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TELETYPE

PRINTING TELEGRAPH SYSTEMS

DESCRIPTION AND ADJUSTMENTS

REVERSIBLE TRANSMITTER

(X18 AND X19)

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THE U.S. PAT. OFF.
CORPORATION

SUBSIDIARY OF

Western Electric Company

CHICAGO, U.S.A.

TELETYPE

PRINTING TELEGRAPH SYSTEMS

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DESCRIPTION AND ADJUSTMENTS

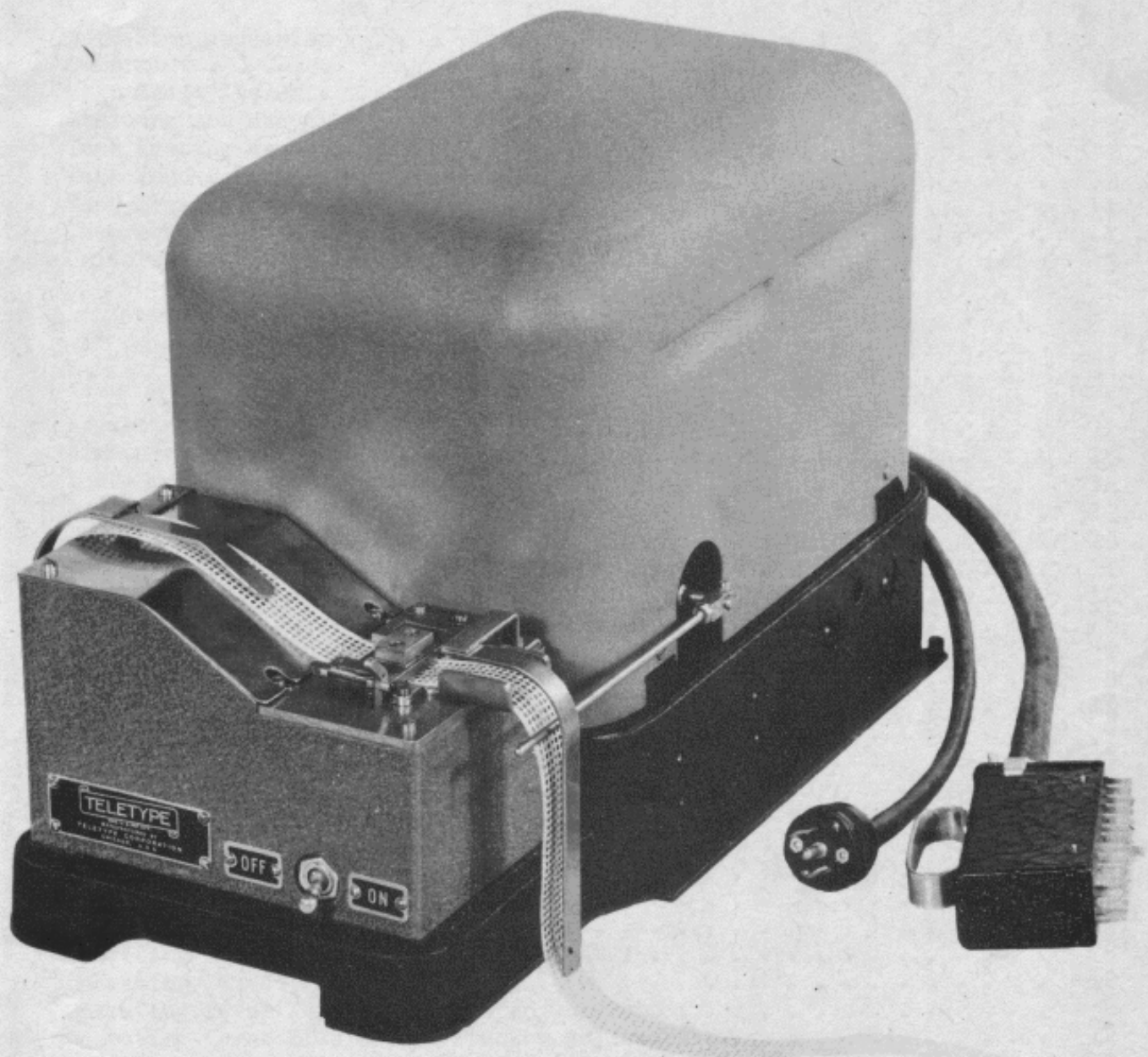
REVERSIBLE TRANSMITTER

(X18 AND X19)

BELL SYSTEM NOTE:

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DESCRIPTION

GENERAL

The TELETYPE REVERSIBLE TRANSMITTER (Figure 1) described herein is a motor driven device which translates code combinations from fully perforated tape into electrical impulses and transmits these impulses to other associated apparatus.

The unit consists essentially of a main shaft assembly, transmitter with tape sensing and tape feeding mechanisms, and a universal and auxiliary contact operating mechanism. It is also equipped with an auto-stop mechanism, power cord, and a control cable. See Figures 2 and 3.

The unit provides means by which tape feeding may be reversed without stopping the transmitter.

THEORETICAL TRANSMITTING CIRCUIT

The portion of the unit through which the perforated tape feeds is known as the transmitter. See Figure 3. The transmitter prepares electrical paths from the signal line battery to the universal and auxiliary contacts. These paths are controlled by tape pins which sense the perforations in the tape and thereby determine the position of the contact tongues with relation to their upper and lower contact screws. If a tape pin protrudes through a perforation in the tape, its contact tongue will make contact with a lower contact screw and thereby transmit a MARKING impulse through the universal contact. If, however, a tape pin is blocked by the tape, its contact tongue will make contact with an upper contact screw and a SPACING impulse will be transmitted through the universal contact.

MAIN SHAFT ASSEMBLY

The main shaft assembly consists mainly of an operating cam attached to its lower end under the base, a stop cam, gear, friction disc, bearings, inner timing disc, an auxiliary cam, and a universal cam. See Figures 2 and 3. The shaft is driven by a motor through the motor pinion and main shaft gear.

The operating cam imparts motion to the transmitter through the medium of an operating lever (Figure 2). The universal and auxiliary cams impart motion to the universal and auxiliary contacts. See Figure 3. A clutch magnet, stop cam, stop arm, and friction clutch serve to control the starting and stopping of the transmitter.

TAPE SENSING MECHANISM

The contact levers (Figure 4) are positioned vertically in the transmitter. They pivot on shaft S and have extensions to the right C, left A and downward B. The right-hand extensions project upward at the ends and have tape pins embedded in them.

An opening is provided in the tape guide plate, located above the right-hand extensions of the contact levers, to permit the tape pins to enter

the code holes in the tape.

The left-hand extension of each contact lever carries a contact tongue which is attached to the contact lever by a pivotal mounting. Each contact tongue is positioned to move between two contact screws, a SPACING contact screw above and a MARKING contact screw below.

A contact lever spring is attached to the mounting end of each contact and tends to hold it against the lower contact screw. A contact lever bail, pivotally mounted just below the contact lever's lower extension, has an arm extending downward which engages a transmitter operating lever. The transmitter operating lever (Figure 2) has a central pivot screw and moves in a horizontal plane. A roller on the rear end of the lever rides a three lobe transmitter operating cam mounted on the lower end of the main shaft.

The motion imparted to the transmitter operating lever by the operating cam causes the contact lever bail to rotate the contact levers on their shafts sufficiently to move the contact tongues up and down between the MARKING and SPACING contact screws. After the tongue strikes the upper screws, any additional clockwise rotation of the contact levers is absorbed by the contact lever springs.

As the operating lever roller rides to a low part of its cam, the tape pins rise. If tape perforated with code combinations is in the tape guide at this time, the contact lever pin will project through the tape wherever it is perforated and permit the associated contact tongues to rest on the MARKING or lower contact screws, while the pins which are blocked by the unperforated portions of the tape will cause the associated contact tongues to rest against the SPACING or upper contact screws.

TAPE FEEDING MECHANISM

Positioned to the rear of the contact levers and pivoted on the contact lever shaft is a feed lever (Figure 5) which is similar in shape to a contact lever. This lever has a spring attached to its left-hand extension and a pair of feed pawls mounted on its right-hand extension C. A spring holds the left feed pawl in contact with its feed wheel ratchet. A flexible armature extension on a reversing magnet armature holds the right feed pawl in contact with its feed wheel ratchet when the reversing magnet armature is operated. (See Figure 5.)

Pins on the circumference of the feed wheel (Figure 3) project through an opening in the tape guide plate and mesh with the feed holes in the tape.

A retaining lid, under which the tape passes, holds the tape in contact with the feed wheel pins.

When the action of the contact lever bail on the contact lever moves the tape pins downward, the feed lever responds in a similar manner, causing a feed pawl to engage a tooth on a feed wheel ratchet and rotate the feed wheel. With each downward motion of the feed pawl, the tape will be advanced either right or left, the distance required to bring the succeeding code combination over the tape pins. The setting of the feed pawls is such that they do not start to rotate the feed wheel until the tape pins have moved clear of the tape.

A feed wheel detent is provided to insure alignment of the code perforations with the tape pins.

TAPE FEED REVERSING MECHANISM

The transmitter feed roll is equipped with two feed wheel ratchets which are operated by two feed pawls mounted on the tape feed lever (Figure 5). A spring holds the left feed pawl in contact with its ratchet so that the tape feeds from right to left. A tape feed reversing magnet, when operated, moves the left feed pawl out of contact with its ratchet, and causes the right feed pawl to engage its ratchet. During the next operation of the feed lever, this pawl rotates the feed wheel in a reverse direction, thereby, causing the tape to be fed from left to right. This reversing of the tape feeding is remotely controlled and may be accomplished without stopping the tape sensing mechanism.

UNIVERSAL AND AUXILIARY CONTACT OPERATING MECHANISM

The universal and auxiliary contact operating mechanism consists of two contact assemblies, an auxiliary operating lever, a universal operating lever, and two springs. Motion is imparted to these levers from cams assembled on the main shaft (Figure 3). The contact bracket and operating levers are assembled to a mounting plate which is, in turn, mounted on the main shaft bracket. The cams, together with an inner timing disc, are assembled together and mounted on the upper end of the main shaft. Each cam is constructed in such a manner that it operates its respective contact three times during each revolution. Elongated holes in the cams provide means for adjusting the cams so that proper timing may be secured.

The universal cam is adjusted so that the universal contact closes after the latest of the six sensing contact tongues make contact with the MARKING contact screws, and opens before the earliest of the six sensing contact tongues breaks contact with its MARKING contact screw.

The auxiliary cam is adjusted so that the auxiliary contact closes approximately 9 to 13 degrees before the stop position of the main shaft, and opens 9 to 13 degrees after the stop position.

STARTING AND STOPPING TRANSMISSION

Transmission is controlled through a clutch magnet and a stop arm. This unit is not equipped with a motor control switch, therefore the motor runs continually as long as the power cord is plugged into its socket. Assuming that the motor is running and the clutch magnet is de-energized, the stop arm is in contact with a lug on the stop cam, the main shaft gear is revolving through its friction clutch disc, and the transmitter is not operating. When the clutch magnet is energized the stop arm is pulled out of contact with the lug on the stop cam and the entire main shaft assembly is permitted to rotate, thereby, imparting motion to the entire unit.

AUTO-STOP MECHANISM

The auto-stop mechanism is made up of an auto-stop lever, shaft, contact assembly and bracket (Figure 3). The purpose of the mechanism is to break the circuit to the clutch magnet. The auto-stop lever is clamped to a shaft which operates the contact through the medium of a stud attached to the

shaft. The lever extends to the transmitter so as to operate in the path of the tape. If the tape becomes tangled or too tight for any reason it raises the auto-stop lever and, thereby, causes the circuit to the clutch magnet to be broken through the auto-stop contact. The transmitter immediately stops and transmission cannot be resumed until the contact is closed by returning the auto-stop lever to its normal operating position.

