

BULLETIN NO. 144
ISSUE 2
SEPTEMBER, 1944

TELETYPE

PRINTING TELEGRAPH SYSTEMS

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DESCRIPTION

TYPE BAR PAGE PRINTER
MODEL 15



CORPORATION
SUBSIDIARY OF
Western Electric Company
CHICAGO, U.S.A.

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DESCRIPTION

GENERAL

The Teletype Model 15 Type Bar Page Printer (Figure 34) is a motor-driven mechanism designed for interchanging typewritten messages between two or more points connected by telegraph communication channels. A sending-receiving station consists of a keyboard transmitting unit (Figure 35), a typing unit (Figure 37), and a motor unit (Figure 41), all mounted on a base unit (Figure 41).

The keyboard transmitting unit is used to transform mechanical motion into electrical impulses of the five unit code, and to send these impulses to the receiving mechanism of the typing unit at any station on the line. These received electrical impulses are then transformed back into mechanical motion, causing the typing unit to print a copy of the message sent by the keyboard operator. The message may be printed on sheets of paper (page form), on a roll of paper or on continuous folded forms. Both the keyboard transmitting unit and the typing unit are driven by the motor.

SIGNALING CODE

The signaling code is an electrical code of current and no-current impulses. Impulses which energize the selector magnets are known as MARKING and those which do not are known as SPACING.

This five unit code is composed of five selecting impulses which may be either MARKING (current) or SPACING (no-current) according to the code sequence of the character to be transmitted. Each group of five selecting impulses is preceded by a start impulse (no-current) and followed by a stop impulse (current) which are used to maintain synchronism between the transmitting and receiving apparatus. Figure 1 shows graphically the code used.

KEYBOARD TRANSMITTING UNIT

The keyboard transmitting unit (Figure 35) consists essentially of: a set of keys, key levers, selector bars and locking levers used in selecting the code combination to be transmitted; (Figure 2) a transmitting cam cylinder, contact levers and contact springs for transmitting the selected code combination; a clutch throwout lever and clutch (Figure 3) used in starting and stopping transmission.

The transmitting cam cylinder (Figure 3), its controlling clutch and the transmitting shaft gear are mounted on the transmitting shaft (Figure 35). The transmitting shaft gear derives its motive force from a gear on the main shaft of the typing unit (Figure 36). The transmitting cam cylinder is held stationary when the clutch teeth are disengaged by the clutch throwout lever (Figure 3).

Beneath the key levers are five selector bars and a universal bar, extending across the width of the keyboard (Figure 3). The selector bars are

made with saw-tooth shaped notches, according to the requirements of the signaling code (Figure 2A). These selector bars rest on rollers and are guided at each end so that they are easily moved endwise. When a key is depressed, the key lever strikes the slanting sides of these notches, moving the bars either to the right or left, depending upon whether the impulses corresponding to the bars are to be SPACING or MARKING impulses.

The universal bar (Figure 3) which is connected to the trip-off pawl controls the starting of the transmitting cam cylinder. It is pivoted at both ends in such a manner that the depression of any key rotates it downward and moves the trip-off pawl forward. This action releases the clutch throwout lever from the driven member of the clutch by means of the intermediate pawl, allowing the transmitting cams to start rotating. As the cams rotate, the impulses are transmitted in succession (Figure 2C).

Each selector bar engages a vertical locking lever at its right-hand extremity and positions it to correspond with the signal impulse to be transmitted (Figure 2A). Each locking lever controls the motion of a contact lever either by allowing the contact lever to close its contact when the cams revolve or by restricting the motion of the contact lever. If the upper end of the locking lever is positioned to the left corresponding to a SPACING impulse, the locking lever engages the contact lever and prevents it from rising into the indent of the cam as the cam rotates, thus holding the circuit open for that impulse (Figure 2A). If the upper end of the locking lever is positioned to the right, corresponding to a MARKING impulse, it does not interfere with the movement of the contact lever (Figure 2B). Then, as the cam revolves, the contact lever rides on the cam periphery and rises into an indent, thereby allowing its contact to close and send out a MARKING impulse.

There are six pairs of contact springs which open and close the signal circuit that are connected in parallel, since each bank of contacts is one piece of metal (Figure 2C). In actual operation the signal line could be controlled from only one pair of contacts. However, multi-contacts are used to facilitate the rapid mechanical sequence of current and no-current signal operations. As the cams rotate, the impulses, either MARKING or SPACING, are transmitted in succession.

The start-stop cam (Figure 3) controls a contact lever which, in turn, actuates the start-stop contacts. These contacts are opened at the beginning of each revolution of the cam cylinder to transmit the start impulse (SPACING) and remain open during the transmission of the five selecting impulses. After the fifth impulse has been transmitted, the start-stop contacts will again close, sending the stop impulse (MARKING) to the line. These contacts will remain closed until the next key lever is depressed. At the end of each revolution, the driven clutch member is cammed out of mesh with the driving clutch member by the clutch throwout lever, preventing the cams from rotating further until the next key is depressed.

