28 TELETYPEWRITER

DESCRIPTION AND OPERATING PRINCIPLES

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1. GENERAL

1.01 This section gives a description and the operating principles of the 28 teletypewriter. This machine, a picture of which is shown in Fig. 1, produces page copy, like the 15 teletypewriter, from 5-unit code signals at speeds of 60, 75, or 100 words per minute. It may be capable of operation at higher speeds if required. Fig. 1

1.02 The model of the 28 teletypewriter described in this section has wiring arrangements which are adapted for private-line service and most attended TWX local stations. The wiring is not readily adaptable to the following applications:

(a) Unattended TWX stations.

(b) Stations served by line-concentrating units.

(c) 128-type subsets.

(d) 130B1 subsets (43A1 carrier terminal).

NOT APP. TO DATA

1.03 Uniformly throughout this section the words "right" and "left" refer to the sides of the machine, or of its component mechanisms, as seen from the front or keyboard side. Some of the figures are rear views; reference to right and left on these is opposite to the way they appear in the figures. For example, if a part is described as moving to the right, it moves toward the left in a figure showing the rear view.

2. DESCRIPTION OF COMPONENTS

(A) Console

2.01 The 28 teletypewriter is mounted in a console, as shown by Fig. 1. Fig. 2 shows the typing unit tilted forward for easier access for maintenance. Fig. 3 identifies a number of the operating features of the console, described in the subsequent paragraphs. For Fig. 3 the typing unit itself was removed to reveal some of the features, including the electrical service unit, behind it. Figs. 1, 2 and 3

2.02 The console consists of a cover, lid and a lower section. The cover and lid are opened by means of push-buttons. The cover-release button is on the right adjacent to the copyholder and the lid-release button on the top right side of the cover. A blank button on the top left side of the cover could be utilized for an additional feature such as a signal lamp.

2.03 A copylight, shown in Fig. 3 under the front of the cover, provides direct lighting on the copy. Fig. 3

2.04 A margin-indicator lamp, behind a translucent red button on the right, lights when the carriage is about six characters from the end of the line.

2.05 A copyholder, shown in Fig. 1, is provided on the front surface of the cover. A larger copyholder is available as an auxiliary feature to mount at the right of the console. Fig. 1

2.06 A manual motor-control switch, identified in Fig. 3 as Power Switch Extension, is on the right of the console just below the keyboard. Remote motor control may be obtained as an auxiliary feature. Fig. 3

2.07 Cover Panel: A combination lower compartment cover panel and maintenance plate is normally fastened in front of the rectifier shelf in the lower part of the console. See Fig. 3. It may be installed horizontally in the upper part of the cabinet with its inside surface up as a work shelf on which to place the typing unit. Fig. 3

2.08 A signal bell is mounted in the lower part of the console outside of the sound-proof section in which the typing unit is.

2.09 Terminal Blocks: There are seven terminal blocks inside the console for making connections between the various units, as follows:

Terminal Block	Location
Three Cabinet Terminal Blocks (for line and power connections)	Across the inner rear wall just under the cover hinge
Selector-Magnet Terminal Block Motor-Control Terminal Block AC-Power Terminal Block	Underside of electrical service unit
Motor-Circuit Terminal Block	On top of the base at the rear just left of the motor

(B) Keyboard

2.10 The keyboard, shown in Fig. 4, supports the motor, the typing unit, and an intermediate shaft assembly. The standard keys (green) are in the conventional three-bank arrangement, spaced as on a standard typewriter. The key stroke is 5/16" and the pressure is uniform regardless of position or previous selection. In addition there are six special keys, with red tops, shown in the top row in Fig. 4. The designations on these keys together with the equivalents on the 15 teletypewriter, are listed in Table 1. Table 1, for completeness, also lists the power switch. Fig. 4

Table 1

SPECIAL KEYTOP DESIGNATIONS

Special Keys (Red)	Equivalent on the 15 TTY
LOC LF	Platen Crank
KBD LOCK, KBD UNLK, BREAK	SEND-REC-BREAK Key
REPT	Repeat Keyboard Feature
LOC CR	Carriage-Return Release Bar
Power Switch (under keyboard at right)	ON-OFF Toggle Switch

2.11 A connector on the top left rear corner of the base receives the plug on the plastic-covered cable from the left end of the electrical service unit.

2.12 Instruction cardholders are provided on both sides of the keyboard, as shown in Fig. 4, for information such as the station and circuit number and instructions for calling repair service. Fig. 4

2.13 Signal Generator: A novel rocking-contact arrangement (inside the signal-generator contact box shown in Fig. 4) uses a single contact to generate spacing and marking signals. This mechanism provides accurate chatter-free signals without delicate adjustment. Fig. 4

2.14 Code-Bar Assembly: There is room in the keyboard code-bar assembly for 13 code bars. Five of the positions are used for the signal-element code bars, one for the keyboard lock bar and one for the keyboard-clutch trip bar.

(C) Receiving Only (RO) Base (Fig. 5)

2.15 The Receiving-Only base is used in place of a keyboard when only receiving facilities are required. It is a sheet-metal structure, which supports the typing unit, the motor, and an intermediate shaft assembly. It has no code-selecting or signal-generating mechanisms. Fig. 5

2.16 The RO base has two keys, CAR RET and LINE FEED, for local operation of the typing unit. With these are associated function levers, which operate in the same way as those on the keyboard to return the carriage or advance the platen without affecting other machines on the same loop.

2.17 The RO base also has an opening (covered by an apparatus blank) which may be used for a Break key if required. A set of parts is available to provide the Break feature.

2.18 A connector on the top left rear corner of the RO base receives the plug on the plastic-covered cable from the left end of the electrical service unit.

(D) Motor and Gear Assembly

2.19 Fig. 4 shows the motor unit and intermediate shaft assembly mounted on the keyboard. The motor is geared to the main shaft of the typing unit. The intermediate shaft assembly couples the motor to the main shaft of the typing unit which, in turn, is geared to the keyboard mechanism. With a standard motor speed of 3600 rpm, synchronous and governed motors are interchangeable. Operating speed changes are made by changing a single pinion and gear. Fig. 4

2.20 Fig. 6 shows the synchronous motor, and Fig. 7 the governed motor.

Figs. 6 and 7

(E) Typing Unit

2.21 Type Box: Fig. 8 shows the typing unit removed from the base. The most obvious new feature is the small, light type box in place of the type basket of the 15 TTY. The weight of the carriage assembly is only eight ounces in place of about five pounds for the 15 TTY. The type box is easily removed and replaced. Since a separate type pallet is provided for each character, no type alignment is required. The printing hammer mechanism assures a uniform type bar blow for all speeds and all positions. Thus good carbon copies are assured. Fig. 8

2.22 A new selecting mechanism gives increased tolerance to distorted signals. It requires fewer and less critical mechanical adjustments. Heretofore the five signal elements were used to select a type bar. Now they are used to position the type box. Signal elements 1 and 2 determine to what horizontal level the type box will be raised. Element 3 determines the right or left movement of the type box. Elements 4 and 5 position the type box to a vertical row.

2.23 Platen Handwheel: When a new roll of paper is to be fed into the machine the dome of the console must be raised. Fig. 8 shows the platen handwheel on the left of the typing unit which is pushed downward to engage the gears in order to rotate the platen.

Fig. 8

2.24 A paper-release lever, shown on Fig. 8, is located on the right side of the typing unit: when pushed back it frees the paper for alignment.

2.25 Messages are ordinarily typed on single-copy paper eight and one-half inches wide. However, paper of lesser widths (minimum three inches) may be used.

2.26 Line-Feed Lever: A single-double line-feed lever is located on the left side of the typing unit. When set in the number 1 position, single line feed is obtained. When set in the number 2 position double line feed is obtained.

2.27 The range finder, shown in Fig. 8, on the right-hand side of the typing unit, is equipped with a range-finder knob. When the knob is pushed in and rotated, its attached range-finder gear moves the range-finder sector either clockwise or counterclockwise about the selector cam clutch. This changes the angular position at which the selector cam clutch stops with respect to the selecting levers. When an optimum setting is obtained, the range-finder knob is released. Its inner teeth engage and lock the range-finder mechanism in position. The setting of the range scale may be read on the knob opposite the fixed index mark.

Fig. 8

2.28 A front-plate assembly as seen in Fig. 9, mounted on the front of the typing unit, is easily removed. It consists of levers, arms, bails and slides, which are used to position the type box. Fig. 9

Function Box

2.29 A function box is located in the rear of the typing unit as shown in Fig. 10. Figs. 11 and 12 are front and rear views, respectively, of an early model of the box which indicates, in general, the character of the box and the appearance of the bars and levers in the occupied slots. These are not pictures of the box as arranged in the present Bell System models. Figs. 10, 11 and 12

2.30 Table 2 shows how the slots are used in the Bell System models. Of the total of 42 slots, 15 are used, with 27 available for features which may be required in the future.

Table 2

Function Box Slot (Note 1)	Function
1	Unshift on Space (LTRS)
2	Shift to Upper Case (FIGS)
3	Shift to Lower Case (LTRS)
4	Automatic Carriage Return
5	Carriage Return
22 (Clip)	Blank (with Slot 23 for Motor Stop on FIGS Blank H)
23	Motor Stop (FIGS H or FIGS M)

Function Box Slot (Note 1)	Function
28 (Clip)	Blank (Space Suppression on Upper-Case Blank)*
29	Bell (Upper Case S)
31	Blank (Space Suppression on Lower-Case Blank)
35 (Clip)	Keyboard Lock on Double Blank*
36	Keyboard Lock on Single Blank
38	Space Suppression on Single Line Feed
39	Automatic Line Feed
40	Line Feed

* The clips at the slots indicated permit variations in the functions as discussed below.

Note 1: The function box has 42 slots, numbered from right to left (as seen from the front). Numbers not shown in this table are vacant.

2.31 Clips on Function Box: As Table 2 indicates, slots 22, 28, and 35, have associated with them, clips, which can be adjusted, as described below, to vary the manner of performance of the functions of motor stop, space suppression on upper-case Blank, and keyboard lock.

2.32 Each of the three clips is attached at the top of the function box to the right of its respective slot. Each clip can be rotated to a right, left or center position as shown in Fig. 13. When the clip is in the right position it has no effect on operation. In the center position the extension of the clip reaches under and elevates the function pawl, preventing it from operating the function lever. Operation of the function is prevented. In its left position the extension of the clip elevates the function pawl and also holds the function lever in its operated position. Table 3 shows how the position of the clips determines the operation of each function.

Fig. 13

Table 3

EFFECTS OF CLIP POSITION

Clip at Slot	Left	Center	Right
22	Motor Stop on FIGS H	No Motor Stop	Motor Stop on FIGS Blank H
28	Not Used	Spacing on Upper-Case Blank	No Spacing on Upper-Case Blank
35	Keyboard Lock on Single Blank	No Keyboard Lock	Keyboard Lock on Double Blank

Main Shaft and Clutches

2.33 Fig. 14 shows the main shaft and its six clutches. They are, from right to left; selector clutch, code-bar clutch, function clutch, spacing clutch, line-feed clutch and type-box clutch.

Fig. 14

2.34 A new all-metal positive-action clutch is used. This type of clutch engages when tripped and disengages to a no-load condition.

2.35 Two other clutches are located on the keyboard base. One is mounted on the signal-generator shaft and is the positive-action type. The other is mounted on the intermediate shaft and is contained within the helical driving gear. This is an overload-type clutch. The purpose of this clutch is to disengage its helical gear when the typing unit or the keyboard becomes jammed, to prevent damage to the equipment. When the clutch is disengaged a clacking sound serves as an audible alarm.

(F) Electrical Service Unit

2.36 Fig. 15 shows the electrical service unit, which is inside the console behind the keyboard. On the basic unit may be mounted the auxiliary features (if provided) which are marked with an * in Part 2 G. The basic unit contains two 10-ampere fuses, various switches, terminal blocks, convenience receptacles and a line shunt relay. The main power switch is located in the right side and is controlled from the switch lever at the right front of the console just below the keyboard. Fig. 16 is a schematic wiring diagram of the Service Unit without the motor control feature.

Figs. 15 and 16

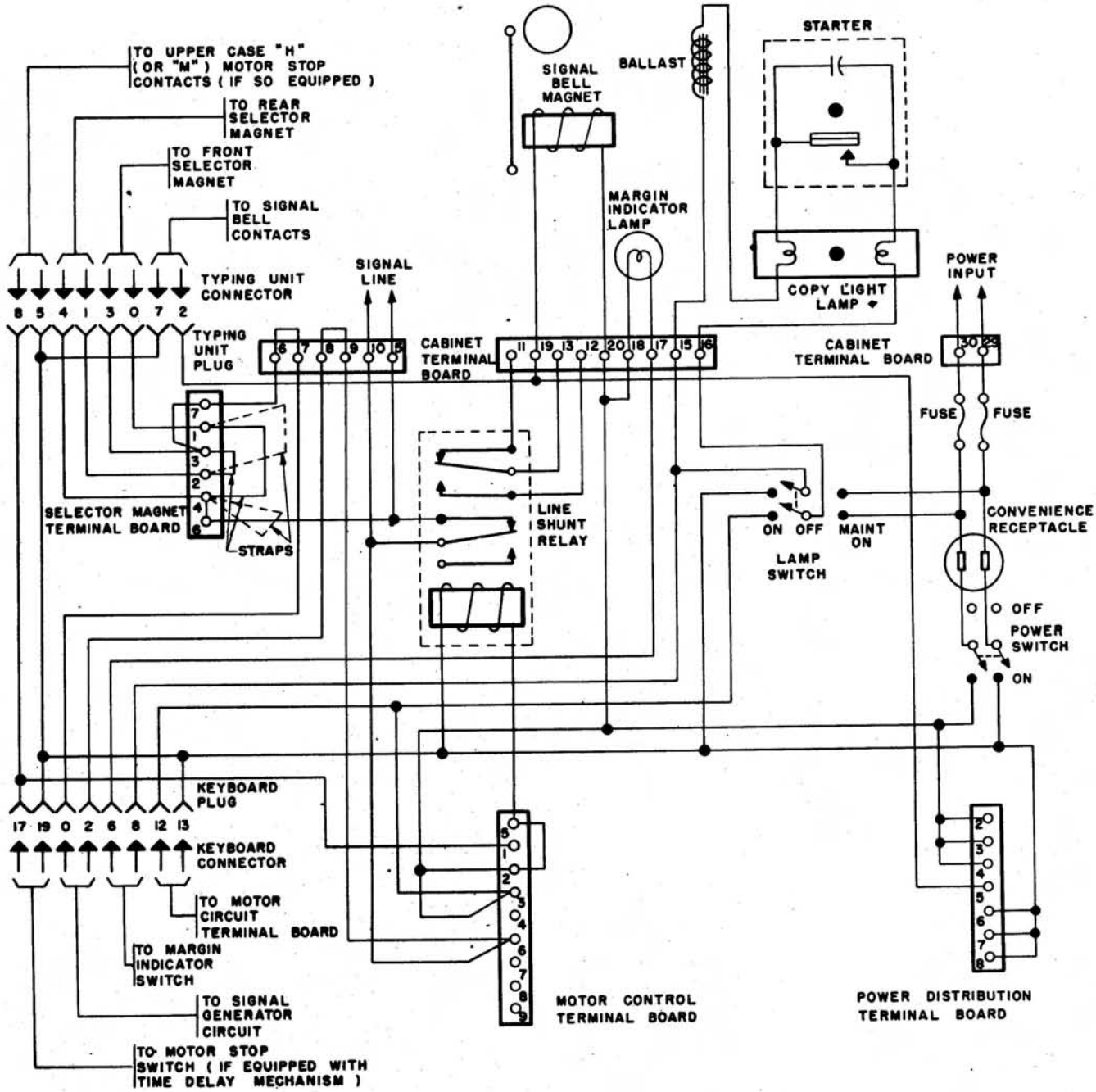

TO UPPER CASE "H" (OR "M") MOTOR STOP CONTACTS (IF SO EQUIPPED)
TO REAR SELECTOR MAGNET
TO FRONT SELECTOR MAGNET
TO SIGNAL BELL CONTACTS
TYPING UNIT CONNECTOR
8 5 4 1 3 0 7 2
TYPING UNIT PLUG
SIGNAL LINE
6 7 8 9 10 5
SIGNAL BELL MAGNET
BALLAST
STARTER
MARGIN INDICATOR LAMP
COPY LIGHT LAMP
POWER INPUT
CABINET TERMINAL BOARD
11 19 13 12 20 18 17 15 16
CABINET TERMINAL BOARD
30 29
FUSE
FUSE
SELECTOR MAGNET TERMINAL BOARD
STRAPS
LINE SHUNT RELAY
ON OFF MAINT ON
LAMP SWITCH
CONVENIENCE RECEPTACLE
OFF
POWER SWITCH
ON
KEYBOARD PLUG
17 19 0 2 6 8 12 13
KEYBOARD CONNECTOR
TO MOTOR CIRCUIT TERMINAL BOARD
TO MARGIN INDICATOR SWITCH
TO SIGNAL GENERATOR CIRCUIT
TO MOTOR STOP SWITCH (IF EQUIPPED WITH TIME DELAY MECHANISM)
MOTOR CONTROL TERMINAL BOARD
POWER DISTRIBUTION TERMINAL BOARD

Fig. 16

2.37 A three-position light switch is in the front corner of the service unit at the right. With the main power switch off, the copylight may be turned on for maintenance purposes by operating the switch to MAINT ON. In the center or off-position of this switch, the copylight is disconnected from the power circuit. In the left or on-position, power for the copylight is taken from and controlled by the motor switch so that the light is on when the motor is running.

2.38 The plug connector and cable assemblies which go to the keyboard and typing unit pass through holes in the top mounting plates at the left and right ends, respectively, of the service unit. Another cable, with spade lug terminations goes from the left side of the unit to the left half of the cabinet terminal block to bring the signal-line circuits into the service unit. Still another connects with the right half of the cabinet terminal block to bring power into the unit and complete the circuits to the various features in the cabinet.

2.39 The line shunt relay is mounted in the left end of the electrical service unit. Its function is to short-circuit the signal line when the machine is turned off to prevent an open-line condition should the keyboard stop with its contacts open.

2.40 Electrical Motor-Control Mechanism: Fig. 15 shows the stop and start magnets of the electrical motor control mechanism which, if provided, is mounted on top of the service unit. The operation of this mechanism is described under Auxiliary Features in Part 6B. Fig. 15

(G) List of Auxiliary Features

2.41 An auxiliary feature is one which may be added to a coded unit by a set of parts, to provide a feature not normally furnished in that coded unit.

Feature	Status
*Motor-Stop Mechanism	As required
*Line Relay	As required
*0.100-ampere Rectifier (115V dc) (for selector magnets)	As required
*Current-limiting Resistor (for operation on dc)	As required
*Line Test Key	As required
Sprocket Feed	Under development
Tabulator Mechanism	Under development
Form-setting Mechanism	Under development
Time-Delay Mechanism	Not furnished on Bell System machines
Offset Copyholder	Provided when regular copyholder is inadequate
Break Key for RO Base	Available as a set of parts TP152911
Auxiliary Apparatus Mounting Rack (for subscriber set, etc.)	TP152909
Keytops to Convert Type Arrangement C to:	
Arrangement D	TP152904 set of keytops
B	TP152905 set of keytops
A	TP152906 set of keytops

* On the electrical service unit

3. THEORY OF OPERATION - KEYBOARD

(A) General

3.01 Uniformly throughout this section the words "right" and "left" refer to the sides of the machine, or its component mechanisms, as seen from the front. However, some of the figures are rear views; reference to right and left on these is opposite to the way they appear in the figures. For example, if a part is described as moving to the right, it moves toward the left in figures which show the rear view.

3.02 The principal components of the keyboard and their relation to the rest of the teletypewriter are shown by the functional block diagram of Fig. 17. Fig. 17

3.03 Keyboard Schematic Wiring Diagram: Fig. 18 shows a schematic wiring diagram of the keyboard. The motor-stop switch shown there is a part of the time-delay mechanism, not furnished on Bell System machines. Fig. 18

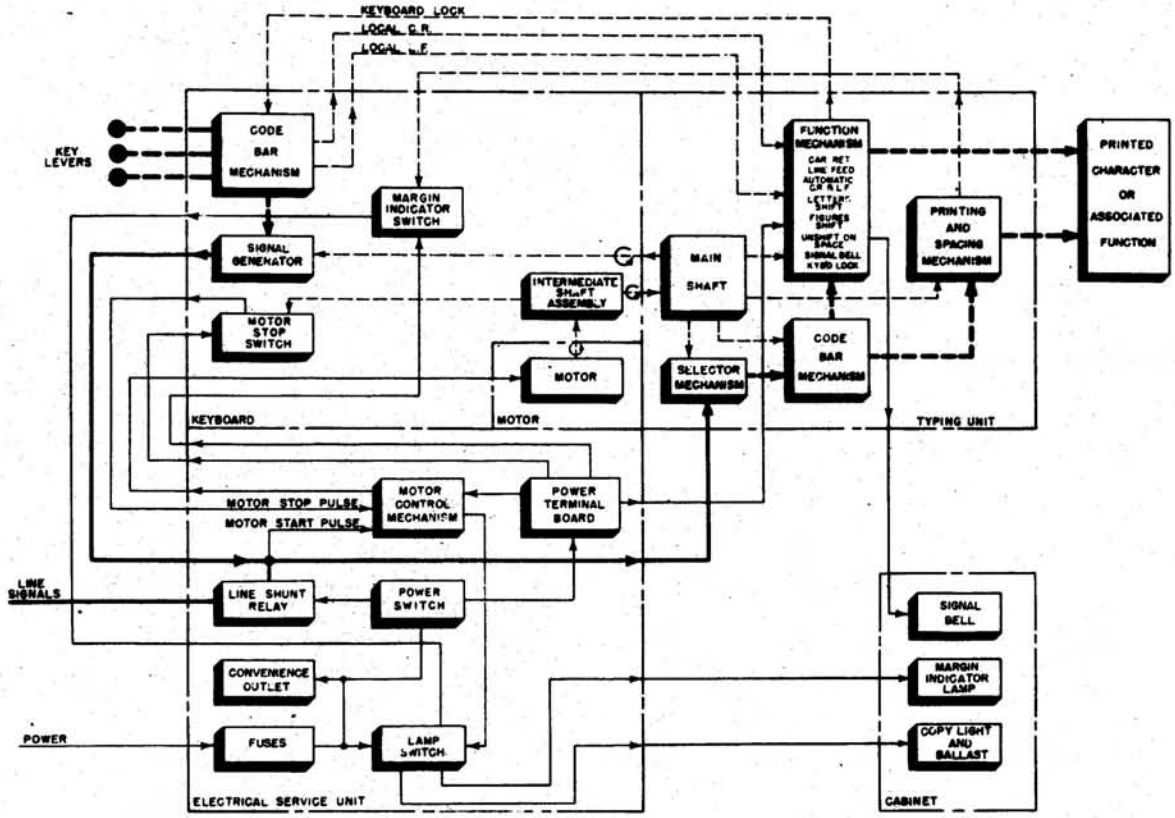

KEYBOARD LOCK
LOCAL C.R.
LOCAL L.F.
KEY LEVERS
CODE BAR MECHANISM
MARGIN INDICATOR SWITCH
SIGNAL GENERATOR
MOTOR STOP SWITCH
INTERMEDIATE SHAFT ASSEMBLY
MOTOR
MAIN SHAFT
SELECTOR MECHANISM
FUNCTION MECHANISM
CODE BAR MECHANISM
PRINTING AND SPACING MECHANISM
PRINTED CHARACTER OR ASSOCIATED FUNCTION
KEYBOARD
MOTOR
TYPING UNIT
MOTOR STOP PULSE
MOTOR START PULSE
MOTOR CONTROL MECHANISM
POWER TERMINAL BOARD
LINE SIGNALS
LINE SHUNT RELAY
POWER SWITCH
CONVENIENCE OUTLET
POWER
FUSES
LAMP SWITCH
SIGNAL BELL
MARGIN INDICATOR LAMP
COPY LIGHT AND BALLAST
ELECTRICAL SERVICE UNIT
CABINET

Fig. 17

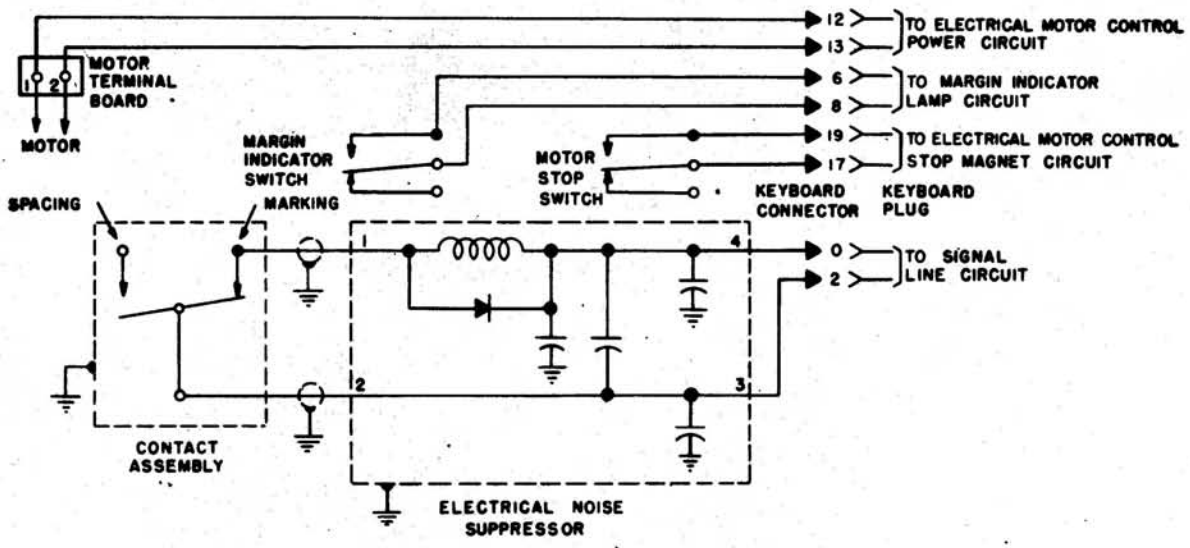

MOTOR TERMINAL BOARD
1 2
MOTOR
MARGIN INDICATOR SWITCH
MOTOR STOP SWITCH
SPACING
MARKING
KEYBOARD CONNECTOR
KEYBOARD PLUG
12
13
TO ELECTRICAL MOTOR CONTROL POWER CIRCUIT
6
8
TO MARGIN INDICATOR LAMP CIRCUIT
19
17
TO ELECTRICAL MOTOR CONTROL STOP MAGNET CIRCUIT
0
2
TO SIGNAL LINE CIRCUIT
1
2
3
4
CONTACT ASSEMBLY
ELECTRICAL NOISE SUPPRESSOR

Fig. 18

(B) Intermediate Shaft

3.04 The intermediate shaft assembly located in the rear central portion of the keyboard has two helical gears and an eccentric cam, as shown in Fig. 4. Fig. 4

3.05 The helical gear which engages the mainshaft gear has an overload clutch. The purpose of this clutch is to disengage its helical gear when the typing unit or the keyboard becomes jammed to prevent damage to the equipment. When an overload occurs the clutch lever disengages its notch in its helical gear. When disengaged the clutch lever strikes its notch with each revolution of the intermediate shaft producing a clacking sound which serves as an audible alarm. To re-engage the overload clutch the power must be turned off and the motor turned over by hand until the clutch lever falls into its notch. If the trouble reoccurs the clutch will again disengage and produce the clacking sound.

3.06 The large fiber helical gear transmits motion from the motor to the intermediate shaft. The gear ratio between the helical driving gear on the motor and the helical driven gear on the intermediate shaft determines the speed (operations per minute) at which the equipment will operate. These gears are interchangeable for the three operating speeds.