ADJUSTMENTS

GENERAL

This bulletin contains the requirements and adjusting procedures for the maintenance of REVERSIBLE TRANSMITTERS. Adjustments are arranged in a sequence that would be followed if a complete readjustment of the unit were undertaken. This fact should be kept in mind when a single adjustment is to be made because a change in one adjustment may affect other adjustments. If one adjustment is changed, related adjustments should be checked.

The spring tension values given in this bulletin are scale readings which should be obtained when Teletype scales are used as specified. Springs which do not meet the requirements specified and for which no adjusting procedure is given should be replaced with new springs. Ordering information may be obtained from the Teletype parts bulletin.

Before proceeding to adjust, remove the following parts: *Cover, tape exit guide, right tape guide, top cover, tape transmitter top plate, tape transmitter snap panel and transmitter base plate. See Figure 1. Also remove the left bracket from the transmitter assembly. See Figure 3.

In the following text when reference is made regarding the left, right, rear, clockwise, or counterclockwise direction, this reference is made when the unit is viewed from the front or transmitter end of the unit unless otherwise specified.

In the following text when reference is made regarding the rotation of the main shaft, the stop lever should be disengaged from a stop lug on the stop cam and the motor fan rotated in a clockwise direction unless otherwise specified.

In the following text a test lamp should be used when checking the breaking or making of two contact points or the adjustment of the timing cams and disc.

Before proceeding to adjust any part, read the description of the adjustment carefully. After the adjustment is completed, be sure to tighten any screws or nuts which may have been loosened. If a part that is mounted on shims is to be removed, the number of shims used at each of its mounting screws should be noted so that the same shim pile-up can be replaced when the part is remounted.

MAIN SHAFT ADJUSTMENT (Figure 6)

Rotate the main shaft until the operating roller just starts to ride up on one of the three high parts of the operating cam. There should be some clearance between the lower surface of the cam and the upper surface of the operating lever when all the play of the operating lever is taken up in a direction to make the clearance a minimum. With the play in the operating lever taken up in a direction to make the clearance a maximum, this clearance

* * *

* X18 only

should not exceed .040". To adjust, loosen the main shaft bearing cap screws and raise or lower the main shaft. Tighten the screws.

MOTOR POSITION ADJUSTMENT

There should be a minimum amount of backlash between the motor pinion and the main shaft gear through a complete revolution of the main shaft (Figure 3). To adjust, loosen the motor mounting screws and position the motor. Tighten the screws.

TAPE STOP MAGNET BRACKET ADJUSTMENT (Figure 7)

- (1) The air gap between both the upper and lower pole faces of the magnet yoke and the face of the armature should be approximately equal and from .010" to .020" when the magnet armature is resting against the magnet core. To adjust for equal air gap, increase or decrease the number of shims on the magnet yoke mounting screws between the magnet yoke and the magnet bracket. To adjust for the .010" to .020" gap, increase or decrease the number of shims between the magnet core and the yoke.
- (2) When the armature is resting against the magnet core and one of the stop cam lugs is opposite the end of the stop arm, there should be .004" to .012" clearance between a stop cam lug and the end of the stop arm. Also, both upper and lower pole faces of the magnet yoke should be parallel to the face of the armature, and the pole faces should not extend beyond either side of the armature. To adjust, position the magnet bracket by means of its mounting screws.

STOP ARM PILOT SCREWS ADJUSTMENT (Figure 8)

With a stop cam lug against the end of the stop arm, the upper edge of the stop arm should overlap the upper edge of the stop cam .002" to .050". The stop arm should be free in its bearings, but it should not have perceptible play. To adjust, loosen the stop arm pilot screw lock nuts and position the arm by means of the pilot screws. Tighten the lock nuts.

STOP ARM SPRING TENSION (Figure 9)

With the stop arm resting on a low part of the stop cam, hook an 8 oz. scale over the end of the stop arm and pull at a right angle to the stop arm. It should require 5 to 7 ozs. to start the stop arm moving away from the stop cam.

DETENT LEVER SPRING TENSION (Figure 10) See Note (A)

Hold the transmitter top plate upside down and in a horizontal plane. Make sure the detent roller is resting in the hollow between two teeth on the feed wheel ratchet. Hook a 32 oz. scale over the end of the detent lever and pull horizontally against the tension of the spring. It should require 12 to 15 ozs. to start the detent lever moving.

* * *

- (A) This adjustment should be checked with the tape transmitter top plate removed.

FEED WHEEL SHAFT BEARINGS ADJUSTMENT - See Note (A)

The feed wheel shaft should be free in its bearing and should have some end play, not over .002". To adjust, loosen the feed wheel shaft bearing mounting screws and position the bearings. Tighten the screws. See Figure 10 for location of parts.

TAPE FEED PAWL SPRING TENSION (Figure 11) - See Note (A)

Rotate the motor shaft until the feed pawl is in its uppermost position. Apply the push end of an 8 oz. scale against the feeding tip of the left feed pawl and push horizontally toward the left. It should require 1/4 to 3/4 ozs. to hold the pawl in a vertical position.

NOTE: While checking this requirement, hold the reverse magnet armature flexible extension away from the post on the feed pawl.

TAPE RETAINING LID LATCH WEARING STRIP SHIMS ADJUSTMENT - See Note (A)

With a .003" thickness gage placed between the retaining lid and the front guide rail on the tape guide plate, the latch should not close freely. With the thickness gage removed and the retaining lid held against the front guide rail on the tape guide plate, the latch should operate freely under its own spring tension. To adjust, increase or decrease the number of shims installed between the latch wearing strip and the top plate. See Figure 12 for location of parts.

TAPE SPACE ADJUSTMENT (Figure 13)

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The clearance between the tape guide and the retaining lid should be ~~.011" to .014"~~ ^{.010" to .012"} throughout the area of the retaining lid plate when the retaining lid is latched closed and the play taken up in a direction to make this clearance a minimum. To adjust, increase or decrease the number of shims installed between the retaining lid and the retaining lid plate.

TAPE GUIDE PLATE ADJUSTMENT (Figure 14)

When a piece of perforated tape is engaged with the pins of the feed wheel, there should be equal clearance between the edges of the tape and the tape guide. To adjust, loosen the tape guide plate mounting screws and position the tape guide plate. Tighten the screws.

WITH THE MAIN SHAFT IN THE STOP POSITION, REPLACE THE TAPE TRANSMITTER TOP PLATE. WHEN DOING THIS, HOLD UP BOTH FEED PAWLS IN A VERTICAL POSITION SO THAT THE LEFT FEED PAWL CAN ENGAGE THE FEED WHEEL RATCHET.

* * *

(A) This adjustment should be checked with the tape transmitter top plate removed.

DETENT BRACKET ADJUSTMENT (Figure 14)

Obtain a piece of tape with a series of RUB-OUT combination perforations. Check the tape to determine if the spacing of the perforations meets the requirement of ten to the inch. Insert the tape so that the feed holes lead the code hole perforations and engage the feed perforations with the feed wheel so that the code hole perforations are directly over the tape pins. With the detent roller resting in a hollow between two teeth on the feed wheel ratchet, disengage the stop arm from a stop lug on the stop cam and rotate the motor fan in a clockwise direction until the tape pins are flush with the bottom of the tape. When the play of the tape on the feed wheel is taken up toward the left and then the right, the clearance between each code perforation and its corresponding pin should be equal. To adjust, loosen the detent bracket mounting screws and position the bracket. Tighten the screws.

TAPE RETAINING LID PLATE ADJUSTMENT

The retaining lid plate should be positioned so that the edges of the plate are parallel to the sides of the tape guide and so that the openings in the plate are centrally located with respect to the tape pins when the tape pins are in their uppermost position. To adjust, loosen the retaining lid plate mounting screws and position the plate. Tighten the screws. See Figure 13 for location of parts.

RETAINING LID LATCH SPRING TENSION (Figure 12)

With the slope on the latch resting against the top plate (not latched), hook an 8 oz. scale over the upper end of the latch and pull at right angles to the formed upper end of the latch. It should require 1-1/2 to 7 ozs. to start the latch moving on its pivot.

OPERATING BAIL WEARING STRIP ADJUSTMENT

NOTE: The following adjustment is made during the initial assembly of the apparatus and should require attention only if the parts have been damaged or dismantled.

When the six contact levers are resting against the contact bail, the upper ends of the No. 0 (front) and the No. 5 (rear) sensing pins should be parallel within .005" to the bottom of a straightedge held across the top of the tape guide. The upper ends of the other four sensing pins should be parallel within .010". To adjust, remove the contact lever bail and increase or decrease the number of shims between the wearing strip and the contact lever bail. Replace the bail and recheck the adjustment. See Figure 22.

FEED LEVER ADJUSTING SCREW ADJUSTMENT (Figure 15)

With the tape reversing magnet unoperated, the armature extension held away from the feed lever and the detent roller resting in a hollow between two teeth of the feed wheel ratchet, operate the contact lever bail slowly by hand. The left feed pawl should engage the first tooth above the horizontal center of the feed wheel ratchet at the instant the tape pins are flush with the upper surface of the tape guide. To adjust, loosen the feed lever adjusting screw lock nut and turn the adjusting screw clockwise if the tape pins are

below the top surface of the tape guide when the feed wheel starts to move or counterclockwise if the pins extend above the top surface of the tape guide when the feed wheel starts to move. Tighten the lock nut.

OPERATING LEVER ADJUSTING SCREW ADJUSTMENT (Figure 16)

With the detent roller resting in a hollow between two teeth of the feed wheel ratchet, the tape reversing magnet unoperated and the armature extension held away from the feed lever and the operating lever roller resting on one of the high parts of the operating cam, there should be some clearance, not more than .010" between the face of the left feed pawl and first tooth below the horizontal center of the front feed wheel ratchet. To adjust, loosen the operating lever adjusting screw lock nut and position the adjusting screw. Tighten the lock nut.

RIGHT HAND FEED PAWL ADJUSTMENT

- (1) With the detent roller resting in a hollow between two teeth of the feed wheel ratchet and the operating lever roller resting on one of the high parts of the operating cam, hold the tape reversing magnet armature operated and see that there is some clearance, not more than .010", between the face of the right feed pawl and the face of the first tooth below the horizontal center line of the rear feed wheel ratchet. To adjust, loosen the mounting screw of the right feed pawl and position the feed pawl vertically to meet the requirement. See Figure 17.
- (2) Check the distance between the two pawls by slowly operating the feed lever and holding the pawl assembly in the neutral position, where neither pawl engages a tooth on the feed wheel ratchets. If it is found that the distance is such that there is no neutral position, turn the adjustable pawl within the play of the adjusting slot, but not far enough to eliminate all clearance between the back edge of the right feed pawl and the top plate when the feed lever is in its uppermost position. Recheck Item 1.

FEED LEVER UPSTOP ADJUSTMENT (Figure 18)

With the operating lever roller on the low part of the operating cam and the detent roller resting in a notch between two teeth of the feed wheel ratchet, the lower surface of the feed pawl should be approximately .020" (Gauge by eye) below the tip of the second tooth above the center of the feed wheel ratchet. Adjust by positioning the feed lever upstop. Hold the upstop so that its formed portion is in contact with the lever guide when tightening the mounting screw.