During the transmission of the selection which has just been set up, the lock loop is held down by spring tension against the upper ends of the locking levers, locking them in their set positions (Figure 2C). This condition prevents a change in the selection and also makes it impossible to depress another key until the present signal has been transmitted. When the transmission of the selection has been completed, the lock loop cam raises the lock

loop away from the locking levers allowing another key to be depressed, which will position the selector bars for transmission of the next combination.

The keyboard may be equipped with a repeat-space mechanism which permits the transmission of continuous spaces (Figure 3). When the space key lever is depressed, the repeat-space rod attached to the space key lever extension will move the intermediate pawl forward and, in turn, will hold the clutch throwout lever out of engagement with the projection on the driven clutch member. Thus the transmitting cam cylinder will be allowed to revolve continuously until the space key lever is released.

TYPING UNIT

GENERAL

The typebar carriage of the Model 15 typing unit consists of typebar similar to those of a typewriter, together with other associated parts. The typebars are mechanically thrown against a platen, causing letters to be printed. The typebar to be selected is determined by the setting of five code bars which are actuated by line signals through the medium of the selector mechanism. The code bars are so arranged that the notches on their upper edge will be lined up to permit a selected pullbar to move down into the path of the pullbar bail. This bail moves the pullbar forward, causing the typebar to which it is connected to strike the platen. A motor drives the main shaft assembly of the typing unit which supplies power to all mechanically operated parts.

MAIN SHAFT ASSEMBLY

Motion for the setting up of selections and for the performance of all functions is derived from cams and gears mounted on the main shaft (Figure 36). This shaft is driven by a motor through the medium of a pinion and gear. The selector cam sleeve is fitted over the end of the main shaft and is driven through the medium of a friction clutch, formed by two pairs of steel discs each separated by a felt washer. The main bail cam (which provides motion for all other functions of the typing unit except selecting and spacing) is driven by a positive clutch consisting of a driving member and a driver member. The transmitting shaft driving gear, near the right end of the shaft drives the keyboard transmitting cam cylinder.

SELECTING MECHANISM

The typing unit may be equipped with either of two types of selecting mechanism: a pulling magnet selector, or a holding magnet selector.

(A) PULLING MAGNET SELECTOR (Figure 4)

The selecting mechanism translates the original line impulses into mechanical motion which causes the code bars to be positioned in accordance with the intelligence impulses received during the selecting cycle. This translation is accomplished by the selector magnet which actuates the magnet armature in conjunction with the armature spring. Each selecting cycle is preceded by a no-current or start impulse which permits the selector cam sleeve to start rotating by releasing its stop arm. The armature spring causes the head of the trip-off eccentric screw to depress the trip latch plunger, actuating the bell crank and, in turn, the trip latch which unlatches

the stop lever.

Each code bar is positioned by a selector cam through the medium of a selector lever, sword, T lever, vane and bell crank (Figures 5B and 10). To illustrate, suppose that a series of impulses corresponding to the code combination for the letter "E" is to be received. At the beginning of the start impulse the armature moves away from the magnet, releasing the stop arm, as explained in the preceding paragraph.

The selector cam sleeve starts to revolve and the No. 1 selector cam engages the No. 1 selector lever during the time that the first intelligence impulse of the signal is being received. Since the first intelligence impulse of the "E" code combination is a current impulse, the magnet armature is attracted, bringing the upper end of the armature extension into the path of the upper sword arm.

As the No. 1 cam rotates clockwise, it rotates the No. 1 selector lever counterclockwise, causing the No. 1 sword to strike the upper end of the armature extension and to pivot at point "A". This positions the No. 1 sword so that when the No. 1 cam rotates past the tip of the No. 1 selector lever, the selector lever spring will cause the sword to depress the lower end of the T lever, moving the front edge of the vane down. With the front edge of the No. 1 vane down, its associated code bar will be positioned to the left through the medium of the No. 1 bell crank.

Since the Nos. 2, 3, 4 and 5 intelligence impulses for the "E" selecting cycle are no-current impulses, the magnet armature moves to the released position with the lower end of the armature extension in the path of the lower sword arm. As the Nos. 2, 3, 4 and 5 cams operate and release their associated selector levers, the associated code bars either remain in their right-hand position or are moved there by the swords. With the No. 1 code bar to the left and the Nos. 2, 3, 4 and 5 code bars to the right, there will be a notch in each code bar opposite the "E" pull bar.

The pulling magnet armature extension is locked while the positioning of each selector sword is taking place and it is unlocked after the selector cams pass the peaks of their associated selector levers. This is accomplished by a cam-operated locking lever which engages a wedge on the armature extension (Figure 5A).

(B) HOLDING MAGNET SELECTOR (Figure 6)

The holding magnet selector is basically the same as the pulling magnet selector. The former, however, has its armature moved against the magnet by a cam, while the latter has its armature attracted to the selector magnet by magnetism.

