Monroe Machine Service Bulletin No. 420-A

MECHANICAL FUNCTIONING

Disassembling - Reassembling - Adjustments - Lubrication

MONROE ADDING-CALCULATORS

Models L 160-X and L 200-X

June 1945

MONROE CALCULATING MACHINE COMPANY, INC.
General Service Department, Orange, New Jersey, U. S. A.

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SPECIFICATIONS

L 160-X
HAND OPERATED CALCULATOR

Equipped with folding legs which elevate the back of the machine so that the keyboard slopes at the proper operating angle when legs are latched outward. By depressing latch protruding from bottom of machine, these legs fold into the bottom when the machine is to be put away. A carrying case is furnished with this model.

Capacity:	Keyboard	- 8 columns
	Upper dials	- 8 places
	Lower dials	- 16 places
Weight:	8 pounds	

L 200-X
HAND OPERATED CALCULATOR

Equipped with proper built-in keyboard slope, (legless). A larger carrying case is furnished for this model.

Capacity:	Keyboard	- 10 columns
	Upper dials	- 10 places
	Lower dials	- 20 places
Weight:	11 pounds	

INDEX

The hand operated "L" models illustrated and described in this bulletin are the basic machines of the various L, LA, M, MA, and A-1 lines and their fundamental mechanism and its method of function can be found in all models of Monroe Calculators. The "L" machine is comprised of two main sections; namely, base and carriage. The major units of the base are side and cross frames, selecting gear shaft, wedge shaft, carry shaft, selecting balls and keyboard. The major units of the carriage consists of a shell, lower dial shaft, upper dial shaft, lift cam shaft, trip rod, hinge rod, clearout gears and crank.

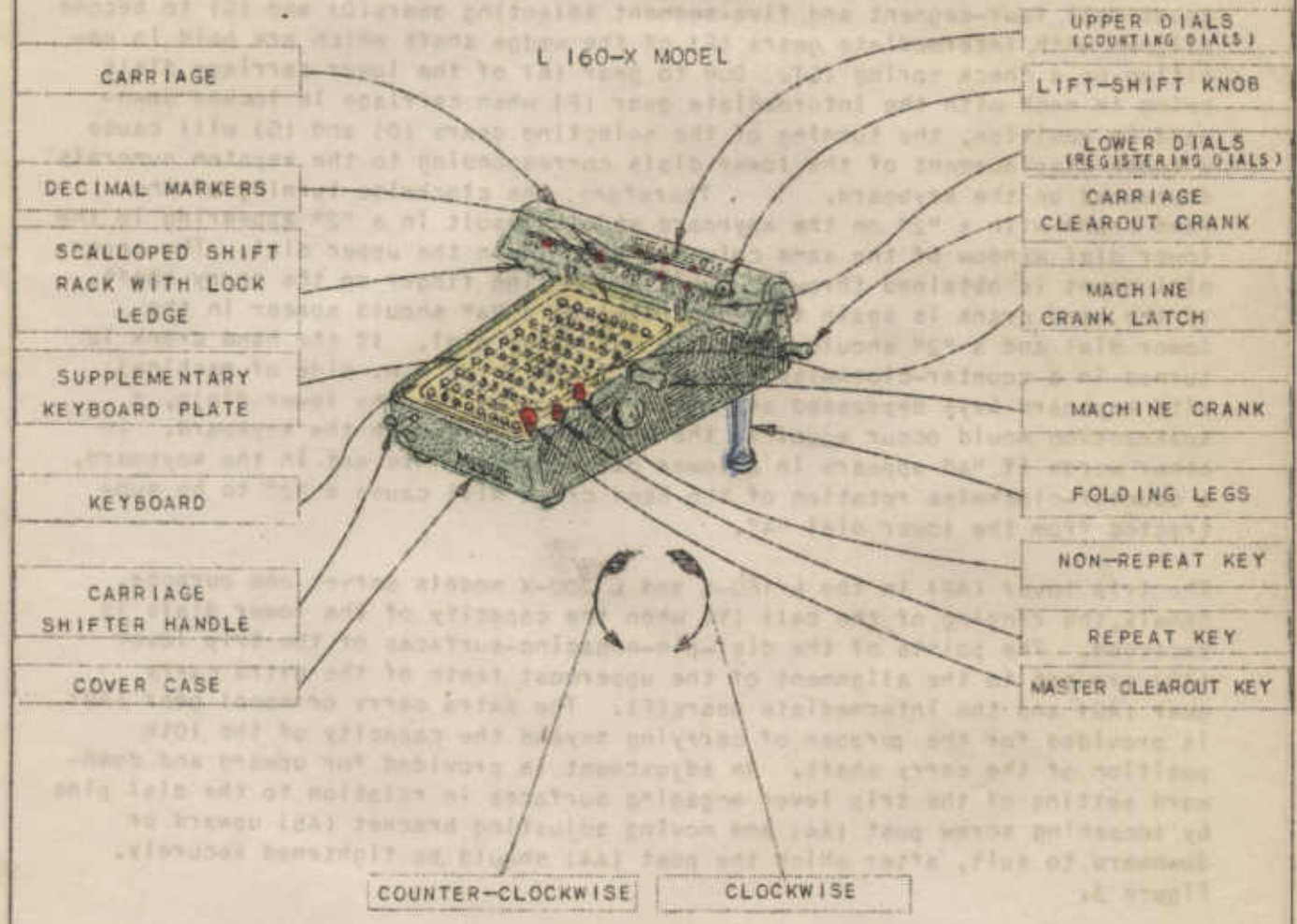


FIGURE 1

Calculating is accomplished on "L" model machines through the turning of the machine hand crank in either a clockwise or counter-clockwise direction with one or more numeral keystems depressed in the keyboard. Addition and multiplication are accomplished by turning the crank clockwise and subtraction and division by turning the crank counter-clockwise. This simple reversible action is the principle underlying the operation of every Monroe Calculator.

FUNCTION EXPLANATION

The depression of a numeral keystem below digit "5" causes a camming surface (Q) on the bottom of keystem (P), Figure 3, to engage a lug (R) on a "four-side" selecting bail (U) and pivot the bail inward on pivot studs (A2). Two extensions (Z) of the bail rest against the outer surface of a selecting gear (G) and through this pivoting motion cause the selecting gear to move inward and into alignment with the intermediate gears. The selecting gear presents one or more of its segments corresponding to keystems depressed in keyboard, to an intermediate gear (F) of the wedge shaft (B3) when the machine crank is used. When numeral keystem of digit "5" is depressed, a lug on the "five-side" bail is engaged by camming surface (D2); however when any keystem above digit "5" is depressed, both camming surfaces on the bottom of the keystem (W), Figure 4, engage lugs of both "four-side" and "five-side" bails, and thereby cause both four-segment and five-segment selecting gears (D) and (G) to become aligned with intermediate gears (F) of the wedge shaft which are held in position by a check spring (C). Due to gear (K) of the lower carriage dials being in mesh with the intermediate gear (F) when carriage is locked downward in position, the turning of the selecting gears (D) and (G) will cause a tooth displacement of the lower dials corresponding to the keystem numerals depressed on the keyboard. Therefore, the clockwise turning of the hand crank with a "2" on the keyboard should result in a "2" appearing in the lower dial window of the same column and a "1" in the upper dial. The upper dial count is obtained through use of a counting finger on the carry shaft. If the hand crank is again turned clockwise, a "4" should appear in the lower dial and a "2" should appear in the upper dial. If the hand crank is turned in a counter-clockwise direction (looking at R.H. side of machine) with keyboard keys depressed and with a factor set in the lower dials, a subtraction would occur equal to the digits depressed in the keyboard. In other words if "4" appears in a lower dial and a "2" is set in the keyboard, a counter-clockwise rotation of the hand crank will cause a "2" to be subtracted from the lower dial "4".

The trip lever (A8) in the L 160-X and L 200-X models serves one purpose, namely, the ringing of the bell (Y) when the capacity of the lower dials is exceeded. The points of the dial-pin-engaging-surfaces of the trip lever (A8) are set to the alignment of the uppermost teeth of the extra carry gear (A9) and the intermediate gears (F). The extra carry or spool gear (A9) is provided for the purpose of carrying beyond the capacity of the 10th position of the carry shaft. An adjustment is provided for upward and downward setting of the trip lever engaging surfaces in relation to the dial pins by loosening screw post (A4) and moving adjusting bracket (A5) upward or downward to suit, after which the post (A4) should be tightened securely. Figure 3.

The check pawl (X5), Figures 29 and 30, serves the purpose of a brake and positioner on the extreme left intermediate gear of the wedge shaft, whereas check pawl (X6) serves the same purpose on the extra carry gear (A9.) In addition to serving as a brake to prevent drifting or overthrow of these gears that are not controlled by the check spring, the check pawls assist in moving these two gears into full tooth displacement.

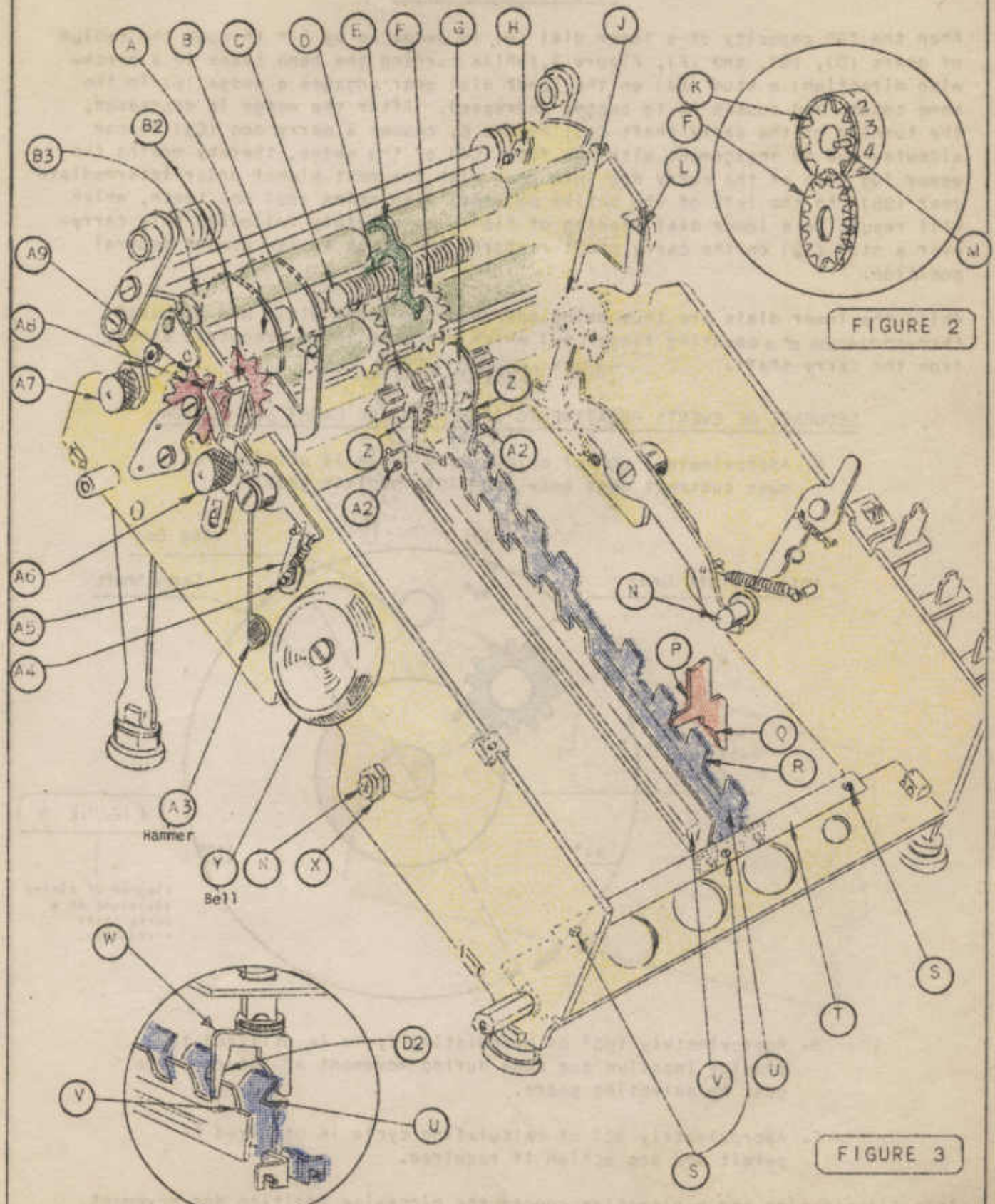


FIGURE 2

FIGURE 3

FIGURE 4

FUNCTION EXPLANATION

When the "9" capacity of a lower dial (M) is exceeded by "1" through the medium of gears (D), (G), and (F), Figure 3, (while turning the hand crank in a clockwise direction) a stud (B4) on the lower dial gear engages a wedge (E) in the same column and causes it to become depressed. After the wedge is depressed, the turning of the carry shaft (A), Figure 6, causes a carry dog (C3) to cam sidewise due to engagement with the foot (C4) of the wedge, thereby moving the upper lug (B6) of the carry dog into mesh with the next higher order intermediate gear (B5) (to the left of the active columns) displacing (B5) one tooth, which will result in a lower dial reading of "10". Immediately following this carry-over a stud (C2) on the carry shaft restores the wedge to its upward neutral position.

While the lower dials are thus being operated the upper dials are revolved through the use of a counting finger (H) which operates in an eccentric stroke from the carry shaft.

