

BASIC TELETYPEWRITER READING COURSE

SECTION A

GENERAL

LESSON NOTES

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LESSON NO. 11. GENERAL

1.01 Theory

The theory of teletypewriters is covered in Bell System Practices AB95.100 series of lectures. Lectures 2 and 3 cover the operation of the teletypewriter set. The other lectures require some electrical background to understand them fully. The study of lectures 2 and 3 will give the fundamentals for understanding the operation of teletypewriters.

The comparison of teletypewriter operation to that of a manual telegraph is a good analogy. Each letter or figure sent out on a manual telegraph system is a combination of dots and dashes. From the combination that is heard at the receiving end, the message is translated. Each letter or figure sent out from a teletypewriter is a combination of open and closed pulses. From the combination of pulses that is received by the teletypewriter, the message is translated by mechanical means into typed copy. When a letter or figure is sent out on a manual telegraph system, the operator on the receiving end must be listening for the combination of dots and dashes while it is being sent. The operator might be said to synchronize himself with the incoming message. When a letter or figure is sent out from a teletypewriter, the receiving teletypewriter must be in synchronism with the sending teletypewriter in order to translate the message by mechanical means.

1.02 Synchronization

In order to synchronize the teletypewriter, it is evident that the motors driving the mechanical apparatus of different machines worked together must produce the same speeds for the shafts. If one is faster or slower than the other, it would get ahead or behind the other machine and cause errors in the copy. Two methods are employed to keep the motors at a constant speed. If the frequency of the alternating current supply is closely regulated, synchronous motors may be used. A synchronous motor keeps in step with the frequency of supply giving a constant speed. If the current supply is direct current or alternating current unsuitable for a synchronous motor, governed motors may be used. The speed of a governed motor is regulated by a centrifugal governor that opens and closes the circuit to the motor armature. The motor drives the sending and receiving shafts through gears. The speed of a governed motor is different from that of a synchronous motor. This difference is remedied by using gears of different ratios that will make the shaft turn at the same speed. The speed of operation of a teletypewriter may be quoted in operations per minute or words per minute. A 60 word per minute machine is the 368 operations per minute machine. The present standard speeds are 60, 75, and 100 words per minute. All TWX and TLX machines are 60 speed machines. Private wire operation may use any of the three speeds; however, all machines that are to work together must use the same speed rating. The speed of the shafts can be changed by the use of different gear ratios. In order to keep the transmitting mechanism and receiving units in unison, the start-stop system is used. The start-stop system means that a start pulse is sent out before each combination to start the receiving mechanism and at the end of each combination a stop pulse is sent out to stop the receiving mechanism. In this way any difference in speed of machines is corrected at the beginning of each combination of pulses. This prevents a cumulative difference of synchronism. The receiving selector cam revolves about 14 per cent faster than the sending selector cam

through different gear ratios. The indents on the sending selector cam are 48.5° apart around the circumference of the cam drum while those on the receiving selector cam are 55.43° . Since the receiving cam is faster than the sending cam it can be stopped and started for each combination of pulses even though the sending cam does not come to a stop.

1.03 Governed Motors

The governed motor method to maintain constant speed utilizes a tuning fork in conjunction with a metal band, painted with alternate black and white spots, (hereinafter referred to as a target) which is attached to the motor unit governor. When the motor is rotating, this target is viewed through slits in a shutter attached to the vibrating prongs of the tuning fork. The shutter opens and closes twice at equally spaced intervals during one cycle of the tuning fork. If the time interval between two successive open periods of the shutter (the fork interval) is equal to the time taken by one of the spots to move a distance equal to (or a multiple of) the length of two spots (the target interval), the spots on the target will appear to be stationary.

If the difference between the fork and target intervals is small, the spots will appear to rotate. If an actual clockwise rotation of the target is assumed, the spots will appear to rotate in a clockwise or a counter-clockwise direction if the target interval is greater or less respectively than the fork interval.

The actual target speed is proportional to the target interval when the target as viewed through the tuning fork shutter appears to be stationary. It is apparent, therefore, that several speeds may be checked by means of one target since the target interval is some multiple of the time required for a spot on the surface of the target to move into the same position occupied by a spot at the time the shutter was open. It can be seen that to obtain the correct speed of a governed motor, the speed must be close to the desired speed before using the target for a final adjustment or some multiple of the time interval may be obtained.

1.04 Orientation

In order to allow for slight differences in speed of teletypewriters, difference in time of transmission and distortion of signals during transmission, an orientation range is used. The receiving mechanism utilizes only about 20 per cent of the duration of a perfect signal element. If the starting point of the receiving mechanism is set so that the selection is made at the middle of the signal element, there will be considerable margin on either side of the selection point which will allow some distortion or shift in the signal element. The method of adjusting the starting point of the receiving mechanism with respect to the received start pulse is called "orientation." The methods of making an orientation setting are covered in Bell System Practices P30.002 or P30.003.

1.05 Reference for Particular Types

The general theory of teletypewriter operation is covered in lectures 2 and 3 (AB95.102 and AB95.103) and the preceding paragraphs. The detailed operation of any particular teletypewriter is covered in the description for that type teletypewriter and should be used with the adjustment specifications and a machine of that type.

For 15 type teletypewriter, use GPP 43.671, Section B, and AB84.139.

For 26 type teletypewriter, use GPP 43.671, Section C, and AB84.141.

For 19 type teletypewriter, use GPP 43.671, Section D, AB84.140, and AB84.138, for perforator transmitter and transmitter distributor. Use Sections on 15 type for other operations.

Bell System Practices including the AB series should be ordered on requisition according to standard practice.

BASIC TELETYPEWRITER READING COURSE
15 TYPE TELETYPEWRITERS

SECTION B

LESSON NOTES

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Note: Use this practice with AB84.139.

LESSON NO. 1TRANSMITTING THE SELECTION

(See Illustration 3 and Figures 2 and 3, B.S.P. Section AB84.139)

When a key lever is depressed, it will position the five selector bars located underneath the base of the keyboard to either the right or left. Those positioned to the right will position the corresponding locking levers to the left interlocking with the corresponding contact levers, preventing them from rising into the indents of the cams, and no impulse will be sent to the receiving set. The selector bars positioned to the left will position the corresponding locking levers to the right, releasing the corresponding contact levers so that they will rise into the indents of the cams, and will transmit a closed pulse to the receiving set.

Let us take, for example, the letter "E," depressing the "E" key lever positions No. 1 selector bar to the left and Nos. 2, 3, 4, and 5 selector bars to the right. As the locking levers rest in notches in the selector bars, the upper end of No. 1 locking lever will be positioned to the right and the other four will be positioned to the left.

The key lever also engages a universal bar located just in front of the selector bars, which in turn operates a trip off pawl. The trip off pawl operates the intermediate pawl, which raises the clutch throwout lever from the throwout cam on the driven clutch member, allowing the driven clutch spring to force the driven clutch member into mesh with the driving clutch member that is constantly rotating through the medium of gears and an electric motor.

When the sending cam sleeve assembly starts to rotate, the high part of the lock loop cam moves away from the extension on the lock loop and allows the lock loop spring to pull the lock loop down on the locking levers, preventing them from being changed during the transmitting of the selection.

The start contact lever (the one farthest to the rear) will then ride on the high part of its cam, opening the start contact and sending an open pulse on the line.

No. 1 contact lever will rise into the indent in its cam, due to the tension of the back contact spring, and will allow No. 1 contact to close, sending a current impulse on the line. No. 1 contact lever will then ride on the high part of its cam and will open No. 1 contact. As Nos. 2, 3, 4, and 5 contact levers will not rise into the indents of their respective cams, due to the action of the locking levers, the line will remain open until the completion of the selection. Then, the start contact lever will rise into the indent to its cam, due to the tension of the back contact spring, the start contact will remain closed and current will again be restored on the line until the next selection is made. The extension on the lock loop rides up on the high part of its cam, raising the lock loop from the locking levers, and the clutch throwout lever riding on the sleeve of the driven clutch, engages the throwout cam and forces the driven clutch member from the driving clutch member against the tension of its spring, and the sending cam sleeve assembly is again at rest.

REPEAT SPACING (See Figure 3, B.S.P. Section AB84.139)

Normally, the trip off mechanism is adjusted for non-repeating operation, except in the case of spacing. When the space key lever is depressed, it operates the repeat space rod, which engages the intermediate pawl, which holds the clutch throwout lever out of engagement with the driven member of the clutch, permitting the space combination to be sent as long as the space key lever is depressed.

LESSON NO. 2(A) RECEIVING THE SELECTION ON PULLING MAGNET TYPE

(See Illustrations 4 and 5 and Figures 4, 5, 6, and 9, AB84.139)

When the open pulse was transmitted on the line, the operating winding of the line relay was opened and the bias winding operated the relay armature away from its marking contact, thereby opening the circuit to the selector magnet, allowing the armature spring to pull the magnet armature to its unoperated position. This causes the trip off eccentric screw to operate the trip latch plunger, which operates the bell crank, which disengages the trip latch from the stop lever. The stop lever rotates on its pivot and allows the stop arm to rotate with the selector cam sleeve through the action of a friction clutch.

As the first impulse transmitted was a closed one for the letter "E," the line relay armature is pulled up to its marking contact, closing the circuit to the selector magnet, pulling its armature to its operated position. The locking lever spring pulls the locking lever into the notch in the locking cam and engages the extension of the locking lever with the locking wedge on the armature extension, holding the armature in its operated position.

No. 1 selector lever rides on the high part of No. 1 selector cam pulling back the sword and engaging the upper extension of the sword arm with the upper armature extension, forcing the tip of the sword downward. When the selector lever rides off the high part of its cam, the selector lever spring forces the sword forward, engaging the lower part of the "T" lever, which operates the rear of the vane upward and the front of the vane downward, operating the bell crank which positioned No. 1 code bar to the left. As the locking lever rides up on the high part of its cam, the extension disengages from the locking wedge and as the next pulse is an open one the armature spring will pull the armature to its unoperated position. The armature will again be locked the same way as it was before and No. 2 selector lever riding on the high part of its cam will pull No. 2 sword back, engaging its lower extension with the lower armature extension, pointing the tip of the sword upward. As the selector lever rides off the high part of its cam, the selector lever spring will force the sword forward and engage the upper end of the "T" lever positioning the rear of the vane downward, the front upward, operating the bell crank, positioning No. 2 code bar to the right.

As Nos. 2, 3, 4, and 5 impulses are open ones, Nos. 3, 4, and 5 code bars will be positioned to the right the same way as the second.

After the fifth impulse, the stop pulse will be received on the line, operating the line relay to the marking side, energizing the selector magnet. The selector magnet, being energized, will allow the stop lever to be latched. The stop arm will engage the stop lever and stop the selector cam sleeve.

LESSON NO. 2(B) RECEIVING THE SELECTION ON HOLDING MAGNET TYPE

(See Illustration 4 and Figure 7, B.S.P. Section AB84.139; and Figures 6, 8, and part of 7, AB84.141)

Upon the receipt of an open pulse from the start contact of the transmitting mechanism, it causes the selector magnet in the receiving teletypewriter to be de-energized and the armature lever to be pulled to its unoperated position by the armature lever spring; causing the trip-off screw to operate the trip latch plunger, which operates the bell crank, and disengages the trip latch from engagement with the stop lever. The stop lever rotates slightly on its pivot and allows the stop arm and selector cam sleeve to rotate in a clockwise direction through the action of a friction clutch on the main shaft.

As the character to be received is the letter "E," and the code is impulse No. 1 Closed, 2-3-4-5 Open.

