Bulletin No. 3.

Nos. 7 and 8 TELEPRINTERS

(PAGE and TAPE).

Description and Principle of Operation.

Creed & Company Limited

NOS. 7 AND 8 TELEPRINTERS

(PAGE and TAPE).

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BULLETIN No. 3.

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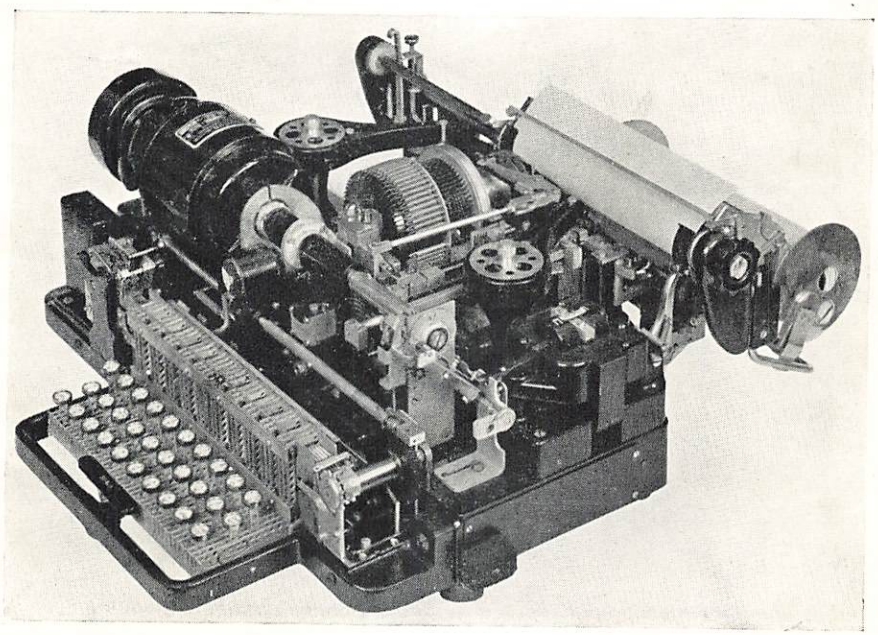
FRONT VIEW OF NO. 7 PAGE TELEPRINTER.
FIGURE 1.

CREED TELEPRINTER MODELS 7 and 8.

CONTENTS.



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FRONT VIEW OF NO. 7 PAGE TELEPRINTER WITH COVER REMOVED.
FIGURE 2.

CREED TELEPRINTER MODELS 7 and 8.

GENERAL.

This bulletin describes the No. 7 Transmitting-Receiving Teleprinter and the No. 8 " Receiving only " Teleprinter. It also includes a technical description of the operating mechanism.

These machines closely resemble other Creed Teleprinters already in extensive use throughout the world, but numerous improvements in design and construction have been introduced as well as a number of new and important operating features.

In their standard form they meet in all respects the requirements recommended by the C.C.I.T.

They have been designed in order to meet a wider range of traffic and operating conditions in the service of Administrations, Press, Railways and other large users of telegraph equipment, and to bring within the bounds of practicability a machine which can be introduced into commerce and industry with the assurance that it will provide an accurate and dependable service.

CONSTRUCTION.

Figures 1, 2, 3 and 4 show the Teleprinter No. 7 fitted with a Page printing attachment and Figure No. 5 shows the Teleprinter No. 8 fitted with a Tape printing attachment.

The standard keyboard shown in these figures and described in the following text can be replaced if desired by a keyboard designed to meet the special requirements of alphabets comprising more than 26 characters. This keyboard is described in Bulletin No. 2.

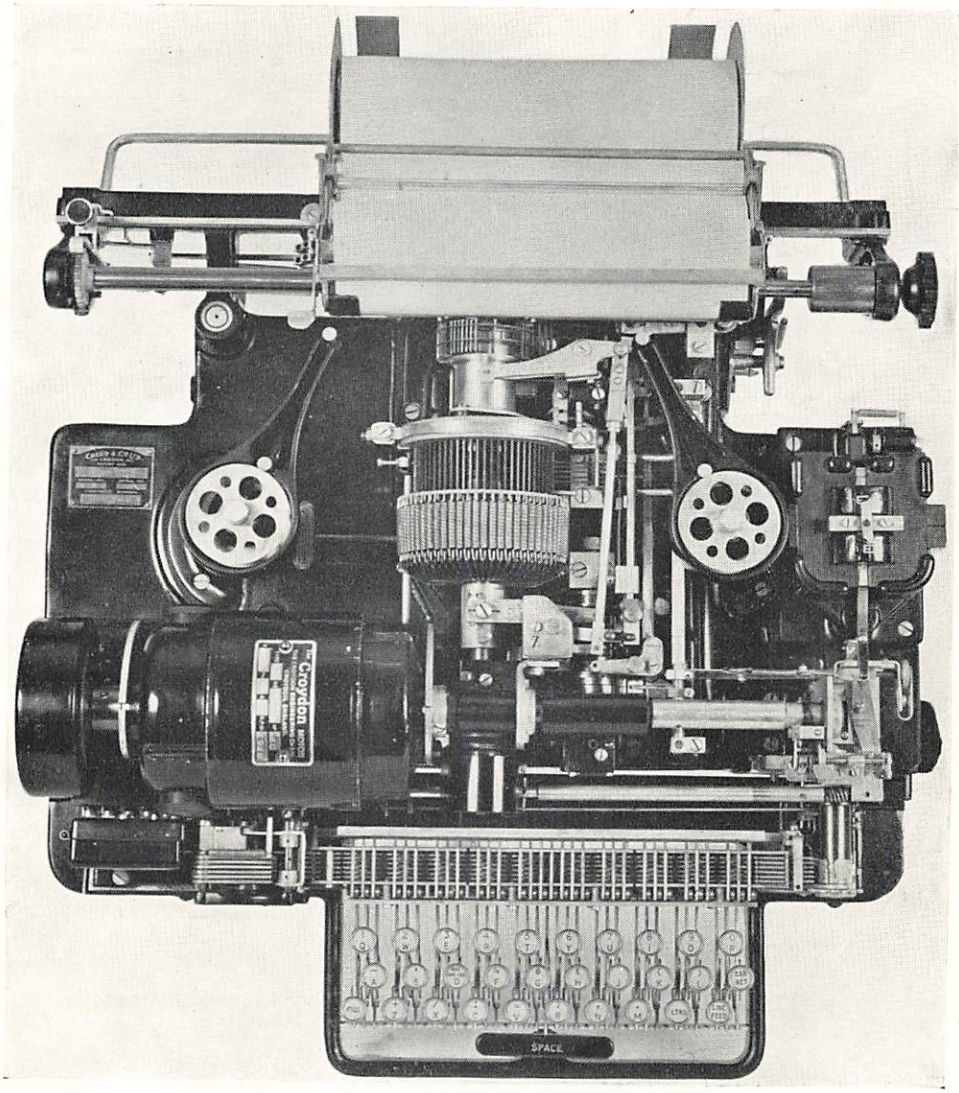
A striking feature is the ease with which the instrument can be taken apart and reassembled.