(C) Code-Bar Mechanism

3.07 Positioning of Code Bars: Fig. 19 shows how depressing a key causes the associated keylever to move the front of a code lever down and the rear of the lever up. Fig. 20 shows how the rear of the code lever rotates the front edge of the code-lever bail upward. The upper extension of the bail travels to the rear of the step on the code-lever-bail latch lever. The code-lever-bail latch lever moves the right end of the code-bar-bail latch lever down. The code-bar-bail latch lever releases the code-bar bail and the lower end of the bail moves to the right as shown in Fig. 21. The code bars, which rest against the code-bar bail tend to move to the right with the code-bar bail. Figs. 19, 20 and 21

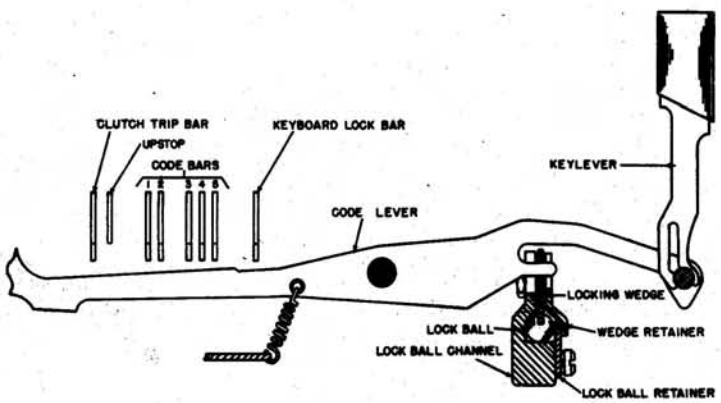


Fig. 19

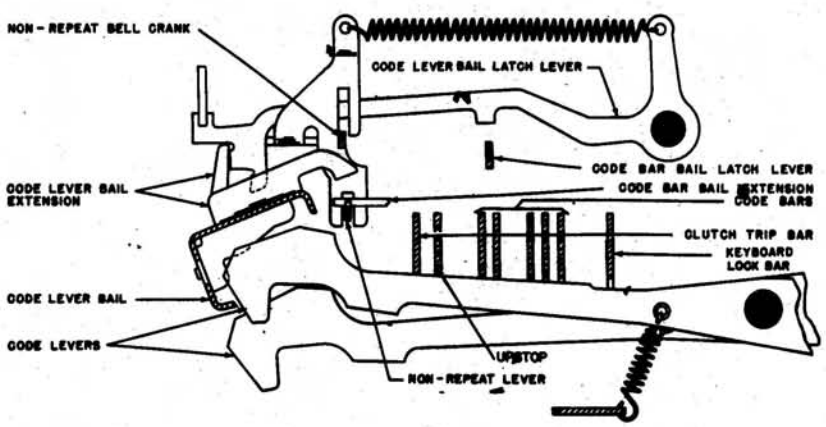


Fig. 20

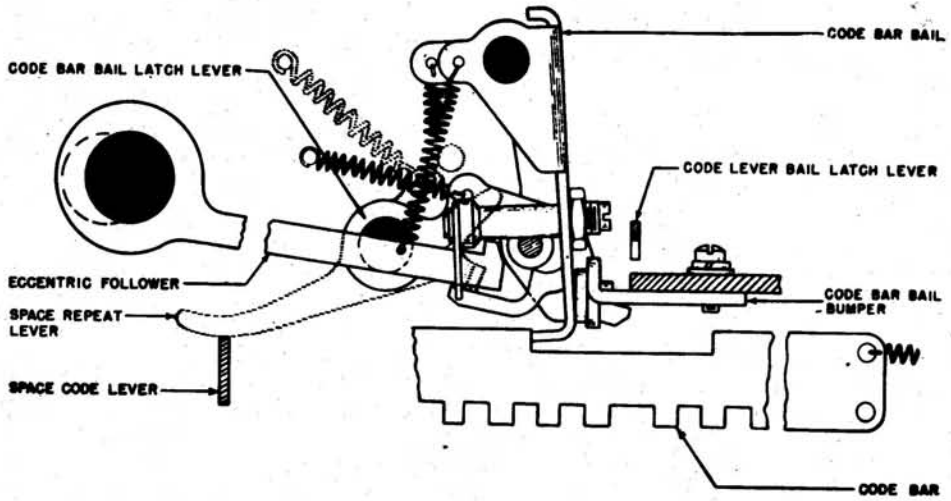


Fig. 21

3.08 Fig. 22 shows how code bars are notched for the five-unit code. When any code lever is operated, the lever moves up into the notches of the code bars. If there is a projection on a code bar immediately to the left of the code lever being operated, the code bar will be blocked from moving to the right and will remain to the left in the spacing position. If there is no such projection, the code bar will follow the code-bar bail to the right - the marking position. Fig. 22

3.09 Code-lever Lock: When the rear end of the code lever is raised as is shown in Fig. 20, it raises the front edge of the code-lever bail. The rear edge of the bail moves under the rear end of the operated code lever and moves over the ends of the unoperated code levers. The code-lever bail is latched in this position by the code-lever-bail latch engaging the upper extension of the bail. During the interval the bail is latched, the operated key will be locked in the operated position and no

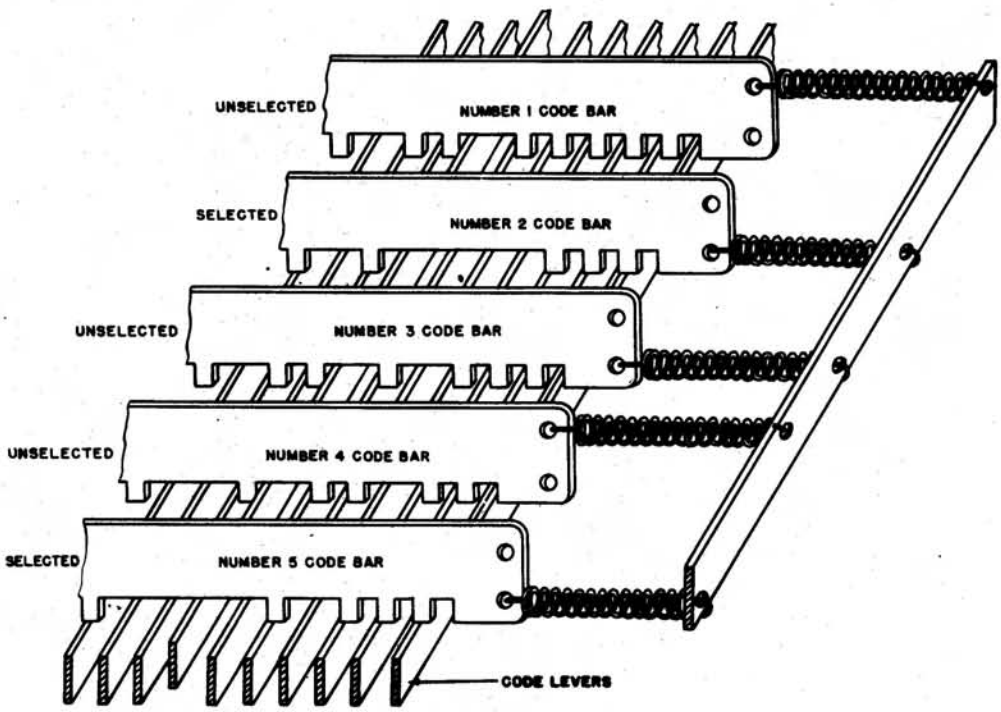


Fig. 22

other key can be moved to the operated position. When the latch lever is raised by the nonrepeat bellcrank (Fig. 23), the code-lever bail will rotate to its unoperated position and will release the operated code lever. The bail in its unoperated position will permit any keylever to be operated. Figs. 20 and 23

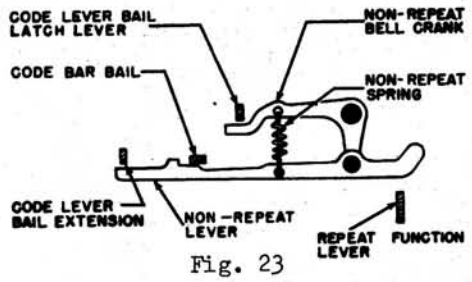


Fig. 23

(D) Clutch Operation

Clutch-Trip Mechanism

3.10 When the lower end of the code-bar bail moves to the right it releases the clutch trip bar which engages the lower extension of the trip bail and moves the extension to the right. (Fig. 24 is a rear view, so that "right" in the text means "left" in the figure.) As the clutch trip bail rotates on its pivot, the clutch stop lever, on the right end of the bail, moves up to release the clutch-shoe lever in the keyboard cam clutch. Fig. 24

3.11 Details of the operation of the clutch mechanism are discussed in Part 4, Typing Unit, under the heading Clutches.

3.12 When the keyboard cam assembly is about to complete one revolution, the clutch-shoe lever comes up to the stop lever. The clutch is disengaged and the cam assembly comes to rest.

3.13 If a keylever is operated while the motor is stopped, the clutch shoes will engage the drum. When the motor is started the keyboard cam assembly will make one revolution and the clutch-shoe lever will be moved against the stop lever. There is a possibility, that because of the low rotational speed of the cam assembly, the clutch shoes might not be completely disengaged from the drum so that undue wear would result. To prevent this, complete disengagement is assured by the clutch-latch mechanism.

3.14 Clutch-Latch Mechanism: As the cam clutch nears the end of its revolution the clutch-shoe lever strikes the stop lever (Fig. 24), and the inertia of the cam-disc assembly causes it to continue to turn until its lug makes contact with the lug on the clutch-shoe lever. At this point the latch lever drops into the indent in the cam disc and the clutch is held disengaged. The lever also prevents the clutch from backing up far enough to allow the shoes to drag on the drum. Fig. 24

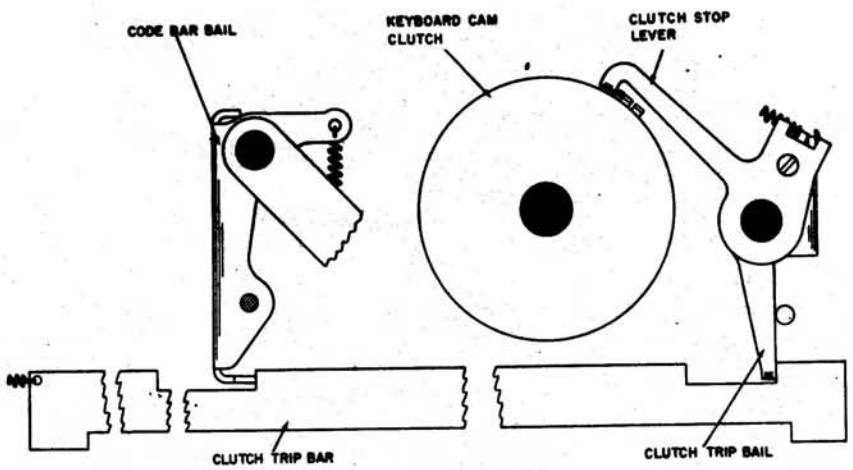


Fig. 24

(E) Code-Bar-Bail Reset Mechanism

3.15 Before the keyboard cam assembly starts its rotation, the eccentric follower will be in its extreme right position (Fig. 21). When the cam assembly starts to rotate, the follower starts to move to the left. The follower engages the adjusting stud mounted in the code-bar bail and the bail is moved to the left. The lower end of the code-bar bail engages a shoulder on each code bar and the clutch trip bar and each bar is moved to the left. When the keyboard cam assembly has made approximately one-half revolution, the eccentric follower will have traveled to its extreme left position and the roller on the code-bar bail will have overtraveled the latching surface of the code-bar-bail latch lever. The code-bar bail will remain latched until another keylever is operated, as shown in Fig. 25. Fig. 25

3.16 Some flexibility in speed is possible in operating the keylevers, though this does not affect the transmitting speed. After about 40 per cent rotation of the keyboard cam assembly the selected character is locked in by the locking bail, whereupon the code-lever bail will rotate to its unoperated position, thereby releasing the operated code bar, code lever and keylever. Another keylever may then be operated which will set up the next selection on the code bars. After the keyboard cam has completed its revolution the next selection will be transferred to the selector levers.

(F) Keylever Locking Mechanism

3.17 Ball Lock: Fig. 26 shows the keylever lock-ball mechanism. As the code lever is operated, its locking wedge moves downward between the lock balls in the lock-ball track, and crowds them together, preventing any other keylever with a locking wedge from being operated at the same time. Therefore, only one code lever will be operated or none will be operated if more than one keylever is struck simultaneously. Fig. 26

(G) Signal-Generator Mechanism

Positioning of Transfer Levers and Selector Levers

3.18 The position of the code bars is transferred to the selector levers by means of the transfer levers. If a code bar moves to the right (marking) (Fig. 27), when a keylever is operated, the lower end of its associated transfer lever moves to the right, the upper end to the left. A selector lever is coupled to the upper end of the transfer lever and therefore also moves to the left (marking). A code bar that is prevented from moving to the right, Fig. 28, prevents the associated transfer lever from moving, and the corresponding selector lever remains to the right (spacing). Figs. 27 and 28

3.19 There are seven transfer levers, designated from front to rear as No. 1, No. 2, Start, No. 3, No. 4, No. 5, and Stop. The five numbered transfer levers, with their associated selector levers, can be in either position, marking or spacing, depending on the five signal

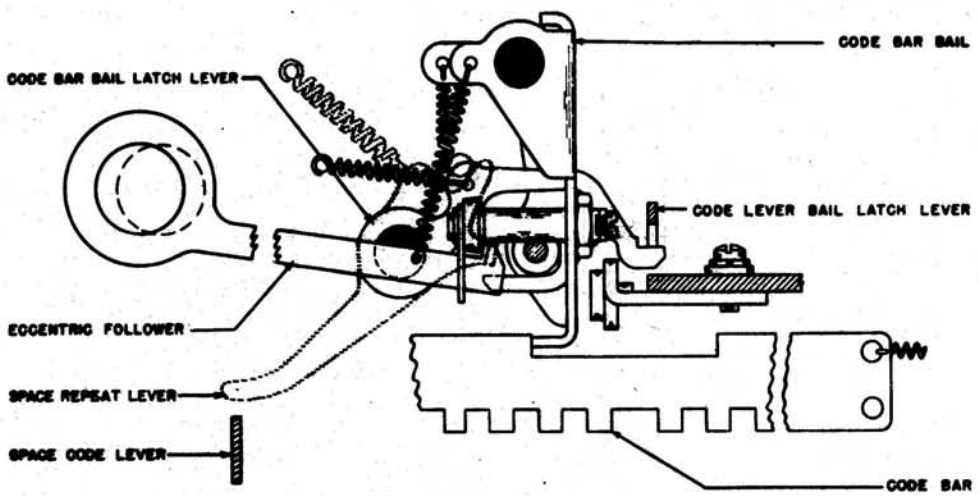


Fig. 25

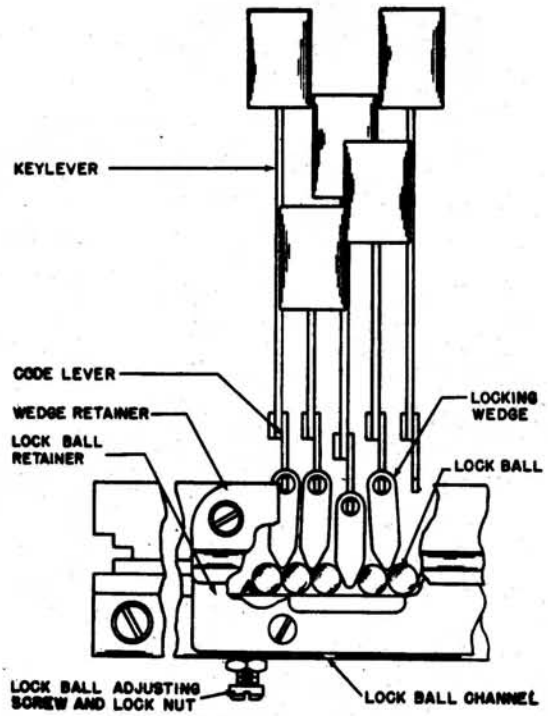


Fig. 26

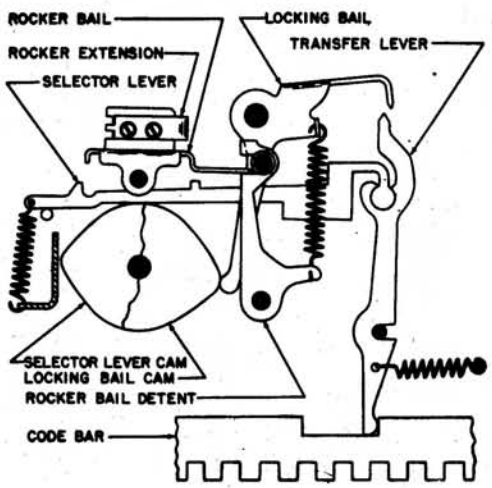


Fig. 27

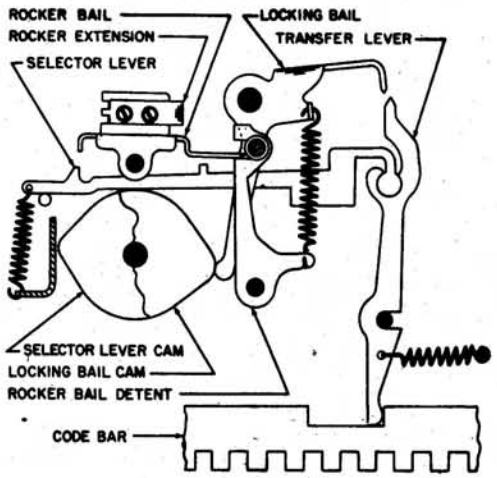


Fig. 28

elements of the character being transmitted. The Start selector lever is always kept to the right (spacing) because its transfer lever rests in a short slot in the transfer-lever guide. The Stop selector lever is always held to the left (marking) by the spring on its transfer lever.

3.20 Transfer-Lever Locking Bail: Fig. 29 shows what happens when the keyboard cam assembly starts to rotate. The left extension of the transfer-lever locking bail rides from the high to the low part of the cam on the selector cam assembly. The right extension of the bail moves downward between the projections on the upper ends of the transfer levers to lock the transfer levers in the position to which they had been moved for the code combination to be transmitted. (The transfer lever shown in Fig. 29 is locked in the marking position.) After a code combination has been transmitted and just before the selector-cam assembly completes a revolution, the locking bail extension rises to the high part of the cam, unlocking the transfer levers. Fig. 29

3.21 Transfer of the Code to the Transmitting Contact: The transfer lever locked in the marking position, as shown in Fig. 29, has moved the corresponding selector lever to the left, where its right projection is in line with the right edge of the rocker bail. When the selector cam raises the selector lever, the lever will rotate the rocker bail counterclockwise where it will be held by the rocker-bail detent. The rocker extension, Fig. 30, will move the (upper) spacing intermediate lever up out of the path of the flutter lever and will allow the (lower) marking intermediate lever to move up into the path of the flutter lever. When the flutter lever rides to the high part

of the flutter cam the upper end of the flutter lever will move to the right (left in Fig. 30) to engage the lower intermediate lever and move it to the right. An extension of the intermediate lever will engage the lower part of the oscillating lever and rotate it counterclockwise (clockwise in Fig. 30). The upper end of the oscillating lever will move the detent toggle toward the keyboard contact assembly and, through the toggle extension, Fig. 31, will move the contact toggle so as to close the marking contact. The line will then be closed through the marking contacts, the contact toggle, the toggle link, the spring and the terminal. Figs. 29, 30 and 31

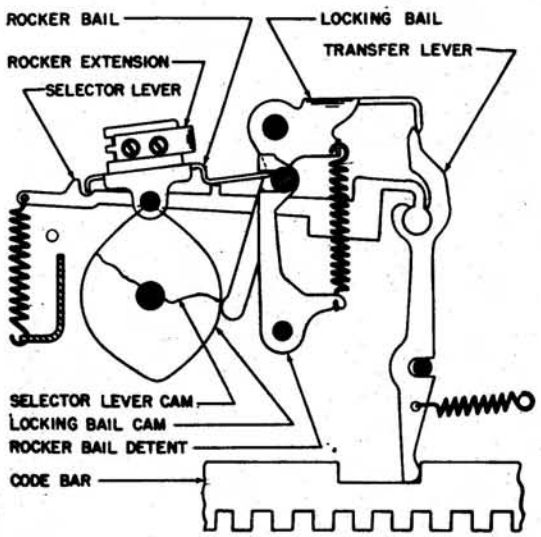


Fig. 29

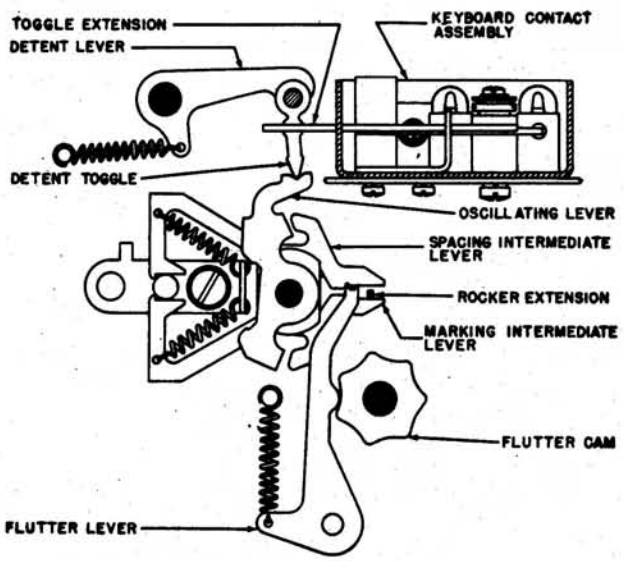


Fig. 30

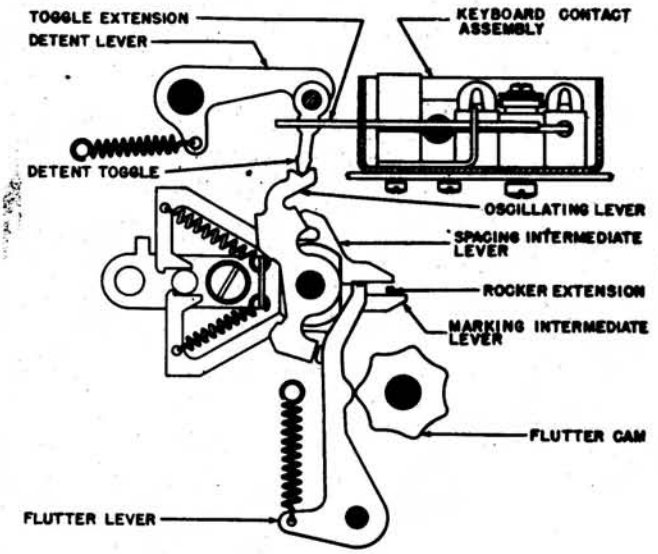


Fig. 31

3.22 If a transfer lever and selector lever are in the spacing position, the left projection of the selector lever would engage the rocker bail, which would then be rocked to a position opposite to that shown in Fig. 29. The rocker extension would then be in the lower position, as shown in Fig. 32, lowering the marking intermediate lever and putting the spacing intermediate lever in position to be pushed by the flutter lever. When the flutter lever is on the high part of its cam, as shown in Fig. 32, the spacing intermediate lever rotates the oscillating lever which in turn pushes the detent toggle, pulling the toggle extension away from the keyboard contact assembly and in turn moving the rear end of the contact toggle to open the marking contact (Fig. 33) and hence send a spacing signal. Fig. 34 shows the stop position, where the flutter lever is on the low part of its cam so that neither the marking or spacing intermediate levers are pushed into a transmitting position. The oscillating lever takes a position such that the keyboard contacts are in the marking position. Figs. 29, 32, 33 and 34

Transmission of the Letter Y from the Keyboard

3.23 As an illustrative example of the operations which have been described, the process involved in transmitting the letter Y from the keyboard will be described. When the Y keylever is depressed the rear end of the associated code lever moves up. The code lever rotates the code-lever bail and the upper extension of the bail releases the code-lever-bail latch lever. This latch lever moves down to depress the right end of the code-bar-bail latch

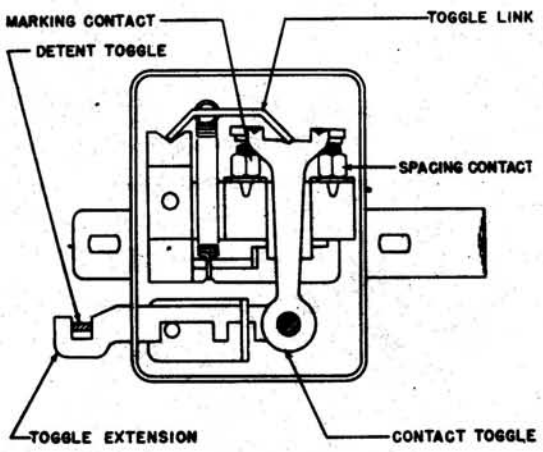


Fig. 32

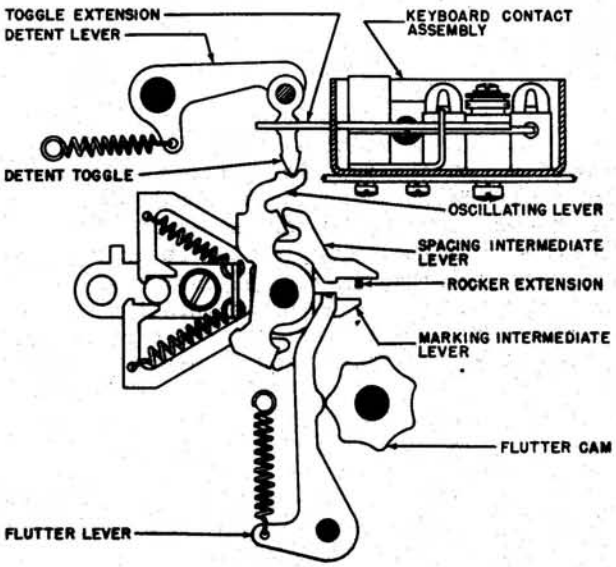


Fig. 33

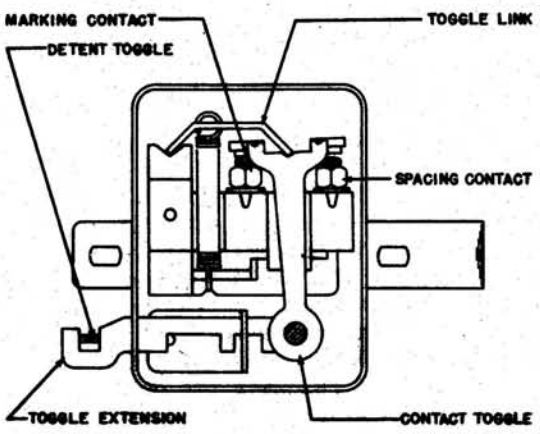


Fig. 34

lever. The code-bar bail is released and code bars 1, 3, and 5 move to the right. Code bars 2 and 4 are blocked and remain to the left.

3.24 The lower ends of the transfer levers 1, 3 and 5 will follow their code bars to the right. The upper ends of these transfer levers will move their selector levers to the left. The upper ends of the transfer levers 2 and 4 will remain to the right and will hold selector levers 2 and 4 to the right. The "Start" selector lever will be to the right and the "Stop" selector lever will be to the left.

3.25 Movement of the lower end of the code-bar bail to the right allows the clutch trip bar to operate the clutch trip bail. The clutch trip bail moves the clutch stop lever away from the clutch-shoe lever and the clutch shoes engage the drum to start the keyboard-cam assembly rotating. The transfer-lever locking bail left extension rides to the low part of its cam; the right extension moves down to lock the transfer levers in position for the "Y" combination.

3.26 When the keyboard-cam assembly had come to rest after the previous operation, the "Start" selector lever was on the high part of its cam. The left upper projection on the lever had rotated the rocker bail clockwise. The rocker extension lowered the lower (marking) intermediate lever out of the path of the flutter lever and allowed the upper (spacing) intermediate lever to move down into the path of the flutter lever. After the keyboard-cam assembly starts to rotate, the flutter lever rides from the low part to the high part of its cam. The upper end of the flutter lever engages the upper (spacing) intermediate lever and moves the intermediate lever to the right. The intermediate lever rotates the oscillating lever clockwise. The oscillating lever moves the detent toggle to the right. The detent toggle moves the toggle extension to the right. The rear end of the toggle is moved to the right. With the spacing contact of the toggle acting as a pivot, the marking contact will open the line circuit to transmit the start element. The flutter lever then rides to the low part of its cam.

3.27 Selector lever No. 1 then rides to the high part of its selector cam. The right upper projection of the lever rotates the rocker bail counterclockwise. The rocker extension moves the upper intermediate lever up out of the path of the flutter lever and allows the lower intermediate lever to move up into the path of the flutter lever. As the flutter lever rides from the low to the high part of its cam, the flutter lever engages the lower intermediate lever and moves it to the right. The intermediate lever rotates the oscillating lever

counterclockwise. The oscillating lever moves the detent toggle to the left. The detent toggle moves the toggle extension to the left. The marking contacts will close, closing the line circuit to transmit No. 1 element marking.

3.28 Because selector levers 2 and 4 will have the same position as the Start selector lever, the resulting action, as the levers in turn ride to the high part of their cams, will be the same as for the Start. Selector levers 3, 5 and Stop will have the same position as No. 1, and the operation for these elements will be the same as for the No. 1.

3.29 In its travel to the left, the lower end of the code-bar bail engages a projection on the nonrepeat lever and the nonrepeat lever is moved to the left. The lever rotates the nonrepeat bellcrank clockwise. The left arm of the bellcrank raises the code-lever-bail latch lever. The right end of the code-bar-bail latch lever moves up to engage the roller on the code-bar bail and latches the bail in its left position. Also when the code-lever-bail latch lever rises, the upper extension of the code-lever bail is unlatched and the bail rotates to its unoperated position. A front extension on the bail moves down against the nonrepeat lever and moves it down out of engagement with the code-bar bail. The keyboard is now conditioned for the operation of another keylever.

3.30 When the keyboard cam completes its revolution, the clutch will be disengaged as previously described under Clutch Trip Mechanism.

(H) Nonrepeat Mechanism

3.31 The keyboard as furnished will not repeat when a keylever is held operated. The code-bar bail in its movement to the left (Fig. 23) engages a projection on the nonrepeat lever and moves the lever to the left. The lever rotates the nonrepeat bellcrank clockwise and the left arm of the bellcrank will rise and hold the code-lever-bail latch lever up so that the code-bar-bail latch lever will move up and latch the code-bar bail, even though a keylever is held operated. Fig. 23

3.32 When the keylever is released, the code-lever bail rotates to its unoperated position. The upper extension of the bail moves beneath the forward step on the code-lever-bail latch lever. The front extension of the code-lever bail moves down against the nonrepeat lever, disengaging it from the code-bar bail. The nonrepeat lever allows the nonrepeat bellcrank to rotate counterclockwise. The left arm of the bellcrank moves down away from the code-lever-bail latch lever. The latch lever is held up by the upper extension of the code-lever bail. The keyboard will have transmitted one code combination and will be conditioned for the next operation of a keylever.

(I) Repeat

3.33 The keyboard is equipped with a repeat keylever (Fig. 35). When the REPT. key is operated, the repeat function lever will raise the right end of the nonrepeat lever rotating it out of engagement with the code-bar bail (Fig. 23). In this position the nonrepeat lever can not be engaged and operated by the code-bar-bail. Therefore, the nonrepeat bellcrank can not reset the operated code-lever-bail latch lever which holds both the code-lever bail and the code-bar-bail latch lever operated until the repeat keylever is released.

Figs. 23 and 35

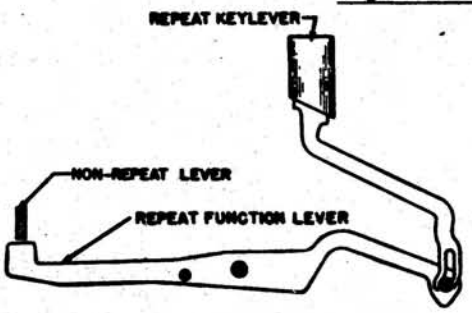


Fig. 35

3.34 If the REPT. key and any other key are held operated simultaneously, the code combination repeated will be the one associated with the key held operated. The clutch trip bar will cause the selector clutch to engage, and a combination will be transmitted. As long as the REPT. key is held operated, transmission will be continuous.

Repeat Space

3.35 Fig. 21 shows what happens when the space bar is depressed. The rear portion of the space code lever lifts the lower end of the space-repeat lever. As the space-repeat lever turns clockwise its frontward projection engages the lower projection on the code-bar-bail latch lever which drops downward and is held in this position until the space bar is released. The space combination will be repeated as long as the space bar is held operated.

3.36 For 100-word speed, repeat space may be undesirable since some operators might hold the space bar operated too long when introducing a space between words in a message. Repeat space can be prevented by removing the repeat-space lever.