Slightly in advance of the closed pulse, the number one cam on the armature lever cam will engage the armature lever which is connected so that the armature is pushed up to the magnet against the tension of the armature lever spring. This operation places the armature in the marking position and the selector arm is pulled to the marking or upward position by the selector arm spring which is connected to the armature lever extension.

Immediately after the closed pulse, which will hold the armature lever in the marking position, the locking lever will ride off the high side of the locking lever cam. The locking lever spring will pull the locking lever into the first notch in the locking cam, and interlock the extension of the locking lever with the locking wedge on the selector arm, locking the selector arm in the marking position.

As the selector cam sleeve continues to rotate, the number one selector lever will ride on the high part of the number one selector cam against the tension of the selector lever spring; and due to the pivot point of the selector lever, the action is imparted to the number one sword through a socket joint connection, causing the number one sword to be pulled backward. The marking sword arm will engage the marking selector arm extension, forcing the tip of the sword to the marking or downward position. When the selector lever rides off of the peak of its cam, the selector lever spring forces the tip of the sword forward, engaging the lower part of the "T" lever which operates the rear of the vane upward and the front of the vane downward, operating the Bell crank which Positioned No. 1 Code Bar to the Left.

During this time, the number two cam on the armature lever cam will engage the armature lever and push the armature up to the operated position against tension of its spring.

After the sword has been positioned, the locking lever will ride on a high part of the locking cam against the tension of its spring. The locking lever extension is disengaged from the locking wedge on the selector arm. This will permit the selector arm to be free for the next selection.

As the number two pulse is an open pulse, the armature lever spring will pull the armature lever to the unoperated position. This operates the selector arm to the spacing or downward position through the medium of the selector arm operating screw connected to the armature lever.

The armature lever will again be locked in the same way as explained above except the selector arm is now in its spacing position and the locking lever is in the second notch in the locking cam.

At this time, the number two selector lever will ride on the high part of the number two selector cam against the tension of the selector lever spring; and due to the pivot point of the selector lever, the action is imparted to the number two sword through a socket joint connection, causing the number two sword to be pulled backward. This causes the spacing sword arm to engage the bottom or spacing selector arm extension, forcing the tip of the sword to the spacing or upward position.

When the number two selector lever rides off the high side of the number two selector cam, the selector lever spring will force the tip of the sword forward, engaging the upper part of the "T" lever which operates the rear of the vane downward and the front of the vane upward, operating the bell crank which positions the No. 2 Code Bar to the right.

After the sword has been positioned, the locking lever will ride on a high part of the locking cam against the tension of its spring. The locking lever extension is disengaged from the locking wedge on the selector arm. This will permit the selector arm to be free for the next selection.

The detent arrangement on the selector arm is provided to prevent a bounce of the selector arm when operating from the marking to the spacing position or vice versa.

As the numbers three, four, and five pulses are open, they will position the receiving mechanism in the same manner as explained on the number two pulse operation. When the selector cam sleeve has completed its revolution, the locking lever will be on the high side of the locking lever cam and the locking lever extension will be disengaged from engagement with the locking wedge on the selector arm.

After the fifth impulse, the stop pulse will be received on the line. The energizing of the selector magnet will allow the stop lever to be latched. The stop arm will engage the stop lever and stop the selector cam sleeve.

LESSON NO. 3PRINTING THE CHARACTER

(See Illustrations 2, 4, 6, 7, & 9, and Figs. 7, 8, & 9, AB84.139)

Right after the fifth cam has operated the fifth selector lever, the sixth cam operates the clutch throwout lever, disengaging it from the throwout cam on the driven member, allowing the driven member spring to engage the driven member with the driving member, causing the printing and function bail cam to rotate.

The printing bail operating arm roller rides off the high part of the printing bail cam and allows the printing bail to move forward through the action of its spring. This also operates the function lever bail, and the downward action of the function lever bail roller allows the locking function lever to be pulled into the vanes by the action of its spring, locking the vanes in their selected position. The pull bar bail is also moved toward the front of the printer, due to its roller resting between the blades of the printing bail, and the pull bar bail rides off the high parts of the pull bars, allowing them to fall down under the tension of their springs on the code bars. The "E" pull bar, under tension of its spring, falls into the indents in the code bars, permitting the projection on its pull bar to engage with the pull bar bail. Further movement of the pull bar bail, pulls the pull bar forward, which action is imparted to the type bar through a gear arrangement. When the type bar is pulled to within approximately an inch of the platen roller, the stripper plate disengages the pull bar from the pull bar bail and momentum prints the selection. The pull bar spring restores the pull bar to normal which in turn restores the type bar.

When the printing bail operating arm roller rides up on the high part of the printing bail cam, the operating arm moves the printing bail backward, which pulls the pull bar bail back on the high parts of the pull bars, pulling them away from the code bars so that the next selection can be made. The function lever bail roller restores the locking function lever.

The clutch throwout lever riding on the sleeve of the driven clutch member engages the throwout cam on the sleeve of the driven clutch member and forces the driven clutch member from the driving clutch member against the tension of its spring, causing the printing and function bail cam to come to rest.

LESSON NO. 4LINE FEED MECHANISM

(See Illustrations 8 and 9 and Figures 9, 15 and 17, AB84.139)

When the function bail roller rides from the high part of its cam, the function bail is moved forward, under tension of its spring, allowing the push bars to rise into the path of the function bail blade. When the function lever bail moves downward, the function lever bail roller allows the line feed function lever to be pulled into vanes, through the action of its spring, raising the push bar into engagement with the function bail blade. Then as the function bail cam rotates, the function bail roller rides onto high side of cam and forces the bail to rear of printer, pushing the push bar which operates line feed bell crank, vertical link, lever and pawl, which engages a tooth on the line feed ratchet, which pulls the platen one or two spaces, depending upon the position of a single double line feed lever located just in front of this pawl. On the right hand end of the platen is an additional ratchet associated with a line feed checkpost and a line feed detent lever. The backward action of the line feed pawl engages the line feed check lever, which pulls the line feed check post into tooth of detent ratchet to prevent overthrowing. The line feed detent lever positions the platen for correct spacing. At the left end of the platen shaft is a platen friction assembly, which applies a drag on the roller while line feeding and aids in preventing overthrow.

Pressure rolls located beneath the platen hold the paper against the platen and feeding is accomplished by the friction of the paper against the platen, caused by these rollers. The paper straightener rod provides slack in paper and also helps to keep the paper straight.

The function lever bail restores the line feed function lever to its normal position. The upper function lever extension moves the line feed push bar down below the path of the function bail blade and the line feed push bar spring holds it there until a line feed combination is again selected.

LESSON NO. 5SHIFTING AND UNSHIFTING (See Illustrations 8 and 9 and Figures 15 and 17, AB84.139)

The selection of the figure shift function lever permits the engagement of the figure shift push bar with the function bail blade, permitting the function bail blade to move the push bar back, which is connected through shift link, shift lever, and vertical link to the platen assembly, moving the platen assembly over a strong detent to shifted position. The detent holds the platen assembly in this position.

The selection of the unshift letters function lever moves the platen assembly to unshift position in much the same manner as before and the detent holds it in position as before.

OPERATING FEATURES (See Figure 18, B.S.P. Section AB84.139)

Located underneath the printer is the unshift on space cutout lever which may be engaged with the space function lever to prevent it from engaging the "letters" push bar when it is not desired to unshift the platen on space operation. This feature is used only on private wire service. The space function lever does not cause spacing. It only causes the machine to unshift on a space selection.

MARGIN SIGNAL BELL (See Figure 11, B.S.P. Section AB84.139)

When the carriage is nearing its extreme right hand position, a margin bell pawl engages a margin bell cam pushing it downward, which imparts its action through the margin bell cam shaft and raises the bell hammer away from the gong. As the carriage spaces farther, the margin bell cam is released and permits the margin bell hammer spring to operate the bell hammer against the margin bell.

LESSON NO. 6SPACING MECHANISM AND SPACE CUTOUT (See Illustrations 6, 7, 8, & 9; and Figs. 9, 10, & 15, AB84.139)

As the printing bail moves forward, the rear spacing escapement pawl is disengaged from the spacing escapement ratchet through the action of the spacing escapement pawl operating arm; and the front spacing escapement pawl is positioned a little in front of the next tooth on the spacing escapement ratchet; and the friction clutch moves the spacing ratchet through about one-sixth of its operation. As the printing bail moves backward, the front spacing escapement pawl is disengaged and the rear spacing escapement pawl is positioned in front of the second tooth on the spacing escapement ratchet, allowing the friction clutch to rotate the spiral gear, which is in mesh with the spacing shaft gear on the spacing shaft. The spacing gear on the other end of the spacing shaft operates the spacing rack on the carriage when the teeth of jaw clutch are in mesh.

On a function that does not require spacing, the function levers move forward into the path of function lever bail, preventing the printing bail from moving forward and disengaging the front and rear spacing escapement pawls, preventing spacing of carriage.

SPACING SAFETY MECHANISM (See Figure 10, B.S.P. Section AB84.139)

In order to prevent the spacing mechanism from operating, when the type basket is in its extreme right hand position, the right margin adjusting screw engages the spacing stop lever, which in turn blocks the spacing stop sleeve and prevents the friction clutch from driving the spacing mechanism on the main shaft.

LESSON NO. 7CARRIAGE RETURN MECHANISM

(See Illustration 2, and Figure 16, B.S.P. Section AB84.139)

The selection of the carriage return function lever causes it to unlatch the carriage return latch bar from the carriage return latch bar latch, permitting the carriage return operating lever, through the pressure of its spring, to operate the carriage return clutch fork, disengaging the clutch on the vertical spacing shaft, allowing the carriage return drum spring to return the carriage to its extreme left hand position. The reset bar spring pulls the latch bar against its latch bar latch and the reset bar against the function bail blade. The reset bar is then in the path of the function bail blade, which returns the carriage return latch bar to engage the carriage return latch bar latch, restoring the carriage return operating lever to its normal position.

When the carriage return clutch fork is operated, it pulls the lock bar through the series of links to the right, engaging it with the lock bar latch, keeping the clutch teeth out of mesh. As the carriage returns, the lock bar latch is operated by the dash pot lever. The lock bar returns to normal and allows the teeth to mesh on the spacing shaft. The dash pot lever operates the dash pot plunger which acts as a cushion to stop the carriage.

LESSON NO. 8SIGNAL BELL MECHANISM

(See Illustration 8 and Figures 19 and 22, B.S.P. Section AB84.139)

The sixth vane is positioned by a flat spring part connected to the letters push bar and is held in position by a detent. When the platen is in upper case position and the other five selecting vanes are positioned for the letter "S" combination, the bell function lever will move forward by the action of its spring and unlatch the bell latch bar, permitting the bell operating lever spring to operate the bell operating lever against the bell hammer arm extension, causing the bell hammer to strike the signal bell once for each bell signal received. Operation of the function bail blade on the bell reset bar restores the bell latch bar to its normal position in readiness for the next operation.

When the platen is in letter position and the "S" combination is received, the bell function lever is prevented from entering the vanes by the action of the sixth vane and the bell does not ring when letter "S" is printed. When the platen is in figures position and the bell function lever enters the vanes, it blocks the function lever bail which prevents the printing bail from operating; and letter "S" is not printed when the bell is rung.

LESSON NO. 9RIBBON FEED AND REVERSE MECHANISM

(See Illustrations 6 and 7 and Figures 12 and 13, AB84.139)

On the forward motion of the pull bar bail, the ribbon feed lever operates the ribbon feed pawl and engages a ratchet wheel which is moved ahead one tooth on the backward motion of the pull bar bail. This action is imparted through feed ratchet shaft and gear to driving gear on ribbon feed shaft. On each end of this shaft are gears, either of which may be in mesh with a small gear on one of the vertical ribbon feed shafts, and are held in position by a detent roller. On the other end of the vertical ribbon feed shaft, a spur gear engages with the spur gear on the ribbon spool shaft which turns the ribbon spool. The ratchet wheel is prevented from turning backward by the action of a check spring.