NOTE: Rotate the motor manually until the contact lever bail just contacts the lobe of the feed lever. With the bail in this position, there should be at least .002" clearance between the contact lever bail and each contact lever lobe (See Figure 22). If necessary, refine the feed pawl lever upstop.

TAPE REVERSING MAGNET ARMATURE BACKSTOP SCREW ADJUSTMENT (Figure 19)

With the tape reversing magnet armature unoperated and the armature resting against its adjusting screw, there should be .035" to .040" clearance between the armature and the face of the magnet pole piece at the point of closest approach. To adjust, loosen the adjusting screw lock nut and position the adjusting screw. Tighten the lock nut.

TAPE REVERSING MAGNET ARMATURE SPRING TENSION (Figure 20)

With the armature held in the operated position, unhook the armature spring from the armature spring hole and hook an 8 oz. scale in the spring eye. It should require 1/2 to 1-1/2 ozs. to pull the spring to its position length.

ARMATURE EXTENSION ADJUSTMENT

The top edge of the flexible armature extension should be parallel to the bottom of the magnet bracket. To adjust, loosen the flexible armature extension clamp screws and position the extension. Tighten the screws. See Figure 19 for location of parts.

TAPE REVERSING MAGNET BRACKET ADJUSTMENT

- (1) With the operating ball roller on a low part of the operating cam, the detent roller resting in a hollow between two teeth of the feed wheel ratchet, and the tape reversing magnet unoperated so that the left feed pawl is resting against a tooth on the feed wheel ratchet, the tape reversing magnet armature flexible extension should be to the left of the horizontal pin in the feed pawl assembly and there should be some clearance, not more than .010", between the extension and the pin, when the play is taken up in a direction to make this clearance a minimum.
- (2) With the tape reversing magnet operated and the feed lever manually operated downward, there should be some clearance, not more than .025" between the flexible armature extension and the end of the feed pawl shoulder screw, when the play is taken up to make this clearance a minimum.

To adjust, loosen the two tape reversing magnet mounting screws and the clamp plate clamp screw and position the magnet assembly. Tighten the clamp plate clamping screw with caution so as to prevent any distortion of parts. Tighten the two mounting screws. See Figure 5 for location of parts.

CONTACT TONGUES ADJUSTMENT (Figure 21)

NOTE: The following adjustment is made during the initial assembly of the apparatus and should require attention only if the parts have been damaged or dismantled. To check, back off contact screws.

The contact tongues should be straight and parallel (both crosswise and lengthwise) to the upper contact screw bridge. The variation in alignment should not exceed .030". To adjust, bend the contact tongues.

LOWER CONTACT SCREWS ADJUSTMENT (Figure 22)

Rotate the main shaft until the operating lever roller is resting on a low part of the operating cam and place a straightedge across the top of the tape guide directly over the tape pins. There should be a clearance of .020" to .025" between the bottom of the straightedge and the top of each tape pin. To adjust, loosen the set screws of the upper and lower contact screws and back off the upper contact screws. Then adjust the lower contact screws to meet the requirement. Tighten the lower contact screw set screws.

NOTE: There should also be a clearance of at least .002" between the contact lever bail and the lobe of each contact lever. If this clearance does not exist, refine the lower contact screw adjustments within the specified limits to obtain the desired clearance.

UPPER CONTACT SCREWS ADJUSTMENT (Figure 22)

With the operating lever roller on a low part of the operating cam, there should be a gap of ^{(.004" to .006") EE-554} .006" to .010" between the contact point of each upper contact screw and its associated contact tongue. To adjust, loosen the upper contact screw set screws and adjust the upper contact screws. Tighten the set screws.

CONTACT LEVER SPRING TENSION ADJUSTMENT (Figure 22)

With the operating lever roller on a low part of the operating cam, hook an 8 oz. scale under each horizontal portion of a contact lever (the scale rod just clearing the contact tongue pivotal mounting) and pull vertically upward. The pull required to separate the contacts should be ~~6 to 7~~ ^{3 to 3 1/2} ozs. Measure all contact springs in the same manner. To adjust, loosen the contact lever spring anchor terminal screws and position the anchors. Tighten the terminal screws.

FEED LEVER SPRING TENSION ADJUSTMENT (Figure 15)

With the operating lever roller on a low part of the operating cam, hook a 32 oz. scale over the end of the feed lever (just below the spring hole) and pull upward in line with the spring. It should require 17 to 19 ozs. to start the feed lever moving. To adjust, loosen the terminal screw and position the spring anchor. Tighten the terminal screw.

UNIVERSAL AND AUXILIARY CAMS ASSEMBLY

- (1) The inner timing disc, auxiliary cam and universal cam should be assembled with the white dot on the timing disc, the A on the auxiliary cam and the U on the universal cam approximately in a vertical line in the order given, with the timing disc on the bottom and the identifying marks visible from the top. Figure 23.
- (2) The three parts should be assembled to the hub with the spacer between the auxiliary and the universal cams. The timing disc should be mounted on the hub so that the mounting screw is in line with one of the two elongated holes in the hub.

- (3) The entire assembly should be mounted on the upper end of the main shaft so that one of the lines inscribed on the timing disc is approximately in line with the 0 mark on the outer (fixed) timing ring when the main shaft is in the stop position. See Figure 23.

ADJUSTING DISC HUB ADJUSTMENT

The upper surface of the inner disc should be flush with the upper surface of the outer (fixed) timing ring. To adjust, loosen the hub mounting screw and nut and position the hub by means of its elongated mounting hole. Tighten the mounting screw and nut.

TIMING DISC ADJUSTMENT

With the main shaft in the stop position, one of the lines inscribed on the inner timing disc should line up with the 0 mark on the outer (fixed) timing ring. To adjust, loosen the mounting screws of the disc and cams and position the disc. Tighten the mounting screws. See Figure 23.

OPERATING CAM ADJUSTMENT

- (1) When the main shaft is rotated by hand, check to see that the contact tongues on all six contact levers break circuit through the MARKING contact screws when one of the inscribed lines on the inner timing disc is within or to the left of the MO mark on the outer (fixed) timing ring. See Figure 23.
- (2) When the main shaft is rotated by hand, check to see that the contact tongues on the six contact levers make circuit through the MARKING contact screws before an inscribed line on the inner timing disc reaches the MC line on the outer (fixed) timing ring. See Figure 23.

To adjust, loosen the operating cam mounting screws and position the operating cam. Tighten the mounting screws.

OPERATING LEVER BIAS SPRING BRACKET ADJUSTMENT

Rotate the main shaft until the operating lever roller is resting on a low part of the operating cam. With the unit resting on its left side, unhook the operating lever bias spring eye from the spring bracket. Hook a 32 oz. scale in the spring eye and pull vertically upward in line with the spring. It should require 10 to 13 ozs. to pull the spring to its position length. To adjust, loosen mounting screws for the operating lever bias spring bracket and position the bracket. Tighten the mounting screws. Replace the spring. See Figure 2 for location of parts.

OPERATING BAIL SPRING TENSION

With the operating lever roller resting on a low part of the operating cam and the unit resting on its left side, hook an 8 oz. scale over the end of contact bail and pull vertically upward. It should require 1 to 2 ozs. to start the contact bail moving away from the operating lever adjusting screw. See Figure 2 for location of parts.

UNIVERSAL AND AUXILIARY CONTACT SPRING TENSION

- (1) The short contact spring on both the universal and auxiliary contact assemblies should be straight and at right angles to the contact assembly.
- (2) With the universal and auxiliary contact levers on a low part of their cams, hook an 8 oz. scale over the long contact springs at the contact points. It should require 3 to 4-1/2 ozs. to separate the contact points. See Figure 23.

UNIVERSAL AND AUXILIARY CONTACT OPERATING LEVERS SPRING TENSION

With the universal and auxiliary contact operating levers resting on a low part of their respective cams, unhook the operating lever springs at the spring post and hook an 8 oz. scale in the eye of each spring. It should require 6 to 7-1/2 ozs. to pull each spring to its position length. Replace the springs on the spring post. See Figure 23.

AUXILIARY CONTACT BRACKET ADJUSTMENT

The auxiliary contacts should remain closed for the length of time it takes to rotate the main shaft so that a scribed line on the inner timing disc moves a distance equal to the distance between the AC and AO marks on the outer (fixed) timing ring. However, the scribed line does not necessarily have to coincide with the AC or AO marks when the contacts close or open. To adjust, loosen the auxiliary contact bracket mounting screw and position the bracket. To increase the length of time the contacts are closed, position the bracket so that the insulator on the long contact spring is moved away from the cam and closer to the cam if the length of time is to be shortened. Tighten the mounting screw. See Figure 23 for location of parts.

AUXILIARY CAM ADJUSTMENT

- (1) The auxiliary contacts should be closed when the center of one of the lines inscribed on the inner timing disc lines up with the center of the AC mark on the outer (fixed) timing ring. The contacts should remain closed until a line inscribed on the inner timing disc lines up with the AO mark on the outer (fixed) timing ring. To adjust, loosen the auxiliary cam mounting screws and position the cam. Tighten the mounting screws. See Figure 23.

NOTE: If it is found that a line inscribed on the inner timing disc does not coincide with the AO mark on the outer (fixed) timing ring when the contacts open, it will be necessary to refine the AUXILIARY CONTACT BRACKET ADJUSTMENT.

- (2) With the auxiliary contact operating lever on a high part of its cam, the contact points should have a gap of at least .010".

UNIVERSAL CONTACT BRACKET ADJUSTMENT

The universal contacts should remain closed for the length of time it takes to rotate the main shaft so that a scribed line on the inner timing disc moves a distance equal to the distance between the UC and UO marks on the outer (fixed) timing ring. However, the scribed line does not necessarily have to coincide with the UC and UO marks when the contacts close or open. To adjust, loosen the universal contact bracket mounting screw and position the bracket. To increase the length of time the contacts are closed, position the bracket so that the insulator on the long contact spring is moved away from the cam and closer to the cam if the length of time is to be shortened. Tighten the mounting screw. See Figure 23 for location of parts.

UNIVERSAL CAM ADJUSTMENT

- (1) The universal contacts should be closed when the center of one of the lines inscribed on the inner timing disc lines up with the center of the UC mark on the outer (fixed) timing ring. The contacts should remain closed until a line inscribed on the inner timing disc lines up with the center of the UO mark on the outer (fixed) timing ring. To adjust, loosen the universal cam mounting screws and position the cam. See Figure 23.

NOTE: If it is found that a line on the inner timing disc does not coincide with the UO mark on the outer (fixed) timing ring when the contacts open, it will be necessary to refine the UNIVERSAL CONTACT BRACKET ADJUSTMENT.

- (2) With the universal contact operating lever on a high part of its cam, the contact points should have a gap of at least .010".

AUTO-STOP MECHANISM ADJUSTMENT (Figure 24)

- (1) When the contacts are held closed by the contact operating post, the bottom of the auto-stop lever should be horizontal and the auto-stop shaft should protrude approximately 1/16" beyond the clamp. Make the adjustments simultaneously by loosening the clamping screw and positioning the clamp.
- (2) With the contact operating post held away from the left contact spring insulator, there should be .015" to .025" clearance between the contact points and .015" to .025" clearance between the right contact spring insulation and the auto-stop mechanism bracket. To adjust, bend the contact spring.