In the holding magnet selector, the translation of signal line impulses into mechanical motion is accomplished by the selector magnet, the armature lever with armature, the selector arm, the armature lever cam, and the armature spring (Figure 7). The armature lever which rides on the armature lever cam moves the armature against the magnet when a signal line impulse is received. The armature will be held against the magnet if a current (MARKING) impulse is received, and will be released from the magnet if a no-current (SPACING) impulse is received. The selector arm is actuated by the armature

lever, since the selector arm spring makes a yield connection between these two parts. Therefore, the selector arm instead of the armature extension (which is used on the pulling magnet selector only) is used to position the swords on the holding magnet selectors.

The operation of the swords, T levers, vanes and code bars is the same as that described under "Pulling Magnet Selector."

The holding magnet selector locking mechanism (Figure 8) operates in a manner similar to the locking mechanism of the pulling magnet selector previously described. In the latter, the armature extension mounts the locking wedge, while in the former the selector arm mounts the locking wedge. Since the armature lever cam starts to move the armature toward the selector magnet before the locking lever releases the selector arm, the selector arm spring acts as a yield between the armature lever and the selector arm.

LOCKING CAM

The locking cam, part of the selector cam sleeve assembly, has five low and five high portions on its periphery (Figure 5A). When the locking lever (which is held against the cam by spring tension) is opposite a low portion of the cam, the armature will be held in position because the locking lever extension will engage the locking wedge on the armature extension. (On units furnished with holding magnet selectors, the locking wedge is on the selector arm.) (Figure 8.) When the locking lever is riding on the high portion of the locking cam, the locking lever extension will be held away from the locking wedge and the armature will be free to move in response to the next impulse (Figure 5A).

MAIN SHAFT CLUTCH THROWOUT LEVER

The main shaft clutch throwout lever (Figure 9) has two arms: the clutch throwout arm, which contacts the sixth cam, and the clutch stop arm, which rides the driven clutch member. During the positioning of the No. 5 selector sword, the sixth cam of the selector cam sleeve disengages the clutch stop arm from the driven clutch member. This allows the main shaft clutch spring to move the clutch members into engagement and causes the printing bail and function bail cams to rotate. At the end of each revolution the clutch stop arm of the clutch throwout lever engages the cam surface of the projection on the driven clutch member, camming it out of mesh with the driving clutch member. It should be noted that the selecting cycle is followed immediately by the operating cycle. While the performance of a previously selected operation is taking place, the selection of the next character may be made. This is known as "overlap" and it facilitates printer operation at high speeds.

PRINTING

The actual printing of a character is done when type bars are thrown against the platen by a force which originates in the motor and terminates just after the character has been printed and the mechanism has been cleared for the selection of another character. The path of this force may be traced from the motor through the main shaft, the printing bail cam, the printing bail operating arm, the printing bail, the plunger roller, pull bar plunger, pull bar bail and, finally, to the type bar (Figure 10).

As the printing bail cam revolves, the roller on the printing bail operating arm moves against the low portion of the cam. The printing bail, held by the tension of its spring, follows the upper end of the operating arm and moves the pull bar bail forward. The forward motion of the pull bar bail permits the pull bar springs to draw the pull bars against the code bars. The selected pull bar is drawn farther down into the path created by the alignment of notches in the code bars and is moved forward when the pull bar bail engages a hook-like projection on its lower edge.

The rack and gear connection between the pull bar and the type bar causes the type bar to rotate about its pivot and the pallet end is swung toward the platen. As the pull bar is moved forward, the sloping surface of its lower projection strikes a stripper plate which causes the pull bar to be released from the pull bar bail shortly before the type bar reaches the platen. Momentum carries the type bar the remaining distance to the platen. As the printing bail operating arm rides to the high part of its cam, the pull bars will be raised to clear the code bars and will then be free to respond to a new selection.

To insure proper spacing between characters, the type bar carriage (Figure 11) must be moved with each character printed. Traveling on two tracks (a cylindrical, slotted rod in front and a rectangular rod in the rear), it moves when the main shaft spacing gear imparts motion to it through the spacing shaft gear, the spacing shaft, and the spacing gear which meshes with the spacing rack on the type bar carriage (Figure 10). Three carriage support rollers, two riding on the front carriage track and one riding on the rear carriage track facilitate its travel. (See Figure 39.) The heads of two carriage guide screws, fastened to the type bar carriage, fit into the slot in the front track and keep the carriage in place throughout the length of its travel. Two other components of the spacing set-up are the spacing escapement ratchet (Figure 12B) and the spacing stop sleeve (Figure 12A), either of which will keep the spacing gear from rotating with the main shaft. Spacing at the end of the carriage travel is prevented by the right margin adjusting screw (Figure 12A), which moves the spacing stop lever into the path of a projection on the spacing stop sleeve.