As the ribbon becomes nearly exhausted from the spool being unwound, a small rivet in the ribbon engages a ribbon reverse arm, which action is imparted through the ribbon reverse shaft, to the ribbon reverse shaft link, to the ribbon reverse pawl link, moving the projection on the ribbon reverse pawl into the path of the ribbon reverse bail. On the backward motion of the ribbon reverse bail, the ribbon reverse pawl operates the ribbon reverse lever, which engages the ribbon feed shaft at the rear of the gear wheel, moving the ribbon feed shaft over the detent roller, disengaging the gear at one end of the feed shaft and engaging the gear on the opposite end.

Should any part of the ribbon reverse mechanism become jammed, the ribbon reverse bail springs would allow the ribbon reverse bail to give and prevent breakage of parts.

See Pages 13 and 14 of AB84.139 for ribbon oscillation and lockout.

LESSON NO. 10KEYBOARD LOCKING MECHANISM

See page 19 of AB84.139 for keyboard locking mechanism.

LESSON NO. 11THEORY OF OPERATION OF 15-TYPE MOTOR STOP MECHANISM

(See Illustration 2 and Figures 22 and 23, AB84.139)

When all selector vanes are unoperated and with the platen in the letters position, the motor stop function lever is blocked by vanes Nos. 3, 5, and 6. By the operation of the figures shift the No. 6 vane is controlled so that it no longer blocks the motor stop function lever; following this with "H" selection, vanes Nos. 3 and 5 are cleared and the motor stop selection is completed.

From the above, it will be seen that when the letter "H" is being printed, the sixth vane prevents the motor stop mechanism from functioning and when the motor stop function is effective the "H" is also set up on the code bars but the blocking of the function lever bail by the function lever prevents the character from being printed.

When the motor stop function lever is drawn into selection with the vanes, it causes the motor stop lever to be thrown toward the selector armature extension where the inner stop pawl engages the thick portion of the motor stop pawl latch.

By the movements of the motor stop function lever and the motor stop contact lever, two contacts are affected. These contacts are in the motor circuit and are arranged in parallel one with the other so that when either contact is closed the motor circuit is unbroken. The right hand motor stop contact is normally closed when the motor is running and opens when the function lever is drawn into selection with the vanes. The left hand contact closes just before the right hand contact opens and remains closed for the interval during which the motor stop function lever is in selection with the vanes; following this, both contacts are open and the motor comes to a stop.

The purpose of the left hand motor stop contact is to hold the motor circuit closed and keep the motor running until the receiving cam sleeve comes to a stop with the armature locking lever resting on the high part of the locking cam with the main clutch disengaged.

In order to start the motor after it has been stopped by the above function, the line must be opened for a short interval and again closed. This operation is performed by a break lever and contact on the key board. The breaking of the line circuit allows the selector armature extension to operate to its unoperated position and in so doing the motor stop pawl latch disengages with the inner stop pawl but engages the outer stop pawl and still holds the motor stop lever operated while the line circuit is open. The closing of the line circuit brings the armature extension to the operated position, causing it to release the motor stop lever, thereby closing the right hand motor stop contact and allowing the motor to receive current.

It is very important that the selector cam sleeve come to a stop with the armature locking lever resting on the high part of its cam, otherwise the armature extension would not be free to move in response to the breaking of the line circuit.

A line condition is possible which would interfere with the proper functioning of the motor stop mechanism if a safety feature were not provided in the form of a motor stop release lever. If the line were to open at some point after the

motor stop function had been initiated and before the completion of that function, the selector cam sleeve would continue to rotate until the main shaft had stopped with the possibility of the locking lever resting on the low part of its cam and locking the armature in the unoperated position. With this condition, the closing of the line would not operate the armature against the pressure applied by the locking lever. To guard against the above condition, a release lever with a stud on its reverse side has been provided and this working in conjunction with the locking lever causes the outer stop pawl to free itself from the outer stop pawl latch in case the printer should stop with an open line circuit and with the locking lever on the low part of the cam.

When the motor stop function lever is operated, the action is extended to the send-receiver-break contacts on the keyboard where a contact lever closes a circuit that shunts the transmitter contacts, making the keyboard inoperative, and at the same time opens a circuit designed to control the starting and stopping of a transmitting distributor on 19 type machine.

LESSON NO. 12

DISASSEMBLY AND ASSEMBLY

1. GENERAL

- 1.01 Work on machine should be done with power disconnected.
- 1.02 A complete set of teletypewriter tools should be on hand. Wrenches should be used wherever possible rather than a screwdriver.
- 1.03 Care should be exercised when using a screwdriver to prevent it from slipping and injuring the hands.
- 1.04 Spring hooks should be used to remove small springs. Use lacing twine or piece of wire run through the loop of stronger springs to prevent breaking a spring hook. Be careful not to stretch or lose springs.
- 1.05 Look for lock washers and shims. Replace shims, lockwashers and screws in their former positions as soon as the part is removed.
- 1.06 Use good judgment in removing parts so a minimum of adjustments will be upset and no parts broken.
- 1.07 On complicated assemblies use some system to lay out parts so that they will be easy to assemble.
- 1.08 When assembling be careful not to break parts and see that all screws and nuts are tight and all springs are replaced.
- 1.09 Check any adjustments that might be affected.
- 1.10 Lubricate parts in accordance with the lubrication chart shown in Bell System Practices.

2. COVER

2.01 Remove Handle.

Three Types

1. Pull straight out.
2. Twist and pull out.
3. Loosen screws and pull out.

2.02 Lift Cover.

Place left hand on lower left rear corner and right hand under copy holder on right front corner. Notice cover guides while lifting.

2.03 Place cover on floor.

Use squatting position so that no strain will be placed on back.

2.04 Use reverse procedure when replacing cover.

3. TYPING UNIT

3.01 Remove three thumb screws.

3.02 Lift Typing Unit.

Place left hand so that it grasps the lower left corner of casting with the thumb over the left end of the front track. Place right hand on the name plate on casting and allow the wrist to engage the right end of the platen shaft for balancing. Lift straight up.

3.03 Use reverse procedure to replace.

Use care to engage guides and turn motor by hand to engage gears.

4. KEYBOARD

4.01 Loosen two thumb screws and pull out keyboard.

4.02 Replacing Keyboard.

Notice guide rails on bottom and be careful when replacing thumb screws so that new threads will not be cut in the soft aluminum casting.

4.03 Remove sending shaft. Remove lock loop spring and rear bracket. Pull shaft from front bracket. Disassemble shaft. Notice order and make-up of parts.

4.04 Remove line test key, if provided. Do not unsolder wires.

4.05 Remove sending contacts.

4.06 Use reverse procedure to assemble keyboard.
When mounting rear bracket, take up play when possible so that there will be some end play not to exceed .002 inch in shaft.

5. DISASSEMBLY AND ASSEMBLY OF TYPING UNIT

5.01 Remove type bar carriage. Use note Paragraph 4, P36.610. When replacing use note Paragraph 4.35, P36.610.

5.02 Remove bell crank mounting plate assembly. Be careful not to bend ends of bell cranks. When replacing use note Paragraph 4.26, P36.610.

5.03 Remove code bars. Notice spacers. When assembling be careful not to get nut tight enough to bind code bars.

Assemble code bars and bell cranks.

5.04 Printing and function bail assembly. Remove function and printing bail springs. Remove right bearing. Work unit out of left bearing. Then remove screws in shaft.

Remove shaft.

Notice makeup especially the escapement pawls because the parts will fall apart when the shaft is removed. Assemble in reverse procedure. Be sure oil cup will be up when replacing screws in shaft.

Assemble unit.

5.05 Range finder.
Place typing unit on right side. Remove left screws and loosen right screw. Remove assembly.

5.06 Armature bracket pulling type. Remove armature spring and armature bracket screws. Remove bracket.

5.07 Armature lever holding type. Remove armature lever and selector arm springs. Remove upper bearing and lift out armature lever.

5.08 Selector arm holding type. Remove upper bearing and lift out selector arm.

5.09 Selector Mechanism.

Remove locking and selector lever springs.
Remove lock nuts, washers, plates, levers

and swords. Be careful not to lose spacers and washers.

5.10 Assembly of selector Mechanism.

Use reverse procedure. Check Paragraph 4.45, P36.610 before replacing separator plates. Get selector levers and "T" levers in proper order. Get spacers in proper places. When replacing selector arm and armature lever on holding type, check Paragraphs 4.46 and 4.48 of P36.610.

5.11 Main Shaft.

Place typing unit on right side and remove range finder assembly. Remove clutch throwout, and locking lever springs. Use 5" regular screwdriver to loosen left hand threaded disc while holding bottom of shaft with cloth on fiber driving gear. On holding type magnet it will be necessary to remove selector cam sleeve. Remove upper and lower bearing caps. Hold swords so selector levers will be out of the way and work shaft down and out slowly.

Do not force it out.

Disassemble main shaft placing parts in order.

Note left hand threads and sliding members.

Assemble main shaft.

Be careful to get prongs of sliding members into their slots.

Replace shaft.

Be careful not to break cams or selector levers.

Line up cams with their respective selector levers.

Check Paragraphs 4.31 and 4.167, P36.610.

5.12 Platen.

Remove detent lever spring.

Loosen three clamping screws on right end of platen between platen and detent ratchet. Operate pressure release lever to the rear. Tap shaft on right end and pull out on left and lift out platen. When replacing be sure to locate clamping screws in the indentures in the shaft. Position friction drag in accordance with Paragraph 4.97, P36.610.

LESSON NO. 13NOTES ON TROUBLE15 TYPE TELETYPEWRITERS

1.01 Good trouble clearing is largely a matter of systematic elimination and knowledge of sequence of operation.

Two classes of trouble: (a) Obvious
 (b) Not so obvious

1.02 Obvious Troubles

The failure of some part of machine to operate, such as: perforator, transmitter distributor, some function or operation of the machine is usually an obvious trouble.

Procedure for locating obvious trouble:

Follow sequence of operation for part of machine involved.

If the typing unit is involved and vanes are being positioned correctly, the cause of the failure should be easily located by observing closely the sequence of operation from the vanes to the completion of the operation.

1.03 Not So Obvious Troubles:

- (a) Intermittent troubles.
- (b) Loss or gain of pulses.
- (c) Vane not correctly positioned.