(J) Keyboard Lock

3.37 When the KBD Lock key is operated, (Fig. 36) the lock function-lever raises the lock-bar pawl to release the keyboard lock bar. The lock bar is moved to the right by spring action (Fig. 37). Projections on the lock bar move above the code levers preventing operation of any of the keylevers. The upper projection of

the lock-bar pawl will rest on the upper surface of the lock bar, causing the lower extension of the latch to hold the lock function lever operated. Figs. 36 and 37

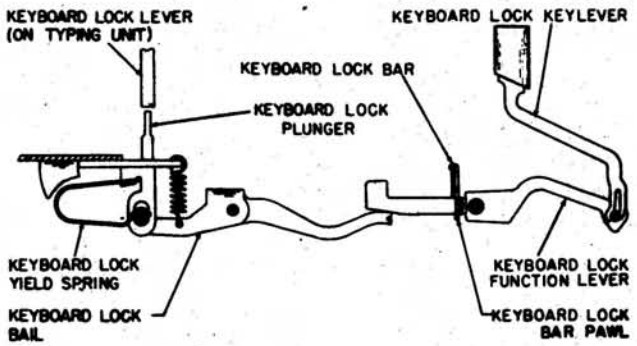


Fig. 36

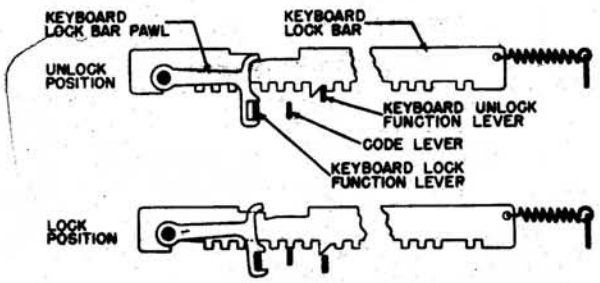


Fig. 37

3.38 The keyboard can be locked automatically on receipt of a single-blank or double-blank signal by suitable adjustment of the clip in slot 35 of the function box on the typing unit. Table 3 in Part 2E and Fig. 13 show how the clip is placed for the desired mode of operation. The details of the typing-unit operations are described in Part 4H under Keyboard Lock. Fig. 13

Keyboard Unlock

3.39 When the KBD UNLK key is operated, as shown in Fig. 38, the unlock function lever moves up against an inclined surface of the lock bar (Fig. 37). The lock bar will be cammed to the left until a shoulder on the bar overtravels the lock-bar pawl. The lock bar will then be held in its unoperated position and any keylever can be operated. Figs. 37 and 38

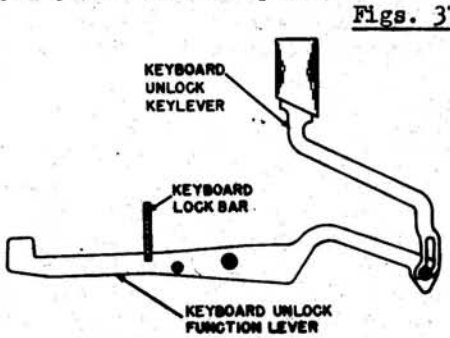


Fig. 38

(K) Local Carriage Return

3.40 When the LOC CR key is operated (Fig. 39) its function lever raises the forward end of the local carriage-return bail. As the bail rotates on its pivot point the upper end engages the carriage-return lever on the typing unit. Thus, the carriage-return mechanism on the local typing unit operates without affecting other typing units on the same circuit. Fig. 39

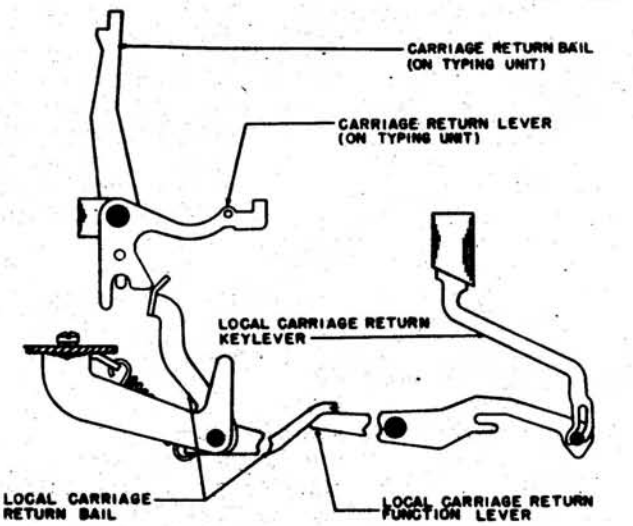


Fig. 39

(L) Local Line Feed

3.41 When the LOC LF key is operated (Fig. 40) its function lever raises the forward end of the local-line-feed bail. As the bail rotates on its pivot point the upper end pushes the trip link until the link engages the line-feed-clutch trip lever on the typing unit. Thus, the line-feed mechanism on the local typing unit operates continuously without affecting the other typing units on the same circuit. Fig. 40

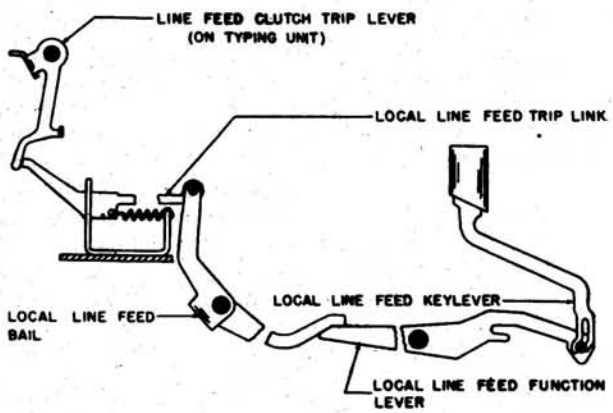


Fig. 40

(M) Break

3.42 A break is effected by using the sending contacts on the keyboard to open the line. When the BREAK key is operated its function lever raises the break rod and shifts the break bail. (Figs. 41 and 42 - Fig. 42 is a rear view so that the directions, right and left, are reversed.) As the break bail moves upward, its lower end engages the lower end of the oscillating lever, rotating it clockwise (counterclockwise in Fig. 42). The oscillating lever shifts the detent toggle, which in turn moves the toggle extension away from the sending-contact assembly, thus pivoting the contact toggle on the spacing contact (Fig. 33) and opening the marking contact. This opens the line until the BREAK key is released. When the key is released, the break bail moves down. The upper end of the bail engages the upper end of the oscillating lever, rotating it to shift the detent toggle toward the contact assembly, thus reclosing the marking contact and the line.

Figs. 33, 41 and 42

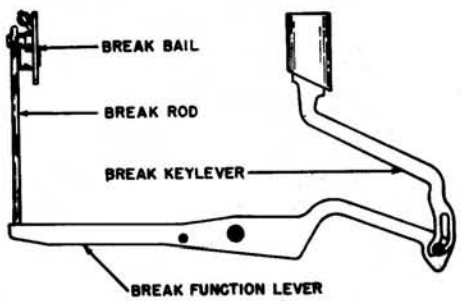


Fig. 41

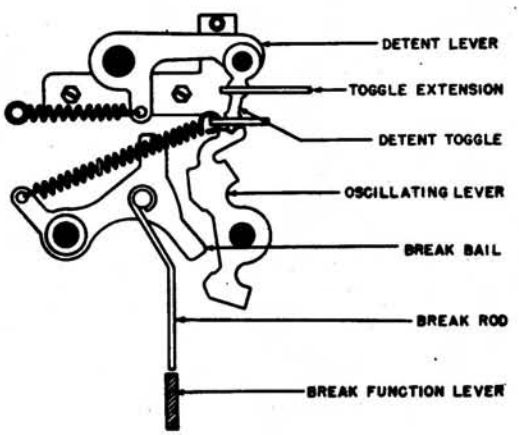


Fig. 42

(N) Margin Indicator

3.43 The margin-indicator cam disc on the typing-unit spring drum rotates with the drum as printing and spacing occurs (Fig. 43). As the end of each line is approached, the cam surface of the disc makes contact with the margin-indicator contact lever and rotates it clockwise. This motion of the lever allows the margin indicator switch to close the circuit to the indicator light in the console. A carriage-return operation returns the cam disc to its starting position and the light switch opens, putting out the light.

Fig. 43

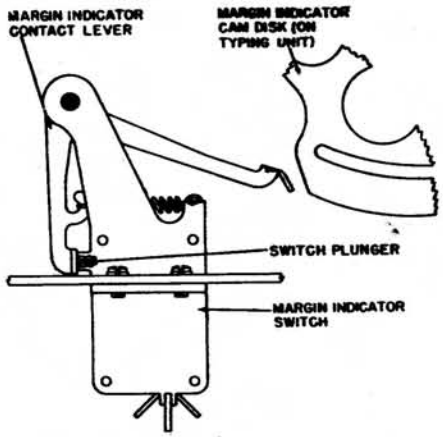


Fig. 43

4. THEORY OF OPERATION - TYPING UNIT

(A) General

4.01 The principal components of the typing unit and their relations to the other parts of the teletypewriter are shown in the functional block diagram of Fig. 17. This figure shows the motor-stop switch and the motor-control mechanism associated with the time-delay mechanism, not furnished on Bell System machines. This diagram does not show the H contacts on the typing unit which are required for remote motor control.

Fig. 17

4.02 Uniformly throughout this BSP section the words "right" and "left" refer to the sides of the machine, or its component mechanisms, as seen from the front or keyboard side. Some of the figures are rear views; reference to right and left on these is opposite to the way they appear in the figures. For example, if a part is described as moving to the right, it moves toward the left in figures which show the rear view.

(B) Main Shaft and Clutches

Main Shaft

4.03 The main shaft, shown in Fig. 44, is located in the lower rear portion of the typing unit and extends the full length of the unit. It is supported by ball bearings mounted in each side frame. When the typing unit is mounted on the keyboard, the main shaft helical driving gear (Fig. 44) meshes with the main shaft driving gear (Fig. 4) on the motor-driven intermediate shaft on the keyboard. The keyboard helical driving gear (Fig. 44) on the main shaft then meshes with the gear on the signal-generator shaft on the keyboard. Thus the motor drives the typing unit main shaft which, in turn, drives the keyboard mechanism.

Figs. 4 and 44

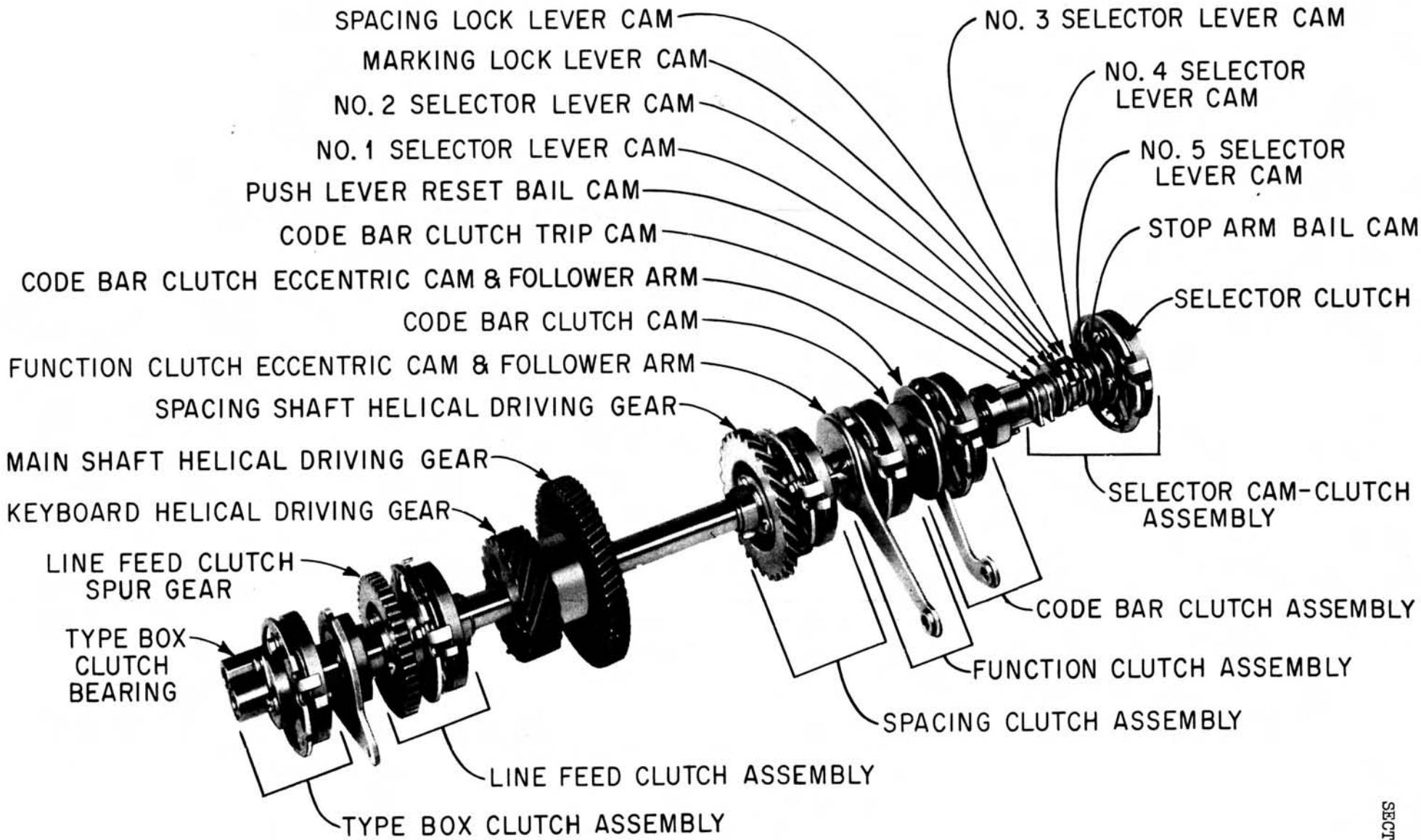

SPACING LOCK LEVER CAM
MARKING LOCK LEVER CAM
NO. 2 SELECTOR LEVER CAM
NO. 1 SELECTOR LEVER CAM
PUSH LEVER RESET BAIL CAM
CODE BAR CLUTCH TRIP CAM
CODE BAR CLUTCH ECCENTRIC CAM & FOLLOWER ARM
CODE BAR CLUTCH CAM
FUNCTION CLUTCH ECCENTRIC CAM & FOLLOWER ARM
SPACING SHAFT HELICAL DRIVING GEAR
MAIN SHAFT HELICAL DRIVING GEAR
KEYBOARD HELICAL DRIVING GEAR
LINE FEED CLUTCH SPUR GEAR
TYPE BOX CLUTCH BEARING
NO. 3 SELECTOR LEVER CAM
NO. 4 SELECTOR LEVER CAM
NO. 5 SELECTOR LEVER CAM
STOP ARM BAIL CAM
SELECTOR CLUTCH
SELECTOR CAM-CLUTCH ASSEMBLY
CODE BAR CLUTCH ASSEMBLY
FUNCTION CLUTCH ASSEMBLY
SPACING CLUTCH ASSEMBLY
LINE FEED CLUTCH ASSEMBLY
TYPE BOX CLUTCH ASSEMBLY

Fig. 44

Clutches

4.04 As Fig. 44 shows, the main shaft has on it six clutches, each of which when tripped drives its associated mechanism. Each clutch has two shoes which bear against the inside of a drum keyed to the main shaft. Fig. 44

4.05 The operation of the clutches, all similar, may be illustrated by reference to the keyboard clutch, Fig. 45. (In Figs. 45, 46 and 47, the direction of rotation is counterclockwise.) A clutch is held in its disengaged position by the pressure of the stop lever against the clutch-shoe lever, B in Fig. 46. The clutch shoes are moved away from the drum and the clutch comes to rest.

Figs. 45 and 46

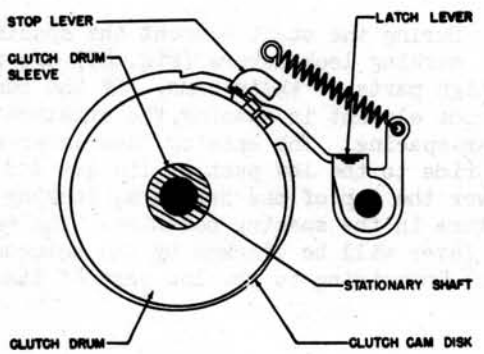


Fig. 45

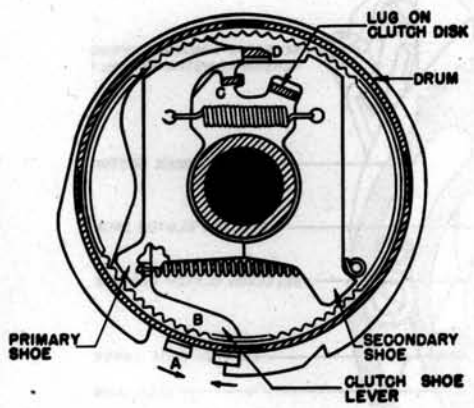


Fig. 46

4.06 At normal operating speeds the momentum of the clutch assures that the clutch shoes are fully disengaged from the drum and held there by the latch lever. The latch lever prevents the clutch from backing up far enough so that the shoes can drag on the drum. When the main shaft is turned over by hand, the clutches do not fully disengage on reaching their stop positions. If the motor is then started the clutches will drag. To prevent this condition, before a typing unit is put back on its base, the lug of each clutch disc should be pushed with a screwdriver until the latch lever engages.

4.07 Fig. 46 shows a clutch disengaged. Disengagement is accomplished by bringing together lug A on the clutch cam disc and the lower end of clutch-shoe lever B. The upper end of lever B pivots about its ear C and allows its other ear D to move toward the right. The upper spring then pulls the two shoes together and away from the drum. Fig. 46

4.08 Clutch engagement takes place when the clutch stop lever (also called the stop arm) (Fig. 45) releases the clutch-shoe lever, B. Fig. 47 shows the inner parts of a clutch when it is engaged. The lug, B, on the clutch-shoe lever is no longer held toward lug A on the clutch disc. The upper end of B pivots around its ear C (which bears against the upper end of the secondary shoe) and moves its ear D and the upper end of the primary shoe toward the left until the shoe makes contact with the drum at point E. As the drum turns counterclockwise it drives the primary shoe down so that it again makes contact with the drum, this time at point F. There the combined forces acting on the primary shoe cause it to push against the secondary shoe at point G. The lower end of the secondary shoe then bears against the drum at point H. The revolving drum acts to drive this shoe upward so that it again makes contact with the drum at point I. Since the forces involved are multiplied at each of the preceding steps, the final force developed at point I is large. This force is applied to lug J on the clutch disc to cause it to turn in step with the drum. The disc on each clutch is connected with the particular mechanism involved. Figs. 45 and 47

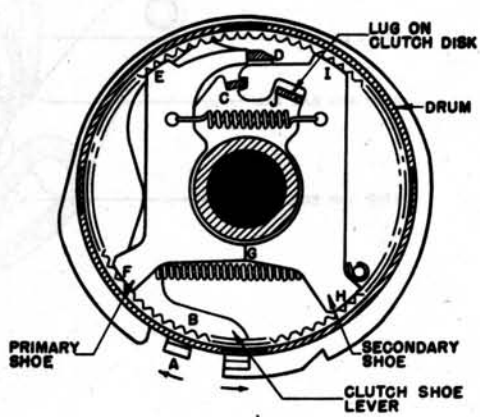


Fig. 47

4.09 Two of the clutches, line feed and spacing, have three sets of lugs equally spaced around their peripheries for controlling the engagement of the clutch shoes with the drum. These clutches turn only one-third of a revolution when tripped except that the line-feed clutch will turn two-thirds of a revolution when the single-double line-feed lever is set for double line feed.

4.10 The function clutch has two sets of lugs diametrically opposite so will turn one-half revolution when tripped. The other clutches have one set of lugs and turn a complete revolution when tripped.

(C) Selection

Orientation Range

4.11 The orientation of the selector is changed by means of a range-finder sector (Fig. 48) which is moved by the range-finder knob on the right side of the typing unit. This knob is normally locked in place by the engagement of its teeth with the teeth of the indexing lock stud; when pushed in (toward the machine) it is free to turn. Its position is indicated by the range scale and its index mark. The scale may be set at any point from 0 to 120.

Fig. 48

Selector Operation

4.12 During the start element there is no current in the selector magnet. The front of the selector armature will move down (spacing) away from the magnet cores (Fig. 48). The start lever, which had been blocked by the front edge of the selector armature, is released and moves to the rear (to the right in Fig. 48). The start lever turns clockwise to move the stop-arm bail into the indent of its cam. As the stop-arm bail rotates, its attached stop arm (also called stop lever) moves away from the clutch-shoe lever of the selector clutch. The clutch shoes engage the drum and the cam assembly starts to turn. The stop-arm bail immediately rides to the high point of its cam where it remains to hold the start lever away from the selector armature until the next stop element.

Fig. 48

4.13 During the start element the spacing and marking lock levers (Fig. 49) are riding the high parts of their cams. If the succeeding code element is spacing, the armature will remain spacing. The spacing lock lever will then ride to the low part of its cam and move in over the top of the armature, locking the armature in the spacing position. The marking lock lever will be blocked by the selector armature from riding to the low part of its cam.

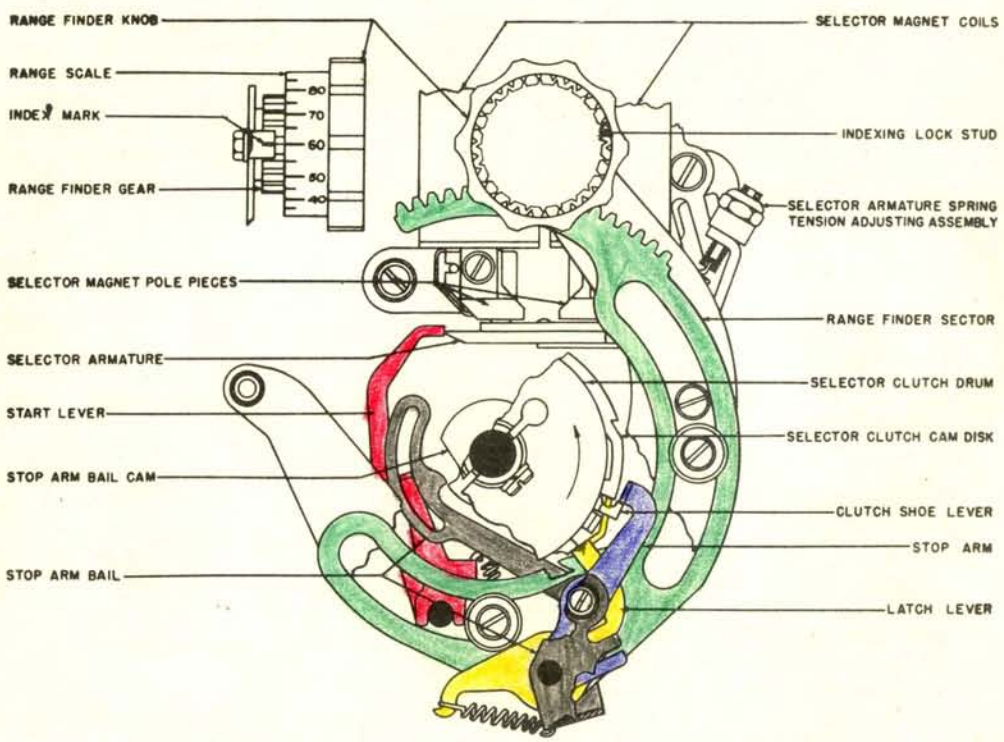


Fig. 48

A projection on the marking lock lever will prevent a selector lever from riding to the low part of its cam. The selector lever is restricted in its rearward movement and does not move far enough for its shoulder to overtravel its associated push lever. The push lever remains spacing (to the rear). Fig. 49

4.14 If a code element is marking there will be current in the selector magnet. When the spacing and marking lock levers ride to the high parts of their cams the selector armature will move up against the selector cores (to the marking position). In the marking position of the armature the marking lock lever is not blocked by the armature and it will ride to the low part of its cam. As the lever moves to the rear beneath the selector armature it locks the armature in the marking position. The extensions on the marking lock lever will have moved far enough to the rear to allow a selector lever to ride to the low part of its cam. The shoulder of the selector lever overtravels the associated push lever. When the selector lever rides to the high part of its cam, the upper end of the lever moves forward, the shoulder of the lever engages the push lever and the push lever is moved forward to its operated position (marking).

4.15 When the stop element is received after the five code elements, the selector armature is pulled up to block the start lever. Thus, the stop-arm bail is prevented from dropping onto the adjacent low part of its cam (stop position of cam clutch), and its attached stop arm will be held in the path of the shoe lever to disengage the clutch and stop the selector cam assembly. When the clutch-shoe lever strikes the stop arm, the inertia of the clutch cam disc causes it to continue to turn until its lug makes contact with the lug on the clutch-shoe lever. The latch lever drops into the indent in the cam disc and the clutch is held disengaged.

4.16 Transfer: If a push lever (Fig. 50) is operated (moved forward, i.e., to the left in Fig. 50), it will move the upper end of its intermediate arm forward. The intermediate arm will cause the upper end of its transfer lever to move to the rear. The front fork of the transfer lever will push its code-bar shift bar to the rear for a marking position. Fig. 50

4.17 If a push lever is unoperated (in its rear position, right in Fig. 50), its intermediate arm will be to the rear, holding the upper end of its transfer lever forward. The rear fork of the transfer lever will hold its code-bar shift bar forward for a spacing position. Fig. 50

4.18 Push-Lever Reset Bail: Immediately after the selector cam assembly starts to rotate, the extension of the push-lever reset bail (Fig. 49) rides to the high part of its cam. The reset bail raises all of the push levers. Any push lever that had been operated during the previous selection will return to its rear (unoperated) position. Fig. 49

(D) Code-Bar Operation

4.19 Code-Bar Clutch: After the fourth element has been received, the code-bar clutch trip-shaft operating lever rides to the high part of its cam on the selector-cam assembly. The lever rotates the trip shaft, moving the code-bar clutch trip lever out of engagement with the code-bar clutch-shoe lever. The clutch shoes engage the drum and the clutch rotates.

4.20 After the code-bar clutch has engaged and started to rotate, the trip-shaft lever will be on the low part of its cam and the clutch trip lever will be in the path of the shoe lever to stop the clutch after one revolution. When the clutch-shoe lever strikes the

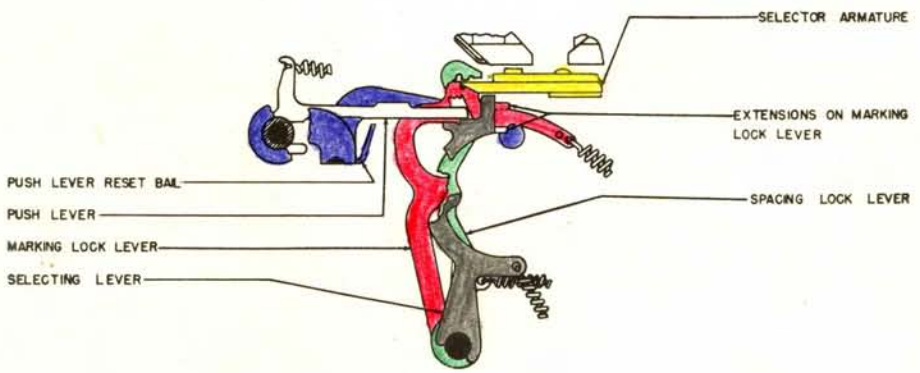


Fig. 49

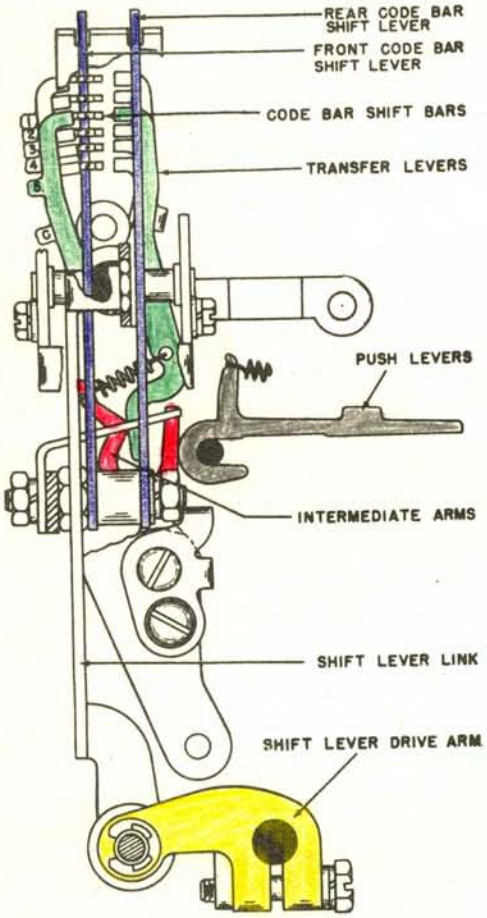


Fig. 50

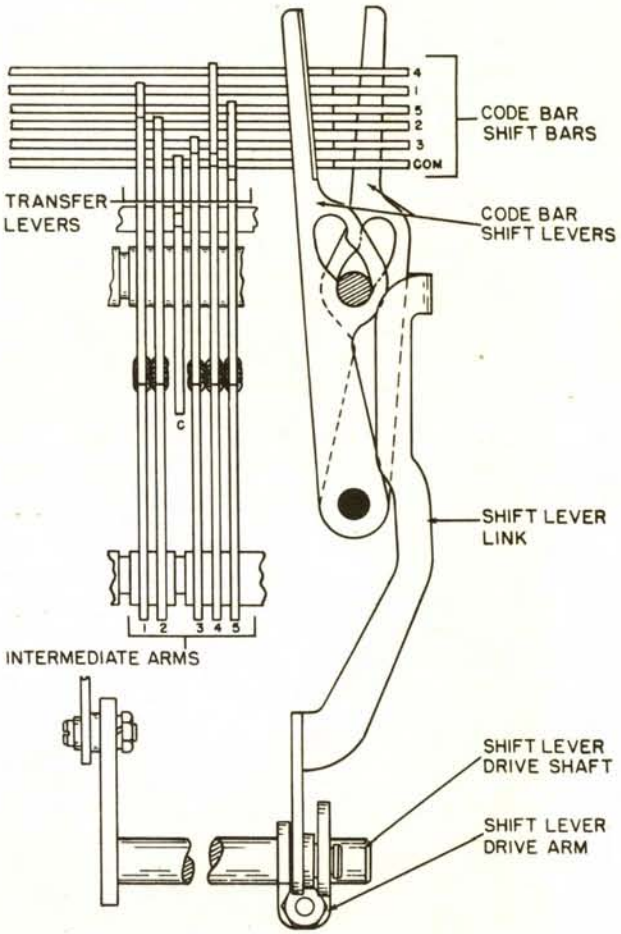


Fig. 51

trip lever, the inertia of the one-stop clutch cam disc causes it to continue to turn until its lug makes contact with the lug on the clutch-shoe lever. The latch lever drops into the indent on the cam disc and the clutch is held disengaged.