The spacing escapement ratchet is regulated by the front and rear spacing escapement pawls which are mounted on the bail mounting shaft. When the printing bail is in its rear position, the rear spacing escapement pawl holds the spacing gear sleeve because it has engaged one of the teeth on the spacing escapement ratchet. As the printing bail moves forward, the spacing escapement pawl operating arm strikes the lower end of the rear spacing escapement pawl and disengages it from the tooth on the spacing escapement ratchet. At the same time the front spacing escapement pawl moves down against the spacing escapement ratchet into the path of another tooth. This moves the carriage one sixth of a space and the printing operation then takes place. The printing bail then returns. Near the end of its return stroke, the spacing escapement pawl operating arm disengages the front spacing escapement pawl from the ratchet as the rear spacing escapement pawl moves against the ratchet. This allows the spacing gear to revolve far enough to complete the remaining five sixths of the space, giving the rear escapement pawl time to engage a tooth on the ratchet.

MARGIN SIGNAL BELL

Before the type bar carriage reaches the end of its travel it rings the margin bell (Figure 13) as a warning to the operator that the end of the line is near. The margin bell pawl on the type bar carriage depresses the margin bell cam which rotates the cam shaft which moves the bell hammer away from the bell against the tension of its spring. When the pawl slips off the end of the cam, the bell hammer spring snaps the bell hammer against the bell.

RIBBON FEEDING

As the pull bar bail plunger travels back and forth, its notched projection engages the ribbon feed lever, a part of the ribbon feed mechanism (Figure 14). This mechanism enables the ribbon to be moved enough with each printing operation to prevent the type bar from hitting the same place on its surface twice in succession. This is done when the ribbon feed pawl, which is attached to the ribbon feed lever, advances the ribbon feed ratchet gear one tooth. The motion is transmitted to one of the ribbon spools through a train of gears and shafts, and the ribbon is wound from one spool to the other. (Figure 11.)

RIBBON REVERSE

Assuming that the ribbon is being wound on the right-hand spool and is almost unwound from the left-hand spool, an eyelet, which is fastened to the ribbon, will engage and move the left-hand ribbon reverse arm (Figure 11). This arm moves the left-hand ribbon reverse pawl into the path of the ribbon reverse bail. As the bail moves toward the rear it engages the pawl and moves the ribbon feed shaft to the left. This will disengage the right-hand ribbon feed shaft gears and engage the left-hand gears (Figure 15). The ribbon then begins to be wound on the left-hand spool. The reversing operation takes place in a similar manner on the right side of the assembly when the eyelet near the right end of the ribbon engages the right-hand ribbon reverse arm.

RIBBON OSCILLATION

When the pull bar bail plunger is in its rear position, the ribbon is held below the printing line by the ribbon carrier which is attached to the ribbon oscillator (Figure 16). The operator then can see each character which has been printed. As the pull bar bail plunger moves forward, the oscillator spiral spring moves the ribbon carrier upward until the ribbon is in the path of the type bars. The ribbon oscillator and the ribbon oscillator extension are pivoted on the ribbon shift lever.

Because the ribbon shift lever spring holds the ribbon shift lever roller against the slide bar on the platen assembly, the ribbon is moved up when the platen shifts to the FIGURES position.

RIBBON LOCKOUT

The ribbon lockout bar (Figure 11) locks the ribbon below the printing line when stencils are to be made. When this condition is desired, the ribbon lockout bar can be pushed inward manually, where it engages the ribbon oscillator, thereby holding the oscillator assembly in the low position and the

ribbon remains below the printing line.

OPERATIONS OF FUNCTION LEVERS

There are two types of operations which can be performed by the typing unit. The first embodies those mechanical actions which are directly necessary to the actual printing of a character. The second type of operation, which embodies mechanical action supplementary to the printing of a character, or which alters the position of various mechanisms, is known as a function. Ten functions which generally are found on standard models and which may be added to as desired, are: bell, blank, carriage return, figures (SHIFT), letters (UNSHIFT), line feed, locking, motor stop, space, and universal (Figure 17).

The function bail cam on the main shaft causes the function bail to travel backward and forward with the printing bail to which it is attached (Figure 18). As the printing bail moves forward, the function lever bail roller moves down off the high portions of the function lever cams. The function lever springs then pull their respective levers against the vanes. The notches in the forward arms of the function levers permit the selected lever to move farther forward than the remaining function levers.

After the function lever bail moves forward far enough to release the function levers, the function bail roller starts to ride up the high part of its cam. This moves the function bail blade to the rear. As it goes, it engages and operates any function pushbar that may have been moved into its path by a selected function lever. The function bail roller then rides down to the low portion of the function bail cam and the function bail blade returns to its forward position in readiness for the next function.

When in the selected position, the bell, carriage return, figures (SHIFT), letters (UNSHIFT), line feed and motor stop function levers will be in the path of one of the blocking extensions on the function lever bail. These extensions prevent the printing bail from moving forward far enough to allow the type bar carriage to space. The function lever bail will not be blocked, however, when the blank, locking, space or universal function levers are selected, because their operation depends upon a complete travel of the printing bail.

