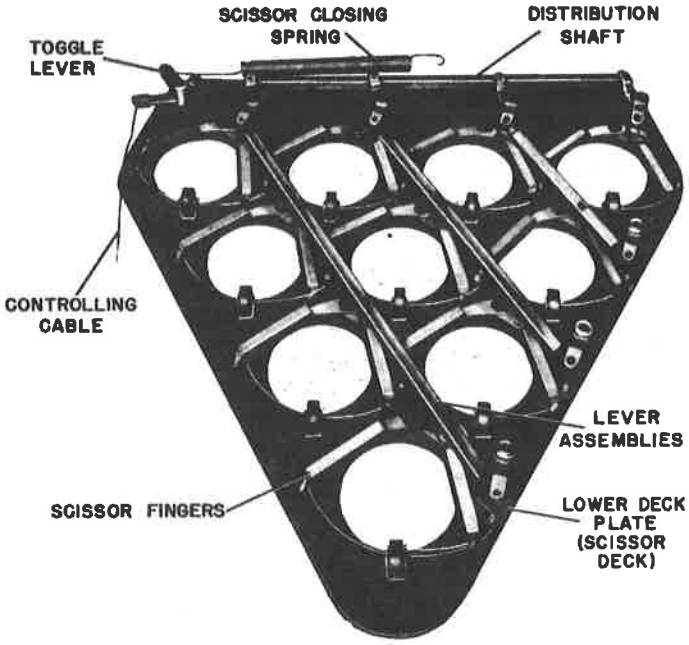


Figure 34. Scissor Deck

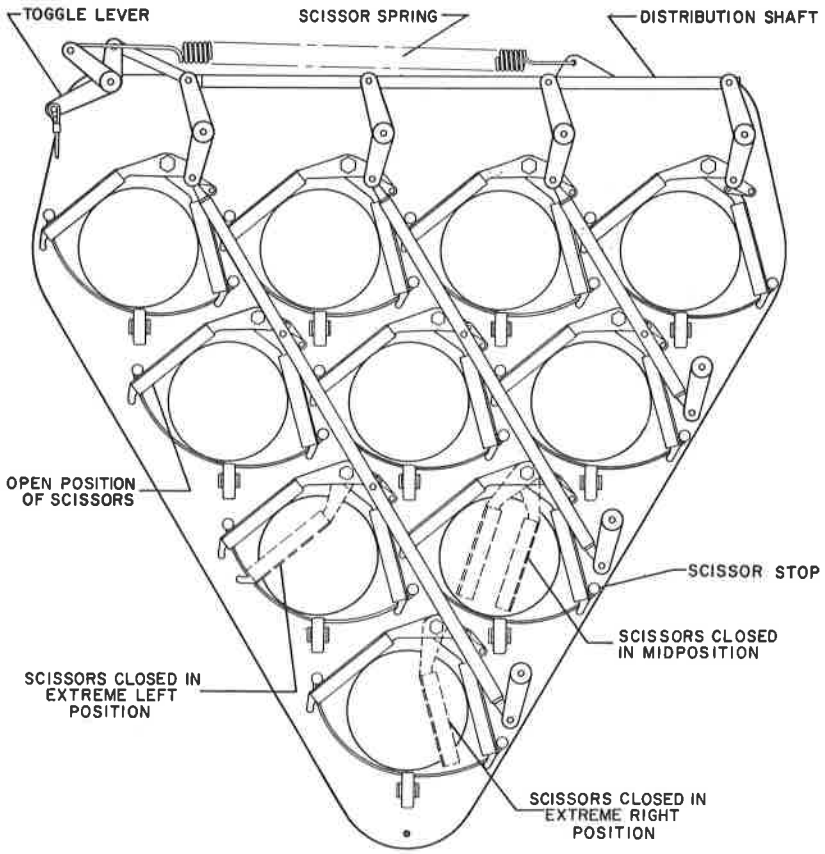


Figure 35. Scissor Operation

CHAPTER 15. RAKE

The rake (figure 36) sweeps the deadwood from the alley proper into the pit. It also protects the deck when it is down in the event that a ball is thrown at the wrong time. The rake consists, in part, of two rake support arms fixed to the rake shaft, which is pivoted on the top of the pinsetter frame. Hinged at the bottom of the rake support arms are the rake sweep arms, on which is mounted a fiber glass gate, or "rake board". When the rake board is drawn back by the rake support arms, it sweeps the pin area. The rake board lowers to the alley and remains down, thereby protecting the deck when it is in any of its lower positions.

Attached to each rake support arm is a telescoping spring guide tube containing a large compression spring. When the rake is drawn back to sweep, the springs compress, and when the sweep motion is complete, the springs urge the rake forward until the support arms reach fixed stops on the side frames.

The rake has two separate motions: an up and down motion for lowering to its sweep position and raising for ball delivery, and a back and forth motion for sweeping the alley. The up and down motion is controlled through a pair of cam followers riding a pair of adjacent cams fixed to a 1 to 1 shaft (figures 38 and 39). Attached to an arm of the inner cam follower is a link connected at its other end to the rake lift shaft, which is mounted across the top of the pinsetter. Fixed to each end of this shaft is a "V"-shaped lever, and from each of these levers a rake lift rod runs down to the rake sweep arms. When the inner cam follower finds a low dwell on its cam, the connecting link from the follower arm rotates the overhead rake lift shaft. This moves the "V"-shaped levers clockwise and, through the rake lift arms, lowers the rake board to the alley. As the cam follower reaches a rising surface on the cam, the motion is reversed, and the rake board is raised.

Normally, it is desired that the rake board lower to protect the deck from shortly after 0 degree through the entire cycle and then go up at 360 degrees. However, in the event that standing pins are left, requiring a second ball, the rake must go up at 360 degrees on the first ball and stay up while the pinsetter cycles an additional 90 degrees. Therefore, on a second ball, the rake must come down just after 90 degrees and then go up at 360 degrees. To control the two different rake cycles, there are two rake cams and followers (figures 38 and 39), with the inner cam having a low dwell effective 90 degrees sooner than the low dwell on the outer cam.

The two cams and their followers function as follows: The rake overtravel latch, which is pivoted on the inner cam follower arm, has a roller which contacts a curved shoe in the detector assembly. On the outer cam follower arm is a latch block. When the curved shoe in the detector assembly is raised, the rake overtravel latch on the inner cam follower will not engage the block on the outer cam follower, and the two followers will follow their separate cams. When the curved shoe is lowered, the overtravel latch engages the block, and the two cam followers are locked together and will follow the highest dwell of either cam.

With the machine at 0 degree, first ball, the overtravel latch is lifted and, at ball impact, the inner cam follower finds an immediate low dwell, lowering the rake to the alley. At 360 degrees, the inner cam follower encounters a rising surface and raises the rake board. If it was a first ball strike, the overtravel latch will be raised ready to repeat the 0 to 360-degree rake down condition. If it was a first ball, standing pin cycle, the overtravel latch will be down to engage the block at 360 degrees and prevent the inner cam follower from following the low dwell while the pinsetter cycles from 0 to 90 degrees. The two cam followers will be locked together and will follow the high dwell of the outer cam, keeping the rake up for this 90-degree overtravel. When the pinsetter is triggered at 90 degrees, second ball, the cam followers will find an immediate low dwell, which will lower the rake and keep it down from 90 to 360 degrees. At 360 degrees, the cam followers reach a high dwell on the cams and the rake will raise, with the overtravel latch out, and be ready to lower to the alley at 0 degree, first ball impact.

The sweep action of the rake board is controlled as follows: (Figures 36, 37 and 40). A crank on the 4 to 1 shaft carries a long link which is freely hinged at its other end to the overhead rake shaft. A link from the detector assembly is attached to a collar which is free to rotate on the overhead cross brace located just under the rake lift shaft. Attached to this collar is a curved shoe which contacts a roller pivoted on the rake shaft. This roller, through a connecting link and spring, can raise and lower the rake sweep hook, which is suspended from the rake shaft. The crank on the 4 to 1 shaft moves the long link back and forth and, as it reaches its foremost position, the hook on the rake shaft can be lowered to engage a block at the end of the long link, and the rake will be drawn back to sweep the alley.

If it is not desired that the rake sweep, the link from the detector assembly will rotate the collar. The curved shoe will then contact the roller and, through the link and spring, will lift the rake sweep hook. As the long link comes forward, the rake sweep hook cannot engage the block, and the rake will not sweep. Refer to figures 37 and 40 for detail of the rake hook. It is the 1 to 1 shaft that controls the sweep action as the rake sweeps once per cycle. The 4 to 1 shaft is used to power the sweep motion in order to complete the sweep in one-quarter cycle.

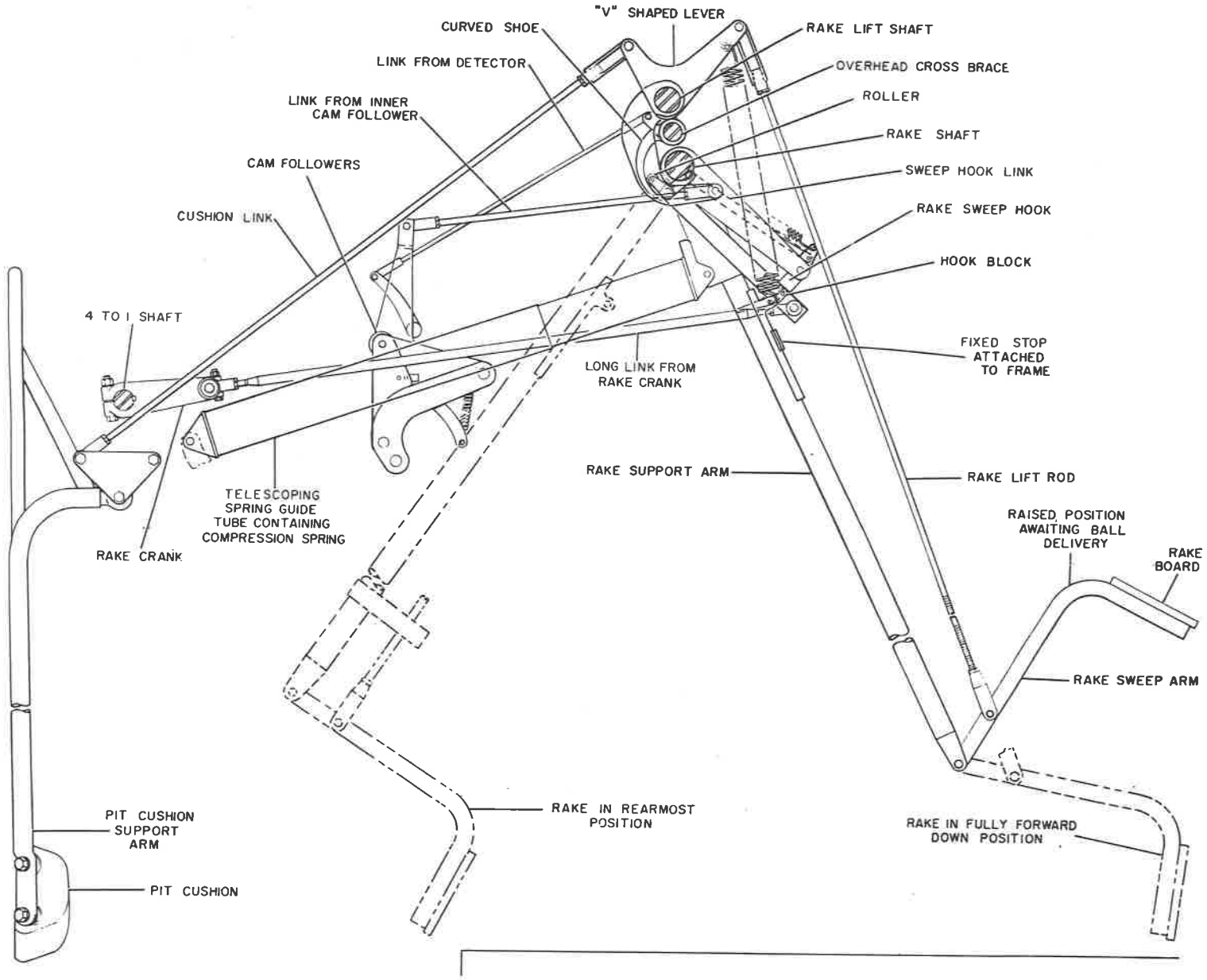


Figure 36. Rake Mechanism

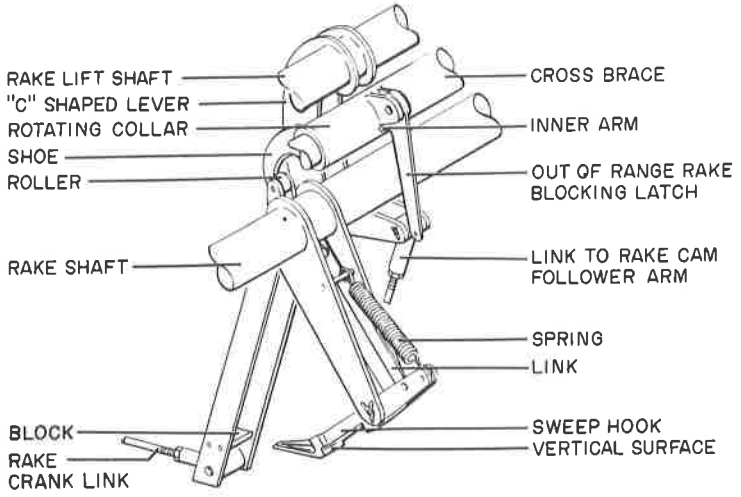


Figure 37. Rake Sweep Hook Mechanism

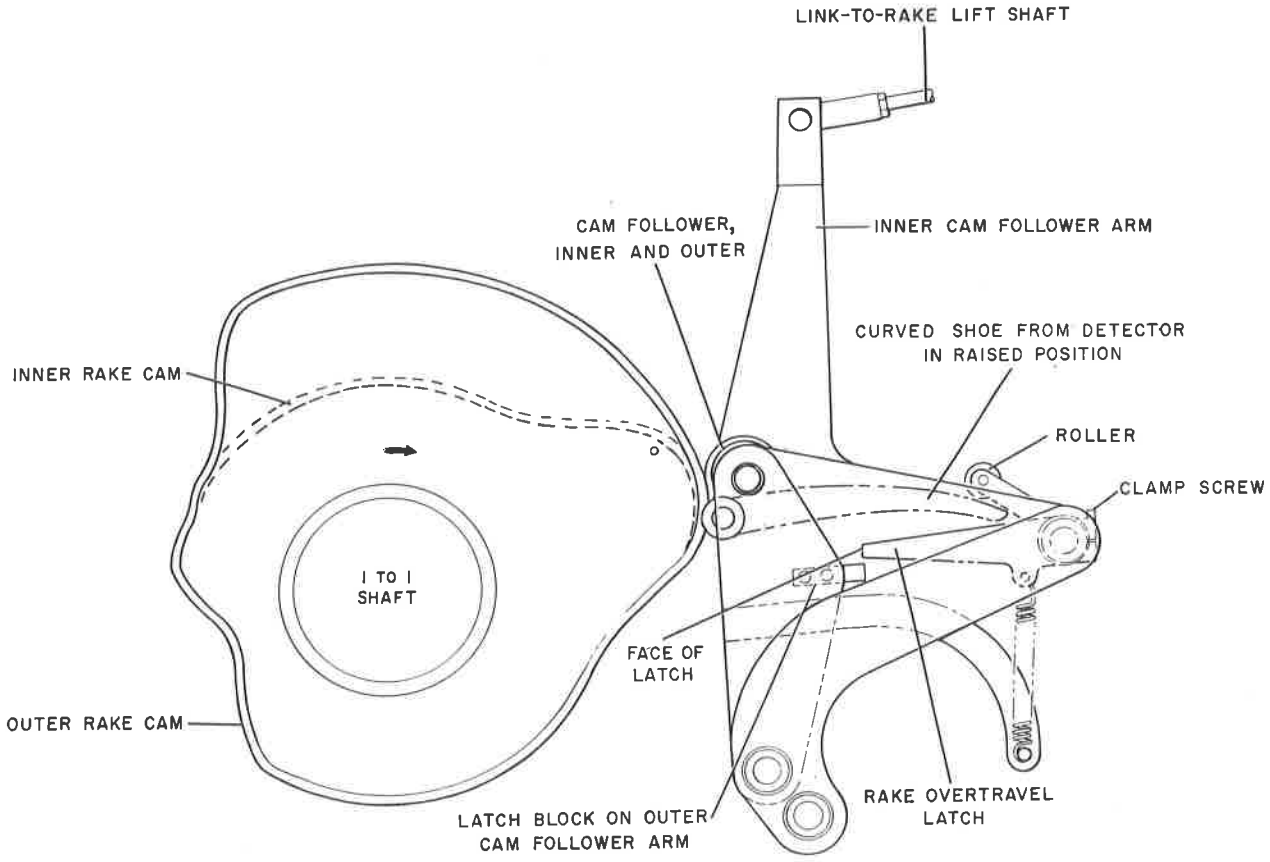


Figure 38. Rake Cam Mechanism

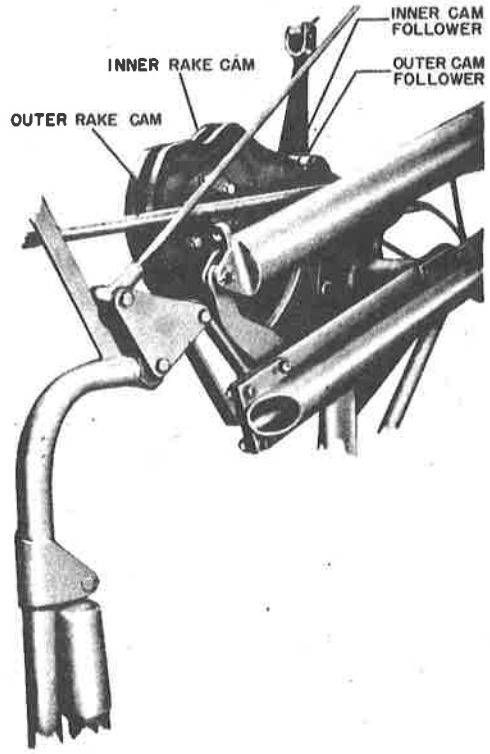


Figure 39. Rake Cams

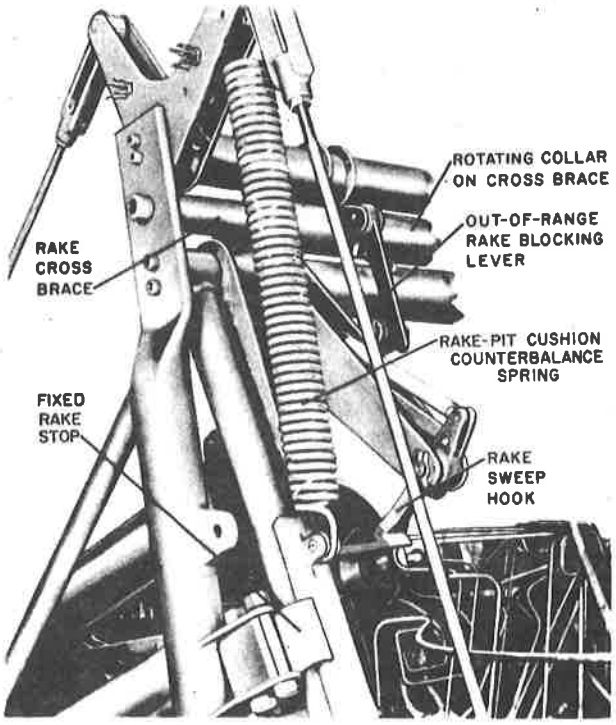


Figure 40. Rake Hook Detail

CHAPTER 16. PIT CUSHION

The pit cushion (figure 41) is suspended across the pit to stop the forward motion of the ball after the ball passes the end of the alley surface. It consists basically of a steel reinforced board, suitably padded and covered with heavy leather. It is suspended above the pit on tubular steel side arms which incorporate airplane type shock absorbers to take up most of the impact shock (figure 42). The top of the side support arms are pivoted on triangular steel plates which are pivoted on the side frames. Pivoted on the top leg of both of the triangular plates are long links which are connected at their other end to the "V"-shaped levers on the rake lift shaft that raise and lower the rake board. When the rake is up for the bowler to deliver the ball, the pit cushion is low enough to insure that the ball will hit it. Then as the rake board lowers to the alley, the action of the "V"-shaped levers in lowering the rake raises the pit cushion enough for the ball to roll under it and reach the ball elevator. The greater weight of the pit cushion is counterbalanced with the rake, with the assistance of two heavy springs connected between the rake sweep arms and the "V"-shaped levers.

Attached to one of the cushion support arms is the gear box trip rod. When the ball strikes the pit cushion, the cushion swings to the rear, moving the trip rod forward, thereby rotating the starter bellcrank lever and engaging the clutch as previously described.

A curtain is suspended from the top of the kickbacks to the top of the pit cushion, thus preventing any pins from being knocked out of the pit by ball impact.

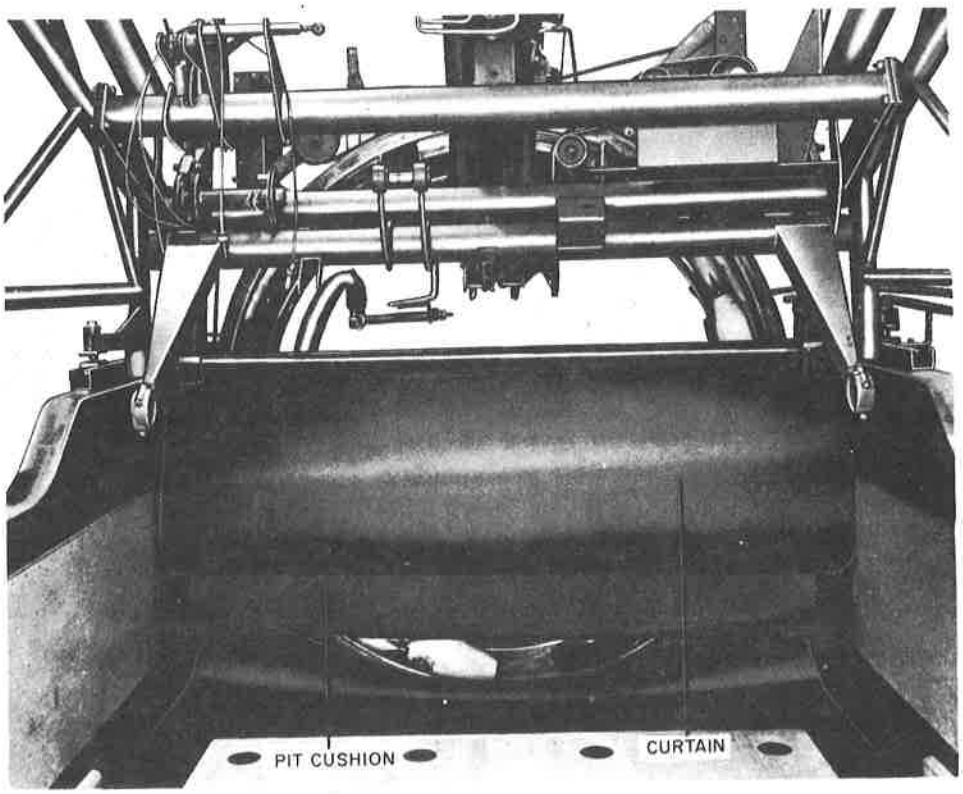


Figure 41. Pit Cushion and Curtain

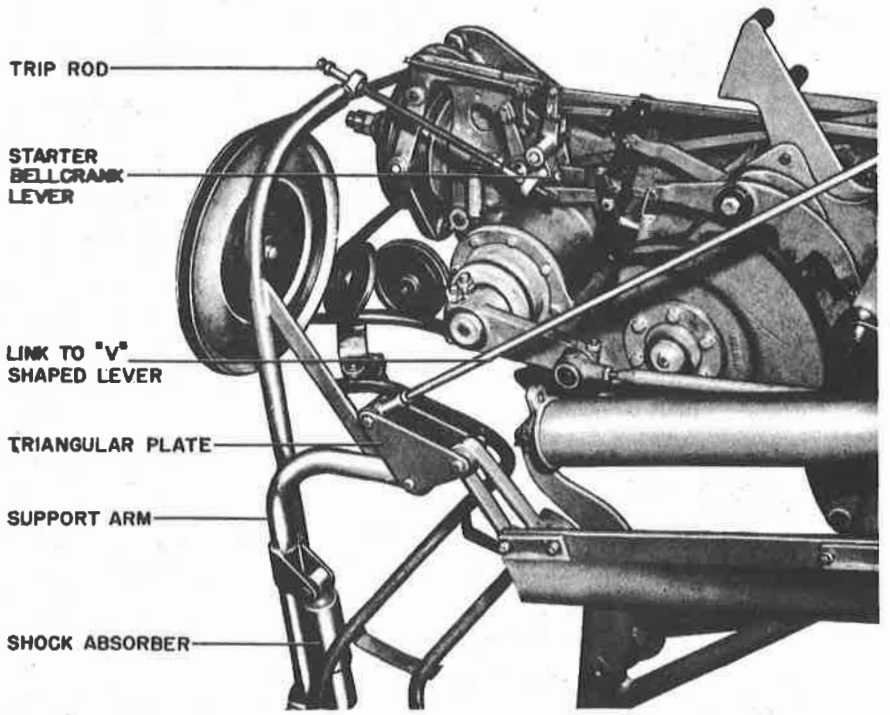


Figure 42. Pit Cushion Support

CHAPTER 17. OUT-OF-RANGE PIN

In the event that 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 to detect a strike or standing pins condition. This abnormal height of the deck during the first ball, detecting stroke of the deck causes a lever in the detector to rotate (Figure 43). Through a link, this lever is connected to a lever pivoted on the same shaft with the 3 part clutch actuating mechanism. This lever carries a projection and a curved arm. When the deck encounters an out-of-range pin, the lever in the detector rotates, and through the link, it rotates the lever carrying the projection and curved arm clockwise. This brings 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 and the clutch will disengage.

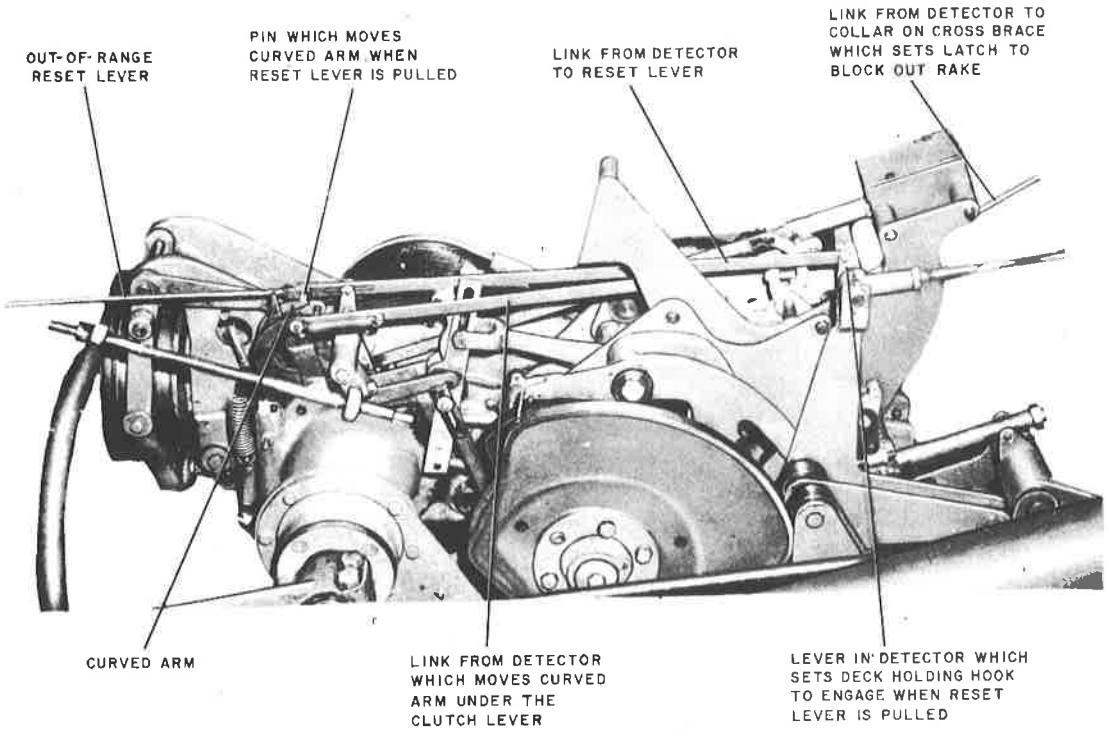


Figure 43. Out-of-Range Mechanism

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 clutch. The reset lever carries a pin and connecting linkage to the deck holding hook and to the rotating collar on the overhead cross brace. When the reset lever is pulled, the pin contacts the projection on the lever, moving the curved arm out from under the clutch lever, thereby re-engaging the clutch; through the linkage to the collar on the overhead cross brace, (Figure 44) it rotates the collar so that a latch pivoted on the collar will engage a pin in the brace, thereby holding the rake sweep hook up so that the rake cannot sweep; through the link to the deck holding hook the hook is forced down so that it will engage the pin on the deck 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 overtravels to 90°, as an out-of-range pin is still a standing pins cycle.

There is no out-of-range problem on second ball as there is no detecting stroke of the deck. The rake will sweep and then the deck will set new pins on second ball.

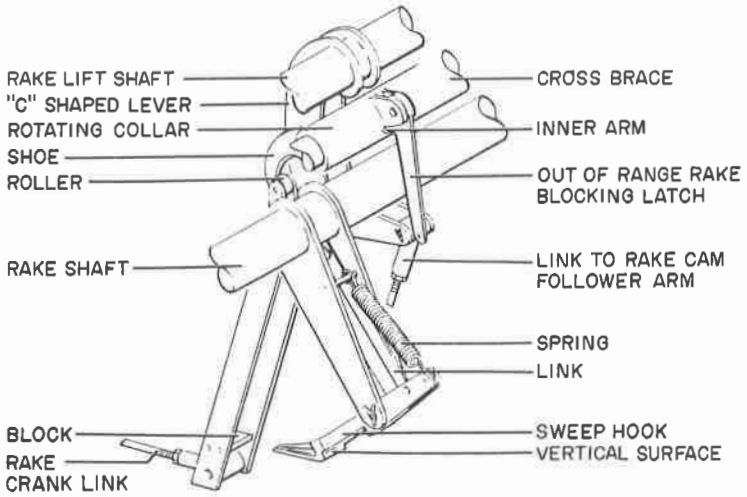


Figure 44. Out-of-Range Rake Blocking Mechanism

CHAPTER 18. NEW PIN SOLENOID

Mounted above the gearbox is the new pin solenoid and linkage (figure 45). If the bowler wants 10 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 trigger 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.

The trigger button should be pushed at 0^{o}, first ball or 90^{o}, second ball.

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

The trigger button is used in the following instances:

1. When you want a rerack because your new pins are off spot or one has fallen over, push the "Trigger Button" to cycle the machine to second ball. When machine has stopped, push the "Trigger Button" again to clear the alley and set a new rack of pins.

2. If you foul on the first ball and pins are left standing, push the "Trigger Button" for ten new pins. If, after you roll your second ball, some pins are still standing, push the "Trigger Button" again so that new pins will be set for the next bowler.

3. Bowling out in the 10th frame:
   A. Sparing in the 10th frame and not making a strike with the next ball.
   B. Striking in the 10th and the 11th frames and not striking in the 12th frame.

4. When machine fails to trigger.

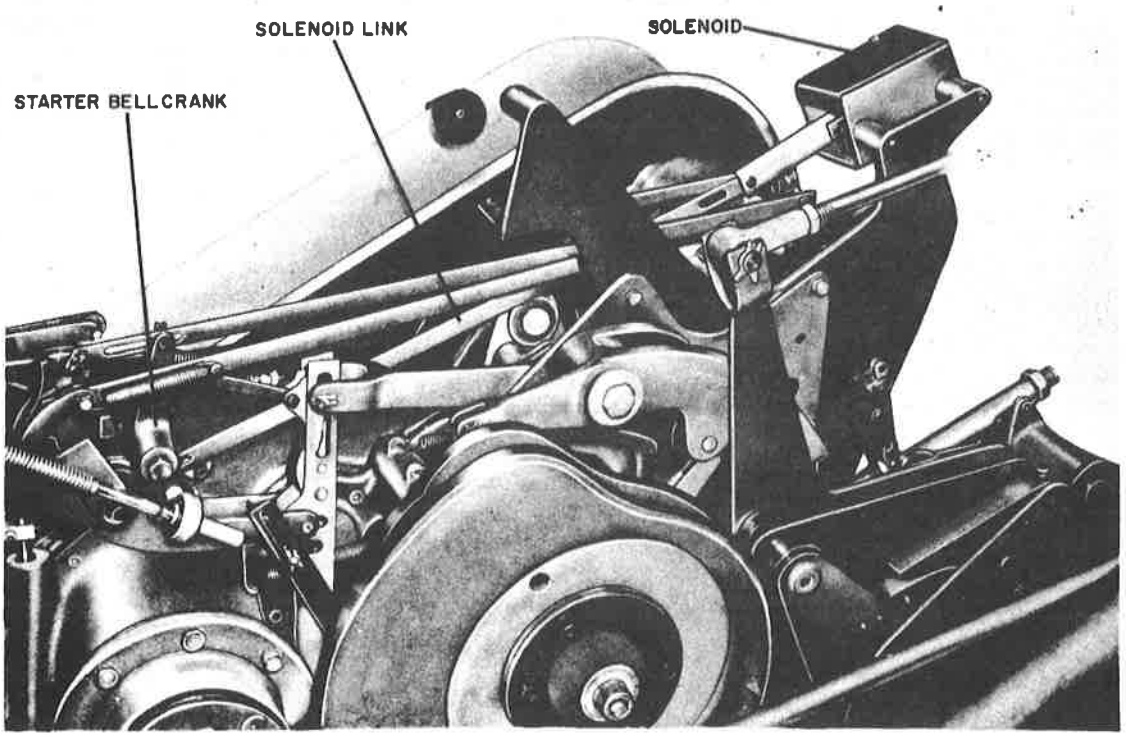


Figure 45. New Pin Solenoid and Linkage

CHAPTER 19. INTERLOCKS

The interlocks (figures 46, 47 and 48) 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.

As the tenth pin drops into the turret, it depresses a lever in the bottom of the bucket which moves the interlock probe outward. If nothing blocks the outward motion of the interlock probe, the 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 outward motion of the interlock probe is blocked, and the spider cannot rotate to release the pins to the deck.

Located just in front of 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 outward to release the pins. Both of the fingers must be up, to allow motion of the interlock probe.

One of the blocking fingers is controlled by the "restricted drop" linkage and is used to prevent the turret from dumping pins when the deck is not in its raised position. The top end of a link is connected to the blocking finger. The lower end of the link is slotted, and a pin, fixed to the deck shaft rides in this slot. The blocking finger is spring urged in a downward, or blocking direction. As the deck lowers, the link, being connected to the deck shaft, is lowered, allowing the finger to move to its down, blocking position, thus preventing the turret from releasing pins when the deck is down. Then as the deck goes up, the link pushes the blocking finger up to its probe release position. The slot in the lower end of the link is used to prevent the blocking finger from lifting too soon as the deck goes up. The pin on the deck shaft must raise to the top of the slot before the link can raise to lift the finger. This insures that pins will not be released until the deck is all the way up.

The second 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 dumping pins. Both conditions must be satisfied before the finger lifts and permits the turret to empty.

There is a single rise on the outer perimeter of the turret indexing cam and, as the turret indexes after receiving the tenth pin, this rise contacts a roller on a long link and pushes the link back. As the link is moved back, a spring-loaded hook latch snaps over a pin on the end of the link and holds it in its back position. As the link was pushed back, a collar on the link contacted the blocking finger and pushed it in its down position. The rise on the cam pushed the link back as the turret indexed after receiving the tenth pin. This indicates that the turret has dumped 10 pins into the deck 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 goes through the long, new pin setting stroke, at which time a projection on the deck shaft contacts the latch and lifts it free of the pin, allowing the link to move forward to its original position. This frees the blocking finger to move in its spring urged, upward motion and lift clear of the interlock probe.

This same blocking finger is also controlled by the moving deck interlock linkage. Attached to the finger through a spring is a shaft which has at its other end a lever which can contact a hub on the moving deck cam follower arm sheave. When the sheave is fully forward, indicating that the moving deck is also fully forward, the hub of the sheave holds the lever on the shaft in a forward position, thereby, through the shaft and spring, holding the blocking finger in its up position. Then, as the sheave moves back, indicating that the moving deck is shifting back, the lever on the shaft is spring urged to move rearward, thereby, through the shaft and connecting spring, lowering the finger into its blocking position. As the sheave moves forward, indicating that the moving deck is moving forward, the sheave rotates the lever on the shaft forward, and lifts the blocking finger.

Because the full deck linkage and the moving deck linkage both control the same blocking finger, either or both linkages can move the finger into its down or blocking position. However, both linkages must be in their neutral position to allow the blocking finger to be up.