SEQUENCE OF EVENTS RELATIVE TO SELECTION AND CARRY DOG ACTION

A. Approximately 90° of calculating cycle is utilized to move subtract dogs away from intermediate gear.

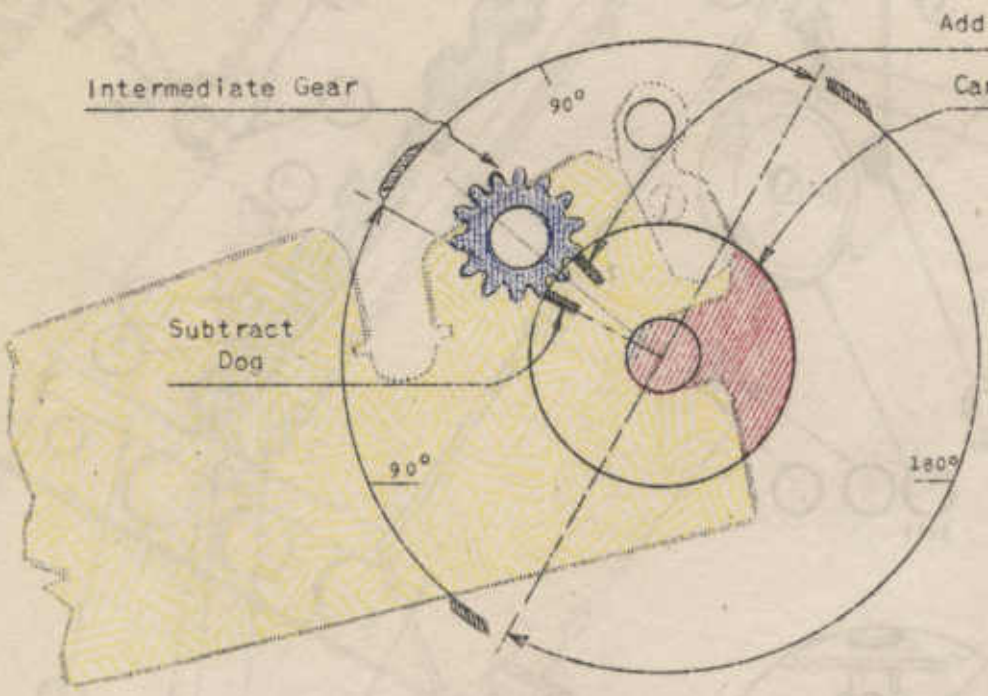


FIGURE 5

Diagram of timing divisions of a carry shaft revolution.

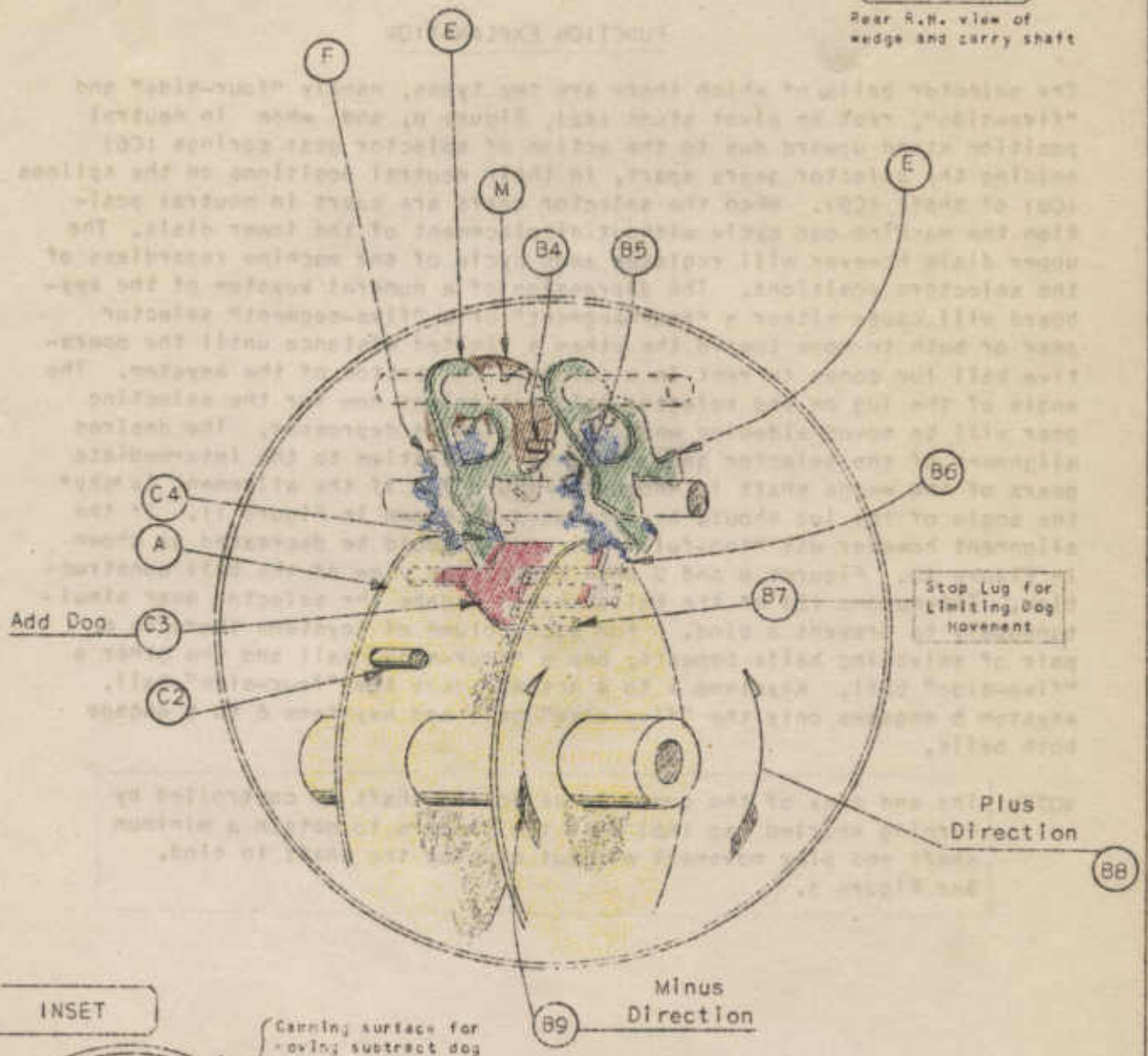
B. Approximately 180° of calculating cycle is utilized to provide inactive dog zone during movement of intermediate gear by selecting gears.

C. Approximately 90° of calculating cycle is utilized to permit add dog action if required.

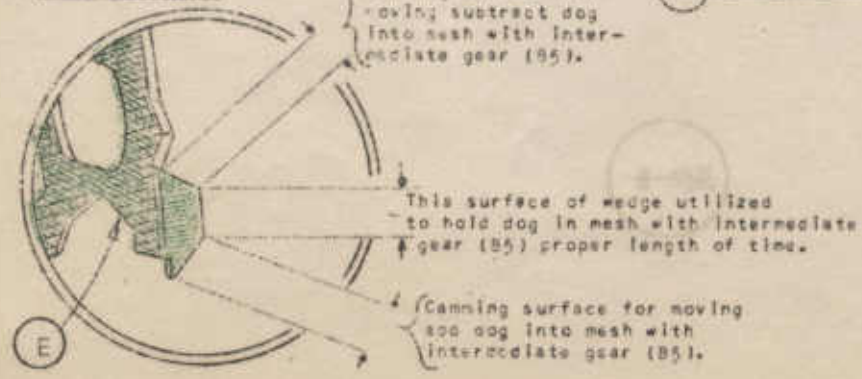
This illustration and explanation covers the clockwise, addition dog movement. The subtract dog movement is the reverse of the above.

FIGURE 6

Rear R.H. view of wedge and carry shaft



INSET



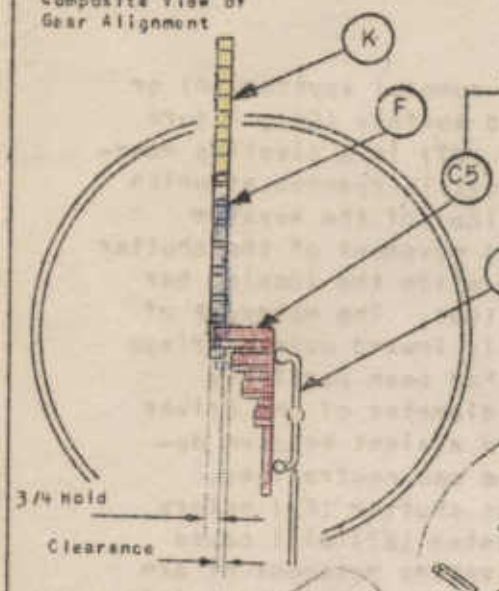
FUNCTION EXPLANATION

The selector bails of which there are two types, namely "four-side" and "five-side", rest on pivot studs (A2), Figure 8, and when in neutral position stand upward due to the action of selector gear springs (C6) holding the selector gears apart, in their neutral positions on the splines (C8) of shaft (C9). When the selector gears are apart in neutral position the machine can cycle without displacement of the lower dials. The upper dials however will register each cycle of the machine regardless of the selectors positions. The depression of a numeral keystem of the keyboard will cause either a "four-segment" or a "five-segment" selector gear or both to move toward the other a limited distance until the operative bail lug comes to rest in a notch in the bottom of the keystem. The angle of the lug on the selector bail determines how far the selecting gear will be moved sidewise when the keystem is depressed. The desired alignment of the selector gear segments in relation to the intermediate gears of the wedge shaft is shown in Figure 7. If the alignment is "shy" the angle of the lug should be increased as shown in Figure 11. If the alignment however was "too-full" the angle should be decreased as shown in Figure 10. Figures 8 and 9 show a skeleton view of the bail construction. Extensions (Z) of the bails should engage the selector gear simultaneously to prevent a bind. For each column of keystems there is a pair of selecting bails beneath; one a "four-side" bail and the other a "five-side" bail. Keystems 1 to 4 actuate only the "four-side" bail, keystem 5 engages only the "five-side" bail and keystems 6 to 9 engage both bails.

NOTE: The end play of the complete selecting shaft is controlled by turning knurled cap (A6) with the fingers to obtain a minimum shaft end play movement without causing the shaft to bind. See Figure 3.

FIGURE 7

Composite View of Gear Alignment



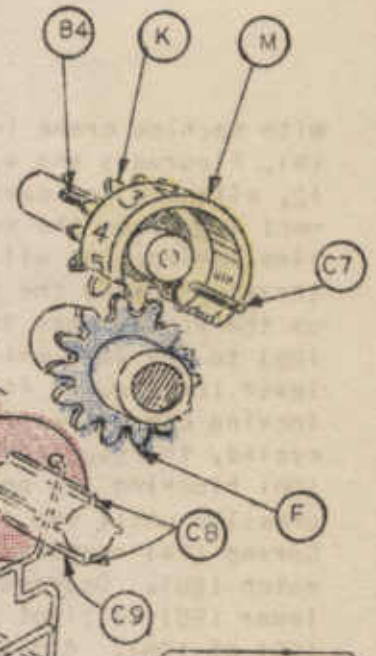


FIGURE 8

Skeleton View of Selecting Balls

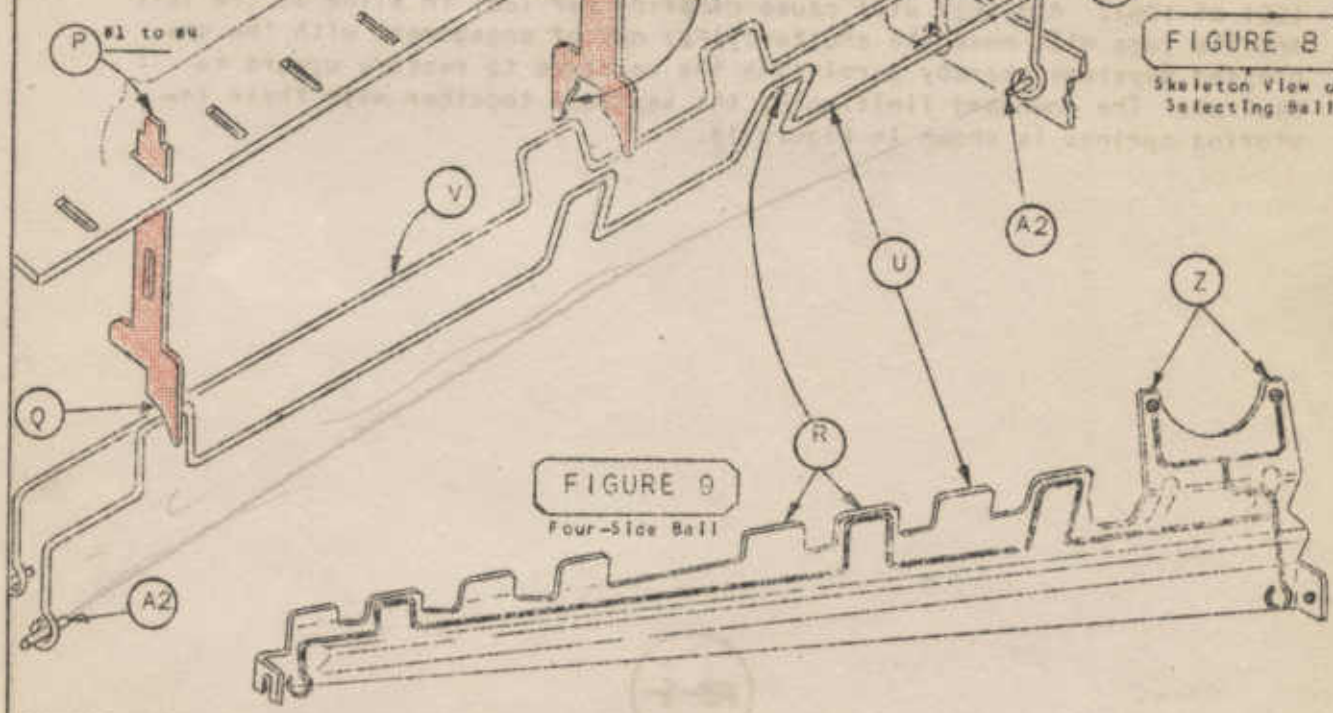


FIGURE 9

Four-Side Ball

FIGURE 10

ADJUSTMENT

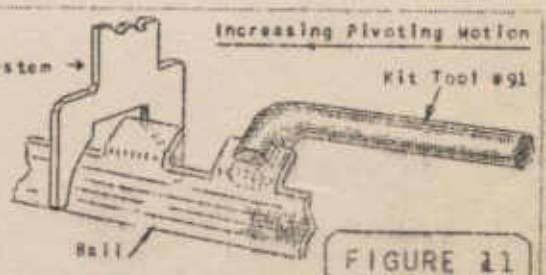


FIGURE 11

FUNCTION EXPLANATION

With machine crank in neutral, the depression of a numeral keystem (P) or (W), Figures 3 and 4, through the medium of beveled surface (E9), Figure 12, will cam keyboard locking shutter (F2) on pins (D7) in a pivoting movement away from the keystem until the depression limit is reached at which time spring (D8) will pull the shutter into notch (E8) of the keystem thereby locking the keystem downward. The pivoting movement of the shutter as the keystem was depressed caused the shutter to slide the locking bar (D3) to the left which in turn pivoted lock lever (D4). The movement of lever (D4) caused its stud (D5) to swing momentarily inward over carriage locking cam driver (D6). If however, the machine had been partially cycled, the stud (D5) would have found the larger diameter of the driver (D6) blocking its path thereby locking the keyboard against keystem depression until the cycling mechanism of the machine was neutralized. Spring (F4) restores locking bar (D3) to neutral as shutter (F2) enters notch (E8). Depression of the master clearing keystem (E7) will cause lever (E5) to pivot at (E4) and in turn cause a pivoting movement of arm (E2) at (D9). Arm (E2) will cause clearing bar (E6) to slide to the left and its lugs will move the shutters (F2) out of engagement with the depressed keystems thereby permitting the keystems to restore upward to neutral. The downward limiting of the keystems together with their restoring springs is shown in Figure 13.