Procedure:

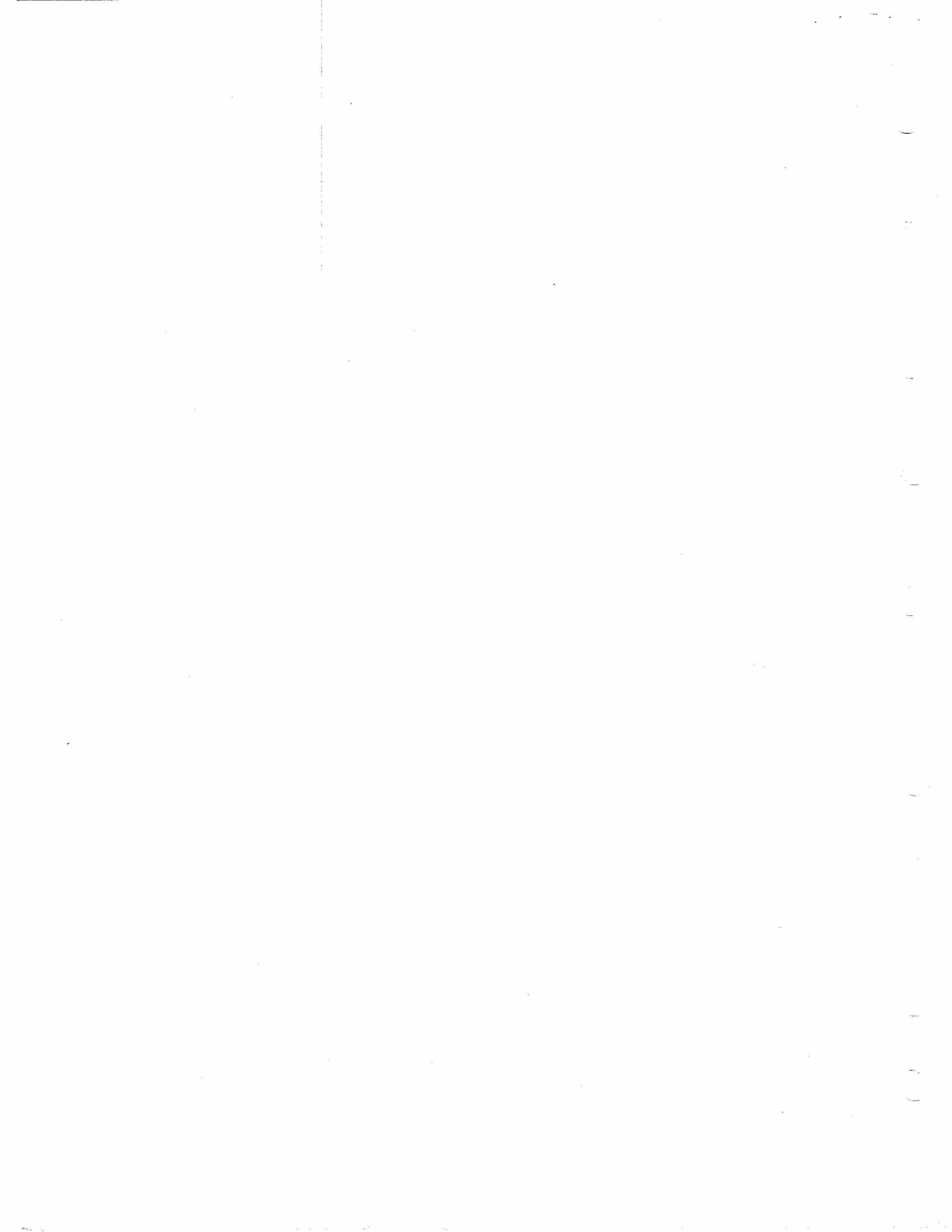
1. Check speed if governed motor is used.
2. Eliminate the line by making local test.
3. Eliminate line relay by substitution if line relay is used.
4. Send copy to other station. If other station received good copy, the keyboard is eliminated.
5. Have other station send copy. If good copy is received, the typing unit is eliminated.
6. By use of (4) and (5) the trouble will be localized to typing unit or keyboard. Locate trouble within unit involved.

7. Analyze trouble by making a chart for errors similar to the following:

CHARACTER	DESIRED PULSE	RECEIVED PULSE	PULSE GAINED	PULSE LOST
E	1	(A) 1,2	2	
Y	1,3,5	(Q) 1,2,3,5	2	
S	1,3	(U) 1,2,3	2	
F	1,3,4	(K) 1,2,3,4	2	
A	1,2	(E) 1		2
W	1,2,5	(Z) 1,5		2
W	1,2,5	(Fig.) 1,2,4,5	4	
Z	1,5	(B) 1,4,5	4	

If trouble occurs only when keys are alternated, it indicates that the cause is some bind or sluggishness in mechanism that operates the code bars.

8. The contacts on the keyboard are the most frequent source of trouble for the keyboard.
9. If a trouble locates in the typing unit, check to see if the selector magnet follows pulses by holding lightly with finger the armature to prevent operation of trip latch plunger, while sending with space bar held down. If armature seems to follow pulses and the vanes are not positioned correctly, the trouble is in the selector mechanism. Check adjustments.
10. To improve margin or tolerance, use Part 4 in P30.002.



BASIC TELETYPEWRITER READING COURSE

SECTION C

26 TYPE TELETYPEWRITERS

LESSON NOTES

TABLE OF CONTENTS

<u>LESSON</u> <u>NO.</u>	<u>TITLE</u>
1.	Transmitting the Selection.
2.	Receiving the Selection.
3.	Printing the Character.
4.	Ribbon Feed and Ribbon Reverse.
5.	Operation of the Space Mechanism.
6.	Carriage Return Function.
7.	Line Feed Function.
8.	Shift and Unshift Function.
9.	Bell Signal and Motor Stop Function.
10.	Space Cut-Out Operation.
11.	Disassembly and Assembly.

Note: Use this practice with AB84.141.

NOTES ON
GENERAL THEORY OF OPERATION

26 TELETYPEWRITER

INTRODUCTION

The purpose of this training course is to provide the teletypewriter student with a detailed course of study, which has been arranged in the normal sequence of operation, which is also the learning sequence.

There are many operating features that are similar to the 14 and 15 teletypewriter; however, these features are confined to the transmitting and receiving mechanism, all other operations of the 26 teletypewriter are exclusive to that type of equipment.

The general features of the No. 26 teletypewriter compared with the No. 15 teletypewriter are as follows:

- | | |
|-----------------------------|---------------------------------|
| 1. Small in size. | 7. No sprocket feed. |
| 2. Less Noise. | 8. No tabulator mechanism. |
| 3. Lighter in weight. | 9. No local test key. |
| 4. Moving paper carriage. | 10. Only 368 speed. |
| 5. Small paper rolls. | 11. Width of paper 8-1/2" only. |
| 6. Paper brackets on cover. | 12. Reduction in cost. |

LESSON NO. 1TRANSMITTING THE SELECTION

(See Illustration 2 and Figures 2 and 3, B.S.P. Section AB84.141)

When a key lever is depressed, it will position the five selector bars located underneath the base of the keyboard to either the right or left. Those positioned to the right will position the corresponding locking levers to the left interlocking with the corresponding contact levers, preventing them from rising into the indents of the cams, and no impulse will be sent to the receiving set. The selector bars positioned to the left will position the corresponding locking levers to the right, releasing the corresponding contact levers so that they will rise into the indents of the cams, and will transmit a closed pulse to the receiving set.

Let us take, for example, the letter "E," depressing the "E" key lever positions No. 1 selector bar to the left and Nos. 2, 3, 4, and 5 selector bars to the right. As the locking levers rest in notches in the selector bars, the upper end of No. 1 locking lever will be positioned to the right and the other four will be positioned to the left.

The key lever also engages a universal bar located just in front of the selector bars, which in turn operates a trip off pawl. The trip off pawl operates the intermediate pawl, which raises the clutch throwout lever from the throwout cam on the driven clutch member, allowing the driven clutch spring to force the driven clutch member into mesh with the driving clutch member that is constantly rotating through the medium of gears and an electric motor.

When the sending cam sleeve assembly starts to rotate, the high part of the lock loop cam moves away from the extension on the lock loop and allows the lock loop spring to pull the lock loop down on the locking levers, preventing them from being changed during the transmitting of the selection.

The start contact lever (the one farthest to the rear) will then ride on the high part of its cam, opening the start contact and sending an open pulse on the line.

No. 1 contact lever will rise into the indent in its cam, due to the tension of the back contact spring, and will allow No. 1 contact to close, sending a current impulse on the line. No. 1 contact lever will then ride on the high part of its cam and will open No. 1 contact. As Nos. 2, 3, 4, and 5 contact levers will not rise into the indents of their respective cams, due to the action of the locking levers, the line will remain open until the completion of the selection. Then, the start contact lever will rise into the indent to its cam, due to the tension of the back contact spring, the start contact will remain closed and current will again be restored on the line until the next selection is made. The extension on the lock loop rides up on the high part of its cam, raising the lock loop from the locking levers, and the clutch throwout lever riding on the sleeve of the driven clutch, engages the throwout cam and forces the driven clutch member from the driving clutch member against the tension of its spring, and the sending cam sleeve assembly is again at rest.

REPEAT SPACING (See Figure 2, B.S.P. Section AB84.141)

Normally, the trip off mechanism is adjusted for non-repeating operation, except in the case of spacing. When the space key lever is depressed, it operates the repeat space rod, which engages the intermediate pawl, which holds the clutch throwout lever out of engagement with the driven member of the clutch, permitting the space combination to be sent as long as the space key lever is depressed.

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LESSON NO. 2

RF

RECEIVING THE SELECTION.

(See Figures 4, 5,

6, 7, 8, and 9, B.S.P. Section
 Upon the receipt of an open pulse from the start contact mechanism, the 215-A relay in the receiving teletypewriter will space due to the 30 mil bias current. This operation from negative on the tongue of the 215-A relay armature through the selector magnet to positive battery.

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This causes the selector magnet in the receiving teletypewriter to be de-energized and the armature lever to be pulled to its unoperated position by the armature lever spring, causing the trip-off screw to operate the trip latch plunger, which operates the bell crank, and disengages the trip latch from engagement with the stop lever. The stop lever rotates slightly on its pivot and allows the stop arm and selector cam sleeve to rotate in a clockwise direction through the action of a friction clutch on the main shaft.

As the character to be received is the letter "E," and the code is impulse No. 1, the 215-A relay armature in the receiving teletypewriter will be pulled to the marking contact, closing the circuit to the line magnet.

Slightly in advance of the closed pulse, the number one cam on the armature lever cam will engage the armature lever which is connected so that the armature is pushed up to the magnet against the tension of the armature lever spring. This operation places the armature in the marking position and the selector arm is pulled to the marking or backward position by the selector arm spring which is connected to the armature lever extension.

When the closed pulse is received, the locking lever will hold the armature lever in the marking position, the locking lever will ride on the high part of the locking lever cam. The locking lever spring will pull the locking lever into the first notch in the locking cam, and interlock the extension of the locking lever with the locking wedge on the selector arm, locking the selector arm in the marking position.

As the selector cam sleeve continues to rotate, the number one selector lever will ride on the high part of the number one selector cam against the tension of the selector lever spring, and due to the pivot point of the selector lever, the action is imparted to the number one sword through a socket joint connection, causing the number one sword to be pulled backward; the marking sword arm will engage the marking selector arm extension, forcing the tip of the sword to the marking or forward position. When the selector lever rides off of the peak of its cam, the selector lever spring forces the tip of the sword to the right, engaging the front or marking indent of the transfer lever.

During this time, the number two cam on the armature lever cam will engage the armature lever and push the armature up to the operated position against the tension of its spring.

After the sword has been positioned, the locking lever will ride on a high part of the locking cam against the tension of its spring; the locking lever extension is disengaged from the locking wedge on the selector arm; this will permit the selector arm to be free for the next selection.

As the number two pulse is an open pulse, the armature lever spring will pull the armature lever to the unoperated position; this operates the selector arm to the spacing or forward position through the medium of the selector arm operating screw connected to the armature lever.

The armature lever will again be locked in the same way as explained above except the selector arm is now in its spacing position and the locking lever is in the second notch in the locking cam.

At this time, the number two selector lever will ride on the high part of the number two selector cam against the tension of the selector lever spring, and due to the pivot point of the selector lever, the action is imparted to the number two sword through a socket joint connection, causing the number two sword to be pulled backward; this will cause the spacing sword arm to engage the front or spacing selector arm extension, forcing the tip of the sword to the spacing or backward position.