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

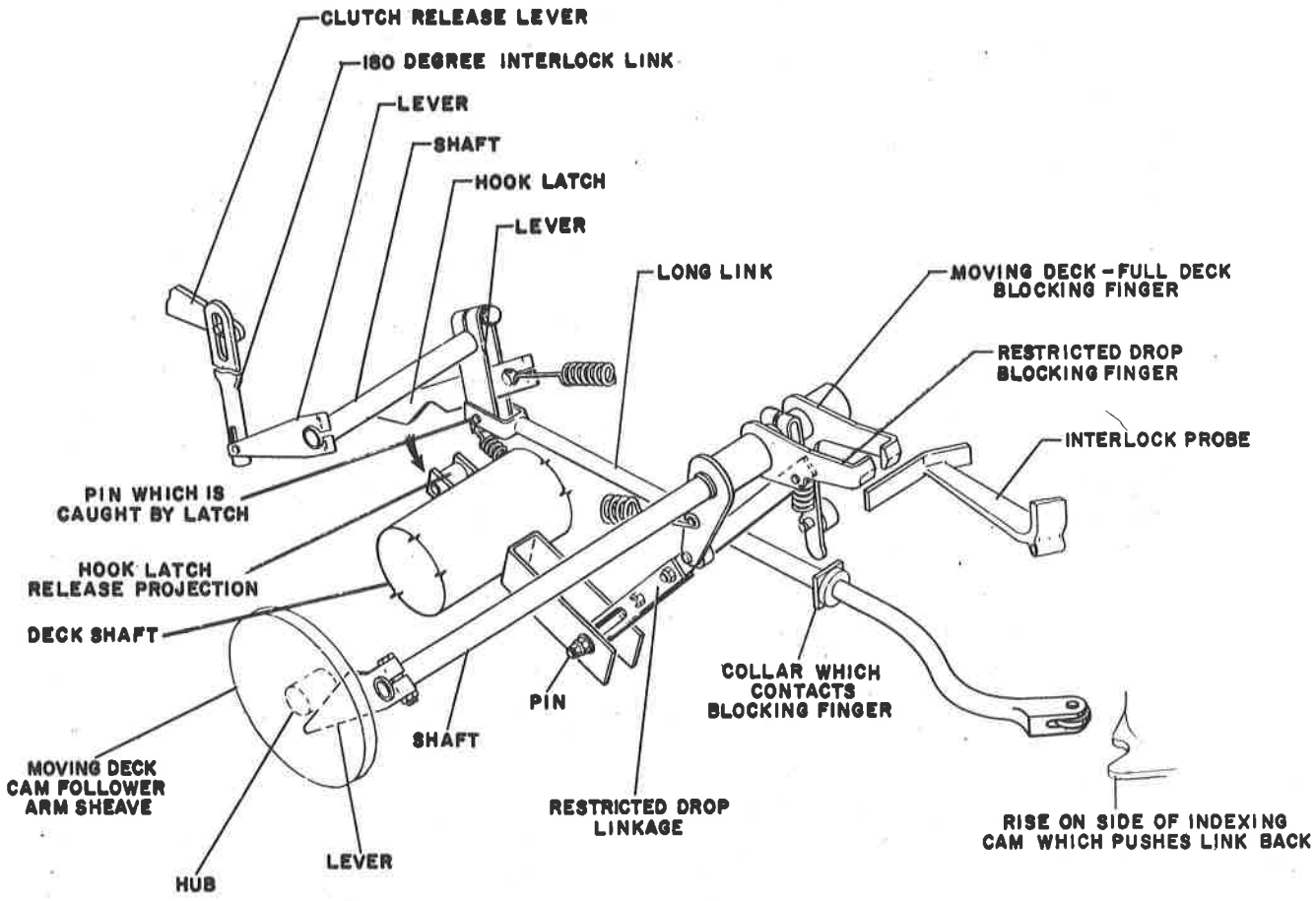


Figure 46. Interlock System

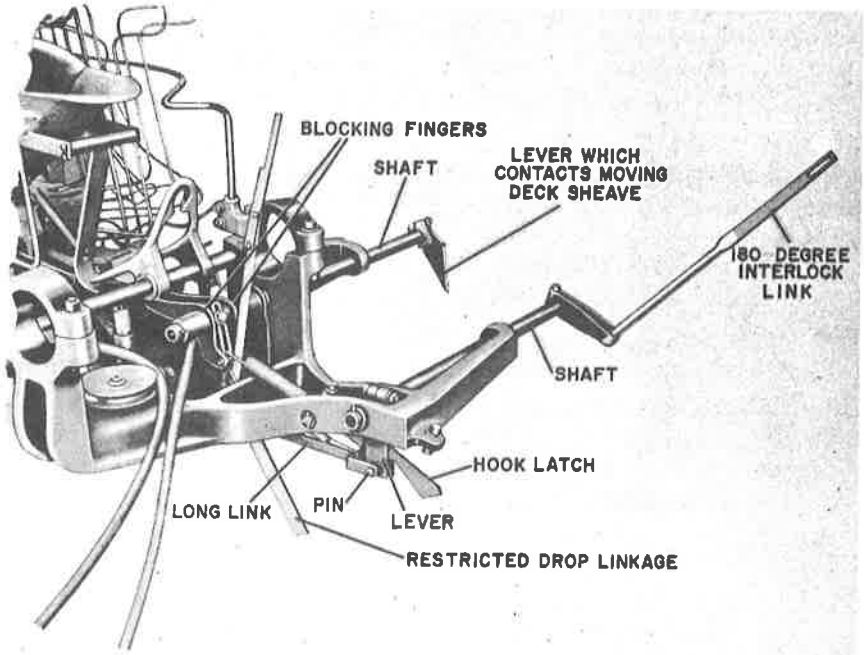


Figure 47. Interlock System - Rear View

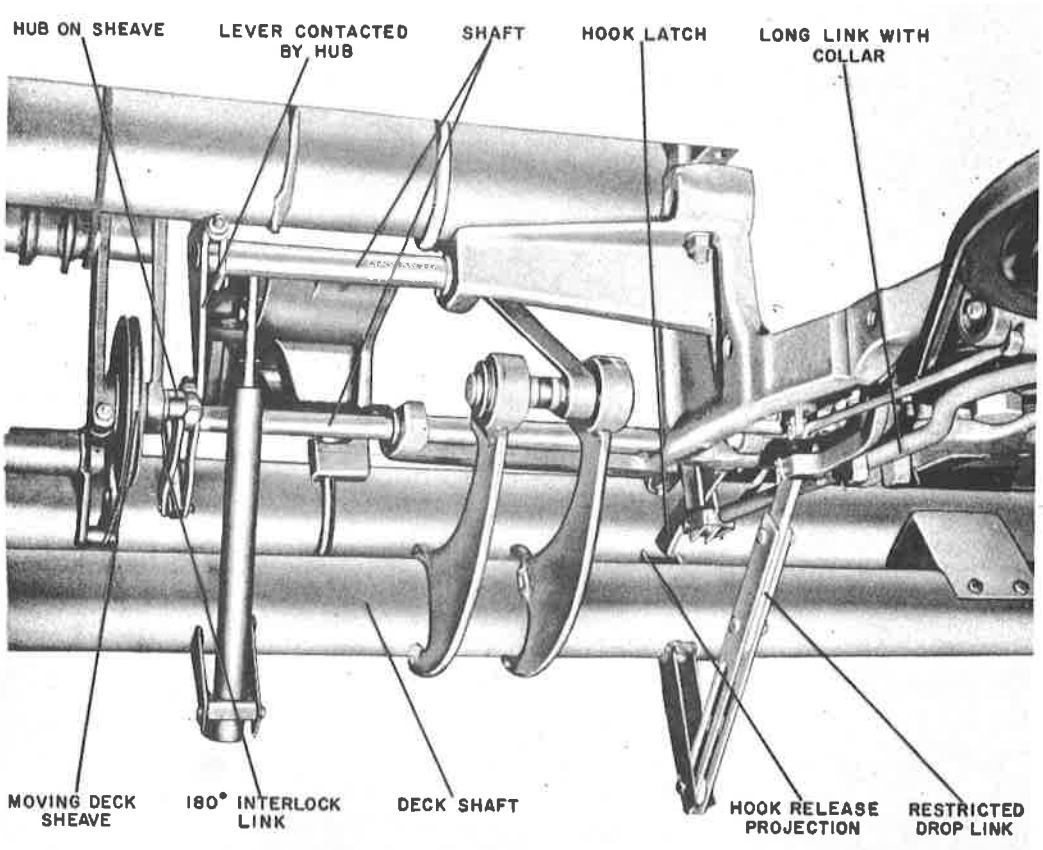


Figure 48. Interlock System - Front View

Attached to the rear of the long link that is pushed back by the single rise on the turret indexing cam is a lever which rotates a shaft as the link is pushed back. Connected to the other end of the shaft, through a lever, is the turret interlock link. This link rises as the shaft is rotated clockwise and lowers as the shaft is rotated counter-clockwise. The interlock link has a slot in its upper end which carries the pin on the clutch release lever.

When the pinsetter approaches 180 degrees, first ball strike, and 180 degrees, second ball, the clutch release lever is put under the control of the turret interlock link by the detector assembly. The clutch actuator link is rotated counterclockwise until the pin on the clutch release lever drops out of the open slot of the clutch actuator link. The turret interlock link does not control the clutch release lever at 180 degrees, first ball, standing pins, since there is no immediate need for 10 new pins because the bowler has standing pins at which to bowl a second ball.

As the pinsetter approaches 180 degrees (first ball strike and second ball), and the turret has not received 10 pins, the interlock link will be in its down position. The clutch release lever is controlled at this time by the interlock link, thus the down position of the link will allow the clutch release lever to rotate clockwise, which allows the stop arm to move under the clutch lever. The clutch will then disengage at 180 degrees. When the turret indexes after receiving the tenth pin, the rise on the cam will push the link back and, through the described linkage, will push the interlock link up. As the link rises, it will rotate the clutch release lever counterclockwise, removing the stop arm from under the clutch lever, and the clutch will re-engage.

The hook latch which holds the long link back will hold the interlock link up until the deck goes through its new pinsetting motion and releases the latch. This insures that the interlock link will stay up, even after the single rise passes the link, at which time the link would normally return to its forward position, the interlock link would come back down, and the clutch would disengage. The hook latch, through the described linkage, will hold the interlock link up until the pin on the clutch release lever re-engages the slot in the clutch actuator link, and the interlock link no longer controls the clutch release lever.

If the turret has received 10 pins before the pinsetter reaches 180 degrees, the rise on the cam will have already pushed the link back, raising the interlock link, and the clutch will not disengage at 180 degrees.

CHAPTER 20. ELECTRICAL SYSTEM

The Brunswick Automatic Pinsetter can be supplied to operate on any of the following three line voltages: 230 volts, 60 cycles, single phase; 208 volts, 60 cycles, single phase; and 115 volts, 60 cycles, single phase.

Figure 49 shows the power wiring in a typical installation. The feeder line is run from the main service panel to a circuit breaker distribution box mounted on the center of the rear wall. A separate line for each pinsetter, protected by a manual reset circuit breaker, is run from the distribution box to a junction box mounted above each pinsetter. From each junction box, a three-conductor drop cord, terminating in a "twist-lock" connector, is plugged into the control box of each pinsetter to supply the power for the pinsetter.

Figure 50 shows the control wiring in a typical installation. For each bank of eight pinsetters, or fraction thereof, one manager's control panel is installed (figure 51). 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. 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 ON-OFF switch on the manager's control panel.

On the terminal post at the rear of the ball return is mounted a trigger button for each pinsetter. Each trigger 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. There is a second trigger button located at the rear of each pinsetter for use by the mechanic.

Mounted on the masking unit for each pinsetter are the first and second ball lights and a manual 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.

A manual ON-OFF switch is also mounted at the rear of each pinsetter. A fourth manual ON-OFF switch is located at the front of the pinsetter control box (figure 52) 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 ON-OFF switch may be located in the circuit breaker distribution panel on the rear wall.

All 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 provided on the pinsetter control box, and the pin light will be on only when the pinsetter is operative.

In series with the manual switches are two microswitches. When any of these switches is 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, is mounted on the cross brace just above the rear turret support. This switch is held closed against the turret support 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 and the rear support will move down from the switch. This will immediately shut off the power.

The other limit switch is the "moving deck jam" microswitch. This switch is mounted on the lower gear box support and is held closed by a button which is connected through a spring to one end of the moving deck control cable. If anything causes a jam in the motion of the moving deck, the cable will become tighter than normal, and the button will pull away from the switch and shut the power off.

If the pinsetter shuts itself off, indicating that one of the microswitches is open, one of the manual switches must be opened before looking for a jam. If the jam is corrected without first opening a manual switch, the pinsetter will start to cycle and might result in injury to the mechanic.

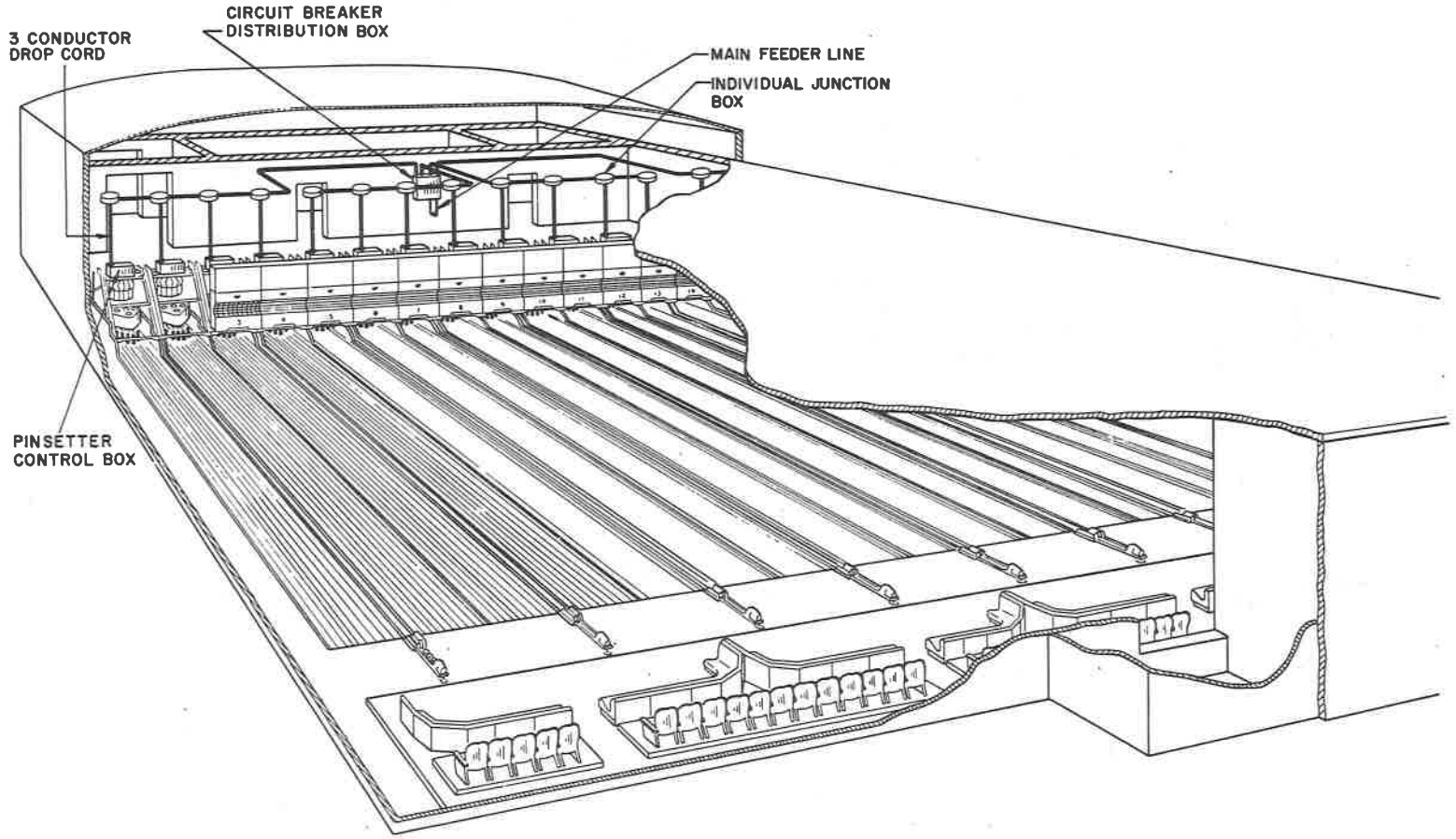


Figure 49. Power Wiring - Typical Installation

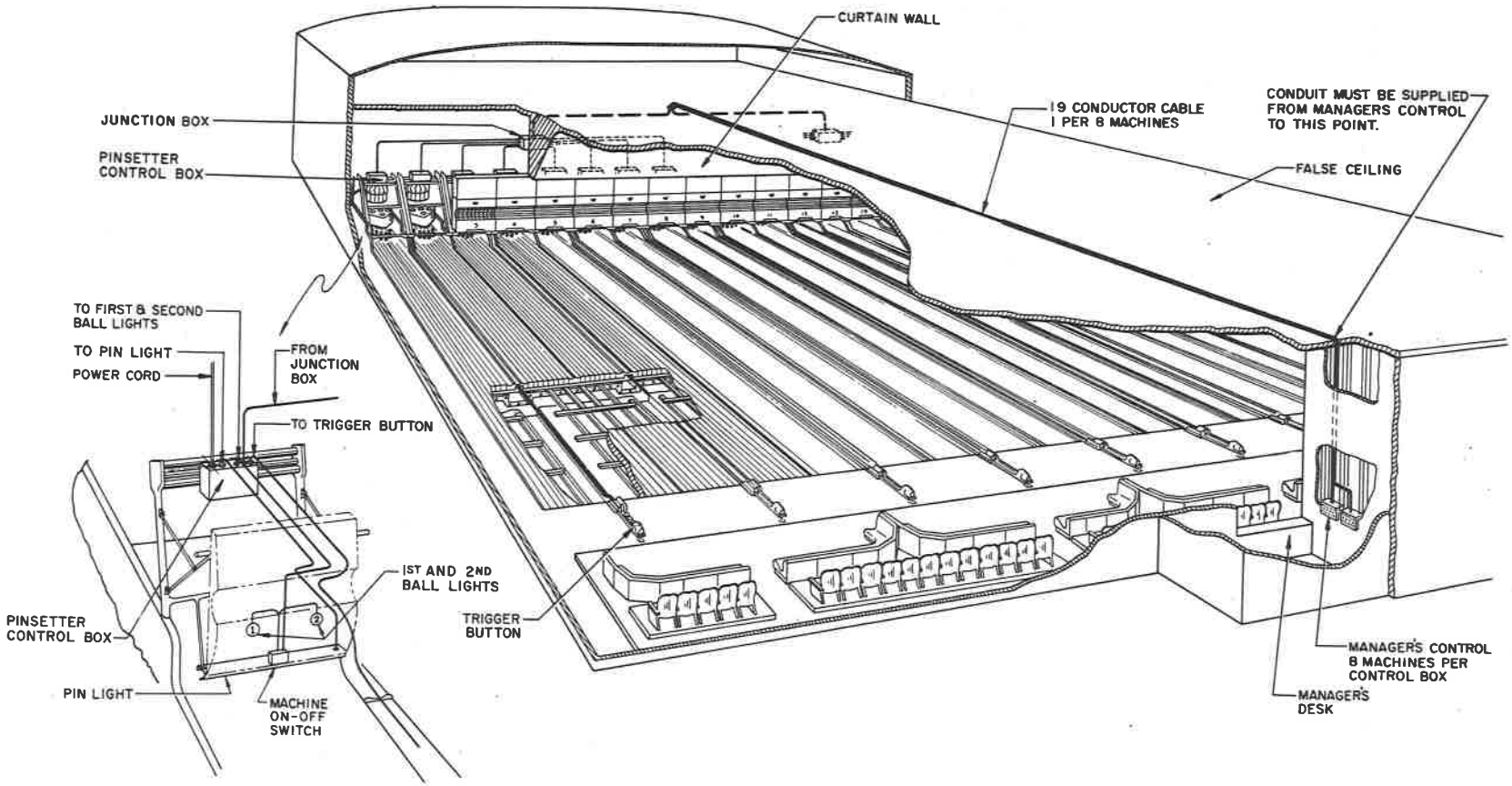
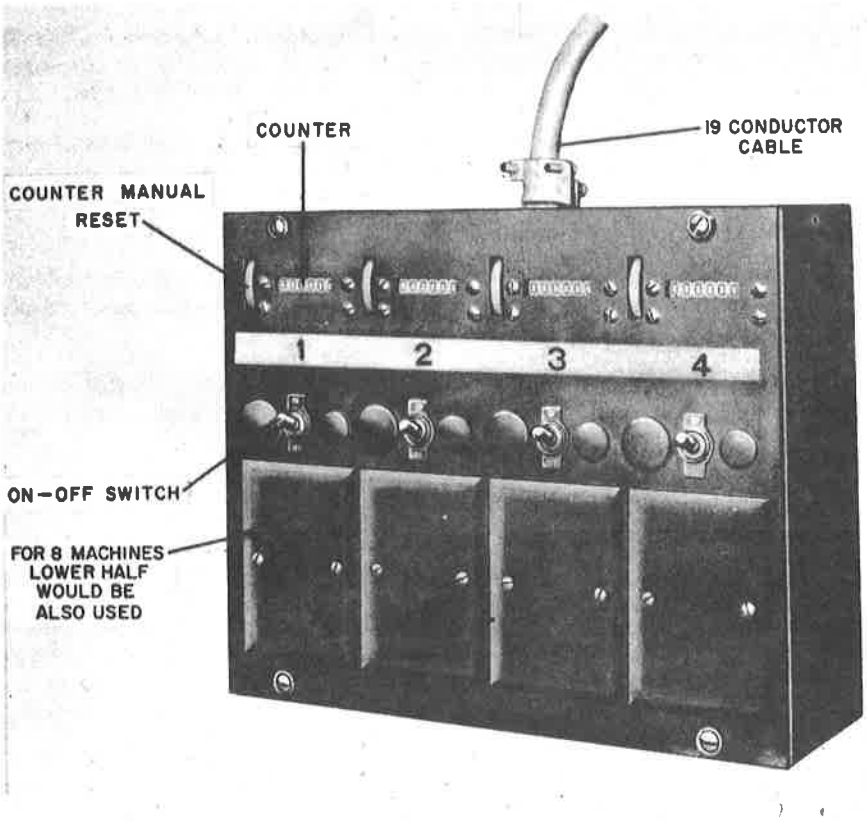
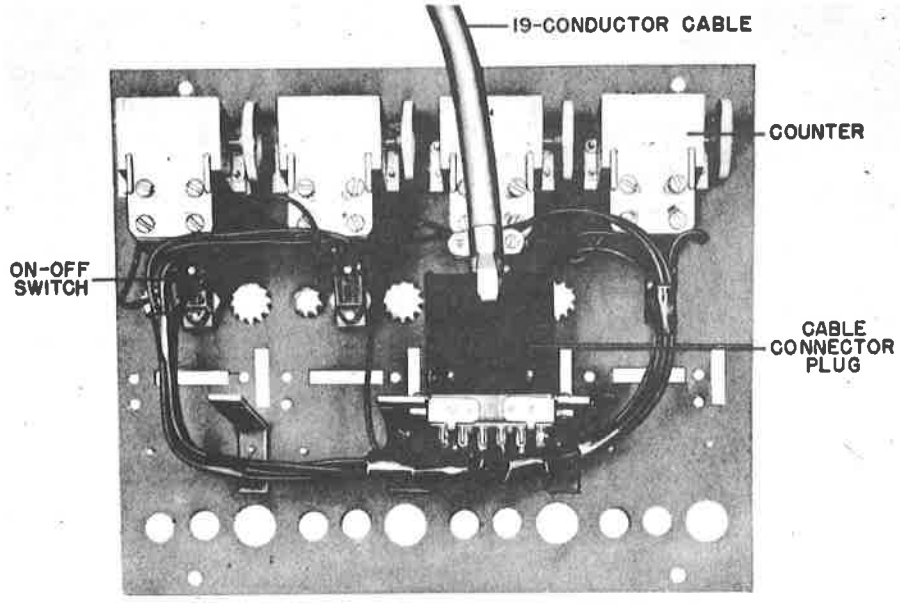


Figure 50. Control Wiring - Typical Installation



a.



b.

Figure 51. Manager's Control Panel - Front and Rear (For Four Machines)

The pinsetter utilizes several other microswitches in its operation. There is the microswitch mounted on the side of the cross conveyor to control the magnetic clutch, as described in chapter 12. The magnetic clutch is operated at 90 volts dc, supplied by a selenium rectifier located in the pinsetter control box. When the contactor coil in the pinsetter control box is energized, the rectifier is placed across the power line. In the 208 and 230-volt systems, the power is supplied from a tap on the transformer.

Mounted near the detector assembly is a microswitch which is contacted by a 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.

When the new pin button is pushed, the new pin relay is energized by being connected across the secondary of the transformer. This closes two sets of contacts on the new pin relay, and places the coil of the new pin solenoid across the power line. This causes the new pin solenoid to pull in the link to engage the clutch, which was previously described in Chapter 18.

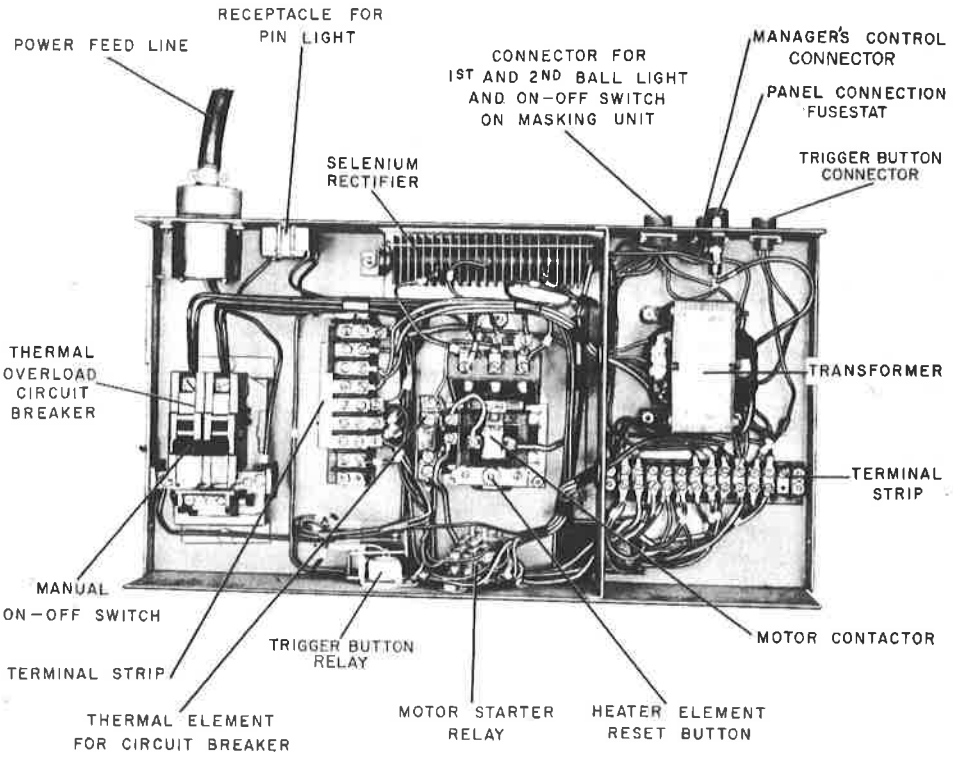
Mounted above the deck shaft is a microswitch which is contacted by a projection on the deck shaft as it goes through its new pin setting motion. This switch operates the counter on the manager's control panel to tabulate the number of frames bowled.

The transformer in the pinsetter control box supplies the 24 volts required for the microswitches, first and second ball lights, new pin relay, etc. There is a fuse in series with the secondary of the transformer to prevent damage in the event of a short circuit or overload.

The pinsetter is wired at the factory for addition of a trouble signal system. This signal system is available as an accessory.

When all seven switches (5 manual, 2 micro) are closed, the motor starter relay coil will be placed across the secondary of the transformer and will be energized. A pair of contacts on the motor starter relay will close when it is energized, placing the contactor coil across the power line. This energizes the contactor coil, which closes the motor contacts to energize the 1-horsepower motor. The motor will run constantly and the pin light will be on when the seven switches are closed. Under no circumstances should the motor starter relay ever be bypassed by jumper or by wedging the relay closed. Doing this would bypass the protective circuits built into the machine and severe damage to the pinsetter may result.

Figures 53 and 54 are schematic diagrams of the pinsetter showing each type of power supply. Figure 55 is a wiring diagram and an electrical arrangement diagram showing the physical location of the components.



52. Pinsetter Control Box-Interior

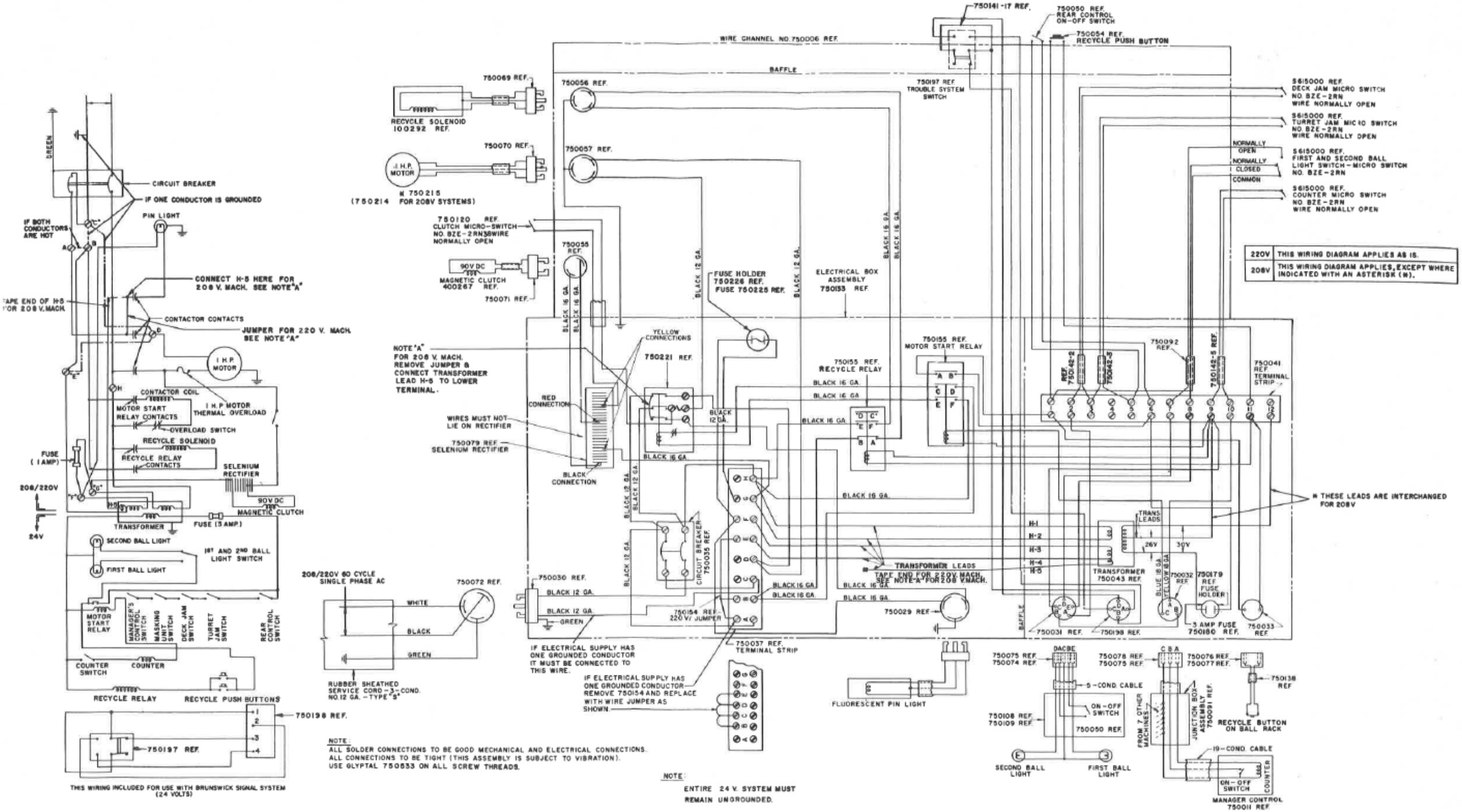


Figure 53. Pinsetter - Schematic Diagram, 208 and 220 Volts

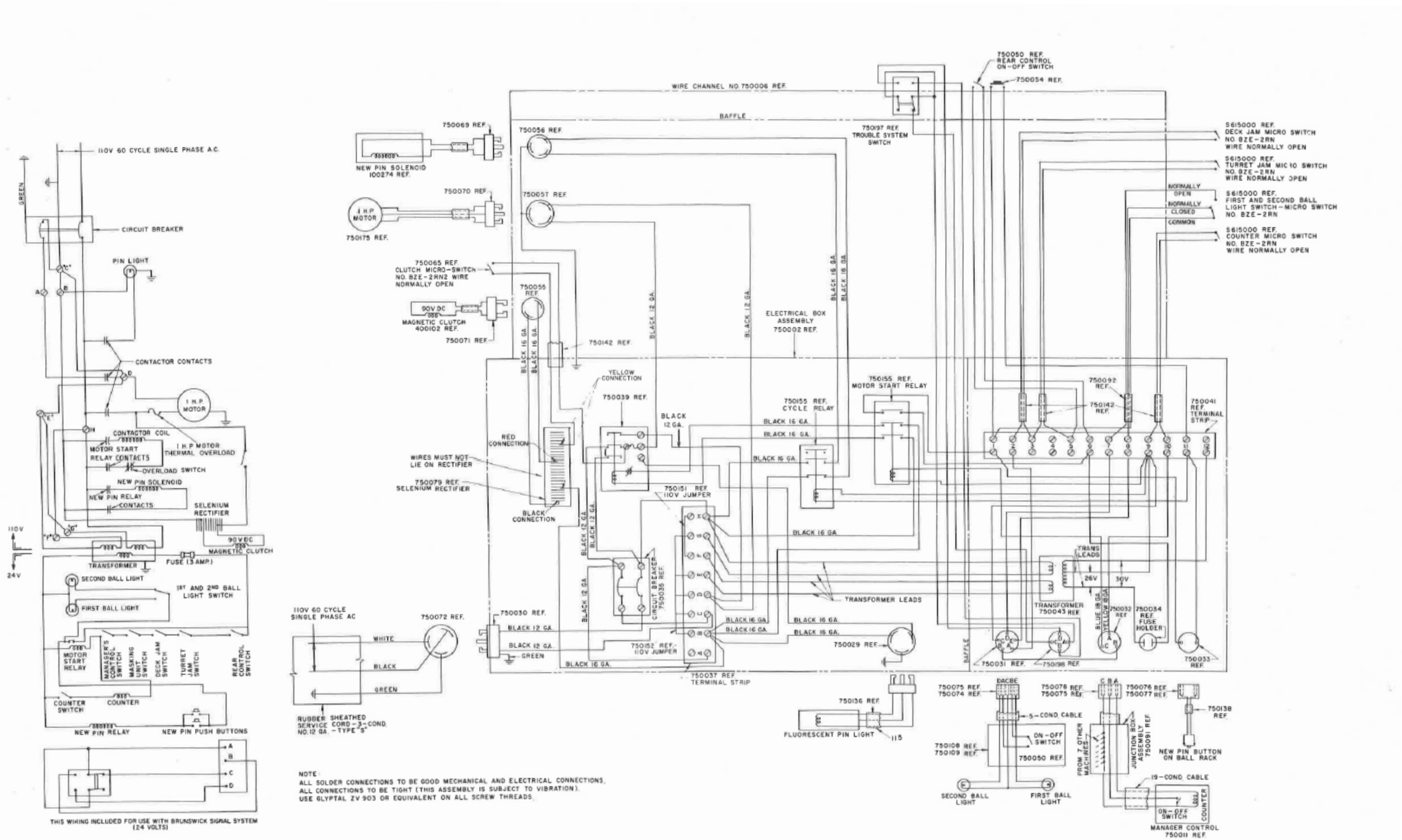


Figure 54. Pinsetter - Schematic Diagram, 110 Volts

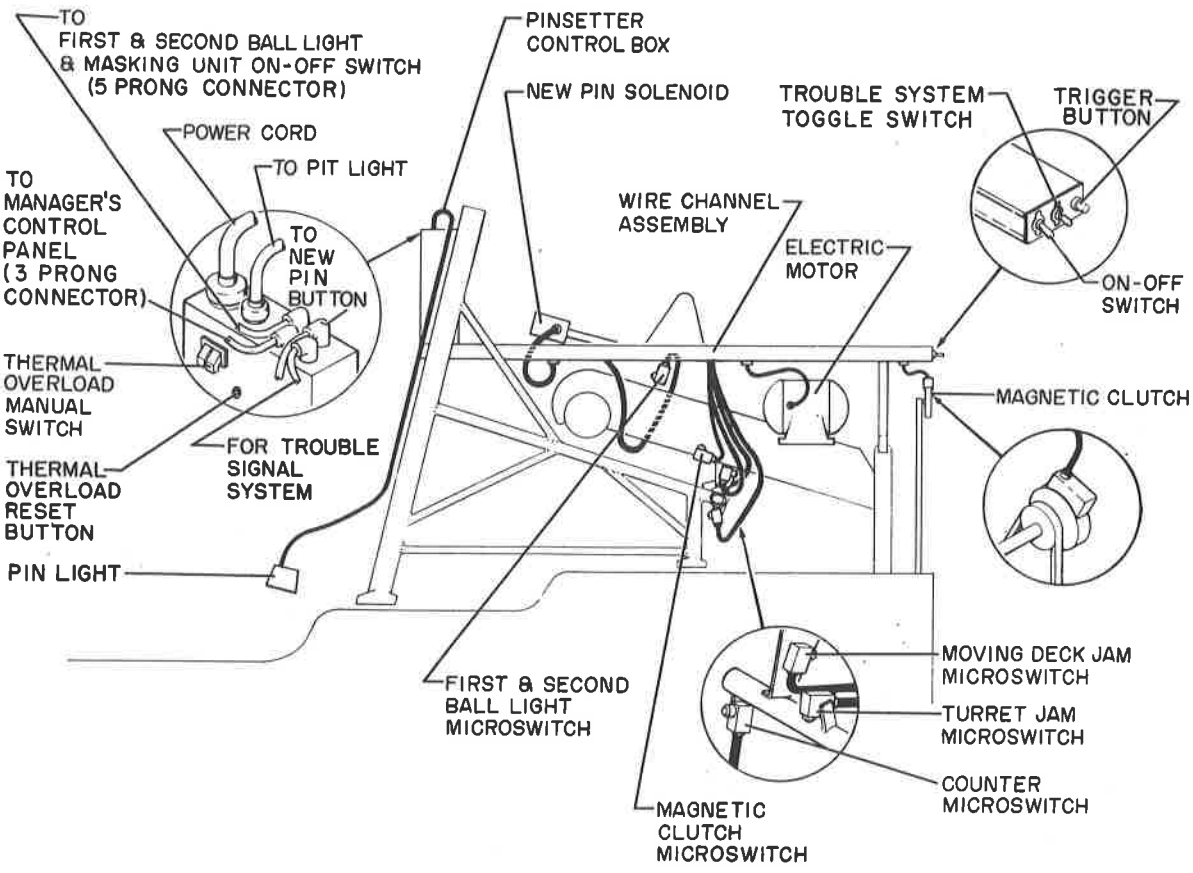


Figure 55. Physical Location of Wiring and Electrical Components

CHAPTER 21. DETECTOR OPERATION

A brief description of the detector assembly was presented in chapter 6, wherein it was explained how the detector disc rotated with the deck shaft, thereby controlling the various actions of the detector assembly. Now that all of the pinsetter assemblies and operations have been described, it will be possible to acquire a more complete understanding of the detector assembly. If it is understood that the pinsetter has a variable control system to accomplish the varied actions of the pinsetter assemblies, and if the following operations are traced back to the detector assembly, link by link, the function of every detector assembly part will become clear.