The sixth vane regulates the operations of the bell and motor stop functions when the platen is shifted by the letters (UNSHIFT) push bar to which the sixth vane is attached. (See Figure 17 for location of parts.) The motor stop function lever is omitted on printers not equipped with mechanical motor control. Printers which are designed to ring the bell on the blank combination do not make use of the sixth vane as the platen may be either in the figures (SHIFT) or letters (UNSHIFT) position.

LOCKING FUNCTION LEVER

The locking function lever (Figure 19) locks the vanes in their selected position when the printing bail has moved forward far enough to let the function lever spring pull the locking function lever against the rear edges of the vanes.

CARRIAGE RETURN FUNCTION

When the carriage return function is selected, the function lever bail, in moving forward, permits the carriage return function lever to engage the vanes. This forces the carriage return function lever extension (Figure 20B) to move the carriage return latch bar upward away from its latch. This releases the carriage return operating lever which, under spring tension, moves the carriage return clutch fork upward. This fork disengages the upper member of the carriage return clutch from the lower member. The spacing shaft may then turn freely in its sleeve, making possible the return of the type bar carriage. The draw-strap of the carriage return spring is fastened to a post on the type bar carriage, and it is this spring which actuates the return of the carriage.

While the carriage return operating lever is held by its spring, a series of levers moves the lock bar until its notch engages the lock bar latch (Figure 20A). This holds the carriage return clutch members disengaged and insures a complete return of the carriage. The lock bar may be operated manually.

The speed with which the carriage returns makes it imperative to provide a dashpot to cushion the shock. The left-hand margin adjusting screw on the carriage strikes the projecting front end of the dashpot lever and drives the plunger into the dashpot air chamber. (See Figure 38.) The lower end of the lock bar latch is tripped in this action by the dashpot lever and the lock bar and carriage return clutch fork are released. The clutch members then engage and the carriage is held in its extreme left position.

FIGURES SHIFT AND LETTERS SHIFT (SHIFT and UNSHIFT) FUNCTION

As the figures (SHIFT) and letters (UNSHIFT) push bars are connected to the shift link (Figure 21), the operations of these functions are of a similar nature. The figures (SHIFT) function lever, when selected, will position its push bar so that it can be moved to the rear by the function bail. This action causes the shift link to pivot, its right end moving back with the figures (SHIFT) push bar. Its left end, connected to the letters (UNSHIFT) push bar, moves forward. The shift lever, the lower end of which engages the left end of the shift link extension moves the platen up to its shifted position by means of the shift vertical link. The letters (UNSHIFT) function reverses the foregoing procedure. The shift detent holds the platen assembly in either position selected. (See note on sixth vane, page 8.)

SPACING FUNCTION

For spacing between words, or any spacing other than that which accompanies printing, the operator uses the space bar, attached to the space key lever, and the function operates in the manner described under "Printing" on page 5. However, there is no pull bar to be selected.

The space function lever may be used to shift the platen to the letters (UNSHIFT) position on both the space and letters combinations (Figure 22.) On a space combination, the space function lever extension will move upward, bringing the letters (UNSHIFT) push bar into the path of the function bail. The platen then shifts to the letters (UNSHIFT) position as was described

under "Figures Shift and Letters Shift." However, if the unshift on space feature is not required, the unshift on space cutout lever can be manually positioned to check the movement of the space function lever.

SIGNAL BELL FUNCTION

When the bell function lever is selected, its extension (Figure 23) raises the bell latch bar from its latch. This releases the bell operating lever, its spring rotates it, and it strikes the bell hammer arm extension, which throws the bell hammer against the ball. The bell reset bar and the bell latch bar, both pivoted on the bell operating lever screw, are reset by the function bail as it returns to its rear position and the blade engages the notch on the reset bar.

LINE FEED FUNCTION

When the line feed function lever (Figure 21) is selected, its extension raises the line feed push bar permitting it to be moved toward the rear by the function bail. This rotates the line feed bail which pulls the line feed vertical link and the line feed lever downward. The line feed pawl pulls down on the ratchet tooth it engages and the platen is rotated one line space. Returned to its normal position, the upper extension of the line feed function lever moves its push bar below the path of the function bail where it is held until line feed is again selected.

A detent lever on the right end of the platen holds it in position between line feed operations. (See Figure 37.) The single-double line feed lever (Figure 34) in its lower position allows the line feed pawl to skip the first and engage the second ratchet tooth, thereby rotating the platen a double line space. In its upper position it engages the first tooth and rotates the platen one space.

A paper straightener rod (Figure 10) is provided to guide the paper as it unwinds from the roll, and, used as a slack rod, to prevent it from tearing. The paper is prevented from slipping by the pressure rollers.

Platen rolls on printers designed to feed printed forms are equipped with sprockets which engage perforations in the margins of the paper.