Shifting the Code Bars

4.21 When the code-bar clutch rotates, its eccentric cam operates the cam arm. The cam arm causes the shift-lever drive shaft to raise the front of the shift-lever drive arm (Fig. 51). The drive arm raises the shift-lever link. The two rollers mounted on the upper end of the link engage camming surfaces of the two shift levers and cause the levers to operate. The front lever is moved to the right and the rear lever to the left. Fig. 51

4.22 Code-bar shift bars that are in their marking (rear) position will be engaged by the rear shift lever and will be moved to the left, moving the associated code bars to the left (marking) (Fig. 52). Code-bar shift bars that are in their forward (spacing) position will be engaged by the front shift lever and will be moved to the right, moving the associated code bars to the right (spacing). Fig. 53 shows the code-bar arrangement with the code bars in their extreme right position. Figs. 52 and 53

4.23 The common code bar (Fig. 51) is moved by the common transfer lever. This lever has an extension extending in back of the numbers 1 and 2 transfer levers. If either number 1 or 2 or both transfer levers are moved marking, they will engage the extension of the common transfer lever and will move the lever to the rear (marking). The common code-bar

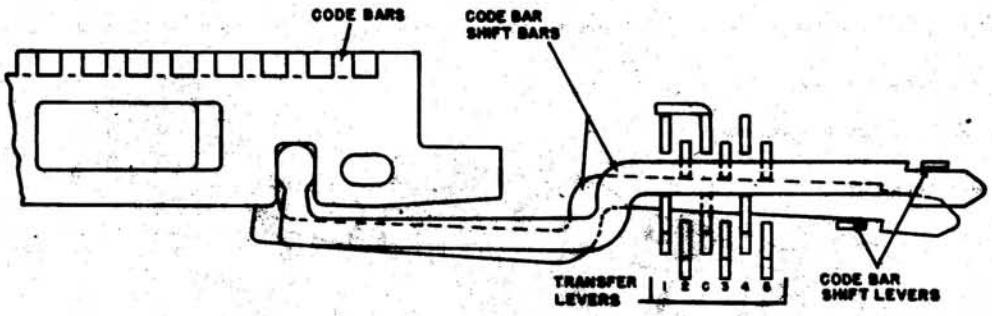


Fig. 52

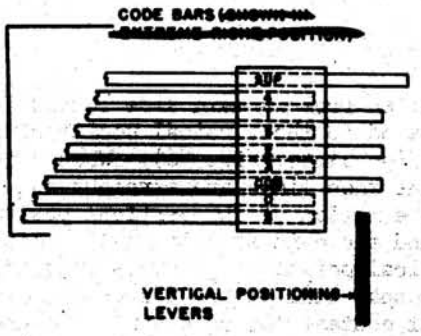


Fig. 53

shift bar will be moved to the rear. The operation of the shift levers will cause the common code bar to be moved to the left (marking) position. Fig. 51

4.24 If neither number 1 nor 2 transfer levers are operated, the common transfer lever remains in the forward (spacing) position. The operation of the shift levers will move the common code bar to the right (spacing) position.

4.25 A detenting mechanism retains all code bars after they have been shifted right or left.

(E) Positioning the Type Box

4.26 The type-box arrangement, as seen from the front of the typing unit, is shown in Fig. 54. The objective of the type-box positioning mechanism is to move the type box so that the pallet for the character to be printed is placed between the printing hammer and the point on the paper where the character is to appear. Fig. 54

Type-Box Clutch

4.27 As the code-bar clutch rotates, the code-bar-clutch cam follower arm and roller ride to the lowest surface of the code-bar-clutch cam (Fig. 55). The cam arm rotates the clutch-trip shaft and moves the type-box-clutch trip lever away from the shoe-release lever. The clutch shoes engage the drum and the clutch rotates. When the type-box clutch completes its revolution, it is disengaged by its trip lever and latch lever in the same manner as was the code-bar clutch. Fig. 55

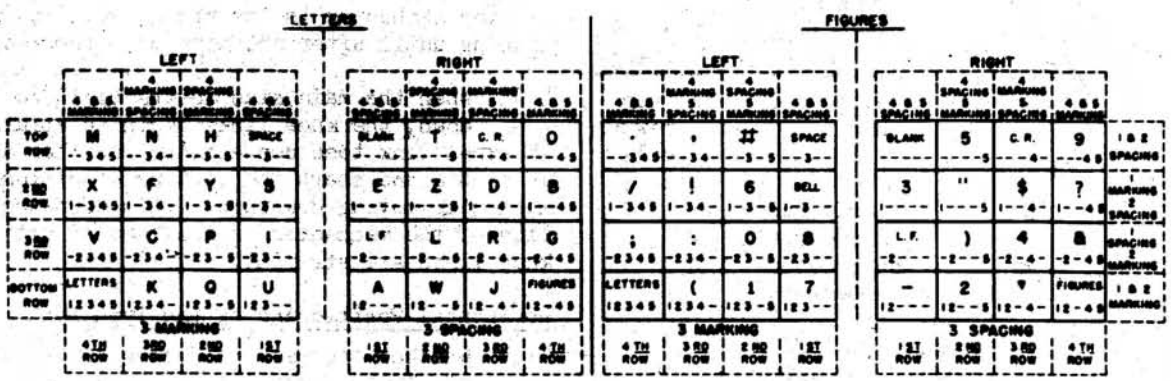


Fig. 54

MLBF

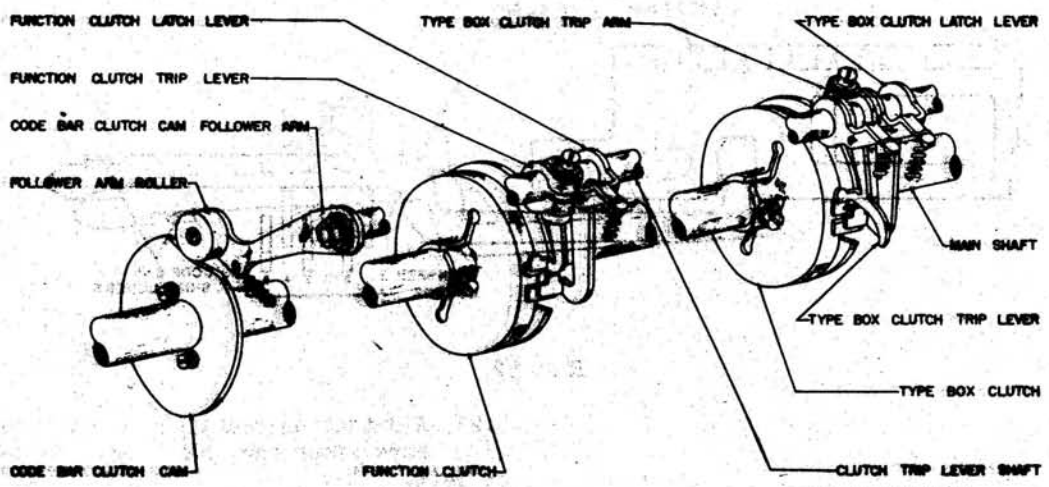


Fig. 55

Vertical Positioning of the Type Box

4.28 When the type-box clutch begins to rotate, motion is transmitted through the drive link and the left rocker-shaft bracket to the main rocker shaft (Fig. 56). The rocker-shaft brackets operate the main side-lever drive links which in turn move the main side levers to impart motion to the knee action vertical positioning levers. The type-box carriage track is attached to the upper ends of the two vertical positioning levers. Fig. 56

4.29 The level to which the type box rises is determined by the stops provided by the code bars. The arrangement of code bars, marking or spacing, for the four levels is summarized in Table 4.

Table 4

Type-Box Vertical Level and Code-Bar Positions

Code Bars 1	Code Bars 2	Common Code Bar	Stop on Vertical Positioning Lever	Type-Box Level
S	S	S	Common code bar	1 (top row of pallets)
M	S	M	2 code bar	2
S	M	M	1 code bar	3
M	M	M	Suppressor code bar	4

M = Marking, to left
S = Spacing, to right

See Fig. 53 for the code-bar arrangement.

4.30 Motion from the main side levers is transmitted to the vertical positioning levers through knee links (Fig. 56). When this motion begins the knee links are straight and the ratio of the motion of the vertical positioning levers and the main side levers is unity. When the vertical positioning levers approach the code bar that will act as a stop, the knee link toes will contact the code bar. The knee links will then begin to buckle and the ratio of the motion of the vertical positioning levers and the main side levers will diminish. By the time the vertical positioning levers contact the code bar, the motion of the levers will have been decelerated so that the vertical positioning mechanism will be stopped with very little shock to the mechanism. Additional motion of the main side levers after the vertical positioning levers have been stopped results in further buckling of the knee links. Fig. 56

4.31 After the vertical positioning levers have been moved up against the code bar, a vertical positioning lock lever, which is controlled by a main side lever follower arm, engages each lever to hold the type-box positioning mechanism in its proper vertical positioning until after printing has occurred.

4.32 When the main side levers begin to move down, the knee links begin to straighten. The knee link toes contact the code bar acting as a stop and start the vertical positioning mechanism moving downward. This downward motion of the mechanism is accelerated until the knee links are straight.

Horizontal Positioning of the Type Box

4.33 Whether the type box moves to the left or right is controlled by the position of the number 3 code bar. If the bar is moved to

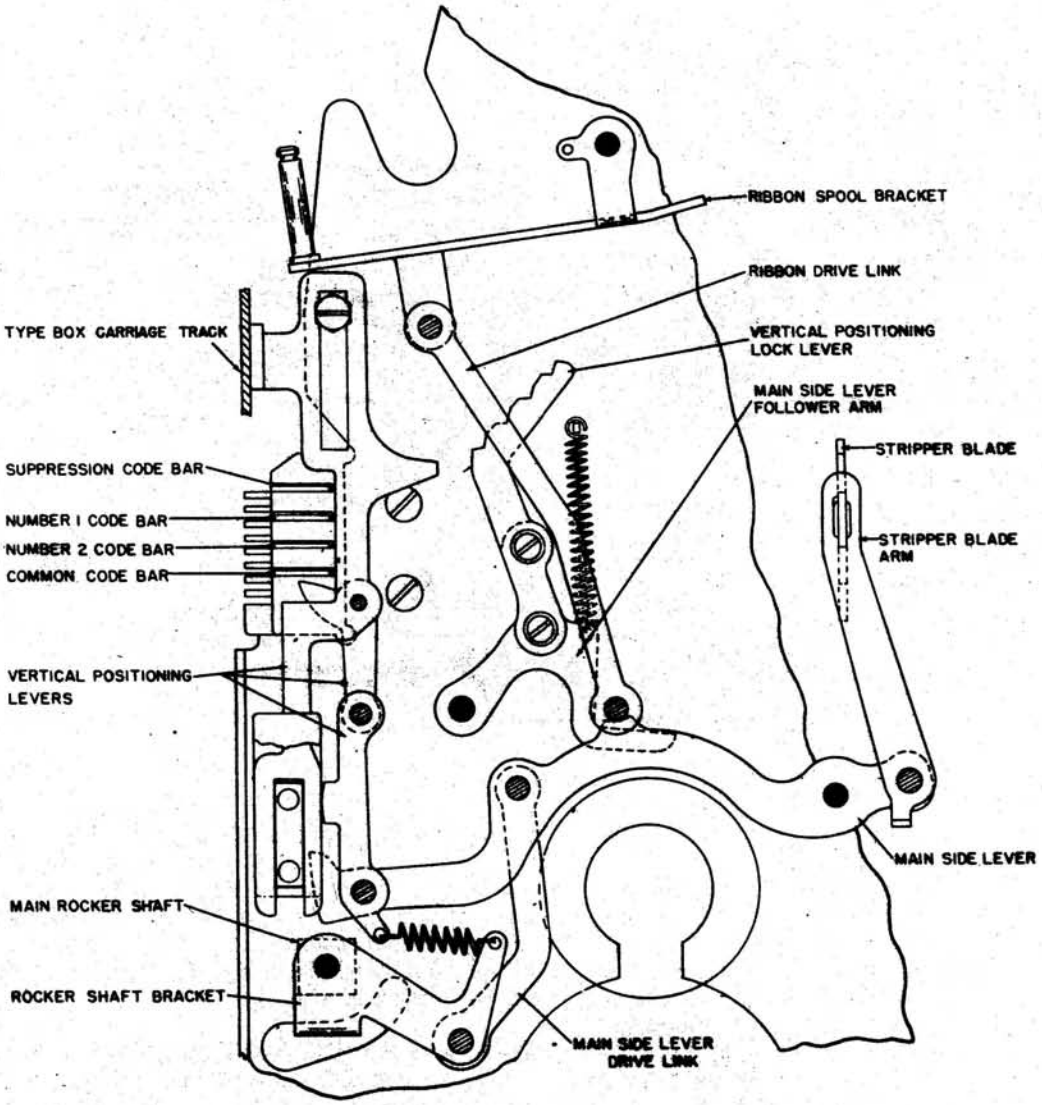


Fig. 56

the right (spacing), the code-bar extension moves the reversing slide shift-lever to the right. The shift lever moves the horizontal motion reversing slide to the right and is held there by the detent levers (Fig. 57). The left extension on the reversing slide will partially buckle the left shift-slide drive linkage. The right linkage will be straight. Fig. 57

4.34 When the rocker shaft is operated, the main-bail drive bracket will cause the main-bail links to move the main bail down. The shift-slide drive linkages (one end of each linkage is attached to the main bail and the other end to the oscillating rail shift slide) will transfer the motion to the oscillating rail shift slide. The right linkage will tend to move the slide to the left, the left linkage will tend to move the slide to the right. Because the left linkage initially is partially buckled and the right linkage is straight, the right linkage will be effective and will move the oscillating rail shift slide to the left.

4.35 The oscillating rail shift slide is connected to the oscillating rail. Therefore, motion of the oscillating rail shift slide to the left will cause the oscillating rail and the type box to move to the left. Because there will be no relative horizontal motion between the oscillating rail and the type box, the type box will be moved further to the left.

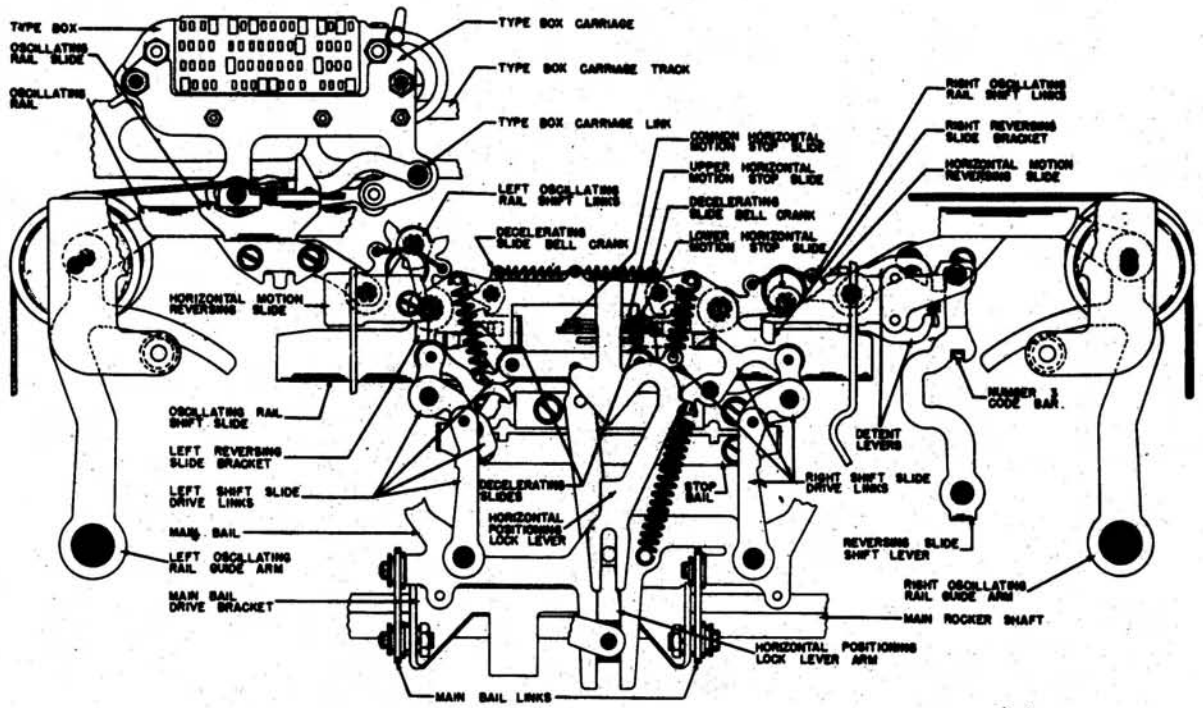


Fig. 57

4.36 If the number 3 code bar is moved to the left (marking), the code bar extension will move the reversing slide-shift lever to the left. The shift lever will move the horizontal motion reversing slide to the left, causing the right extension on the slide to partially buckle the right slide-drive linkage, and the left linkage will be straight. When the main bail moves down, the left linkage will be effective and will move the oscillating rail shift slide (also the oscillating rail and the type box) to the right.

Amount of Left or Right Motion

4.37 The amount of left or right motion of the type box is determined by the positions, marking or spacing, of code bars 4 and 5. Their positions for the four type-box rows are shown in Table 5.

Table 5

Type-Box Horizontal Level and Code-Bar Positions

Code Bars		Stop on Oscillating Rail Shift Slide	Type-Box Row (Fig. 54)
4	5		
S	S	Common Horizontal Stop	1
S	M	No. 4 Stop	2
M	S	No. 5 Stop	3
M	M	Stems of Horizontal Stops	4

4.38 A knee action, similar to that on the vertical positioning mechanism, absorbs the shock of stopping as the type box moves into its horizontal position (Fig. 57). After the type box reaches its stop, further movement of the shift slide results in greater buckling of the drive linkage. Fig. 57

4.39 A horizontal positioning lock lever (Figs. 57 and 58) engages the locking roller on the lock-lever arm to help move and to hold the shift slide against the horizontal stop until after the printing operation has occurred. Figs. 57 and 58

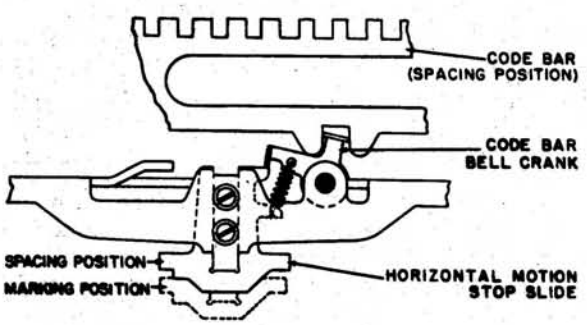


Fig. 58

(F) Printing

4.40 When the main bail moves down, the printing track (mounted on the main bail) moves the right horizontal extension of the printing arm (Fig. 59). The upper extension of the printing arm moves the operating bail latch away from the printing-hammer operating bail to release the bail (Fig. 60). A spring attached to the bail causes the bail to move the printing hammer against the proper type pallet in the type box to print the desired character.

Figs. 59 and 60

printing has occurred, the motion of the rocker shaft will move the cam plate away from the trip-lever bail. The spacing trip lever moves down to engage the spacing-clutch trip-lever arm. This causes the trip lever to move the spacing-clutch trip lever away from the spacing-clutch-shoe lever. The clutch engages and makes a third of a revolution. Motion of the clutch is transmitted through the spacing gear (Fig. 62). One of the pawls moves up to engage a tooth on the spacing drum and moves

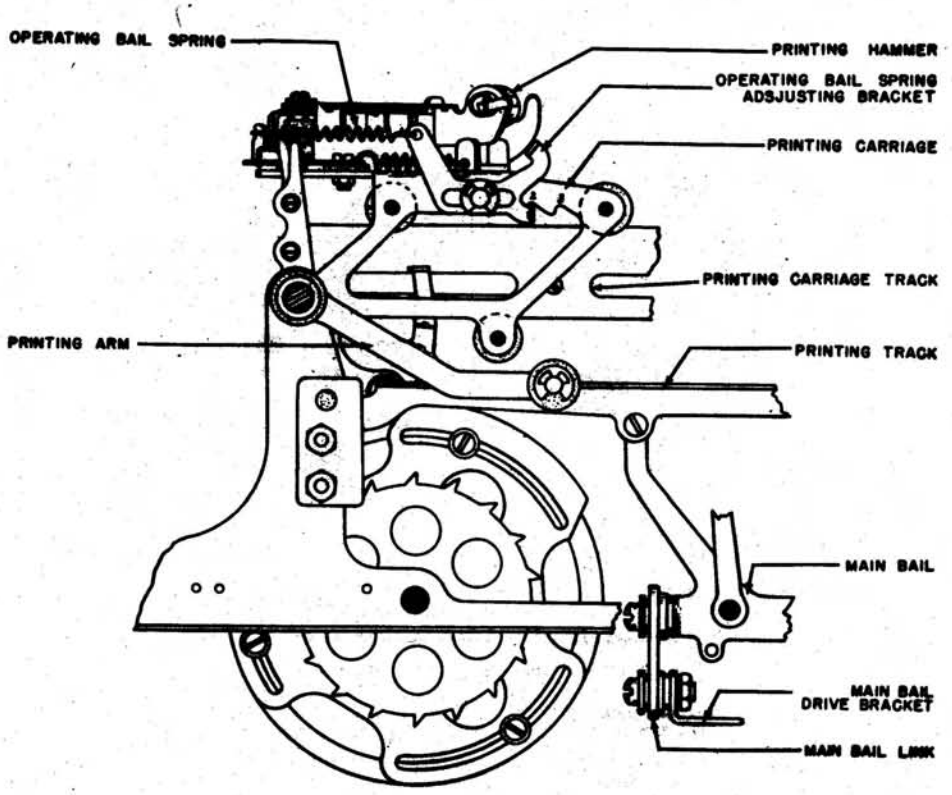


Fig. 59

4.41 When the printing track moves up, the right extension of the printing arm is moved up. The upper extension moves the printing hammer operating bail to the left, past the shoulder on the latch.

(G) Spacing

4.42 When the rocker shaft is rotated (Fig. 61), the rocker-shaft cam plate engages the spacing trip-lever bail and moves the bail to its upper position, where the lever overtravels the spacing-clutch trip-lever arm. After

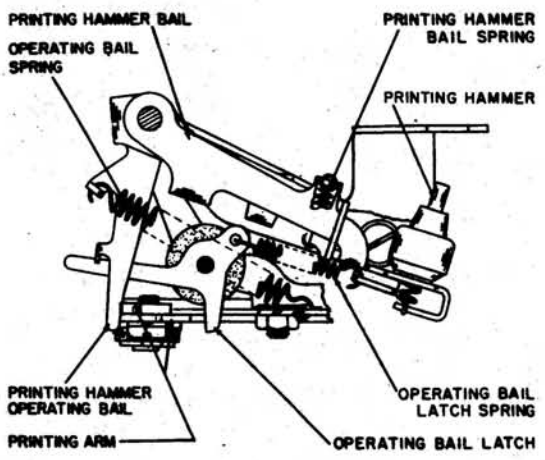


Fig. 60

the drum one tooth. A wire rope from the spacing drum to the printing hammer carriage and to the type box carriage moves the carriages one space. Figs. 61 and 62

Suppression of Spacing on Functions

4.43 The operation of a function lever causes the lower extension of the lever to move the space-suppression bail forward (Fig. 61). The bail moves the spacing suppression slide forward. The slide moves the upper end of the spacing trip lever forward so that the trip lever in its downward movement can not engage the spacing-clutch trip-lever arm. The spacing clutch will remain unoperated and spacing will be suppressed. Fig. 61

4.44 For the upper case Blank signal, the spacing suppression function lever involved can be blocked, if desired, by the clip at slot 28 of the function box, so that spacing on FIGS Blank is optional. The clip adjustment is described in Part 2E of this section.

Suppression of Spacing at the End of the Line

4.45 After the spacing drum is rotated to space the printing hammer carriage and the type-box carriage a predetermined number of spaces, further spacing is suppressed by having the spacing cutout lever on the spacing drum engage and operate the spacing-cutout transfer bail (Fig. 61). The transfer bail moves the spacing cutout bail which in turn moves the suppression slide forward. The slide moves the spacing trip lever forward so that the lever in its downward movement can not engage the spacing-clutch trip-lever arm. The spacing clutch will remain disengaged and no further spacing will occur even on further printing operations. Fig. 61

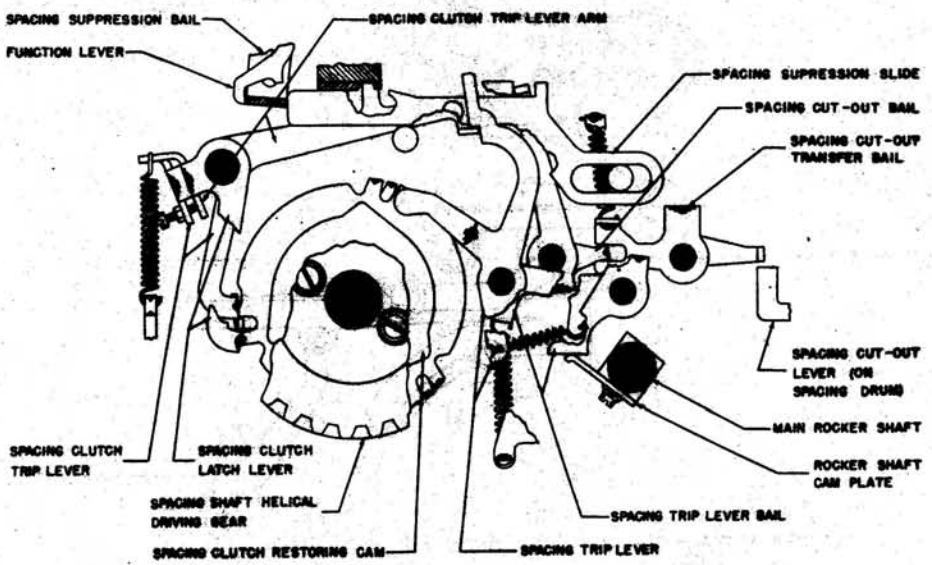


Fig. 61

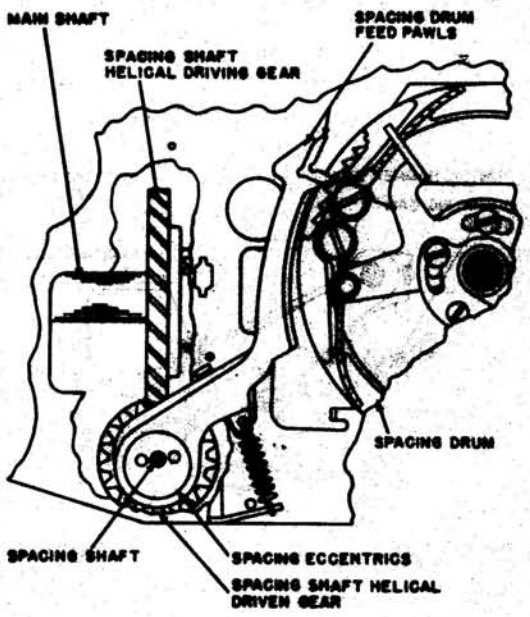


Fig. 62

(H) Functions

General

4.46 Functional operations are initiated by function bars mounted in the function box. Figs. 11 and 12 are typical photographs of a function box; the slot occupancy shown in these figures is not the same as that on Bell System machines. Table 2 lists the slots which are occupied on the standard Bell System model and shows the function associated with each. Figs. 11 and 12

4.47 All of the code bars (suppressor 4, 1, 5, 2, 3 and shift - see Fig. 53) are notched identically at the rear as shown in Fig. 63. The code for the operation of a particular function bar is provided in the bar itself by fingers offset to the left for marking and the right for spacing as shown in Fig. 63. Fig. 63

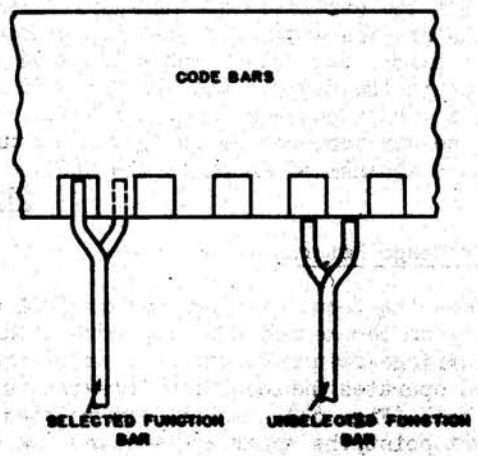


Fig. 63

4.48 After the code bars have been positioned, the code-bar-clutch cam follower arm rides to the low part of the code-bar-clutch cam. The cam-follower arm rotates the clutch trip-lever shaft to cause the function-clutch trip lever to release the function-clutch-shoe lever, allowing the function clutch to rotate one-half revolution. Motion of this clutch is extended through the cam-follower arm and function-rocker shaft and the reset-bail drive links to the function-bar reset bail (Fig. 64). As the bail moves forward, all the function bars tend to move forward, i.e., to the left in Figs. 65 and 66. Figs. 64, 65 and 66

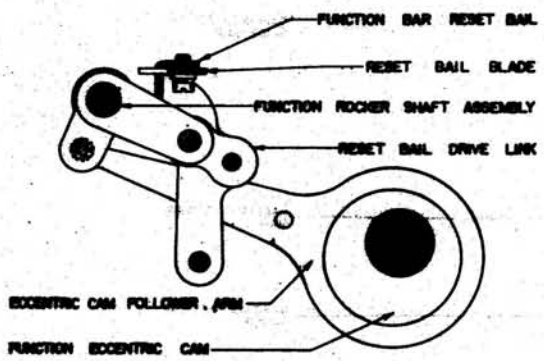


Fig. 64

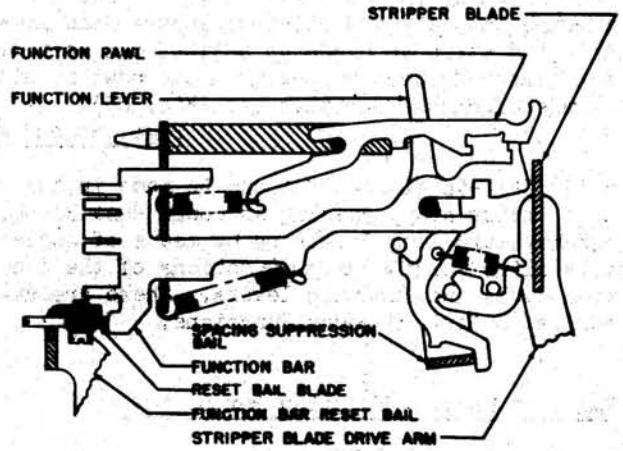


Fig. 65

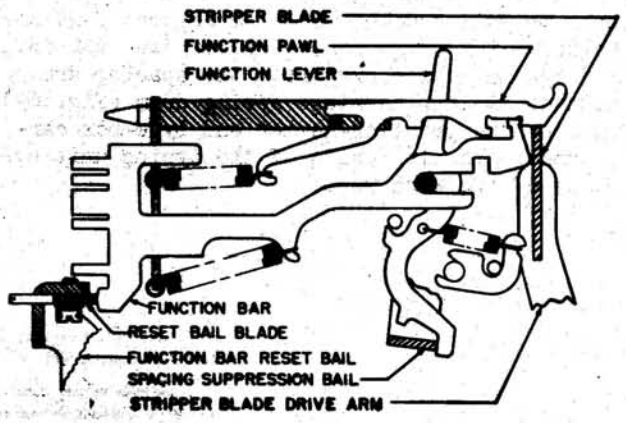


Fig. 66

4.49 If the code combination setup is not for a particular function, the function-bar fingers will rest on one or more code-bar projections and will be in the unoperated position (Fig. 65). If the code combination is for a particular function, the fingers of the function bar associated with the code combination will enter the notches of the code bars and will be in the operated position. A function bar moves farther forward (to the left in Fig. 65) to its operated position than to its unoperated position. Figs. 65 and 66

4.50 When a function bar moves into selection, its rear extension overtravels the shoulder of its function pawl (Fig. 66). When the function-bar reset bail moves to the rear, the selected function bar will move its function pawl to the rear. A projection on the function pawl moves the upper end of the associated function lever to the rear. The movement of the function lever is used to perform the function as described hereafter. Fig. 66

4.51 After the function cycle has been completed, the main side levers (Fig. 56) through the left and right stripper-blade arms, move the stripper blade up against the rear of the operated function pawl and the pawl is disengaged from the function bar (Fig. 65).
Figs. 56 and 65

4.52 Certain alterations can be made in the motor stop, spacing on upper case Blank, and keyboard-lock functions by means of adjustable clips which modify the motions of the function pawls and function levers. These are described in Part 2E under Functions.