When the number two selector lever rides off the high side of the number two selector cam, the selector lever spring will force the tip of the sword to the right, engaging the rear or spacing indent of the transfer lever.

After the sword has been positioned, the locking lever will ride on a high part of the locking cam against the tension of its spring, the locking lever extension is disengaged from the locking wedge on the selector arm. This will permit the selector arm to be free for the next selection.

The detent arrangement on the selector arm is provided to prevent a bounce of the selector arm when operating from the marking to the spacing position or vice versa.

As the numbers three, four, and five pulses are open, they will position the receiving mechanism in the same manner as explained on the number two pulse operation. When the selector cam sleeve has completed its revolution, the locking lever will be on the high side of the locking lever cam and the locking lever extension will be disengaged from engagement with the locking wedge on the selector arm.

As mentioned above, each selector sword will engage a marking or spacing indent on each transfer lever, one end of the transfer lever is connected to the code disc lever, the other end of the transfer lever extends to the front in such a manner that the transfer lever lock arm will lock the transfer levers in their marking or spacing position depending upon the selection received.

The transfer levers are not operated by the swords at the time the swords are positioned on account of the locking feature and due to the fact that the code discs are difficult to move with the stop pin previously selected drawn in the notches of the code disc.

Before the fifth selector cam completes its operation, the sixth cam on the selector cam sleeve will operate the front shaft clutch throwout lever against the tension of its spring. This operation will cause the front shaft clutch throwout lever to disengage from the driven member of the front shaft clutch, which will permit the driven member of the front shaft clutch to engage the driving member under the tension of the driven clutch spring; this permits the front shaft to rotate in a counter clockwise direction.

As the front shaft rotates, the transfer bail roller will ride on the high side of the transfer bail cam, causing the transfer lever lock arm, which is a part of the transfer bail, to unlock the transfer levers. The transfer bail also causes the transfer yield springs to engage the selector levers, applying a force through the selector levers, selector swords, transfer levers, and code disc levers to operate the code disc to the selected position.

This operation will cause the stop pin previously selected to be cammed out from engagement with the five notches in the code disc. The selected stop pin will

be pulled into a row of five notches lined up in the five code disc, under the tension of the stop pin spring; in this manner the selected stop pin will be in the path of the typewheel stop arm on the typewheel shaft; the other 31 stop pins will be cammed out by a raised portion of one or more of the five code discs.

The type wheel stop arm will always find its new position immediately after the new selection has positioned any one of the thirty-two stop pins on account of the fact that the typewheel stop arm and anti-bounce device is mounted on a vertical shaft operated by the motor through gears and a friction clutch. In this manner, the type wheel is positioned so the selected character is facing the platen. The function arm assembly is also positioned at the same time, placing the selected function arm in the path of the selected function lever, should a function operation be desired.

On further rotation of the front shaft, the transfer bail roller will ride to the low side of the transfer bail cam under tension of the transfer bail spring. This will cause the transfer lever lock arm to again lock the transfer levers in the selected position before the printing of the character. While they are locked, another selection may be setting up.

LESSON NO. 3PRINTING THE CHARACTER

(See Figures 4, 5, 10, and 13, B.S.P. Section AB84.141)

After the selection has been received and all of the selecting mechanism is set up for the desired character or function, the typewheel is raised to the printing position by the continued rotation of the front shaft and typewheel lifting bail cam.

The upper roller on the typewheel lifting bail will ride to the high side of the typewheel lifting bail cam, causing the rear portion of the typewheel lifting bail to raise the typewheel guide and typewheel through the medium of a yield spring. The amount to be raised is previously determined by the position of the shift plate.

There are two rows of type on the typewheel; letters in the upper row and figures and other symbols in the lower row.

The main shaft is started by the operation of the main shaft clutch throw-out lever cam on the front shaft. This cam operates the main shaft clutch throw-out lever against the tension of its spring, releasing the rear portion of the main shaft clutch throwout lever from engagement with the main shaft driven clutch, which permits the driven clutch spring to force the driven clutch into engagement with the driving clutch. The main shaft is started just before the front shaft comes to a stop.

The typewheel is held in its raised position after the front shaft has completed its rotation by the operation of the typewheel lifting bail auxiliary cam on the main shaft. This cam operates against the lower roller on the typewheel lifting bail and, through the same procedure as explained in raising the typewheel, the typewheel lifting bail auxiliary cam will hold the typewheel in the raised position until the character is printed.

As the printing bail cam on the main shaft rotates in a clockwise direction, the printing bail cam follower arm roller rides off the high side of the printing bail cam. This operation permits the printing bail cam follower arm spring to rotate the printing bail slightly and the printing bail cam follower arm on the printing bail shaft.

Through this operation, the printing hammer is moved toward the rear of the machine and strikes the selected type pallet. The type pallet will force the ribbon against the paper on the platen and the character is printed. The force applied in printing the character is controlled by the adjustment of the printing bail follower arm spring.

The complete travel of the printing hammer is not a positive action, but is an overthrow of the printing hammer and its mechanism, caused by momentum set up by the printing bail cam follower arm spring. The purpose of the overthrow feature is to provide a uniform impression of each character, minimize noise, and reduce excessive wear of the ribbon and platen.

As the roller on the printing bail cam follower arm rides to the high side of its cam, the printing bail and printing hammer through the tension of the yield spring will be restored to normal position against the tension of the printing bail follower arm spring.

Further rotation of the main shaft and the typewheel lifting bail auxiliary cam allows the typewheel lifting bail to return to the down position under the tension of typewheel lifting bail spring. The typewheel and typewheel guide will return to the normal position by their own weight.

The primary purpose in having the typewheel lowered after the printing of a character is to provide an unobstructed view of the last printed character.

LESSON NO. 4

RIBBON FEED AND REVERSE

RIBBON FEED (See Figure 18, B.S.P. Section AB84.141)

The ribbon feed operating lever is mounted on the right side of the typing unit, and is pivoted a little above the center, the bottom end extending into the path of the function bail, which is controlled by the function cam.

On each revolution of the main shaft and function bail cam, the function bail will be moved to the rear, moving the lower portion of the ribbon feed operating lever to the rear. This causes the top end of the ribbon feed operating lever to move to the front.

As the ribbon feed lever is attached to the top of the ribbon feed operating lever through the medium of the ribbon feed operating link, the left end of the ribbon feed lever is moved forward and backward on each operation of the ribbon feed operating lever, and revolution of the function bail cam.

The left end of the ribbon feed lever is connected to the ribbon feed pawl which works against the right or left ribbon feed ratchet. On each forward and backward motion of the ribbon feed pawl, the ratchet which is engaged by the ribbon feed pawl will be moved the distance of one tooth on the ribbon feed ratchet. This operation will turn the ribbon feed ratchet shaft, which turns the ribbon spool, causing the ribbon to be wound on the spool. The other ribbon spool will be free to unwind.

A friction drag spring is connected to each ribbon feed ratchet to prevent the ribbon spools from unwinding too fast, which would cause excess slack in the ribbon. The feed pawl is held against the ribbon feed ratchet by a spring and extension.

The ribbon feed check pawl under the tension of its spring will engage the ribbon feed ratchet that is being operated and the ribbon feed ratchet will be held during the interval when the ribbon feed pawl moves forward to engage the next tooth of the ribbon feed ratchet.

RIBBON REVERSE (See Figure 18, B.S.P. Section AB84.141)

The ribbon reverse lever has two lever arms. The end of each lever arm is provided with two small pins through which the ribbon will pass as it is being wound from one spool to the other. As the ribbon becomes nearly exhausted from the spool being unwound, a small rivet in the ribbon will engage the two pins mounted on one of the ribbon reverse lever arms, pulling the ribbon reverse lever into the opposite position. A detent feature is provided to hold the ribbon reverse lever in this position until the next reverse operation.

When the ribbon reverse levers are moved as explained above, the operating arm will be positioned directly in the path of a projection on the rear end of the ribbon feed pawl. On the next operation of the ribbon feed pawl, the projection on the ribbon feed pawl will engage the operating arm, causing the ribbon feed pawl to pivot on its axis, which will reverse the position of the ribbon feed pawl, and in this position will engage the other ribbon feed ratchet, causing the ribbon to be wound on the empty ribbon spool.

The ribbon feed check pawl will also change its position at the same time, due to a stud on the ribbon feed pawl which operates against the ribbon check pawl. The stud also serves the purpose as a guide or back stop for the ribbon feed pawl.

The ribbon reverse mechanism will be positioned to the opposite direction in the same manner as explained above.

LESSON NO. 5

OPERATION OF THE SPACING MECHANISM

(See Figures 11 and 15, B.S.P. Section AB84.141)

When the teletypewriter is receiving copy, the spacing mechanism will function automatically after the printing of each character.

The spacing pawl is connected to the function bail and on each revolution of the main shaft and function cam, the function bail roller will ride to the high side of the function bail cam, causing the function bail to move the spacing pawl to the rear. The spacing pawl is held against the spacing ratchet by the spacing pawl spring. The backward movement of the spacing pawl will turn the spacing ratchet the distance of one tooth of the ratchet. Each spacing operation will wind the carriage return drum spring.

As the spacing ratchet is turned in a counterclockwise direction, the vertical spacing shaft will turn the spacing pinion which is meshed with the spacing rack. This operation will move the paper carriage the normal space required between a character.

The spacing pawl has a slot where it is connected to the function bail and a yield spring is fitted into this slot. During the normal operation of a space, the yield spring will not permit lost motion between the spacing pawl and the function bail. The purpose of the yield spring is to render the spacing pawl inoperative when the paper carriage has reached the limit of its travel. The yield spring would also prevent the breakage of parts should the paper carriage mechanism become jammed.

The space retaining pawl is held against the spacing ratchet by its spring and prevents back spacing by holding the spacing ratchet in the desired position until the next operation of the spacing pawl.

Each space operation is constantly winding the carriage return drum spring which will furnish the power to return the carriage for the beginning of a new line.

LESSON NO. 6CARRIAGE RETURN FUNCTION

(See Figure 11, B.S.P. Section AB84.141)

When the carriage return selection has been received, the typewheel stop arm and typewheel will position the carriage return function arm on the eighth level directly in the path of the projection on the carriage return function lever.

As the main shaft and operating bail cam channel rotate in a clockwise direction, the operating bail roller will ride to the high side of the cam, pivoting the operating bail slightly on its axis and positioning the carriage return function lever projection against the carriage return function arm. This will cause the carriage return function lever to pivot on its fulcrum which enables the rear portion of the carriage return function lever to move the front end of the carriage return lever against the tension of its spring to the right, where it will engage a stud on the spacing pawl, causing the spacing pawl to be cammed out from engagement with the spacing ratchet against the tension of the spacing pawl spring.

The operation of the carriage return lever will also cam the space retaining pawl against the tension of its spring out from engagement with the spacing ratchet. At this time, the carriage return lever will be locked in the carriage return position by the carriage return lever latch and its operating spring, holding the spacing pawl and space retaining pawl out from engagement with the spacing ratchet.

The carriage will return to its normal position under the tension of the carriage return drum spring which was wound up by the spacing operation. As the carriage is returned to its extreme position, the carriage will strike the top of the dash pot lever, actuating the dash pot which checks the return of the carriage and minimizes noise and shock. The dash pot lever also pushes the carriage return release plunger against the carriage return release lever, positioning the carriage return release lever into the path of the carriage return release lever link.