NOTE: Blank, motor stop and universal functions are described under "Send-Receive Break Mechanism." "Automatic Carriage Return and Line Feed Function" is described on page 14.

MOTOR SPEED CONTROL

The Model 15 printer is equipped with either of two types of motor: Constant speed synchronous, (will operate only on regulated AC current) or governed speed (will operate on AC or DC current). (See Figure 41.)

The governor (Figure 27) on the governed speed motor is attached to the end of the motor shaft opposite to the end which mounts the pinion. This governor and a resistor, which the governor contact spring shunts in and out of the motor circuit, control the speed of the motor. The contact arm is held against the stationary contact by its spring until centrifugal force in the

contact arm (as the motor and governor rotate) overcomes the tension of the contact arm spring.

The speed of the motor is reduced when these contacts open and shunt the resistor into the motor circuit. When the contacts close, the resistor is shunted out of the circuit and the speed of the motor is increased. The rapid operation of these contacts tends to maintain a very nearly constant motor speed. The degree of tension in the spring determines the speed at which the motor will operate. Therefore, the speed may be regulated by turning the speed-adjusting wheel to which the spring is fastened in a direction which will increase or decrease the tension of the spring. This wheel extends through the governor cover.

A target of alternate black and white spots is painted around the outer rim of the governor and is used with a speed indicator (tuning fork) to check the motor speed visually. When viewed through the shutters of the speed indicator, the spots on the target should appear stationary, provided the spring tension has been adjusted properly.

SYNCHRONISM (See Figure 3)

Because the signals sent out by the transmitter must be interpreted correctly by the receiving units, both transmitting and receiving units must be synchronized. Two factors make this synchronism possible: first, the receiving cam sleeves are designed to rotate faster than the rotation of the transmitting cam cylinder, and, second, the start and stop impulses are employed to create pauses in the rotation of the receiving cam sleeves of sufficient duration to control this additional speed.

The reception of the start impulse starts the receiving selector cam sleeves revolving. At that instant these sleeves are in unison with the transmitting cam cylinder. However, for a certain travel of the transmitting cam cylinder, the corresponding travel of the selector cam sleeve is greater but, as the selector cam sleeve travels faster, it reaches its second position at the same time the transmitting cam cylinder reaches its second position.

As the selector cam sleeve completes its revolution before the transmitting cam cylinder, this cylinder sends out the stop impulse which stops the selector cam sleeve until the start impulse is again transmitted. Usually the selector cam sleeve is one-seventh faster than the transmitting cam cylinder and remains at rest one-seventh of the transmission time. When the speed of the selector cam sleeve is faster or slower than the proper speed, the cam remains at rest more or less, as the case may be. A slight error in the relative position of the selector cam sleeve in the various positions is possible, but the mechanism is constructed to compensate for this, and so, because the selector cam sleeve starts its revolution in unison with the transmitting cylinder, this error does not become any greater.

ORIENTATION

Orientation is a term applied to the operation of the range-finder mechanism (Figure 40) which places the starting point of the selector cam sleeve in the most favorable position to utilize the receiving margin of the selector mechanism.

The movements of the stop lever and trip latch (Figures 4 and 6), which are mounted on the stop lever plate, vary the degree of relationship between the start of the selector cam sleeve and the time the selector cams operate the selector levers. The setting of this stop mechanism is indicated on a graduated scale by an index arm held, when set, by a thumb screw.

The range is determined (while receiving RY on the receiving unit) by moving the range finder index arm in one direction until errors appear and then moving it back slowly until the errors disappear, noting the position on the scale. In a similar manner, the opposite limit of the range is located by moving the index arm toward the opposite end of the scale. The proper setting is midway between these two limits; or if a distortion test set is available, the setting is made at the optimum point for the reception of biased signals.

OPTIONAL FEATURES

SEND-RECEIVE-BREAK MECHANISM

By depressing the blank key twice in succession, or by breaking the line for a time interval equivalent to at least two printer operations, all keyboards in the circuit can automatically be locked out. The line may be opened by depressing the break lever until the break contacts open. The keyboard short-circuiting contacts will then close and move the send-receive lever to its low position. All keyboards will remain locked out until the send-receive lever is restored to its up position. (See Figure 24 for location of parts.)

The send-receive break mechanism can only be used manually on printers arranged to operate the bell on the blank signal combination.

Every operation of the printer moves the universal function lever, and its extension moves the right arm of the T lever down (Figure 25). This causes the top of the T lever, the pivot of the intermediate lever, and the reset lever to be moved to the right. The lower end of the intermediate lever is thus kept out of the path of the blank function lever extension.