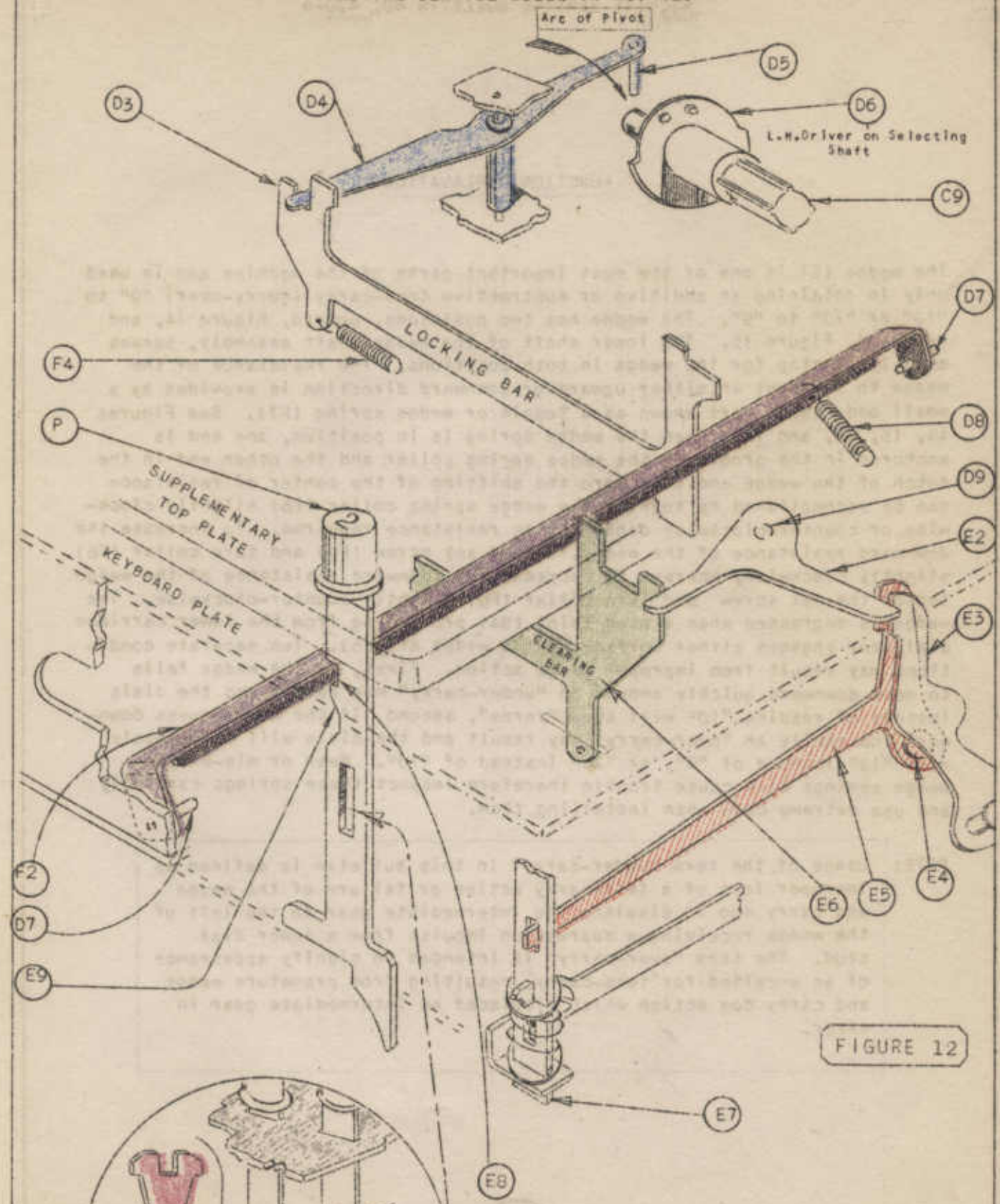


FIGURE 12

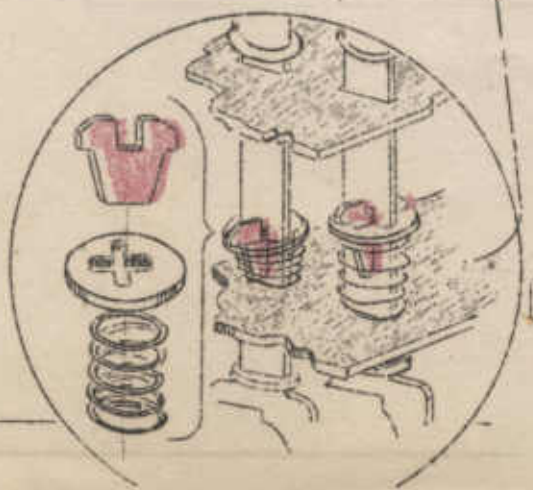


FIGURE 13

FUNCTION EXPLANATION

The wedge (E) is one of the most important parts of the machine and is used only in obtaining an additive or subtractive tens-carry (carry-over) "9" to "10" or "10" to "9". The wedge has two positions, upward, Figure 14, and downward, Figure 15. The lower shaft of the wedge shaft assembly, serves as a limit stop for the wedge in both positions. The resistance of the wedge to movement in either upward or downward direction is provided by a small odd-shaped part known as a toggle or wedge spring (F7). See Figures 14, 15, 16, and 17. When the wedge spring is in position, one end is anchored in the groove of the wedge spring collar and the other end in the notch of the wedge and therefore the shifting of the center of resistance can be accomplished by turning the wedge spring collar (F6) slightly clockwise or counter-clockwise dependent on resistance required. To increase the downward resistance of the wedge, loosen set screw (F9) and turn collar (F6) slightly clockwise, whereas to decrease the downward resistance of the wedge loosen the set screw and turn collar (F6) slightly counter-clockwise. The wedge is depressed when a stud (pin) (B4) protruding from the lower carriage dial gear engages either surface of the wedge at (F5). Two separate conditions may result from improper wedge action. First, if the wedge fails to move downward quickly enough an "under-carry" may result and the dials instead of reading "10" will show "zeros", second, if the wedge moves downward too easily an "over-carry" may result and the dials will erroneously read "19" instead of "9", or "20" instead of "10". Weak or mis-shapen wedge springs will cause trouble therefore inspect these springs carefully and use extreme care when installing them.

NOTE: Usage of the term "under-carry" in this bulletin is defined as improper loss of a tens-carry action or failure of the wedge and carry dog to displace the intermediate gear to the left of the wedge receiving a depression impulse from a lower dial stud. The term "over-carry" is intended to signify appearance of an uncalled-for "tens-carry", resulting from premature wedge and carry dog action which displaced an intermediate gear in error.

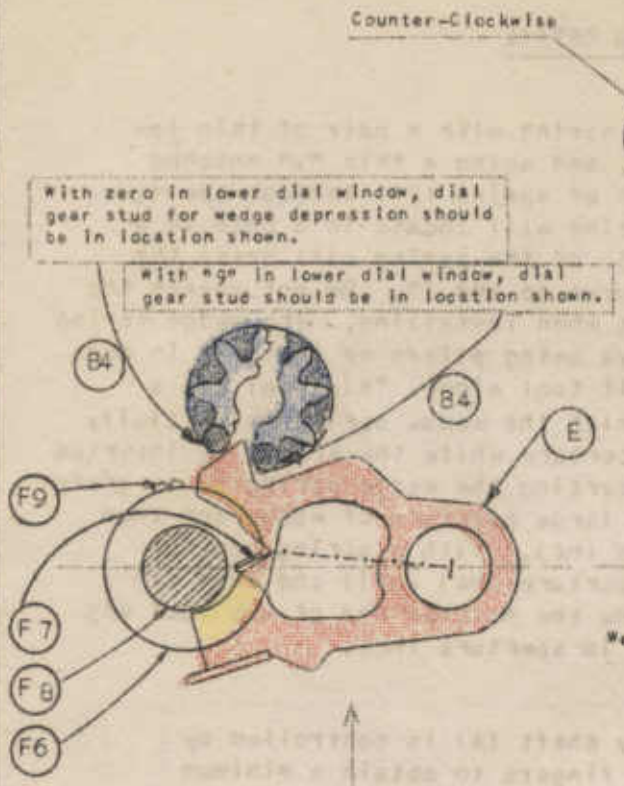


FIGURE 14

Wedge in upward position

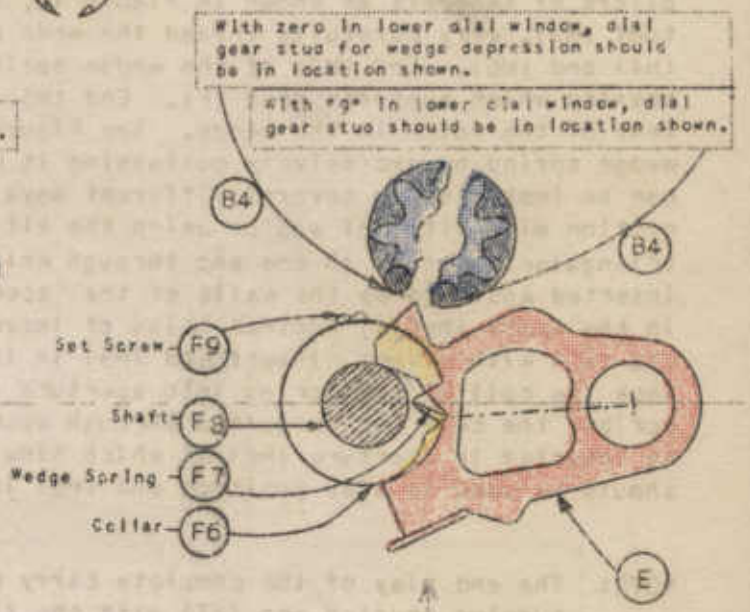


FIGURE 15

Wedge Depressed

FIGURE 16

Wedge in upward position

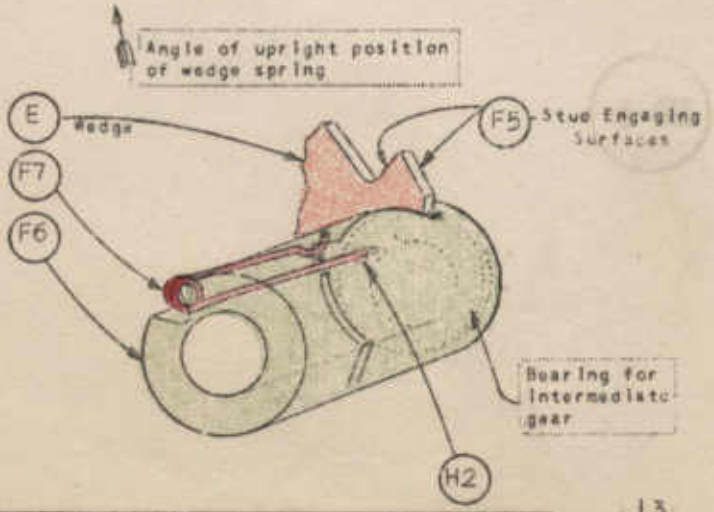
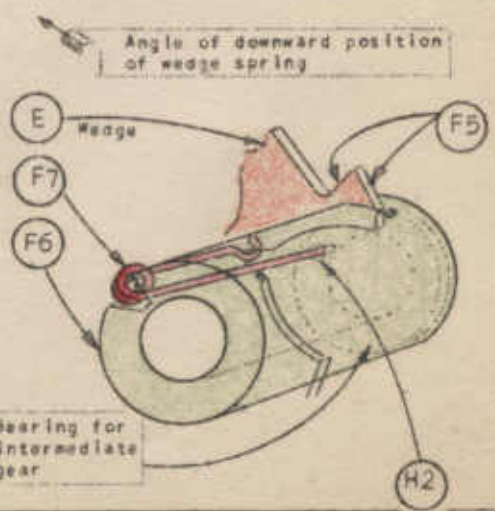


FIGURE 17

Wedge Depressed



WEDGE SPRING DETAIL

To insert a wedge spring (F7), grasp the spring with a pair of thin jaw pliers or tweezers as shown in Figure 18, and using a thin "V" notched tool (H5), very carefully thread the ends of spring (F7) through apertures (H4) and (H6). End (H2) of the wedge spring will locate in a hole in a bearing which supports gear (F). End (H3) of the spring will grasp the seat of the notch in the wedge. See Figures 16 and 17. Do not weaken the wedge spring by excessively collapsing it when installing. The wedge spring can be installed in several different ways using pliers or tweezers in connection with kit tool #35 or using the kit tool alone. This tool has a triangular aperture in one end through which the wedge spring is partially inserted and held by the walls of the aperture while the spring is inserted in the wedge shaft. Another means of inserting the wedge spring is to grasp end (H2) with pliers, insert end (H3) in large aperture of wedge and then back the coil of the spring into aperture (H4). With a spring hook or scriber the coil can be pulled through aperture (H4) until end (H2) can be inserted in aperture (H6) at which time the notched end of kit tool #35 should be used to also position end (H3) in aperture (H6).

NOTE: The end play of the complete carry shaft (A) is controlled by turning knurled cap (A7) with the fingers to obtain a minimum shaft end play movement without causing the shaft to bind. See Figures 34 and 35.