The best way to accomplish the foregoing is to take each of the following operations, one at a time, and actually physically trace the controlling linkage back to the detector assembly, observing how the detector assembly controls each action. The operation of the detector latches at various points in the pinsetter cycle are shown in the charts presented in figures 56a through 56c. A complete explanation of the detector is contained in the detector manual.

FIRST BALL, STRIKE.

DECK LOWERING HOOK. At ball impact, the hook must engage the pin because the deck will make a short detecting stroke. The hook must then be held out as the deck makes the long, new pin setting stroke. At the end of the cycle, the hook must again be ready to engage the pin for the next detecting stroke.

RESET LEVER LATCH. The latch on one of the reset lever cam follower arms must engage the roll on the companion reset lever cam follower arm. This is to insure that the inner extended cycle cam will control the reset lever, and the clutch will disengage at 360 degrees.

MOVING DECK-SCISSOR LATCH. The latch must rotate counterclockwise to block out the scissor cam follower arm and free the moving deck cam follower arm.

RAKE OVERTRAVEL LATCH. The curved shoe must lift to hold the latch out so that the inner cam follower arm will follow its cam and lower the rake at 0 degree and raise the rake at 360 degrees.

RAKE SWEEP HOOK. The collar on the overhead cross brace must be rotated clockwise to allow the sweep hook to engage the pin on the sweep arm in order to sweep the deadwood. The collar must then be rotated counterclockwise to remove the hook from the path of the sweep arm.

180-DEGREE STOP INTERLOCK. The clutch actuator link must be rotated counterclockwise to bring the clutch release lever under control of the turret interlock link at 180°. The clutch actuator link must then be rotated clockwise to remove the clutch release lever from the control of the turret interlock link.

DECK HOLDING HOOK. The hook must be held up so that it will not engage the pin on the deck arm.

FIRST AND SECOND BALL LIGHT. The lever must contact the microswitch to light the first ball light.

FIRST BALL, STANDING PINS.

DECK LOWERING HOOK. At ball impact, the hook must engage the pin because the deck will make a short detecting stroke. The hook will stay in position to engage the pin for a short, pin respotting stroke. The hook will then lift at the end of the cycle, since it will not be used for the second ball when the deck makes a full new pin stroke.

RESET LEVER LATCH. The latch on the reset lever cam follower arm must be moved away from the roll on the companion reset lever cam follower arm. This is to insure that the outer extended cycle cam will control the reset lever to disengage the clutch after the 90-degree overtravel.

MOVING DECK-SCISSOR LATCH. The latch must remain in its clockwise position to block out the moving deck cam follower arm and free the scissor cam follower arm.

RAKE OVERTRAVEL LATCH. The curved shoe must hold the latch up free of the block so that the rake will come down at ball impact and come up at 360 degrees. The curved shoe must then lower the latch to engage the block so that the rake will stay up during the 90-degree overtravel.

RAKE SWEEP HOOK. The collar on the overhead cross brace must be rotated clockwise to allow the sweep hook to engage the pin on the sweep arm to sweep the deadwood. The collar must then be rotated counterclockwise to remove the hook from the path of the sweep arm.

180-DEGREE STOP INTERLOCK. The clutch actuator link will not be rotated counterclockwise, since there is no need for a 180-degree stop on a standing pin cycle.

DECK HOLDING HOOK. The hook must be held up so that it will not engage the pin on the deck arm during detecting and respotting motions of the deck. The hook must then be lowered to engage the pin at 360 degrees to hold the deck up during 90-degree overtravel.

FIRST AND SECOND BALL LIGHT. The lever must contact the microswitch at the beginning of the cycle to light the first ball light. At the end of the cycle, the lever must move away from the microswitch to light the second ball light.

SECOND BALL.

DECK LOWERING HOOK. The hook is held up out of the path of the pin because only the long new pin setting stroke is required on the second ball. At the end of the cycle, the hook must be in position to engage the pin at the next first ball impact.

RESET LEVER LATCH. The latch on the reset lever cam follower arm must contact the roll on the companion reset lever cam follower arm. This is to insure that the inner extended cycle cam will control the reset lever and disengage the clutch at 360 degrees.

MOVING DECK-SCISSOR LATCH. The latch must be rotated counterclockwise to block out the scissor cam follower arm and free the moving deck cam follower arm.

RAKE OVERTRAVEL LATCH. The curved shoe must lift the latch free of the block at the end of the cycle so that the inner cam follower arm will be free to follow its cam and lower the rake at the next first ball impact.

RAKE SWEEP HOOK. The collar on the overhead cross brace must be rotated clockwise to allow the sweep hook to engage the pin on the end of the sweep arm in order to sweep the deadwood. The collar must then be rotated counterclockwise to lift the hook out of the path of the sweep arm.

180-DEGREE STOP INTERLOCK. The clutch actuator link must be rotated counterclockwise to bring the clutch release lever under the control of the turret interlock link at 180 degrees. The clutch actuator link must then be rotated clockwise to remove the clutch release lever from the control of the turret interlock link.

DECK HOLDING HOOK. After second ball impact, the hook must lift so that the deck can set new pins. At the end of the cycle, the hook must be held up so that it will not engage the pin at first ball impact.

FIRST AND SECOND BALL LIGHT. The lever must contact the microswitch at the end of the cycle to change from the second ball light to the first ball light.

OUT-OF-RANGE PIN.

In the event that the deck encounters an out-of-range pin, the detector assembly must automatically move the lever to disengage the clutch. When the out-of-range reset lever is pulled and the machine starts to cycle, the machine will overtravel to 90^{O}, as an out-of-range pin is actually a standing pins condition.

If all of the actions described are carefully observed, and the linkages from the detector assembly that are causing these actions are traced back to the detector assembly, a complete knowledge of the detector assembly will be obtained. As a quick check for correct functioning of the detector assembly, there are three, easily visible, check points. A table showing the correct position of these three points at various degrees of cycle is given in figure 57.

FIRST BALL — STRIKE

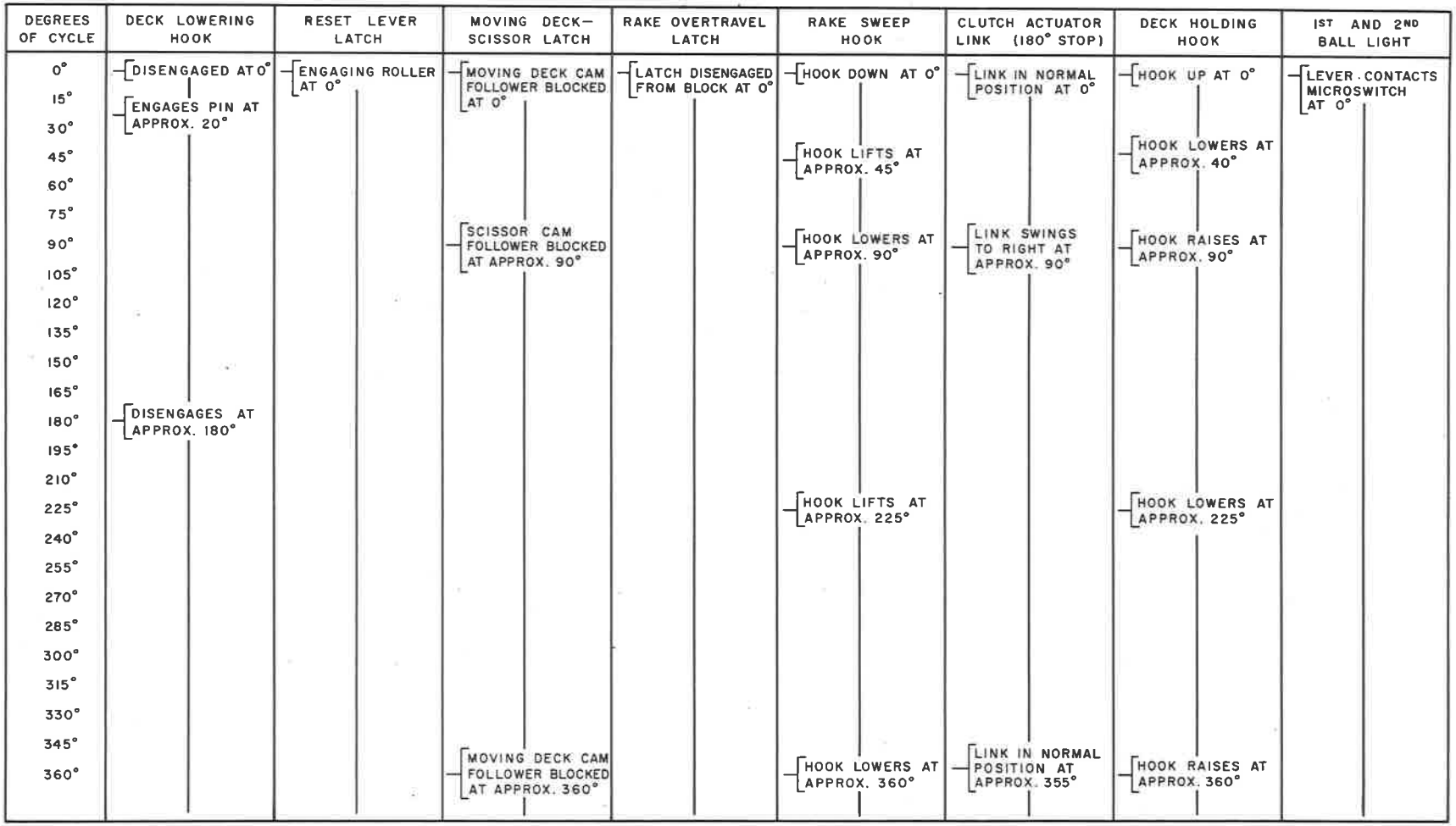


Figure 56a. Detector Function Chart, First Ball - Strike

FIRST BALL—STANDING PINS

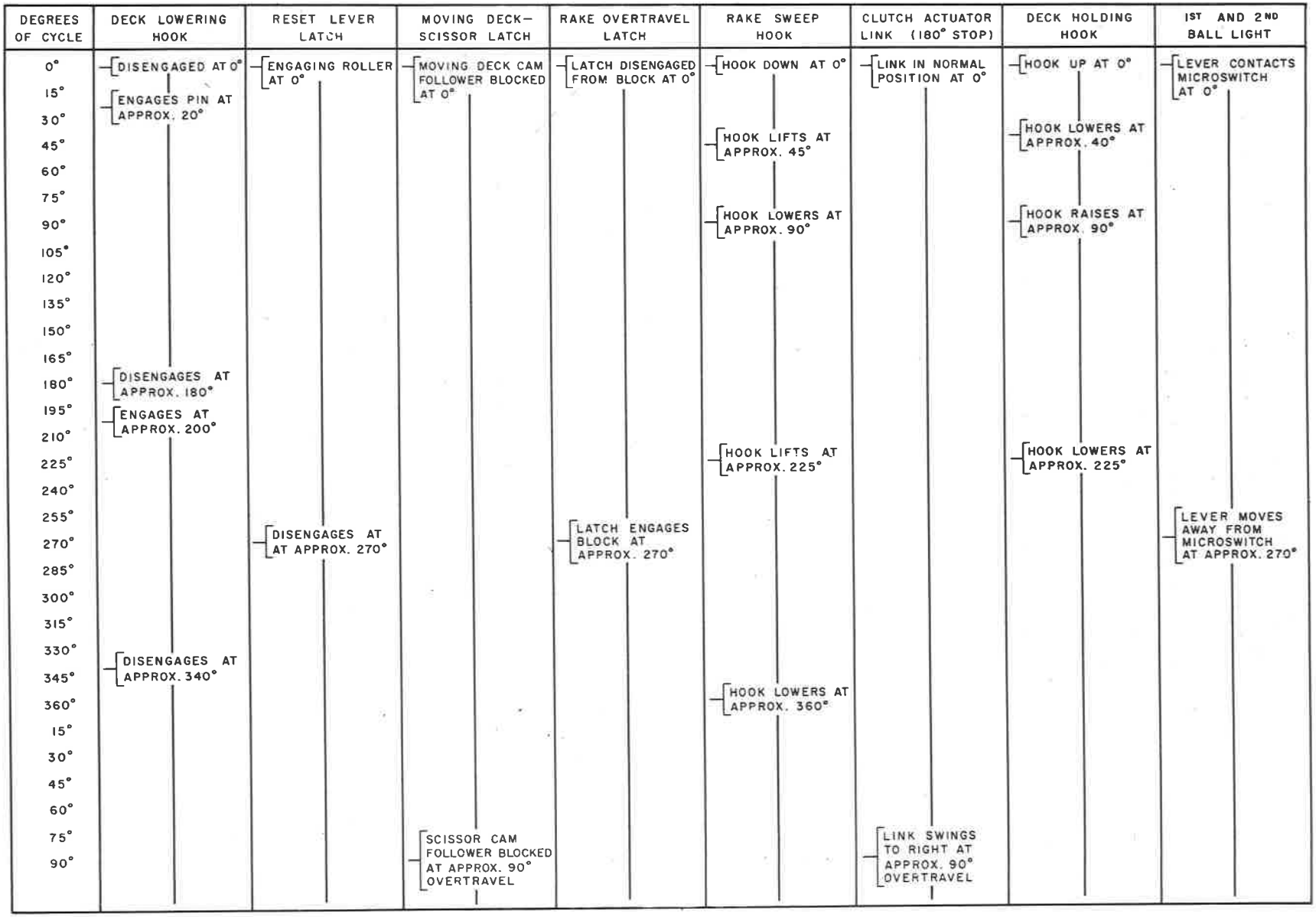


Figure 56b. Detector Function Chart, First Ball - Standing Pins

SECOND BALL

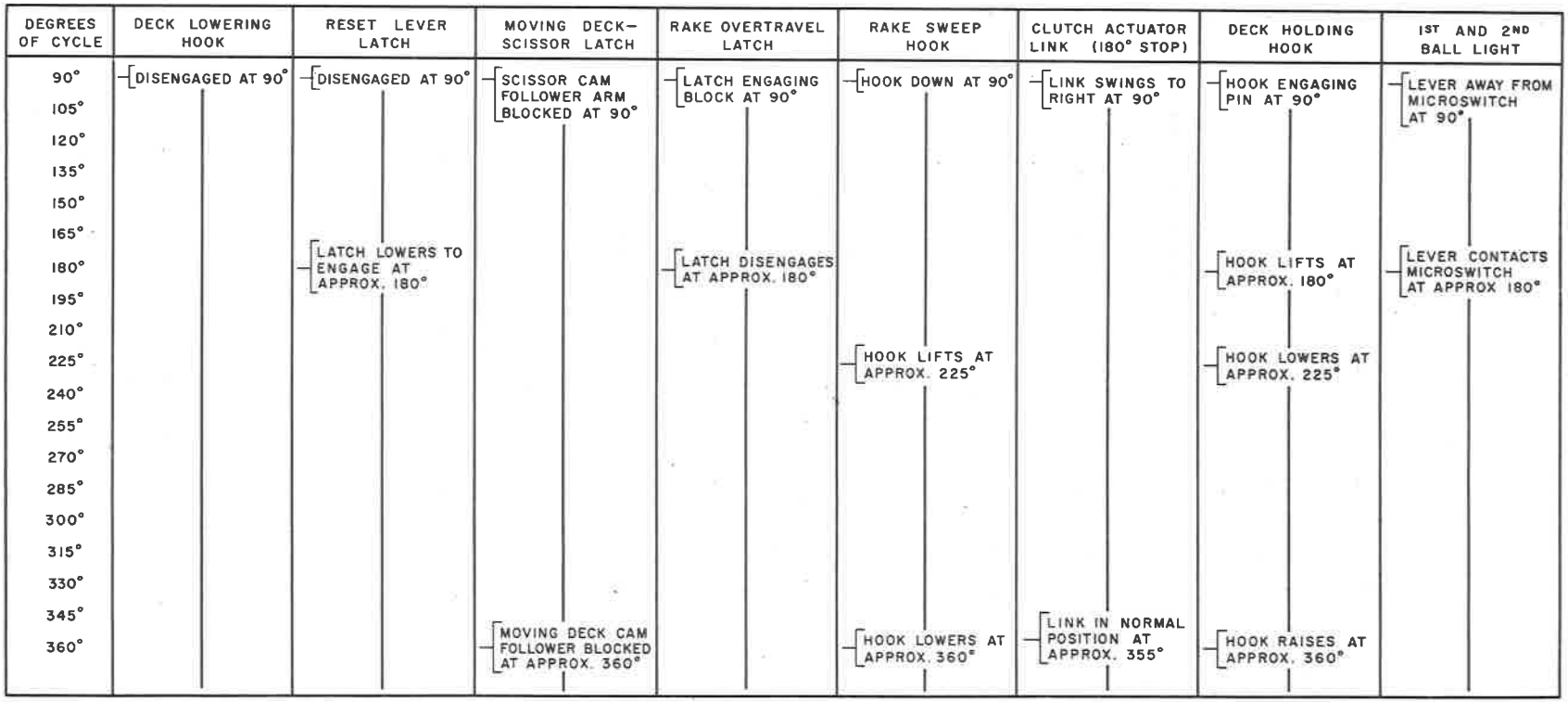
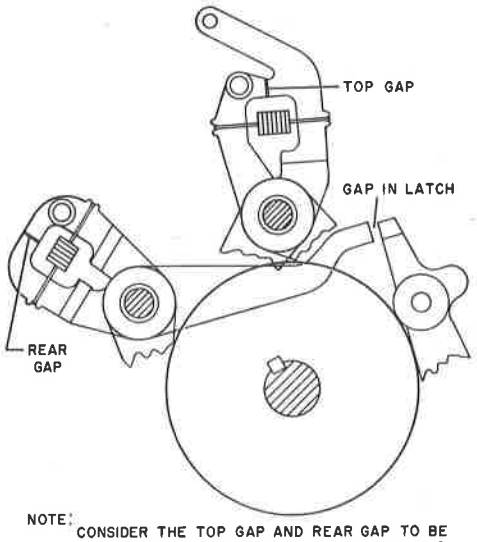


Figure 56c. Detector Function Chart, Second Ball



NOTE: CONSIDER THE TOP GAP AND REAR GAP TO BE CLOSED UNLESS THE GAP IS 1/16 OR GREATER.

DEGREE	TOP GAP	REAR GAP	LATCH GAP
FIRST BALL - STRIKE			
0°	CLOSED	CLOSED	
90°	CLOSED	CLOSED	
180°	CLOSED	OPEN	
270°	CLOSED	OPEN	
360°	CLOSED	CLOSED	
FIRST BALL - STANDING PINS			
0°	CLOSED	CLOSED	
90°	CLOSED	CLOSED	
180°	CLOSED	CLOSED	
270°	CLOSED	CLOSED	
360°	OPEN	CLOSED	
90°	OPEN	CLOSED	
SECOND BALL			
90°	OPEN	CLOSED	
180°	CLOSED	OPEN	
270°	CLOSED	OPEN	
360°	CLOSED	CLOSED	

Figure 57. Detector Assembly - Quick Check Diagram

OPERATING CYCLES.

A brief running description of the various actions that occur during the different pinsetter cycles is presented in the following paragraphs.

When all five manual switches and the two automatic limit switches are closed, the motor will be energized and, therefore, the pit conveyor, the ball and pin elevators, the cross conveyor, and the turret will be operative. With 10 pins spotted on the alley and the rake and deck in their up position, the pinsetter is ready for the first ball.

FIRST BALL, STANDING PIN CYCLE.

The impact of the ball against the pit cushion engages the clutch and the pinsetter starts its first ball cycle. The detector assembly allows the deck lowering hook to engage the deck pin, and the deck makes a short detecting stroke. The deck lowers, encounters standing pins and, through the detector rod and detector disc, the detector assembly receives the information that the bowler left standing pins. The detector assembly then controls the moving deck-scissor latch to block out the moving deck and allow the scissors to close on the standing pins.

The rake sweep hook is lowered into position, ready to engage the block on the rake sweep arm, and the deck holding hook is raised out of the path of the pin on the deck arm. The deck is then raised, with the pins (which are held by the scissors) lifted high enough to clear the rake as it sweeps the deadwood into the pit. The deck lowering hook is again placed in the path of the deck pin, and the deck lowers and releases the pins in the positions from which they were taken.

As the deck approaches the respotting position, a second detecting cycle takes place. The rake sweep hook is lifted so that it will not engage the block on the rake sweep arm, and the deck holding hook is lowered so that it will engage the pin on the deck arm when the deck comes back up. The lever moves away from the first and second ball light microswitch to change from first ball light to second ball light. The reset lever latch is moved above the latch roller so that the pinsetter will cycle through 90 degrees, second ball, before the clutch is disengaged. The rake overtravel latch is lowered to engage its block so that the rake will lift at 360 degrees, first ball, and stay up until ball impact at 90 degrees, second ball.

The deck rises and the deck holding hook engages the pin on the deck arm holding the deck up during the 90^{o} overtravel. The rake sweep hook is lowered so that it will engage the block on the rake sweep arm and sweep the alley after delivery of second ball. The moving deck-scissor latch is rotated to block out the scissor action and free the moving deck to operate. Just before 90 degrees, the reset lever rotates counterclockwise and brings the stop arm under the clutch lever to disengage the clutch at 90 degrees.

SECOND BALL CYCLE.

The clutch was disengaged at 90 degrees of the second ball cycle, with the deck held up by the holding hook. As the clutch is engaged by the second ball impact, the reset lever rotates clockwise and eliminates the tension on the spring connecting the reset lever with the clutch release lever. The clutch actuator link is swung counterclockwise to completely place the start-stop mechanism under control of the 180-degree stop interlock link. As the pinsetter cycles toward 180 degrees, the interlock link will be down to disengage the clutch at 180 degrees if the turret does not have 10 pins to deliver to the deck. When the turret indexes after receiving the tenth pin, the 180-degree interlock link will be pushed upward to re-engage the clutch. If the turret has already received the tenth pin before 180 degrees, the link will be in its up position and the clutch will not disengage at 180 degrees.

At 180 degrees, with the rake having swept the alley, the deck holding hook is disengaged, the deck lowering hook is held out of the path of the deck pin, the deck makes the long, new pin setting stroke at 270 degrees, and the action of the moving deck sets the new pins on the alley. As the deck approaches its pin setting depth, a second detecting cycle takes place. The latch on the reset lever is lowered to engage the latch roller so that the clutch will disengage at 360 degrees. The lever is moved against the first and second ball light microswitch to light the first ball light. The deck holding hook is lifted out of the path of the pin on the deck arm, and the rake overtravel latch is lifted above the latch block so that the rake can lower at 0 degree of the next cycle.

The rake and the deck then come up and the clutch disengages at 360 degrees. The pinsetter is now ready for delivery of the next "first ball".

FIRST BALL, STRIKE.

As the clutch is engaged by the ball impact, the deck lowers in the short, detecting stroke and finds no standing pins. The detector assembly then rotates the moving deck-scissor latch to block out the scissor action and allow the moving deck to operate. The rake sweep hook is lowered into position, ready to engage the block on the sweep arm, and the deck holding hook is raised out of the path of the pin on the deck arm. The 180-degree interlock link controls the start-stop mechanism as described in second ball, standing pins.

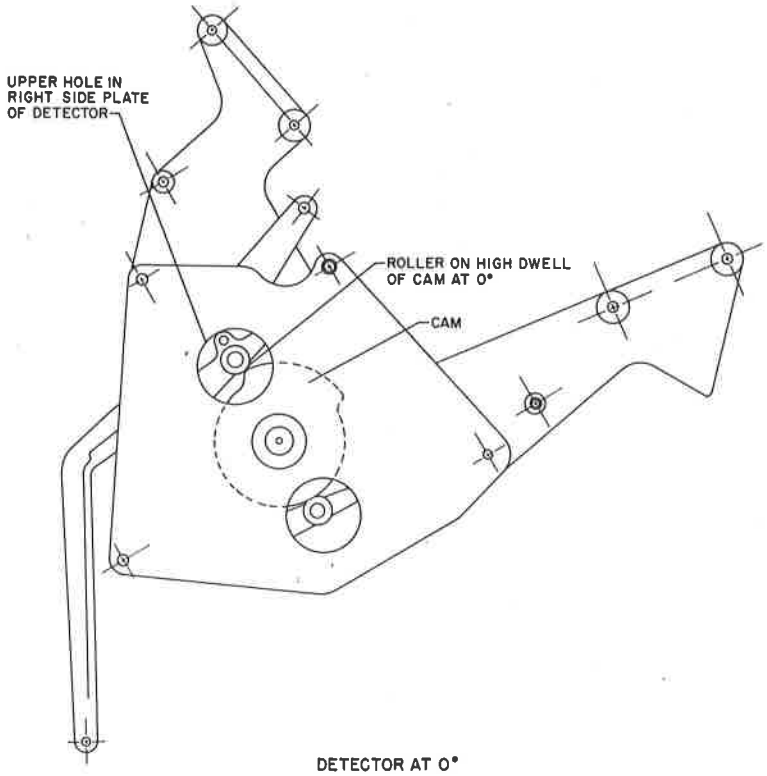
The deck is then raised and the rake sweeps the alley. The deck lowering hook is held out of the path of the deck pin, the deck makes the long, new pin setting stroke, and the moving deck shifts to set the pins on the alley. As the deck approaches the pin setting position, a second detecting cycle takes place. The rake sweep hook is lifted so that it will not engage the block on the sweep arm, and the deck holding hook is lifted so that it will not engage the pin on the deck arm. The lever contacts the first and second ball light microswitch to light the first ball light. The reset lever latch is lowered to engage the latch roller so that the clutch will disengage at 360 degrees, and the rake overtravel latch is lifted above the latch block so that the rake will be ready to lower at 0 degree of the next cycle. The deck and rake then raise and the pinsetter is ready for delivery of the next ball.

DETECTOR TIMING

Due to the fact that the detector assembly is geared to the drive system through three external gears, it is possible to install a detector assembly "out of time". If a detector assembly is removed from the gear box, it is absolutely essential that it be replaced exactly in time with the gear train. If the detector assembly is replaced a tooth or two off in either direction, the pinsetter will perform in an erratic manner.

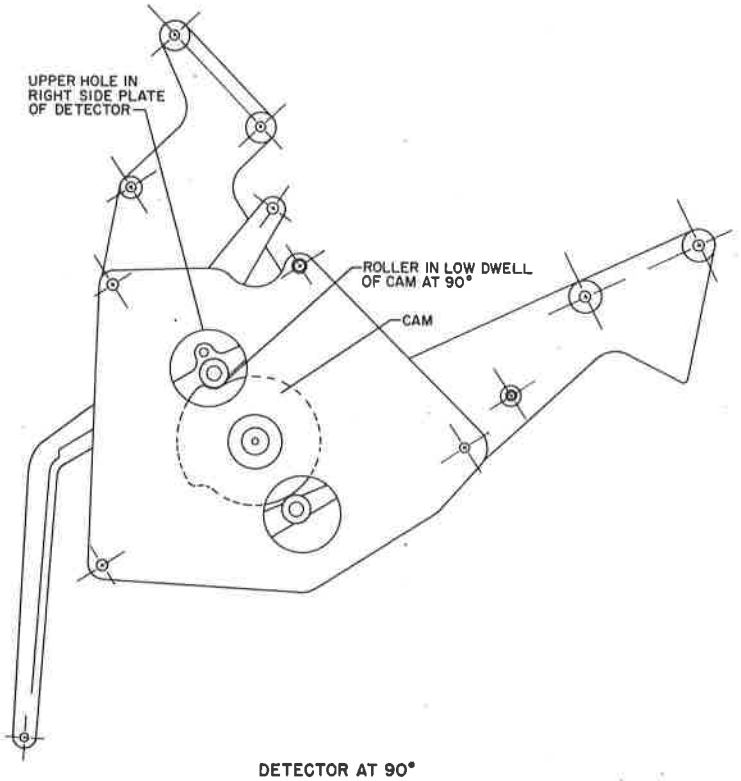
When replacing a detector assembly, there is a simple method to determine if the timing is correct. Figure 58 shows a view through the upper hole in the right side plate of the detector assembly. It also illustrates the correct position of the roller on the cam at 0 and 90 degrees. If the roller is in a different position at 0 and 90 degrees than is shown in figure 58, the detector assembly is out of time and must be corrected.

A detector "timing pin" is furnished with each spare parts kit. This pin may be used whenever a detector is removed and then replaced. Cycle the machine to 0 degrees and place the pin through the hole in the detector side plate and through the hole in the detector gear. This will effectively lock the detector at 0 degrees. If the pinsetter is not manually cycled while the detector is off and if the detector is locked at 0 degrees, the detector may be replaced without the danger of being "out-of-time".



DETECTOR AT 0°

a.



DETECTOR AT 90°

b.

Figure 58. Detector Assembly Timing Check

SECTION C

MAINTENANCE

SAFETY PROCEDURES

As with all machinery, there is an element of risk in 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.

GENERAL SAFETY REGULATIONS

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 pants 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 or inflammable.

4. Immediately wipe up any spilt oil or liquids to prevent slipping.

5. Store oily rags and 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 to work on it, be extra cautious when the machine is turned on. Replace the guards immediately when the work is completed.

3. Always open at least 2 of the manual ON-OFF switches before working on the machine.

4. When the pinsetter shuts itself off electrically, be sure to open a manual ON-OFF switch before looking for 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 tubes before disassembling 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 at 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 machines.

CHAPTER 22. ADJUSTMENTS

NOTE: THE ADJUSTMENTS ARE NOT LISTED IN ANY SPECIAL SEQUENCE AND CHANGING ONE ADJUSTMENT MAY AFFECT OTHER ADJUSTMENTS. CARE MUST BE TAKEN TO COMPENSATE FOR ALL SUCH INTERRELATED ADJUSTMENT CHANGES.

ADJUSTMENT INDEX

1. DETECTOR ROD ADJUSTMENT. (FIGURE 59)

The purpose of the detector rod adjustment is to insure that the pinsetter accurately detects strikes, standing pins from 10 full-size pins (15-1/32" high) to 1 undersize pin (14-13/16" high), and out-of-range pins.

a) Cycle to pinsetter to 90°, strike. To install the rod, screw the threaded end into the tapped hole in the short link pinned to the detector disc. Screw the rod in until it bottoms and then back it out until the two roll pins on the exposed part of the rod are perpendicular to the slots in the stop bracket. The two pins must straddle the two plates in the stop bracket. Tighten the lock nut. The lower end of the detector rod assembly is fastened to the deck shaft with an "X" washer pin.

b) At 0°, loosen the allen head screw in the detector rod pivot block and work the tube upward until it touches the bottom of the stop bracket. Tighten the allen head screw.

c) Run the machine to 90°, strike cycle, and loosen the allen head screw in the pivot block. Slowly work the tube down until the strike cam follower drops to the low level of the timing cam with a pronounced click.

d) Work the tube upward until the motion of the detector disc stops. Be careful not to compress the spring in the tube.

e) Carefully work the tube down 1/16". Tighten the allen head screw.

f) As a check, observe if the pinsetter detects strikes, standing pins from 10 full size pins to one undersize pin, and also detects an out-of-range pin. Check the one undersize pin on the No. 1 spot, then the No. 2 spot and then the No. 3 spot.

2. RAKE SWEEP HOOK ADJUSTMENT. (FIGURES 60 and 61)

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 sweep motion is obtained from a 4 to 1 gear ratio, and two large compression springs urge 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.

a) Cycle the pinsetter until the rake crank link is a direct continuation of the main rake crank on the 4 to 1 shaft (this will occur at 45 degrees).

b) Loosen the lock nuts on both ends of the rake crank link and turn the rake crank link until the vertical surface of the rake sweep hook is 1/8 + 1/32 inch -0 behind the latch block that the sweep hook engages. Tighten the lock nuts.

c) Loosen the lock nuts 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 3/16 + 1/16 inch -0 above the latch block that the hook engages. Tighten the lock nuts. As a check, cycle the pinsetter and make sure the hook fully engages the block during the sweep motion, and that the hook lifts at least 1/8 inch above the block when the hook disengages at approximately 225 degrees.

3. RAKE BOARD HEIGHT ADJUSTMENT. (FIGURE 60)

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

a) Loosen the lock nuts on both ends of the link which runs from the rake cam follower arm to the "C"-shaped lever on the overhead rake lift shaft, and turn the link until it measures 22-3/8 ± 1/32 inch between the centers of the link pivot pins. Tighten the lock nuts.

b) Cycle the pinsetter until the rake is all the way back (180 degrees).

c) Measure the horizontal distance from the zero line on the alley to the center of the lower hinge pin on the rake support arm. This dimension must be 13-7/8 ± 1/8 inch, and may be obtained by adjusting the rake crank link which was previously adjusted in Adjustment No. 2.

d) If any adjustment must be made to obtain this 13-7/8 ± 1/8-inch dimension, it will change the 1/8 + 1/32 inch -0 dimension obtained in Adjustment No. 2, and the following readjustment must be made:

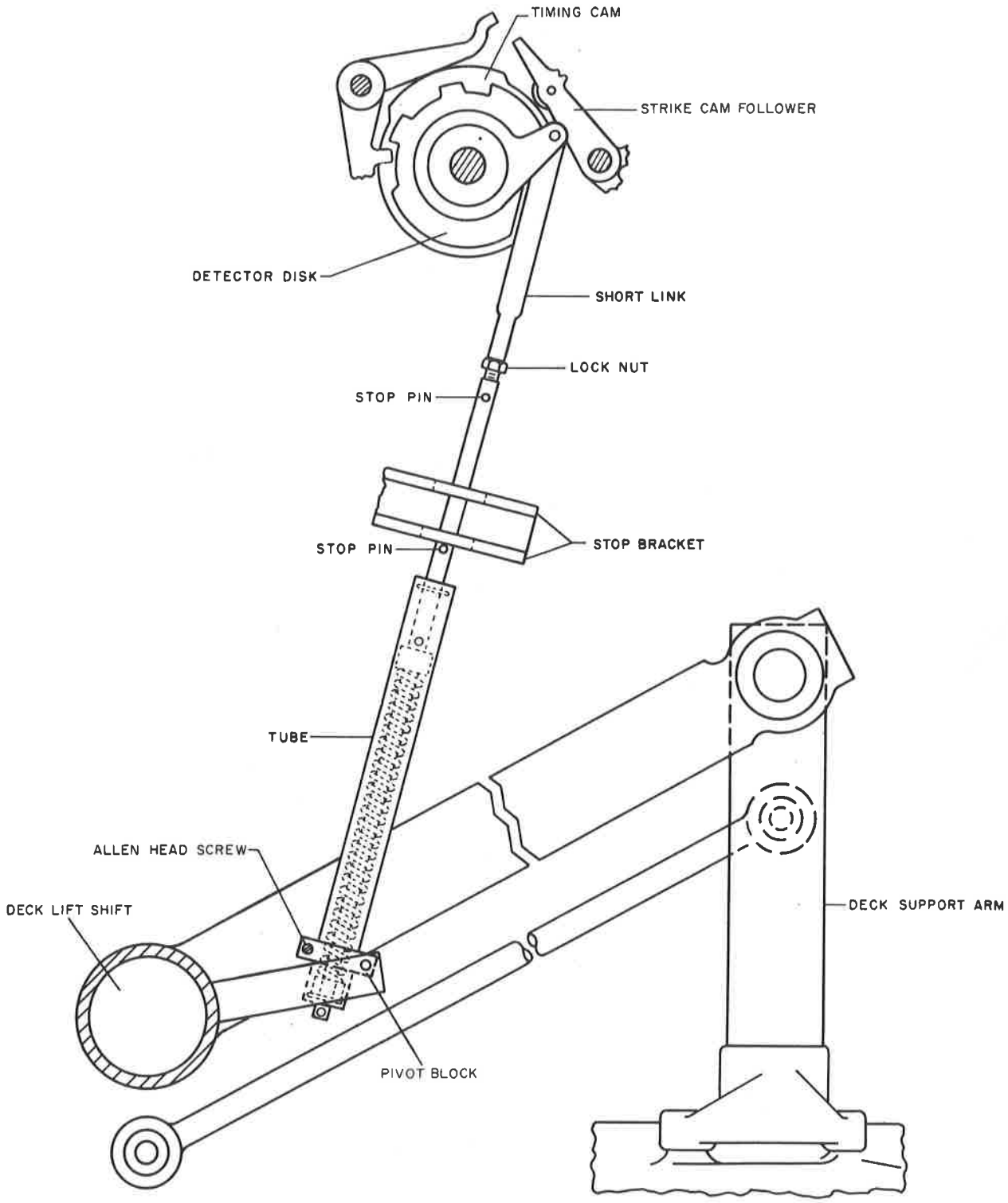


Figure 59. Detector Rod Adjustment

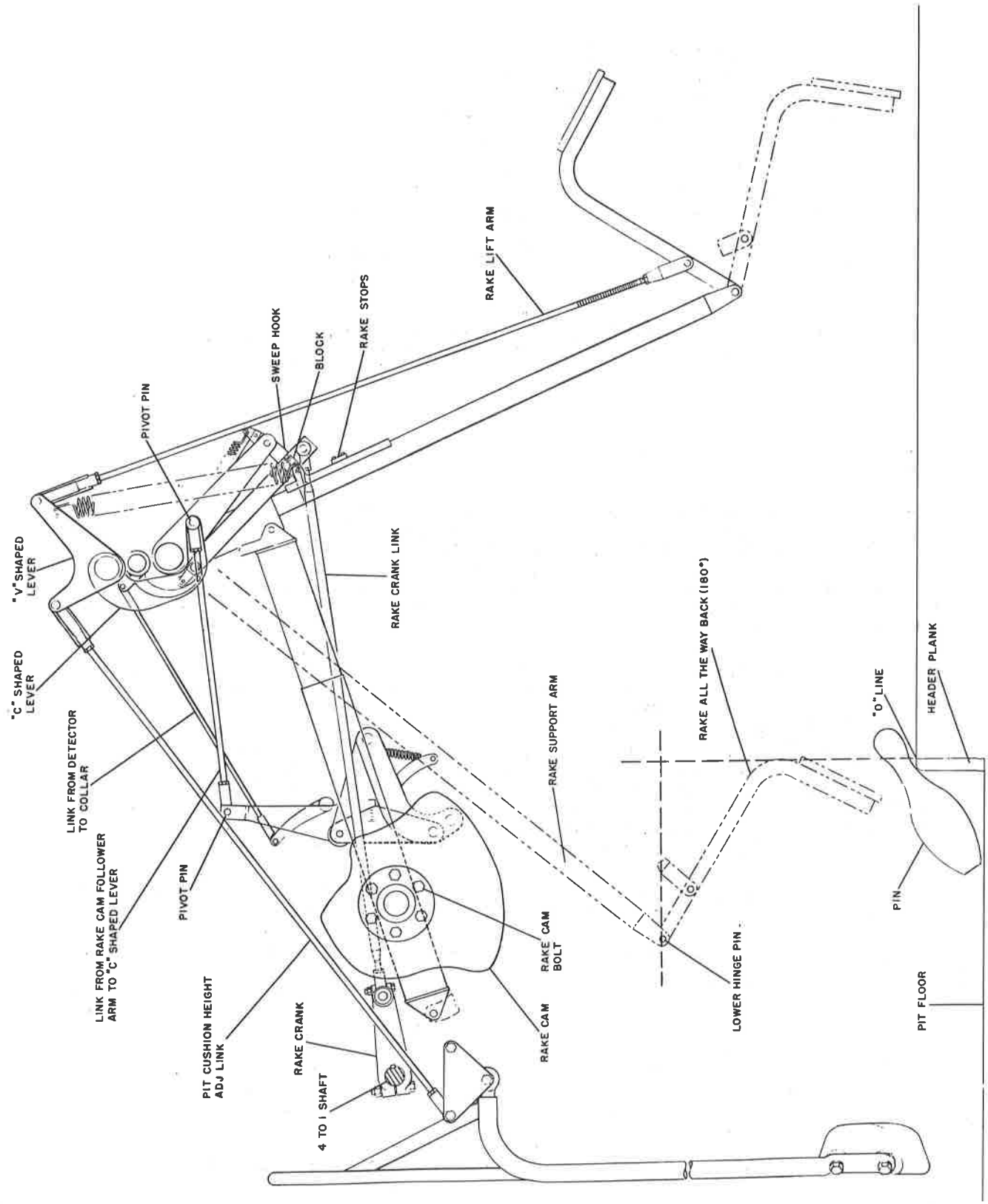


Figure 60. Rake Adjustments

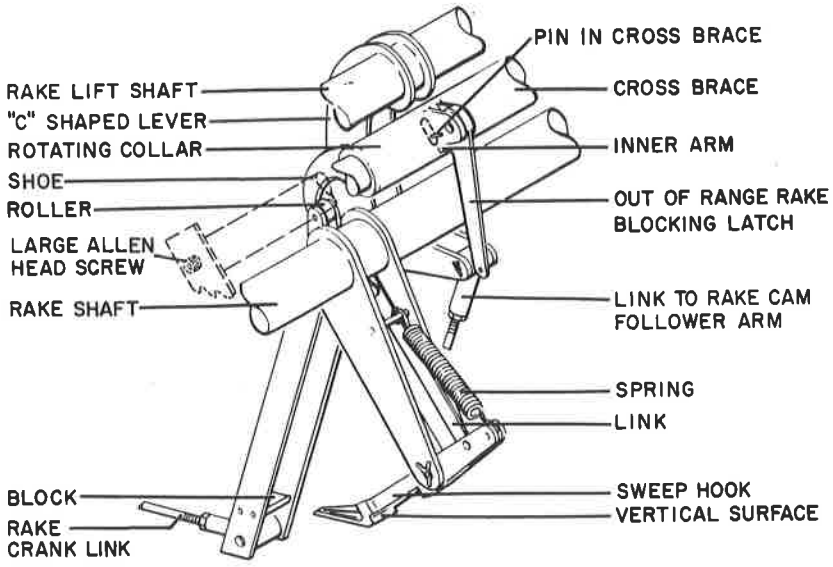


Figure 61. Rake Adjustments

e) Cycle the pinsetter to 45 degrees and adjust the rake stops on the side frames so that the rake sweep hook is again 1/8 + 1/32 inch -0 behind the block the sweep hook engages. Moving the stops forward will decrease the gap; moving them backward will increase the gap.

f) Cycle the pinsetter until the rake is in its fully forward, down position (45 degrees). Loosen the lock nuts on both ends of the rake lift arms, and turn the arms until the lower edge of the rake board is 2-1/16 ± 1/32 inch above the alley surface at the center of the alley.

g) Cycle the pinsetter and stop when the rake is between the 2, 3 spots and 4, 5, and 6 spots. Adjust the same rake lift arms so that the lower edge of the rake board is parallel with the alley surface, and does not vary more than 1/32 inch from one end of the rake board to the other.

h) With the rake between the 2, 3 spots and 4, 5, and 6 spots, adjust the rake cam so that the lower edge of the rake board is 3/8 + 1/8 inch -0 above the alley surface. To raise the rake, rotate the cam counterclockwise; to lower the rake, rotate the cam clockwise. Loosen the six bolts around the hub of the cam, and relieve the pressure of the cam followers against the cam surface so that the cam will turn easily. The pressure may be relieved by carefully disengaging the rake sweep hook and allowing the rake to come fully forward. Tighten the cam bolts carefully after adjusting the cam.