When the blank function lever is selected by setting up an all spacing or no current combination, its extension moves downward at about the same time as the universal function lever (Figure 25). However, because the spring on the blank function lever is considerably stronger than the spring on the universal function lever, the left arm of the T lever will be moved down. The upper part of the T lever, the intermediate lever pivot, and the reset lever all move to the left. The lower end of the intermediate lever then moves against the side of the blank function lever extension when this lever is in its low position. At the end of the operating cycle, when the blank function lever extension moves upward, it permits the lower end of the intermediate lever to swing beneath it. If another blank selection is now made, the intermediate lever is pulled downward, the reset lever is moved against the upper contact lever which releases the upper contact lever. The spring on the upper contact lever then moves its extension against the contact springs which close the keyboard short-circuiting contacts, thereby moving the send-receive lever to its low position (Figure 24).

If only one blank signal is received and is followed by a space or a character, the keyboard will not be locked out.

The upper contact lever, in closing the keyboard short-circuiting contacts, is also opening a second pair of contacts which are used when it is desired to control a tape-transmitting distributor.

MOTOR STOP FUNCTION

This description applies only to machines equipped with mechanical motor control.

The motor stop function lever (Figure 26) is selected when, with the platen in the figures (SHIFT) position, the H key lever is depressed. This not only stops the motor of the sending machine but the motors of all machines connected in the circuit will also be automatically stopped.

When the motor stop function lever is moved forward into its selected position in the vanes, its lower rear extension raises the motor stop lever. This latches the inner motor stop pawl onto the thick part of its latch on the armature extension. Simultaneously, the front extension of the motor stop function lever closes the left-hand motor contacts, and, as the rear extension of the motor stop contact lever moves up, the front extension moves down against the tension of its spring. This opens the right-hand motor stop contacts. As both pairs of contacts are wired in multiple, the motor will not stop until the motor stop function lever is restored to its normal position and the left-hand contacts open. These contacts hold the motor circuit closed until the receiving cam sleeve comes to rest, which insures the disengagement of the main shaft clutch before the motor stops.

In order to start the motors again, the line must be opened for a short interval by depressing the break lever (Figure 24). This moves the upper contact lever extension against the line contact insulator. The line is opened, the selector armature extension is moved downward by the armature spring, and the upper end of the motor stop lever, having moved forward a slight distance, is again stopped when its outer pawl catches the cut-away portion of the motor stop pawl latch.

When the line is closed again, the armature moves to its operated position, the outer motor stop pawl unlatches the armature extension, and the motor stop function lever returns to its normal position. The extension on the lower portion of the motor stop function lever, which has been holding the motor stop contact lever away from the right-hand motor stop contacts, will now permit the spring to move the front extension of the motor stop lever upwards, closing the motor stop contacts.

It should be noted that when the motor stop function is operated, the keyboard short-circuiting contacts are closed and the keyboard transmission is locked out. To do this, the forward end of the motor stop function lever moves downward against the lower screw on the reset lever (Figure 25). This lever, in turn, moves the contact operating lever as described under "Send-Receive Break Mechanism."

Immediately after the motor stop function has been set up and before

the motor has stopped, should the line be accidentally opened, it would be impossible to operate the mechanical motor control. The magnet armature would be released, the selector cam cylinder would revolve beyond its stopping point, the armature locking lever might come to rest in an indent in its cam, and the armature extension could not respond to the next open line interval.

The motor stop release lever is provided to prevent such a condition by making it impossible for the motor stop pawl latch to be engaged by the pawl. When the locking lever falls into an indent in its cam, its spring brings its lower extension against the stud on the release lever. This shifts the upper end of the motor stop release lever and holds its eccentric against the lower part of the outer motor stop pawl, preventing it from latching under the motor stop pawl latch. Thus the motor stop will not be permitted to function and the motor will continue to rotate.

AUTOMATIC CARRIAGE RETURN AND LINE FEED

Automatic carriage return and line feed is accomplished by a bail assembly, a trigger assembly, and a bell crank retainer assembly (Figures 28 and 29). When the type bar carriage reaches the end of a line, a yield lever on the lower end of the bell crank retainer (Figure 28) engages a screw on the trigger of the trigger assembly, thereby moving the trigger (with its extension) to the right. When this occurs, the automatic carriage return and line feed function lever (Figure 28) of the bail assembly, normally blocked by the trigger extension, is unblocked. This function lever then moves forward and operates a bail, whose rearward extensions (Figure 29) move the carriage return latch bar and the line feed push bar into their selected positions. Combined carriage return and line feed, upon reception of the carriage return selection, is accomplished by operating the specially designed carriage return function lever which, in turn, operates the same bail mentioned in the foregoing paragraph. Thus the bail may be operated by the automatic carriage return and line feed function lever and/or the specially designed carriage return function lever.

TABULATOR MECHANISM

This mechanism is used to facilitate the tabulation of printed matter and responds to the selection of upper case G or upper case Z, depending upon the set of parts installed. Tabulator stops are positioned to conform to column spacing.