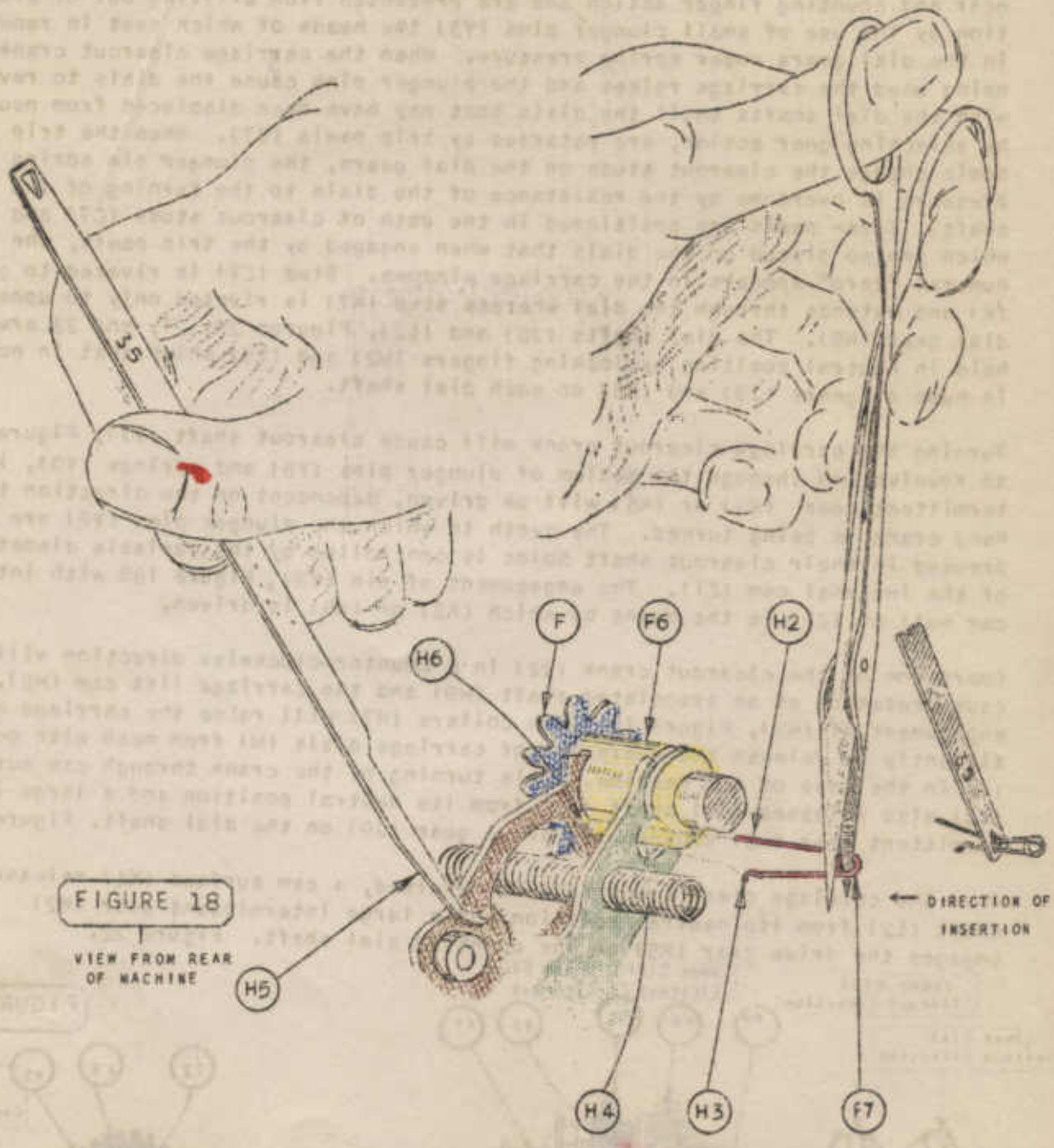


FIGURE 18

VIEW FROM REAR OF MACHINE

FUNCTION EXPLANATION

The carriage is cleared by turning the crank (J2), Figure 20, one complete revolution clockwise and a complete revolution counter-clockwise. A counter-clockwise revolution will clear the lower dials (M) whereas a clockwise revolution will clear the upper dials. The carriage registering dials (lower) (M) and counting dials (upper) (K9) revolve on their shafts through intermediate gear and counting finger action and are prevented from drifting out of position by the use of small plunger pins (Y3) the heads of which seat in recesses in the dial gears under spring pressure. When the carriage clearout crank is being used the carriage raises and the plunger pins cause the dials to revolve with the dial shafts until the dials that may have been displaced from neutral by selecting gear action, are retarded by trip pawls (J7). When the trip pawls engage the clearout studs on the dial gears, the plunger pin spring pressure is overcome by the resistance of the dials to the turning of the dial shaft. These pawls are positioned in the path of clearout studs (C7) and (K7) which are so placed on the dials that when engaged by the trip pawls, the numeral "zero" appears in the carriage windows. Stud (C7) is riveted to gear (K) and extends through the dial whereas stud (K7) is riveted only to upper dial gear (K8). The dial shafts (J6) and (L2), Figures 20, 21, and 22 are held in neutral position by locking fingers (M2) and (L9) which seat in notches in hubs of gears (J9) and (K5) on each dial shaft.

Turning the carriage clearout crank will cause clearout shaft (Y7), Figure 18A to revolve and through the medium of plunger pins (Y8) and springs (Y9), intermittent gear (K2) or (K6) will be driven, dependent on the direction the hand crank is being turned. The depth to which the plunger pins (Y8) are depressed in their clearout shaft holes is controlled by the variable diameter of the internal cam (Z1). The engagement of pin (Y8), Figure 18B with internal cam wall at (Z2) is the means by which (K2) or (K6) is driven.

Operation of the clearout crank (J2) in a counter-clockwise direction will cause rotation of an associated shaft (H9) and the carriage lift cam (H8). The engagement of (H8), Figure 19, with collars (H7) will raise the carriage sufficiently to release the gears (K) of carriage dials (M) from mesh with gears (F) in the base of the machine. This turning of the crank through cam surfaces (K4) also releases dial shaft (J6) from its neutral position and a large intermittent gear (K6) engages the drive gear (J9) on the dial shaft. Figure 22.

When the carriage clear crank (J2) is reversed, a cam surface (K4) releases shaft (L2) from its neutral position and a large intermittent gear (K2) engages the drive gear (K5) on the counting dial shaft. Figure 22.