MAIN SHAFT CLUTCH TORQUE ADJUSTMENT

With the motor running, it should require a pull of 45 to 48 ozs. to hold the operating cam stationary when a 64 oz. scale is hooked over a stop cam lug. This measurement should be made when the unit is warm from recent operation; otherwise, the unit should be operated for at least ten minutes with the friction clutch slipping before the measurement is taken. The operating cam should be relieved of the operating arm load during torque measurement. To adjust, loosen the adjustable clutch disc lock nut and turn the adjustable clutch disc in a clockwise motion to increase the torque and counterclockwise

to decrease the torque. Hold the disc and tighten the lock nut.

REPLACE THE BASE PLATE, LEFT BRACKET, TOP COVER, TAPE EXIT GUIDE, SNAP PANEL, AND *COVER.

SYNCHRONOUS MOTORS - STARTING SWITCH ADJUSTMENTS

The following requirements should not be checked unless there is reason to believe that the starting switch is out of adjustment:

- (1) Remove the motor unit from the base and remove the motor fan and pinion.
- (2) Remove the switch end shield screws and the switch commutator mounting screws. Remove the switch end shield.
- (3) Pull out the rotor until the brush holder spring is accessible and remove the spring.
- (4) The tension of the spring for 60 cycle motors should measure 3 to 3-3/4 ozs. when extended to a length of five inches, using an 8 oz. scale. The tension of the spring for 50 cycle motors should measure 1-1/2 to 2-1/2 ozs. when extended to a length of five inches using an 8 oz. scale.
- (5) The brush holders should be mounted by means of the center set of mounting holes and should be free.
- (6) The brush holder stop pins should be safely within the holes of the fibre disc when all the play in the brush holders has been taken up to make the engagement of the pins with the disc a minimum.
- (7) Replace the brush holder spring, making certain that the spring eyes are fully engaged with each other.
- (8) Replace the switch commutator screws and tighten the two screws alternately a little at a time until both screws are tight.
- (9) Replace the switch end shield screws, using the same precaution in tightening as above.
- (10) Apply the push end of a 12 lb. scale against the fan end of the shaft and push parallel to the shaft. It should require at least 7 lbs. pressure to start the shaft moving.
- (11) Replace the motor fan and pinion. Replace the motor on the base and remake the motor position adjustment.

* * *

* X18 only

LUBRICATION

GENERAL

The oil and grease specified in the supplement furnished with this bulletin should be used to lubricate the REVERSIBLE TRANSMITTER.

Unless otherwise specified, one or two drops of oil at each of the places indicated will be sufficient. Use oil for lubrication at all of the places listed, except where the use of grease or oil-grease-oil is specified.

NOTE: Oil both loops of all helical springs that exert a nominal tension of less than 2-1/2 lbs. Apply grease to both loops of all helical springs that exert a nominal tension of 2-1/2 lbs. or more.

1. Universal and auxiliary cams - thin film of grease on periphery of cams.
2. Universal and auxiliary contacts insulator - thin film of grease.
3. Contact operating levers - pivot.
4. Main shaft - bearings.
5. Clutch felt washers - saturate with oil.
6. Operating lever - bearing (oil hole which runs between top of base casting and operating lever bearing).
7. Stop cam - apply oil-grease-oil to periphery of cam.
8. Stop arm - apply oil-grease-oil to bearings and also to end of arm at point of engagement with cam.
9. Main shaft gear - apply thin film of grease.
10. Motor pinion - apply thin film of grease.
11. Contact lever bail - bearings.
12. Contact levers - bearings.
13. Feed lever - bearing.
14. Feed pawls - bearings.
15. Feed wheel - bearings.
16. Detent lever - bearing.
17. Detent roller - bearing.
18. Retaining lid - bearings.
19. Reversible magnet armature - bearings.
NOTE: Be careful not to get oil between the pole face of the magnet coil and armature.
20. Flexible armature extension on reversing magnet - apply thin film of grease at point of contact with feed pawl operating post.
21. Motor bearings - oilers (two).
22. Operating cam - apply thin film of grease to periphery of cam.
23. Operating cam roller-bearing.
24. Operating lever adjusting screw - apply thin film of grease to head of screw.