Note: A 1/16-inch rotation of the cam will raise or lower the rake approximately 1/2 inch, therefore relatively little movement of the cam will be required in making this adjustment.

i) As a check, cycle the pinsetter to 180 degrees (rake all the way back). Place a standard sized pin with the butt in the pit and the neck between the header plank and the lower edge of the rake. Cycle the pinsetter and observe if the pin falls into the pit or if the rake carries it back on the alley. If the pin stays in the pit, the rake adjustments are complete. If, however, the rake carries the pin back on the alley, follow procedure j, which follows.

j) Rotate the cam clockwise to increase the height of the rake above the alley surface. Raise the rake only enough to insure that any pin caught between the header plank and the rake will not be carried back on the alley. If any cam adjustment is made, it will change the height of the rake as set in step h, and the following readjustment must be made:

k) Cycle the pinsetter until the rake is between the 2, 3 and 4, 5, and 6 spots. If the rake board is lower than 3/8 inch above the surface of the alley, use the rake lift arms to raise it to the minimum height of 3/8 inch. Never lower the rake board at this final stage.

4. RAKE BOARD OVERTRAVEL LATCH ADJUSTMENT. (FIGURE 62)

This adjustment is made to insure that the latch prevents the rake from lowering during the 0^{o} to 90^{o} overtravel.

a) With the rake up at 0^{o}, loosen the clamp screw on the latch on the inner rake cam follower arm.

b) Set the bottom of the latch at 1/8 + 1/32 inch -0 above the top of the block on the outer rake cam follower arm.

c) At this point, make sure the roller on the latch is in contact with the curved shoe from the detector assembly, and tighten the clamp screw.

d) As a check, cycle the pinsetter to 90^{o}, second ball and observe the engagement of the latch and block. The face of the overtravel latch must engage a minimum of 5/16" on the face of the block.

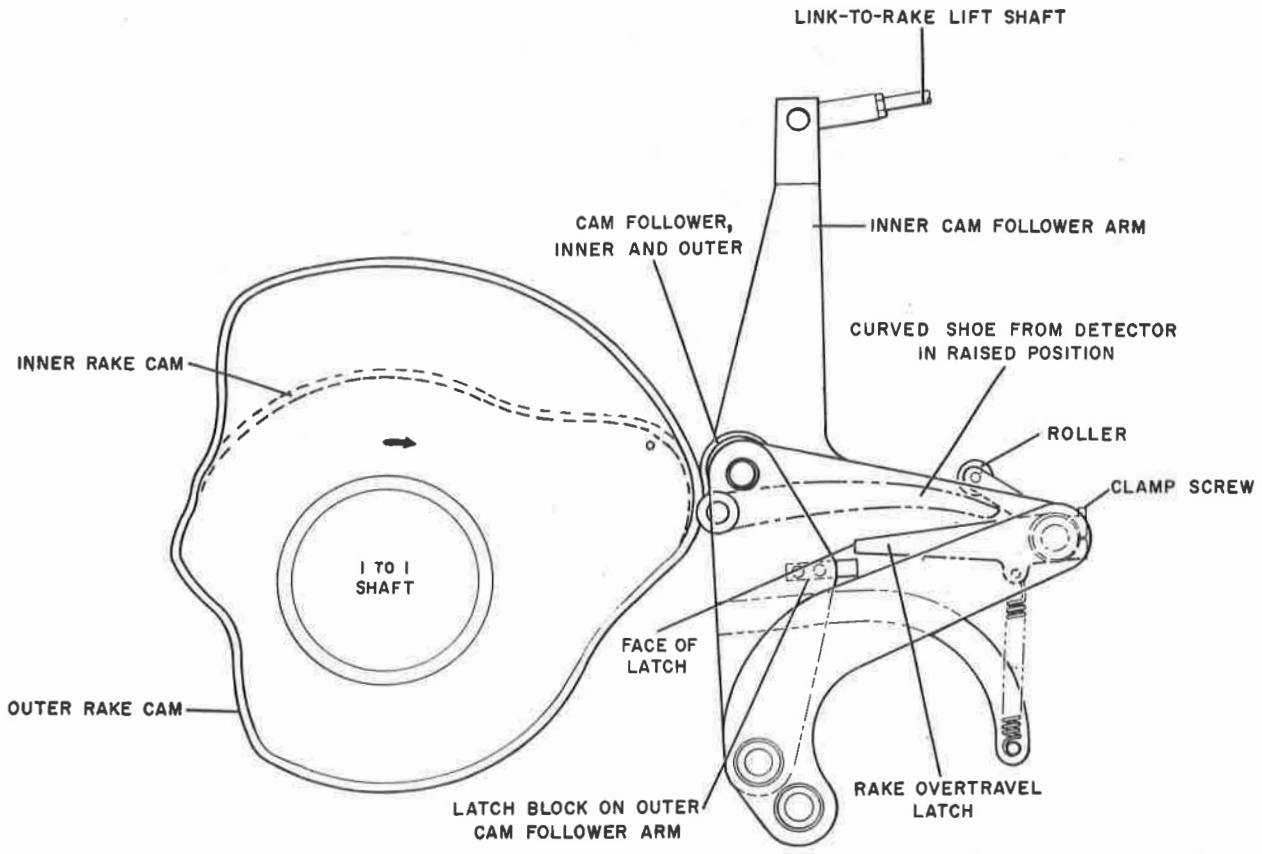


Figure 62. Rake Overtravel Latch

5. RAKE OUT-OF-RANGE ADJUSTMENT. (FIGURES 61 and 63)

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

a) Set a pin out-of-range and cycle the pinsetter until the clutch automatically disengages. Then turn off the power by opening one of the manual ON-OFF switches.

b) Loosen the large allen head screws which mount the middle cross brace to the overhead frame.

c) 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 rake blocking latch just drops over the pin in the cross brace. Tighten the allen head screws. The cross brace may be rotated by placing a punch in the hole provided.

d) 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 rake 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.

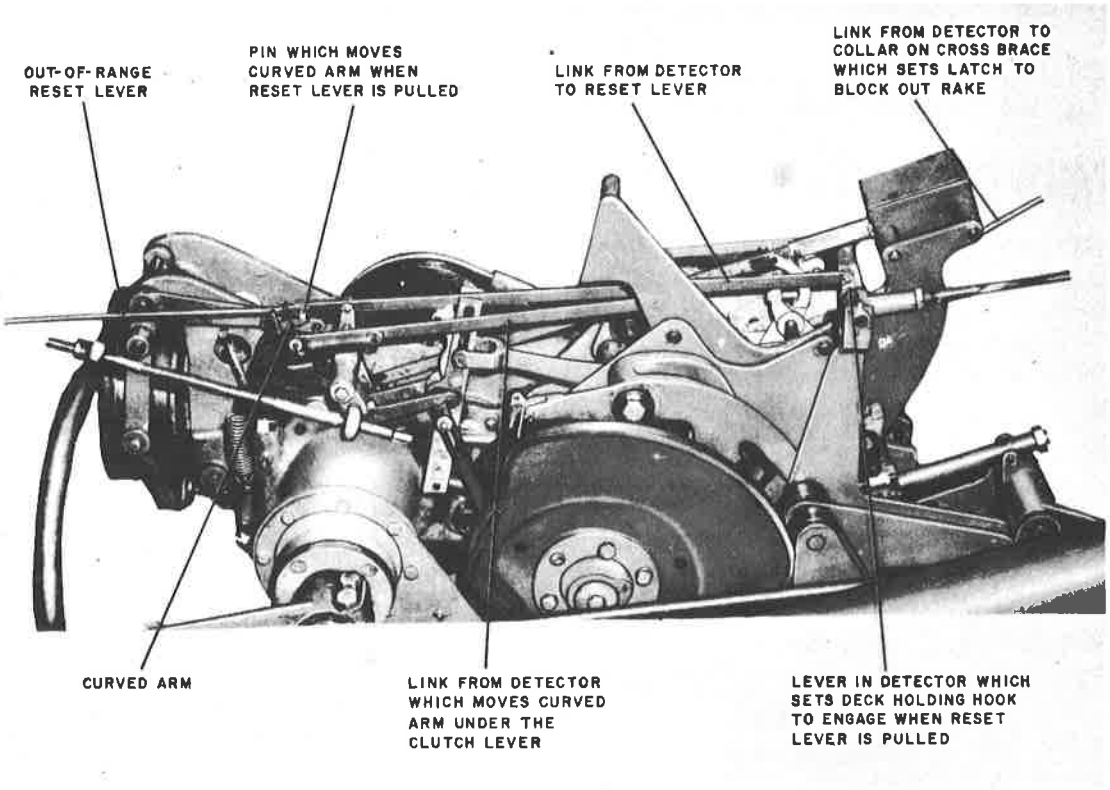


Figure 63. Out-of-Range Linkage

6. DECK SHAFT ADJUSTMENT. (FIGURE 64)

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

a) Set the deck lift shaft at 15-13/16" +0 -1/8 inch from the rear of the deck shaft to the center of the 7, 8, 9 and 10 spots. To move the pinsetter forward or backward, loosen the cap screws at the four anchor points on the top of the kickbacks.

b) Set the deck lift shaft at 32-5/8" ± 1/16" from the bottom of the deck shaft to the surface of the alley, at both ends of the deck shaft. The shaft may be raised or lowered by means of the REAR jack screws on both side frames.

NOTE: When using the jack screws in making any adjustment, it is preferable to use them for raising, rather than lowering. Always use the jack screws in pairs so that the weight of the machine is never supported by a single screw.

7. DECK HEIGHT AND LEVEL ADJUSTMENT. (FIGURES 64 and 65)

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

a) With the pinsetter at exactly 270° after detecting a strike, level the deck to the alley surface. If the apex of the deck requires adjustment, use the jack screws at the front of the side frames. If the rear of the deck requires adjustment, use the jack screws at the rear of the side frames.

b) With the pinsetter still at 270°, set the bottom of the scissor deck at 13/16" ± 1/32" above the alley surface. To raise or lower the deck, loosen the locking cap screw where the deck lowering link is threaded into the pin on the bronze deck eccentric. Rotate the adjusting sleeve until the deck is 13/16" ± 1/32" above the alley surface. The sleeve may be rotated by means of a punch placed in the holes of the sleeve. Tighten the cap screw. The sleeve is easily rotated if the deck is blocked up to take the weight off the lowering link.

NOTE: (1) If the deck has to be lowered beyond the limits obtainable with both the jack screws and lowering link, 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 link, be sure to readjust the restricted drop interlock (Adjustment 43) and the deck holding hook (Adjustment 13).

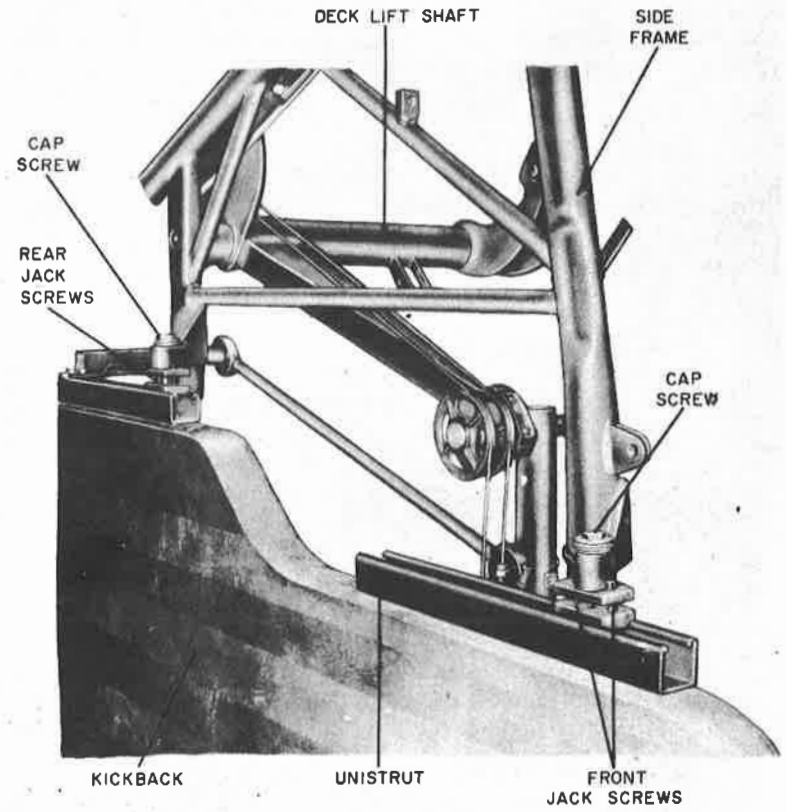


Figure 64. Deck Shaft Adjustment

8. MOVING DECK-SCISSOR LATCH ADJUSTMENT. (FIGURE 66)

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

a) With the pinsetter at 0°, measure the gap between the rear of the latch and the front surface of the scissor cam follower arm. This gap should be 5/32" ± 1/32".

b) If the gap must be changed, the link connecting the latch to the detector is adjustable and may be lengthened or shortened, as required.

c) As a check, cycle the pinsetter to 90°, strike. A minimum of 3/16" of the top of the latch should contact the lower surface of the scissor cam follower arm. If it is less than 3/16", adjust accordingly.

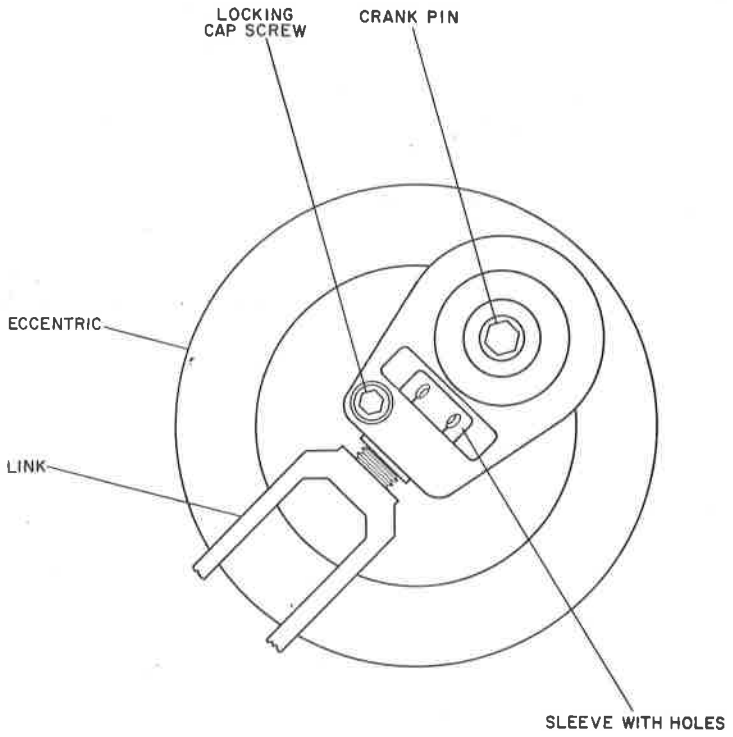


Figure 65. Deck Lowering Link Adjustment

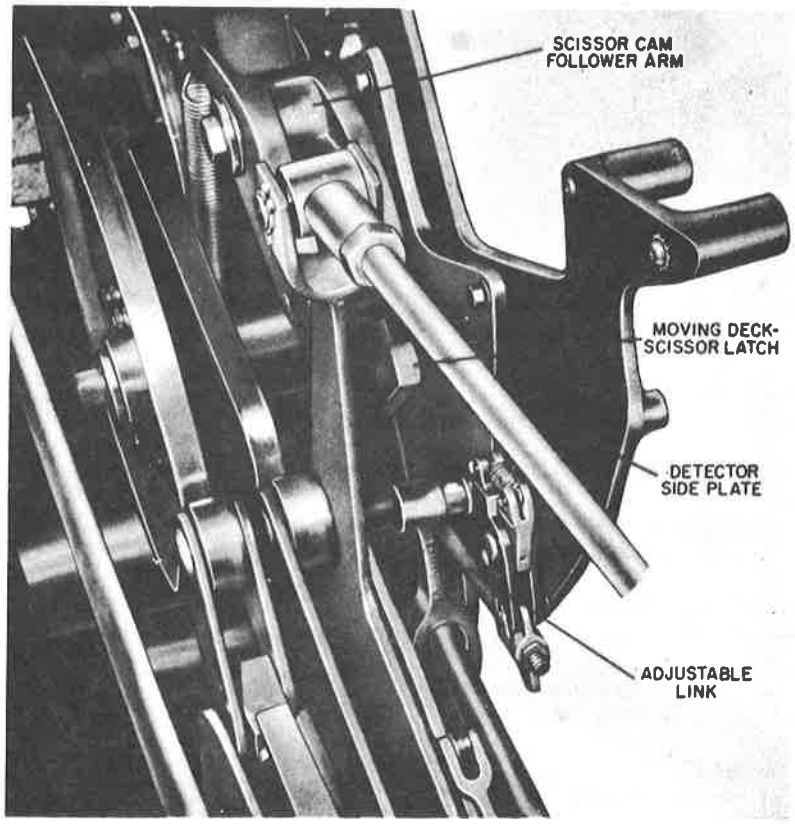


Figure 66. Moving Deck-Scissor Latch Adjustment

9. MOVING DECK CABLE ADJUSTMENT. (FIGURE 67)

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

a) With the moving deck in its fully retracted position (approx. 290°, strike cycle) adjust the moving deck cable (outer cable) by means of the turnbuckle, until the machined surface at the rear of the moving deck is approximately 3/16" from the front of the stop pin. (The minimum allowable gap is 1/32").

b) Run the pinsetter through several new pin setting cycles and observe if the pins wobble when set. If they do wobble, cycle the pinsetter slowly by hand and observe if the cast fingers or the lower, front edge of the deck buckets are causing the pins to wobble.

c) If the cast fingers brush the pins as the deck goes back up, the cable must be slackened. If the lower, front edge of the deck buckets brush the pins as the deck goes back up, the cable must be tightened.

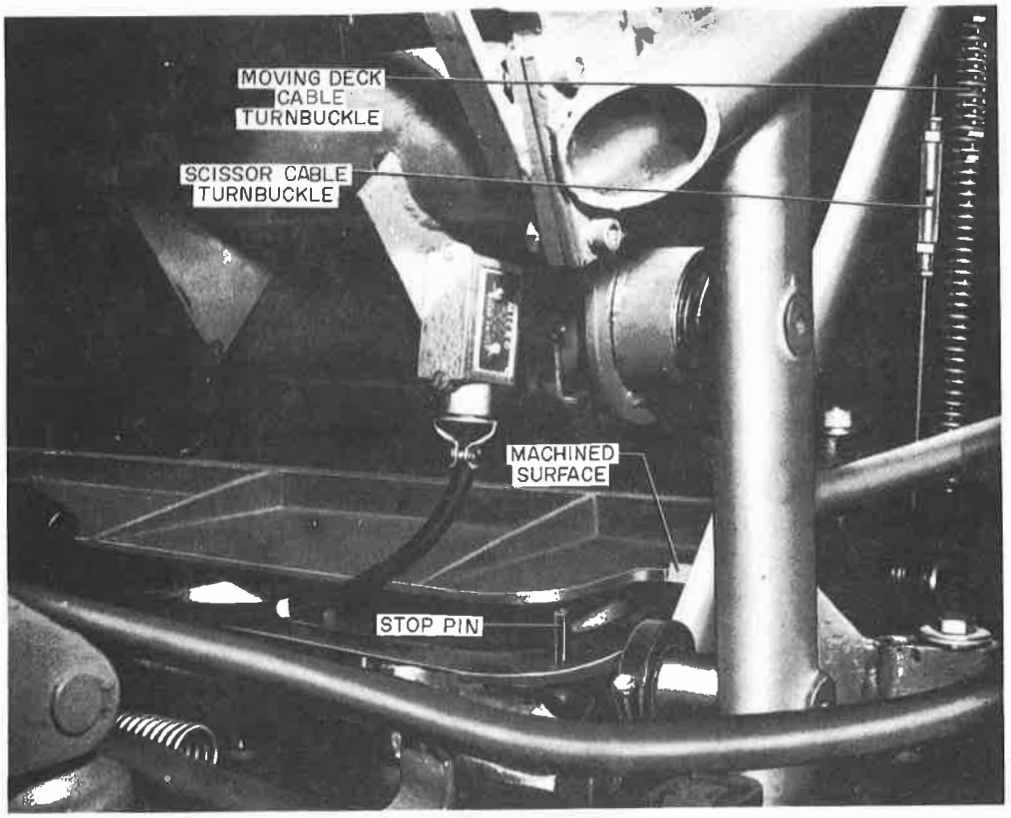


Figure 67. Moving Deck and Scissor Cables Adjustment

10. SCISSOR CABLE ADJUSTMENT. (FIGURE 67)

The purpose of this adjustment is to insure that the scissors open fully, so as not to interfere with the setting of new pins by the moving deck.

a) Cycle the pinsetter to 0°, with the scissor cam follower on the high dwell of its cam, holding the scissors open.

b) Adjust the scissor cable (inner cable) by means of the turnbuckle, until the scissors are fully open, just touching their rubber stops.

11. DECK ECCENTRIC ADJUSTMENT. (FIGURE 68)

This adjustment is made to insure that undersize pins are accurately respotted after being picked up by the scissors.

a) Cycle the pinsetter to 90°, strike (no pins on alley).

b) Loosen the two nuts on the deck lowering hook "U" clamp and rotate the bronze eccentric until the bottom of the scissor deck is 8-1/2" above the alley surface. Tighten the lock nuts. Be careful not to over-tighten the "U" clamp, as the eccentric may become deformed. The eccentric may be rotated by placing a punch in the holes provided.

c) Cycle the pinsetter and observe if the scissors respot one undersize pin accurately. If the pin is off spot, the deck must be lowered further by again rotating the bronze eccentric. Rotate the eccentric in 1/2" increments.

NOTE: 1. In making this adjustment, it is helpful to scribe a mark on the eccentric and disc so that the amount of rotation will be readily visible.

2. Whenever the deck height is changed by means of the eccentric, it will be necessary to re-adjust the detector rod. (adjustment No. 1).

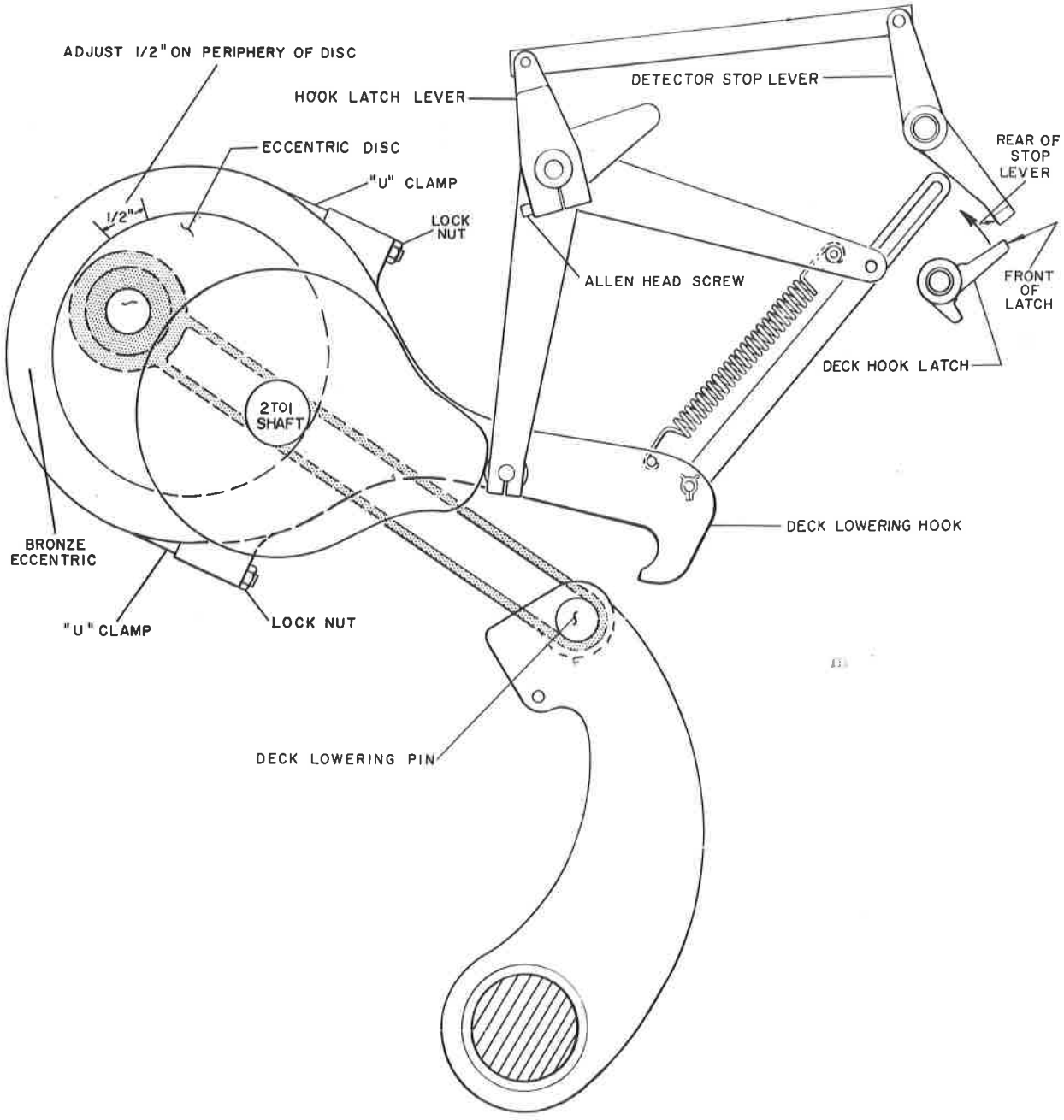


Figure 68. Deck Eccentric Adjustment

12. DECK LOWERING HOOK LATCH ADJUSTMENT. (FIGURE 68)

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.

a) Cycle the pinsetter to exactly 180 degrees second ball and shut the power off.

b) Loosen the allen head screw on the hook latch lever and set the gap between the rear of the deck lowering hook stop lever and the front of the blocking latch at 1/32 ± 1/64 inch. (The stop lever and latch are in the front end of the detector assembly.) Tighten the allen head screw.

13. DECK HOLDING HOOK ADJUSTMENT. (FIGURE 69)

This adjustment is made to insure that the hook fully engages the pin during the 0^{o} to 90^{o} overtravel and that it clears the pin when the deck lowers.

NOTE: 1. Before making this adjustment, make sure adjustment No. 5, (Rake Out-of-Range) is correct.

2. Make this adjustment carefully, as the hook is the only support for the deck when it engages the pin.

a) Cycle the pinsetter to 0^{o} and loosen the lock nuts and remove the allen head adjusting screws from both the upper and lower control links.

b) 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 post. Tighten the lock nut.

c) 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 FREE PLAY in the hook. Tighten the lock nut.

d) As a check, run the pinsetter through several standing pin and out-of-range pin cycles and observe if the hook fully engages the pin and if it clears the pin when the deck lowers.

14. DECK PIN SPOTTING ADJUSTMENT. (FIGURE 70)

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

NOTE: Use new standard sized pins in making this adjustment.

a) Cycle the pinsetter through several new pin setting cycles and observe whether the pins are accurately placed on the spots.

b) If the pins are spotted too far to the left or right, cycle the pinsetter until the deck is all the way down (270 degrees), with the weight of the deck supported on blocks. Loosen the bearing caps on the front of the four deck arms, and move the deck right or left as required. Tighten the bearing caps.

c) 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 backward. Tighten the four bolts.

NOTE: THE FOLLOWING SERIES OF ADJUSTMENTS, NUMBERS 15 THRU 22, WHILE SEEMINGLY UNRELATED, ALL AFFECT THE PINSETTER TRIGGERING EFFICIENCY. TO OBTAIN MAXIMUM TRIGGERING EFFICIENCY, ALL OF THESE ADJUSTMENTS (NUMBERS 15 THRU 22), MUST BE CORRECT.

15. GEAR BOX CLUTCH ADJUSTMENT. (FIGURE 71)

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

a) Trigger the pinsetter and loosen the jam nut on the end of the input worm shaft. Turn the inside nut until a gap of approximately 0.010 inch is obtained all around between the gear box housing and the clutch disc. Tighten the jam nut.

16. GEAR BOX CLUTCH LEVER ADJUSTMENT. (FIGURES 71 and 72)

This adjustment is made to insure that the roller on the clutch lever engages the stop arm to disengage the clutch at exactly 0, 90, or 180 degrees, as required.

a) Cycle the pinsetter and allow it to come to a normal 0-degree stop.

b) Check the position of the rake crank arm and the long rake crank link, which should be in the same horizontal plane, with the crank link bisecting the center of the crank hub.

c) If the link is higher than the crank arm, the clutch lever must be lowered. If the link is lower than the crank arm, the clutch lever must be raised.

d) To adjust the clutch lever, loosen the jam nut on the inner 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 jam nut.

e) Cycle the pinsetter and observe whether the crank and link stop in the same plane. Repeat adjustment if necessary.

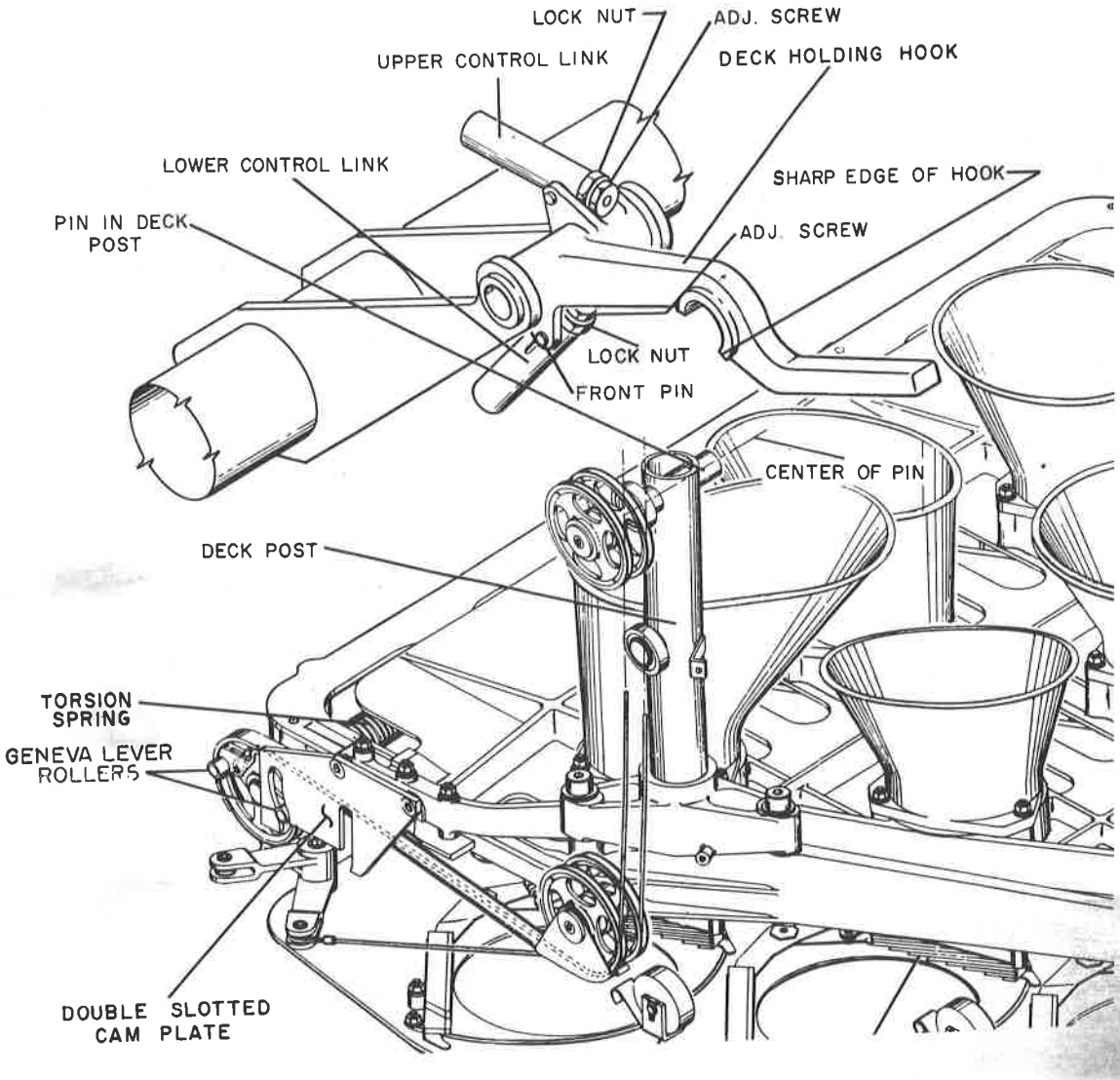


Figure 69. Deck Holding Hook Adjustment

17. GEAR BOX DASHPOT STOPCOLLAR ADJUSTMENT. (FIGURE 73)

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

a) Cycle the pinsetter to exactly 180° second ball and shut off the power.

b) Loosen the set screw on the dashpot stop collar.

c) Position the clutch actuating link so that the horizontal edge of the clutch latch is opposite the center of the "X" washer pin in the end of the reset lever.

d) Hold the clutch actuating link in this position and slide the stop collar down against the top of the dashpot and tighten the set screw.

e) As a check, if the stop collar is set too high, the pinsetter will recycle; if set too low, the clutch will disengage at 270°.