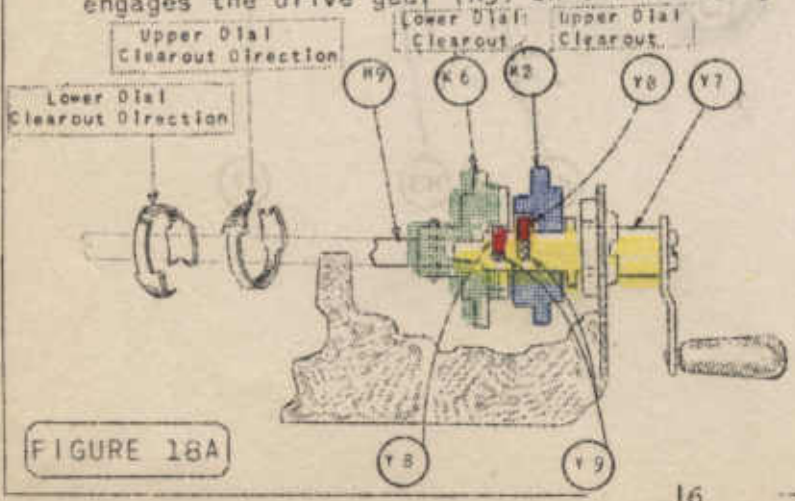


FIGURE 18A

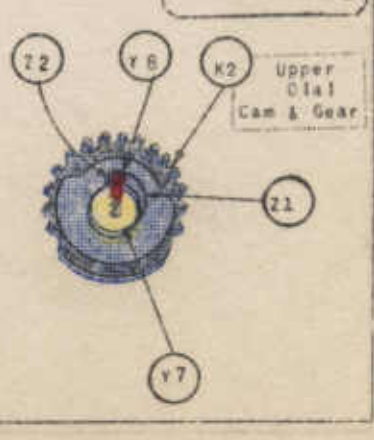


FIGURE 18B

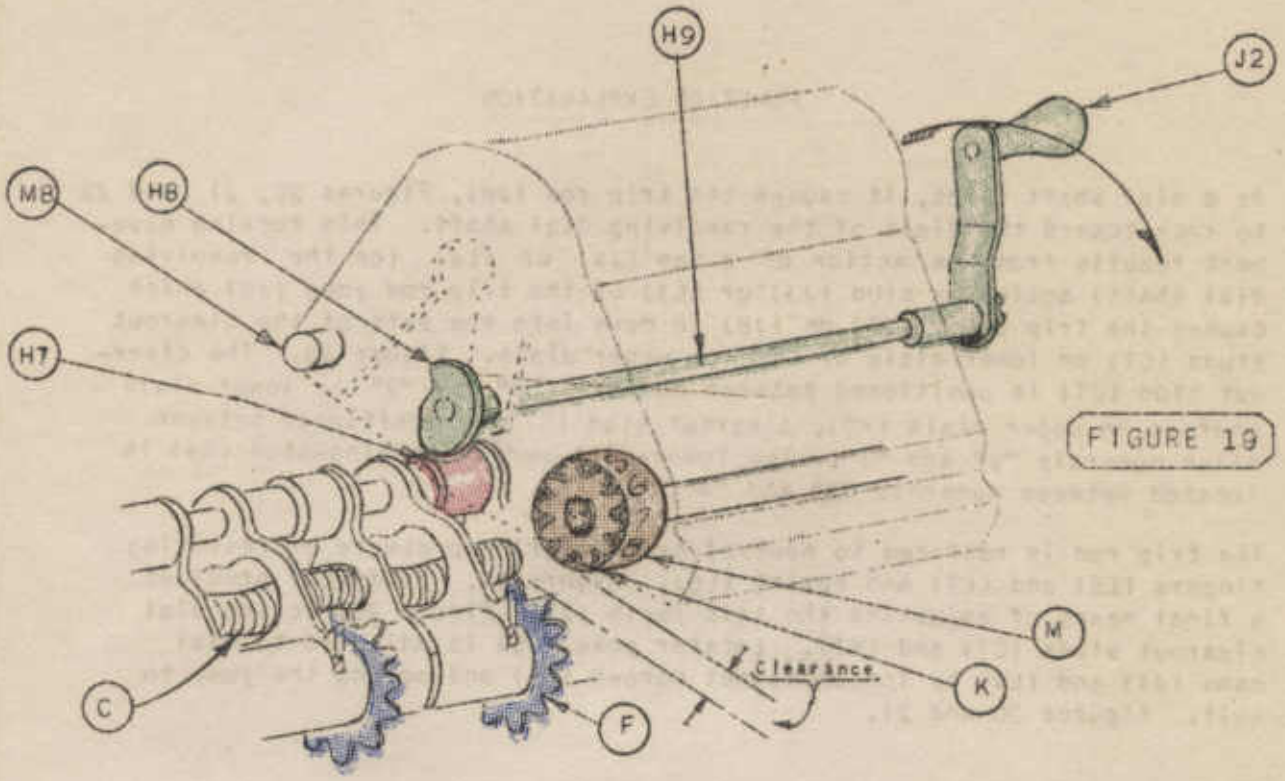


FIGURE 19

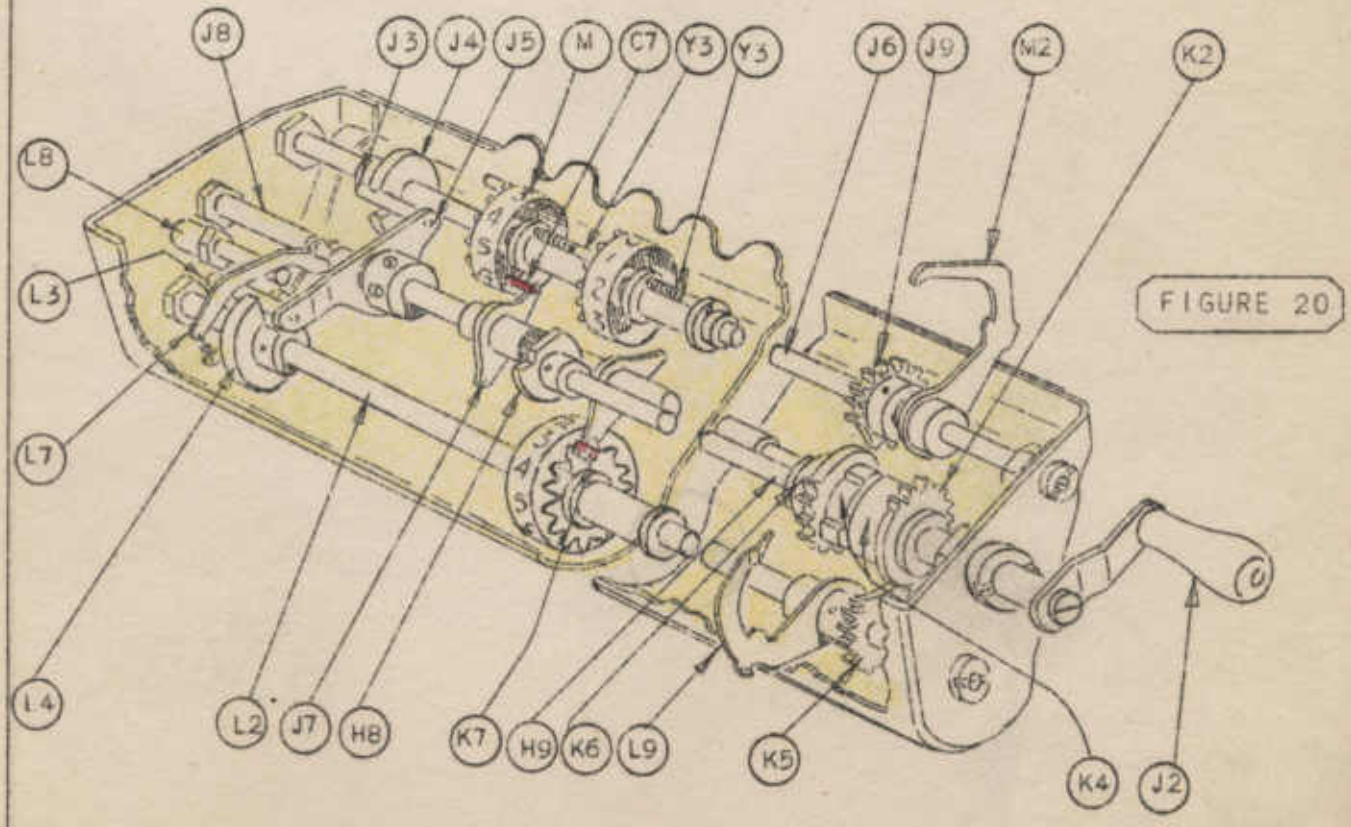


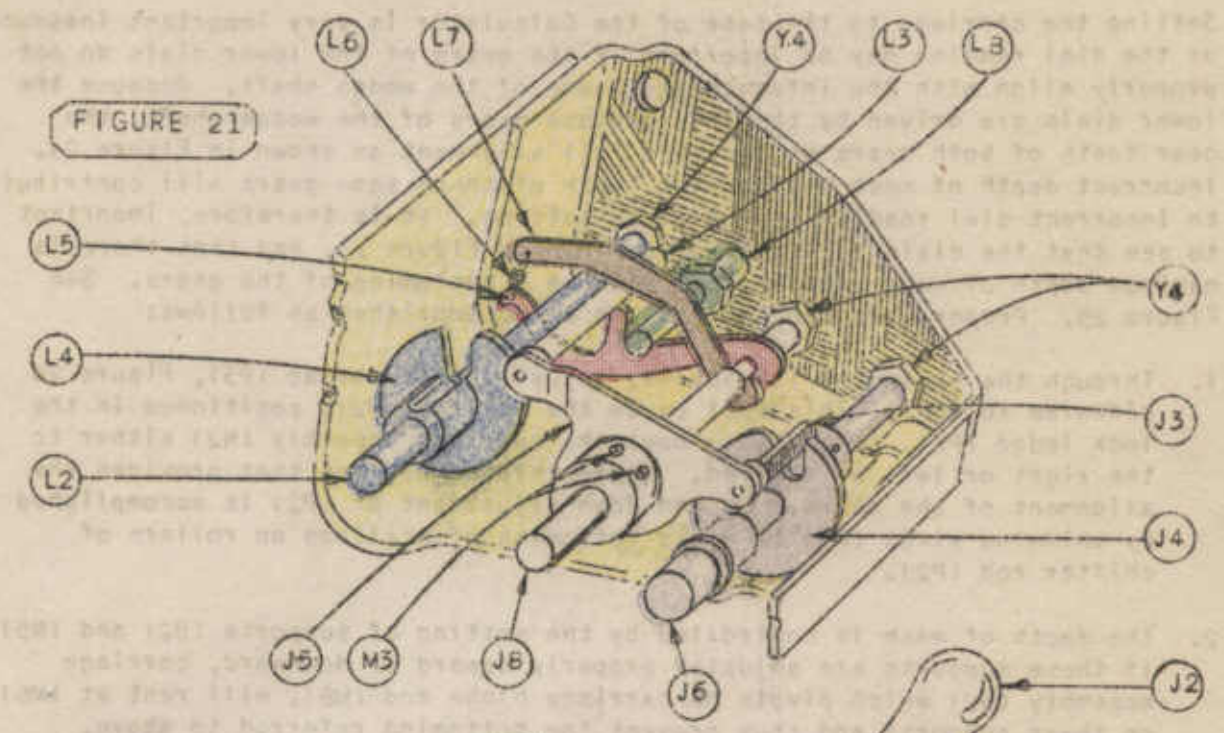
FIGURE 20

FUNCTION EXPLANATION

As a dial shaft turns, it causes the trip rod (J8), Figures 20, 21 and 22 to rock toward the dials of the revolving dial shaft. This rocking movement results from the action of a cam (J4) or (L4) (on the revolving dial shaft) against a stud (J3) or (L3) of the trip rod yoke (J5) which causes the trip pawls (J7) on (J8) to move into the path of the clearout studs (C7) on lower dials or (K7) on upper dials. Figure 20. The clearout stud (C7) is positioned between numerals "8" and "9" on lower dials whereas on upper dials (K9), clearout stud (K7) is positioned between black numerals "2" and "3". The lower-dial-wedge-engaging-stud (B4) is located between numerals "3" and "4".

The trip rod is restored to neutral by the spring pressure of restoring fingers (L5) and (L7) and spring (L6). Figure 21. Stud (L8) provides a final means of adjusting the trip pawls (J7), Figure 20, to the dial clearout studs (C7) and (K7). Locator yoke (J5) is adjusted to dial cams (J4) and (L4) by loosening set screws (M3) and moving the yoke to suit. Figures 20 and 21.

FIGURE 21



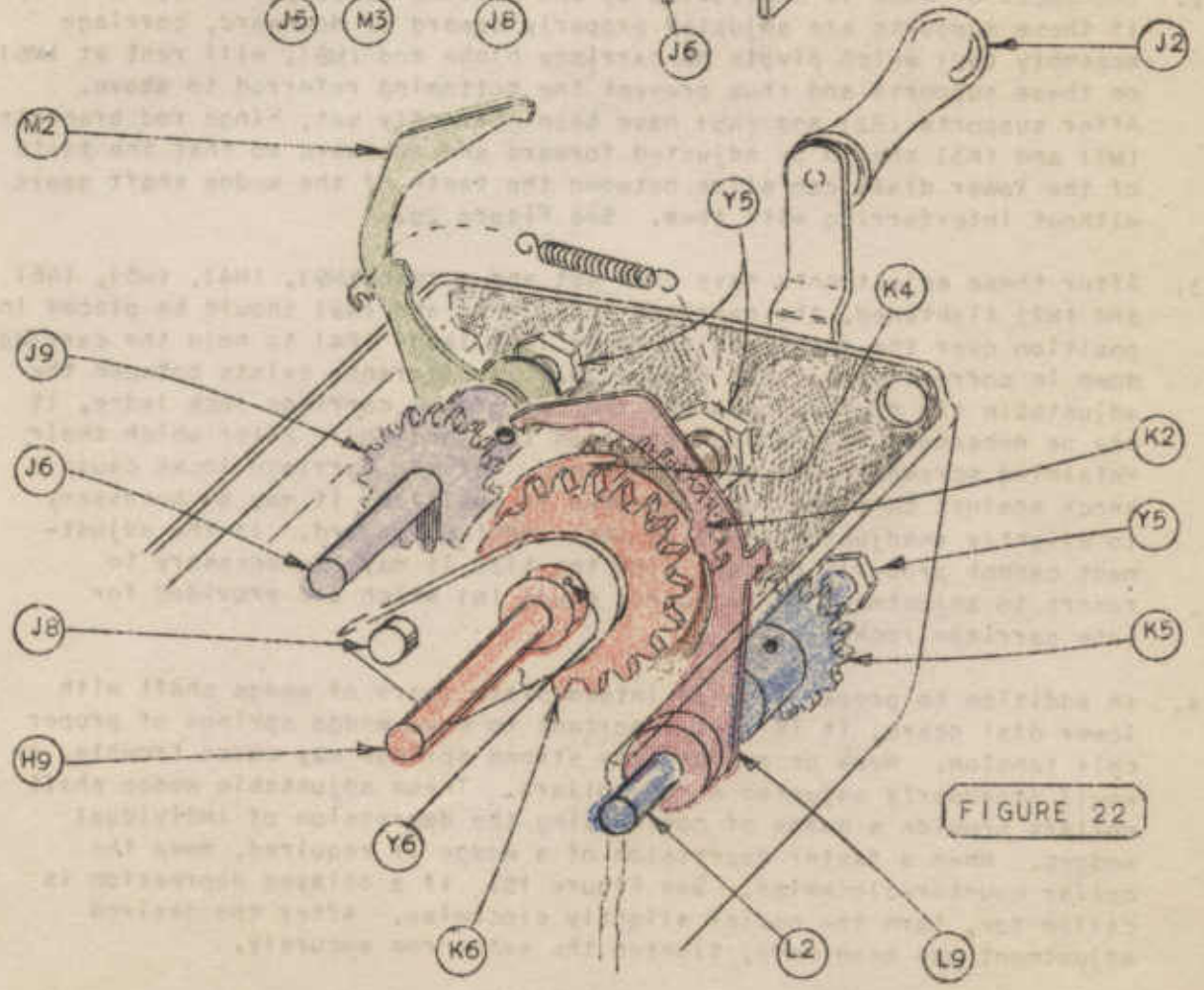


FIGURE 22

SETTING CARRIAGE TO BASE

Setting the carriage to the base of the Calculator is very important inasmuch as the dial reading may be incorrect if the gears of the lower dials do not properly align with the intermediate gears of the wedge shaft. Because the lower dials are driven by the intermediate gears of the wedge shaft, the gear teeth of both gears should have full alignment as shown in Figure 23. Incorrect depth of mesh between the teeth of these same gears will contribute to incorrect dial reading and carriage setting. It is therefore, important to see that the dials fully align as shown in Figure 23, and that there is maximum depth of mesh between them without a bottoming of the gears. See Figure 25. Proper carriage setting can be accomplished as follows:

1. Through the medium of its screws, adjust shifter strap (P3), Figure 24 sidewise to suit. This will cause the shifter (P2), positioned in the lock ledge (P4), to slightly move the carriage assembly (N2) either to the right or left as desired. It is this adjustment that provides the alignment of the gears. Up and down adjustment of (P2) is accomplished by shimming strap (P3) to avoid bottoming of scallops on rollers of shifter rod (P2).

2. The depth of mesh is controlled by the setting of supports (B2) and (N5). If these supports are adjusted properly upward or downward, carriage assembly (N2) which pivots on carriage hinge rod (M6), will rest at (M6) on these supports and thus prevent the bottoming referred to above. After supports (B2) and (N5) have been correctly set, hinge rod brackets (M7) and (N3) should be adjusted forward and rearward so that the teeth of the lower dials can slide between the teeth of the wedge shaft gears without interferring with them. See Figure 25.

3. After these adjustments have been set and screws (M9), (N4), (M5), (N6) and (N7) tightened, the carriage locks (P7) and (N9) should be placed in position over the scalloped carriage lock ledge (P4) to hold the carriage down in correct mesh. See Figure 28. If clearance exists between the adjustable tip of the locks and the top of the carriage lock ledge, it may be necessary to readjust the tips (M4) and (N8); after which their retaining screws should be retightened. If the carriage locks cause a knock against carriage lock cam when in position, it may be necessary to slightly readjust these tips (M4) and (N8) upward. If the adjustment cannot properly be made with the tips it may be necessary to resort to adjustment of eccentric studs (N) which are provided for both carriage locks.

4. In addition to proper mesh of intermediate gears of wedge shaft with lower dial gears, it is very important to have wedge springs of proper coil tension. Weak or excessively strong springs may cause trouble, as would improperly adjusted wedge collars. These adjustable wedge shaft collars provide a means of controlling the depression of individual wedges. When a faster depression of a wedge is required, move the collar counter-clockwise. See Figure 15. If a delayed depression is called for, turn the collar slightly clockwise. After the desired adjustment has been made, tighten the set screw securely.