FIGURE I

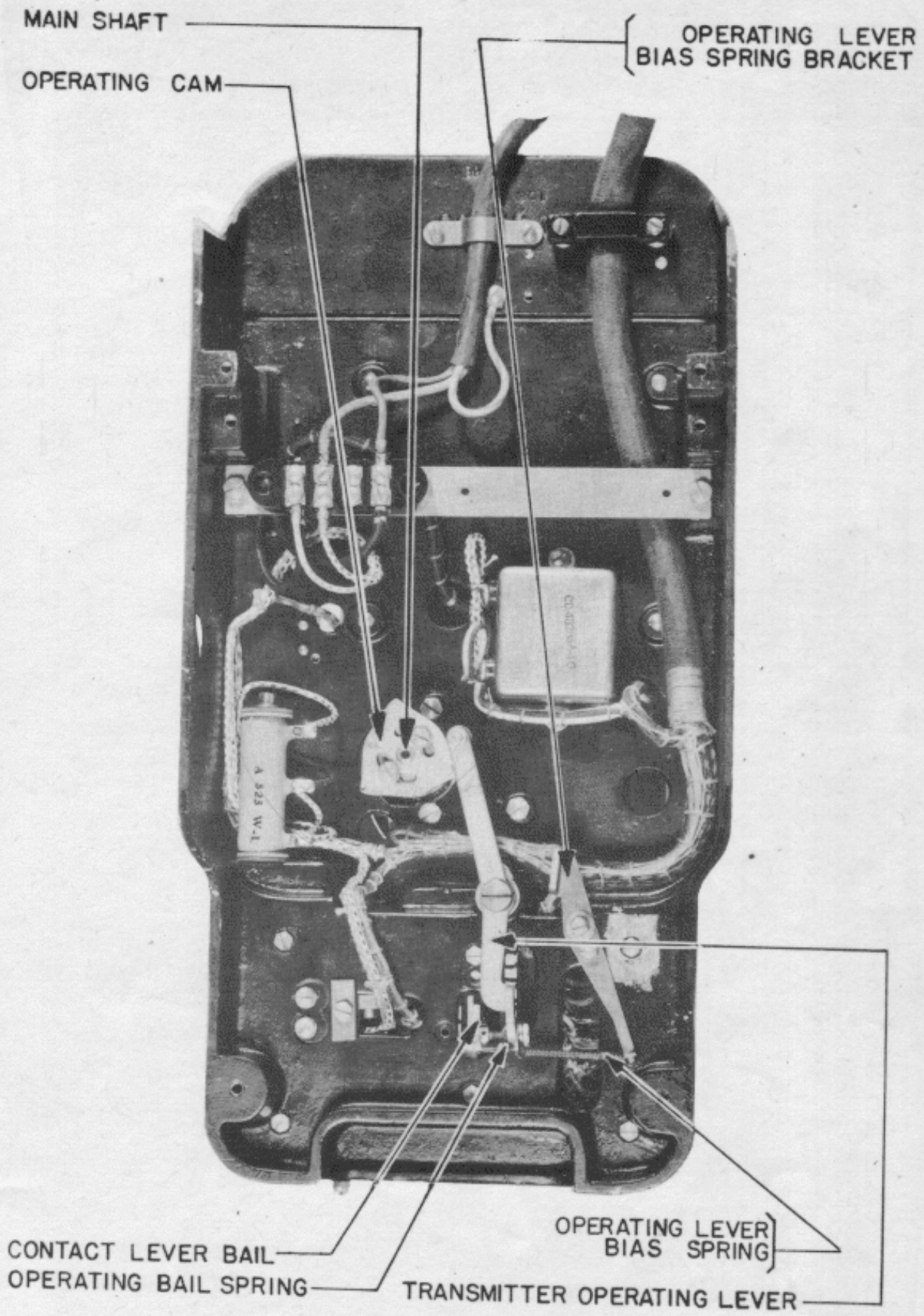


FIGURE 2

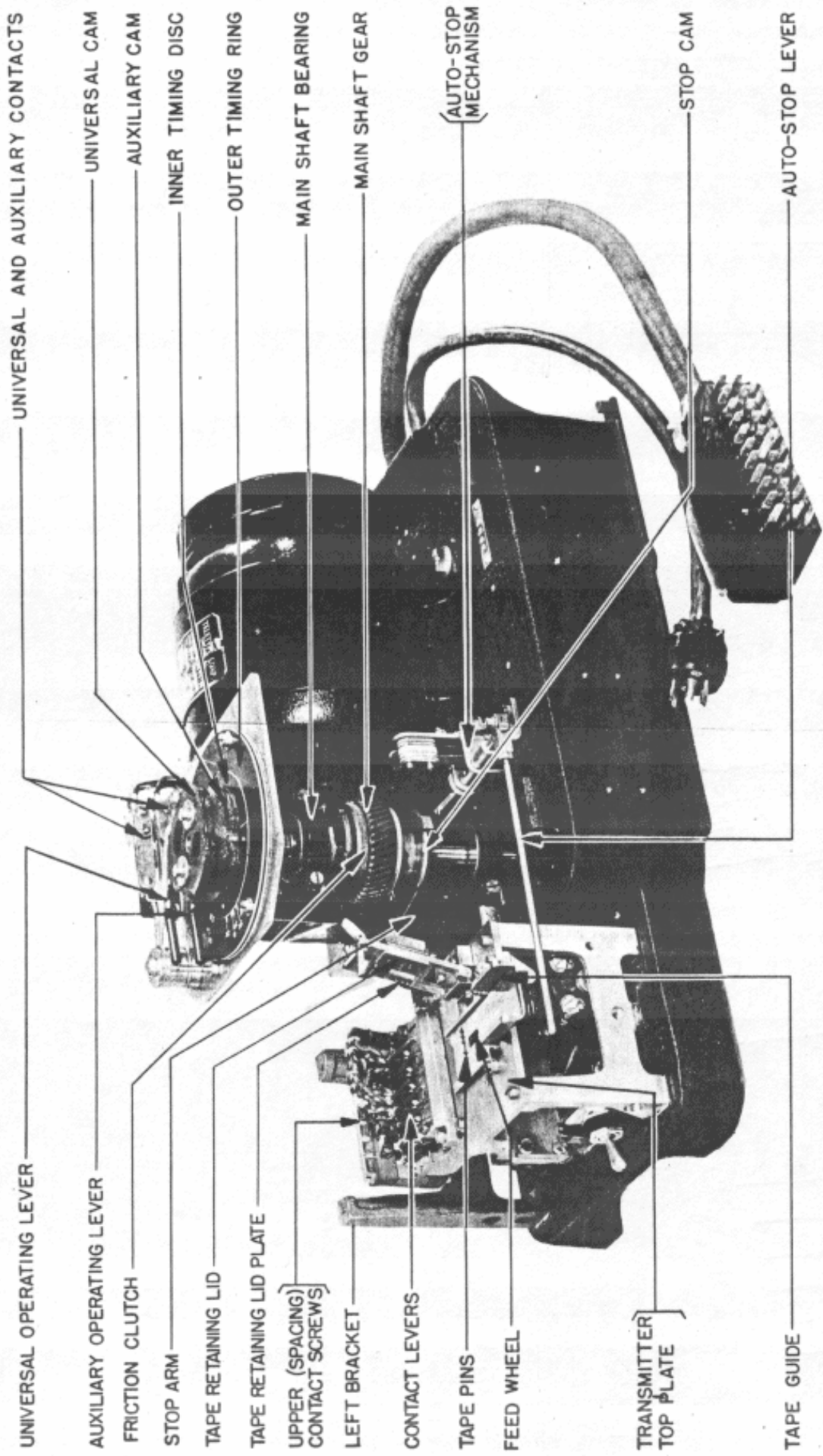


FIGURE 3

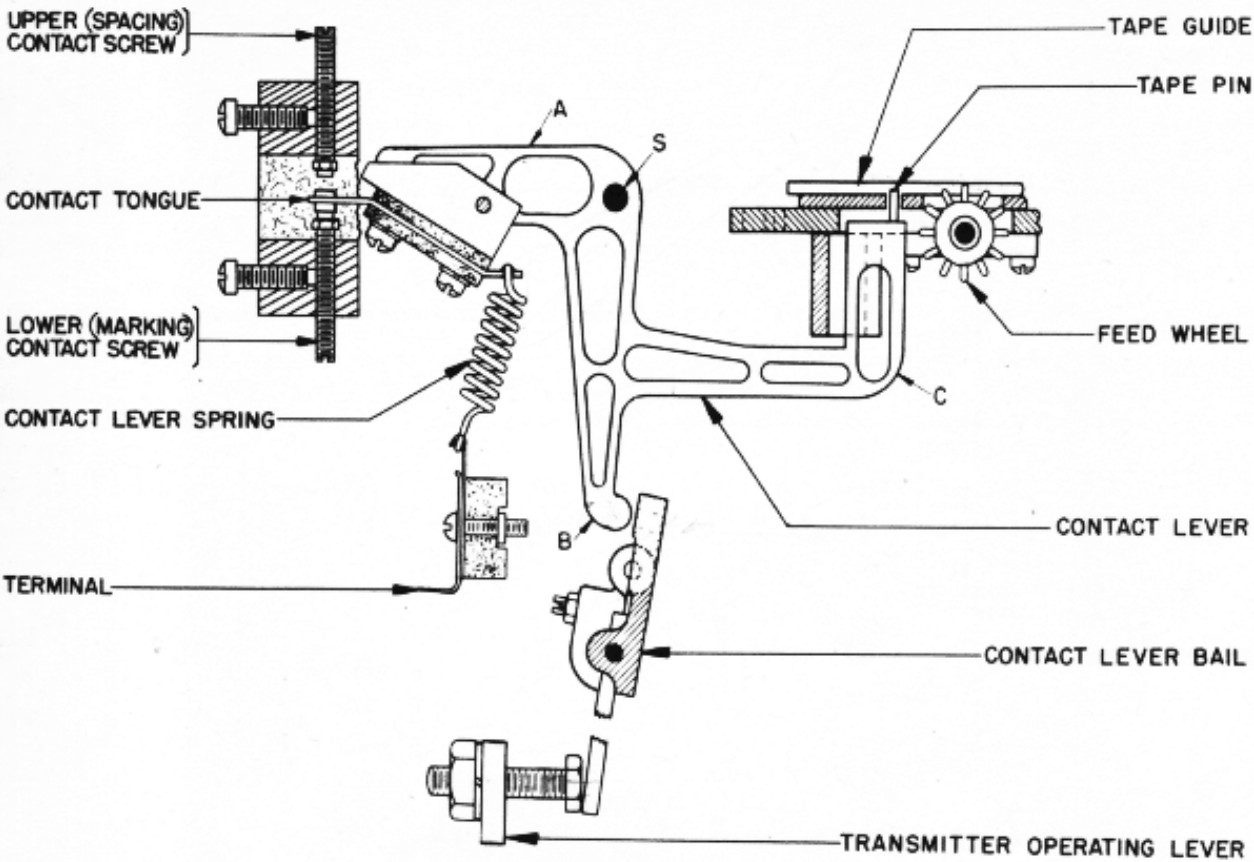


FIGURE 4

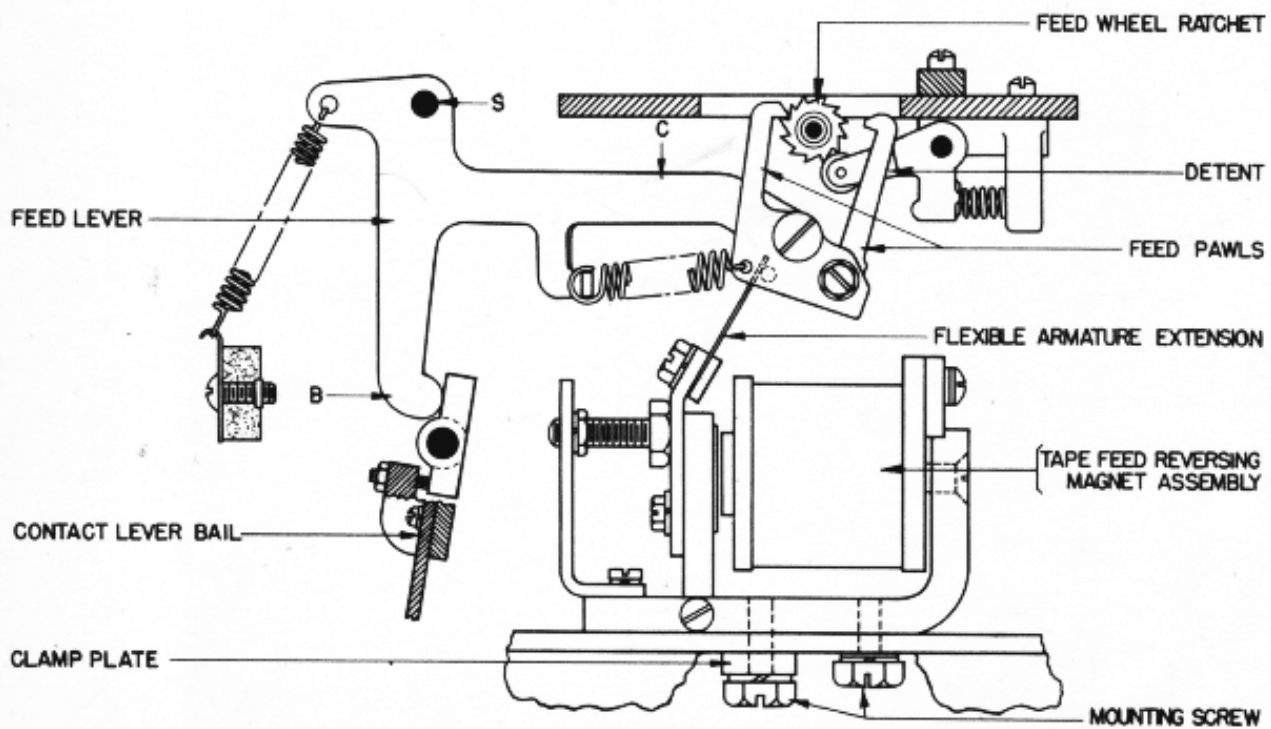


FIGURE 5

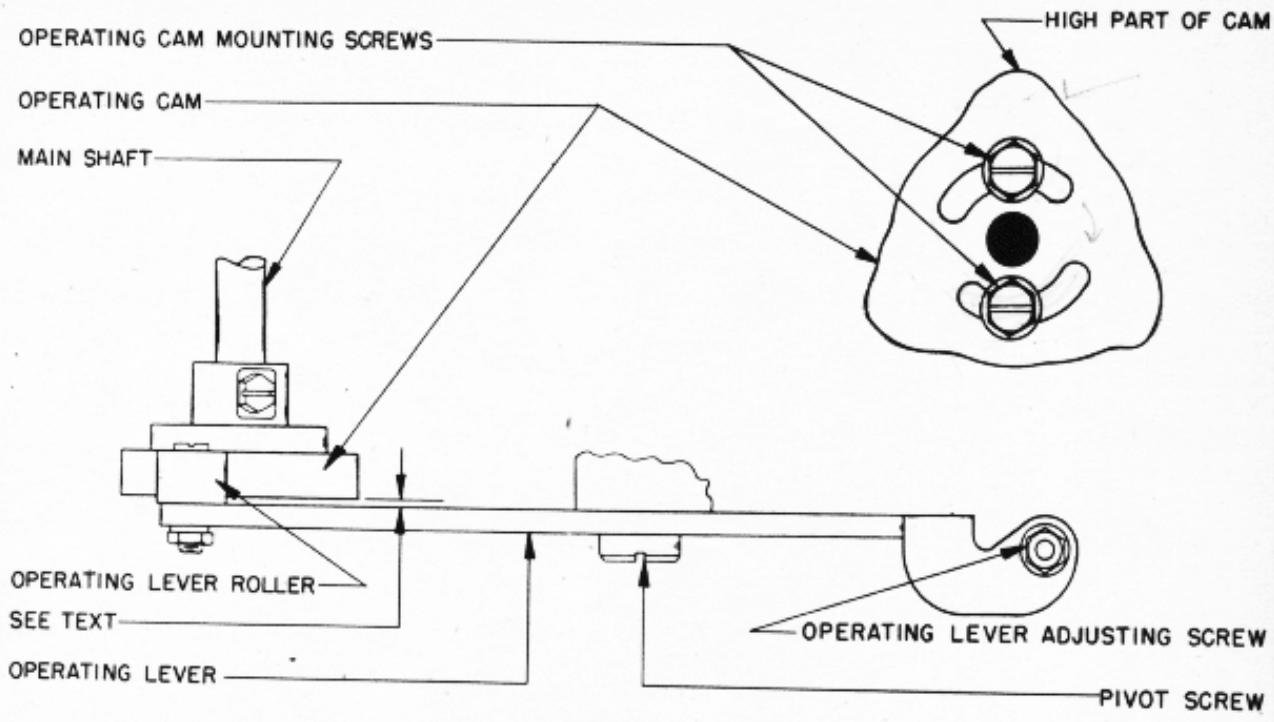


FIGURE 6

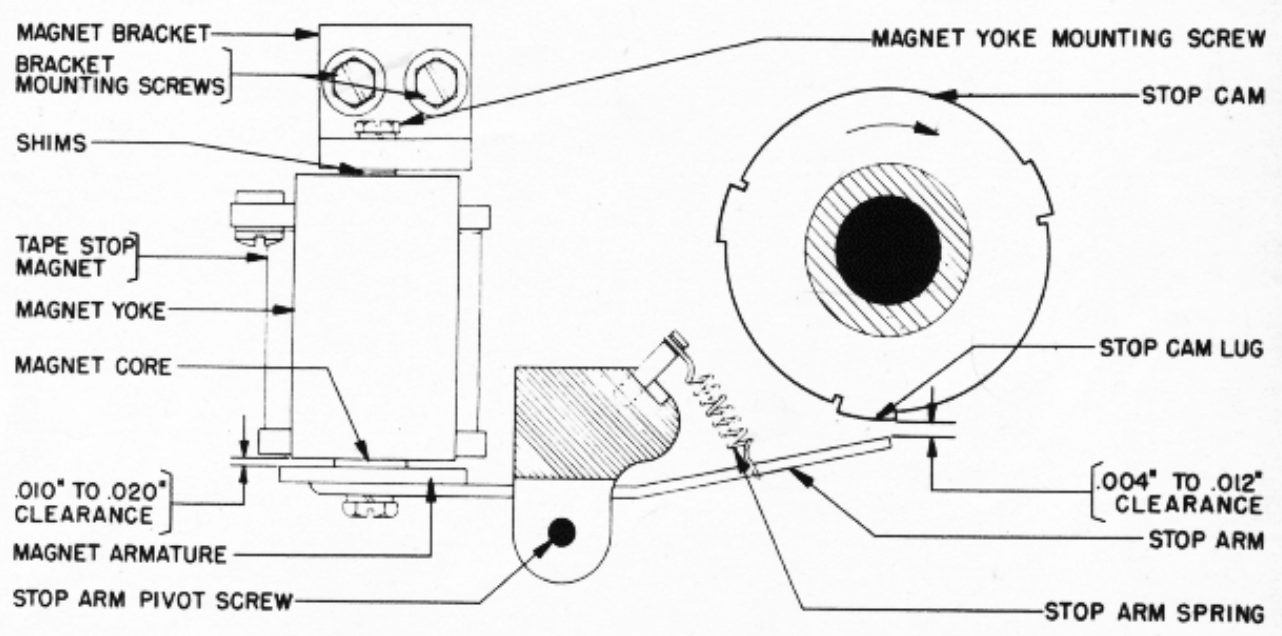


FIGURE 7