18. GEAR BOX TIME DELAY ADJUSTMENT. (FIGURE 71)

This adjustment is made to provide for a time delay from the instant of ball impact to actual deck contact with standing pins.

a) Loosen the jam nut on the adjusting screw at the bottom of the dashpot. Turning the screw in will increase the time delay; turning the screw out will decrease the time delay.

b) Adjust the screw until a time delay of approximately four seconds is obtained, from the time the ball passes the No. 1 pin spot, to the time the deck contacts any standing pins. Tighten the jam nut.

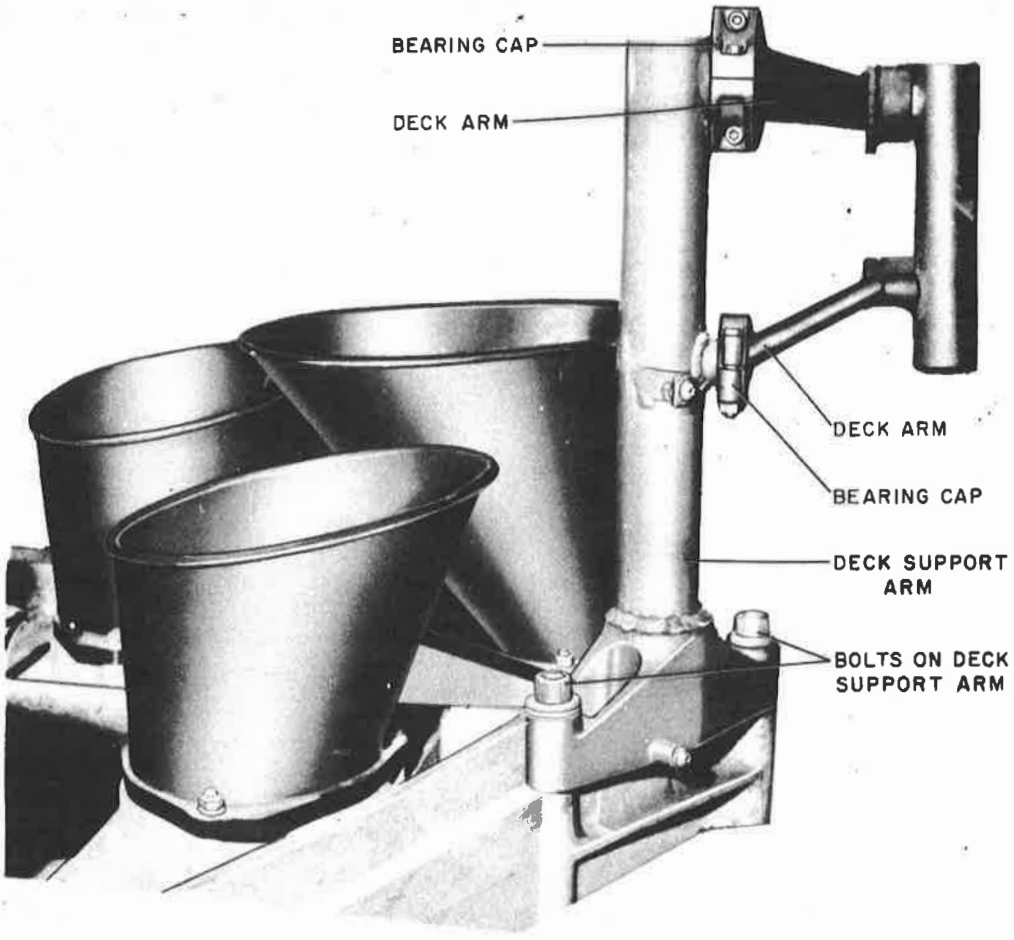


Figure 70. Pin Spotting Adjustment

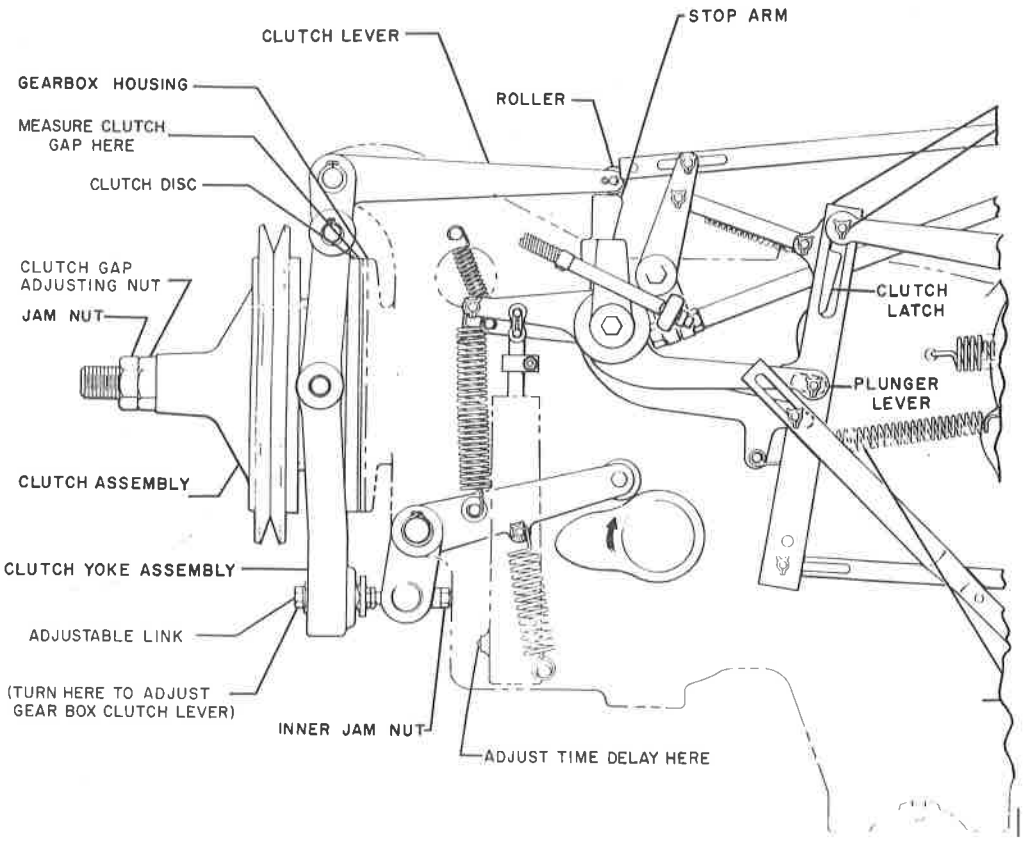


Figure 71. Gear Box Clutch Adjustment

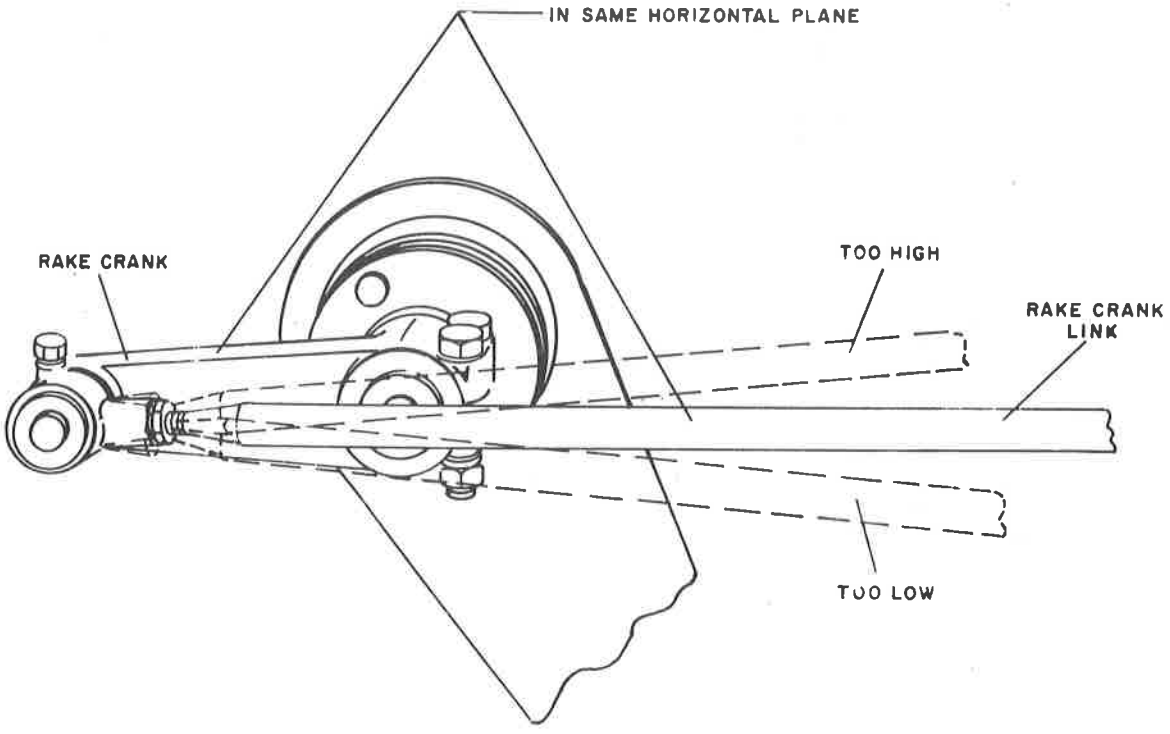


Figure 72. Clutch Lever Adjustment

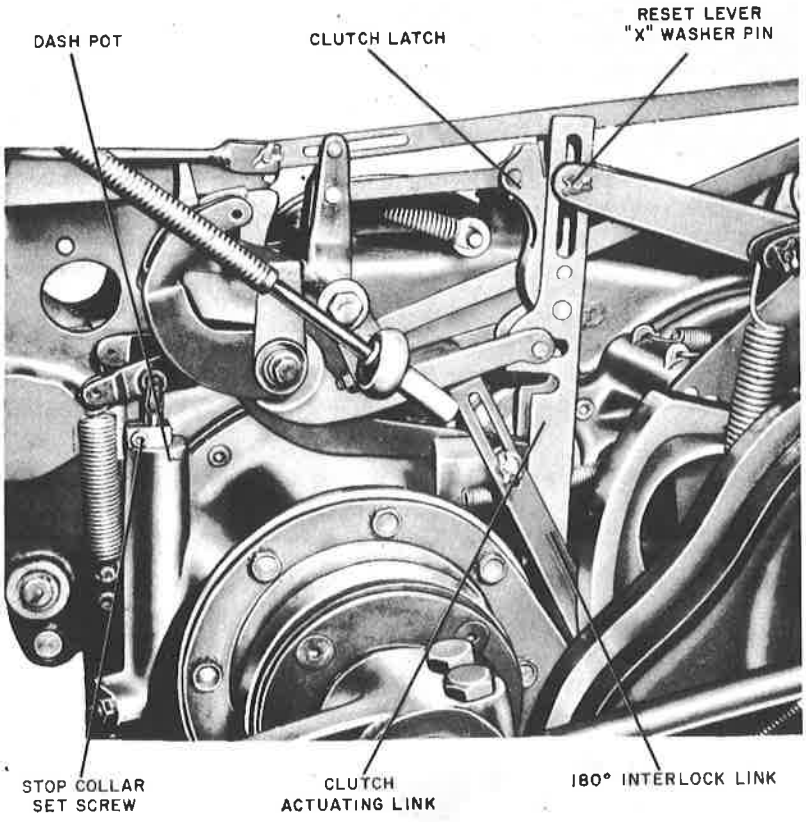


Figure 73. Dashpot Stop Collar Adjustment

19. GEARBOX 180^{O} STOP INTERLOCK ADJUSTMENT. (FIGURE 74)

This adjustment is made to insure that the clutch will disengage at 180^{O} when the deck must wait for pins to deliver to the alley, and that the clutch will then automatically re-engage when the turret delivers 10 pins to the deck.

a) Allow the pinsetter to come to a normal 180^{O} stop, waiting for pins. (Make sure that the hook latch shown in Figure 46 is not holding the link in its back position.)

b) Loosen the clamp screw on the lever at the lower end of the 180^{O} interlock link.

c) Position the interlock link to obtain a gap of 1/4" ± 1/64", between the rear face of the projection on the clutch release lever and the surface of the clutch actuator lever, which the projection contacts. Tighten the clamp screw.

d) As a check, cycle the pinsetter and observe if the clutch disengages at 180^{O} when it must wait for pins and then re-engages automatically when the turret indexes after delivering 10 pins to the deck. If the pinsetter stops at 180^{O}, and then fails to restart automatically, the link is set too low.

e) As a further check, let the pinsetter run at 0^{O}, without engaging the clutch. Allow the cross conveyor to deliver 10 pins to the turret and observe if the pinsetter triggers itself, when the turret indexes after delivering 10 pins to the deck. If it does trigger itself, the link is set too high.

20. PIT CUSHION ADJUSTMENT. (FIGURE 75A and 75B)

This adjustment is made to insure that there is no binding or restriction in the motion of the cushion; and to insure that the cushion lifts high enough for the ball to clear the bottom of the cushion immediately, when the rake lowers.

NOTE: The A. B. C. requires a minimum distance of 25", from the face of the cushion to the zero line of the alley.

a) Grasp the cushion and swing it back and forth to determine if there is any binding or restriction in its motion. If the cushion does not swing freely, check for rubbing against kickbacks or binding in the cushion pivot points in the cushion arms, shock absorbers and triangular plates. Correct any cause for binding before proceeding.

b) Cycle the pinsetter until the rake is in its full down position (approximately 45^{o}).

c) Loosen the jam nuts on the two, long links which run from the "V" shaped levers on the overhead rake lift shaft to the triangular plates on the pit cushion arms.

d) Adjust the links until clearance of 1/8 +1/16-0" is obtained between the top of a standard ball and the center of the pit cushion bottom. Set both links at the same length. Tighten the jam nuts. This adjustment must be made at 45^{o}, first ball, to prevent any delay in the ball return time.

e) At 0^{o}, loosen the jam nuts on the two pit cushion arm jack screws which contact the lower ends of the shock absorbers.

f) Turn the left hand (trigger side) jack screw in as far as it will go (no threads showing).

g) Turn the right hand jack screw out to its full extent and lock the jam nut.

h) Turn the left hand jack screw out until it just contacts the shock absorber and tighten the jam nut.

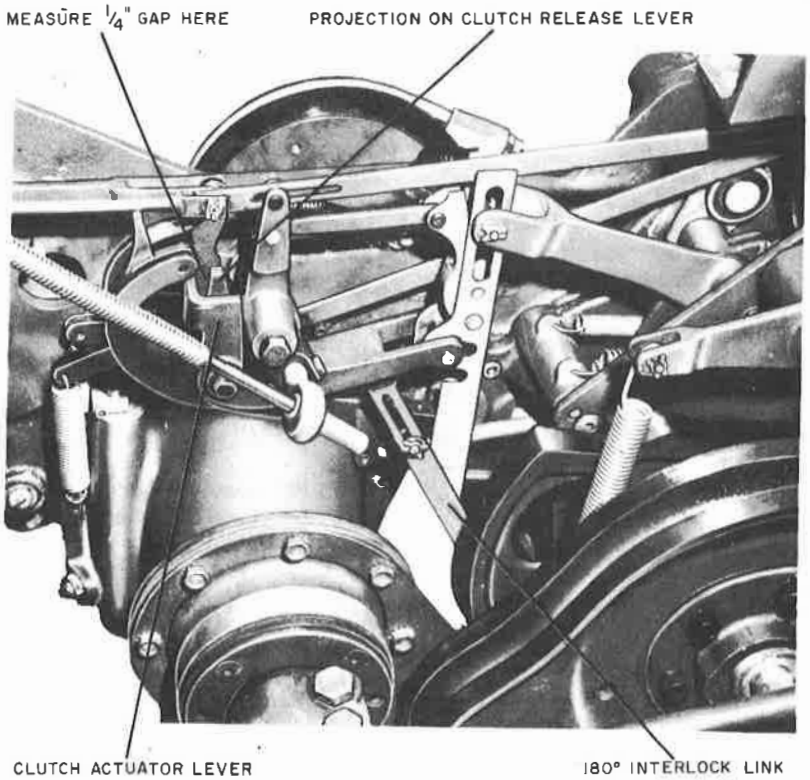
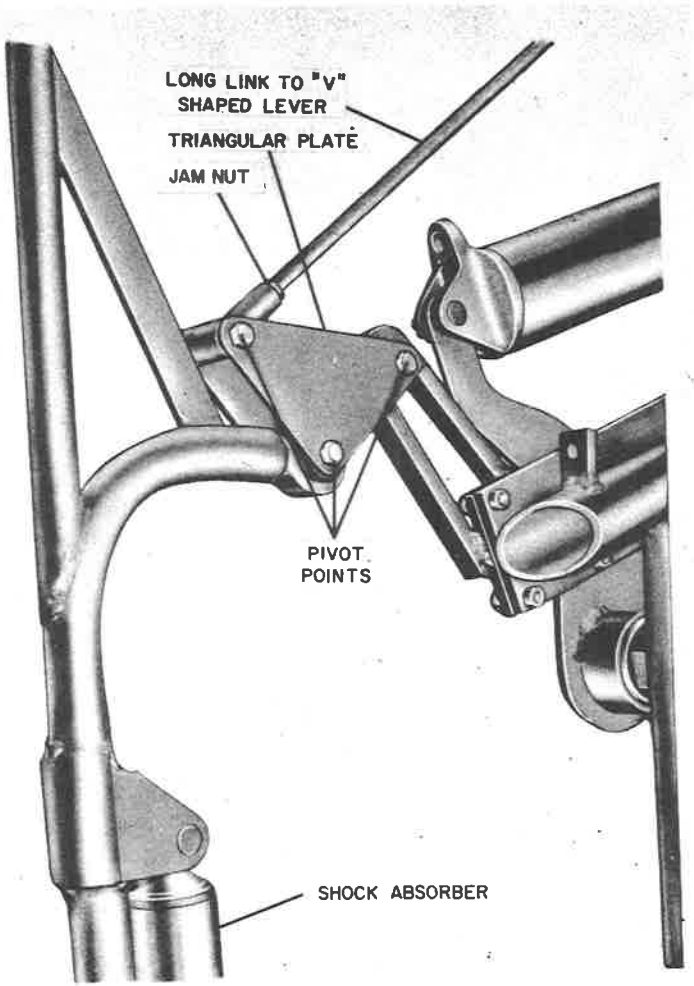
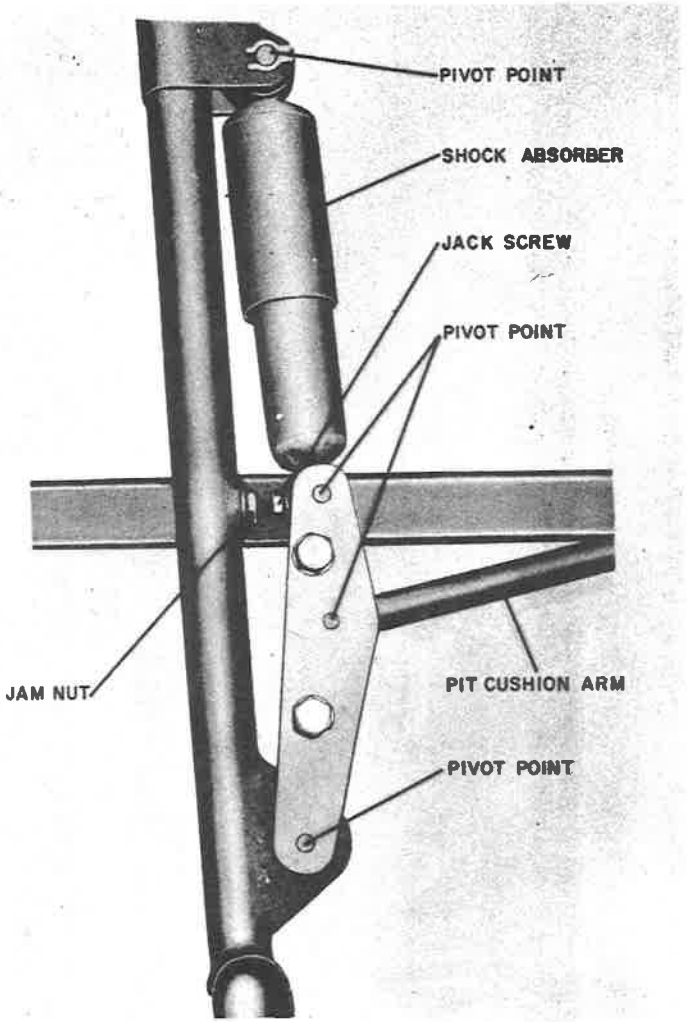


Figure 74. 180^{o} Stop Interlock Adjustment



a



b

Figure 75. Pit Cushion Adjustment

21. PIT CURTAIN ADJUSTMENT. (FIGURE 76)

This adjustment is made to position the curtain correctly, thereby preventing excess pin rebounds and to prevent curtain interference with pinsetter triggering. Later machines have a fixed, non-adjustable mount.

a) Loosen the bolts mounting the top curtain rod to the unistruts.

b) Position the top curtain rod to obtain 3" + 1/2 -0" from the center of the rod to the center of the front "X" washer pin in the cushion link assembly. Check at both ends of curtain rod and tighten the mounting bolts.

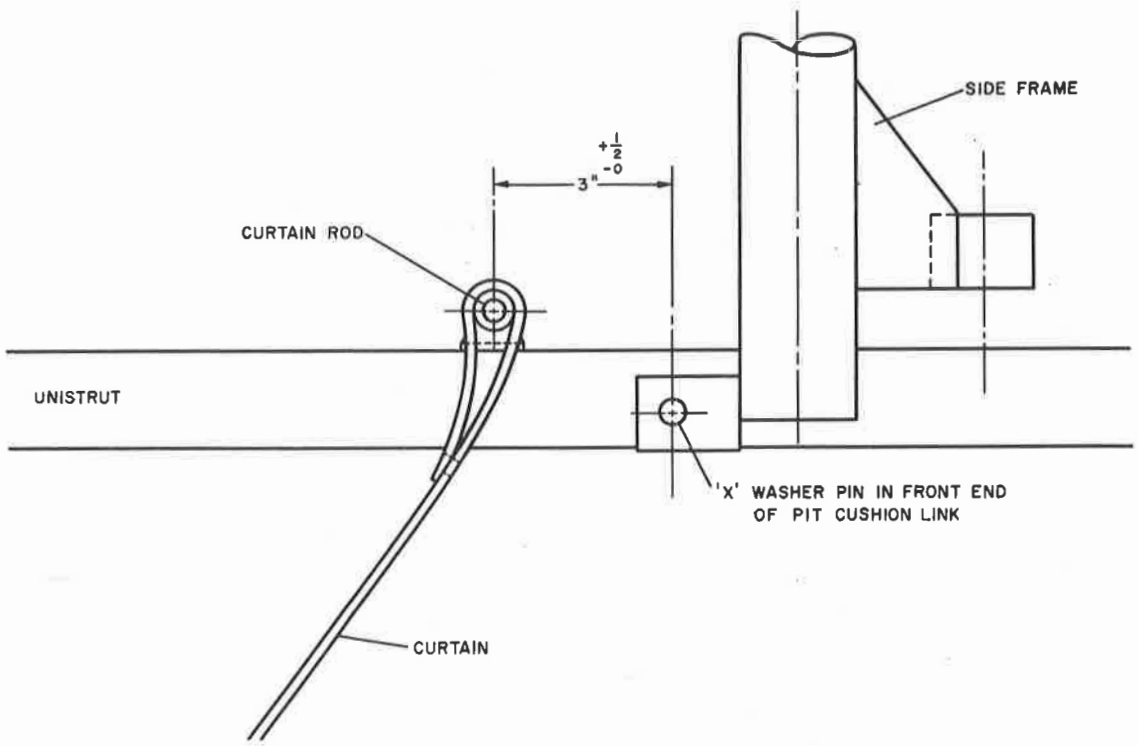


Figure 76. Pit Curtain Adjustment

22. GEARBOX TRIGGER LINK ADJUSTMENT. (FIGURE 77)

This adjustment is made to insure that the triggering mechanism will be sensitive enough so that a very slight ball impact will cycle the pinsetter, but not so sensitive that the pinsetter will tend to recycle.

a) Cycle the pinsetter to exactly 180°, shut off the power and then loosen the jam nuts on the trigger trip rod "Uniballs".

b) Tilt the top of the front Uniball to the rear until only 1/32" of the rear of the ball is exposed. Tighten the jam nut.

c) Set the rear Uniball parallel to the front Uniball and tighten the jam nut.

d) Cycle the pinsetter to 0° and check the front Uniball. At 0°, approximately 1/32" of the front of the ball should be exposed.

e) Check the gap between the stop on the lower end of the trip rod spring and the front Uniball. This gap must be exactly the same at 0° first ball and 90° second ball. The gap at 90° second ball is adjustable by means of adding or removing shims in the rake overtravel latch block. The gap at 90° second ball can be increased by removing shims and decreased by adding shims.

f) When the trigger gap has been equalized, cycle the machine to 0^{o} and loosen the lock nut at the upper end of the trigger trip rod. Turn the adjusting nut until the stop at the lower end of the trip rod spring just touches the front Uniball.

g) Loosen the jam nuts on the right hand link (not on trigger side) which runs from the "V" shaped lever on the overhead rake shaft to the triangular plate on the pit cushion arm.

h) Adjust this link until the stop on the trip rod spring loses contact with the front Uniball. Tighten the jam nuts.

i) Readjust the trigger trip rod until the stop again just touches the Uniball. Tighten the trip rod lock nut.

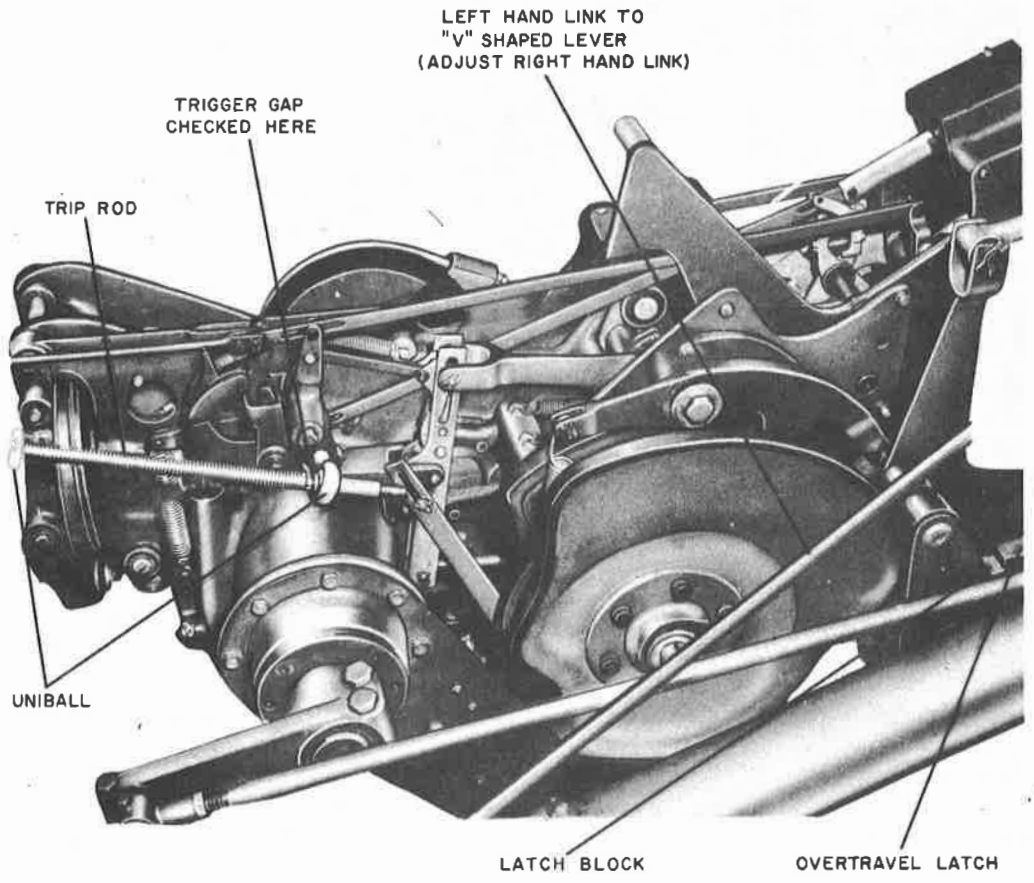


Figure 77. Trigger Link Adjustment

23. ELEVATOR FRAME ADJUSTMENT. (FIGURE 78)

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

a) The inside of the frame should be 39-13/16 ± 1/8 inch from the zero line of the alley. This dimension is not adjustable and depends upon the proper installation of the submounting plates.

b) The frame must be plumb, however, and this is done as follows: Place a vertical level or a plumb line on the frame and loosen the allen head screw in the slot of the motor mount shaft assembly.

c) Tilt the frame forward or backward until the frame is plumb, and tighten the allen head screw.

24. PIT CONVEYOR ADJUSTMENT. (FIGURE 79)

This adjustment is made to insure that the pit conveyor is the ABC required distance below the alley surface to prevent pins rebounding from the pit to the alley. The adjustment is also made to insure that the ball and pins will easily transfer from the pit to the elevators.

a) Set the pit conveyor at 5-1/8 to 5-3/8 inches from the surface of the carpet to the surface of the alley. Check this dimension at both ends of the front of the pit conveyor.

b) Set the middle of the rear pit clamping plate at 1/8 inches + 0-1/16 inch above the front edge of the ball wheel.

c) All of the above dimensions may be obtained by adding or removing spacers between the submounting plates and the pit conveyor frame.

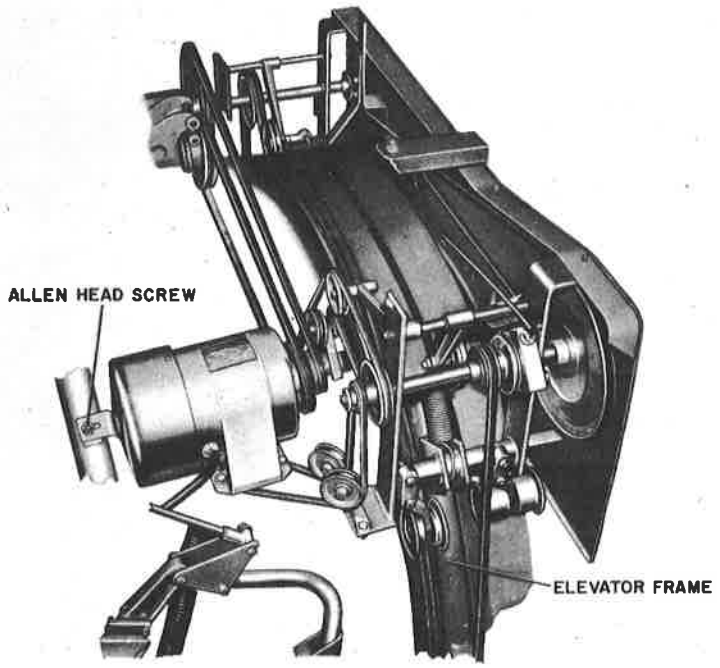


Figure 78. Elevator Frame Adjustment

25. BALL WHEEL AND PIN WHEEL GUIDE ROLLER ADJUSTMENT. (FIGURE 80)

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

a) Release the belt tension on both wheels.

b) Loosen the "U" bolts on all four upper guide rollers and move them upward until they lose contact with the wheels.

c) Check to insure that the wheels are properly seated on both of their lower rollers, without interference from machine parts or kickbacks.

d) Lower the four upper guide rollers until they just contact the wheels and tighten the "U" bolts.

e) Slowly rotate the wheels by hand and observe if an out-of-round condition exists, causing binding in the rollers at the high spots of the wheels. If such high spots exist, loosen the "U" bolts and back the guide rollers off so that the rubber in the rollers just contacts the wheels at the high spots.

f) Carefully tighten the "U" bolts to insure that the guide rollers are not moved during the tightening process. Re-tension the belts.

NOTE: The rollers should be checked periodically for proper adjustment.

NOTE: THE FOLLOWING ADJUSTMENTS, NUMBERS 26 THRU 28, ARE ALL 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.

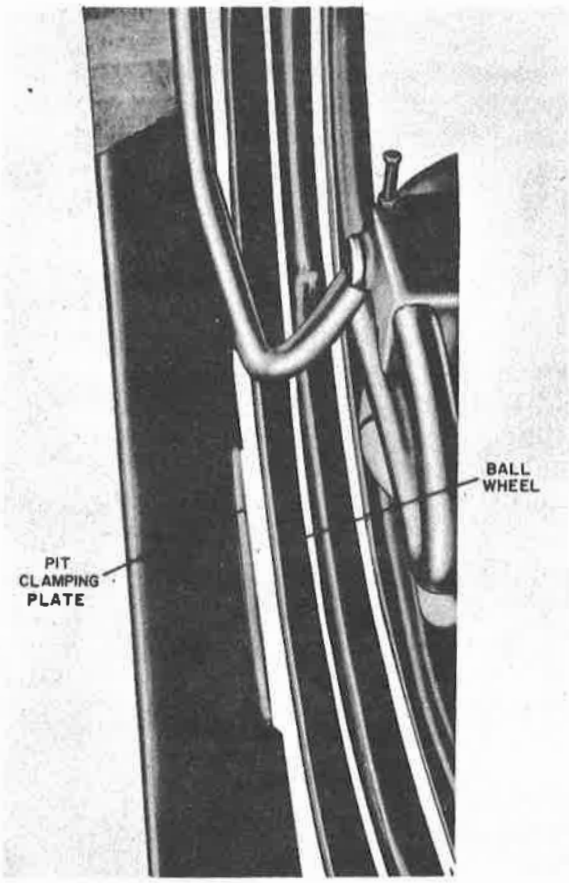


Figure 79. Pit Conveyor Adjustment

26. BALL LIFT ROD ADJUSTMENT. (FIGURE 81)

This adjustment is made to obtain the maximum ball pickup efficiency, with the lift rods in the lowest possible position.

a) Make sure the pit conveyor height (adjustment No. 24) is correct.

b) Disconnect the spring rod which supports the upper end of the ball lift rods and move the upper end of the rods toward the ball wheel. The ball wheel should be centered between the two rods. If it is not, the rods may be carefully bent until the wheel is centered between them.

c) Reposition the spring rod so that it rides freely in the bushing. Replace the two nuts so that 1/8 inch of thread protrudes beyond the last nut.

d) Adjust the ball lift rods to their lowest position by means of the adjusting screw.

e) 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 1/8 inch ± 1/16 inch clearance between the lower portion of the ball and the rear edge of the pit conveyor clamping plate.

f) If the clearance is more than 1/8 inch ± 1/16 inch, the rear lift rod may be carefully bent forward until the proper dimension is obtained. If the clearance is less than 1/8 inch ± 1/16 inch, there are two possible corrective measures. The lift rods may be raised by means of the adjusting screw, or the rear lift rod may be carefully bent toward the rear. If raising the rods just a small distance will give the required dimension, use the adjusting screw. If the rods have to be raised considerably to obtain the required dimension, it is preferable to carefully bend the rear rod toward the rear. The reason for this is, if the rods are raised too much, the ball transfer from the lift rods to the ball track will become much rougher.

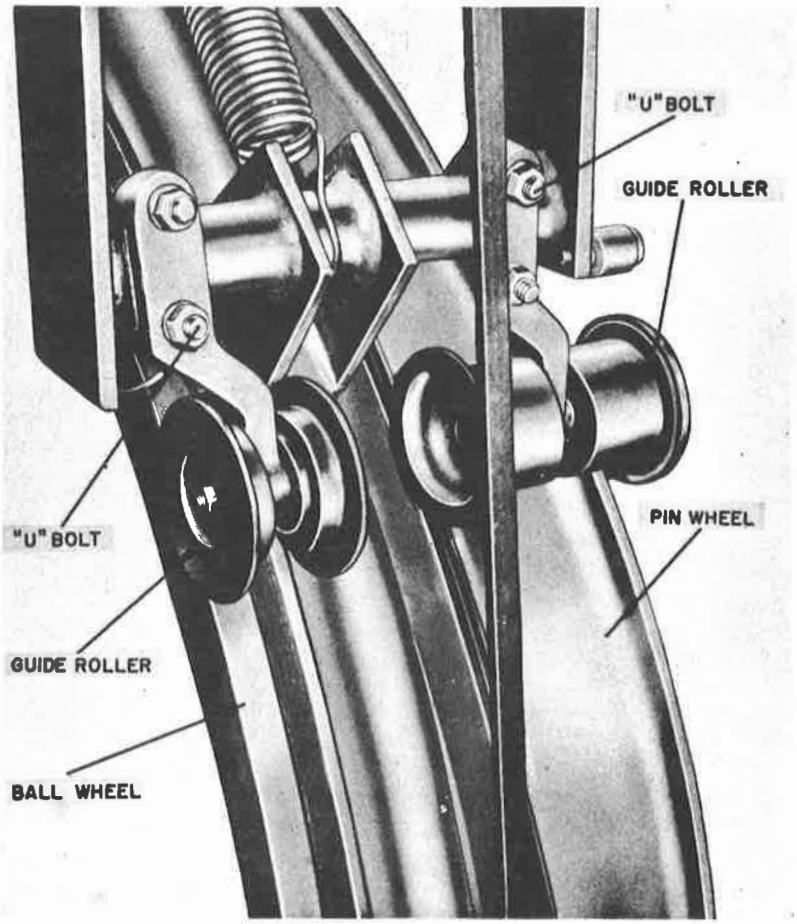


Figure 80. Elevator Guide Rollers

27. BALL TRANSFER ADJUSTMENT. (FIGURE 82)

The following adjustment is made to obtain smooth ball transfer from the ball lift rods to the ball return tracks and to prevent ball damage by the ball return tracks. Rough transfer is more likely to be encountered on machines prior to serial no. 2400.

a) If rough transfer is observed on any machine, the ball tracks must be raised at the junction with the ball lift rods.

b) To raise the ball tracks, add a spacer or washers between the track bracket and the bracket on the elevator assembly upon which the track is mounted. The tracks may be raised a maximum of 1-1/16 inch. On early machines this will require the use of a longer bolt, as the original bolt is too short to allow the use of shims.

c) 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 ball damage.

d) Place a ball in the pit and slowly jog the pinsetter until the ball is at the top of the ball lift wires. 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. The inner track is most likely to require bending. Extreme care must be taken to avoid distorting the rest of the track or the mounting brackets, when bending the track ends down.