FIGURE 23

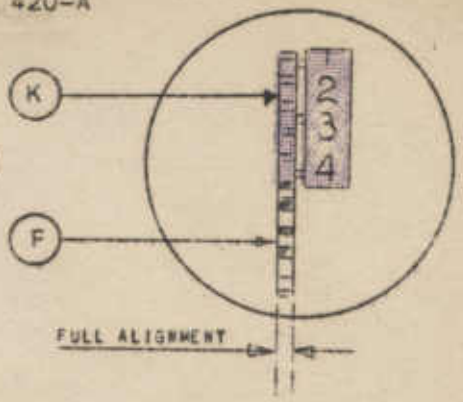


FIGURE 24

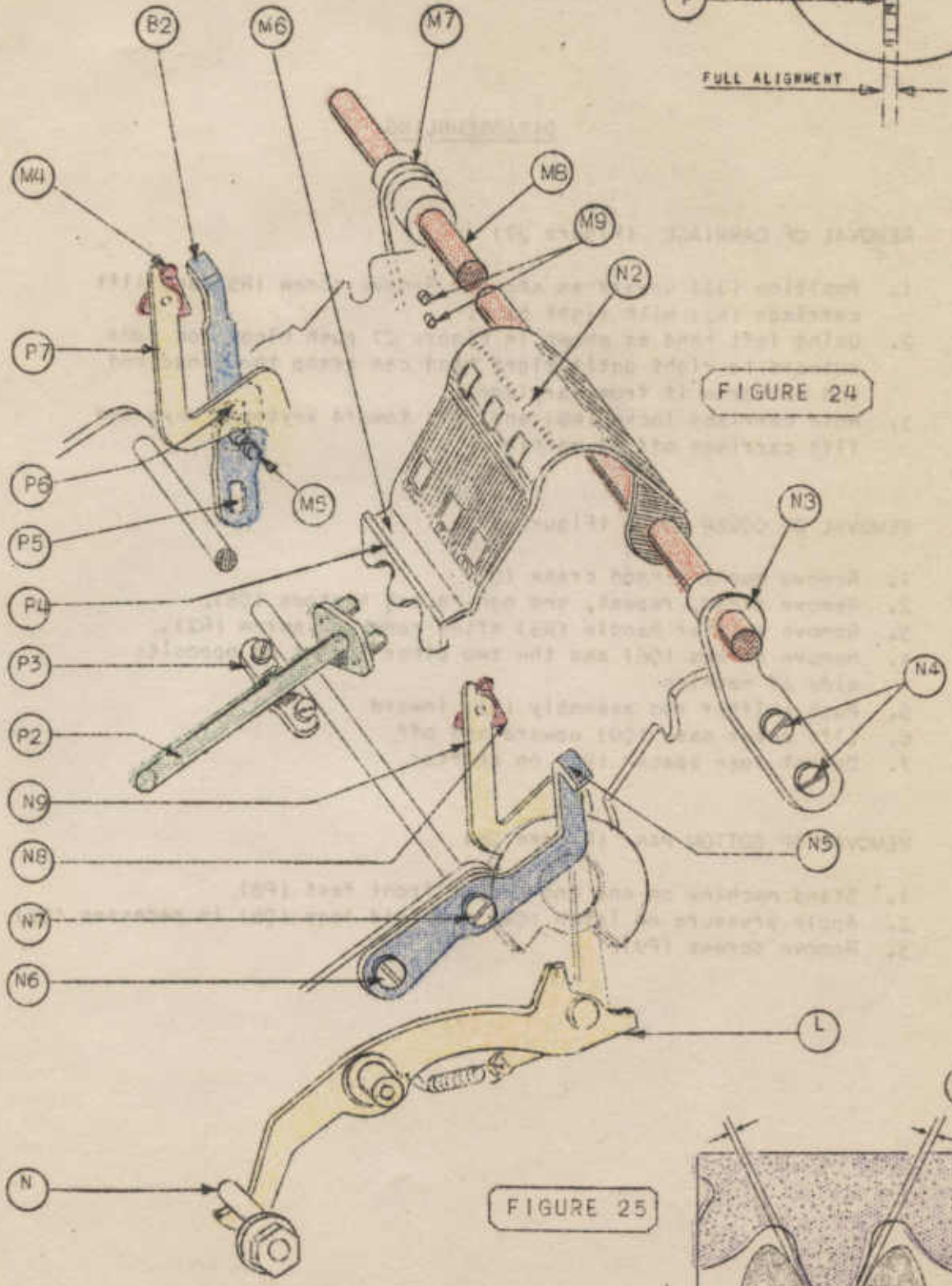


FIGURE 25

DISASSEMBLING

I. REMOVAL OF CARRIAGE (Figure 27)

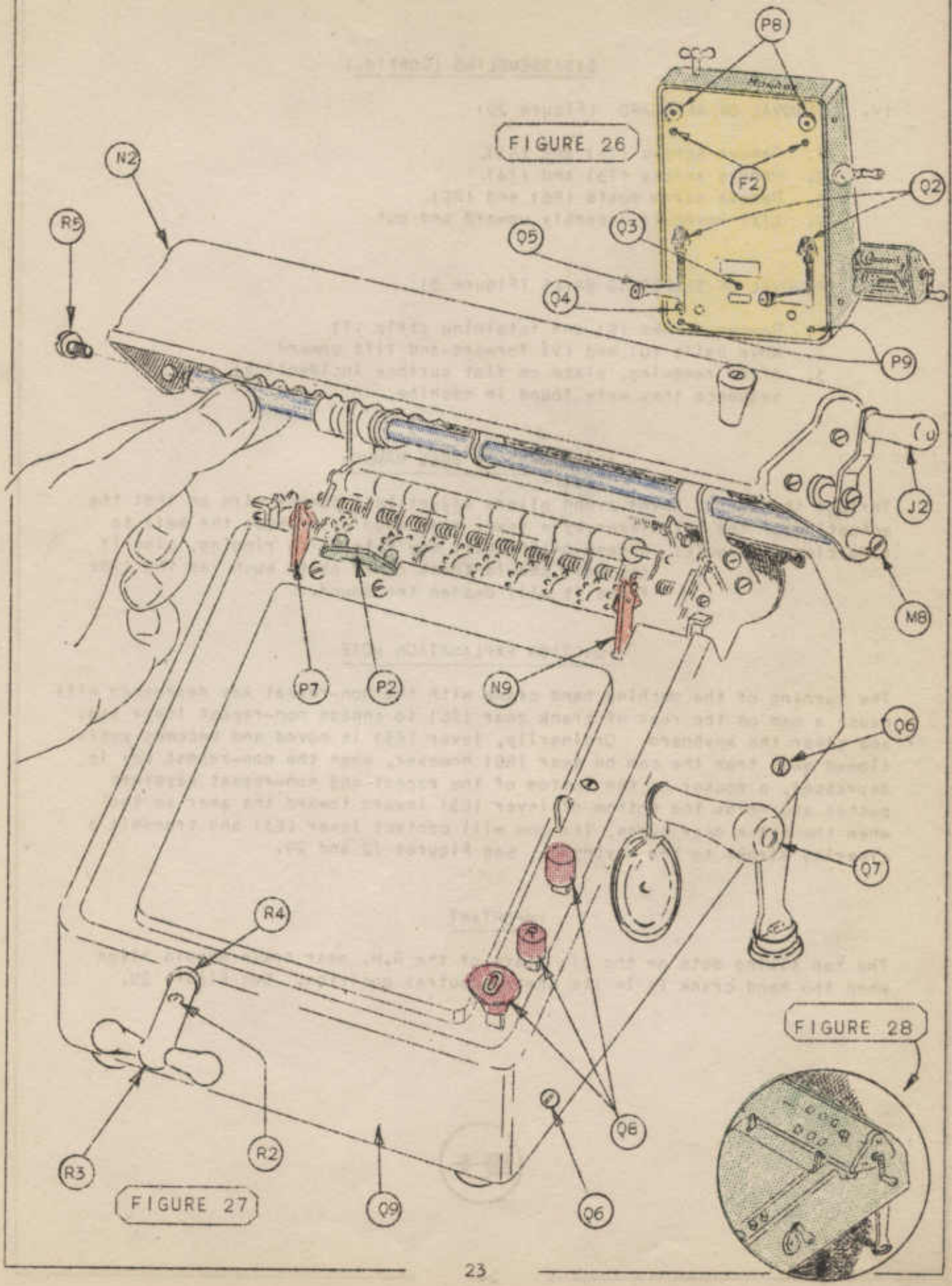
1. Position (J2) upward as shown. Remove screw (R5) and lift carriage (N2) with right hand.
2. Using left hand as shown in Figure 27 push hinge rod (M8) outward to right until right hand can grasp the hinge rod and withdraw it from carriage.
3. Hold carriage locks (N9) and (P7) toward keyboard keys and lift carriage off of machine.

II. REMOVAL OF COVER CASE (Figure 27)

1. Remove machine hand crank (Q7).
2. Remove clear, repeat, and non-repeat keytops (Q8).
3. Remove shifter handle (R3) after removing screw (R2).
4. Remove screws (Q6) and the two other screws on opposite side of machine.
5. Push shifter rod assembly (P2) inward.
6. Lift cover case (Q9) upward and off.
7. Do not lose spacer (R4) on shifter.

III. REMOVAL OF BOTTOM PAN (Figure 26)

1. Stand machine on end and remove front feet (P8).
2. Apply pressure on latch (Q4) and fold legs (Q5) in recesses (Q2).
3. Remove screws (P9).


P8
FIGURE 26
N2
F2
Q2
R5
Q3
Q5
Q4
P9
J2
M8
P7
P2
N9
Q6
Q7
R4
FIGURE 28
Q8
R2
R3
FIGURE 27
Q9
Q6

DISASSEMBLING (Cont'd.)

IV. REMOVAL OF KEYBOARD (Figure 29)

1. Remove screws (T5) and (S3).
2. Remove screws (T3) and (T4).
3. Remove screw posts (R6) and (R9).
4. Lift keyboard assembly upward and out.

V. REMOVAL OF SELECTING BAILS (Figure 3)

1. Remove screws (S) and retaining strip (T).
2. Move bails (U) and (V) forward and lift upward.
3. After removing, place on flat surface in identical sequence they were found in machine.

ADJUSTMENT OF BELL HAMMER

Through the use of three prong pliers adjust bell hammer wire so that the actuation of the trip lever by a lower dial stud will cause the bell to ring clearly. NOTE: Grease on the bell may retard its ringing, also if the bell should touch other parts such as the side frame it will deaden the sound.

FUNCTION EXPLANATION NOTE

The turning of the machine hand crank with the non-repeat key depressed will cause a cam on the rear of crank gear (S6) to engage non-repeat lever (E3) and clear the keyboard. Ordinarily, lever (E3) is moved and becomes positioned away from the cam on gear (S6) however, when the non-repeat key is depressed, a rocker on the bottom of the repeat and non-repeat keystems pushes and holds the bottom of lever (E3) inward toward the gear so that when the crank gear turns, its cam will contact lever (E3) and transmit a clearing stroke to the keyboard. See Figures 12 and 29.

IMPORTANT

The ten timing dots on the six gears of the R.H. gear train should align when the hand crank is in its upward neutral position. See Figure 29.

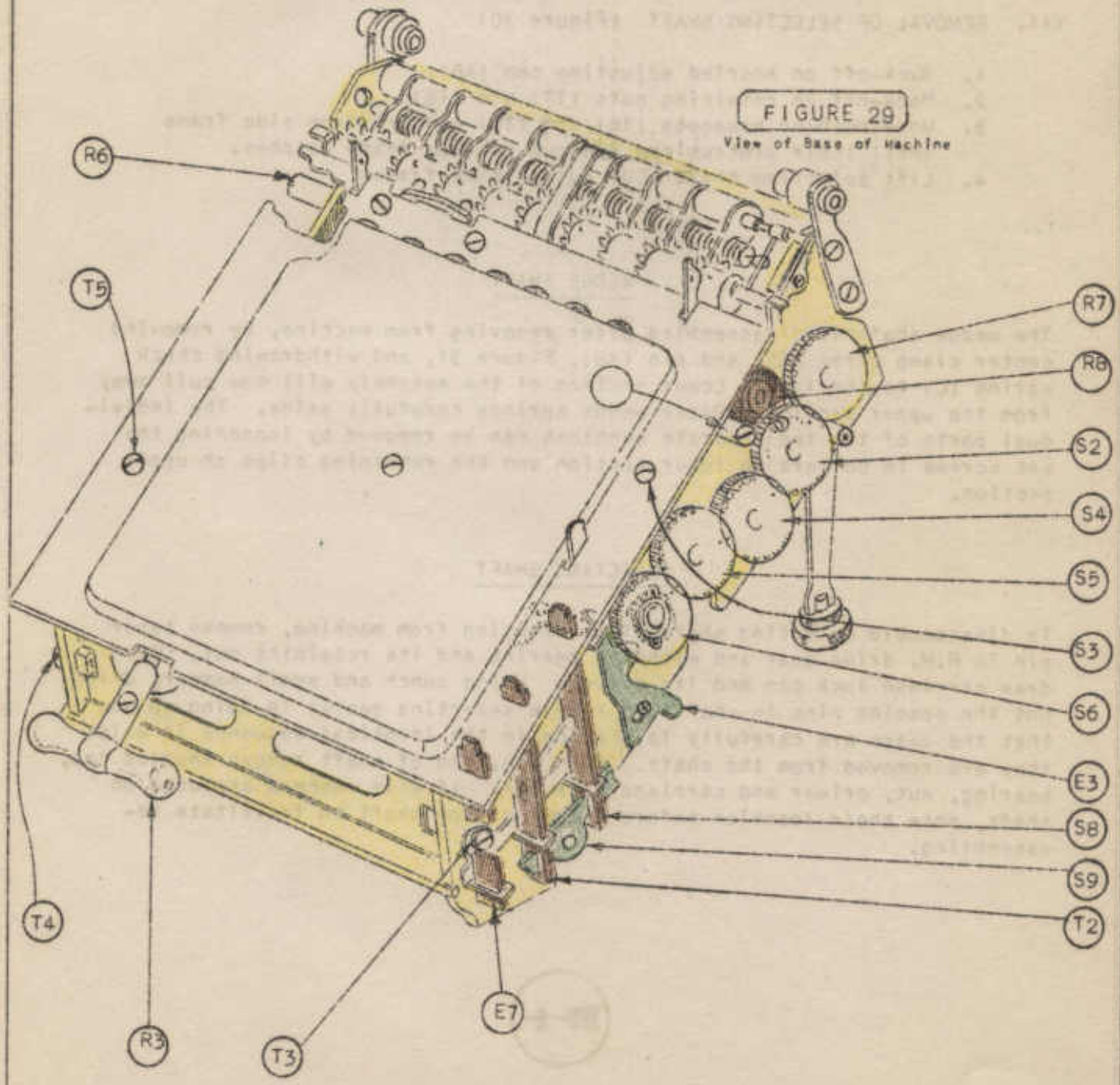


FIGURE 29
View of Base of Machine

DISASSEMBLING (Cont'd.)

VI. REMOVAL OF WEDGE SHAFT (Figure 31)

1. Remove screws (U7) and (U3).
2. Remove spring retainer (U6).
3. Remove retaining blanks (U8) and (U2).
4. Remove screws (U4).
5. Remove plate (U5).
6. Lift wedge shaft upward and out.

VII. REMOVAL OF SELECTING SHAFT (Figure 30)

1. Back-off on knurled adjusting cap (A6).
2. Back-off on retaining nuts (T7) and (T8)
3. Move bushing hexagons (T6) and (T9) outward from side frame until their protrusions are out of side frame notches.
4. Lift selecting shaft (C9) out of side frames.

WEDGE SHAFT

The wedge shaft is disassembled after removing from machine, by removing center clamp strap (Y2) and pin (X8), Figure 31, and withdrawing check spring (C) to the left. Lower section of the assembly will now pull away from the upper section. Place wedge springs carefully aside. The individual parts of the two separate sections can be removed by loosening the set screws in collars on lower section and the retaining clips on upper section.

SELECTING SHAFT

To disassemble selecting shaft after removing from machine, remove taper pin in R.H. drive gear and withdraw bearing and its retaining nut. Withdraw carriage lock cam and its driver. Using punch and small hammer, drive out the spacing pins in shaft and remove selecting gears; in doing so see that the gears are carefully laid aside in the identical sequence in which they are removed from the shaft. From L.H. end of shaft remove knurled cap, bearing, nut, driver and carriage lock cam. If shim washers are used on shaft, note their location before removing from shaft to facilitate reassembling.