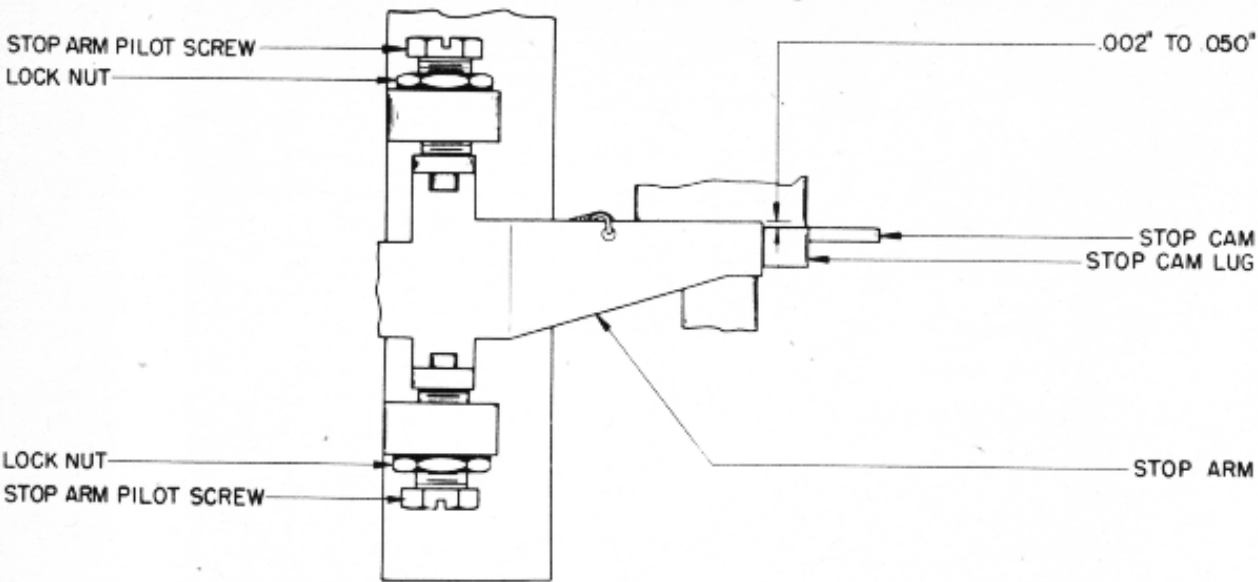


FIGURE 8

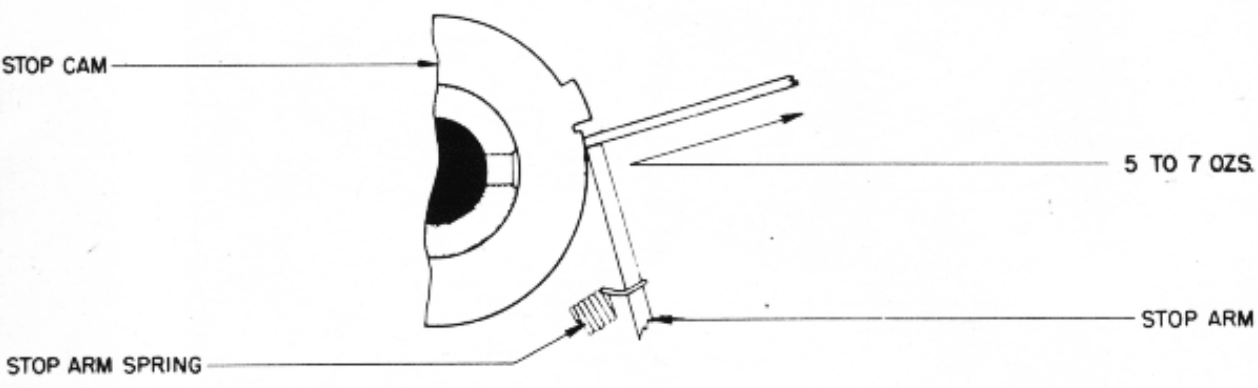


FIGURE 9

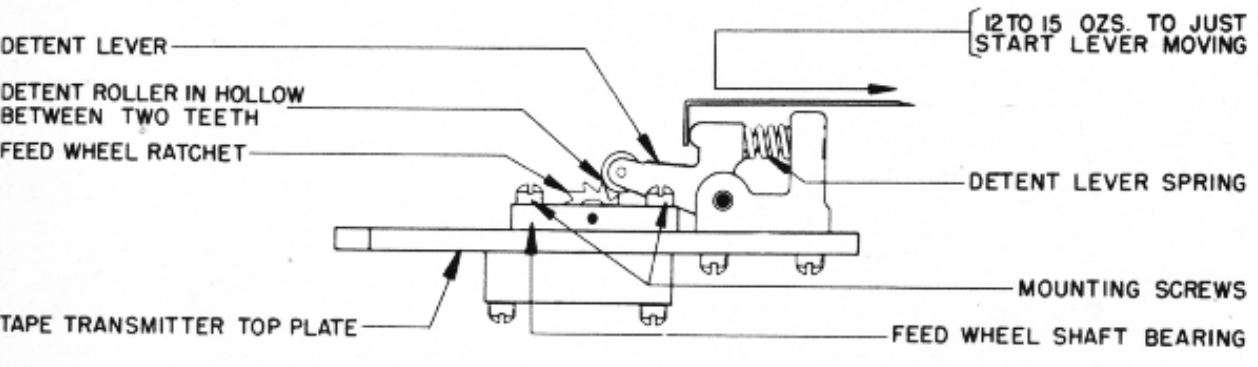


FIGURE 10

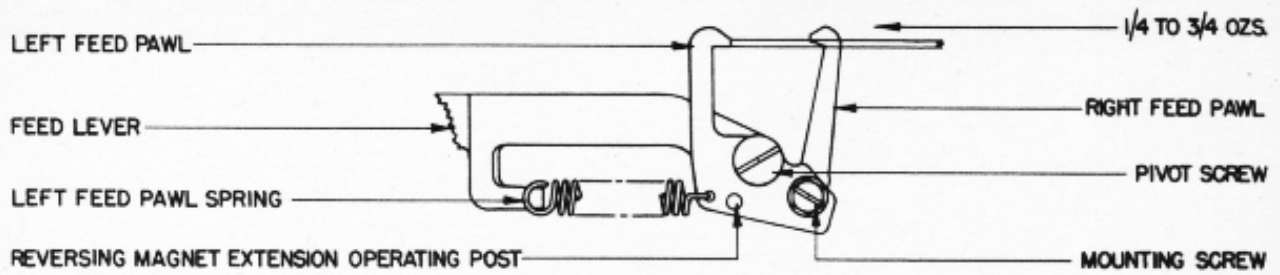


FIGURE 11

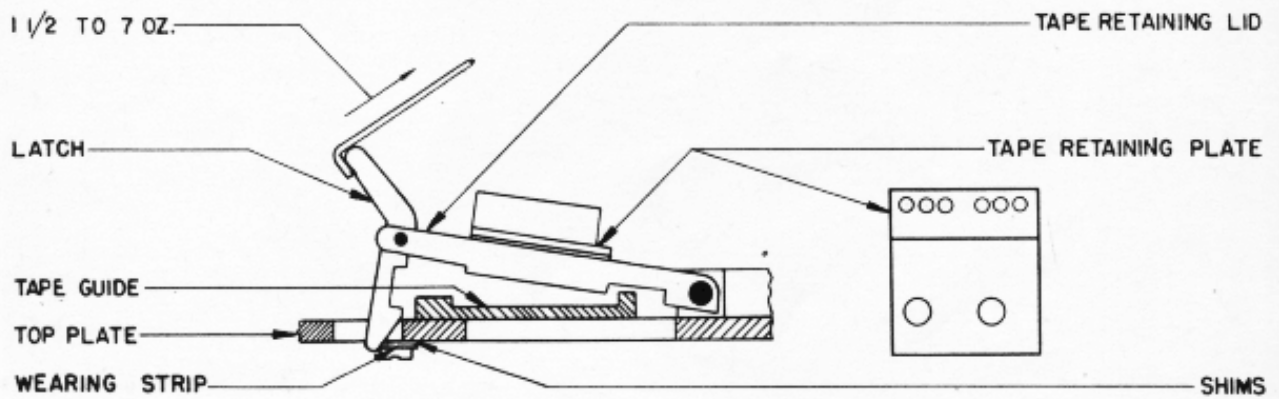


FIGURE 12

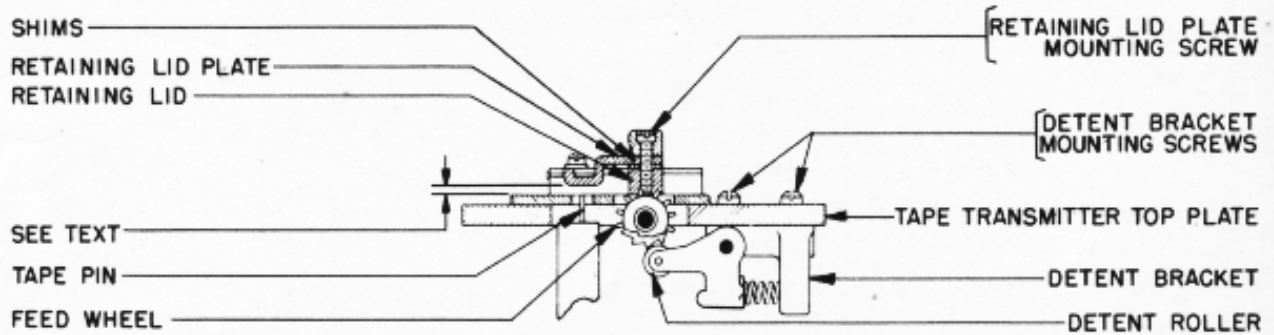


FIGURE 13