Upon the selection of the next character or the rotation of the main shaft and operating bail cam channel, the operating bail will push the carriage return release lever link to the rear, operating the carriage return release lever, causing the carriage return release lever latch to be unlatched from the carriage return lever which is pulled into normal position under the tension of its spring. This operation will permit the spacing pawl and space retaining pawl to be pulled into engagement with the spacing ratchet under the tension of their springs.

Further rotation of the main shaft causes the function bail to push the spacing pawl to the rear. Since the spacing pawl has engaged a tooth of the ratchet, the spacing of the carriage will again take place.

The carriage may be returned by the manual operation of the carriage return lever.

LESSON NO. 7LINE FEED FUNCTION

(See Figure 12, B.S.P. Section AB84.141)

When a line feed selection has been received, the typewheel stop arm and typewheel shaft will position the line feed function arm on level three, placing the line feed function arm directly in the path of the projection on the line feed function lever.

As the operating bail cam roller begins to ride on the high side of the operating bail cam channel, the operating bail will pivot slightly on its axis and position the line feed function lever projection against the line feed function arm. This will cause the line feed function lever to pivot on its fulcrum and the rear of the line feed function lever will move the function intermediate lever to the right against the tension of its spring, placing the line feed function pawl to the right and directly in the path of the line feed bail operating lever.

When the function bail roller rides to the high side of the function bail cam, the function bail will push the line feed function pawl to the rear, moving the line feed bail operating lever to the rear. The line feed function pawl latch will prevent the line feed function pawl from slipping off the line feed bail operating lever.

On the backward movement of the line feed bail operating lever and line feed bail adjusting screw, the lower portion of the line feed bail is moved to the rear. As the line feed bail is in the form of a plate and is pivoted on each side, the top of the line feed bail will move to the front, transmitting motion to a roller, lever, line feed shaft, line feed pawl lever and line feed pawl.

As the line feed pawl is held against the line feed ratchet by a spring, the platen will be turned the distance of one or two teeth of the line feed ratchet, depending on the position of the single double line feed lever.

A line feed detent lever has a roller that rides on the teeth of the line feed ratchet and is held in place by a strong spring. This feature provides accurate spacing between each line of printed copy, and also prevents a tendency of the line feed ratchet to overthrow during the line feed operation.

As the function bail roller rides off the high side of the function bail cam, the function bail and line feed function pawl will be restored to their normal position under the tension of the function pawl springs. The line feed bail operating lever spring will restore the line feed bail operating lever and position the line feed pawl to the front ready for the next line feed operation.

The paper is held securely against the platen by pressure rolls under the tension of springs. The pressure rollers are mounted underneath the platen. A pressure roller release lever is mounted on the left side of the platen assembly that may be operated forward until it will catch on a stationary latch, releasing the paper so that it can be straightened.

LESSON NO. 8SHIFT AND UNSHIFT FUNCTIONSSHIFT FUNCTION (See Figures 13 and 14, B.S.P. Section AB84.141)

After a shift selection has been received, the typewheel stop arm and typewheel shaft will position the shift function arm on the fifth level, placing the shift function arm directly in the path of the projection on the shift function le

As the operating bail cam channel rotates clockwise, the operating bail cam roller rides to the high part of the operating bail cam channel, pivoting the operating bail which positions the shift function lever projection against the shift function arm. This causes the shift function lever to pivot on its fulcrum and the rear of the shift function lever moves the function intermediate lever and shift function pawl to the right against the tension of their springs directly in the path of the function pawl latch.

As the function bail roller rides to the high side of the function bail cam, the shift function pawl is moved to the rear, latching with the function pawl latch. The projection on the shift function pawl comes into contact with the shift lever and as the bottom of the shift lever is moved to the rear, the shift plate is positioned toward the front. The shift plate is held in this position by a detent lever and spring which operate against a guide stud.

The shift stop arm on the typewheel guide is now free to rise into a long slot in the shift plate which permits the typewheel lifting mechanism to raise the typewheel guide and typewheel into the upper case position for the printing of figures or other symbols.

The typewheel restores to the normal position in the same manner as explained in the previous lesson.

UNSHIFT FUNCTION (See Figures 13 and 14, B.S.P. Section AB84.141)

With the unshift function set up, the typewheel stop arm and typewheel shaft positions the unshift function arm on the fourth level, placing the unshift function arm directly in the path of the projection on the unshift function lever.

As the operating bail cam channel rotates clockwise, the operating bail cam roller rides to the high part of the operating bail cam channel pivoting the operating bail on its axis, which positions the unshift function lever extension against the unshift function arm. This causes the unshift function lever to pivot on its fulcrum and the rear of the unshift function lever moves the function intermediate lever and unshift function pawl to the right against the tension of their springs, directly in the path of the function pawl latch.

As the function bail roller rides to the high side of the function bail cam, the unshift function pawl is moved to the rear, latching with the function pawl latch. The projection on the unshift function pawl comes into contact with the unshift lever and as the bottom of the unshift lever is moved to the rear, the shift plate is moved to the rear. The shift plate is held in this position by a detent lever and spring which operate against a guide stud.

The shift stop arm on the typewheel guide is now controlled by the short slot in the shift plate which permits the typewheel lifting mechanism to raise the typewheel guide and typewheel into the lower case position for the printing of characters.

The typewheel is restored to the normal position after the printing of a character in the same manner as explained in other lessons.

LESSON NO. 9BELL SIGNAL AND MOTOR STOP FUNCTIONBELL SIGNAL FUNCTION (See Figure 16, B.S.P. Section AB84.141)

When an "S" selection is received, the typewheel stop arm and typewheel shaft positions the bell function arm on the second level directly in the path of the projection on the function lever. The typewheel is also positioned with the "S" type pallet facing the platen.

As the operating bail cam channel rotates clockwise, the operating bail cam roller rides to the high part of the operating bail cam channel pivoting the operating bail which positions the function lever projection against the bell function arm. This causes the function lever to pivot on its fulcrum and the rear portion to engage the intermediate yield lever. Through a yield spring connection and common axis, the function intermediate lever positions the function pawl to the right. The rear of the function pawl is now directly in line with the function pawl latch.

The function blocking plate is attached to the shift plate. When the shift plate is in the upper case or forward position, the function blocking plate is also in the forward position and out from engagement with the extension on the function pawl.

As the function bail roller rides to the high side of the function bail cam, the function bail moves the function pawl to the rear, latching the function pawl with the function pawl latch and pushing the operating lever against the tension of its spring to the rear, moving the bell hammer away from the signal bell.

When the function bail roller rides off the high side of the function bail cam, the function bail immediately pulls the function pawls to the front under the tension of the function pawl springs and ribbon operating lever spring.

The bell hammer is pulled forward under the tension of the operating lever spring, causing the bell hammer to strike the bell one stroke for each operation just explained.

When the shift plate and function blocking plate are in the letters or rear position and the "S" selection is received the "S" will be printed, and the bell operation blocked out by the function blocking plate being directly in the path of the projection on the function pawl, preventing the function pawl from operating the operating lever and bell hammer.

MOTOR STOP FUNCTION (See Figure 16, B.S.P. Section AB84.141)

At present, there is no standard method providing for a built-in remote control device. If this feature is desired, it may be engineered locally with the assistance of several sets of parts and other external equipment. (See B.S.P. AB84.136 for the sets of parts.) An operating lever would be provided to control the motor stop contacts and its operation would be similar to that of the Bell Signal Function in the above paragraphs.

NOTE

The motor stop operation may be operated from the number one or number two level on the function arm assembly.

There will be no condition where the number one and number two levels would be required at the same time for the motor stop function. The choice will depend on whether the "bell" or the "break lock" operation is desired. In the former case, a motor control function arm on level one in the "H" position is required. In the latter case, a motor control function arm on level two in the "H" position is required.

LESSON NO. 10SPACE CUT-OUT OPERATIONUPPER CASE SPACE CUT-OUT (See Figure 15, B.S.P. Section AB84.141)

The space cut-out mechanism is provided to prevent the space operation on all functions except space. The space cut-out function arms are located on the sixth and seventh levels of the function arm assembly.

When any of the functions are to be operated in the upper case, the typewheel stop arm and typewheel shaft positions the selected function arm. At the same time a space cut-out function arm on the seventh level is positioned directly in the path of the projection on the upper case space cut-out function lever.

When the operating bail cam roller begins to ride to the high side of the operating bail cam channel, the operating bail pivots and positions the projection on the space cut-out function lever against the upper case space cut-out function arm.

The space cut-out function lever pivots on its fulcrum, moving the rear of the space cut-out function lever to the right, which in turn moves the forward end of the yield lever to the right. Through a yield lever spring and common axis, the yield lever operates the function intermediate lever to the right, engaging the intermediate lever with a stud on the spacing pawl, moving the spacing pawl to the right against the tension of its spring, and out from engagement with the spacing ratchet.

When the function bail roller rides to the high side of its cam, the function bail moves the spacing pawl to the rear and the spacing pawl clears the spacing pawl latch on its rear movement. As the operating bail cam roller rides to the low side of its cam the operating bail moves the space cut-out function lever away from the function arm. This releases the pressure on the yield lever and the yield spring then restores the yield lever and the function intermediate lever, releasing the spacing pawl. When the function intermediate lever releases the spacing pawl, the spacing pawl latch holds the spacing pawl out from engagement with the spacing ratchet. The space retaining pawl holds the spacing ratchet and the selected function completes its operation but the carriage remains in the desired position.

When the function bail returns to its normal position, as explained before, the spacing pawl is pulled forward and out from engagement with the spacing pawl latch. The spacing pawl spring causes the spacing pawl to engage the spacing ratchet, placing the spacing pawl in position for the next space operation.

LOWER CASE SPACE CUT-OUT (See Figure 15, B.S.P. Section AB84.141)

When any of the functions are to be operated in the lower case, the typewheel stop arm and typewheel shaft position the selected function arm. At the same time, a space cut-out function arm on the sixth level is positioned directly in the path of the projection on the lower case space cut-out function lever.

The operation of the space cut-out function levers are the same for both the upper and lower case operation, except in case of the bell on upper case "S" and the motor stop on upper case "H." When "H" or "S" is printed, it is necessary to provide a space in the lower case. When a function is performed on upper case "H" or "S," it is necessary to cut out a space. In the lower case position, the shift plate blocks the function intermediate lever arm on the seventh level, allowing the carriage to space if there is no space cut-out function arm lined up on the sixth level. In upper case position, the shift plate does not block the function intermediate lever arm on the seventh level, leaving it free to cut out a space when a function is selected.

3.05 Replace other two thumb screws on base.

4. REMOVE RIBBON MECHANISM ASSEMBLY

4.01 Remove ribbon.

Roll up excess ribbon on to spools.

4.02 Remove screws.

Take care not to lose washers.

4.03 Remove assembly.

Unlatch printing hammer, disengage from ribbon feed operating link.

4.04 Replace screws.

5. REMOVE RANGE FINDER ASSEMBLY

5.01 Remove left screw and loosen right screw.

Take care not to lose washer.

5.02 Remove assembly.

5.03 Replace screw.

6. REMOVE MOTOR

6.01 Remove 2 bottom and 1 top screw.

Support motor to prevent falling.

6.02 Replace screws.

7. REMOVE BACK CASTING

7.01 Loosen margin bell screw.

Not necessary on later models as no obstruction exists.

7.02 Remove 4 mounting screws.

Support to prevent falling. Remove with caution to prevent breakage of parts.

7.03 Remove casting.

Place casting on back.

7.04 Replace screws.

8. REMOVE CARRIAGE

8.01 Remove platen crank bracket.

a) Remove two screws. Remove small paper holder
b) Take care not to lose shims between bracket and casting. if present, and paper.

c) Replace screws and shims.