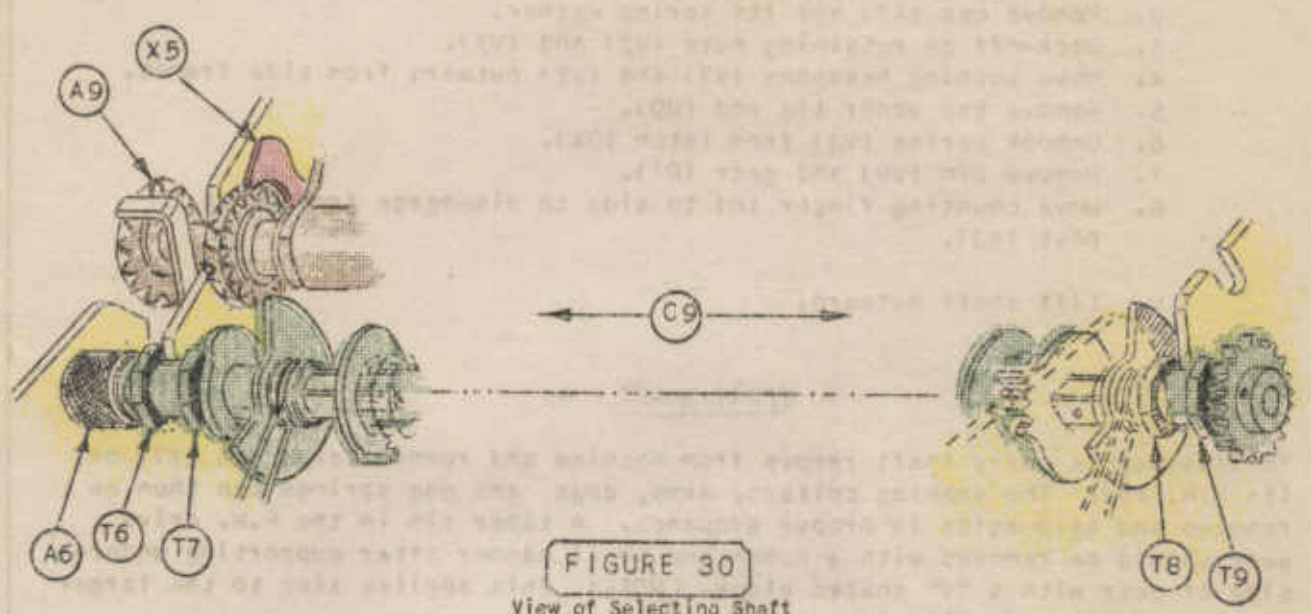


FIGURE 30
View of Selecting Shaft

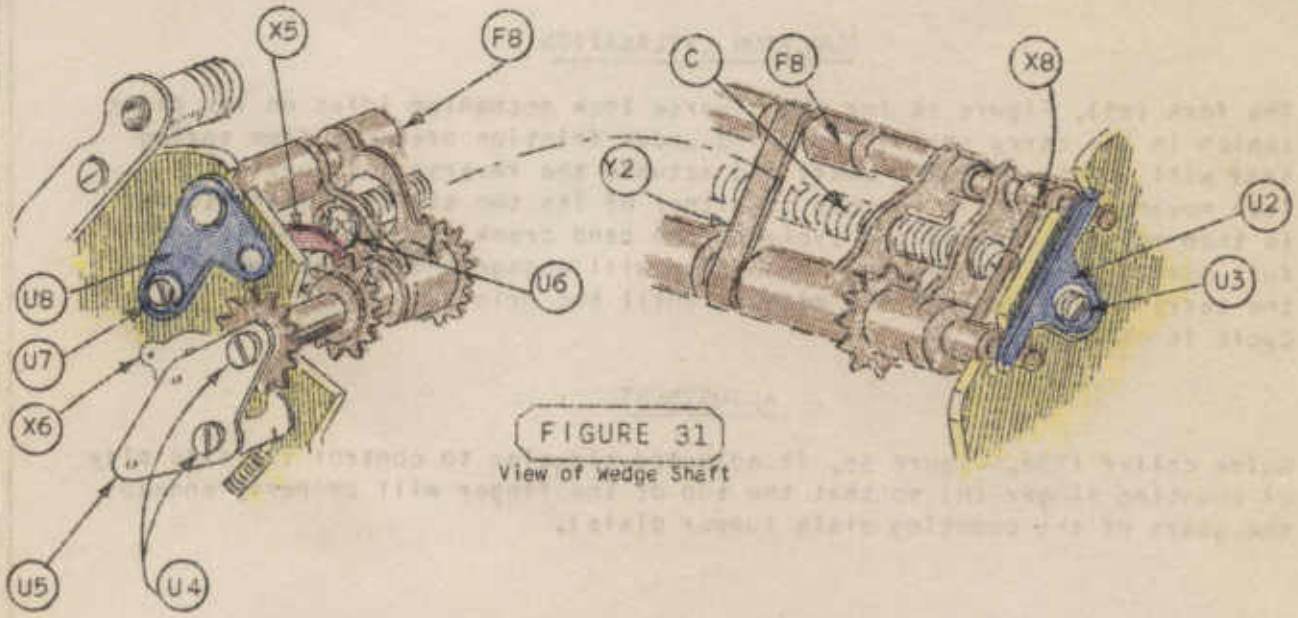


FIGURE 31
View of Wedge Shaft

DISASSEMBLING (Cont'd.)

VIII. REMOVAL OF CARRY SHAFT (Figures 34 and 35)

1. Remove locator arm (V8) and ratchet pawl (V6) by removing nut (X3) and screw (X2). Figures 34 and 35.
2. Remove cap (A7) and its spring washer.
3. Back-off on retaining nuts (V2) and (V3).
4. Move bushing hexagons (V7) and (V5) outward from side frames.
5. Remove the upper tie rod (U9).
6. Unhook spring (V4) from latch (Q4).
7. Remove pin (V9) and gear (R7).
8. Move counting finger (H) to side to disengage from guide post (W2).
9. Lift shaft outward.

CARRY SHAFT

To disassemble carry shaft remove from machine and remove large nut (X7) on its L.H. end. The spacing collars, arms, dogs and dog springs can then be removed and laid aside in proper sequence. A taper pin in the R.H. drive gear should be removed with a punch and small hammer after supporting underside of gear with a "V" shaped block. (NOTE: This applies also to the larger pin in R.H. spacer collar).

FUNCTION EXPLANATION

The fork (W3), Figure 34 for the reverse lock mechanism idles on its pivot (which is the carry shaft) and being under friction pressure from spring (X4) will rotate with the shaft and actuate the reverse lock until the lock movement limit is reached at either of its two studs. If an attempt is then made to reverse the cycle of the hand crank before completing a full stroke, the reverse lock mechanism will engage the ratchet wheel of the carry shaft and lock the machine until the original direction of a cycle is completed.

ADJUSTMENT

Guide collar (X9), Figure 33, is adjusted sidewise to control the side play of counting finger (H) so that the top of the finger will properly engage the gears of the counting dials (upper dials).

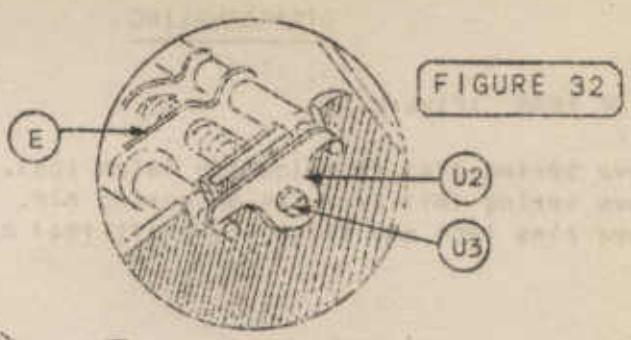


FIGURE 32

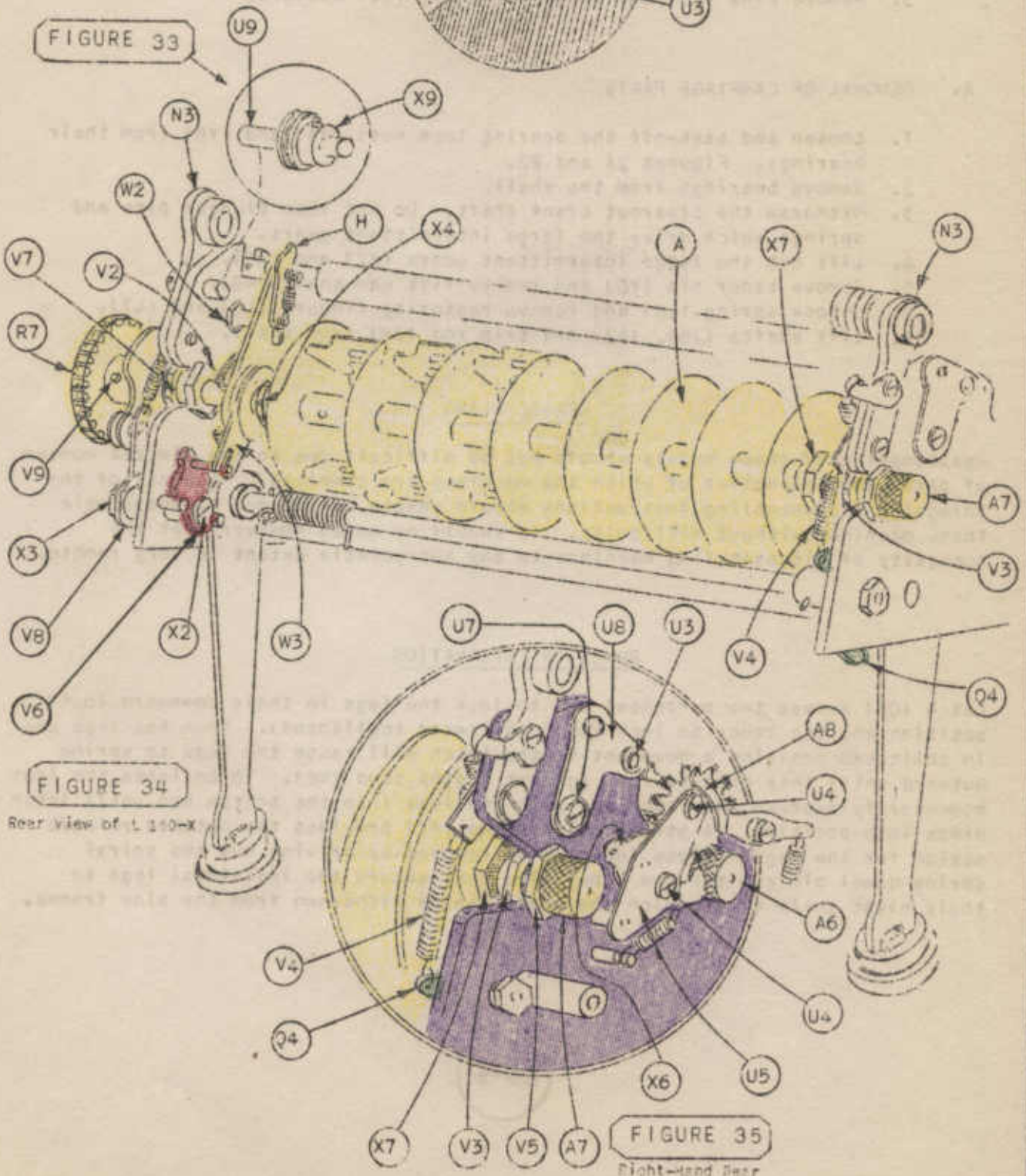


FIGURE 33

FIGURE 34

Rear view of L 110-X

FIGURE 35

Right-Hand Rear
Detail View

DISASSEMBLING

IX. REMOVAL OF LEGS (Figure 36)

1. Remove spring (V4) from locking latch (Q4).
2. Remove spring (W7) from its anchoring pin.
3. Remove pins (W5) and slide the shaft (W4) outward.

X. REMOVAL OF CARRIAGE PARTS

1. Loosen and back-off the bearing lock nuts (Y4) and (Y5) from their bearings. Figures 21 and 22.
2. Remove bearings from the shell.
3. Withdraw the clearout crank shaft. Do not lose plunger pins and springs which drive the large intermittent gears.
4. Lift out the large intermittent gears (K2) and (K6).
5. Remove taper pin (Y6) and remove lift cam shaft (H9).
6. Unhook spring (L6) and remove restoring fingers (L5) and (L7).
7. Lift shafts (J6),.(L2) and trip rod (J8) from shell.

REASSEMBLING

Reassembling of these models should not be difficult due to the limited number of parts and assemblies of which the machines are composed. Reversal of the foregoing Disassembling instructions should enable servicemen to reassemble these machines without difficulty. It should be noted however that the necessity of disassembling machines to any appreciable extent is very remote.

FUNCTION EXPLANATION

Latch (Q4) serves two purposes; one to lock the legs in their downward (out) position and the other to lock the legs inward (collapsed). When the legs are in collapsed position a movement of the latch will cause the legs to spring outward until they come to rest against a stop stud (W6). To collapse the legs momentarily depress the latch and push the legs into the bottom pan until latch drops into position. A strong coil spring (W7) provides the outward release action for the legs. These legs can be removed by driving out the spiral spring dowel pin and the two taper pins that secure the individual legs to their pivot shaft after which the shaft can be withdrawn from the side frames.