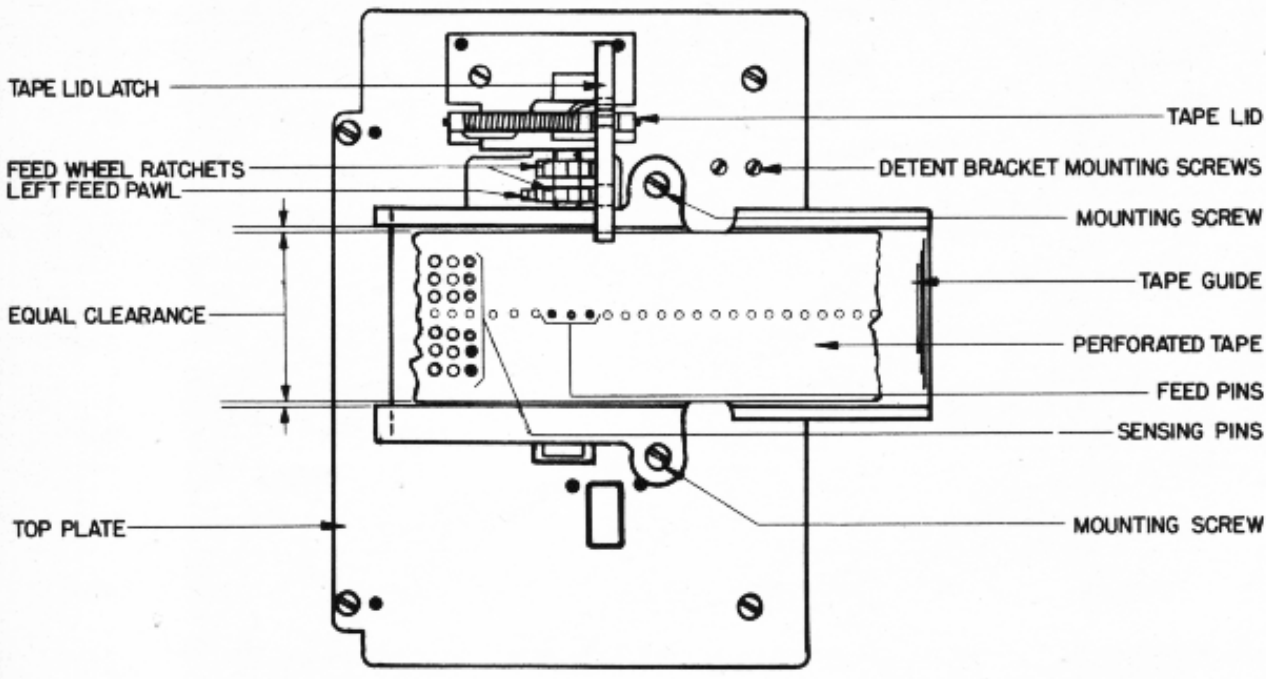


FIGURE 14

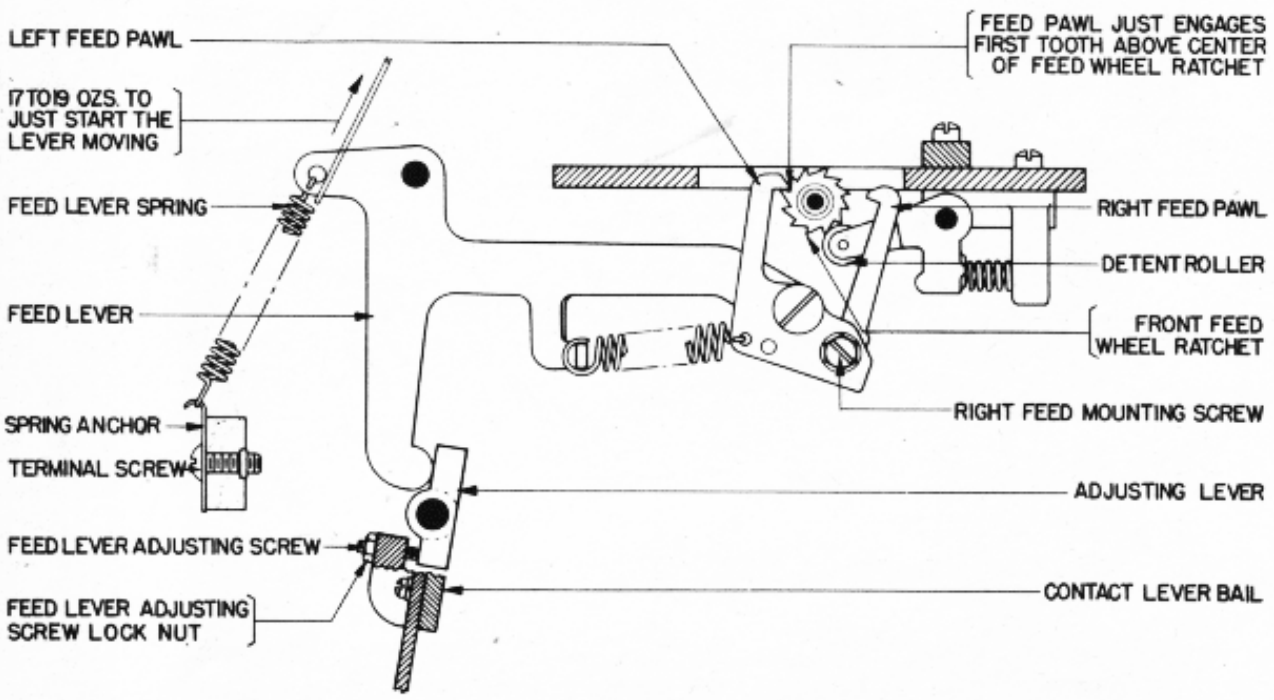


FIGURE 15

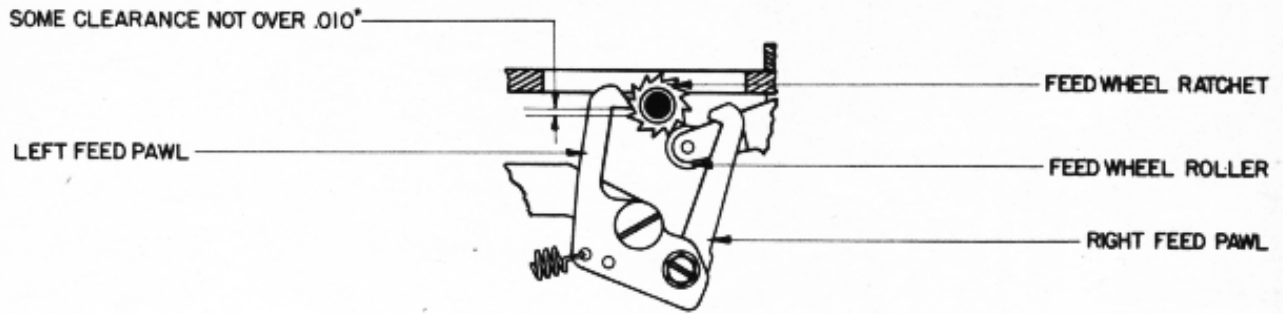


FIGURE 16

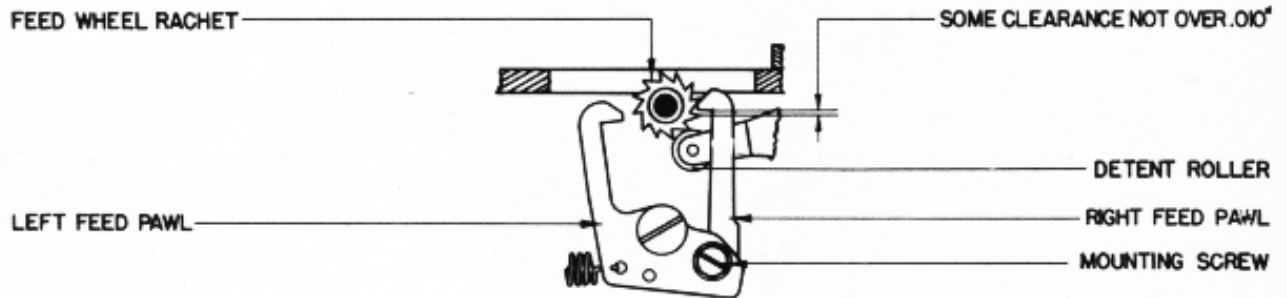


FIGURE 17

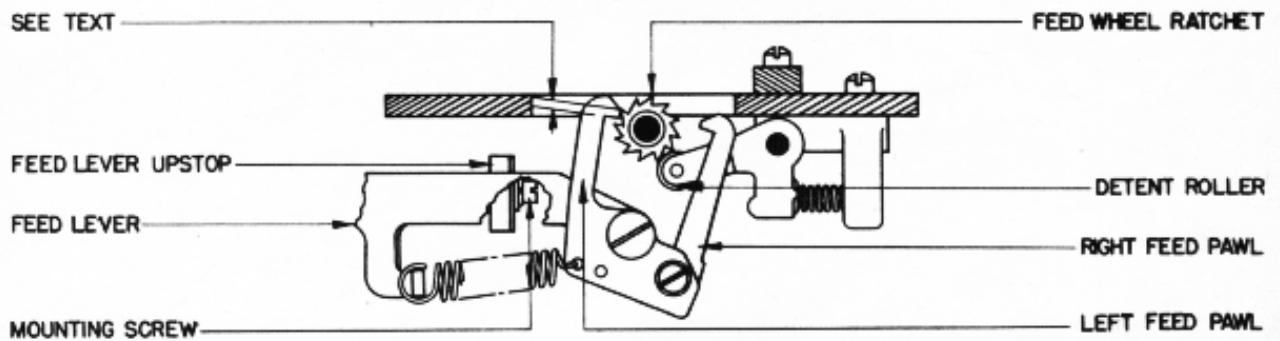
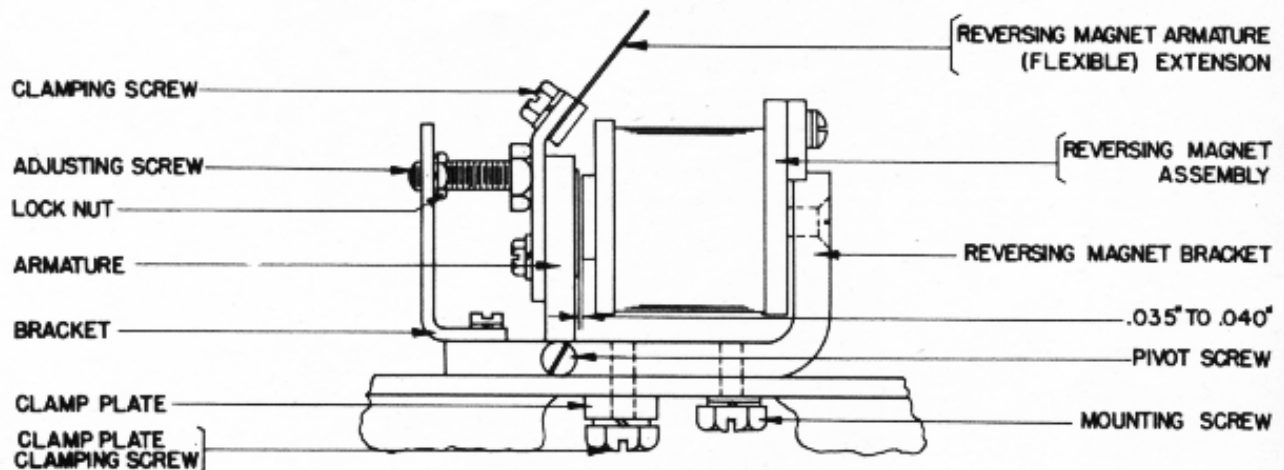
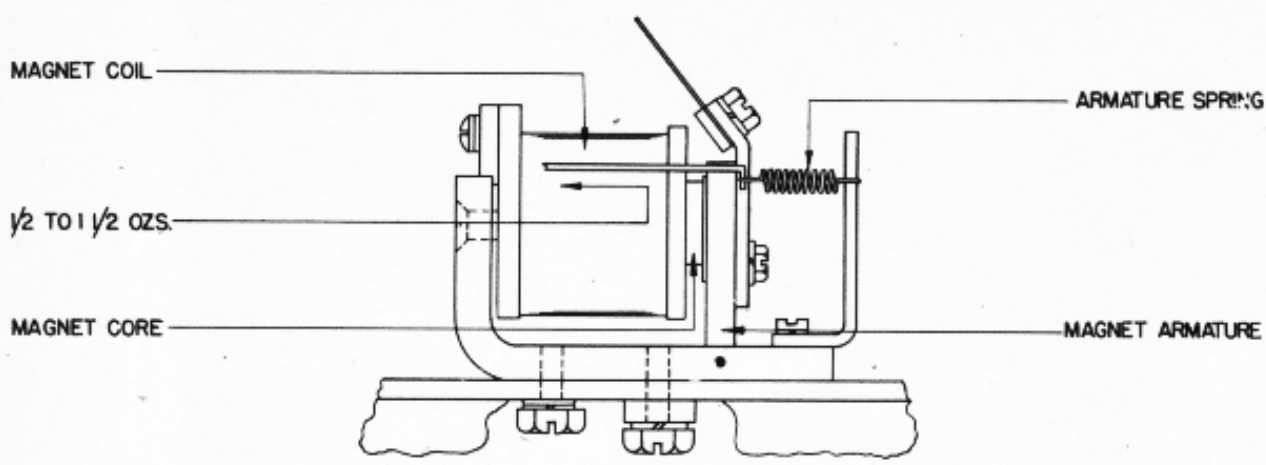