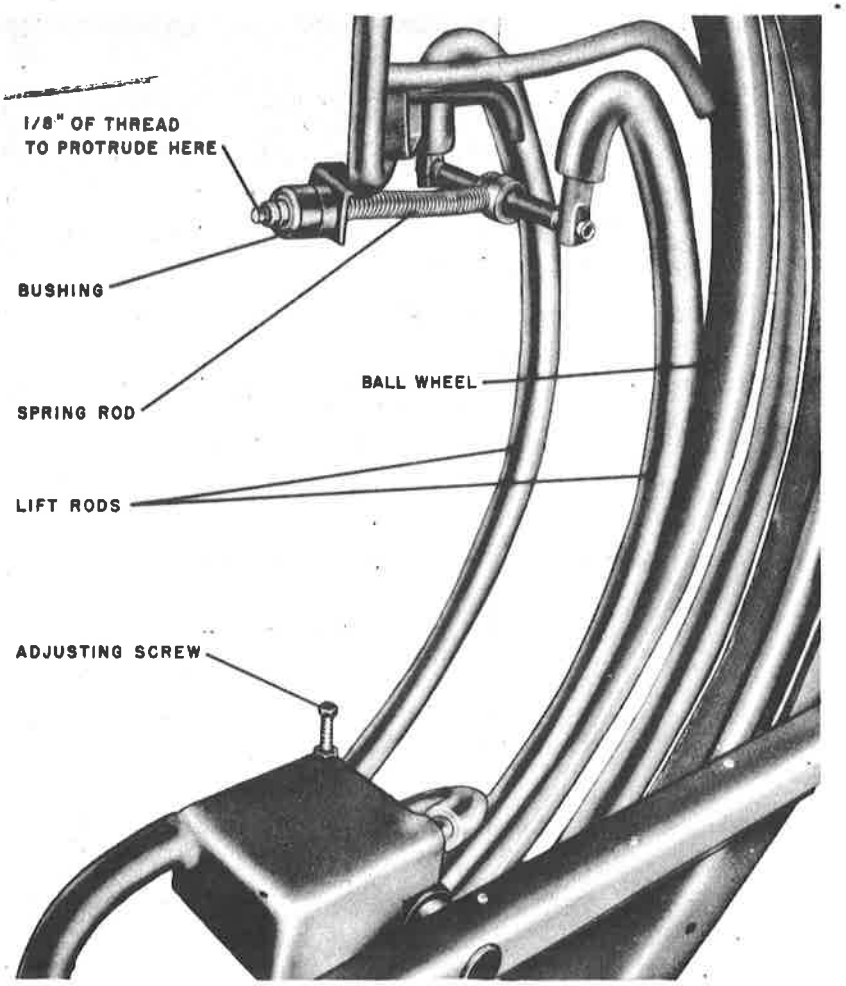


Figure 81. Ball Lift Rod Adjustment

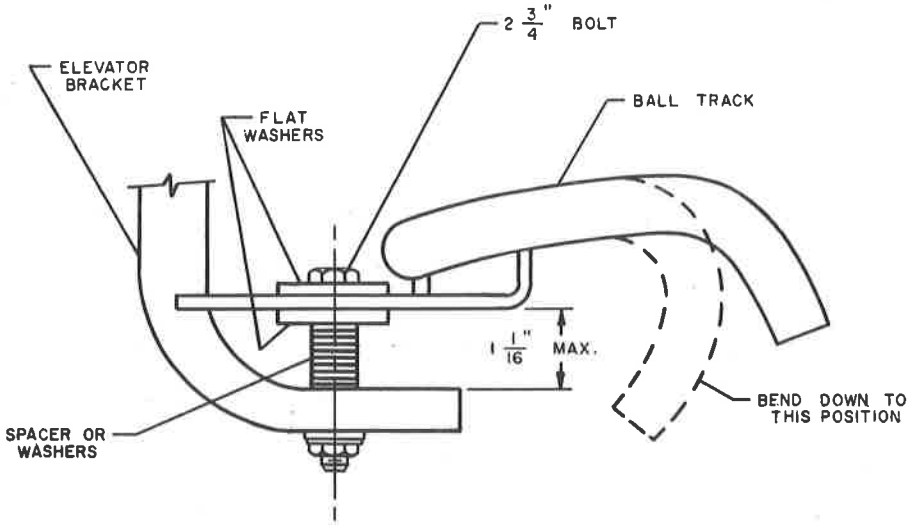


Figure 82. Ball Transfer Adjustment

28. BALL RETURN TRACK AND PREFERENCE BAR ADJUSTMENT-CENTER RETURNS. (FIGURE 83)

This adjustment is made to insure rapid ball return and to prevent two balls from reaching the common track simultaneously, thereby causing a jam.

NOTE: The following lengthy installation and adjustment procedure normally will not be accomplished by the house mechanic. It is actually an original installation procedure and is incorporated in the manual to aid the house mechanic in tracing possible malfunctions and to aid in later installation of new assemblies, if required.

a) Begin with "C" track machine. Place the track supporting cross unistrut in its approximate position across the kickbacks. Leave the mounting screws loose.

b) Set the "C" track in place, with its front support bracket parallel to the kickbacks and 15-3/4 inch from the inside face of the left hand kickback.

c) Adjust the fore and aft position of the "C" track until the rear rail clears a ball (held between the top of the ball lift rods and the ball wheel) by 1/32 inch on machines prior to No. 5750 or by 17/32 inch on all later machines. Lock the elevator end of the "C" track in place.

d) Place the "Y" track, preference bar and stop roller assembly in their approximate positions, leaving the mounting screws loose.

e) Adjust the cross unistrut fore and aft until a distance of 9-1/8 inch ± 1/16 inch is obtained, from the center of the stop roller pivot pin and the center of the preference bar. This should provide a minimum of 1/16 inch clearance between the end of the trip assembly latch and the bottom of the stop roller assembly, when the stop roller assembly is in its horizontal position. Maintain the cross unistrut square to the kickbacks and lock it in place.

f) Adjust the lateral position of the trip assembly until the latch is centered between the sides of the stop roller assembly, when the stop roller assembly is in both its horizontal and vertical positions. Lock the preference bar assembly in place.

g) Place the "S" track cross unistrut, ball latch rod assembly and straight track in their approximate positions. Leave the mounting screws loose.

h) Repeat steps "a" thru "g" on the next "C" track machine. This is done to properly locate the left hand end of the "S" track cross unistrut.

i) The cross unistruts of the "C" and "S" tracks should be in line and at the same elevation. Shim either cross unistrut to obtain the same elevation but adjust only the "s" track cross unistrut to place them in line. Some slight misalignment may be forced into the adjustment due to the fact that the left hand end of the "S" track unistrut is positioned by the adjoining "c" track unistrut. Under any conditions, the right hand edge of the "S" track unistrut must be in line and at the same elevation with the left hand end of the "C" track cross unistrut.

j) Place the "S" track in place with the front support bracket parallel to the kickbacks and 28-27/32 inch from the inside face of left hand kickback.

k) Adjust the fore and aft position of the "S" track until the rear rail clears a ball (held between the top of the ball lift rods and the ball wheel) by 1/32 inch on machines prior to No. 5750 or by 17/32 inch on all later machines. Lock the elevator end of the "S" track in place.

l) Set the lateral position of the preference bar to obtain a distance of 2-5/8 inch between the "S" track bracket and the left hand preference bar pivot block. Lock the left hand pivot block in place. Set the right hand preference bar pivot block at the extreme end of the cross unistrut or the end of the straight portion of the preference bar, whichever occurs first. Lock the right hand pivot block in place. The rubber bumper at the end of the preference bar should be centered under the front, "S" track rail. The preference bar may be carefully bent to obtain this centered position.

m) Place a standard ball on the "S" track, so that it depresses the preference bar. This should create a gap of at least 1/32 inch at the junction of the two preference bars and maintain this gap until the ball leaves the "S" track.

NOTE: At this point check the stop roller assembly for complete freedom to rotate to its horizontal position. If the stop roller assembly is not free to rotate or if the 1/32 inch gap in step "m" cannot be obtained, the preference bars will have to be removed and inspected for conformance with drawings 9-500021 and 500020. Rework as necessary. These drawings may be obtained from the Brunswick Regional Service Engineer.

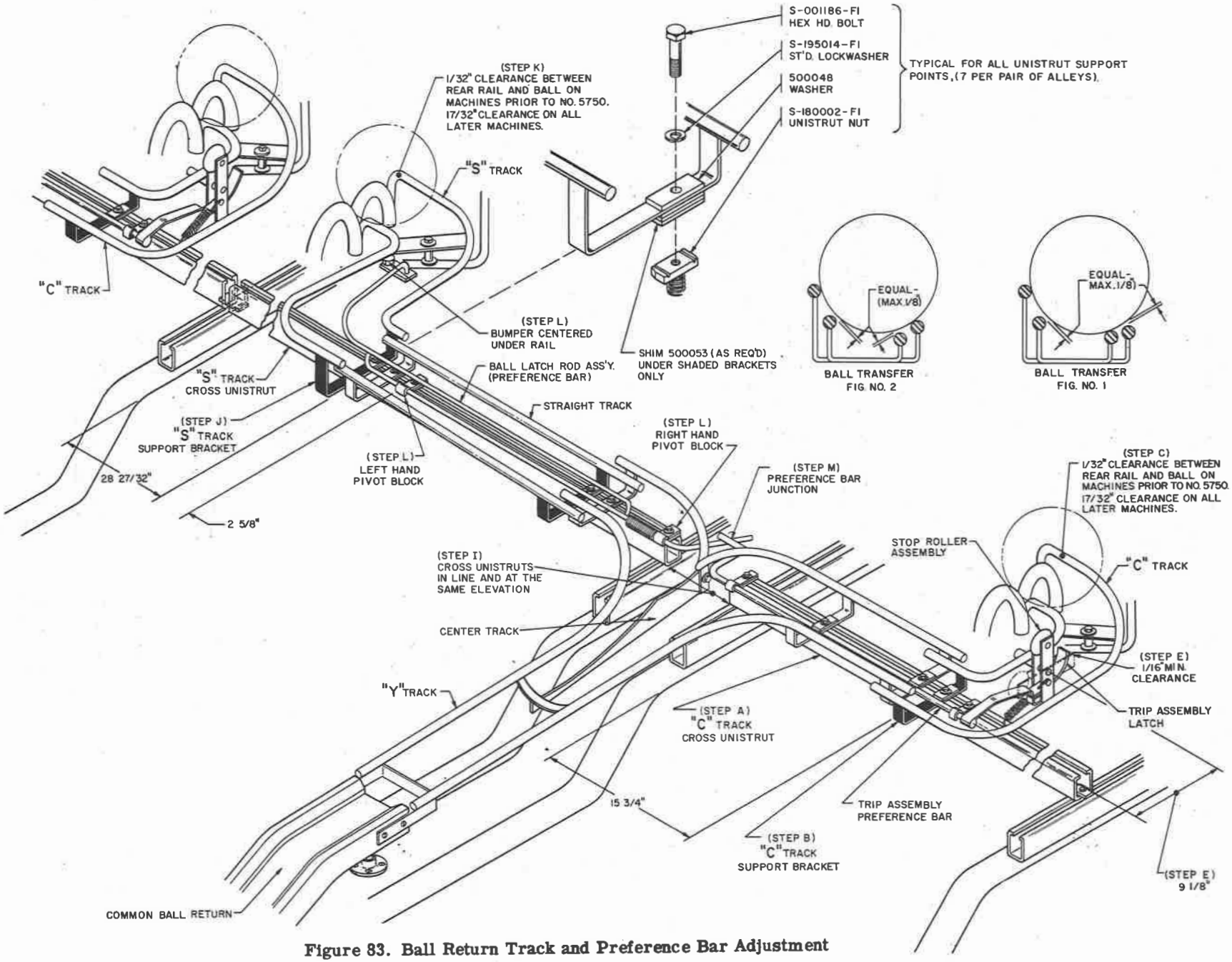


Figure 83. Ball Return Track and Preference Bar Adjustment

n) Adjust the fore and aft position of the "Y" track to obtain smooth ball transfer at the junction with the "C" track. A smooth transfer is obtained when the ball contacts all four rails at the same time. If four rail contact cannot be obtained, shim under the "C" track bracket and adjust the "Y" track to obtain equal clearance as shown in Ball Transfer Figure 1. Lock the "C" track in place. Lock the unistrut end of the "Y" track in place. Adjust the height of the front end of the "Y" track for smooth ball transfer to the common return and lock in place. It may be necessary to trim away some of the wooden return, to obtain smooth transfer.

o) Adjust the left hand end of the straight track for smooth ball transfer from the "S" track. If four rail contact cannot be obtained, add or remove shims under the "S" track bracket and adjust the straight track for equal clearance as shown in Ball Transfer Figure 2.

CAUTION: Do not shim if it reduces the 1/32 inch gap obtained in step "m".

p) Repeat the procedure for the right hand end of the straight track, shim if necessary and adjust the straight track to obtain equal clearance as shown in Ball Transfer Figure 1. Lock the "S" track, both ends of the straight track and the unistrut end of the "Y" track in place.

q) Adjust the center track piece of the "Y" track assembly, so that it properly supports a ball from either machine as the ball follows the curve leading to the common portion of the Y track.

r) Check the operation of the preference bars as follows: Place a ball at the beginning of the "S" track preference bar, with the ball thumb hole on the track to prevent it from rolling. Then roll a ball with considerable force against the stop roller assembly on the "C" track machine. The ball must not be able to depress the stop roller. Leave the ball against the stop roller and roll the ball on the "S" track machine. If the installation is correct, there will be no motion of the trip assembly latch at the "C" track, until the latch snaps open, as the rolling ball enters the "Y" track.

29. PIT CONVEYOR IDLER ARM ADJUSTMENT. (FIGURE 84)

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.

a) Shut the machine off and loosen the adjusting screw lock nut on the pit conveyor idler pulley arm.

b) Turn the adjusting set screw until a clearance of 1/8 inch is obtained between the point of the set screw and the elevator frame. This 1/8 inch is measured with the machine turned off. Tighten the lock nut.

NOTE: This set screw is a limit screw only and must not be used to tension the belt. The proper belt tension is obtained through the spring loaded, ball wheel belt idler arm.

30. PIN GUIDE ASSEMBLY ADJUSTMENT. (FIGURE 85)

This adjustment is made to insure that the pins are held securely in the pin elevator and that they are released at the center of the turnaround pan.

a) The curved steel spring must be concentric to the pin elevator and also should be 2-3/8 ± 1/16 inch from the rear of the spring to the rear of the pin elevator wheel. The guide assembly mounting holes are slightly oversized, and this dimension may be obtained by loosening the mounting bolts and moving the spring.

b) The top surface of the curved steel spring should be 4-11/16 inches ± 1/16 inch from the inner surface of the pin wheel. This dimension may be obtained by adding or removing shims between the steel spring and the mounting bracket.

31. TURNAROUND PAN ADJUSTMENT. (FIGURE 85)

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

a) The turnaround pan is spring loaded and should resist vertical pressure of 2-1/2 to 3 pounds from the rear edge of the pan. When a pin drops into the turnaround pan, the weight of the pin should not move the back of the pan down more than 1/2 inch.

b) When the turnaround pan is pulled down from the rear edge, it should return freely by spring action to its original position, with the tongue at the front of the pan resting on the polished steel plate at the bottom of the cross conveyor. If the pan does not return freely to its spring loaded position, the rubber mounting bushings may be lubricated with brake fluid.

32. CROSS CONVEYOR BELT ADJUSTMENT. (FIGURE 85)

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

a) Remove the spring loaded idlers from the cross conveyor belts and loosen the rear pulley assembly "U" clamps and loosen the lower bolts in the slotted channel.

b) Swing the rear pulley assembly to the rear until the belts are tensioned. Tighten the clamps and bolts and replace the spring loaded idlers.

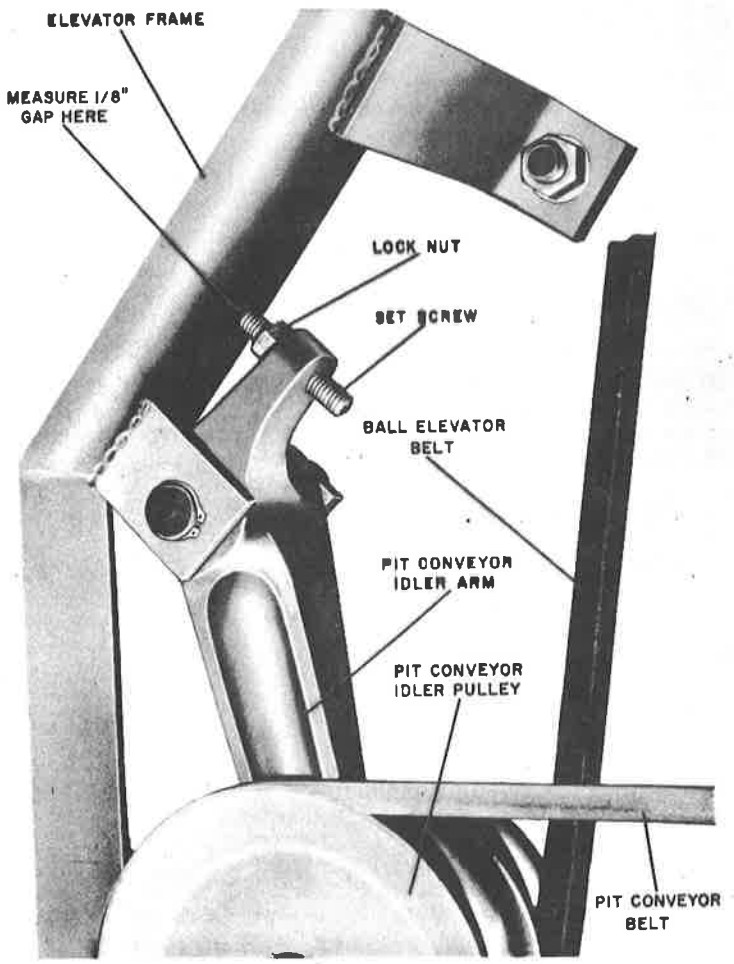


Figure 84. Pit Conveyor Idler Arm Adjustment

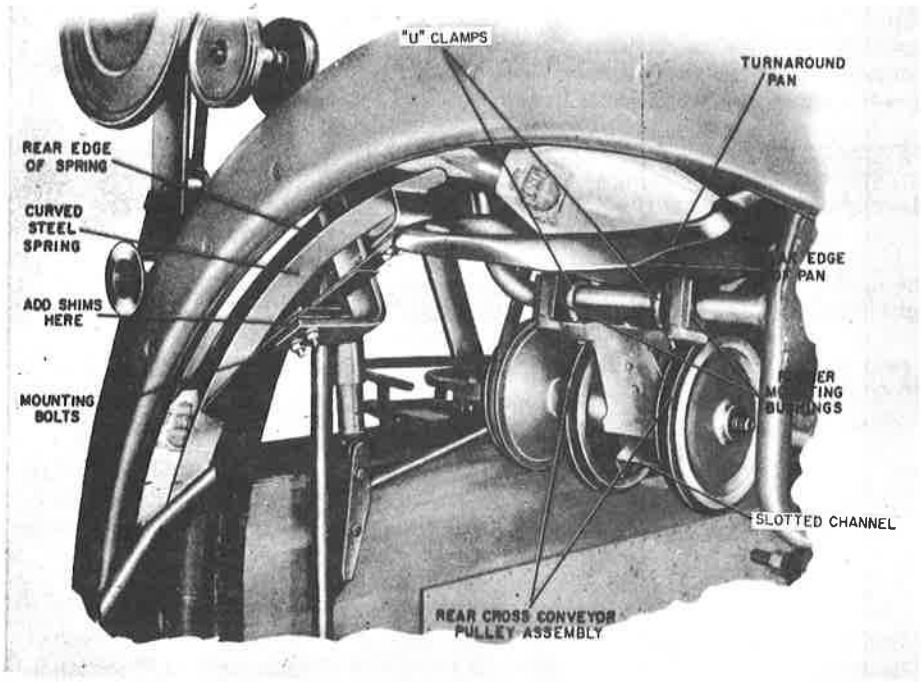


Figure 85. Pin Guide Adjustment

NOTE: THE FOLLOWING SERIES OF ADJUSTMENTS, NUMBER 33 THRU 45 ARE CLOSELY RELATED AND CHANGING ONE MAY AFFECT THE OTHERS. ALL OF 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.

33. CROSS CONVEYOR PIN PLATE ADJUSTMENT. (FIGURE 86)

This adjustment is made to insure that the plate at the bottom of the cross conveyor is positioned to support the heads of the pins only.

NOTE: Check this adjustment with an undersize pin.

a) Loosen the pin plate mounting bolts along both sides of the cross conveyor.

b) Move the plate up or down until it supports the head of the pin only. If the body of the pin touches the **plate, the pin will tend to slip on the belts.** Tighten the mounting bolts.

34. PIN GATE ADJUSTMENT. (FIGURE 87)

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. Adjust cross conveyor pin plate before adjusting pin gate.

NOTE: Before proceeding with this 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 that there is no redius on the shoulder. File flat if necessary.

a) Index the turret by hand until the stop lever roller is on a high dwell of the turret indexing cam. This **will locate the latch link in its lowest position.**

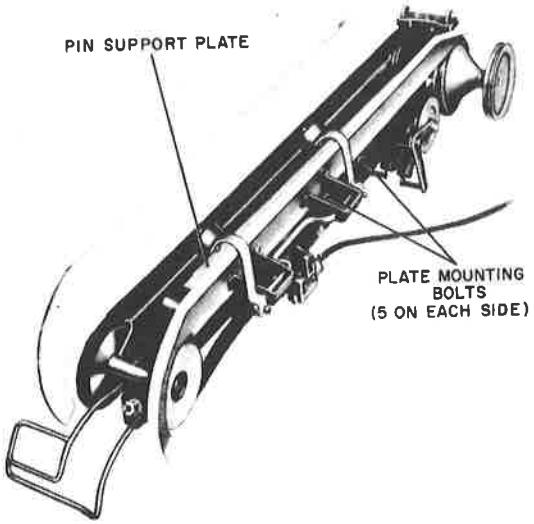


Figure 86. Cross Conveyor Adjustment

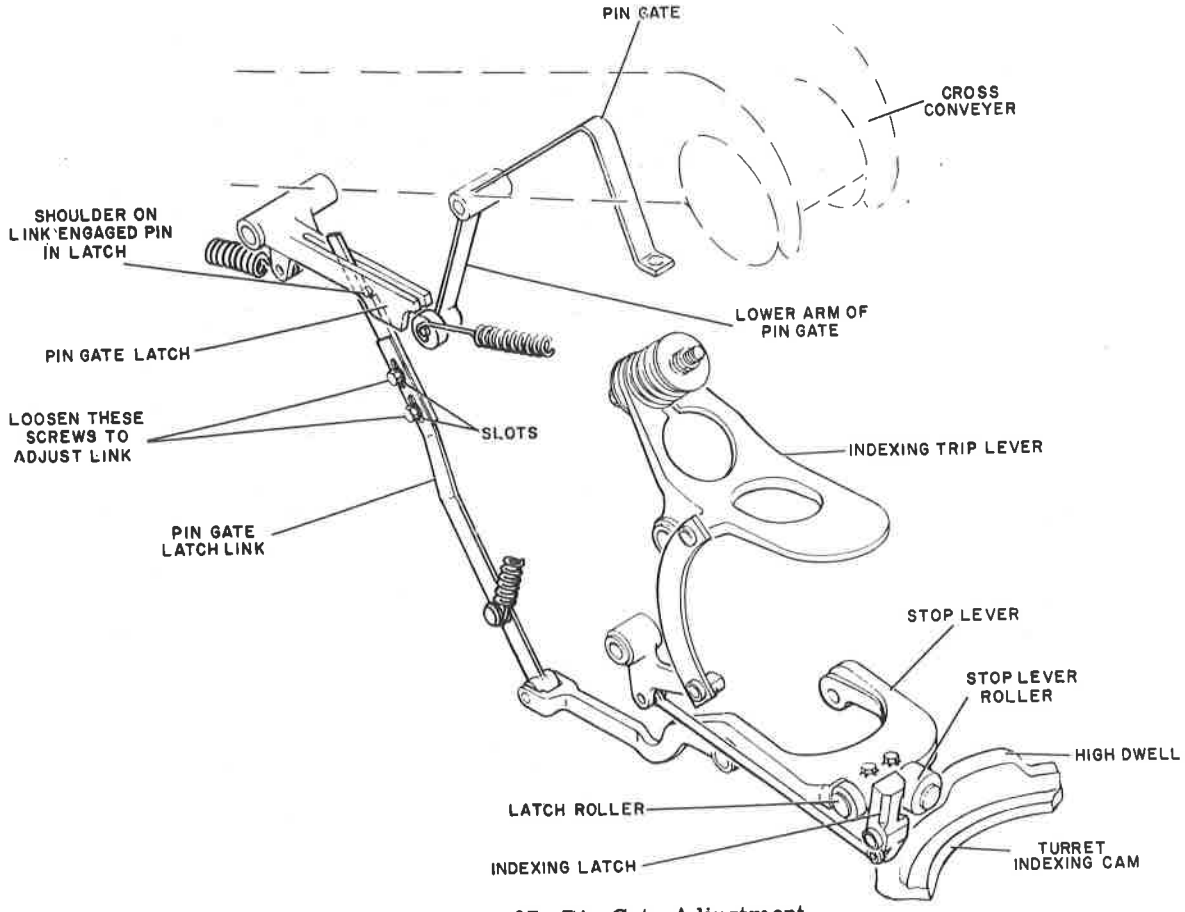


Figure 87. Pin Gate Adjustment

b) 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 inch to 3/16 inch below the bottom of the pin in the pin gate latch. Tighten the two screws.

c) Index the turret by hand until the stop lever roller is on a low dwell of the turret indexing cam. This will release the pin gate.

d) Slowly move a pin up the cross conveyor until the body of the pin depresses the pin gate. Then move the pin up until the neck of the pin is over the pin gate. At this point the gate should come up in the neck of the pin and be latched. Then as the head of the pin passes over the pin gate, the pin gate should not depress. If the pin gate can not come up high enough in the neck of the pin to automatically latch the gate, follow step "e" below.

e) Latch the pin gate and with the heel of the hand, carefully press down on the top of the pin gate. This will bend the gate and make the top of the gate lower. Bend the gate just enough to insure that it can raise and latch when the neck of a pin passes over.

f) As a final pin gate test, latch the pin gate and allow 3 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. (FIGURE 88)

The purpose of this adjustment is to insure that the turret is level with the alley surface, thereby preventing any interference with the turret by pins in the deck in its up position.

a) Loosen the jam nuts on the two front turret supports and place a level under the main turret pulley.

b) Turn the adjusting nuts until the turret is level front to rear and right to left. Tighten the jam nuts.

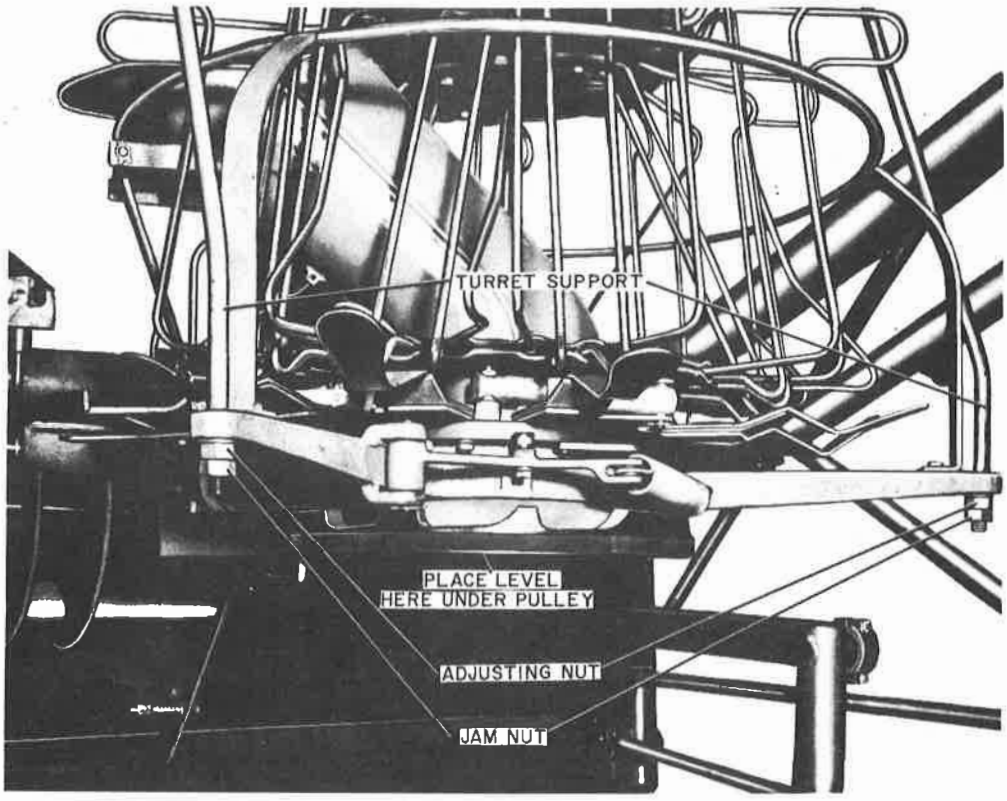


Figure 88. Turret Adjustment

36. TURRET WIRE ADJUSTMENT. (FIGURE 89)

This adjustment is made to insure that the turret can receive full size and undersize pins and that the turret accurately delivers the pins to the deck.

a) Make sure each cluster of four wires is symmetrical with the center of the turret at the top and bottom of the turret.

b) 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 three pins to the deck.

c) Make sure the inner wires on all nine baskets are parallel with each other from top to bottom.

d) Fill the turret with 9 full size pins. Adjust the lower ends of all the outside wires, to obtain 1/16 inch maximum clearance between the wires and the bodies of the pins.

e) With the turret empty, position the spider in its open, pin releasing position. Slide a full size 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.

NOTE: If any establishment uses oversize pins, check steps "d" and "e" with oversize pins.

f) Make sure all the upper and lower clamping plate bolts are tight.

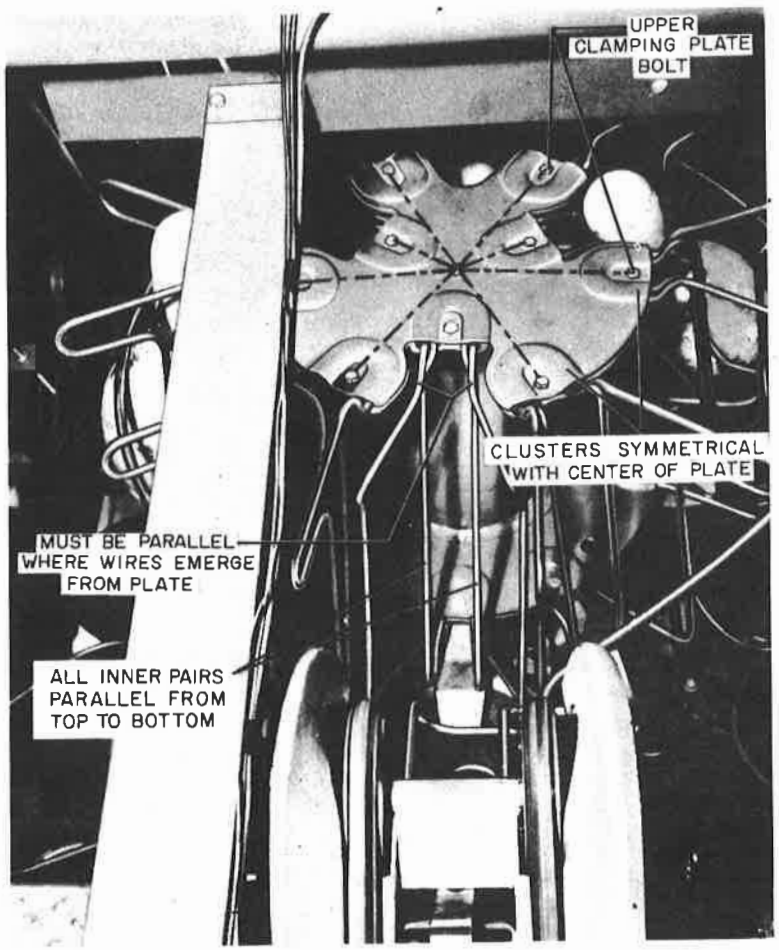


Figure 89. Turret Wire Adjustment

37. TURRET SPIDER ADJUSTMENT. (FIGURE 90)

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 relatched after releasing the pins.

a) Position the No. 5 pin chute under the cross conveyor and release the spider to its open, pin release position. Apply a light (one to two pound) counterclockwise pressure to the spider, which will cause the piston of the spider dashpot to move into the dashpot body, against a stop. Hold the spider in this position and make a pencil mark on the piston where it enters the body of the dashpot. Apply a light (one to two pound) clockwise pressure to the spider and observe how far the pencil mark moves away from the body of the dashpot. This distance should not exceed 1/16 inch. Shims may be added to the bottom of the dashpot to reduce the motion to 1/16 inch or less.

b) Check the roller of the turret release lever when it is in the low dwell of the turret release cam. The roller should be tight enough to resist spinning by the fingers. If the roller may be rotated freely, it indicates that the inner stop on the turret 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.

c) Position the spider in its open, pin releasing position. Slide a standard size 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.

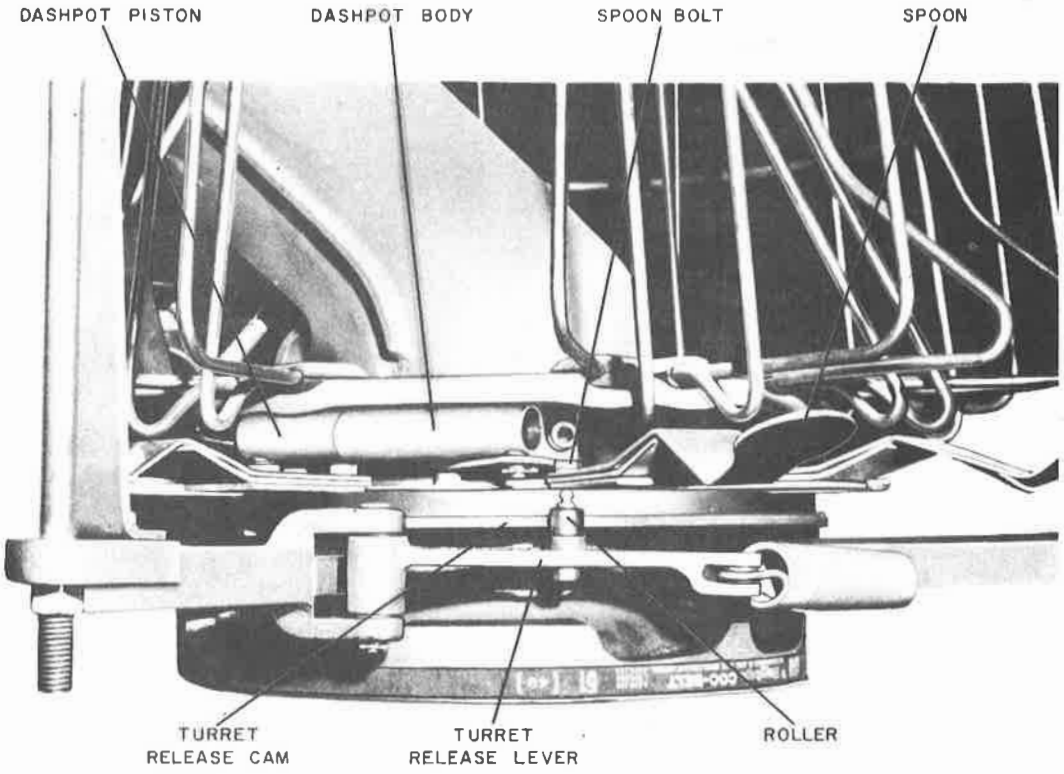


Figure 90. Turret Spider Adjustment

38. TURRET HALO RING ADJUSTMENT. (FIGURE 91)

This adjustment is made to insure that the halo ring does not contact the pins in the turret or the No. 5 pin chute as the turret indexes.

a) Loosen the clamps supporting the two rear legs of the halo ring.

b) Move the halo ring up or down until the top of the halo ring is 6-1/4 +0 -1/16 inch above the machined surfaces, on which the clamps are mounted. Tighten the clamps.

c) As a check, observe if the halo ring rubs the No. 5 pin chute or full size pins in the turret, as the turret indexes. Adjust as required. If the front of the halo ring must be raised, shims may be added under the two front legs of the halo ring.