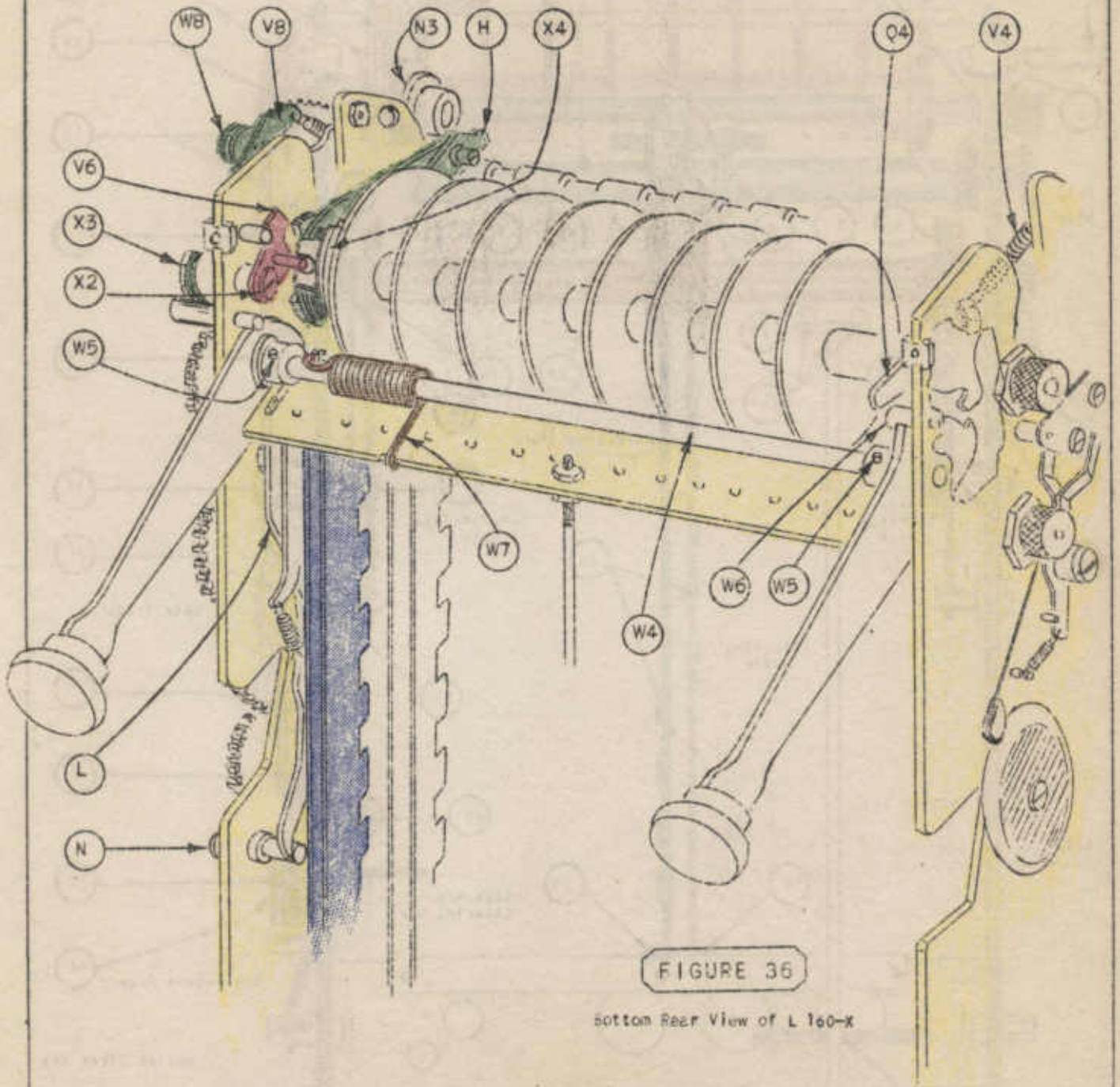


FIGURE 36

Bottom Rear View of L 160-X

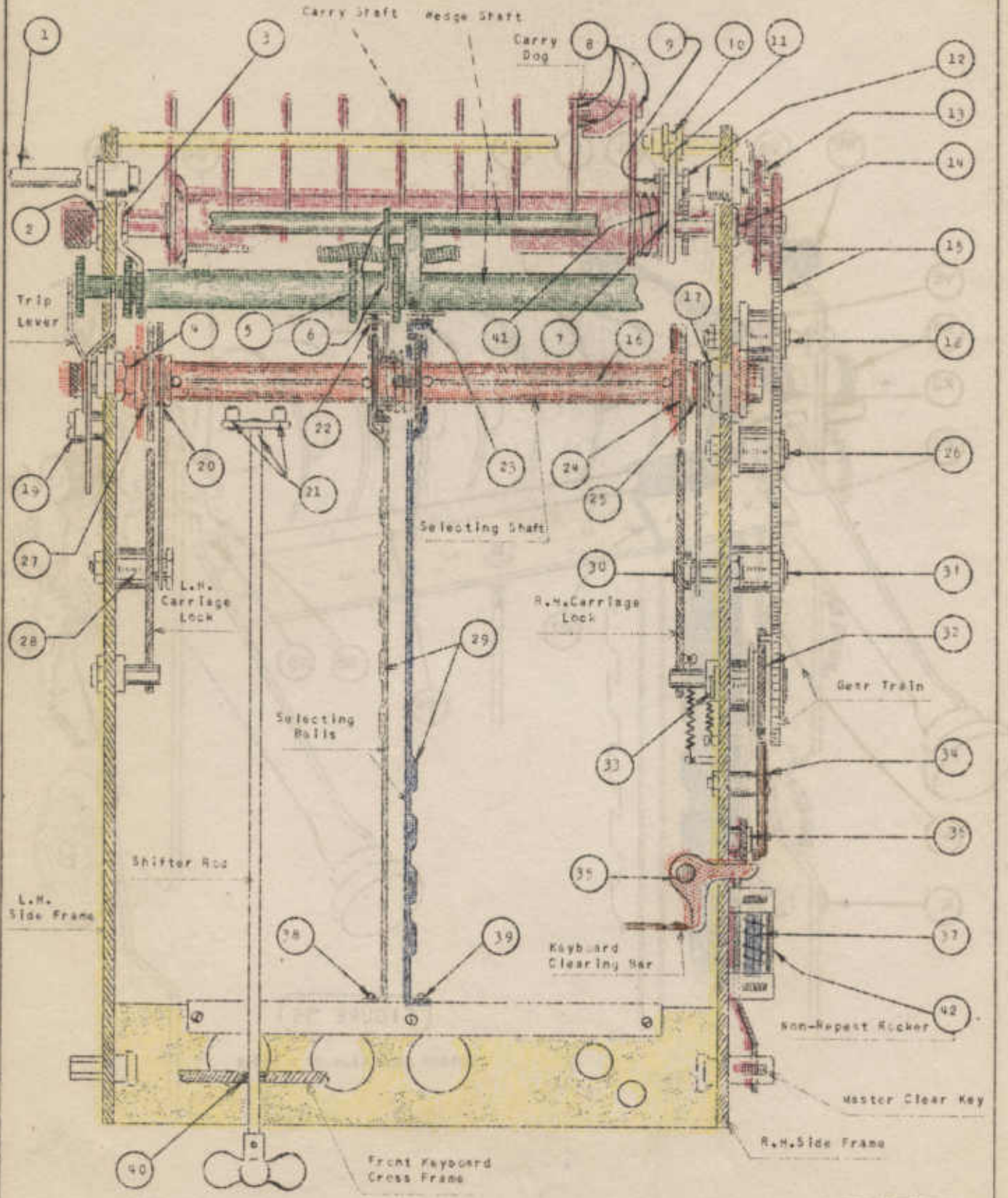


FIGURE 37

Schematic diagram of base

LUBRICATING POINTS
of base and keyboard

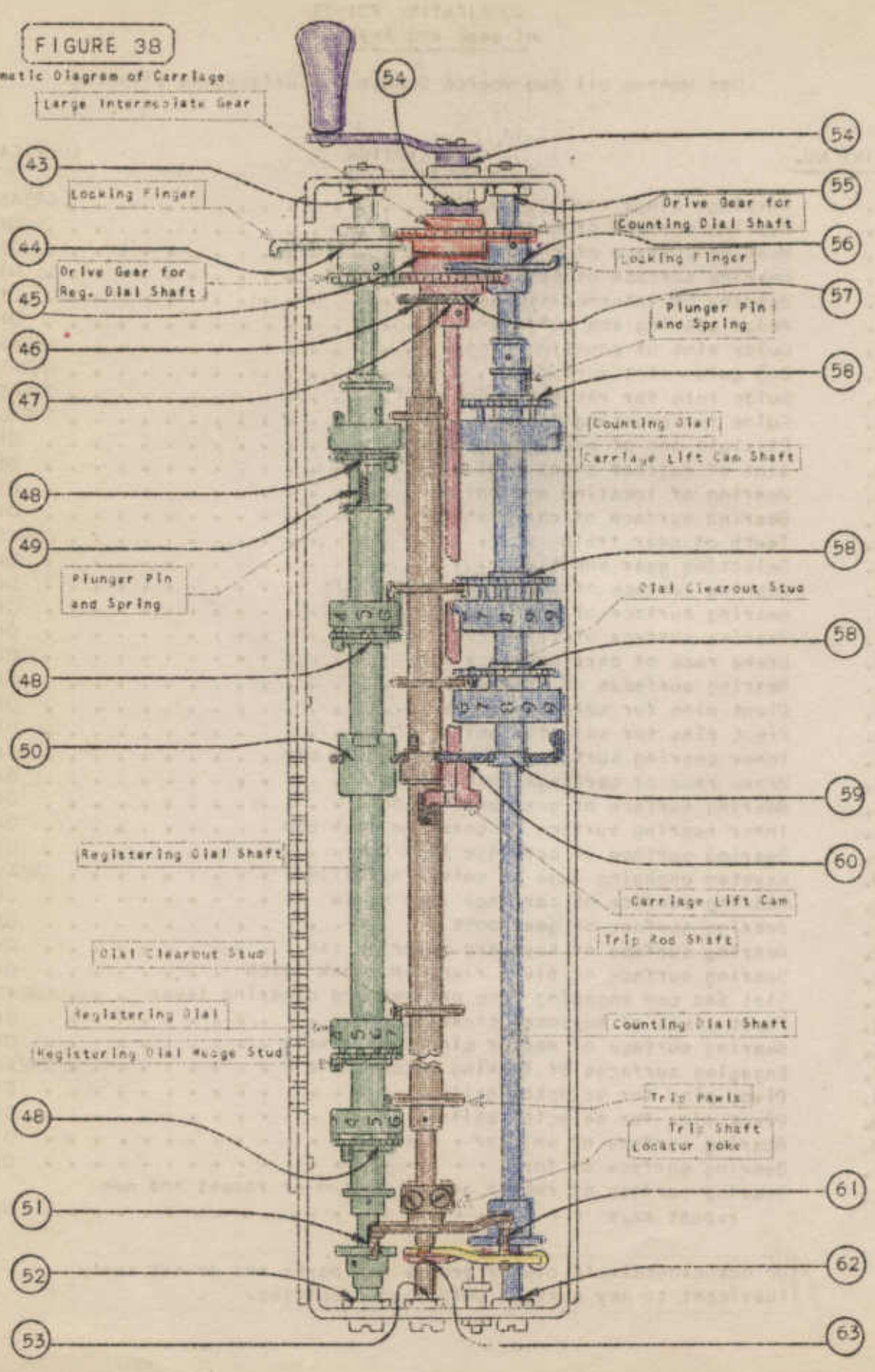
Use Monroe Oil And Monroe Grease On Surfaces As Directed

POINT NO.	DESCRIPTION	LUBRICANT
1.	Carriage hinge rod	GREASE
2.	Bearing surface of carry shaft	OIL
3.	Bearing surface of check pawl	OIL
4.	Bearing surface of selecting gear shaft	OIL
5.	Bearing of intermediate gear	OIL
6.	Wedge bearing and guide slot	OIL
7.	Guide slot of counting finger	GREASE
8.	Dog guide slot surface	GREASE
9.	Guide fork for ratchet check pawl	GREASE
10.	Guide for counting finger	GREASE
11.	Flexible top of counting finger	OIL
12.	Slot of ratchet check pawl	OIL
13.	Bearing of locating arm roller	OIL
14.	Bearing surface of carry shaft	OIL
15.	Teeth of gear train	GREASE
16.	Selecting gear shaft	OIL
17.	Bearing surface of selecting gear shaft	OIL
18.	Bearing surface of gear bearing post	OIL
19.	Bearing surface of trip lever screw	OIL
20.	Brake race of carriage lock cam	OIL
21.	Bearing surfaces of shifter rod	OIL
22.	Pivot pins for selector bails	OIL
23.	Pivot pins for selector bails	OIL
24.	Inner bearing surface of carriage lock cam	OIL
25.	Brake race of carriage lock cam	OIL
26.	Bearing surface of gear bearing post	OIL
27.	Inner bearing surface of carriage lock cam	OIL
28.	Bearing surface of carriage lock screw	OIL
29.	Keystem engaging lugs of selecting bails	GREASE
30.	Bearing surface of carriage lock screw	OIL
31.	Bearing surface of gear post	OIL
32.	Bearing surface of keyboard clearing cam	OIL
33.	Bearing surface of pivot rivet in crank latch	OIL
34.	Slot and cam engaging face of keyboard clearing lever	GREASE
35.	Pivot rivet of keyboard clearing arm	OIL
36.	Bearing surface of master clear key lever	OIL
37.	Engaging surfaces of locking latches	GREASE
38.	Pivot pins for selector bails	OIL
39.	Pivot pins for selector bails	OIL
40.	Bearing surface of shifter	OIL
41.	Bearing surface of fork	OIL
42.	Bearing surface of rocker arm on bottom of repeat and non-repeat keys	OIL

Do not excessively oil or grease any parts and do not apply lubricant to any surface unless so specified.

FIGURE 38

Schematic Diagram of Carriage



LUBRICATING POINTS of Carriage

Use Monroe Oil And Monroe Grease On Surfaces As Directed

POINT NO.	DESCRIPTION	LUBRICANT
43.	Bearing surface of registering dial shaft	OIL
44.	Bearing surface of locking finger	OIL
45.	Bearing surface of large intermittent gears	OIL
46.	Bearing surface of trip rod shaft	OIL
47.	Bearing surface of carriage lift shaft	OIL
48.	Bearing surface of registering dials	OIL
49.	Bearing surfaces of plungers for registering dials	OIL
50.	Bearing surface of collar	GREASE
51.	Stud on yoke	GREASE
52.	Bearing surface of registering dial shaft	OIL
53.	Bearing surface of trip rod shaft	OIL
54.	Bearing surfaces of clear out plunger shaft	OIL
55.	Bearing surface of counting dial shaft	OIL
56.	Bearing surface of locking finger	OIL
57.	Bearing surfaces of large intermittent gears	OIL
58.	Bearing surface of counting dials	OIL
59.	Bearing surface of collar	GREASE
60.	Bearing surface of clear out shaft	OIL
61.	Stud on yoke	GREASE
62.	Bearing surface of counting dial shaft	OIL
63.	Bearing surface of trip rod shaft	OIL

Do not excessively oil or grease any parts and do not apply lubricant to any surface unless so specified.

Illustrated detail information covering L 160-X and L 200-X parts and assemblies, list prices, descriptions, specifications, visual assembling aids etc., is contained in Monroe Machine Service Bulletin No. 420.

MONROE CALCULATING MACHINE COMPANY, INC.

General Service Department, Orange, New Jersey