When the tabulator selection (upper case G or Z) is set up on the vanes, a tabulator function lever will be selected. As the tabulator function lever moves into the path set up for it in the vanes, its rear arm operates a centrally pivoted latch bar (Figure 30), causing the rear end of the latch bar to rise and the front end to drop. As the rear end of the latch bar rises, it carries upward a spacing pawl link which, in turn, lifts the rear spacing escapement pawl out of engagement with the spacing escapement ratchet. The front end of the latch bar engages the shoulder of a tabulator latch which holds the latch bar operated and thus permits the spacing mechanism to rotate with the main shaft and impart motion to the carriage. The carriage will advance along the line until a pawl mounted on the front of the carriage strikes a tabulator stop located on a tabulator bar extending across the front of the typing unit. This tabulator bar is pivoted at each end; extending downward from it is the tabulator latch. As the carriage pawl passes a tabulator stop it

imparts a rocking motion to the tabulator bar and latch, thus releasing the latch bar from the latching shoulder of its latch. At each station tabulator stops must be positioned at intervals on the tabulator bar to conform to column spacing.

LINE AND SELECTOR CIRCUIT-CLOSING JACKS

On bases equipped with line relays, the relay mounting plate is sometimes provided with a jack which automatically shunts the line and selector magnet slip connection terminals when the relay is removed from its mounting. The purpose of this jack is to permit removal of the relay for examination or replacement without opening the signal line or selector circuit. The jack is mounted on the line relay mounting plate and its contacts are held open by a plunger which the relay base depresses when the relay is in place. (See Figure 31.)

RADIO FREQUENCY INDUCTION SUPPRESSORS

Radio frequency induction suppressors may be connected across various operating contacts to suppress radio frequency induction, permitting radio receiving sets to be used in close proximity to the printer set.

REPERFORATOR MOTOR CONTROL CONTACT

The reperforator motor control mechanism (Figure 32) can be installed on a Model 15 printer and is used when certain messages, received on a Model 15 printer and a Model 14 reperforator in series, are to be relayed by means of the tape from the reperforator. This mechanism provides means whereby only those messages to be relayed will be punched out on the reperforator, yet all messages will be received on the printer.

The mechanism consists of a send-receive plate which mounts a reperforator control contact assembly, a contact pawl, pawl latch, and two function levers.

Used for cutting the reperforator in and out, the reperforator motor control contact opens when upper case H is received*, and remains latched open until upper case S is received*. A few false characters will be printed directly after the reception of these combinations before synchronism can be established, because of the time required for the reperforator motor to slow down or speed up to get in step with the transmitting motor.

If the printer is equipped with a tabulator and/or a motor stop mechanism, these must be removed before the reperforator motor control mechanism can be installed.

* (If desired, this mechanism may be installed to be operated by any two of a variety of figures combinations.)

REMOTE SIGNAL BELL MECHANISM

A bell, chime, howler, or any signaling device can be operated at a distance from the Model 15 printer through the installation of the set of parts which makes up the remote signal bell mechanism (Figure 33). This mechanism,

when installed, is actuated by the bell pull bar when the bell combination is selected.

REVERSE CURRENT MOTOR CONTROL RELAY

The motor on a Model 15 printer can be controlled electrically on the signaling wire when a reverse current motor control relay is installed. Actuated from a manually operated switch, which reverses the signal line battery, this relay controls the operation of a control relay which, in turn, starts and stops the motor. In the normal operating condition, the line signals do not operate the reverse current control relay because a spring provides a bias in the direction of the marking signal. However, when the line current is reversed, the reverse current control relay tongue is moved in a direction against its spring to turn the motor off.

LINE RELAY

A line relay base is provided on the Model 15 printer (mounted on a bracket located to the rear of the typing unit) so that a line relay may be used.

The wiring is arranged so that either the line relay or the selector magnets may be connected in the line circuit. In the former case, the contacts of the line relay repeat the signals to the selector magnets, whereas, in the latter, the selector magnets are connected directly to the line.

LINE-TEST OR POLAR-NEUTRAL KEY

Keyboards equipped with a key which is mounted on top of the keyboard base to the left of the transmitting contact assembly may be wired as follows:

(A) LINE-TEST

The key is in the LINE position when the knob is in, and the selector magnets and keyboard contacts are connected to the line. The key is in the TEST position when the knob is out and the selector magnets and keyboard contacts are disconnected from the line and a local circuit is established.

(B) POLAR-NEUTRAL

For polar operation a line relay must be used. The key is in the POLAR position when the knob is in and the bias winding of the line relay and keyboard is disconnected, permitting the receiving of polar signals. The key is in the NEUTRAL position when the knob is out and the keyboard contacts and relay are connected to the line.

WIRING DIAGRAM

The wiring diagram on the last page shows the theoretical wiring of a typical Model 15 printer. The motor circuit shown is for use with 110 volt direct current motors. Refer to actual wiring diagram for circuits used with other types of motors.

The top figure on the wiring diagram shows the motor and the motor control circuits. When mechanical motor control is used, loops A'B' and G'H' are open, and A' is connected to A, B' to B, G' to G, and H' to H. When