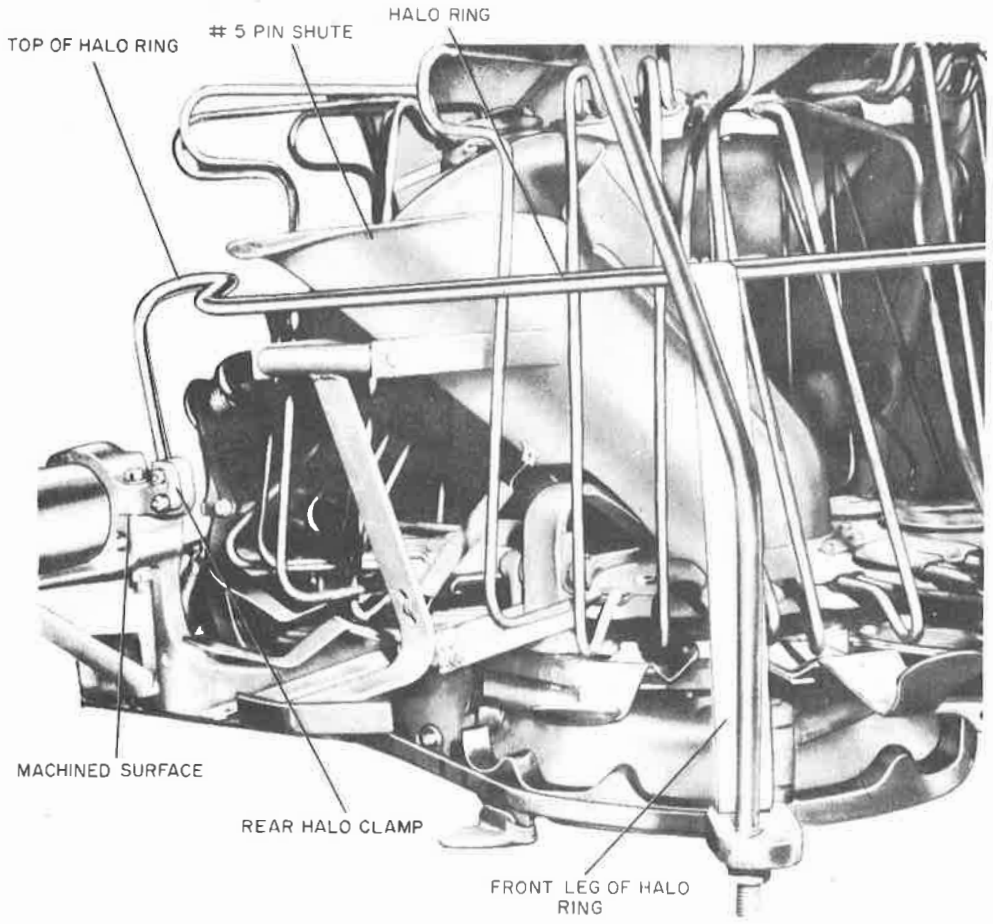


Figure 91. Halo Ring Adjustment

39. SNUBBER ADJUSTMENT. (FIGURE 92)

This adjustment is made to insure that the snubber correctly seats the pins in the turret.

a) Position the 1, 7, or 10 basket under the cross conveyor and fully seat a standard size pin in the basket.

b) Loosen the lock nut at the front end of the snubber spring and turn the adjusting nut to obtain clearance of 1/4 inch between the snubber and the pin in the 1, 7 or 10 basket. Tighten the lock nut.

c) Position the 2, 3, 4, 6, 8 or 9 basket under the cross conveyor and fully seat a standard size pin in the basket.

d) Loosen the lock nut at the rear end of the snubber spring and turn the adjusting nut until depressing the snubber 1/4 inch will fully compress the snubber spring. Tighten the lock nut.

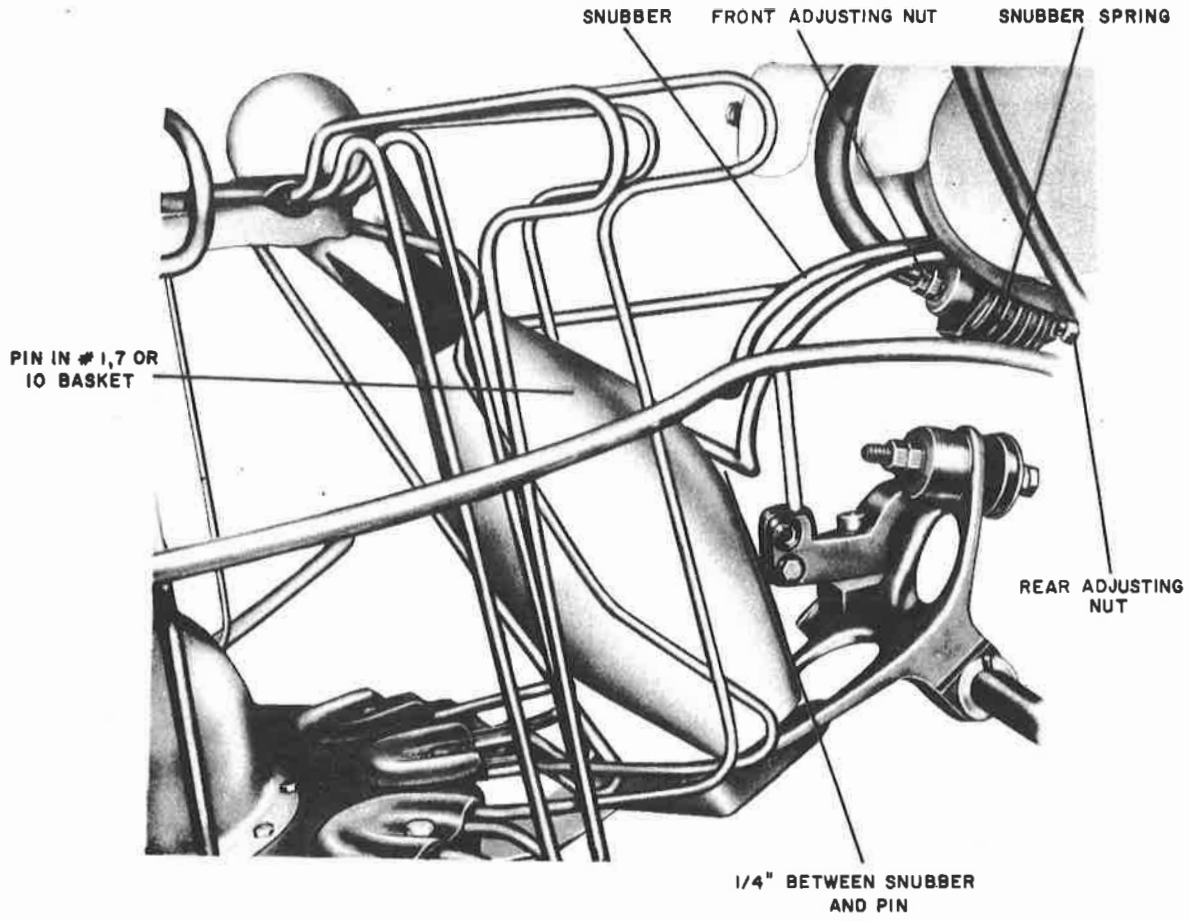


Figure 92. Snubber Adjustment

40. TURRET INTERLOCK PROBE ADJUSTMENT. (FIGURE 93)

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

a) Rotate the turret until the interlock probe is over the time delay gear latch. The clearance between the bottom of the probe and the top of the latch must be at least 1/32 inch.

b) Position the No. 5 pin chute under the cross conveyor and release the spider by pulling the probe to its outer 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 inch.

c) These two dimensions may be obtained by carefully bending the probe in the required direction.

41. TURRET INDEX TRIP LEVER ADJUSTMENT. (FIGURES 87 & 94)

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

a) Position the turret so that the stop roller on the stop lever assembly, is in a low dwell of the indexing cam. Loosen the lock nut 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.

b) Position the turret so that the stop roller on the stop lever assembly is on a high dwell of the indexing cam. Loosen the lock nut at the front of the trip lever spring and turn the front adjusting nut until depressing the trip lever 1/8 inch, will solidly compress the spring. Tighten the lock nut.

c) Position the No. 5 pin chute under the cross conveyor. Check the 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.

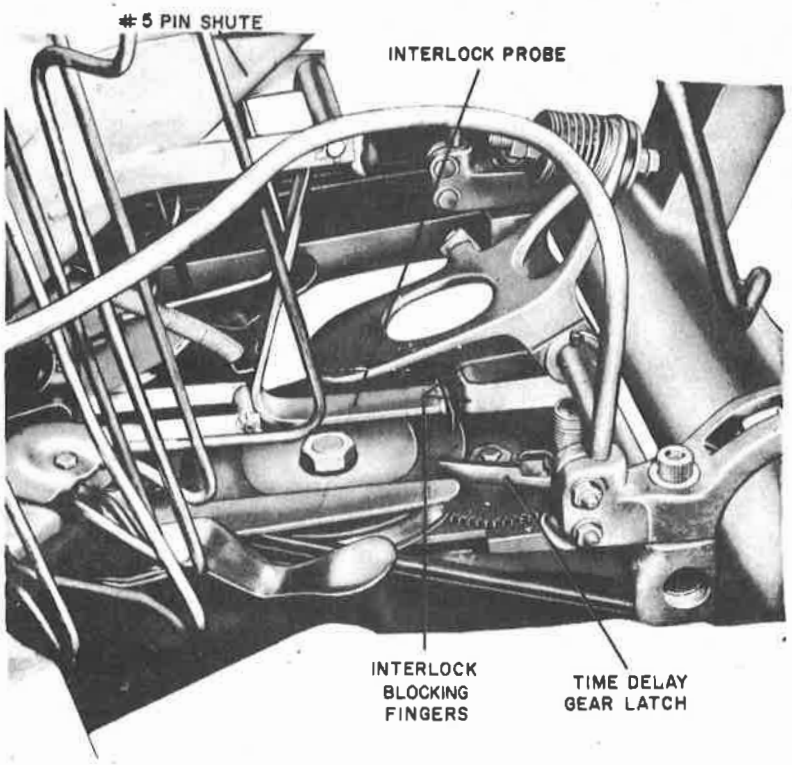


Figure 93. Turret Interlock Probe Adjustment

42. TURRET TIME DELAY GEAR ADJUSTMENT. (FIGURE 94)

This adjustment is made to insure that the turret indexes once, after delivering 10 pins to the deck.

NOTE: There is actually no adjustment for the time delay gear. The following is an operational check only.

a) Position the No. 5 pin chute under the cross conveyor. Check the position of the delay gear trip arm with relation to the delay gear latch. The trip arm should be in a horizontal plane with the center of the arm of the latch. The trip arm may be carefully bent to insure that it will properly contact the latch.

b) Position an empty pin basket in front of the cross conveyor and trip the time delay 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 that either the turret cog belt is stretched, or the 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 latch. Also check to insure the two gears are properly meshed.

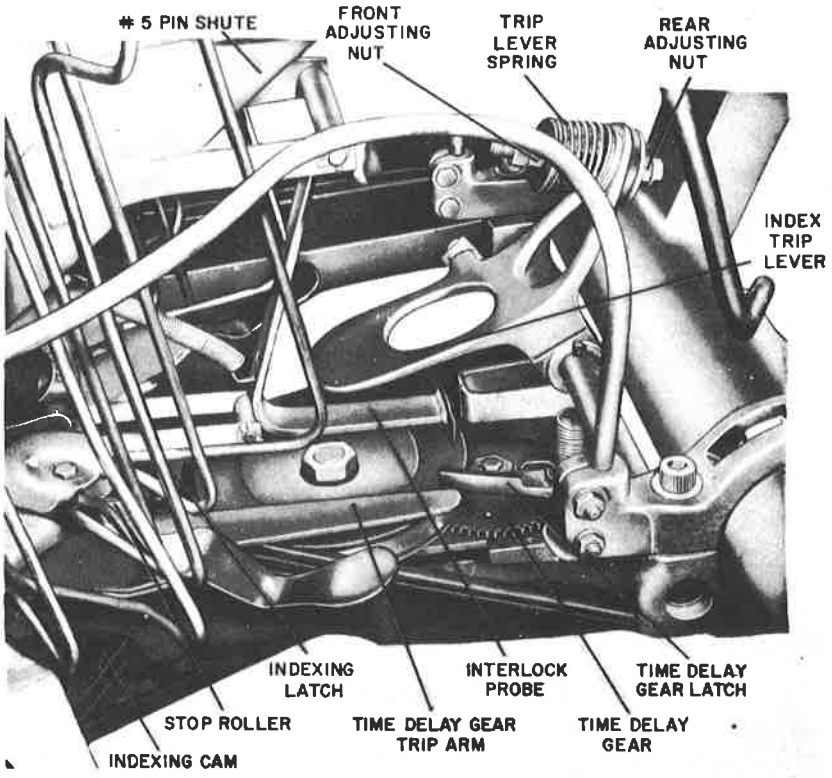


Figure 94. Turret Index Trip Lever Adjustment

43. RESTRICTED DROP INTERLOCK ADJUSTMENT. (FIGURE 95)

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.

a) With the pinsetter at 0^{o}, loosen the two bolts which connect the upper and lower parts of the restricted drop link.

b) Move the upper part of the link upwards, until the blocking finger is in its full up position.

c) Carefully work the upper part of the link down, until there is 1/16 inch free play in the blocking finger. This is very important, as no free play can result in severe damage to the restricted drop mechanism.

d) Make sure the 1/16 inch free play is maintained and tighten the two bolts.

44. TURRET INTERLOCK ADJUSTMENT. (FIGURE 95)

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

a) The full deck interlock is not adjustable. To check the operation of the full deck interlock, allow the turret to receive 10 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^{o}. The latch must not release when the deck is at detecting height.

b) To adjust the moving deck interlock, cycle the machine to 0^{O} and position the No. 5 pin chute under the cross conveyor, waiting for a pin. Make sure the latch is not holding the long link in its rear position.

c) Loosen the clamping bolt on the lever which contacts the moving deck sheave. Push the right hand blocking finger down and drop an oversize pin in the No. 5 pin chute.

d) Rotate the cross shaft carrying the lever which contacts the moving deck sheave, until the blocking finger lifts, releasing pins to the deck. Rotate the shaft further until the bottom of the blocking finger is 1/16 inch above the top of the interlock probe. Hold the shaft in this position, push the lever against the hub of the moving deck sheave and tighten the clamping bolt. (The shaft may be easily rotated by placing a punch in the hole provided.)

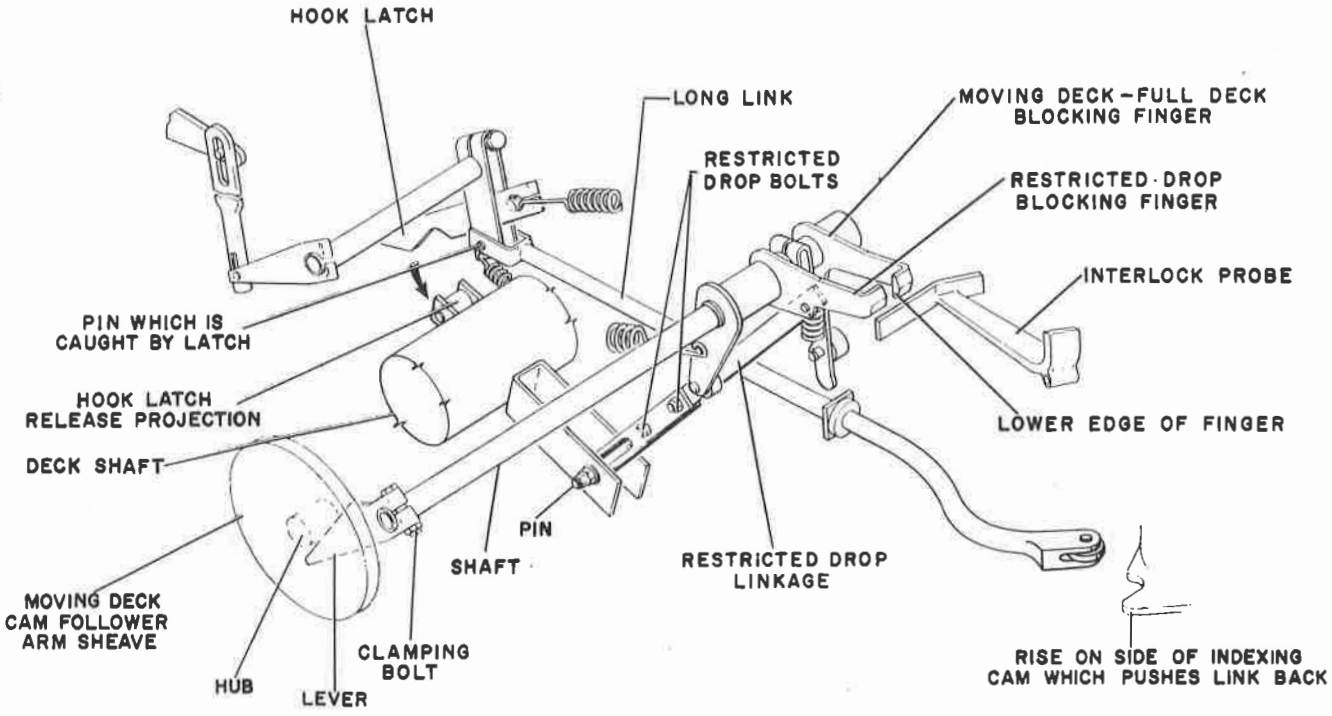


Figure 95. Interlock Adjustments

45. MAGNETIC CLUTCH ADJUSTMENT. (FIGURES 96 and 97)

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

a) With the clutch de-energized (power shut off) loosen the set screw on the stop collar which positions the pin elevator drive pulley.

b) Push the pulley firmly against the magnetic clutch.

c) Set the gap between the pulley and the stop collar at 1/32 inch. Tighten the set screw.

d) Latch the pin gate so that no pins can be delivered to the turret and allow two undersized pins to be delivered to the cross conveyor and be stopped by the latched pin gate.

e) 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. Still 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.

NOTE: In the event a magnetic clutch or selenium rectifier burns out, making the pin elevator inoperable, the following emergency repair may be made, pending replacement of the defective part:

a) Loosen the stop collar set screw and move the stop collar and pulley away from the magnetic clutch.

b) Place a thin piece of cardboard, such as a match book cover, between the rear face of the pulley and the magnetic clutch.

c) Force the collar and pulley against the magnetic clutch and tighten the set screw. This will keep the pin elevator running continuously and should be used as an emergency measure only.

CAUTION: Never remove the plug to the magnetic clutch when the machine is electrically "on", as this can cause the selenium rectifier to be ruined.

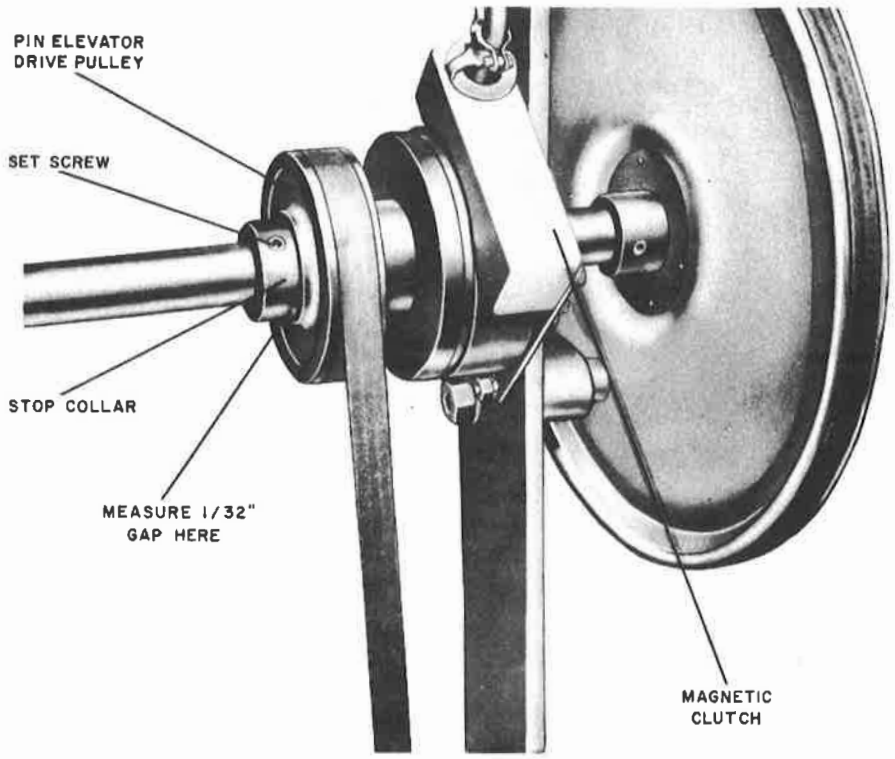


Figure 96. Magnetic Clutch Adjustment

NOTE: AS A FINAL OPERATIONAL TURRET CHECK, PROCEED AS FOLLOWS:

a) Lower the deck to 90°, detecting standing pins.

b) Raise both interlock blocking fingers to the up position.

c) Remove the belt from the motor to the gearbox.

d) Allow the cross conveyor to deliver 10 pins to the turret. When the pins are released to the deck observe the long fall into the deck chutes. Properly adjusted turret wires and spoons will result in the pins being accurately delivered to the deck chutes. This test should be made at least 5 consecutive times without a pin missing the deck chutes. Readjust if necessary.

e) As the pins are being delivered from the cross conveyor to the turret, to the deck, check the operation of the pin gate, snubber, trip lever, turret and interlocks, for proper operation. Readjust as required.

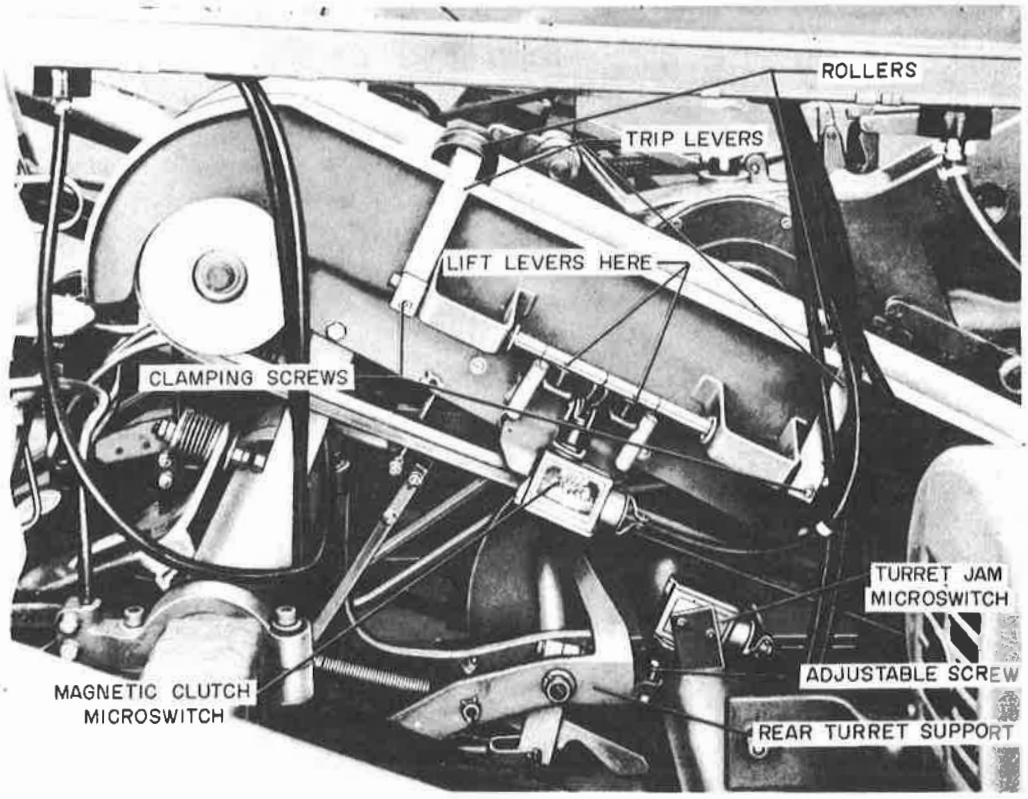


Figure 97. Magnetic Clutch Adjustment

46. FIRST AND SECOND BALL LIGHT MICROSWITCH ADJUSTMENT. (FIGURE 98)

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.

a. With the pinsetter at 0 degree, first ball, loosen the clamping bolt on the lever from the detector assembly that contacts the first and second ball light microswitch.

b. 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 inch. Tighten the bolt.

c. As a check, cycle the pinsetter and observe whether the first and second ball lights light at the proper time.

47. COUNTER MICROSWITCH ADJUSTMENT. (FIGURE 99)

This adjustment is made to insure that the frame counter counts once, each time the deck sets 10 new pins.

a) Cycle the pinsetter to exactly 270^{o}, setting new pins.

b) 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 so positioned that the pad hits the microswitch twice, once going down and again on the way up.

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.

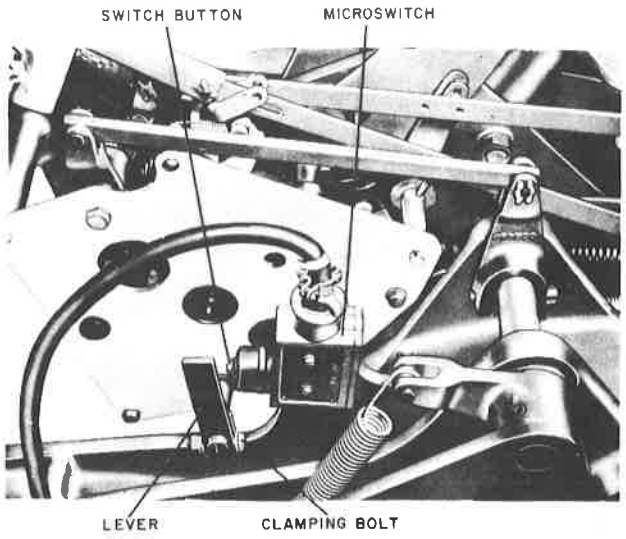


Figure 98. First and Second Ball Light Microswitch Adjustment

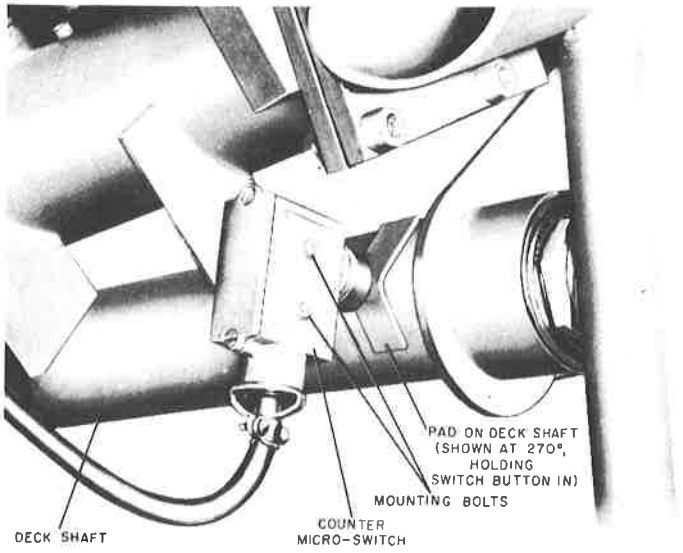


Figure 99. Counter Microswitch Adjustment

48. TURRET JAM MICROSWITCH ADJUSTMENT. (FIGURE 97)

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.

a) Loosen the lock nut on the adjustable screw located under the turret jam microswitch.

b) Lift the turret 3/8 inches in the front turret supports and while holding it in this position, turn the adjustable screw down until the microswitch clicks, indicating it is open. Tighten the lock nut.

49. MOVING DECK JAM MICROSWITCH ADJUSTMENT. (FIGURE 100)

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

a) At 0^{O}, check the position of the microswitch button, with relation to the sliding button which holds the microswitch closed.

b) 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.

c) As a check, create a deck jam with a pin or block of wood and observe if the sliding button moves away from the switch, thereby shutting off the power.

If the center contact of step "b" 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 can 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:

a) Shut off the power by opening a manual on-off switch.

b) Rotate the gear box drive pulley backwards (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.

c) Remove the pins from the deck and resume normal operation.

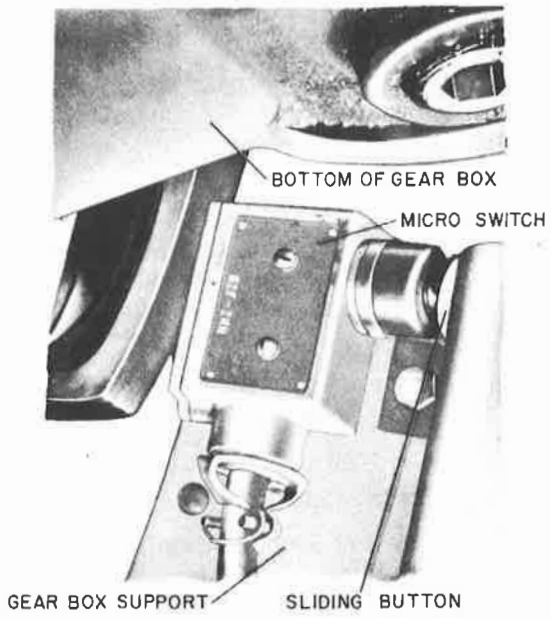


Figure 100. Moving Deck Jam Microswitch Adjustment

CHAPTER 23. PREVENTIVE MAINTENANCE

The preventive maintenance section of this manual, pages 108 through 122 have been intentionally omitted. Refer to the separate Preventive Maintenance Manual.

CHAPTER 24. TROUBLE SHOOTING

Note: The following index to the Trouble-shooting section may be used to readily locate any malfunction.

TROUBLE SHOOTING INDEX

Complaint No. 1: RAKE FAILS TO SWEEP
Cause a: Rake sweep hook failed to engage.
Remedy a: Check rake sweep hook adjustment (adj No. 2 — page 67).
Cause b: Out-of-range rake blocking latch engaged pin on overhead shaft.
Remedy b: Check rake out-of-range adjustment (adj No. 5 — page 71).

Complaint No. 2: RAKE SLIPS OFF SWEEP HOOK
Cause: Out-of-range rake blocking latch engaged pin on overhead shaft.
Remedy: Check rake out-of-range adjustment (adj No. 5 — page 71).

Complaint No. 3: RAKE SWEEPS OUT-OF-TIME
Cause a: Rake sweep hook engaged when it should not have done so.
Remedy a: Check rake sweep hook adjustment (adj No. 2 — page 67).
Cause b: Detector out-of-time.
Remedy b: Check detector timing (page 63).

Complaint No. 4: RAKE CONTACTS ALLEY SURFACE DURING SWEEP MOTION
Cause: Rake set too low.
Remedy: Check rake height adjustment (adj No. 3 — page 67).

Complaint No. 5: RAKE DOES NOT EJECT A DRAGGED PIN INTO PIT
Cause: Rake cam misadjusted.
Remedy: Check rake height adjustment (adj No. 3 — page 67).

Complaint No. 6: PINS PASS UNDER RAKE BOARD DURING SWEEP MOTION
Cause: Rake set too high.
Remedy: Check rake height adjustment (adj No. 3 — page 67).

Complaint No. 7: RAKE LOWERS TO ALLEY DURING 0 to 90-DEGREE OVERTRAVEL
Cause: Rake overtravel latch too high.
Remedy: Check rake overtravel latch adjustment (adj No. 4 — page 71).

Complaint No. 8: RAKE LOWERS AT 90 DEGREES INSTEAD OF 0 DEGREE, FIRST BALL
Cause: Rake overtravel latch too low.
Remedy: Check rake overtravel latch adjustment (adj No. 4 — page 71).

Complaint No. 9: RAKE SWEEPS DURING AN OUT-OF-RANGE CYCLE
Cause: Out-of-range rake blocking latch did not engage pin on overhead cross brace.
Remedy: Check rake out-of-range adjustment (adj No. 5 — page 71).

Complaint No. 10: PINS WOBBLE OR FALL WHEN SET BY MOVING DECK
Cause a: Pins touched by deck buckets or cast fingers as deck rises.
Remedy a: Check moving deck cable adjustment (adj No. 9 — page 75).
Cause b: Scissors not fully open, thereby touching the pins.
Remedy b: Check scissor cable adjustment (adj No. 10 — page 75).
Cause c: Deposit built up in deck buckets - pins not seating correctly in buckets.
Remedy c: Clean buckets as per preventive maintenance instructions (page 110).
Cause d: Worn, round bottom pins.
Remedy d: Replace pins.
Cause e: Stationary deck not level or not at correct height.
Remedy e: Check deck height and level adjustment (adj No. 7 — page 72).
Cause f: Out-of-time moving deck-scissor cam. If "cause a" to "cause d" have been checked and the trouble still persists, check for an out-of-time cam. Any one, or combination of, the following symptoms may indicate an out-of-time cam:

1. New pin spotting very poor, pins wobble or fall over. Deck comes down to set new pins and starts back up before pins are released, causing pins to be dropped from above the alley surface.
2. The moving deck does not complete its forward shift at 360°. The shift will be completed when the gearbox is triggered after the 0° stop.
3. The rake sweeps out-of-time and hits or hangs up under the deck.

If one or more of the above symptoms occur and readjusting the pinsetter does not correct the malfunction, check for an out-of-time cam as follows:

1. Cycle the pinsetter to exactly 90° and shut off the power.
2. Check the position of the scribe line on the outer edge of the moving deck-scissor cam, with relation to the center of the axle pin of the scissor cam follower roller. (See Figure 119). The scribe line should be approximately 3/32" counterclockwise from the center of the axle pin.

Complaint No. 10: PINS WOBBLE OR FALL WHEN SET BY MOVING DECK (cont'd)

Cause f (cont'd):
3. If this dimension is appreciably greater than 3/32", the cam is out-of-time and must be corrected.

Remedy f: Call the Otis Service Office to send a man to time the cam.

Cause g: Deck too low. In some rare instances, when all of the previous causes have been checked and the cam is in time, the deck will persist in setting wobbling pins. In these rare cases, the deck may be raised above the normal 13/16" dimension, as follows.

Remedy g: Increase the height of the deck above the alley surface in 1/32" increments, readjusting the moving deck cable each time until the pins no longer wobble when set. Raise the deck by means of the slotted deck lowering link.

There is a maximum height beyond which the deck must not be raised. To determine this maximum height, proceed as follows:

1. Cycle the machine until the moving deck makes its first rearward shift (approximately 225°). At this point, the pins drop down and are supported between the sides of the rollers and the cast spotting fingers.
2. Measure the distance the pins protrude from the bottom surface of the scissor deck. Make sure the pins are fully seated and are vertical to the alley surface. (See Figure 120).
3. The maximum height that the deck can be raised to is the distance the pins protrude from the deck, less 3/32". For example, if the pins protrude 31/32", the deck can be raised to 31/32" less 3/32" or 7/8". If the pins protrude 1", then the deck can be raised to 29/32", etc.

Note: Whenever the deck is raised by means of the deck lowering link, the restricted drop interlock (adj No. 43) must be readjusted.

Complaint No. 11: UNDERSIZED PINS RESPOTTED POORLY BY SCISSORS

Cause: Scissors releasing undersize pins too soon.

Remedy: Check deck eccentric adjustment (adj No. 11 — page 75).

Complaint No. 12: DECK SETS PINS TOO FAR OFF SPOT

Cause: Deck not centered over pin area.

Remedy: Check pinspotting adjustment (adj No. 14 — page 77).

Complaint No. 13: NEW PINS SET FROM DETECTING OR RESPOTTING HEIGHT

Cause a: Deck lowering hook not prevented from engaging deck lowering pin.

Remedy a: Check deck lowering hook latch adjustment (adj No. 12 — page 77).

Cause b: Malfunction of moving deck-scissor latch. The latch may be out of adjustment or a burr on the latch or scissor cam follower arm prevents the latch from moving away from scissor cam follower arm. This prevents the scissors from closing at 90°, detecting cycle. The moving deck will operate at the wrong time and when the deck goes down to respot, the moving deck will retract to set pins. If any pins are in the deck, they will drop on the alley from respotting height, on top of the pins the scissors failed to pick up.

Remedy b: Check the moving deck-scissor latch adjustment (adj No. 8 — page 73). If the adjustment is correct, check for burr. If burr exists on either the latch or cam follower arm, file smooth, until latch can move freely under the cam follower arm.

Complaint No. 14: SCISSORS WILL NOT OPEN OR WILL NOT CLOSE

Cause a: Scissor cable misadjusted.

Remedy a: Check cable adjustment. (adj No. 10 — page 75).

Cause b: Scissor pivot screw missing.

Remedy b: Check underside of scissor deck for missing screw and replace.

Cause c: Malfunction of moving deck-scissor latch (See Complaint No. 13 - Cause b).

Remedy c: (See Complaint No. 13 - Remedy b).

Complaint No. 15: MOVING DECK WILL NOT SHIFT TO SET NEW PINS

Cause a: Jam in deck or cable.

Remedy a: Check and correct.

Cause b: Malfunction of moving deck-scissor latch. (See Complaint No. 13 - Cause b).

Remedy b: (See Complaint No. 13 - Remedy b).

Complaint No. 16: PINS SET OR RESPOTTED FROM DECK'S HIGHEST POSITION (DECK HELD UP ON DECK HOLDING HOOK)

Cause a: Out-of-range rake blocking 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 rake out-of-range adjustment (adj No. 5 — page 71).

Cause b: Deck holding hook engaged when it should not.

Remedy b: Check deck holding hook adjustment (adj No. 13 — page 71).

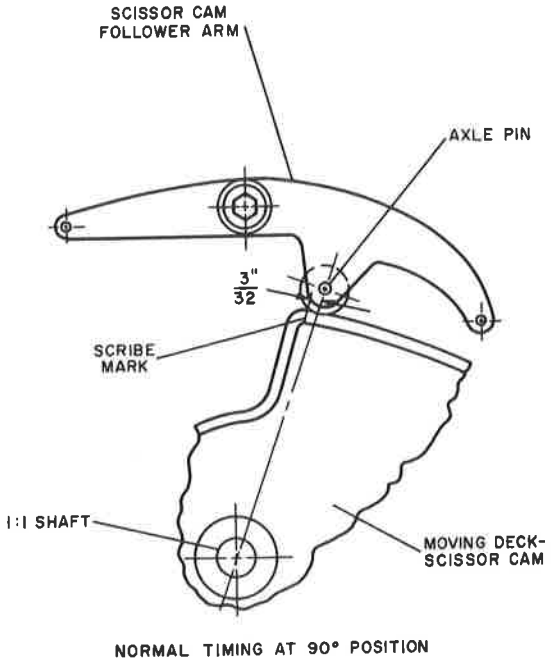


Figure 119. Out-of-Time Moving Deck-Scissor Cam

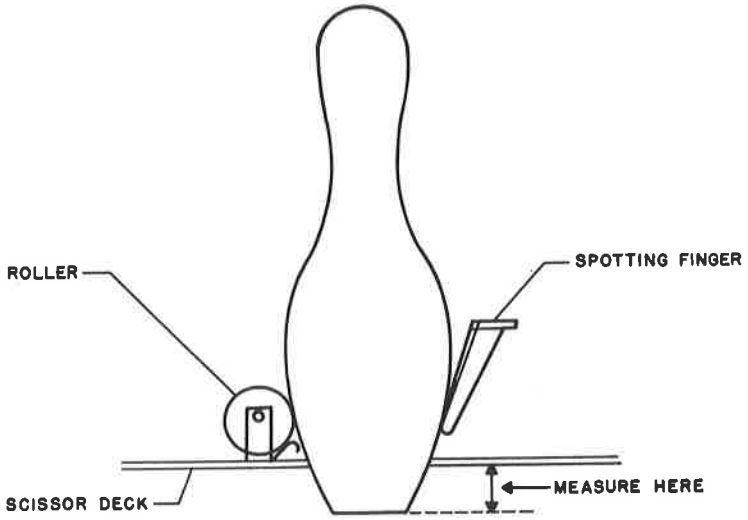


Figure 120. Wobbling Pins

Complaint No. 17: DECK DOES NOT MAKE SHORT DETECTING OR RESPOTTING STROKE
Cause: Deck lowering hook prevented from engaging deck pin.
Remedy: Check deck lowering hook latch adjustment (adj No. 12 — page 77).