Carriage Return (Function Box Slot 5)

4.53 When the CAR RET combination is set up and the carriage-return function lever is operated (Fig. 67) the lower end of the function lever moves the carriage-return slide-arm forward. The arm causes the carriage-return bail to pull down on the spacing-drum feed-pawl release link (Fig. 68). The release link moves the spacing pawls away from the spacing-drum ratchet and the carriage spring drum (Fig. 69) returns the printing-hammer and type-box carriages to the left side of the typing unit by means of the wire rope.

4.54 To insure that the carriage is fully returned, the carriage-return bail is latched in its operated position by the carriage-return latch bail (Fig. 68) until the stop arm on the spacing drum moves the latch away from the bail when the carriages are fully returned. The spacing-drum feed pawls then re-engage the spacing-drum ratchet. Figs. 67, 68 and 69

4.55 When the carriages are nearly returned, the spacing-drum stop arm will engage the transfer slide (Fig. 68). The slide will compress air in the dashpot and the air will escape at a regulated rate through a vent. This allows the carriages to return without bouncing and with a minimum of shock to the unit.
Fig. 68

Local Carriage Return

4.56 When the local carriage return (LOC CR) key on the keyboard is depressed, the local carriage-return function lever on the keyboard operates the local carriage-return trip arm or bail (Fig. 67). As the arm rotates on its pivot point, the upper end engages the carriage-return lever on the typing unit. The front extension of the lever moves down to disengage the spacing-pawl release link to perform the carriage-return operation. Fig. 67

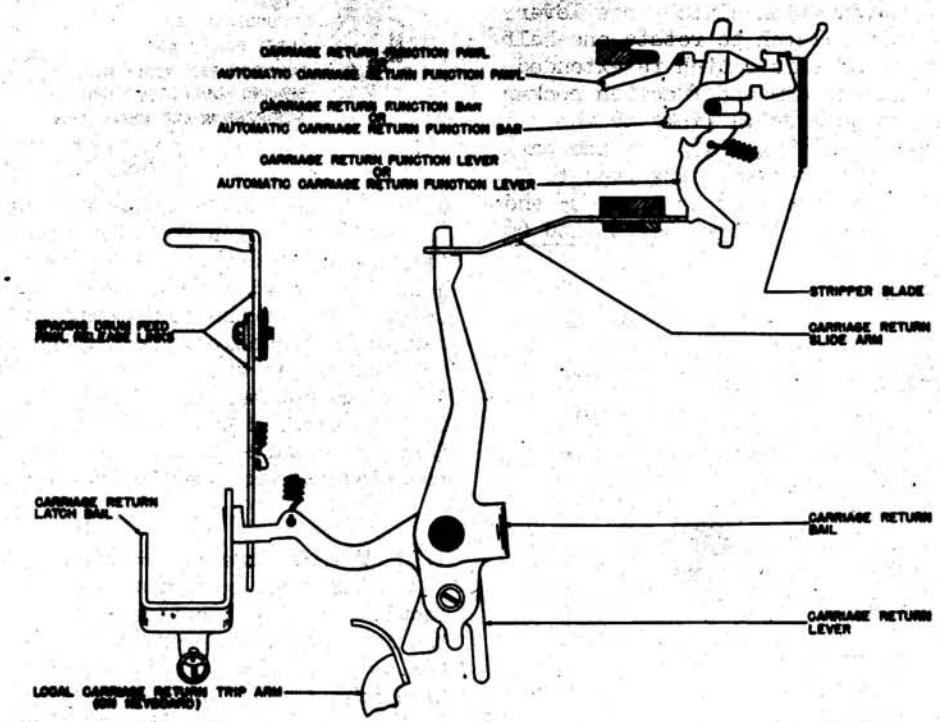


Fig. 67

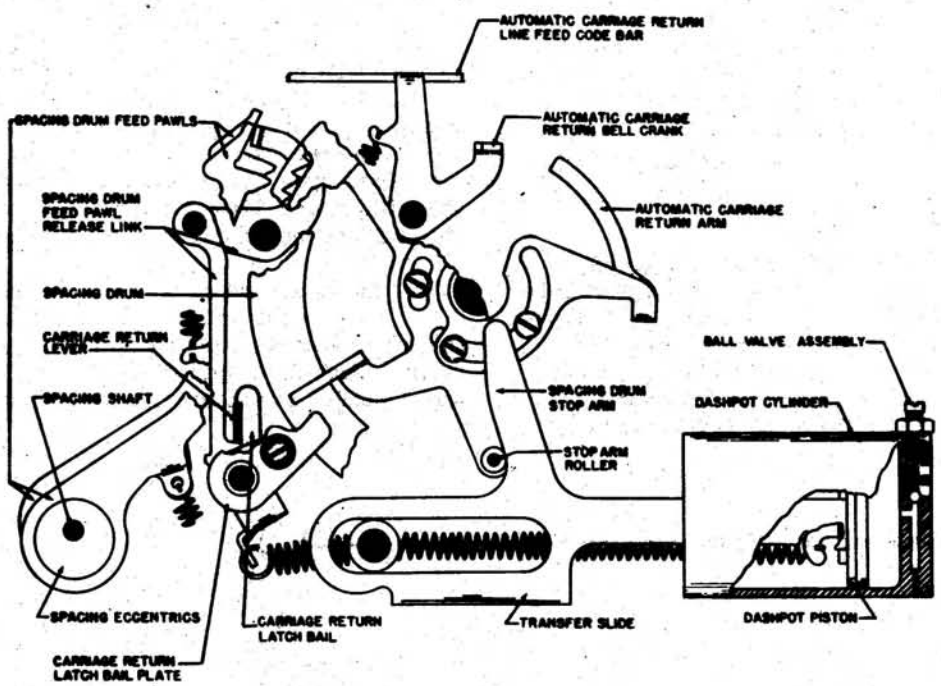


Fig. 68

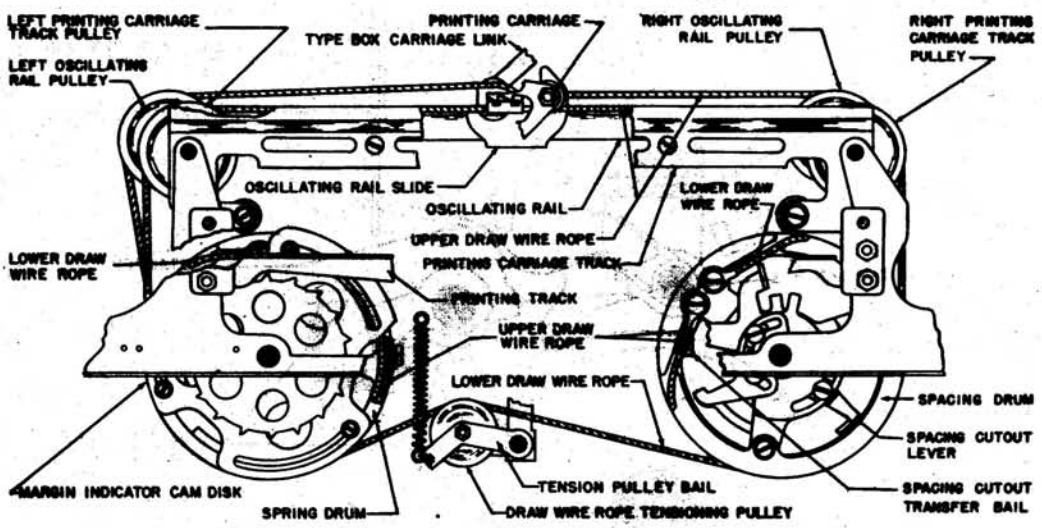


Fig. 69

Automatic Carriage Return (Slot 4)

4.57 Bell System 28 teletypewriters shipped from the factory have the automatic carriage return and line-feed features disabled. These features can be provided by a simple adjustment described in Section P34.610. When they are activated, the carriage-return operation is as follows (Figs. 67 and 68). After the carriage has advanced the number of spaces after which automatic carriage return is desired, the automatic carriage-return line-feed arm mounted on the spacing drum will move the automatic carriage-return line-feed bellcrank. The bellcrank will move the automatic carriage-return line-feed bellbar to the right. On the next printing or spacing operation the automatic carriage-return function-bar (and the

automatic line-feed function bar) will move into selection and overtravel its pawl. When the function bar is moved to the rear by the reset bail, the pawl will cause the function lever to move the carriage-return slide-arm forward. Carriage return then takes place as previously described. Figs. 67 and 68

Line Feed (Slot 40)

4.58 When the line feed combination is selected, the line-feed function lever will be operated (Fig. 70). The lower end of the line-feed function lever will move the line-feed slide-arm forward. The slide-arm will operate the line-feed-clutch trip-arm which causes the line-feed-clutch trip lever to release the line-feed-clutch-shoe lever. Each one-third revolution of the line-feed clutch causes its attached spur gear to rotate the line-feed eccentric spur gear and attached eccentrics one-half revolution (Fig. 71). The eccentrics (offset 180 degrees to each other) each operate one of the two line-feed bars which alternately engage the line-feed spur gear on the platen and advance the platen one line for each one-half revolution of the eccentrics. Figs. 70 and 71

4.59 The position of the single-double line-feed lever (Fig. 72) determines whether the platen moves one or two lines for each functional line-feed operation. With the lever in the "double" position the line-feed function

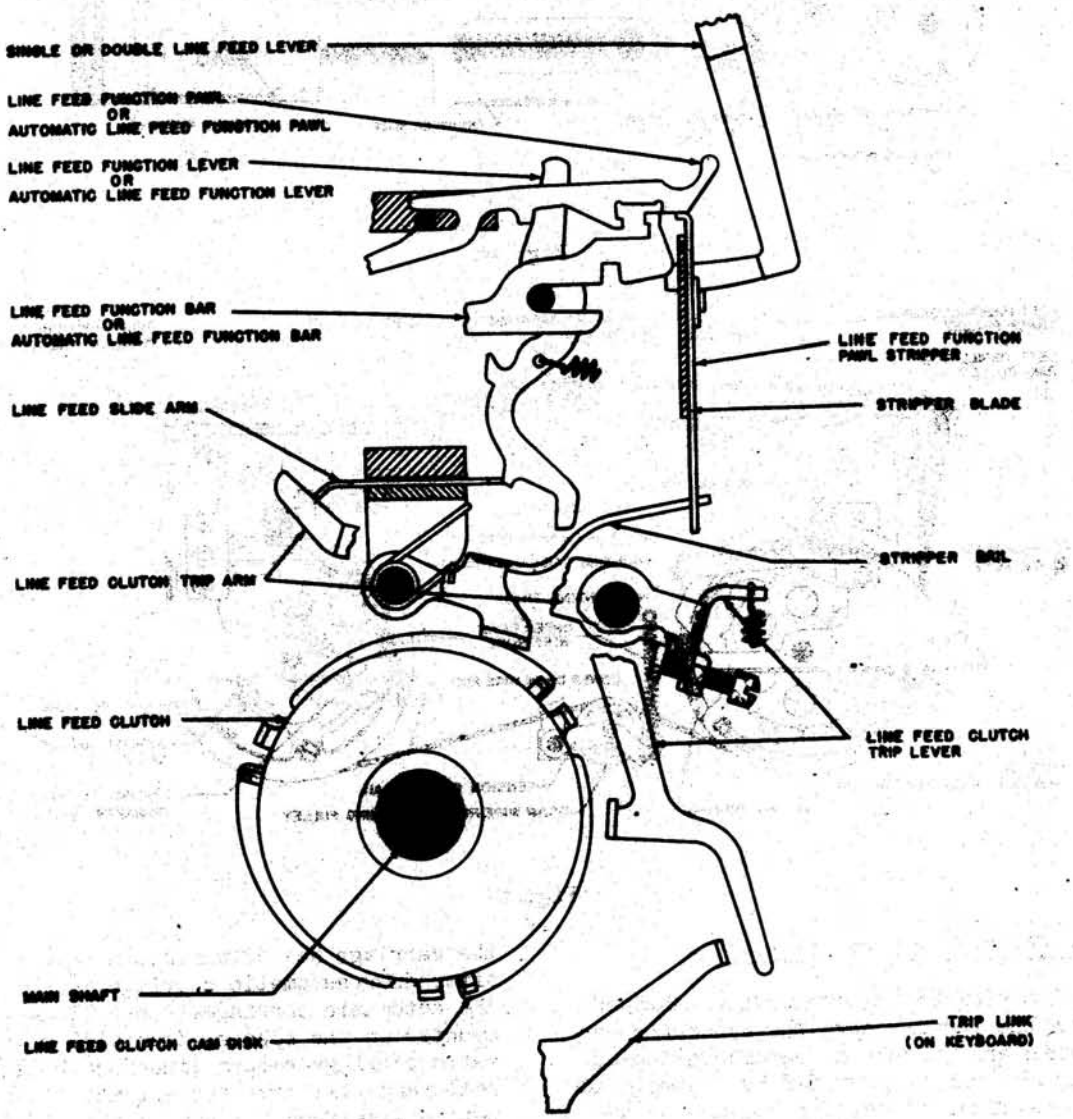


Fig. 70

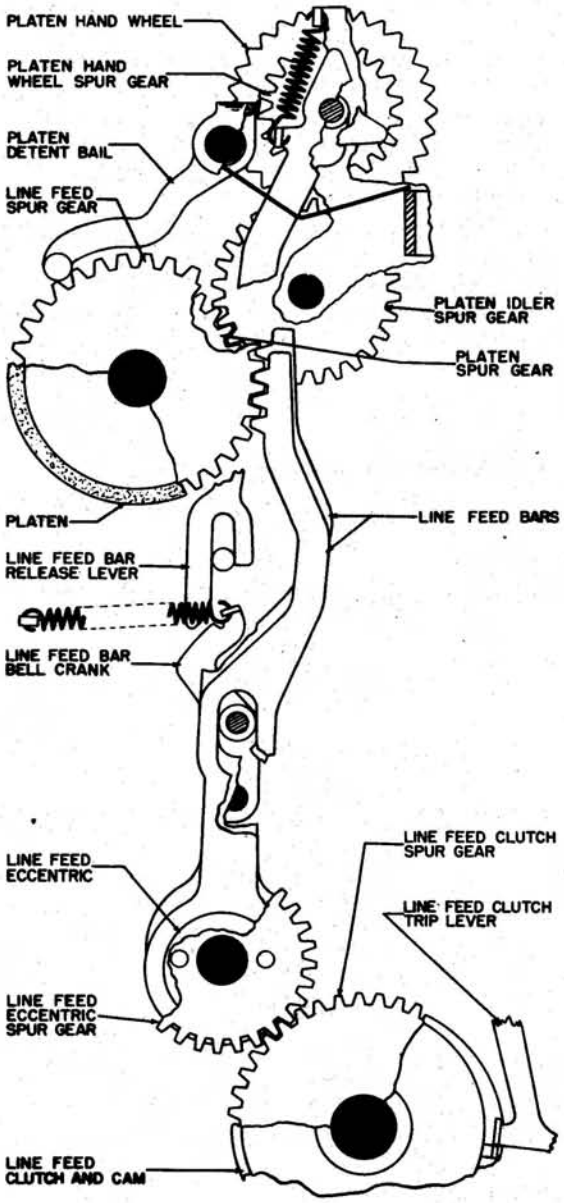


Fig. 71

pawl remains engaged on the line-feed function-bar until the stripper blade moves up to disengage the pawl. The line-feed-clutch trip lever will be released after the line-feed clutch has made slightly more than one-third revolution. The clutch will continue to rotate until it has completed two-thirds of a revolution. The platen will have been advanced two lines.

Fig. 72

4.60 When the single-double line-feed lever is moved to the "single" position, the lower end of the lever cams the stripper blade to the left. The blade moves the line-feed function-pawl stripper to the left and the two upper

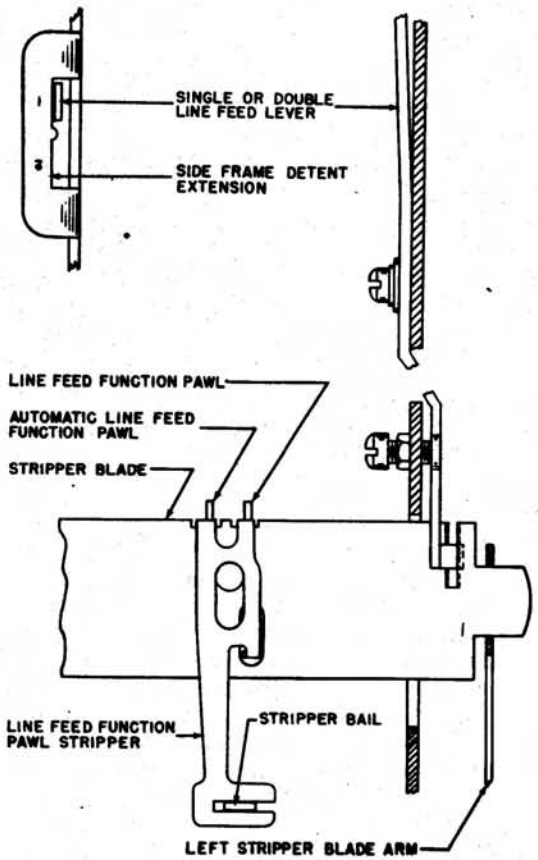


Fig. 72

projections of the stripper will be beneath the line-feed function pawls. When the line-feed function operates, the line-feed function-pawl stripper is raised by the stripper bail riding to the high part of the line-feed clutch cam disc. The stripper will move up and disengage the function pawl from the function bar before the line-feed clutch completes one-third revolution. The platen will have been advanced one line.

4.61 In single line-feed operation, the line-feed function lever is released before spacing has been suppressed. Therefore, an additional line-feed function bar, pawl and lever are installed in slot 38 of the function box for the sole purpose of suppressing spacing on single line-feed operations. When the line-feed operation takes place, this mechanism remains operated until the stripper blade disengages the function pawl from the function bar.

4.62 Local Line Feed: When the local line feed (LOC LF) key on the keyboard is depressed, the local line-feed function-lever on the keyboard operates the local line-feed bail. This action causes the local line-feed trip

link to move the line-feed-clutch trip lever away from the shoe lever of the line-feed clutch. Rotation of the line-feed clutch causes rotation of the platen as long as the key is depressed.

4.63 Manual Line Feed (Handwheel): Manual rotation of the platen may be accomplished by pushing down on and turning the platen handwheel (Fig. 71). This causes the platen handwheel spur gear to mesh with the platen spur gear. At the same time the line-feed bar release lever moves the line-feed bellcrank and causes it to disengage the line-feed bars from the line-feed spur gear, permitting rotation of the platen. Fig. 71

4.64 Automatic Line Feed: Bell System 28 teletypewriters shipped from the factory have the automatic-carriage-return and line-feed features disabled. They can be activated by a simple adjustment described in Section P34.610. The operation of automatic line feed is the same as that of automatic carriage return described above except that for line feed, when the automatic-line-feed function bar is moved to the rear by the reset bail, the automatic line-feed pawl will cause the function lever to move the line-feed slide-arm forward. Line feed then takes place as previously described. Fig. 70

4.65 Shift (FIGS): When the FIGS combination is set up and the FIGS function lever in slot 2 is operated, the function lever moves the FIGS function slide to the rear (Fig. 73). The slide cams the LTRS-FIGS code-bar fork to the left, moving the LTRS-FIGS shift code bar to the left. The extension of the code bar moves the LTRS-FIGS shift slide to the left (Fig. 74). The lower end of right shift-link breaker slide is moved above the right breaker-slide bail. When the main bail moves up, the right breaker-slide bail will engage the lower end of the right shift-link breaker slide and the slide will be moved up. The upper end of the slide will engage and will buckle the right oscillating rail shift links to move the oscillating rail to the left. Because there will be no relative horizontal motion between the oscillating rail and the type box, the type box will be moved to the left and the figure indicator on the type box will align with the printing position on the platen. Figs. 73 and 74

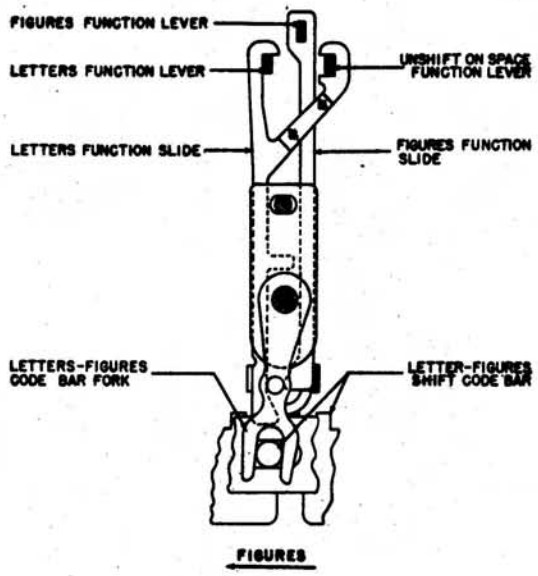


Fig. 73

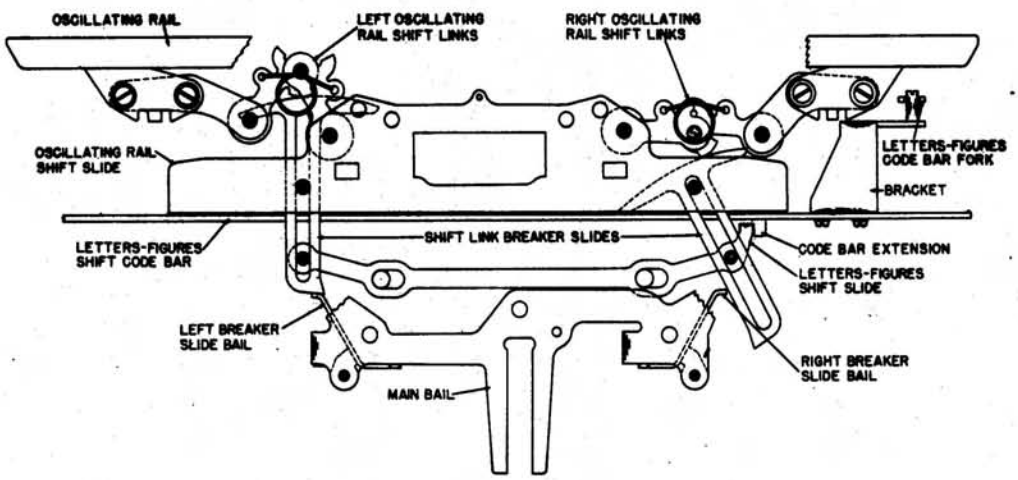


Fig. 74

4.66 Unshift (LTRS): When the LTRS combination is set up and the LTRS function lever in slot 3 is operated, the function lever moves the LTRS function slide to the rear (Fig. 75). The slide cams the LTRS-FIGS code-bar fork to the right, moving the LTRS-FIGS shift code bar to the right. The code bar moves the LTRS-FIGS shift slide to the right (Fig. 74). The left shift link breaker slide is moved into the path of the left breaker slide bail. The breaker slide will buckle the left oscillating rail shift links and the type box will be moved to the right to the LTRS position.

Figs. 74 and 75

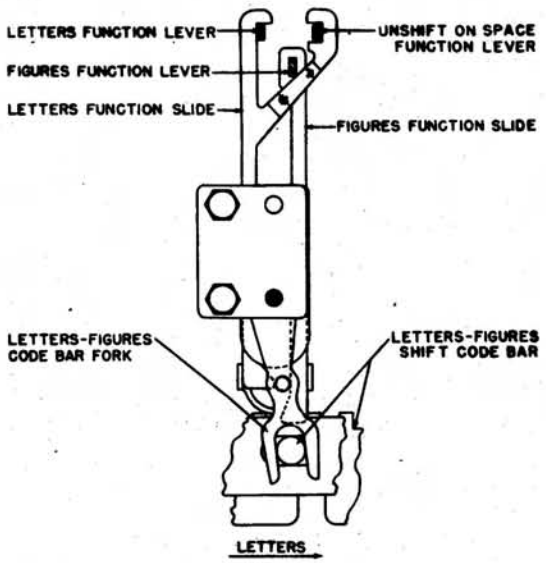


Fig. 75

Unshift on Space

4.67 A function bar is provided in slot 1 which will move into selection on the space code combination (Fig. 76). The associated function lever will engage an extension of the LTRS function slide (Fig. 75) and unshift will occur as described previously under Unshift (LTRS). The projection on the lower end of the unshift-on-space function lever is omitted in order not to suppress spacing.

Figs. 75 and 76

4.68 If unshift on space is not desired, a disabling screw can be turned down against the upper front of the space function pawl (Fig. 76) until the rear end of the pawl is raised so it can not be engaged when the unshift on space function bar is selected. Fig. 76

Note: The space function bar must be in its rearmost position when the screw is turned down.

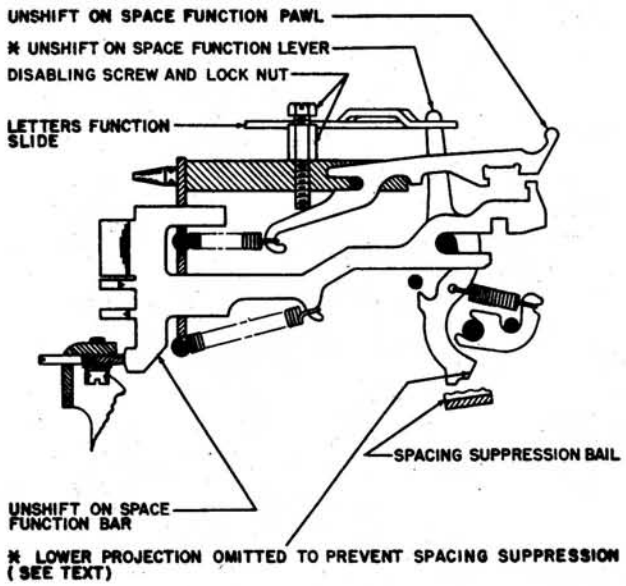


Fig. 76

Signal Bell

4.69 The signal bell, mounted in the lower part of the console behind the sloping panel, is operated by a set of normally-open contacts on the function box over the signal-bell function lever in slot 29 (Fig. 77). These contacts are closed momentarily on receipt of the bell combination upper case (FIGS) S. After the LTRS-FIGS code bar has been shifted to the FIGS position and the S combination has been set up, the signal-bell function bar will be selected (Fig. 78). This releases the signal-bell function lever which will move out and permit the signal-bell contacts to close to ring the bell one stroke. The FIGS S signal must be repeated each time the bell is to be rung. Figs. 77 and 78

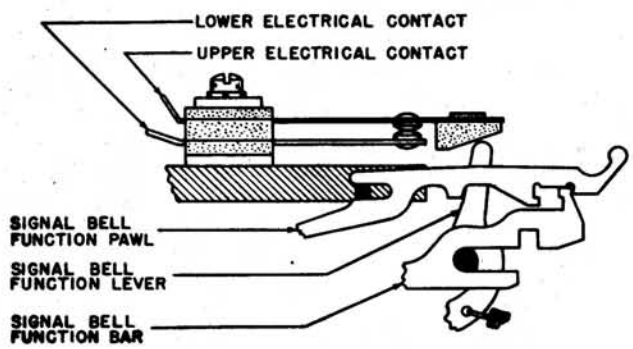


Fig. 77

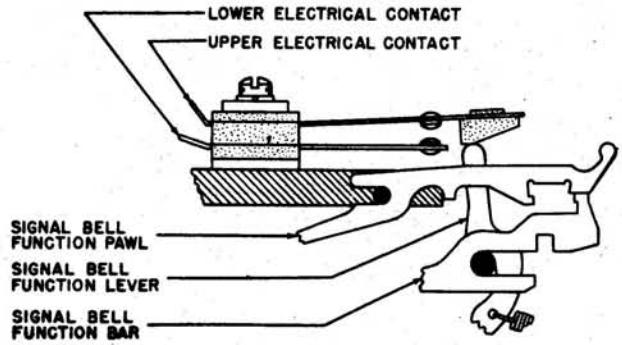


Fig. 78

4.70 When the letter S is received with the LTRS-FIGS code bar in the LTRS position, the signal-bell function bar is blocked by one code bar and the bell does not ring.

Keyboard Lock

4.71 The keyboard can be locked, if desired, on receipt of either a single-blank or double-blank signal, depending on the position of the clip on the function box at slot 35. (The positions of the clip are described in Part 2E of this section under Functions.)