FIGURE 18



FRONT VIEW
FIGURE 19



REAR VIEW
FIGURE 20

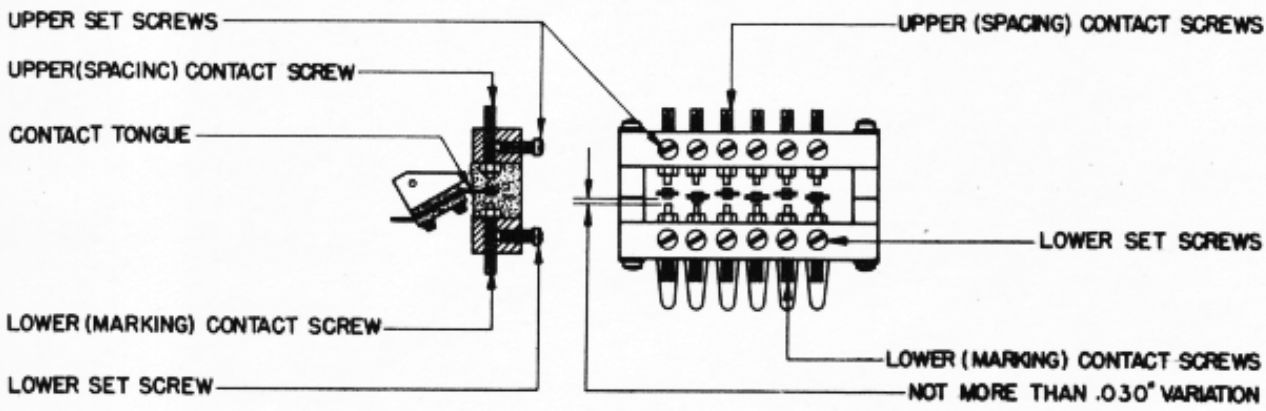


FIGURE 21

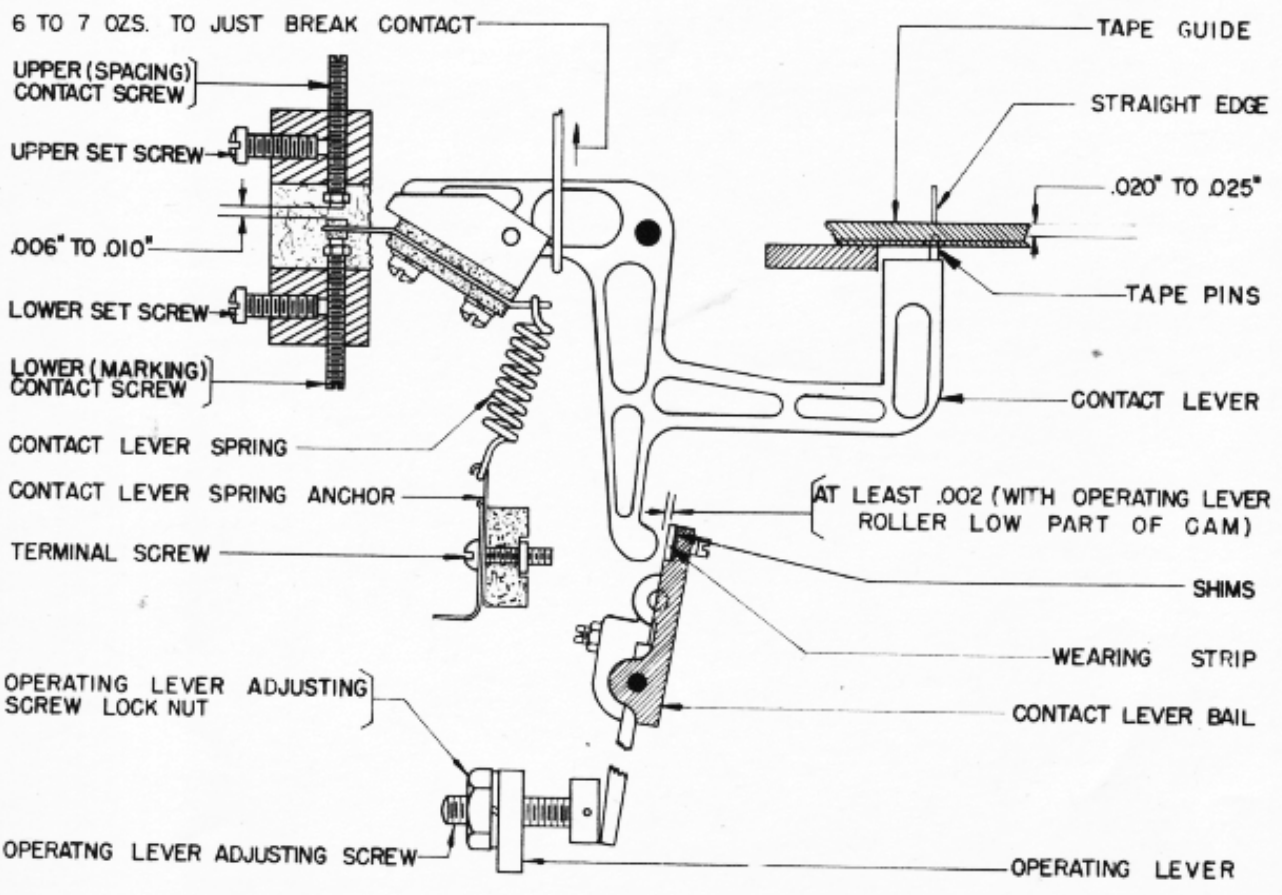


FIGURE 22

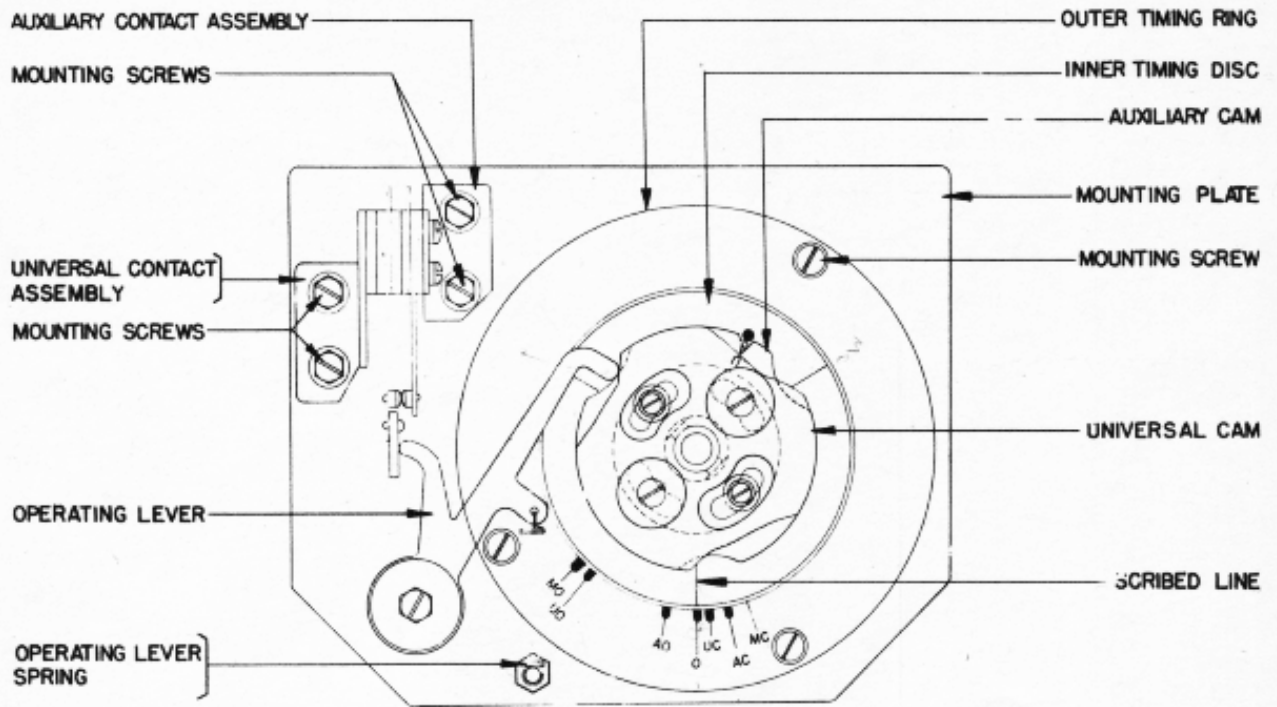


FIGURE 23

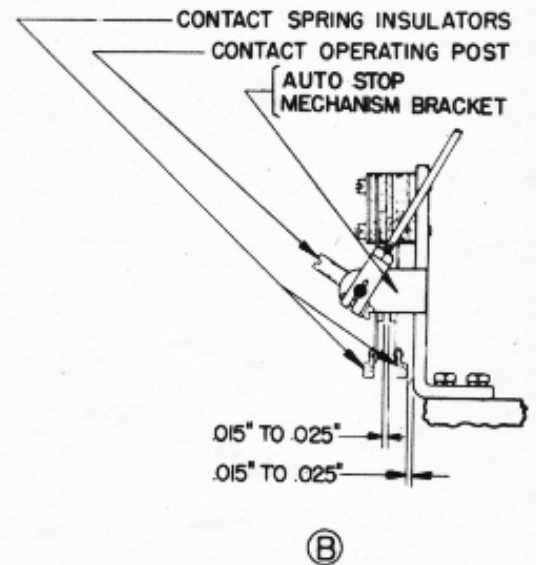
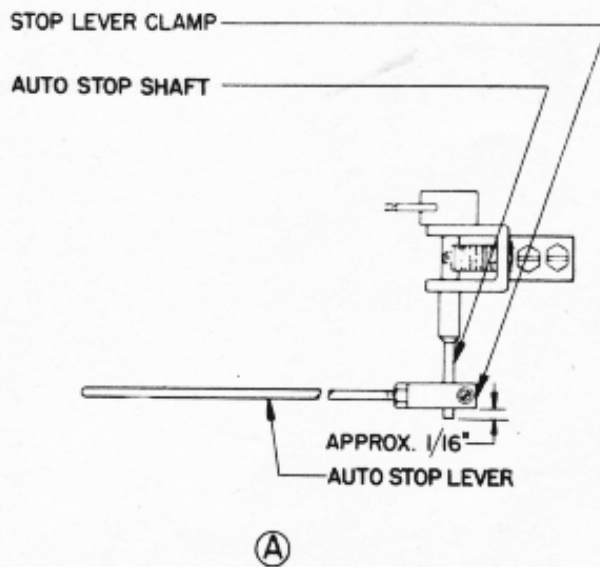


FIGURE 24