8.02 Remove draw strap.

a) Hold carriage return drum assembly.

b) Remove draw strap from drum assembly.

c) Allow drum to rotate slowly until it rests against stop.

8.03 Remove or loosen rear rail. (Do not remove unless necessary.)

a) Remove screws or loosen.

b) Note shims behind rail.

c) Note position of ball bearing assembly.

8.04 Remove platen.

- d) Keep carriage from falling.
- e) Replace screws.
- a) Remove paper guide. Caution not to lose spacers.
- b) Replace screws.
- c) Remove paper fingers.
- d) Loosen clamping screw on platen bearing tube.
- e) Remove tube by pressing to right.
- f) Lift out platen.

9. REMOVE PRINTING BAIL AND HAMMER

9.01 Remove printing arm spring.

9.02 Remove screw in top of printing bail shaft.

9.03 Remove upper extension of printing bail shaft.

Extension has shoulder which shall be removed.

9.04 Remove printing bail.

Slide printing bail downward until it slides off shaft.

9.05 Replace shoulder and upper extension of shaft, screw and washers.

10. REMOVE FRONT SHAFT ASSEMBLY (See note in Par. 4.21, B.S.P. Section P40.610)

10.01 Remove typewheel lifting bail yield spring, printing arm spring, and typewheel lifting bail return spring.

Note difference in springs.

10.02 Remove typewheel lifting bail shaft - 1 screw.

10.03 Remove 2 large hex screws in front of plate on left of shaft.

10.04 Remove assembly.

Be careful of roller in internal cam and oil wick in shaft.

10.05 Replace screws.

11. REMOVE MAIN SHAFT

11.01 Remove selector cam sleeve.

- a) Remove left hand threaded screw on top of main shaft. Use 5" screw-driver.
- b) Remove top friction clutch. Note construction.
- c) Remove selector cam sleeve*. It is not necessary to

remove bottom friction clutch.

* Press on marking sword arms to free selector levers from selector cams.

11.02 Remove main shaft.

a) Remove the 2 screws from lower bearing.

b) Remove the 2 screws from upper bearing.

c) Remove shaft.

Caution as to operating bail cam roller falling off.

Note position of shaft. Must not be forced.

d) Replace screws.

12. REMOVE FUNCTION ARM ASSEMBLY

12.01 Remove function arm assembly.

a) Rotate type wheel shaft until screw can be reached.

b) Loosen screw.

Do not have to remove.

c) Slip assembly off typewheel shaft.

Watch for shims.

13. REMOVE TYPE WHEEL

13.01 Remove type wheel.

a) Loosen the three screws inside. All screws should be loosened approximately equally so that they will not jam against pallets.

Be careful not to damage pallets with screwdriver.

Exert upward pressure on type wheel when removing screws to prevent injury to pallet.

13.02 Disassemble type wheel.

a) Remove screws from bottom plate.

Be careful not to let pallets fall out.

Probably will not be practical to replace all screws, so take good care that they are not lost.

14. REMOVE PIN BARREL ASSEMBLY

14.01 Remove transfer levers - one bolt.

14.02 Remove pin barrel assembly.

- a) Remove resistor and printer magnet cover.
- b) Remove screws, taking care of washers.
- c) Remove resistor and replace screws.
- d) Remove screws in base of Pin Barrel Assembly. Use "R" wrench or offset screwdriver on right screw. Note position of dowel pin and slot.

14.03 Remove assembly.

14.04 Replace screws.

ASSEMBLY

1. REPLACE PIN BARREL ASSEMBLY

1.01 Add 2 screws - Use "R" wrench on front screw.

1.02 Replace front bearing screw of shift plate.

2. REPLACE TYPEWHEEL

2.01 Position on shaft - note dowel pin.

2.02 Place and tighten 3 screws.

3. REPLACE FUNCTION ARM ASSEMBLY

3.01 Rotate assembly counterclockwise before tightening screw to take up play.

4. REPLACE MAIN SHAFT

4.01 Note dowel pins and place 4 screws.

4.02 Replace selector cam sleeve assembly.

5. REPLACE FRONT SHAFT ASSEMBLY

5.01 Be careful of roller in internal cam.

5.02 Replace typewheel lifting bail shaft - 1 screw.

5.03 Place 2 screws.

5.04 Replace typewheel lifting spring, typewheel lifting bail return spring and printing arm spring.

6. REPLACE PRINTING BAIL

6.01 Replace upper stud.

6.02 Replace upper screw.

7. REPLACE CARRIAGE

7.01 Note shims and tighten 2 screws on rear rail.

7.02 Replace C. R. draw strap.

7.03 Replace paper fingers.

8. REPLACE BACK CASTING

- 8.01 Helpful to use cardboard.
Place between function pawls and function levers.
- 8.02 Watch dowel pins and place 4 screws.

9. REPLACE MOTOR

- 9.01 Place 3 screws.
- 9.02 Adjust motor - see P40.610 Paragraph 4.26.

10. REPLACE RANGE FINDER

- 10.01 Place and tighten 2 screws.

Note: Caution not to break trip latch plunger.

11. REPLACE RIBBON MECHANISM

- 11.01 Place 2 screws.
- 11.02 Place print hammer.

Note: Place washer over slot.

12. PLACE TYPING UNIT ON BASE

- 12.01 Adjust backlash on motor pinion and gear.
- 12.02 Tighten 3 screws.
- 12.03 Connect motor lead.

BASIC TELETYPEWRITER READING COURSE

SECTION D

15 TYPE PERFORATOR TRANSMITTER
14 TYPE TRANSMITTER DISTRIBUTOR
USED ON 19 TYPE TELETYPEWRITERS

LESSON NOTES

TABLE OF CONTENTS

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4.	Character Counter
5.	Operation of the 14 Type Transmitter Distributor

Note: Use this practice with B.S.P. Section AB84.140 and AB84.138.

LESSON NO. 1

GENERAL (See Illustrations 1 and 2, B.S.P. Section AB84.140)

With the tape keyboard key in the up position, direct keyboard transmitting may be accomplished. The operation of the direct keyboard mechanism on the 15 Type Perforator Transmitter is almost identical to that of the 14 or 15 type equipments. However, the locking levers are operated in somewhat different manner.

DIRECT KEYBOARD TRANSMITTING (See Figures 2 and 3, B.S.P. Section AB84.140)

When a key lever is depressed, it will position the five rear selector bars and each associated front selector bar located underneath the base of the keyboard to either the up or down position. The rear selector bar positioned to the down position operates its corresponding "Y" lever and connecting link to the left position, moving the lower part of the locking lever to the left and the top part of the locking lever to the right, releasing the corresponding contact lever. This will permit the projection on the contact lever to rise into the indent on its corresponding cam and close the corresponding transmitting contact so that a closed pulse will be transmitted to the line. The rear selector bar positioned to the up position will operate its corresponding "Y" lever and connecting link to the right position, moving the lower part of the locking lever to the right and the top part of the locking lever to the left, interlocking with the corresponding contact lever so that the projection on the contact lever will not rise into the indent of the corresponding cam. This operation will prevent a closed pulse from being transmitted to the line.

For example, transmit letter "E," depressing the "E" key lever positions number one rear selector bar to the down position and the corresponding "Y" lever and connecting link to the left position, rear selector bars numbers two, three, four, and five to the up position, and the corresponding "Y" lever and connecting link to the right position. As the locking levers rest in notches near the right end of the connecting link and are pivoted directly above, the upper end of the number one locking lever will be positioned to the right, releasing the number one contact lever. This operation will permit the number one contact to transmit a closed pulse to the line.

The upper ends of the locking levers numbers two, three, four, and five will be positioned to the left interlocking with their corresponding contact levers. This operation will prevent transmitting contacts numbers two, three, four, and five from transmitting a closed pulse to the line.

Further depressing of the "E" key lever operates the universal bar located just in front of the selector bars, which in turn operates the trip off pawl. The trip off pawl operates the intermediate pawl which operates the clutch throwout lever. This operation releases the clutch throwout lever from engagement with the driven member of the clutch, allowing the driven clutch spring to mesh the driven clutch member with the driving clutch member. The driving clutch member is constantly rotating through the medium of a motor and gears. This operation causes the transmitting cam sleeve assembly to start rotating.

When the transmitting cam sleeve assembly starts to rotate, the peak of the lock loop cam moves away from the extension of the lock loop and permits the lock loop spring to pull the lock loop down against the locking levers. This operation

prevents the locking levers from being changed during the transmitting of this selection. The projection on the start contact lever will ride out of the indenture to the high part of its cam and open the start contact which presents an open or start pulse to the receiving teletypewriter.

The projection on the number one contact lever will then rise into the indent of its cam due to the tension of the number one contact spring. This operation will close the number one contacts and transmit a closed pulse to the receiving teletypewriter. The projection on the number one contact lever will then ride on the high part of its cam and will open the number one contacts. As the projection on the numbers two, three, four, and five contact levers will not rise into the indent of their respective cams, due to the action of their respective locking levers, the line will remain open. This operation will present four open pulses to the receiving teletypewriter; namely, pulses numbers two, three, four, and five.

When the transmitting cam shaft has nearly completed its cycle, the projection on the start contact lever will rise into the indent of its cam due to the tension of the start contact spring. This operation closes the start contact which transmits a closed (or stop pulse) to the receiving teletypewriter. This contact will remain closed until the next selection is transmitted.

At this time, the lock loop cam will raise the lock loop against the tension of its spring from engagement with the locking levers, freeing the locking levers for another selection.

As the clutch throwout lever rides against the throwout cam of the driven clutch member, it will cam the driven clutch member, against the tension of its spring, out from engagement with the driving clutch member. This operation causes the transmitting cam sleeve assembly to be restored to normal or stopped position.

REPEAT SPACING (See Figure 3, B.S.P. Section AB84.140)

Normally, the trip off mechanism is adjusted for non-repeating operation, except in the case of spacing. When the space key lever is depressed, it operates the repeat space rod which engages the intermediate pawl, which holds the clutch throwout lever out of engagement with the driven member of the clutch, permitting the space combination to be sent as long as the space key lever is depressed.

LESSON NO. 2

COMBINED - DIRECT KEYBOARD SENDING AND TAPE PERFORATING

GENERAL (See Illustrations 1 and 2 and Figures 2, 3, 5, and 6, B.S.P. Section AB84.140)

With the keyboard control operating lever in the mid-position the combined operation of direct keyboard and perforating of tape may be accomplished.

The mechanical operation of the direct keyboard mechanism will function in the same manner as explained in lesson number one. The cam pulsing contacts are operated by the numbers four and five cams on the transmitting cam shaft, these contacts close a circuit to energize the perforator magnet when in the tape-keyboard position. The operation of the perforating of tape is explained in Lesson No. 3.

LESSON NO. 3OPERATION OF TAPE PERFORATOR

GENERAL (See Illustrations 1 and 2, B.S.P. Section AB84.140)

With the tape keyboard key in the tape, or down position, which only provides for the perforating of tape, the trip off pawl and repeat space rod will be positioned in such a manner by the keyboard control operating lever that the intermediate pawl will not function during the perforating of tape. A character counter will operate on each character perforation, this mechanism is explained in Lesson No. 4.