4.72 With the clip set for keyboard lock on double blank, the operation is as follows. The operation involves the blank and keyboard-lock function bars in slots 35 and 36, respectively. These two bars are coded identically to operate on the Blank code combination.

4.73 On the first Blank the blank function bar in slot 35 moves into selection (Fig. 79). The keyboard-lock function bar in slot 36 is prevented from moving into selection by an extension of the blank function lever which engages a notch in the keyboard-lock function bar. (Figs. 79 and 80.) When the blank function bar moves to the rear it moves the blank function pawl, which in turn moves the blank function lever. The blank function lever disengages from the keyboard-lock function bar and is then latched in its operated position by the blank function-lever latch. Figs. 79 and 80

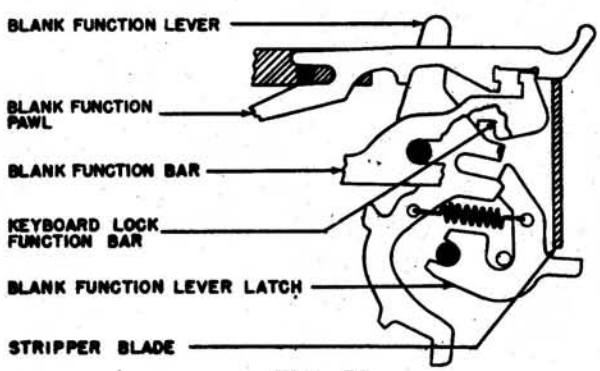


Fig. 79

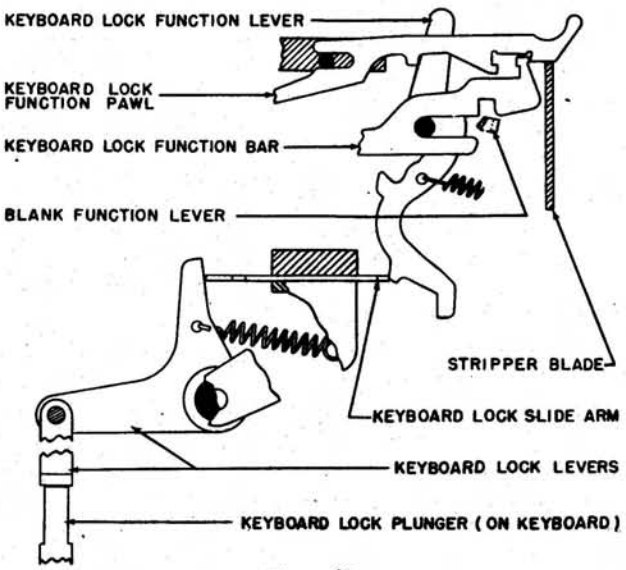


Fig. 80

4.74 On the second Blank code combination both the blank and the keyboard-lock function levers move into selection. When the keyboard-lock function lever is operated, it moves the keyboard-lock slide-arm (Fig. 80) forward to operate the keyboard lock levers. The lock levers operate the keyboard-lock plunger, the lock-plunger arm and the lock function arm (keyboard lock) bail on the keyboard. The function arm raises the rear end of the keyboard-lock function lever on the keyboard. The function lever raises the keyboard lockbar pawl to lock the keyboard. Fig. 80

4.75 If the first Blank combination is followed by a code combination other than Blank, the code bars will block the keyboard-lock function bar from moving into selection. The lower edge of the stripper blade will move the blank function lever latch and the blank function lever will be released to re-engage the keyboard-lock-function lever. Thus the mechanism will be reset and it will require two consecutive Blank code combinations to operate it.

4.76 By proper adjustment of the clip at slot 35, the keyboard lock may be arranged to operate on a single Blank signal, or it may be suppressed so that the keyboard is not locked by any signal. The KBD LOCK key on the keyboard may be used to lock the local keyboard by direct mechanical action; it does not transmit signals to a distant keyboard.

4.77 To unlock the keyboard requires manual operation of the KBD UNLK key.

Motor Stop

4.78 The function box is equipped, in slots 22 and 23, with function-lever operating mechanisms and contacts to operate either the electrical motor-stop mechanism, if provided as an auxiliary feature on the electrical service unit, or an associated 120-type subset. To operate the electrical motor-stop mechanism the contacts on the function box are arranged to give a momentary closure; to operate a 120-type subset, they should give a momentary open. Details of the operation of the motor-stop mechanism are discussed in Part 6B of this section.

4.79 The function bar associated with slot 22 is coded to be selected on FIGS Blank and the codebar in slot 23 to be selected on FIGS H (or FIGS M). By proper setting of the clip at slot 22 the combination of function levers can be arranged to operate the motor-stop contacts on the desired one of these code combinations or to suppress contact operation entirely. The subsequent discussion refers to the operation on FIGS Blank H. On the 28 teletypewriter these three characters must be sent in that order to stop the motor.

4.80 To select the motor-stop function, the LTRS-FIGS code bar must first be shifted to the FIGS position. As the Blank signal is received, the blank function bar in slot 22 is selected. As in the case of keyboard lock, described above, the operation of the function lever associated with slot 22 releases the H function bar in slot 23 so that it can go into selection on the receipt of the H character. The H function-lever associated with slot 23 is then operated, opening or closing the motor-stop contacts in accordance with the way they are arranged.

4.81 If the signal for H were received with the LTRS-FIGS code bar in the LTRS position, the motor-stop function bar would be blocked by the shift code bar.

(I) Ribbon Mechanism

Oscillation

4.82 Before a character is printed it is necessary for the ribbon to cover the type pallet that is to be operated after the type box has been moved to the printing position. After the character has been printed it is desirable that the ribbon be lowered so that the entire printed line, including the last character printed, is visible to the operator seated at the keyboard.

4.83 This is accomplished by having the ribbon-feed mechanism oscillate with a component of motion in a vertical plane. The right and left ribbon mechanisms each pivot on a shaft. When the main side levers move up, motion is transmitted from the levers through the ribbon drive links (Fig. 81) to the ribbon-spool brackets, causing the front of the mechanism to move upward. Because the ribbon is engaged with the roller on the front of each ribbon mechanism, the ribbon will be raised. The ribbon is held in place at the point of printing by a ribbon guide mounted to the rear of the type box carriage. When the main side levers move down, the front of each ribbon mechanism moves down, lowering the ribbon below the printed line.

Fig. 81

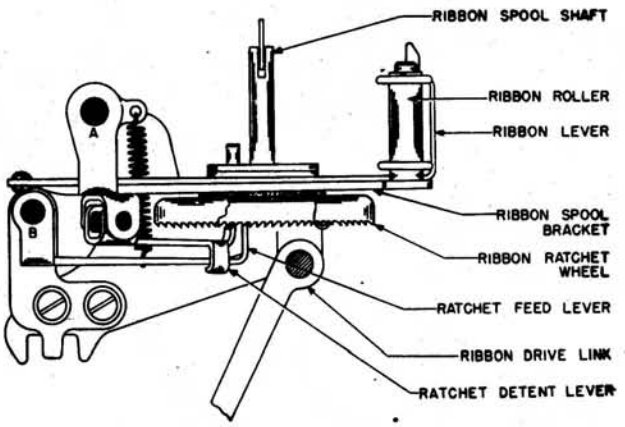


Fig. 81

Feeding

4.84 The oscillation of the ribbon mechanism is used to accomplish ribbon feeding. When the mechanism is oscillated about its pivot, the ribbon ratchet wheel has a horizontal component of motion in a forward and backward direction (Figs. 81 and 82). The ratchet detent lever and ratchet feed lever have only a small horizontal component of motion since the levers are limited in their motion by the stop bracket. Effectively, the ribbon ratchet wheel is moved forward and backward, and the feed levers are stationary.

Figs. 81 and 82

4.85 When the ribbon spool bracket moves up, the ratchet feed lever rides over one tooth, while the ratchet detent-lever holds the ribbon ratchet wheel from turning backward.

4.86 As the ribbon-spool bracket moves down, the ratchet feed lever engages a tooth advancing the ratchet wheel one tooth. At this time the detent-lever rides over the ratchet wheel one tooth into the next indentation.

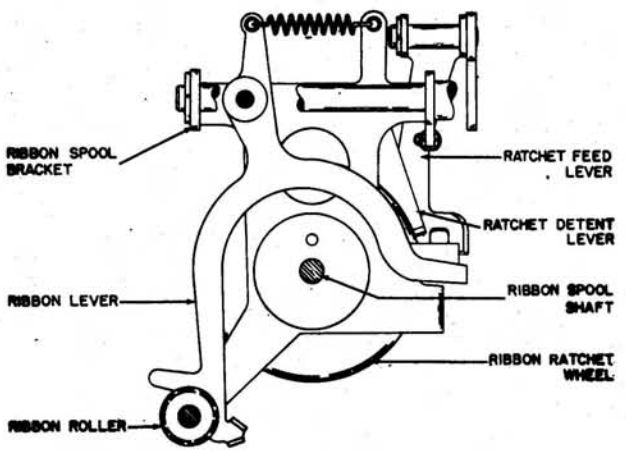


Fig. 82

4.87 Viewed from the top, the teeth on the left and right ribbon ratchet wheels face in opposite directions, so that, when their feed-levers are engaged the left and right ribbon ratchet wheels turn clockwise and counter-clockwise, respectively.

4.88 In order for the ribbon to be pulled from one ribbon spool to the other, only one of the ribbon mechanisms can have its ratchet feed and ratchet detent levers engaged with its ribbon ratchet wheel at a time.

4.89 Ribbon Tension Spring: As the ribbon ratchet wheel turns, the ribbon tension-plate turns, and extends the ribbon tension spring (Fig. 83). A lug on the ribbon tension-plate contacts the ribbon tension bracket and rotates the ribbon-spool shaft. Thus, the ribbon is wound on the ribbon spool. Fig. 83

4.90 Reversing: When the ribbon is almost completely unwound from one spool, the ribbon feed reverses automatically. This is accomplished by disengaging one set of ratchet-feed and ratchet-detent levers and engaging the other set. Near the end of the ribbon is an eyelet. When the ribbon is almost unwound from a spool, the eyelet will move the ribbon lever so that a projection of the lever will be moved beneath the front extension of the ribbon reversing lever. When the ribbon mechanism is pivoted upward the ribbon lever will engage the reversing lever and will move it up. The ribbon reversing lever will move the ribbon-feed

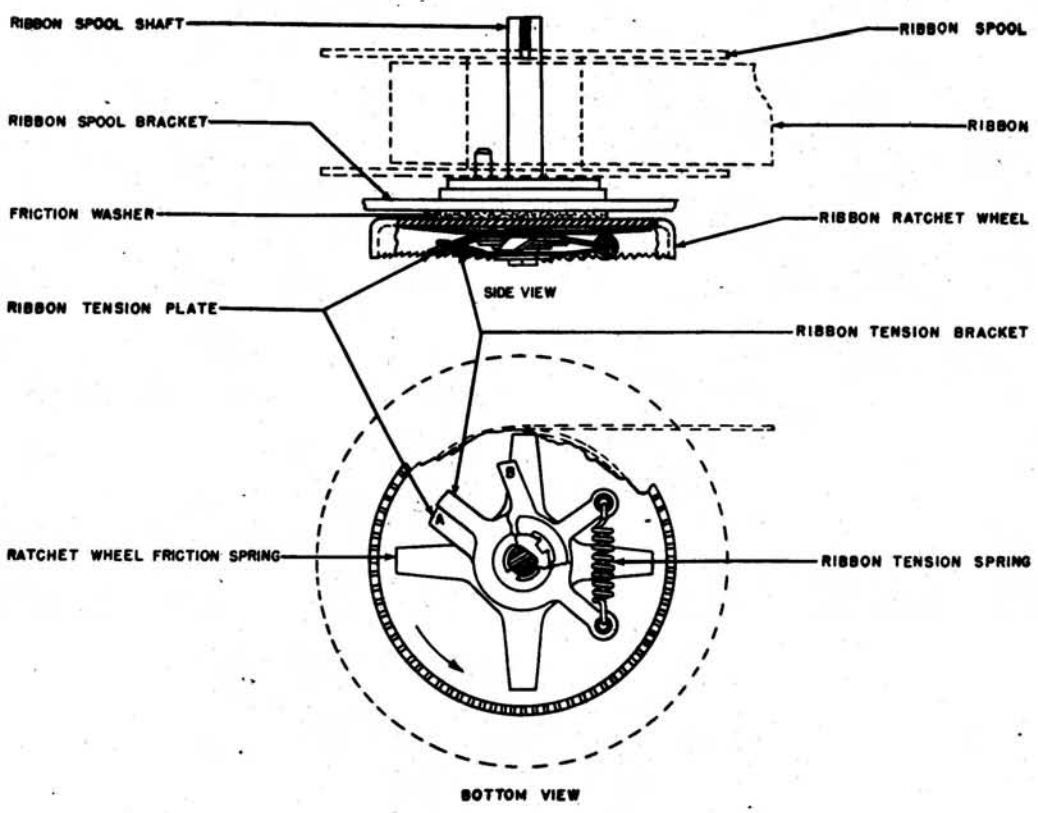


Fig. 83

reverse lever upward (Fig. 84) allowing the ratchet-feed and ratchet-detent levers on that side of the unit to move up into contact with the ribbon ratchet-wheel (Fig. 81). The rack on the lower end of the ribbon-reversing lever will rotate the ribbon-reverse spur gear which is mounted to the ribbon-reverse shaft (Fig. 84). Rotation of the reverse shaft will cause the spur gear on the opposite end of the reverse shaft to move its associated ribbon-reversing lever downward. The ribbon-feed reverse lever at that side will move the ratchet-feed and ratchet-detent levers away from the ratchet wheel and the ribbon will feed in the reverse direction. Figs. 81 and 84

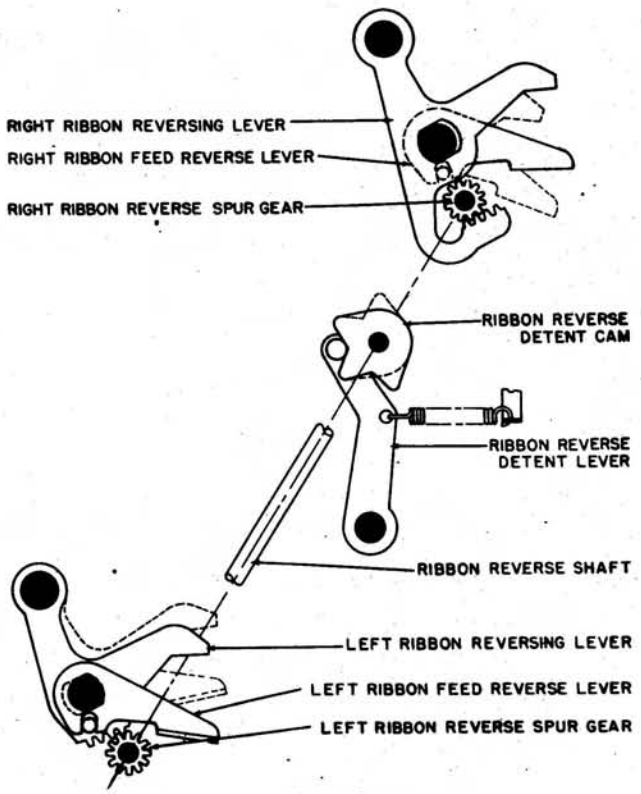


Fig. 84

(J) Paper-Straightener Rod

4.91 The spindle that mounts the roll of paper has each end flared to hexagonal shape. This shape prevents the spindle from moving freely and vibration will not cause the paper to unroll. On a line-feed operation the paper-straightener rod will yield until reaction caused by the increased spring tensions will cause the spindle to rotate one face of the hexagonal ends. Slack in the paper will then allow the rod to move up to its released position.

4.92 As the paper feeds around the platen, the paper tends to drift to one side or the other. As the paper drifts, it carries with it the paper straightener rod until the end of the rod extends into the slot in the side frame. Then as the line-feed operates, one end of the rod is prevented from moving down all the way and the rod will tilt and cause the paper to drift toward the other side.

5. MOTOR UNITS AND POWER SUPPLY REQUIREMENTS

(A) General

5.01 Table 6 gives statistics on the three types of motors used with the 28 teletypewriter.

Table 6

Motor Data

	Synchronous Motor	Governed Motor	
		AC	DC
Input Volts	115 ± 10%	115 ± 10%	115
Phase	Single	Single	DC
Frequency	60 ± 0.5 cycles	50-60 cycles	DC
Input Current (amperes)			
Start	9	1.8	-
Run	1.8	1.	-
Power Factor	0.3	0.8	-
Watts (input)	65	95	-
Heat Dissipation (watts)	50	75	-
HP	1/20	-	-
RPM	3600	3600	3600

AC - Governed motor used without current limiting resistors.

DC - Governed motor requires current-limiting resistors, located in the electrical service unit.

(B) Synchronous Motor

5.02 Fig. 6 is a photograph of the synchronous motor and Fig. 85 is a schematic wiring diagram. Figs. 6 and 85

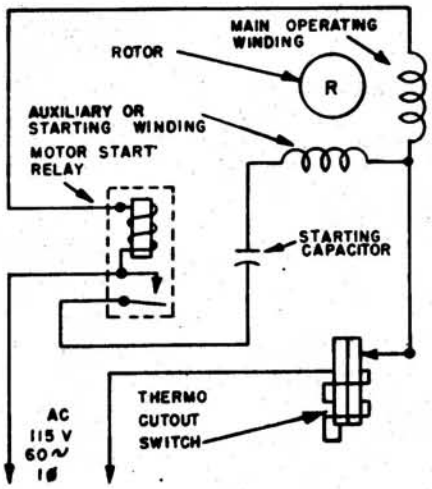


Fig. 85

5.03 The motor is a 2-pole, wound-stator, ball-bearing motor, with a squirrel-cage rotor. The stator has two windings, a main operating winding and a starting winding. The starting winding is in series with a 43-uf ac electrolytic capacitor through the contacts of a motor-starting relay. The larger initial starting current operates the relay, which closes the auxiliary winding circuit through its contacts. As the rotor gains speed the current decreases until the relay releases, disconnecting the starting winding from the circuit. The motor continues to gain speed until it reaches synchronous speed, 3600 rpm. The motor rotates counterclockwise as viewed from the fan end.

5.04 The starting relay and capacitor are mounted in a compartment under the motor. A thermal cutout switch will open the circuit if excessive current is drawn by the motor as, for instance, because of a blocked rotor. This switch is manually reset by pressing the red button on the motor mounting plate.

5.05 For cooling, there is a fan at each end of the rotor which draws air through the slots in the end bells and exhausts it through the slots in the motor housing. The end bells have rubber vibration mounts held in the mounting brackets by means of mounting straps. The bracket is fastened to the keyboard by four screws and lock washers. The motor shaft has a tapped hole for a screw to fasten the helical driving gear. End play is taken up by a conical spring which bears against the outer race of one of the ball bearings.

(C) Governed Motor

5.06 Fig. 7 is a picture of the governed motor and Fig. 86 is a schematic wiring diagram. (The electrical noise suppressor and the noise-suppression capacitors for the motor brushes are not standard for Bell System machines.) The same motor is used for either ac or dc operation; for dc operation, external current-limiting resistors are required. The armature, which has a 48-segment commutator, is in series with the two field windings and the governor contacts. The motor armature rotates counterclockwise as seen from the governor end. The mounting is similar to that of the synchronous motor. Figs. 7, 86

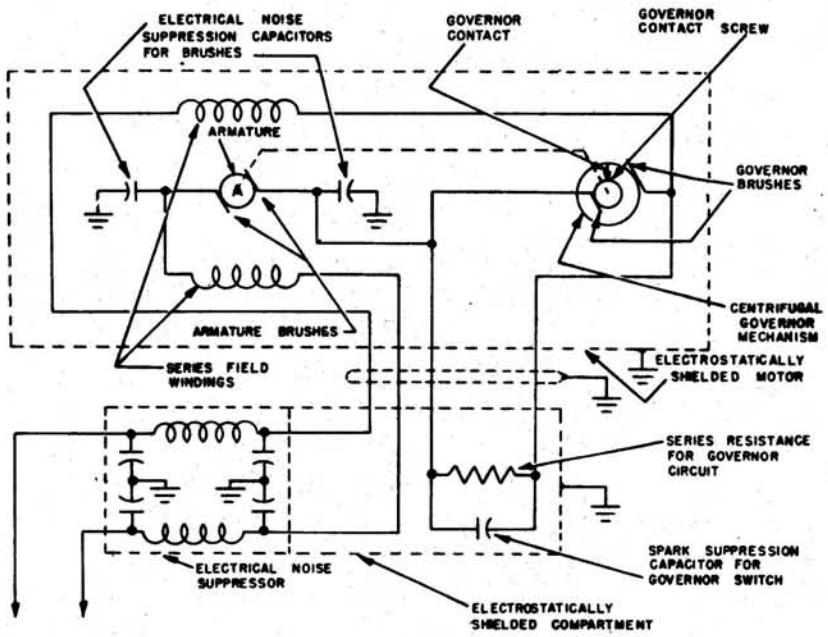


Fig. 86

5.07 In a compartment under the motor are the 250-ohm resistor and the 0.5-uf capacitor in the governor circuit. The compartment may be opened by removing a screw and lock washer and sliding the bottom cover plate aside.

5.08 The combination fan and governor is mounted on one end of the motor shaft. The fan draws cooling air through the motor housing and also serves as a mounting plate for the governor slip rings and governor-contact mechanism.

Governor

5.09 The governor regulates the speed of the motor. The governor (see Fig. 87) contains two centrifugally-operated contacts, which, when closed, short-circuit a 250-ohm resistor in series with the motor. When the contacts are open, the resistor is in the motor circuit to limit the current and thus reduce the speed. External connection to the contacts is made by two brushes mounted on the ends of the motor housing and sliding on two slip rings mounted on the fan and wired to the contacts. Fig. 87

5.10 Normally the governor-contact spring (Fig. 87) holds the governor contact against the contact screw. When the motor exceeds the speed for which the governor is set, 3600 rpm, the centrifugal force overcomes the pull of the governor spring and the governor contact leaves the contact screw until the motor slows down. Fig. 87

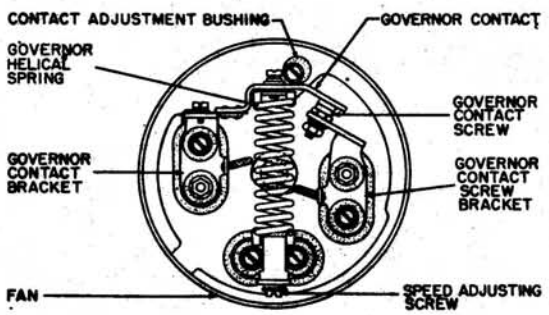


Fig. 87

5.11 Observation of the motor speed is made by means of black and white target rings on an aluminum cover which fits against the side of the fan. The three rings have 4, 6, and 35 spots, respectively, around the periphery. The 4-spot ring, viewed with a TP104986 120-cycle tuning fork, will set the speed to 3600 rpm. The 35-spot target with a 10A (mfr. disc.) or TP103628 fork gives a speed of 3604 rpm. The 6-spot ring is for an initial setting, after which the speed is increased slightly for the 35-spot ring.

5.12 The motor speed is adjusted by turning the contact-adjustment bushing, shown in Fig. 87, with a screwdriver through a hole in the governor-shield housing. This hole is normally closed with a threaded plug. The motor must be stopped to adjust the speed. Fig. 87

(D) Rectifier

5.13 A 0.100-ampere rectifier in the electrical service unit provides current for the selector magnet and the relay bias windings. It is not designed to supply the signal line current.

6. THEORY OF OPERATION OF AUXILIARY FEATURES

(A) General

6.01 A list of the auxiliary features associated with the 28 teletypewriter is given in Part 2G of this practice. The discussion below is confined to two novel arrangements, the electrical motor control and the time-delay mechanism.

(B) Electrical Motor Control

6.02 A set of motor-stop contacts, referred to for convenience as the H contacts, is a standard feature of the 28 teletypewriter provided on all units. The contacts may be arranged to close momentarily (or by means of a different upper contact spring, to open momentarily) on receipt of the motor-stop signal, which may be sent either from a remote point or from the local keyboard. The operation of the H contacts is affected by the position of the clip at slot 22 of the function box, as discussed in Part 2E of this practice. If M is to be used for motor stop instead of H a differently coded function bar is used at slot 23.

6.03 When motor control is used, additional apparatus is provided as follows:

(a) For closed-loop motor control (PLS or TWX), the electrical motor-control mechanism furnished as an auxiliary feature of the 28 teletypewriter mounts in the center of the electrical service unit. With this mechanism, the H contacts close momentarily on the stop signal to operate the stop magnet and stop the motor.

(b) For TWX open-loop operation, a 120-type subset (external to the teletypewriter) is used. This subset (120C, described in Section P31.231, or 120D, described in Section P31.241) contains relays which operate to stop the motor when the H contacts momentarily open.

6.04 The motor is started as follows:

(a) With the 28 TTY motor control, by pressing and releasing the break key (locally or remotely), which first opens the loop and then closes it.

(b) With the 120C TWX subset, by a 6-second ring from the switchboard.

(c) With the 120D TWX subset, by a reversal of the current in the tip conductor of the loop when the switchboard operator operates a key.

6.05 The detailed operation of the electrical motor-control mechanism is given in the succeeding paragraphs, which describe a complete cycle. Fig. 88 is the schematic wiring diagram. Fig. 88

Stop Position (Fig. 89)

6.06 In the idle condition, with the motor stopped, the marking current in the closed loop holds the start magnets energized. The start-magnet armature is pulled down and the stop-magnet armature is held in its operated position (toward the stop magnet) by the latch lever. The motor-power contacts are opened by the stop-magnet armature and the signal line switch, also operated by the stop-magnet armature, is closed, closing the teletypewriter loop through the start magnets. Fig. 89

To Start the Motor (Fig. 90)

6.07 The loop is opened by the break key or otherwise. The start magnets are de-energized and that start-magnet armature is released. As it moves up it carries the latch-lever with it. This releases the stop-magnet armature, which starts to swing away from the stop-magnet but is immediately blocked by the

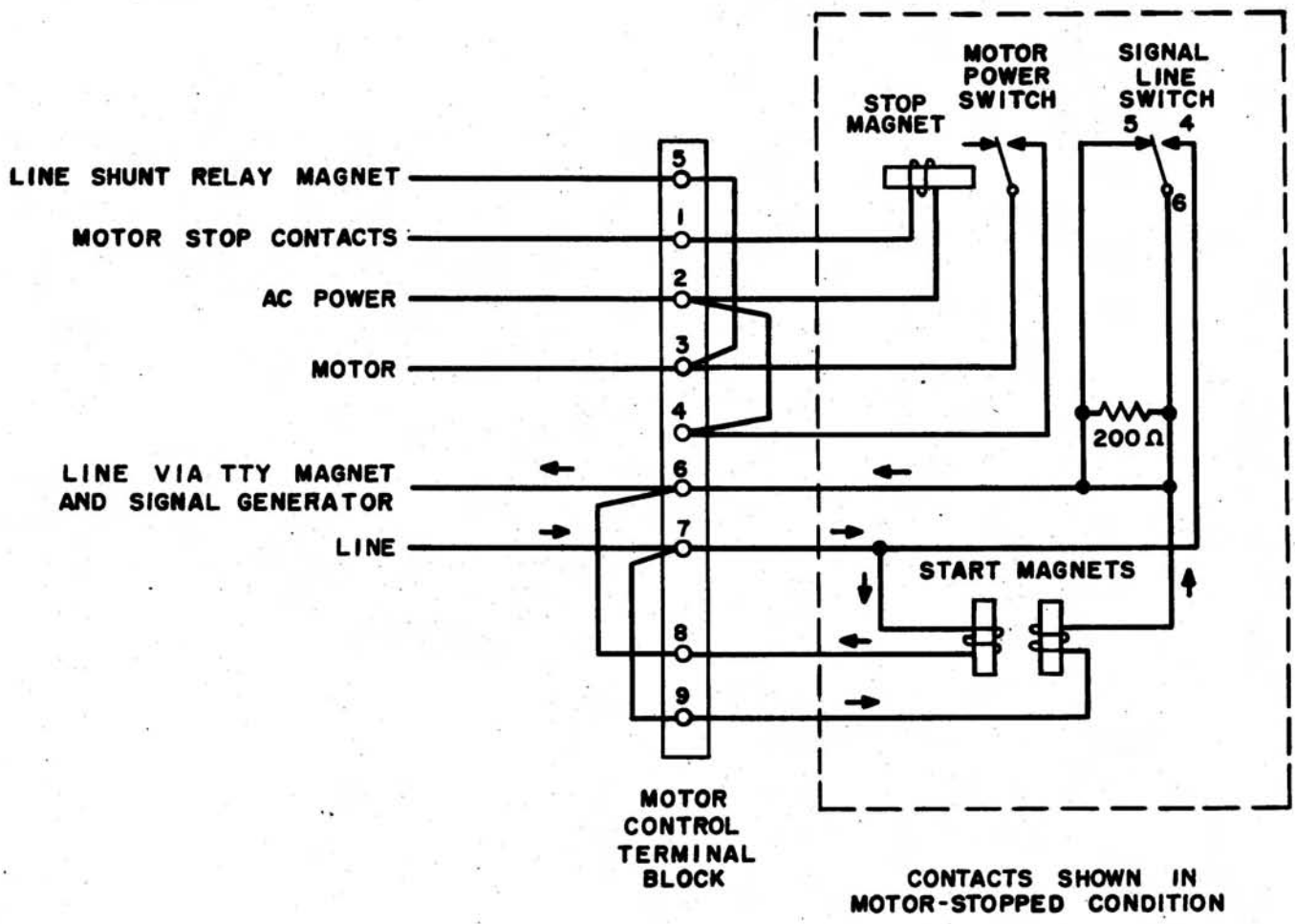


Fig. 88

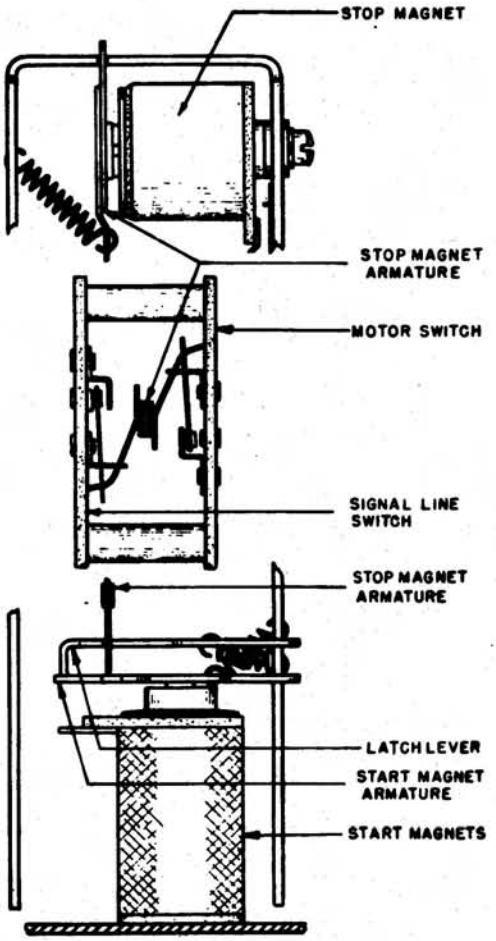


Fig. 89

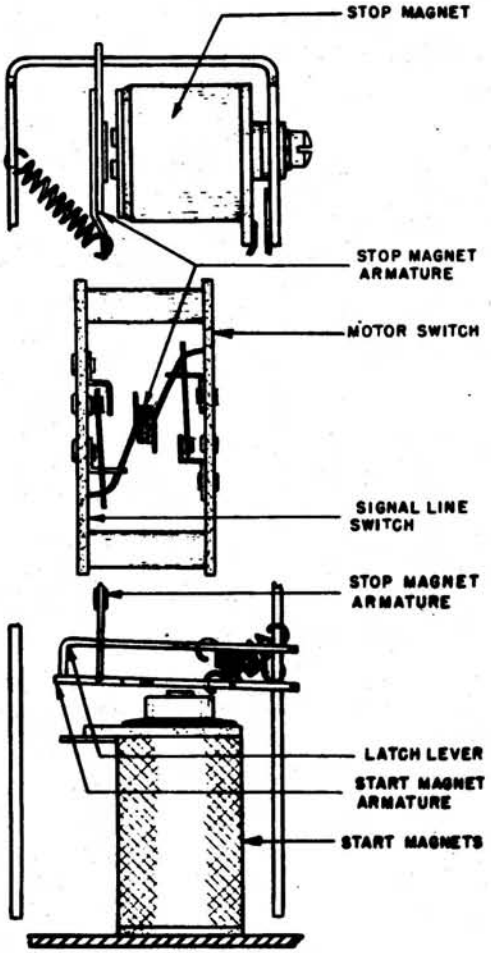


Fig. 90

start-magnet armature. The slight movement of the stop-magnet armature was not sufficient to change the position of the motor-power and signal-line switches. Fig. 90