Complaint No. 18: DECK COMES DOWN DURING 0 to 90-DEGREE OVERTRAVEL
Cause: Deck holding hook failed to engage pin on deck arm.
Remedy: Check deck holding hook adjustment (adj No. 13 — page 77).

Complaint No. 19: DECK HELD UPON DECK HOLDING HOOK AT WRONG TIME
Cause: Deck holding hook engaged pin on deck arm when it should not.
Remedy: Check deck holding hook adjustment (adj No. 13 — page 77).

Complaint No. 20: 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 fed to turret while turret is full or indexing.
Remedy a: Check pin gate adjustment (adj No. 34 — page 94).
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. Snubber misadjusted.

Remedy b: Check turret wire adjustment (adj No. 36 — page 97).
Check spider adjustment (adj No. 37 — page 98).
Check halo ring adjustment (adj. No. 38 — page 98).
Check snubber adjustment (adj No. 39 — page 99).
Cause c: Restricted drop interlock failure - pins dropping too great a distance and miss the deck buckets.
Remedy c: Check restricted drop adjustment (adj No. 43 — page 102).
Cause d: Pins dumped from turret into full deck.
Remedy d: Check turret interlock adjustment (adj No. 44 — page 102).
Cause e: Turret double index - causes pin to miss turret basket and fall on or in deck.
Remedy e: Check turret index trip lever adjustment (adj No. 41 — page 100).
Check turret time delay gear adjustment (adj No. 42 — page 101).
Check interlock probe adjustment to make sure probe doesn't trip the time delay gear latch. (adj No. 40 — page 100).
Cause f: Scissors do not open completely - causing pins to hang up in deck buckets.
Remedy f: (See complaint 14).
Cause g: Pins not released to alley because moving deck did not fully retract.
Remedy g: Check for jam in cable or moving deck.
Cause h: Pins hang up in deck buckets due to buildup of deposits in deck buckets.
Remedy h: Clean deck buckets as per preventive maintenance section (page 110).
Cause i: Malfunction of moving deck scissor latch due to misadjustment or burr. When the deck detects a strike, the burr prevents the latch from moving under the scissor cam follower arm, to block out the scissor action and the scissors close. Then when the deck lowers to set new pins, the closed scissors prevent the pins from being released on the alley and when the deck shift forward, the pins are jammed.
Remedy i: (See Complaint 13, Remedy b.)
Cause j: Malfunction of moving deck scissor latch due to out-of-time or damaged detector.
Remedy j: Check detector timing as per detector section, page 63 and malfunction section in the Detector Manual.

BALLS AND BALL RETURNS

Complaint No. 21: BALL DOES NOT PASS UNDER PIT CUSHION AFTER TRIGGERING PINSETTER
Cause: Pit cushion set too low.
Remedy: Check pit cushion height adjustment (adj No. 20 — page 81).

Complaint No. 22: BALLS NICKED OR DAMAGED
Cause: Ball strikes end of track or machine part enroute from pit to bowler.
Remedy: Check ball transfer adjustment (adj. No. 27 — page 88). Also check entire return system for sharp edge which can contact ball.

Complaint No. 23: BALL DOES NOT RETURN OR RETURN TIME TOO LONG
Cause a: Ball lodged in pin elevator - ball lift rods too high.
Remedy a: Check ball lift rod adjustment (adj No. 26 — page 87).

Cause b:	Ball jam at common track - balls from two machines reach common track simultaneously due to preference bar failure.
Remedy b:	Check preference bar adjustment (adj No. 28 — page 90).
Cause c:	Ball falls off track on top of pit cushion due to rough transfer from lift rods to track.
Remedy c:	Check ball transfer adjustment (adj No. 27 — page 88).
Cause d:	Ball stays at rear edge of pit conveyor due to edge of pit conveyor being lower than ball elevator.
Remedy d:	Check pit conveyor adjustment (adj No. 24 — page 85).
Cause e:	Ball spinning in normal pickup position due to oil or alley dressing on ball or elevator.
Remedy e:	Clean ball and clean elevator as per preventive maintenance section (page 110).
Cause f:	Ball contacts front edge of ball elevator only, due to misadjusted ball lift rods.
Remedy f:	Check ball lift rod adjustment (adj No. 26 — page 87).
Cause g:	Ball cannot pass front ball lift rod due to misadjusted or deformed rod.
Remedy g:	Check ball lift rod adjustment (adj No. 26 — page 87). If adjustment is good, check for deformed rod and carefully bend it to conform.
Cause h:	Ball spinning near top of ball lift rods due to oil on elevator or ball, or due to misadjusted ball lift rods.
Remedy h:	Clean ball and elevator and check ball lift rod adjustment (adj No. 26 — page 87).
Cause i:	Gear box time delay too long.
Remedy i:	Check time delay adjustment (adj No. 18 — page 79).
Cause j:	Ball does not pass under pit cushion when rake first lowers.
Remedy j:	Check pit cushion adjustment (adj No. 20 — page 81).
Cause k:	Ball slowed down due to poor ball track alignment and ball transfer.
Remedy k:	Check ball transfer adjustment (adj No. 27 — page 88) and ball return track adjustment (adj No. 28 — page 90).
Cause l:	Drop sweeps old and worn or incorrectly installed.
Remedy l:	Drop sweep should be 10-1/2" above kickback and in good condition (see Figure 121).

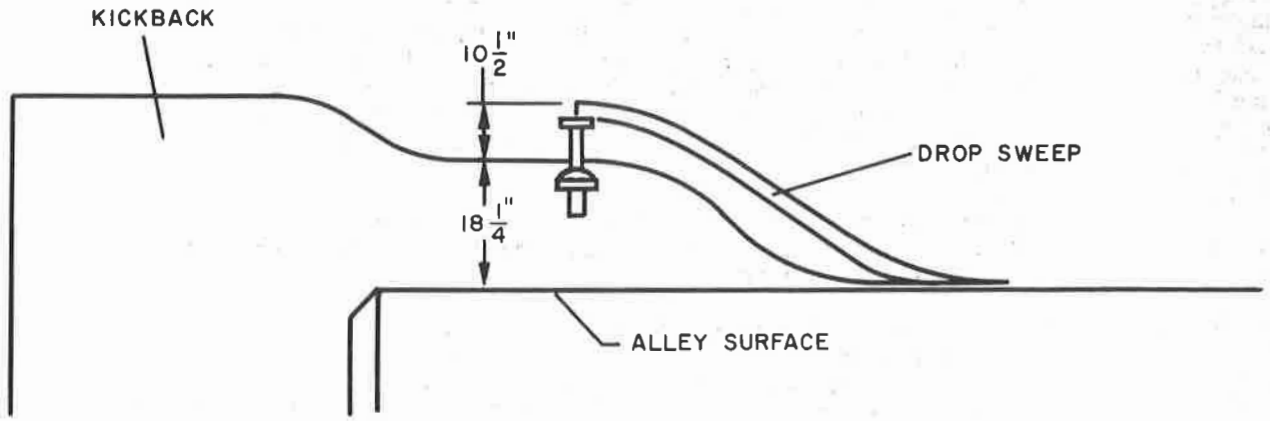


Figure 121. Drop Sweep

TURRET

Complaint No. 24:	PINS DROP FROM TURRET WHEN DECK IS DOWN TOO FAR
Cause:	Restricted drop interlock failure.
Remedy:	Check restricted drop interlock adjustment (adj No. 43 — page 102).
Complaint No. 25:	PINS DROP FROM TURRET WHEN DECK IS FULL OR MOVING DECK RETRACTED
Cause a:	Turret interlock malfunction.
Remedy a:	Check turret interlock adjustment (adj No. 44 - page 102).

Cause b:	Latch does not hold long, push-pull link back after turret empties into deck.
Remedy b:	Check action of latch. Make sure latch is not being released when deck is only at detecting height. Latch must not release until deck reaches new pinsetting depth.
Complaint No. 26:	PINS DO NOT RELEASE FROM TURRET WHEN 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 (adj No. 43 — page 102).
Cause b:	If right hand finger is down, there is a turret interlock malfunction.
Remedy b:	Check turret interlock adjustment (adj No. 44 — page 102).
Cause c:	Interlock probe too high - cannot get under raised blocking fingers.
Remedy c:	Check interlock probe adjustment (adj No. 40 — page 100).
Cause d:	Bottom of pin jammed between turret wire and side of spoon thus preventing spider from releasing the pins.
Remedy d:	Check turret wire adjustment (adj No. 36 — page 97) and the spider adjustment (adj No. 37 page 98).
Cause e:	The No. 5 pin slips through 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 upwards the portion of the pin release lever that the 5 pin rests on, in the chute.
Complaint No. 27:	TURRET FAILED TO INDEX
Cause a:	Turret index trip lever not functioning correctly.
Remedy a:	Check index trip lever adjustment (adj No. 41 — page 100).
Cause b:	Pin does not contact index trip lever due to tight snubber or tight turret wires.
Remedy b:	Check snubber adjustment (adj No. 39 — page 99) and turret wire adjustment (adj No. 36 - page 97).
Cause c:	The time delay gear trip 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 (adj No. 38 — page 98).
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:	Grease from indexing cam flows into belt pulley causing belt to slip.
Remedy f:	Clean belt and pulley and use light oil film 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. May be restricted by rubber cushion or dry bushing.
Cause h:	Turret clutch assembly does not freely slide back and forth due to lack of lubrication.
Remedy h:	Oil clutch slides as per preventive maintenance section (page 117).
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 as per preventive maintenance section (page 112).
Cause k:	Index trip lever spring stud bent, causing index trip lever to bind against stud.
Remedy k:	Carefully bend stud straight.
Complaint No. 28:	TURRET FAILED TO INDEX AFTER No. 5 PIN ONLY
Cause a:	Trip arm on spider too high. Fails to release time delay gear latch.
Remedy a:	Check time delay gear adjustment (adj No. 42 — page 101).
Cause b:	Index trip lever contacts interlock probe, preventing full stroke of trip lever.
Remedy b:	Check interlock probe adjustment (adj No. 40 — page 100).
Cause c:	Bind in rotation of time delay gear.
Remedy c:	Check for cause and correct.
Cause d:	Time delay gear sloppy on stud and gear moves upward instead of depressing 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 and correct.
Cause f:	Clutch does not turn drive gear.
Remedy f:	Check clutch for misalignment of roll pins in spring guide assembly, etc., or anything that prevents internal clutch compression spring from exerting enough pressure to drive the gear.
Cause g:	Roll pins in clutch spring guide assembly pushed too far through the guide collar, which jams roll pins against friction disc thus preventing the disc from turning the time delay gear.
Remedy g:	Drive pins to correct, flush position.

Complaint No. 29:	TURRET MULTIPLE INDEXING
Cause a:	Turret index trip lever out of adjustment.
Remedy a:	Check trip lever adjustment (adj No. 41 — page 100).
Cause b:	Bind in index trip lever action.
Remedy b:	Check for binding in linkage or pins between the trip lever and latch.
Cause c:	Time delay gear latch stays in open position, causing time delay gear to keep rotating.
Remedy c:	Check for loose or broken latch torsion spring, or bind in rotation of latch.
Cause d:	Interlock probe too low, thereby tripping time delay gear latch.
Remedy d:	Check interlock probe adjustment (adj No. 40 — page 100).
Cause e:	Stretched turret cog belt. This is an easy malfunction to recognize, as the turret will index normally for the first nine pins and double index after the No. 5 pin only.
Remedy e:	Change belt.
Cause f:	Loose turret index pulley prevents index latch from moving over the roller.
Remedy f:	Tighten pulley mounting bolts.

GEAR BOX

Complaint No. 30:	GEAR BOX CLUTCH CHATTERS
Cause:	Gap in clutch too large.
Remedy:	Check gear box clutch adjustment (adj No. 15 — page 77).
Complaint No. 31:	GEAR BOX CLUTCH OVERHEATS
Cause:	Gap in clutch too small.
Remedy:	Check gear box clutch adjustment (adj No. 15 — page 77).
Complaint No. 32:	PINSETTER RECYCLES
Cause a:	Gear box clutch lever out of adjustment.
Remedy a:	Check clutch lever adjustment (adj No. 16 — page 77).
Cause b:	Gear box dashpot stop collar too high.
Remedy b:	Check stop collar adjustment (adj No. 17 — page 78).
Cause c:	180^{o} interlock link too high.
Remedy c:	Check 180^{o} interlock adjustment (adj No. 19 — page 81).
Cause d:	Gear box trigger link or uniballs out of adjustment.
Remedy d:	Check trigger link adjustment (adj No. 22 — page 84).
Cause e:	Bind in trigger link assembly.
Remedy e:	Make sure trigger link moves freely in uniballs.
Cause f:	Weak or broken spring.
Remedy f:	Check springs on gear box clutch cam follower, clutch latch and stop arm.
Complaint No. 33:	PINSETTER FAILS TO CYCLE
Cause:	This malfunction is a common one and is usually caused by misadjustment or binding in the triggering mechanisms.
Remedy:	If any pinsetter repeatedly fails to trigger check all of the triggering adjustments, Numbers 15 thru 22.
Complaint No. 34:	CLUTCH DOES NOT DISENGAGE AT EXACTLY 0, 90 or 180 DEGREES
Cause	Clutch lever out of adjustment.
Remedy	Check clutch lever adjustment (adj No. 16 — page 77).
Complaint No. 35:	CLUTCH DISENGAGES AT 90 DEGREES WITH RAKE AND DECK DOWN
Cause a:	Wire link that controls reset lever latch is stretched or broken. (Old type link only).
Remedy a:	Replace wire link. Cycle pinsetter and observe if latch engages roller to stop pinsetter at 0 degree when required. (New type wire link is spring loaded and will not break or stretch).
Cause b:	Spring on reset lever latch weak or broken.
Remedy b:	Replace spring.
Complaint No. 36:	CLUTCH DISENGAGES AT 180 DEGREES TO WAIT FOR PINS WHEN DECK IS FULL
Cause a:	180-degree stop interlock link too low.
Remedy a:	Check 180-degree interlock adjustment (adj No. 19 — page 81).
Cause b:	Latch, which holds long push-pull link back when deck receives pins from turret, not holding link back until deck sets new pins.
Remedy b:	Observe action of latch to make sure link is not released before deck sets new pins.
Complaint No. 37:	CLUTCH DOES NOT DISENGAGE AT 180 DEGREES WHEN DECK IS EMPTY — DECK GOES THROUGH NEW PINSETTING MOTION WHILE EMPTY
Cause a:	180-degree stop interlock link too high.
Remedy a:	Check 180-degree stop interlock adjustment (adj No. 19 — page 81).

Cause b: Latch, which holds long push-pull link back when deck receives pins from turret, not releasing link when deck sets new pins.

Remedy b: Observe action of latch and make sure latch releases the link when deck sets new pins.

Complaint No. 38: PINSETTER DOES NOT START AFTER 180-DEGREE STOP WHEN DECK RECEIVES PINS FROM TURRET

Cause: 180-degree stop interlock link too low.

Remedy: Check 180-degree interlock adjustment (adj No. 19 — page 81).

Complaint No. 39: CLUTCH DISENGAGES AT 270 DEGREES

Cause a: 180-degree stop interlock link too low.

Remedy a: Check 180-degree interlock adjustment (adj No. 19 — page 81).

Cause b: Gear box dashpot stop collar too low.

Remedy b: Check gear box stop collar adjustment (adj No. 17 — page 78).

Cause c: If both previous adjustments are correct and pinsetter stops at 270 degrees, the clutch actuator link may be binding.

Remedy c: At 270 degrees, the top of the clutch actuator link should be about as high as the long flat link that is part of the out-of-range reset lever. If the clutch actuator link is lower than the lever, check for reason motion is restricted.

Complaint No. 40: DOES NOT DETECT STRIKE — SCISSORS CLOSE AS ON STANDING PINS AND NEW PINS ARE NOT SET

Cause: Detector rod too high.

Remedy: Check detector rod adjustment (adj No. 1 — page 67).

Complaint No. 41: DETECTS AN OUT-OF-RANGE PIN ON STRIKE OR STANDING PIN CYCLE

Cause: Detector rod too high.

Remedy: Check detector rod adjustment (adj No. 1 — page 67).

Complaint No. 42: DOES NOT DETECT STANDING PINS — SCISSORS DO NOT CLOSE AND DECK SETS NEW PINS

Cause: Detector rod too low.

Remedy: Check detector rod adjustment (adj No. 1 — page 67).

Complaint No. 43: OUT-OF-RANGE PIN DOES NOT DISENGAGE CLUTCH

Cause: Detector rod misadjusted.

Remedy: Check detector rod adjustment (adj No. 1 — page 67).

Complaint No. 44: DETECTOR ASSEMBLY OPERATES ERRATICALLY

Cause: Excessive wear of levers 100272, 100267 and 100263, due to lack of lubrication. As the rounded ends of these levers wear, the displacement of the blocking lever that the follower lever controls, prevents the required blocking action from occurring. The resulting malfunctions may be recognized as follows:

1. Detector Lever Assembly 100272.

The Pinsetter seemingly will not be able to differentiate between strikes and standing pins. It will act normally on first ball, standing pins but on a strike the machine will not stop at 0 degree; it will go through the 90 degree overtravel with the deck on the deck holding hook and the rake held up. Then everytime the machine is triggered, it will cycle to 90 degree, second ball; it will never stop at 0 degree to set up for first ball.

2. Detector Lever Assembly 100267

When this lever wears excessively it is most easily recognized by the fact that the scissor cam selector assembly 100193 cannot be blocked resulting in the following:

a) Scissors will always be blocked out — moving deck will be operative.
b) Deck lowering hook will be blocked out — deck cannot make the short stroke.

3. Detector Lever Assembly 100263

When levers 100272 and 100267 are found to be worn, lever 100263 will also be worn. Wearing of lever 100263 which controls the detector out-of-range linkage will not cause an immediate malfunction, but it should be replaced if 100272 and 100267 are replaced.

Remedy: Several temporary field repairs can be made pending actual replacement of worn levers. (See figure 122).

Method No. 1: The end of the blocking lever may be carefully bent so that it may again engage the lever it must block. If this is done, it will be necessary to file the bottom of the projection that rides the detector disk. If the follower end is worn 0.010 inch, the same amount should be filed off the bottom of the projection. This filing is done to assure that the projection will not bind in the cutouts of the detector disk.

Method No. 2: File the contact face of the worn lever until the blocking lever returns to its normal position. Be sure to file the worn lever — not its mating lever. Then file the bottom of the projection as detailed in method No. 1.

Either of the two methods above will correct the malfunctioning of the machine, but ultimately the worn levers will have to be replaced. Lever 100272 can be repaired without removing the detector from the machine. Lever 100267 cannot be repaired without removing the detector. Both levers may be repaired without actual disassembly of the detector.

Proper cleaning and lubricating of the detector, as detailed in the Service Manual, will immeasurably lengthen the life of the detector.

PINS, PIN JAMS, PIN GATE

Complaint No. 45: PINS REBOUND TO ALLEY PLAYING SURFACE
Cause a: Gear box time delay too long.
Remedy a: Check time delay adjustment (adj No. 18 — page 79).
Cause b: Pin curtain not positioned correctly.
Remedy b: Check pin curtain adjustment (adj No. 21 — page 84).

Complaint No. 46: PINS DAMAGED BY PINSETTER
Cause a: Pin strikes edge of turret clutch pulley as it drops from turret to No. 8 deck bucket, causing damage just below belly of pin. (See figure 123). This occurs when the No. 8 pin turret spoon deflects the pin as the pin drops toward the deck or the turret wires are misadjusted.
Remedy a: Move the No. 8 pin turret spoon as far clockwise (when viewed from above) as possible, in keeping with proper turret operation and check the turret wire adjustment (adj No. 36 — page 97).
Cause b: Pin strikes edge of turret drive belt idler as it is delivered to the No. 9 deck bucket, causing nicks around the head of the pin. (See figure 123).
Remedy b: Check turret wire adjustment (adj No. 36 — page 97). On early machines rotate the No. 9 deck chute clockwise, 120°. This will position the highest side of the chute toward the right side of the pinsetter. Later machines are assembled with chute in new position.
Cause c: Burr on top of the top cross conveyor pulley shaft housing causes little nicks in neck of pin.
Remedy c: File smooth.
Cause d: Broken 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 clamping plates.
Cause f: Pins nicked by sharp edge or burr at tip of pin guide.
Remedy f: File smooth.
Cause g: Vertical cuts on plastic bottom rings caused by pins striking the edge of the No. 5 pin shute as the pins are delivered from the cross conveyor to the No. 8 and No. 9 turret basket.
Remedy g: Correctly position turret wires and grind or file the protruding edge of the No. 5 pin shute.

Complaint No. 47: PINS STAY IN PIT
Cause: Ball wheel higher than rear pit clamping plate.
Remedy: Check pit conveyor adjustment (adj No. 24 — page 85).

Complaint No. 48: PINS NOT CARRIED UP BY CROSS CONVEYOR
Cause: Pins slipping on cross conveyor belts.
Remedy a: Check conveyor belt adjustment (adj No. 32 — page 93).
Remedy b: Check pin supporting plate adjustment (adj No. 33 — page 94).
Remedy c: Check for badly worn belts.
Remedy d: Check for dirty or oily belts.
Remedy e: Check for badly chipped pins.

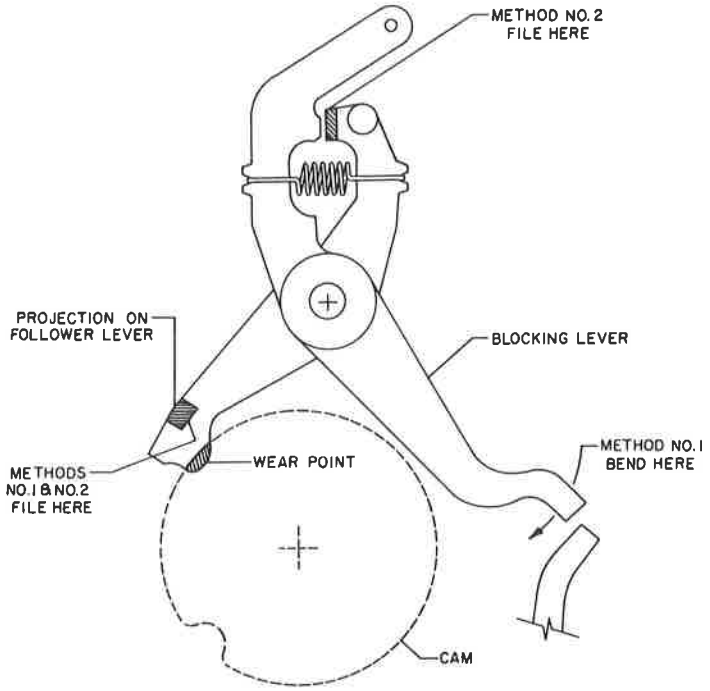


Figure 122. Detector Repair

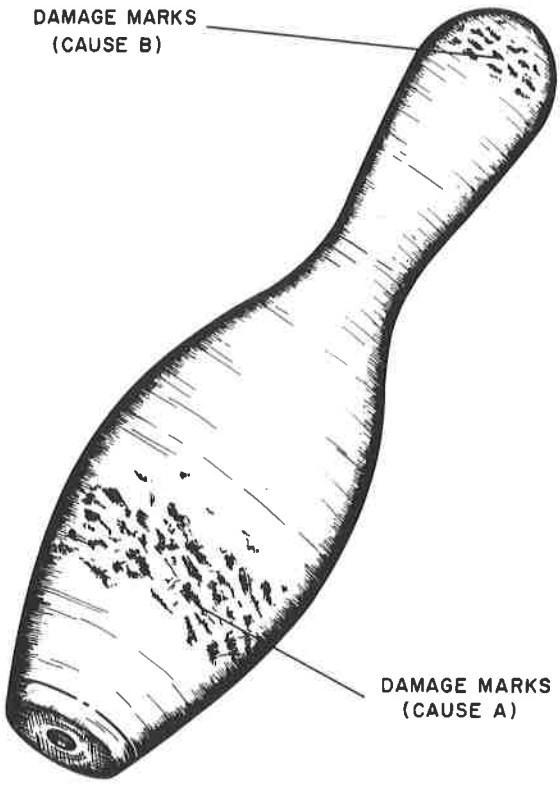


Figure 123. Pin Damage

Complaint No. 49:	PIN ELEVATOR DELIVERS PINS WHEN CROSS CONVEYOR IS FULL
Cause:	Magnetic clutch not disengaged.
Remedy:	Check magnetic clutch adjustment (adj No. 45 — page 103).
Complaint No. 50:	PIN JAM IN PIN GUIDE
Cause:	Pin guide out of specified adjustment.
Remedy:	Check pin guide adjustment (adj No. 30 — page 92).
Complaint No. 51:	PIN JAM IN TURNAROUND PAN OR PIN HEAD FIRST ON CROSS CONVEYOR
Cause a:	Turnaround pan not functioning correctly.
Remedy a:	Check turnaround pan adjustment (adj No. 31 — page 92).
Cause b:	Turnaround pan located incorrectly.
Remedy b:	Right-hand upper edge of pan should be 1/2 to 3/4 inch below the edge of the pin wheel.
Cause c:	Rough or dirty turnaround pan.
Remedy c:	Clean turnaround pan per preventive maintenance instructions on page 92 .
Cause d:	Pin guide not holding pins correctly.
Remedy d:	Check pin guide adjustment (adj No. 30 — page 92).
Cause e:	Pin elevator not stopped by full cross conveyor.
Remedy e:	Check magnetic clutch adjustment (adj No. 45 — page 103).
Cause f:	Cross conveyor does not carry pins up.
Remedy f:	Check and correct dirty, worn, twisted, or misadjusted cross conveyor belts.
Cause g:	Pin elevator rotates backward when machine or pin wheel stops.
Remedy g:	Check performance of pin wheel reverse brake.
Casee h:	Pins stick in pin elevator and are not released soon enough.
Remedy h:	Clean pin wheel per preventive maintenance instructions on page 110 . If trouble persists, mark the pin pockets which are responsible and check for abnormality.
Complaint No. 52:	PIN GATE FAILS TO RELEASE
Cause a:	Pin gate latch slips off shoulder of release link.
Remedy a:	First, as a test, with the link in its up, pin gate releasing position, lift the latch as high as possible and let it drop. The shoulder on the link must catch the latch and prevent it from latching the pin gate. If it slips off, file the notch until it is more perpendicular (but never beyond 90 degrees).
Cause b:	Latch and link motion is binding.
Remedy b:	First 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 for reason and correct.
Cause c:	Link not lifting latch high enough.
Remedy c:	Check pin gate adjustment (adj No. 34 — page 94).
Complaint No. 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 alley. 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:	Pin gate failure.
Remedy a:	Check pin gate adjustment (adj No. 34 — page 94).
Remedy b:	Check pin support plate adjustment (adj No. 33 — page 94).
Remedy c:	Free latch and link motion of any binding.

ELECTRICAL

Complaint No. 54:	PINSETTER SHUTS ITSELF OFF - ELECTRIC POWER OFF
Cause a:	Fuse blown.
Remedy a:	Replace fuse; if it blows again, check for short and correct.
Cause b:	Circuit breaker open.
Remedy b:	Close circuit breaker; if it opens again, check for short or overload and correct.
Cause c:	Thermal overload ciruuit open.
Remedy c:	Close circuit; if it opens again, check for short or overload and correct.
Cause d:	Manual switch opened accidently.
Remedy d:	Check manual switches on manager's control panel, masking unit, control box on pinsetter, and rear of wire channel.
Cause e:	Turret jam microswitch open, too fine an adjustment, or actual turret jam.
Remedy e:	Check turret jam adjustment (adj No. 48 — page 106) or, for actual turret jam.
Cause f:	Moving deck jam microswitch open.
Remedy f:	Check moving deck jam adjustment (adj No. 49 — page 107) or check for actual moving deck jam.

Complaint No. 55: MOTOR INOPERATIVE - PIN LIGHT ON
Cause: Thermal overload open.
Remedy: Press thermal overload reset button

Complaint No. 56: FIRST BALL LIGHT BLINKS
Cause: Too fine an adjustment.
Remedy: Check ball light adjustment (adj No. 46 — page 105).

Complaint No. 57: PIN LIGHT BLINKS WHEN DECK SETS NEW PINS
Cause: Moving deck micro switch incorrectly positioned.
Remedy: Check moving deck micro switch adjustment (adj No. 49 — page 107).

Complaint No. 58: MANAGERS COUNTER DOES NOT REGISTER-OR COUNTS INACCURATELY
Cause: Counter micro switch incorrectly positioned.
Remedy: Check counter micro switch adjustment (adj No. 47 — page 105).

Complaint No. 59: MANAGERS COUNTER EXCESSIVELY NOISY WHEN ENERGIZED
Cause: The screw in the bottom of the counter which holds the coil to the frame, has worked loose.
Remedy: Tighten screw. (See figure 124).

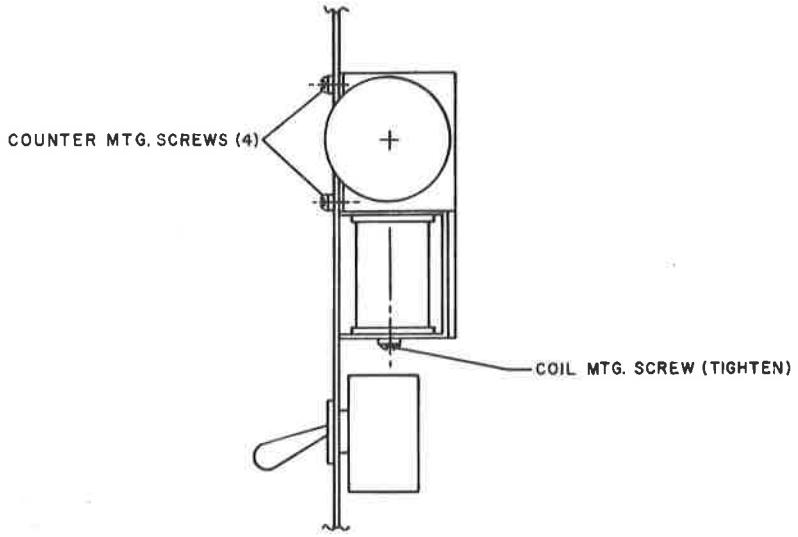


Figure 124. Noisy Counter

Complaint No. 60: PIN ELEVATOR STOPS TURNING (MAGNETIC CLUTCH NOT OPERATING).
Cause a: Magnetic clutch shorted or open.
Remedy a: Take ohmmeter reading of the clutch coil at the clutch plug. The coil resistance should be approximately 900 ohms. Replace any clutch if resistance is less than 700 ohms.
Cause b: Faulty or incorrectly wired resistor (208V and 230V only).
Remedy b: Check clutch voltage with clutch plugged in. Connect meter leads to red and black connections on the rectifier. The D.C. voltage should be 90V ±15%. If the D.C. reading is in excess of 110V. D.C, check the resistor and resistor wiring and correct as required.
Cause c: Faulty rectifier causing recurrent failure of the resistor (208V and 230V systems only).
Remedy c: To check rectifier after installing new resistor:

1. Measure the A.C. voltage across the resistor with the power on. This voltage should not exceed 140V., A.C.
2. With the main switch of the control box off, remove the plug for the magnetic clutch and measure the resistance of the clutch. This should not be below 700 ohms.

If the voltage drop across the new resistor exceeds 140V. A.C. and the resistance of the clutch is over 700 ohms, the selenium rectifier should be replaced. If the resistance of the clutch is below 700 ohms, replace the clutch.
Note: The resistor operates normally at high temperature and a hot resistor is not necessarily a faulty one.

Cause d: Magnetic clutch out of adjustment.
Remedy d: Check magnetic clutch adjustment (adj No. 45 — page 103).

MISCELLANEOUS

Complaint No. 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 3 clamp screws at the front plate are tight.
Cause b: Pit frame to sub mounting plate bolts are loose.
Remedy b: Tighten mounting bolts.
Cause c: Sub-mounting plates to pit floor bolts are loose.
Remedy c: Make sure sub-mounting plates are securely tightened to the pit floor.

Complaint No. 62: PIT CONVEYOR BELT CONSISTENTLY WEARS, BREAKS OR COMES OFF PULLEY
Cause a: Pit conveyor idler arm misadjusted.
Remedy a: Check idler arm adjustment (adj No. 29 — page 92).
Cause b: Stretched ball wheel belt.
Remedy b: Shorten belt and splice with alligator belt fastener.
Cause c: Stretched pit conveyor belt.
Remedy c: Replace belt.

Complaint No. 63: PINSETTER CONSISTENTLY GENERATES BLACK DIRT
Cause a: Elevator guide rollers not lubricated.
Remedy a: Lubricate guide rollers and elevators as per preventive maintenance section (page 110).
Cause b: Misalignment of guide rollers.
Remedy b: Consult Brunswick or Otis Service for best method of aligning rollers.

Complaint No. 64: BELT JUMPS OFF MOTOR OR GEAR BOX WHEN MACHINE IS STARTED
Cause: Motor mount roll pin missing or down too far.
Remedy: Set roll pin at least 1/8 inch above motor mount (see figure 125).

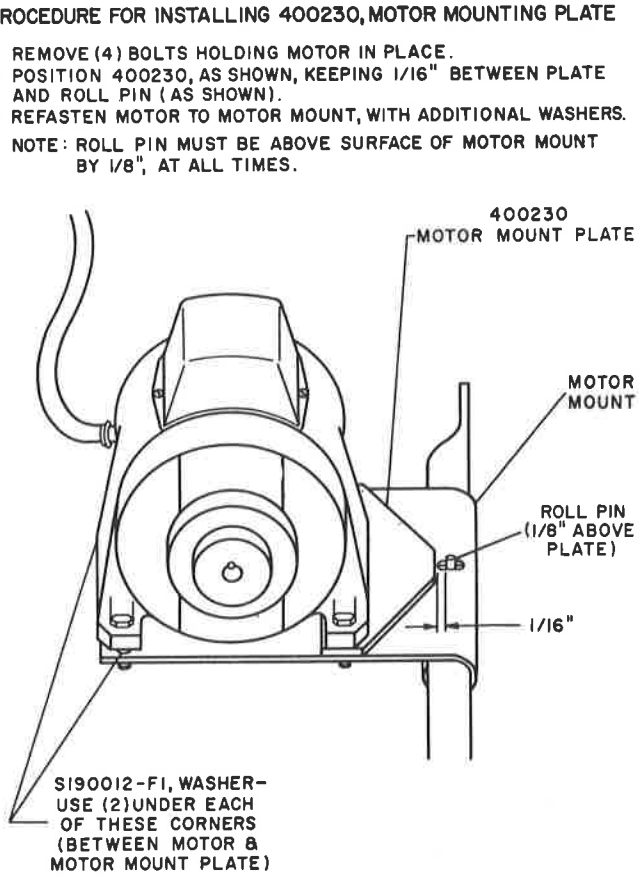


Figure 125. Gear Box Belts

Complaint No. 65: OIL LEAK AROUND GEAR BOX WORM SHAFT
Cause: Defective worm shaft oil seal and spacer.
Remedy: Replace oil seal and spacer. The following is the detailed procedure used when performing subject operation. Refer to pages 8 and 9 of your Parts Catalog.

1. Stop the machine at 270 degrees with the deck at its full new pinsetting depth.

2. Remove Nut GB124 and Spacer GB125.

3. Unscrew Bolt GB117 and Pin GB126. It is not necessary to loosen the two Jam Nuts GB115.

4. Remove Snap Ring GB118, Washer GB119, and Pin GB154.

5. Remove Hex Nuts GB130, Clutch Drive Disc GB131, Pulley Assembly GB132, Clutch Drive Disc Assembly GB133 with Yoke Assembly GB120, and Spring GB134.

6. Unlock Washer GB136 and remove Locknut GB135, Washer GB136, and Spring Disc GB137.

7. Remove four (4) Socket Head Cap Screws GB36 and Clutch Brake Disc Assembly GB138. Caution should be exercised in sliding the Clutch Brake Disc Assembly over the Worm Shaft to prevent possible damage to the Oil Seal 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 Clutch Brake Disc Assembly 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 Brake Disc 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 to 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 the old Spacer.

9. Clean the mating surfaces of the Clutch Brake Disc Assembly and the Gear Box Housing thoroughly and apply a coat of Permatex No. 1372.

10. Re-install the Clutch Brake Disc Assembly and the four (4) Socket Head Cap Screws. Exercise caution when sliding the Brake Disc over the Worm Shaft to prevent damage to the Oil Seal.

11. Install the new Spacer GB139 with a .010 thick Vellumoid gasket or equal between the Spacer and the Bearing. This gasket can be formed by using the Spacer as a template and cutting around it. The new Spacer must be installed with its rounded leading edge toward the front of the machine. Do not install backwards or damage to the seal may result.

12. Re-install Spring Disc GB137, Lockwasher GB136, and Locknut GB135. Tighten Locknut securely and lock in place by bending an ear of the Lockwasher.

13. Re-install Spring GB134, Clutch Drive Disc Assembly GB133 with Yoke Assembly GB120, Pulley Assembly GB132, Clutch Drive Disc GB131, and Hex Nuts GB130. Run the Locknut up securely then back off until a clearance of .010 is obtained between Clutch Drive Disc GB133 and Clutch Brake Disc GB138. Run the Jam Nut up and lock securely.

14. Re-install Pin GB154, Washer GB119, and Snap Ring GB118. Lubricate the Pin prior to installation to assure freedom of movement.

15. Adjust the Clutch Lever (adj No. 16 — page 77).