PERFORATION OF TAPE ONLY (See Figures 2, 3, and 4, B.S.P. Section AB84.140)

When a key lever is depressed it will position the five rear selector bars and each associated front selector bar located underneath the base of the keyboard to either the up or down position. The rear selector bar positioned to the down position will position the "Y" levers and connecting link to the left position, moving the selector finger on the left end of the connecting link to the left position, causing the selector finger on the left end of the connecting link extension to be interposed between a punch operating lever and the corresponding punch so that when the keyboard control operating lever is in the down position for tape perforation, the "U" selector bar contact will be closed by the operation of the "U" selector bar. An anti-chatter contact lever is used to prevent chatter of the punch magnet. The punch magnet being energized operates the punch operating lever which will strike the selector fingers that have been interposed between the punch and the punch operating lever. This will cause the punch to be forced through the tape into the punch block under which the tape passes. The punches are not long enough to be operated by the punch operating lever unless the selector finger is interposed between the punch and the punch operating lever. In addition to the five punches just mentioned, a feed punch has been provided. This is operated on each operation of the punch operating lever due to the feed punch selector finger being constantly interposed between the feed punch and punch operating lever. This condition perforates a row of small holes near the center of the tape for feeding the tape through the perforator and transmitter distributor.

At the time when the punch operating lever operates the selector fingers and punches, the rear extension of the punch operating lever operates a tape feed pawl which engages the next tooth of the tape feed ratchet. When the punch magnet has been de-energized the punch operating lever spring will restore the punch operating lever to normal position which will step the tape feed wheel around for the operation of one tooth of the tape feed ratchet.

Errors in punching the tape may be obliterated by backing the tape by the operation of the back space lever, and repunching with the "letters key." The letters signal when transmitted merely restores or retains the platen in the unshift or lower case position and nothing is printed. If figures were being punched when the error occurred, the obliterating with the "letters key" would make it necessary to perforate the "figures" signal again after the last "letters" signal.

LESSON NO. 4CHARACTER COUNTER

GENERAL (See Illustrations 1 and 2, B.S.P. Section AB84.140)

With the keyboard control operating lever in the down position, which only provides for the perforation of tape, a character counter has been provided to show the position in a line where the characters are being perforated. This character counter has a pointer which rotates above a numbered dial. A signal lamp which warns the operator that the end of the line has been reached will light after the sixty-fifth character has been printed, and remains lighted until the carriage return key has been depressed.

OPERATION OF CHARACTER COUNTER (See Figures 7 and 8, B.S.P. Section AB84.140)

The character counter is electrically controlled and mechanically operated. The operation of the universal selector bar will close the universal selector bar contacts which close a circuit to the counter magnet. This operation will cause the counter magnet armature to be operated which in turn causes the feed pawl to engage the next tooth of the ratchet wheel. When the universal selector bar contacts are permitted to open, the counter magnet will be de-energized and the feed pawl spring will step the ratchet wheel the distance of one tooth for each character operation. The latch pawl holds the ratchet wheel against the tension of the ratchet wheel spring on the forward operation of the feed pawl. After the operation of the feed pawl, the latch pawl again engages the next tooth of the ratchet wheel. After the sixty-fifth operation, a cam on the indicator shaft will operate a set of contacts closing a circuit to light the signal lamp. When a function selection is being transmitted, the circuit to the counter magnet is opened by the operation of the connecting link which opens the set of contacts. Therefore, the counter will not operate on some of the function selections.

When a carriage return is desired, the carriage return key lever is operated which operates the connecting link which opens the counter control contacts and closes a circuit to energize the release magnet. When the release magnet armature is operated, a release lever will be operated which will disengage the latch pawl and feed pawl from engagement with the ratchet wheel. The end of the feed pawl will become engaged with the notch in the release latch, holding the feed pawl and latch pawl out from engagement with the ratchet wheel until the ratchet wheel spring returns the ratchet wheel to its normal position. This operation will permit the lamp contacts to restore to the normal or open position, extinguishing the signal lamp in case it had been lighted. An extension on the feed pawl will engage the release latch, causing the feed pawl to be free to operate the ratchet wheel on the next operation of a character. The return operation of the ratchet wheel is checked by the operation of a dash pot piston.

LESSON NO. 5

GENERAL (See Illustrations 1 and 2, B.S.P. Section AB84.138)

The 14 type Transmitter Distributor is used for transmitting the characters that have been perforated in the tape by the 15-A Perforator Transmitter. The 14 type Transmitter Distributor is operated by a governed motor or a synchronous motor operated on regular 60 cycle A.C. power. This set provides automatic tape transmitting to any receiving teletypewriter used by the Bell System providing the receiving set is operating at the same speed of the Transmitter Distributor.

OPERATION OF THE 14 TYPE TRANSMITTER DISTRIBUTOR (See Figures 1, 2, 3, and 4, B.S.P. Section AB84.138)

When the power switch is turned to the "On" position, power is immediately applied to the motor on the 14 type Transmitter Distributor.

Normally the main shaft is held at rest by the stop arm having engaged the stop cam; therefore, the operating lever roller is on the high part of the operating cam. The operating lever has the lower part of the contact lever bail positioned to the right, the top part of the contact lever bail is positioned to the left, holding the five contact levers in such a manner as to have all five of the tape pins below the surface of the tape guide plate. At the same time, the contact tongues mounted on the left end of each contact lever are resting against the upper or space contact screws. At this time the transmitting distributor brush is resting across the common or inner commutator disc and the outer stop segment, causing the line to remain closed.

Before placing a section of perforated tape in the 14 type transmitter distributor, caution should be taken to determine that the tape is not turned over; this may be observed by detecting that one side of the tape is slightly rougher than the other. This may be explained by stating that the punches in the 15-A Perforator Transmitter come up through the tape from the underneath side. Therefore, the top of the tape will be slightly rougher than the underneath side.

A tape lever is provided which projects through the loop of untransmitted tape between the 15-A Perforator Transmitter and the 14-A Transmitter Distributor and stops the automatic transmitting of the tape when the loop becomes short, raising the tape lever and opening a set of contacts which breaks the circuit to the stop magnet. When the magnet is de-energized the stop magnet armature and stop arm will be operated to normal position by tension of stop arm spring. When the projection on the stop cam engages the stop arm the transmitting distributor will be restored to normal until additional slack in the tape is provided.

When a section of perforated tape has been properly placed in the transmitter and the retaining lid plate has been latched, and the tape stop switch turned to the "On" position, this will close a circuit through the stop magnet energizing the stop magnet which pulls up its armature against the tension of its spring operating the stop arm which releases from engagement with the projection of the stop cam. The main shaft starts to rotate through the medium of the friction clutch propelled by a motor. Immediately after the release of the main shaft clutch the transmitting brush will pass off from the stop commutator segment onto the open or start commutator segment which sends a start impulse to the receiving teletypewriter. When the high part of the operating cam moves away from the roller on the operating lever the front part of the operating lever will move to the left, per-

mitting the top part of the contact lever bail and contact levers to move to the right under tension of each contact lever spring. Assume that the perforation in the tape directly above the tape pins represent character "E." The right end of the number one contact lever will position the number one tape pin directly up and through the perforation for the number one selection in the tape. This will cause the corresponding transmitter contact lever at the left to move its corresponding contact from the space contact screw to the marking contact screw, closing a circuit to the number one segment on the transmitter distributor commutator disc, then to the line circuit and receiving teletypewriter. The transmitter brush passes over each respective commutator segment and each of the transmitter contacts is closed or open due to the tape passing or blocking the pins.

In view of the fact that the perforated selection in the tape only included the number one hole, the two, three, four, and five pins will not move in an upward direction through the tape, on account of being blocked out; therefore, the numbers two, three, four, and five transmitting contacts will remain against the space contact screw. Therefore, when the transmitting brush passes over the numbers two, three, four, and five commutator segments the line will remain open.

The tape is stepped forward by means of the tape feed lever and feed pawl, which operates a feed wheel ratchet, which turns a feed wheel and the feed wheel engages the feed holes cut in the tape. A detent lever and roller operated by a spring provides for accurate stepping of the tape.

BASIC TELETYPEWRITER READING COURSE

SECTION E

14 TYPE TELETYPEWRITER
LESSON NOTES

1. GENERAL

1.01 The purpose of this section is to furnish some notes that will be helpful in explaining those operations of a 14 type teletypewriter on which no character is printed.

1.02 For other features of the 14 type teletypewriter refer to AB84.128 and the related "P" sections of the Bell System Practices. Where the student is already familiar with the operation of the 15 or 19 type teletypewriter, the transmitting, receiving, and printing features can be readily explained by comparison.

1.03 Refer to AB84.143 for the operation of the 14 type typing reperforator.

2. SHIFTING AND UNSHIFTING (See Figures 31, 32, and 33, B.S.P. Section P35.610)

2.01 The selection and operation of the shift or figures pull bar will cause the carriage locking pawl to disengage from engagement with the carriage locking toe. This operation will cause the carriage to be operated to the figures position under the tension of the carriage return spring. The carriage will remain in this position until the operation of the letters or space pull bar.

2.02 The selection and operation of the unshift or letters pull bar will operate the shift rocker lever and shift rocker in such a manner as to operate the carriage to the unshift or letters position against the tension of the carriage return spring. The selection and operation of the space pull bar will also operate the carriage to the letters position in the same manner.

3. SIGNAL BELL (See Figures 34 and 35, B.S.P. Section P35.610)

3.01 When the carriage is in the figures position, the roller on the pull bar lockout lever is moved out from engagement with the bell pull bar. The selection and operation of the bell pull bar will cause the extension on the lower portion of the bell pull bar to engage the bell hammer. This operation will cause the bell clapper to strike the bell one stroke for each operation of the bell pull bar.

3.02 When the platen is in letters position and the "S" selection is set up, the bell pull bar will be blocked by the roller on the pull bar lockout lever. The "S" pull bar is also blocked out by the pull bar lockout lever when the platen is in the figures position and the "S" selection is set up.

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4. FEEDING THE TAPE (See Figures 26, 27, and 28, B.S.P. Section P35.610; and Figures 9 and 10, B.S.P. Section AB84.128)

4.01 As the main bail plunger moves up, the spacer operating lever roller rides on the high part of the plunger and the spacer feed pawl is moved into position to engage a tooth on the spacer ratchet wheel. As the main bail and main bail plunger move downward, the roller on the spacer operating lever will ride into the indent of the main bail plunger under the tension of its spring. This operation will cause the spacer feed pawl to rotate the spacer ratchet wheel one tooth on the ratchet wheel. A detent lever and roller operated by a spring will provide for accurate operation of the spacer feed pawl together with the spacer ratchet wheel. The spacer ratchet wheel transmits its motion through the medium of two gears and two short shafts to the platen roll. A tape feed roll is operated through a gear arrangement from the platen shaft.

4.02 The tape feed roll is held against the platen under tension of the tape feed roll lever and spring.

5. SPACE CUTOUT (See Figure 26, B.S.P. Section P35.610; and Figure 10, B.S.P. Section AB84.128)

5.01 On operations that require no spacing, the lower portion of the selected pull bar will engage the spacer locking bail. On the upward travel of the pull bar, the spacer locking bail will be raised against the tension of its spring. This causes the extension in the center of the spacer locking bail to be moved downward disengaging from engagement with the spacer locking pawl which will be moved upward under tension of its spring. This operation blocks the operation of the spacer operating lever in such a manner that the roller on the spacer operating lever will not be moved into the indent on the main bail plunger. Under this condition, the printer will not space.

6. "BREAK" FEATURE (See Figures 13 and 14, B.S.P. Section P35.620)

6.01 When the blank pull bar is selected, a projection on the lower rear portion of the blank pull bar will engage the rear portion of the manual contact lever. On the upward travel of the blank pull bar, the rear portion of the manual contact lever will be raised and the front lowered, causing the bell hammer to strike the signal bell. The manual contact lever will be held in this position by the detent arm and spring until manually restored to normal. At the time the manual contact lever was operated, the contact arm will be positioned so as to permit a set of contacts to close which will short circuit the keyboard contacts until the manual contact lever is restored by hand.