6.08 On the release of the break key the loop is again closed (Fig. 91). The start magnets are energized and pull the start-magnet armature down, releasing the stop-magnet armature. As the stop-magnet armature releases, it operates the switch to turn on the motor power switch, which short-circuits the start magnets so that they do not respond to the loop signals during transmission of test. Fig. 91

To Stop the Motor (Fig. 89)

6.09 The momentary closure of the H contacts on the typing unit (or the time-delay contacts on the keyboard) energizes the stop magnet, whose armature pulls up, opening the power switch, to shut off the motor and the copylight, and operating the signal-line switch. The operation of the signal-line switch removes the short circuit from the start-magnet coils, which in turn pull the start-magnet armature down. This allows the latch lever to engage the stop-magnet armature and hold it in the stop position. Fig. 89

(C) Time-Delay Mechanism

6.10 The time-delay mechanism, an auxiliary feature not furnished on Bell System 28 teletypewriters, contains contacts (motor-stop switch) which momentarily close to operate the motor control mechanism and stop the motor in the same way as the H contacts in the closed-loop case described above. The motor-stop switch closes whenever the teletypewriter runs idle for longer than about one to three minutes, the time depending on the speed of transmission and the position of the wheels of the device when the idle period starts. The

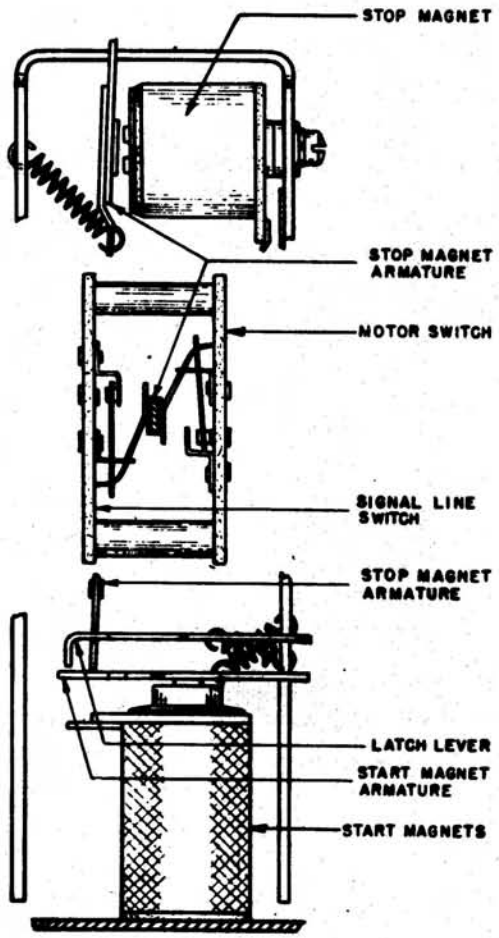


Fig. 91

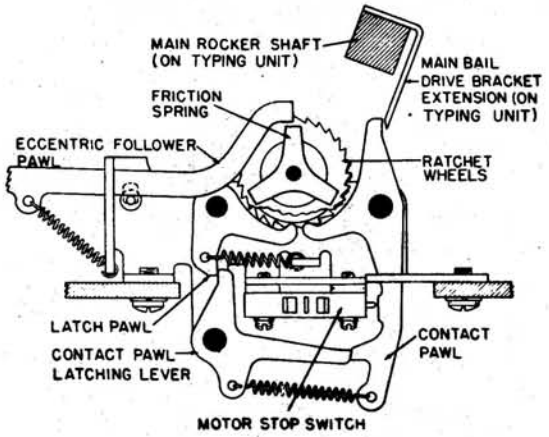


Fig. 92

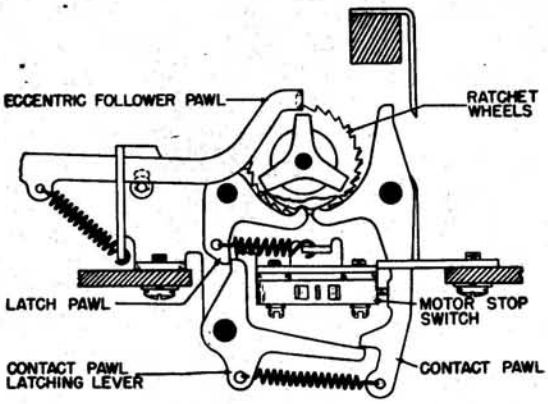


Fig. 93

discussion in the succeeding paragraphs is of the operation of the time-delay mechanism to produce the momentary closure of the motor-stop switch.

6.11 The time-delay mechanism contains two ratchet wheels, one with 27 teeth and one with 28 teeth. A reciprocating eccentric-follower pawl (Fig. 92), driven from an eccentric on the intermediate shaft, drives the ratchet wheels one tooth at a time. The ratchet wheel with 27 teeth turns a little faster than the wheel with 28 teeth. Fig. 92

6.12 Each ratchet wheel has an indent in its inner flange. For every 756 revolutions of the intermediate shaft the indents are adjacent for nearly one revolution. The latch pawl bears against the inner flanges of the two ratchets. When the adjacent indents pass over the tip of the latch pawl, the latch pawl moves the contact-pawl latching lever away from the contact pawl and the contact pawl is then free to bear against the inner flanges of the two ratchets. Fig. 93

6.13 If the typing unit remains idle for 756 revolutions of the intermediate shaft after the contact pawl is unlatched, the contact pawl moves into the indents momentarily as the two indents become adjacent. This operation of the contact pawl closes the motor-stop switch momentarily (Fig. 94) which in turn operates the stop magnet of the motor-control mechanism of the teletypewriter. Fig. 94

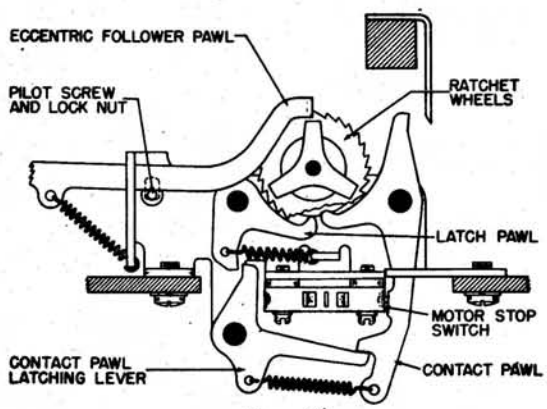


Fig. 94

6.14 If loop signals start coming into the teletypewriter after the contact pawl is unlatched but before the intermediate shaft has made 756 revolutions the motor-stop cycle is interrupted and the complete cycles must be repeated before the motor stops. What happens is that the main-bail drive-bracket extension on the typing unit engages the upper end of the contact pawl (Fig. 92) and moves it so that its lower end is again latched by the contact-pawl latching lever. Thus the contact pawl is prevented from riding on the inner flanges of the ratchets until it has again been unlatched by the operation of the contact-pawl latching lever. Fig. 92

6.15 The time lapse between the reception of the last loop signal and the stopping of the motor varies from 86 to 172 seconds for 60 speed and from 53 to 106 seconds for 100 speed.

6.16 After the motor has been stopped by the time-delay mechanism it is started either locally or from a remote point by any signal, such as a break signal, which first opens the loop and then closes it. The subsequent operation of the motor-stop mechanism to start the motor (which is the same as that described for the electrical motor control) does not involve the time-delay mechanism, whose only function is to stop the motor.

6.17 The time-delay mechanism may be disabled by moving a pilot screw (Fig. 94) which holds the eccentric-follower pawl out of engagement with the ratchet wheels. Fig. 94

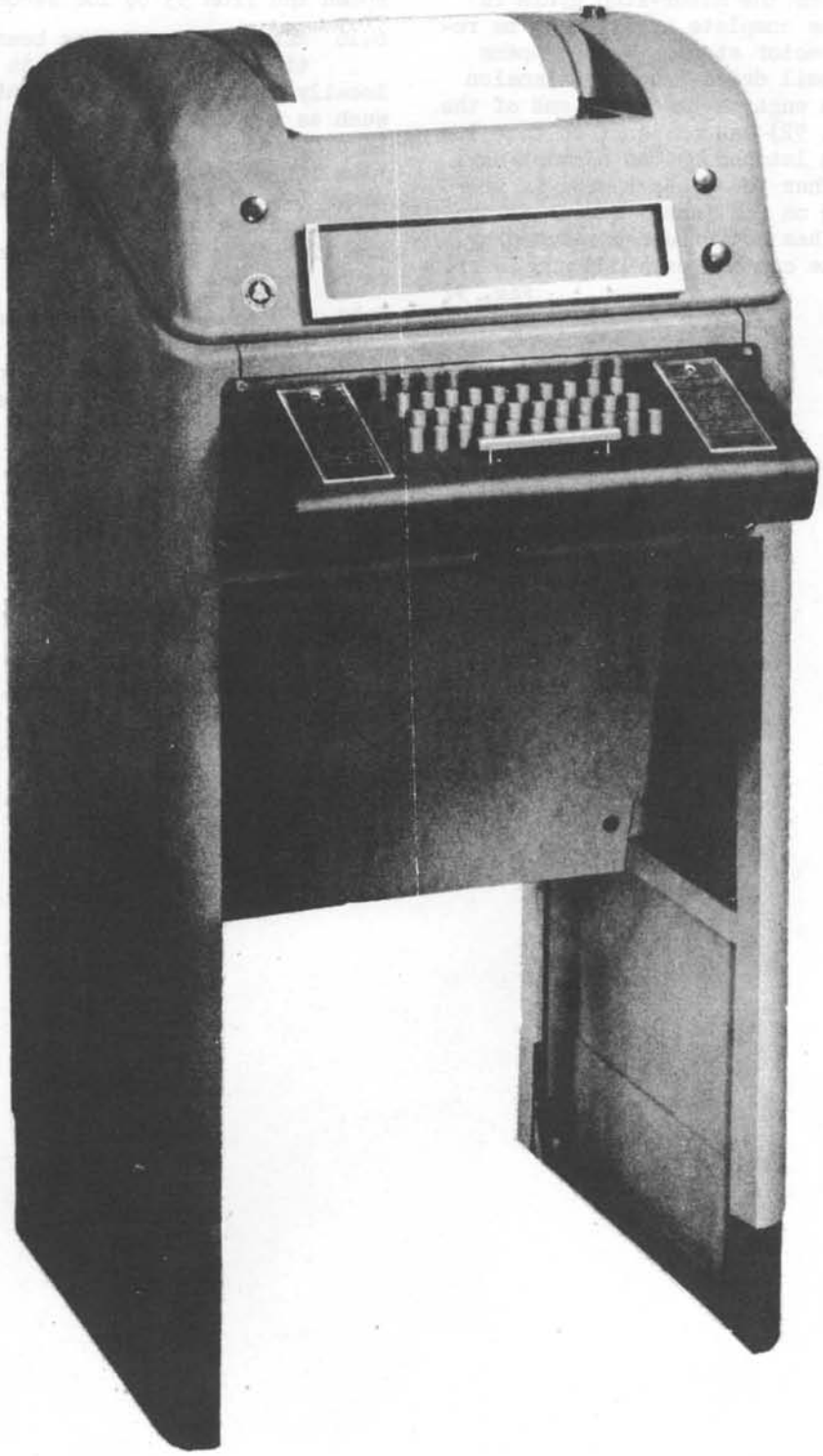


Fig. 1

Fig. 2

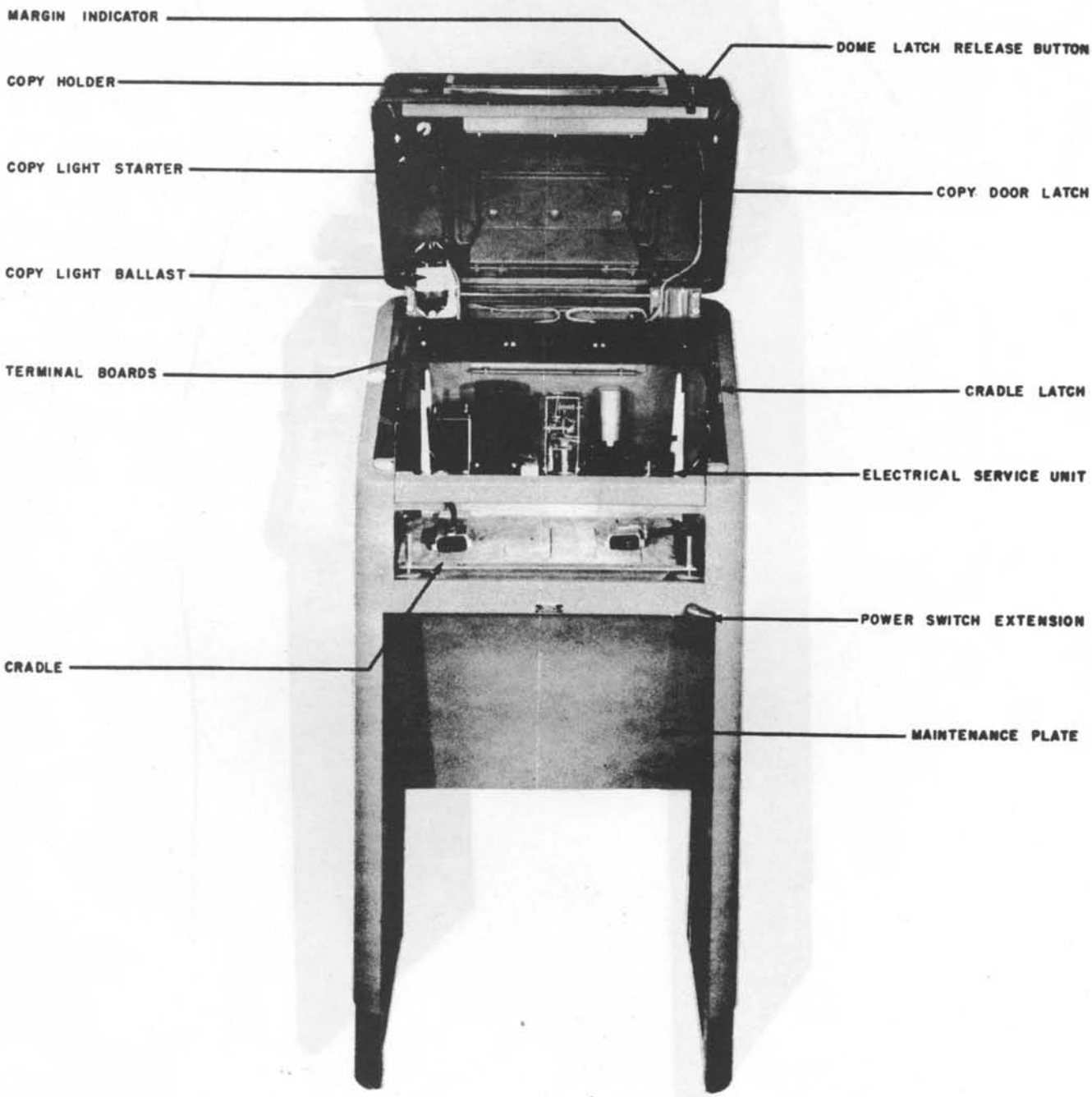

MARGIN INDICATOR
COPY HOLDER
COPY LIGHT STARTER
COPY LIGHT BALLAST
TERMINAL BOARDS
CRADLE
DOME LATCH RELEASE BUTTON
COPY DOOR LATCH
CRADLE LATCH
ELECTRICAL SERVICE UNIT
POWER SWITCH EXTENSION
MAINTENANCE PLATE

Fig. 3

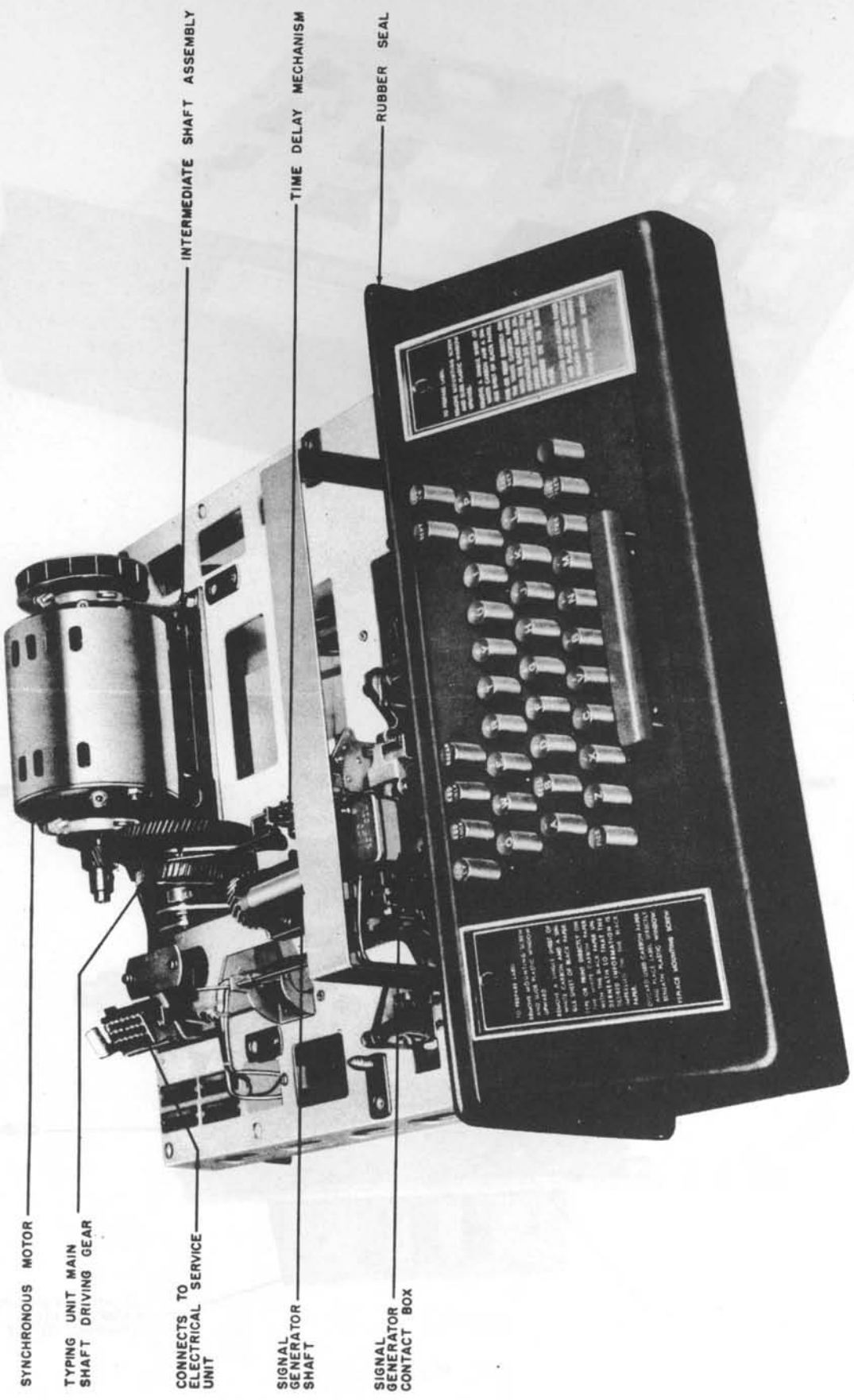

SYNCHRONOUS MOTOR
TYPING UNIT MAIN SHAFT DRIVING GEAR
CONNECTS TO ELECTRICAL SERVICE UNIT
SIGNAL GENERATOR SHAFT
SIGNAL GENERATOR CONTACT BOX
INTERMEDIATE SHAFT ASSEMBLY
TIME DELAY MECHANISM
RUBBER SEAL

Fig. 4

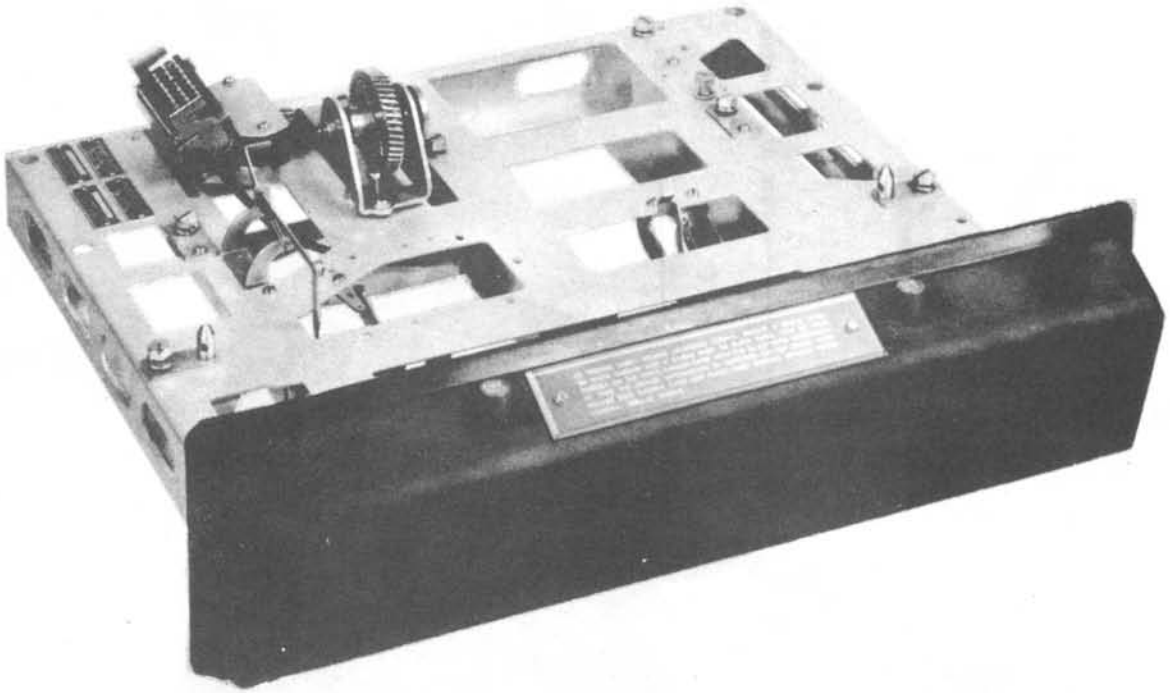


Fig. 5

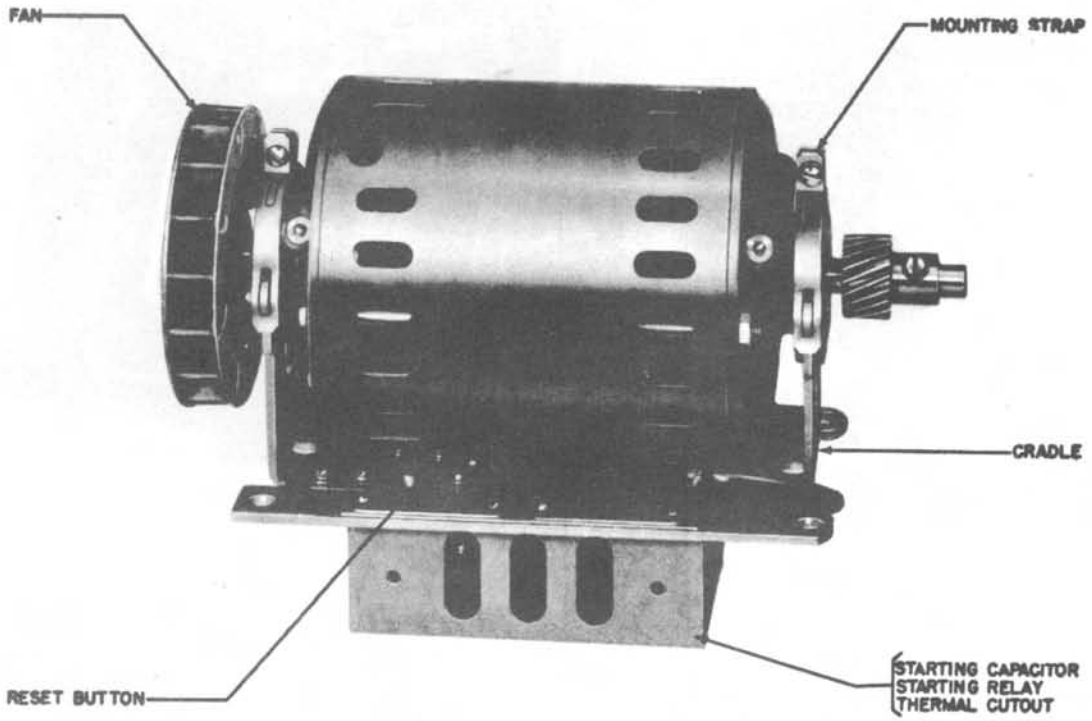

FAN
MOUNTING STRAP
CRADLE
RESET BUTTON
STARTING CAPACITOR
STARTING RELAY
THERMAL CUTOUT

Fig. 6

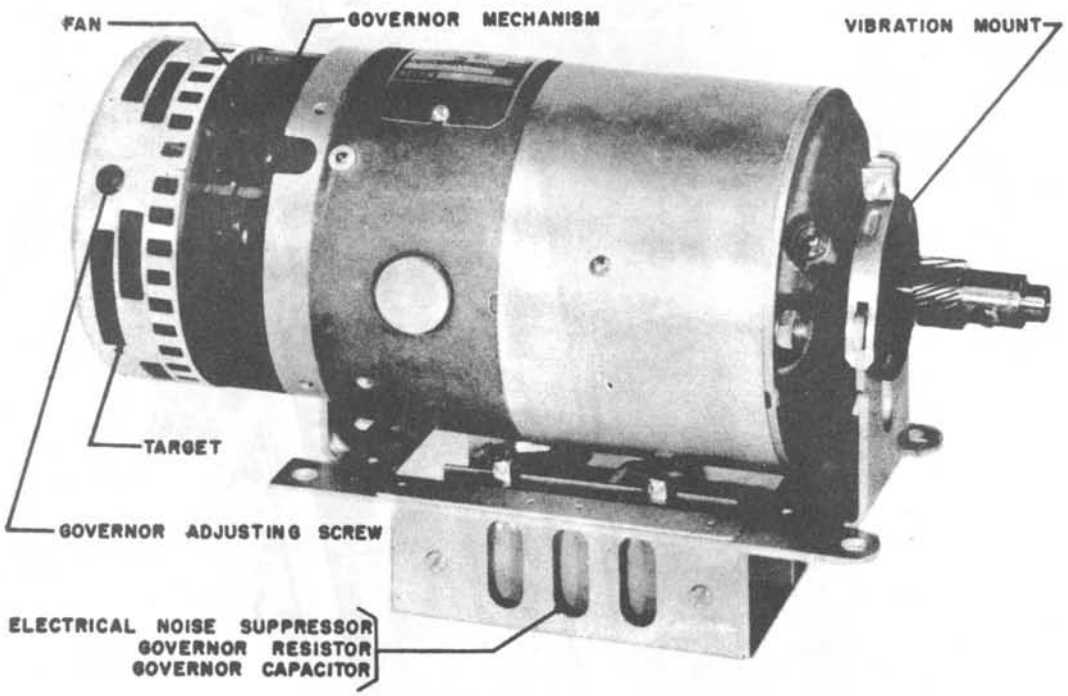

FAN
GOVERNOR MECHANISM
VIBRATION MOUNT
TARGET
GOVERNOR ADJUSTING SCREW
ELECTRICAL NOISE SUPPRESSOR
GOVERNOR RESISTOR
GOVERNOR CAPACITOR

Fig. 7

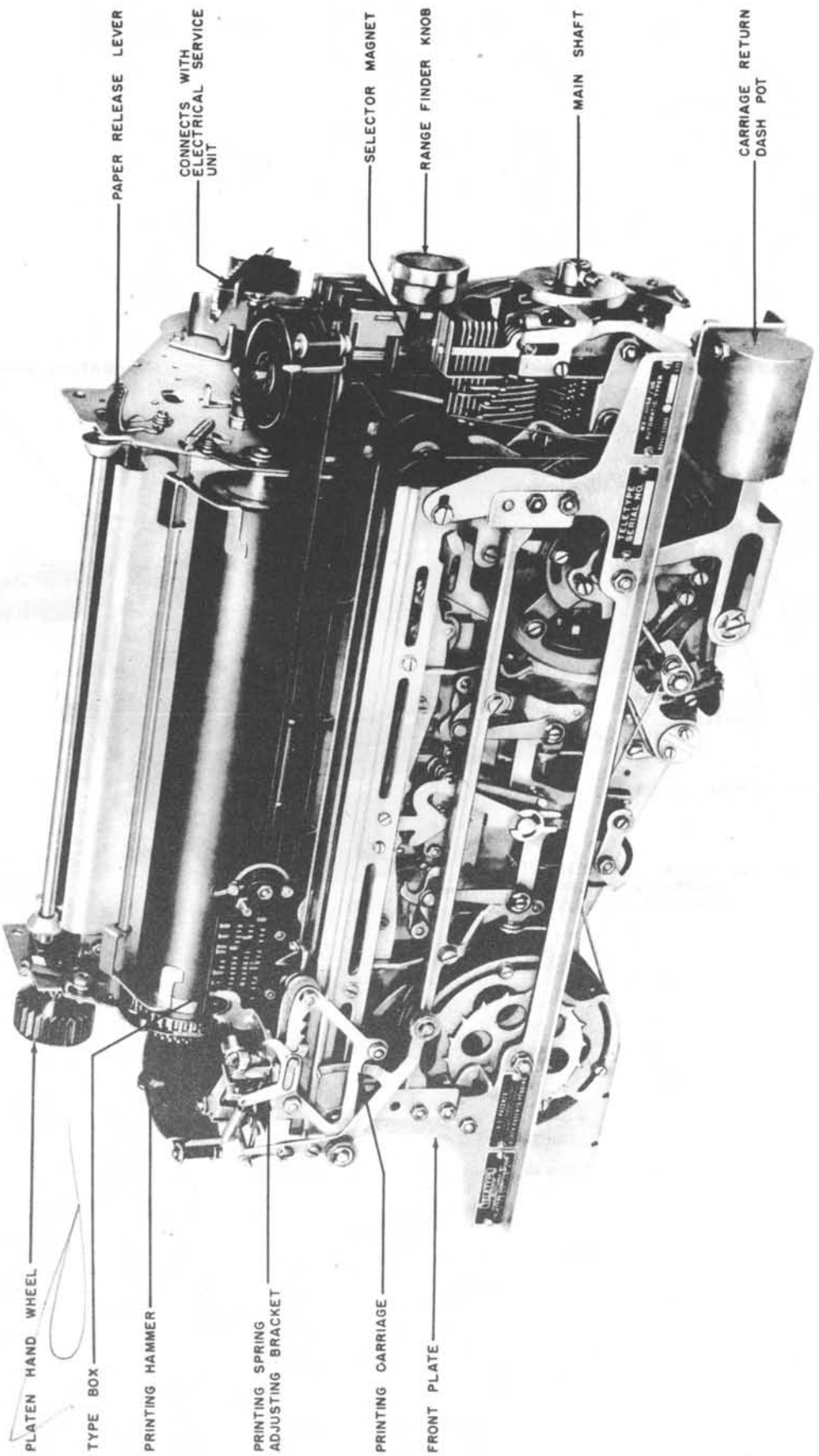

PAPER RELEASE LEVER
CONNECTS WITH ELECTRICAL SERVICE UNIT
SELECTOR MAGNET
RANGE FINDER KNOB
MAIN SHAFT
CARRIAGE RETURN DASH POT
PLATEN HAND WHEEL
TYPE BOX
PRINTING HAMMER
PRINTING SPRING ADJUSTING BRACKET
PRINTING CARRIAGE
FRONT PLATE

Fig. 8

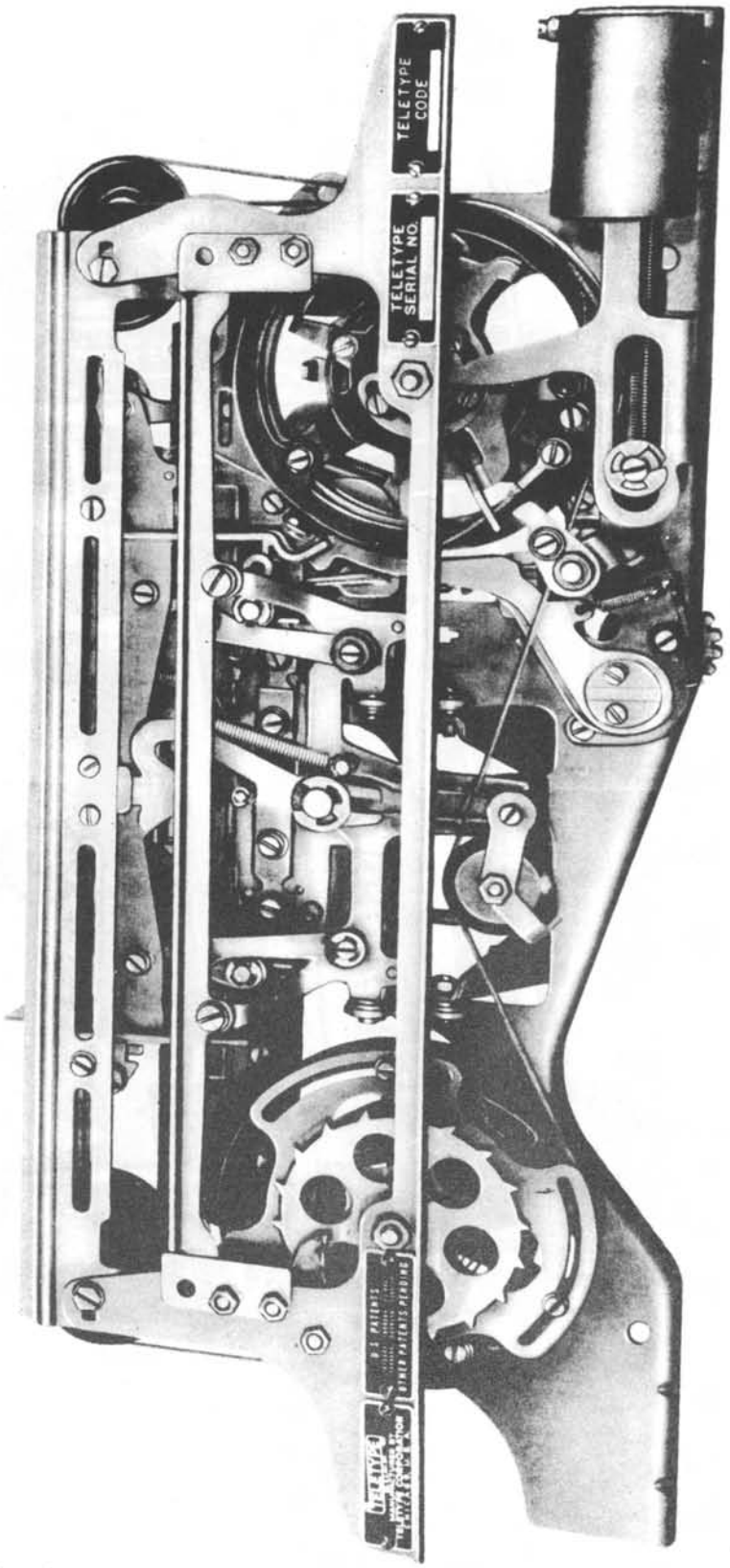


Fig. 9

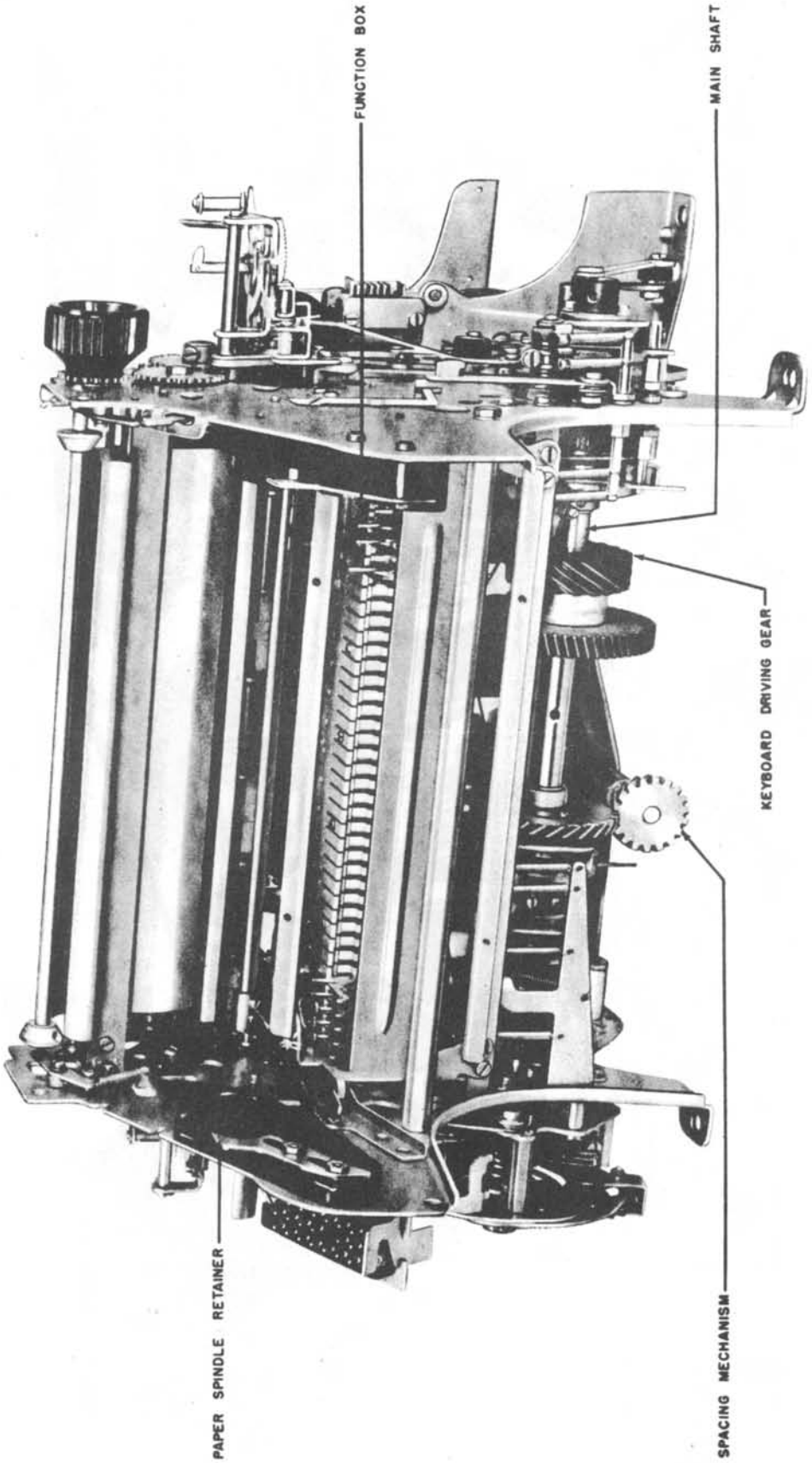

FUNCTION BOX
MAIN SHAFT
KEYBOARD DRIVING GEAR
PAPER SPINDLE RETAINER
SPACING MECHANISM

Fig. 10

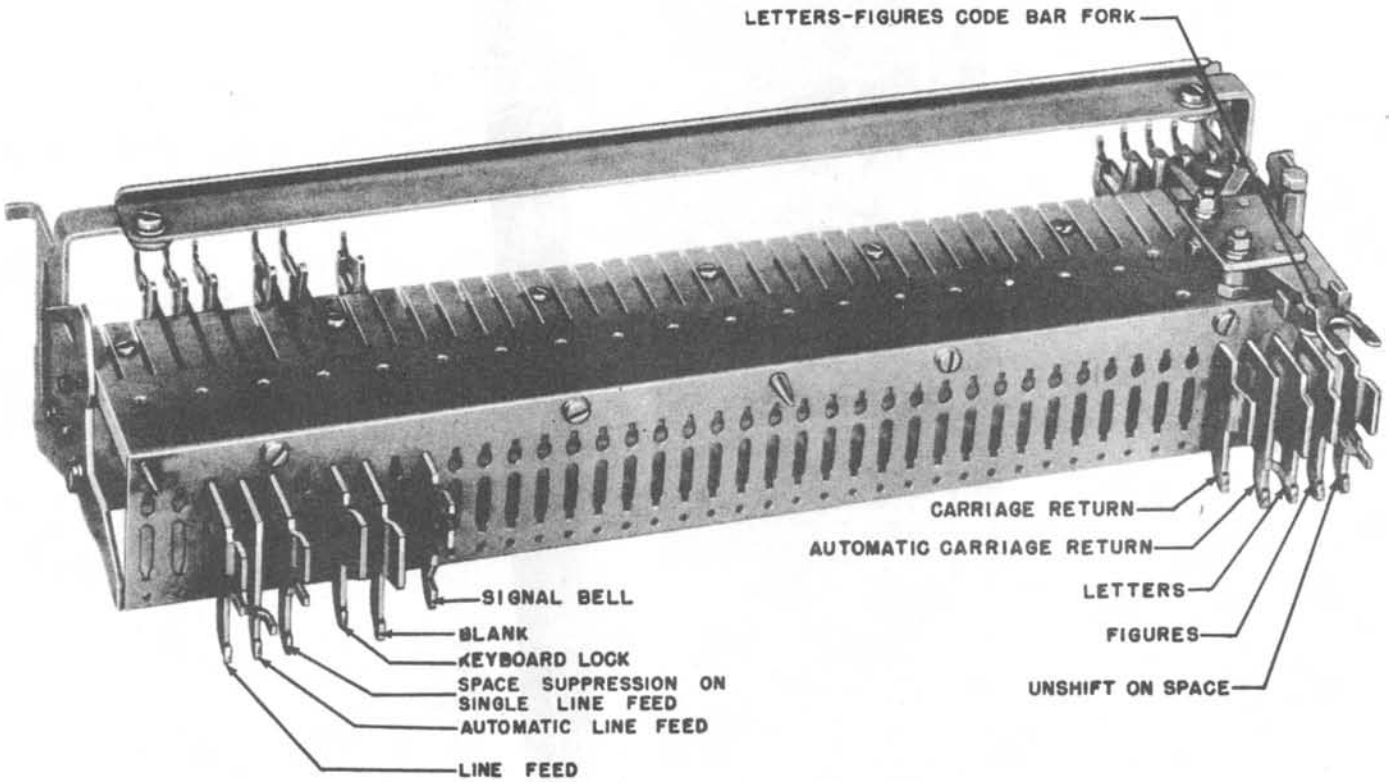

LETTERS-FIGURES CODE BAR FORK
CARRIAGE RETURN
AUTOMATIC CARRIAGE RETURN
LETTERS
FIGURES
UNSHIFT ON SPACE
SIGNAL BELL
BLANK
KEYBOARD LOCK
SPACE SUPPRESSION ON SINGLE LINE FEED
AUTOMATIC LINE FEED
LINE FEED

Fig. 11

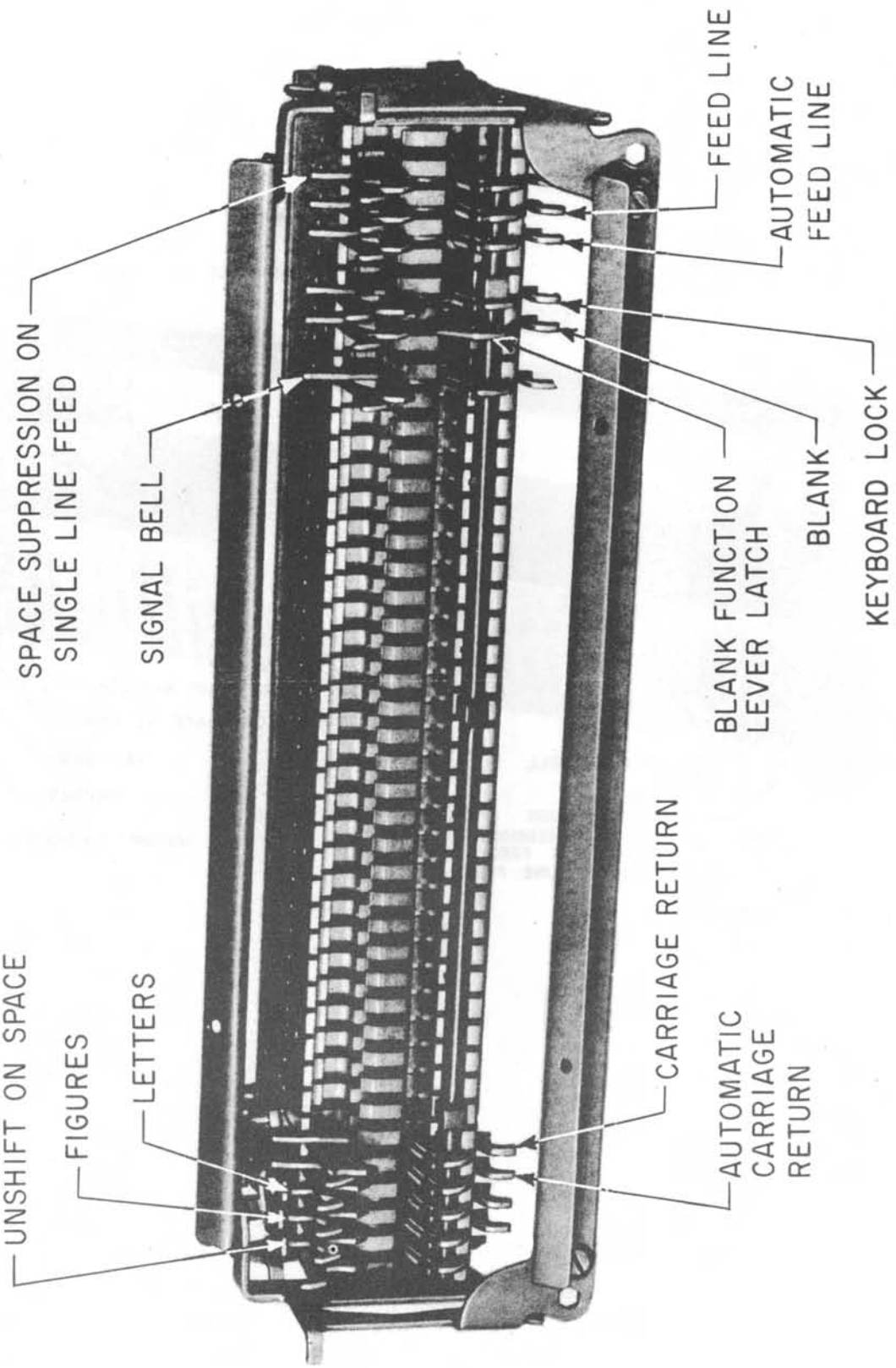
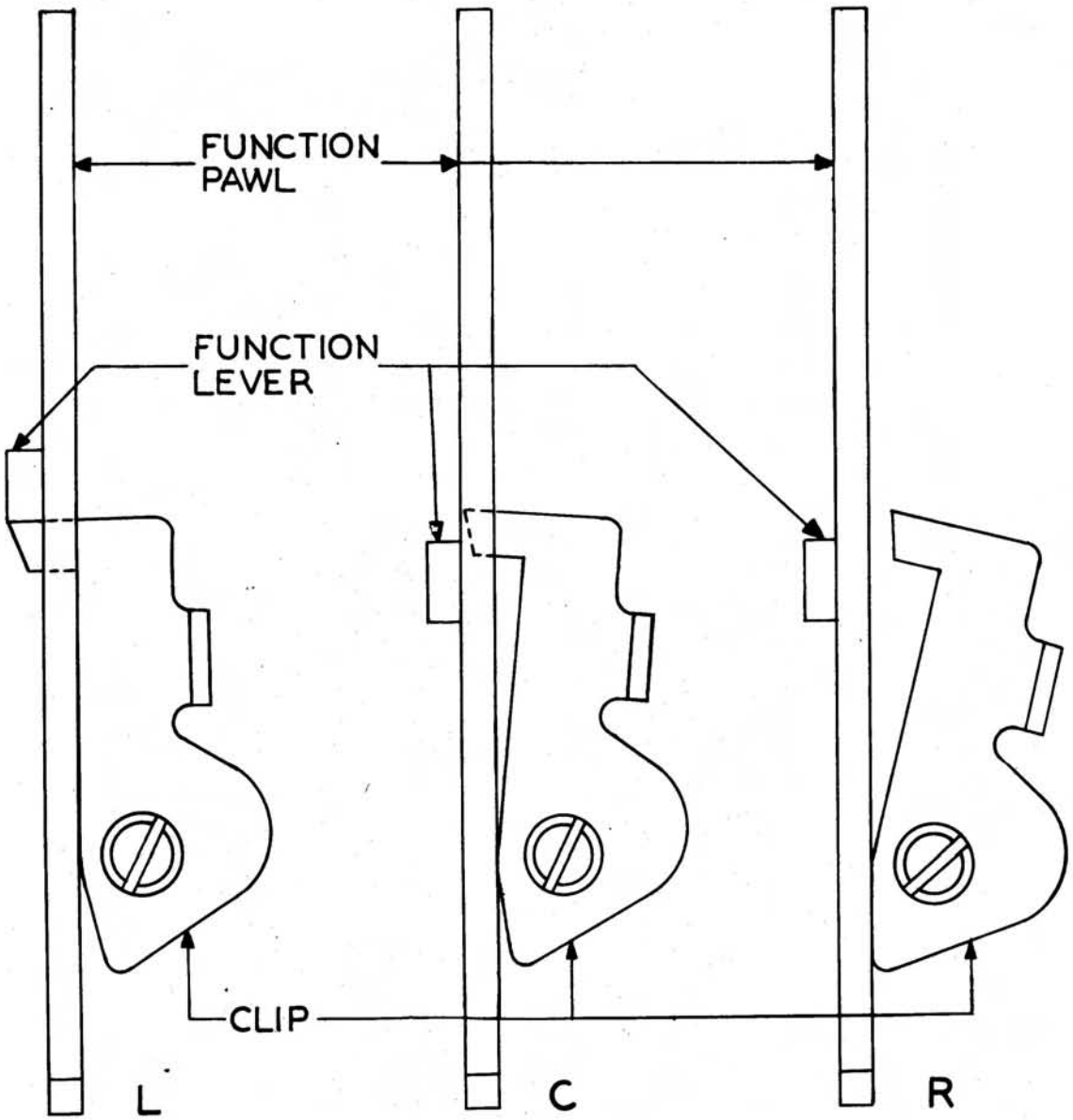

UNSHIFT ON SPACE
FIGURES
LETTERS
SPACE SUPPRESSION ON SINGLE LINE FEED
SIGNAL BELL
AUTOMATIC CARRIAGE RETURN
CARRIAGE RETURN
BLANK FUNCTION LEVER LATCH
FEED LINE
AUTOMATIC FEED LINE
BLANK
KEYBOARD LOCK

Fig. 12



CLIP TO THE LEFT UNDER FUNCTION PAWL AND IN FRONT OF FUNCTION LEVER, HOLDING LEVER IN OPERATED POSITION.

CLIP IN CENTER POSITION, UNDER FUNCTION PAWL, BLOCKING ITS OPERATION.

CLIP TO RIGHT; NO INTERFERENCE WITH OPERATION OF FUNCTION LEVER OR FUNCTION PAWL.

FRONT OF TYPING UNIT
TOP VIEW

Fig. 13

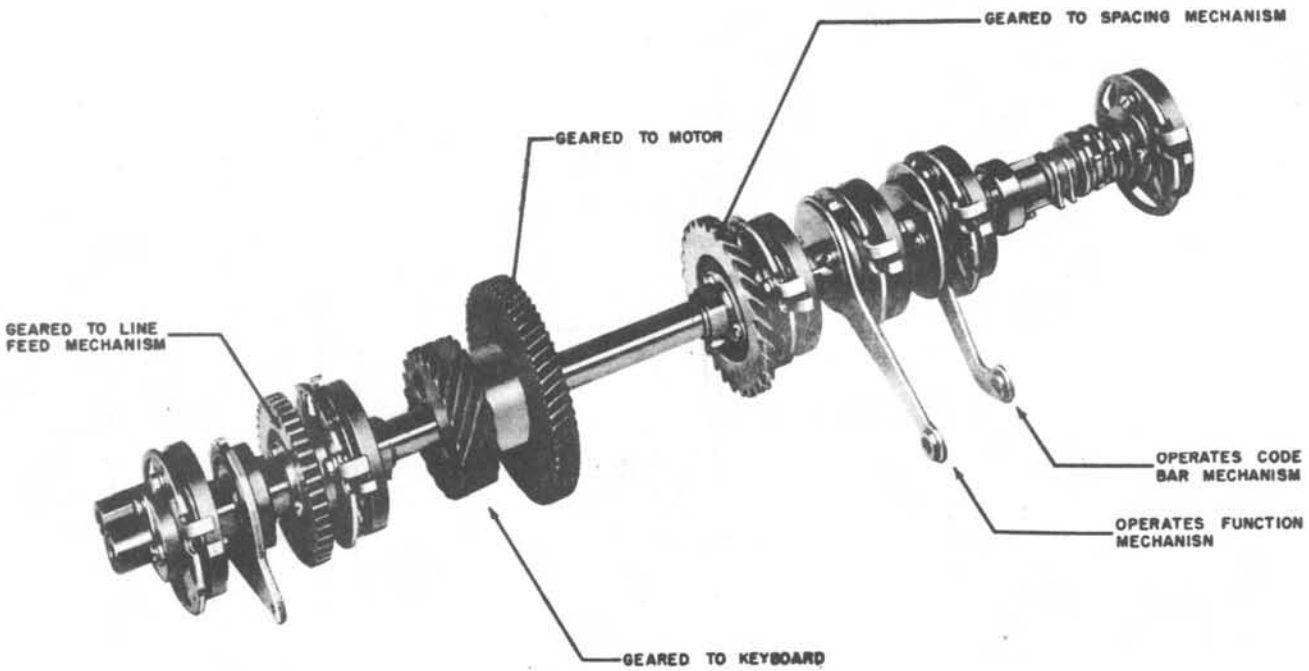

GEARED TO SPACING MECHANISM
GEARED TO MOTOR
GEARED TO LINE FEED MECHANISM
OPERATES CODE BAR MECHANISM
OPERATES FUNCTION MECHANISN
GEARED TO KEYBOARD

Fig. 14

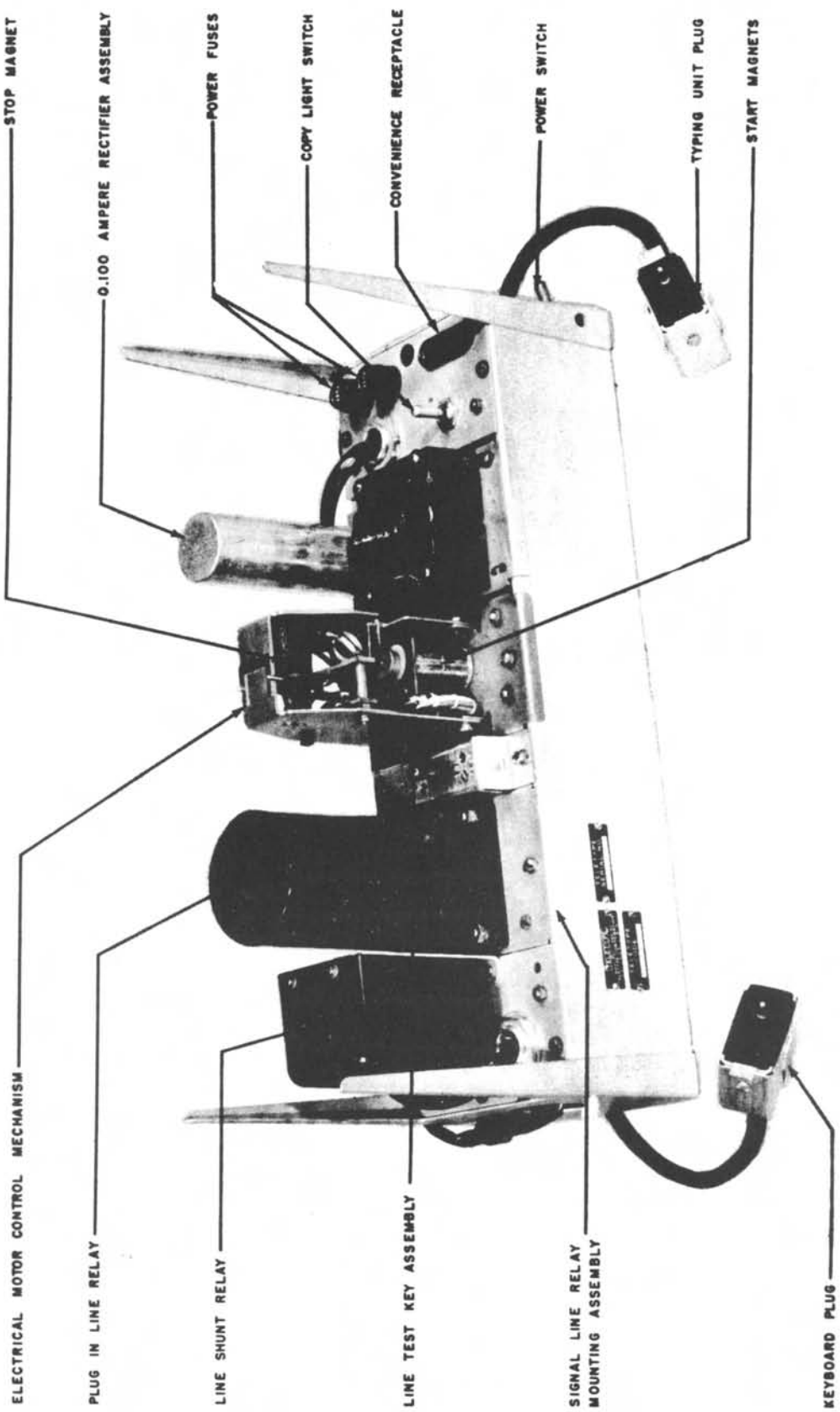

STOP MAGNET
0.100 AMPERE RECTIFIER ASSEMBLY
POWER FUSES
COPY LIGHT SWITCH
CONVENIENCE RECEPTACLE
POWER SWITCH
TYPING UNIT PLUG
START MAGNETS
ELECTRICAL MOTOR CONTROL MECHANISM
PLUG IN LINE RELAY
LINE SHUNT RELAY
LINE TEST KEY ASSEMBLY
SIGNAL LINE RELAY MOUNTING ASSEMBLY
KEYBOARD PLUG

Fig. 15