It is designed in unit assemblies, each unit being complete in itself and readily detachable from the main base without disturbing the adjustment of adjoining units.

In the commercial typewriter the carriage travel occupies from 18″ to 19″ and by determining the width of the new Teleprinter on this basis it has been possible to place all the apparatus on one level.

The machine may be divided into three main sections :—

The Teleprinter sub-assembly.
The Keyboard Unit.
The Printing Attachment.



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PLAN VIEW OF NO. 7 PAGE TELEPRINTER WITH COVER REMOVED.
FIGURE 3.

The Teleprinter sub-assembly comprises the following units :—

The Main Base.
The Combination Head.
The Typehead.
The Cam Unit.
The Typehammer Unit.
The Control Lever Unit.
The Operating Electro-magnet.
The Biasing Unit.
The Starter Switch Control Unit.
The Motor Unit.
The Governor Unit.
The Mainshaft.
The Starter Switch.
The Ribbon Feed Brackets.

The Keyboard Unit is attached to the Teleprinter sub-assembly by two fixing screws and comprises the following units :—

The Keyboard Assembly.
The Transmitting Unit.
The Answer-Back Unit.

The printing attachment may be either for page or tape printing, the two attachments being interchangeable.

The Page printing attachment can also be replaced by one employing a sprocket type of paper feed which is essential where a number of copies are required on printed stationery.

All units are provided with locating abutments, adjusted to functional gauges in the factory and are, therefore, interchangeable.

All the electrical and mechanical connections of the units are made automatically when they are screwed down on the main base.

The coupling between the main driving shaft and the motor is simple and practically self-aligning and the motor can be removed by removing two screws.

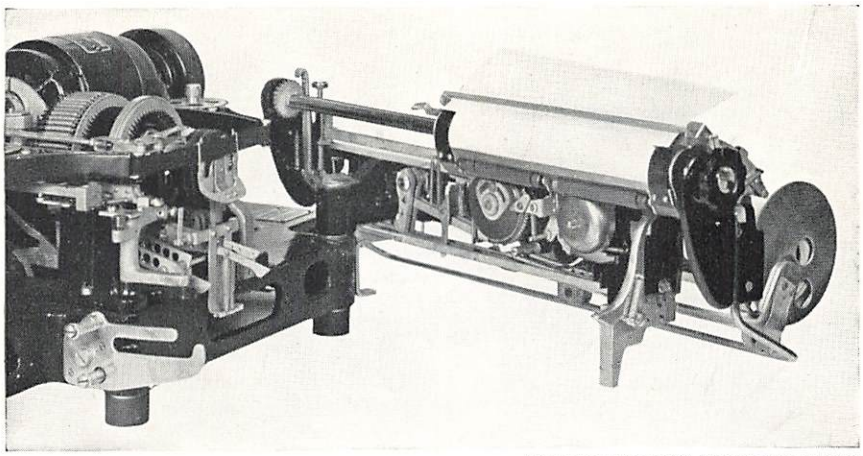
There is only one high speed shaft in the machine. At one end of this shaft is the motor and at the other end the automatic motor starter. At right angles to this shaft and driven from it are the printing head, the receiving cam shaft, the transmitting cam shaft and the " Answer-back " shaft.

The typehead is provided with an outer bearing in order to preserve accurate alignment of the printing and the typehead stop is provided with an efficient shock absorber.

The mounting of the driving shafts in ball bearings has enabled a smaller motor to be used than on previous models. It has also eliminated the need for frequent lubrication.

THE MOTOR AND GOVERNOR.

The motor is normally series wound and has half the field winding connected on each side of the armature to reduce interference with radio circuits.



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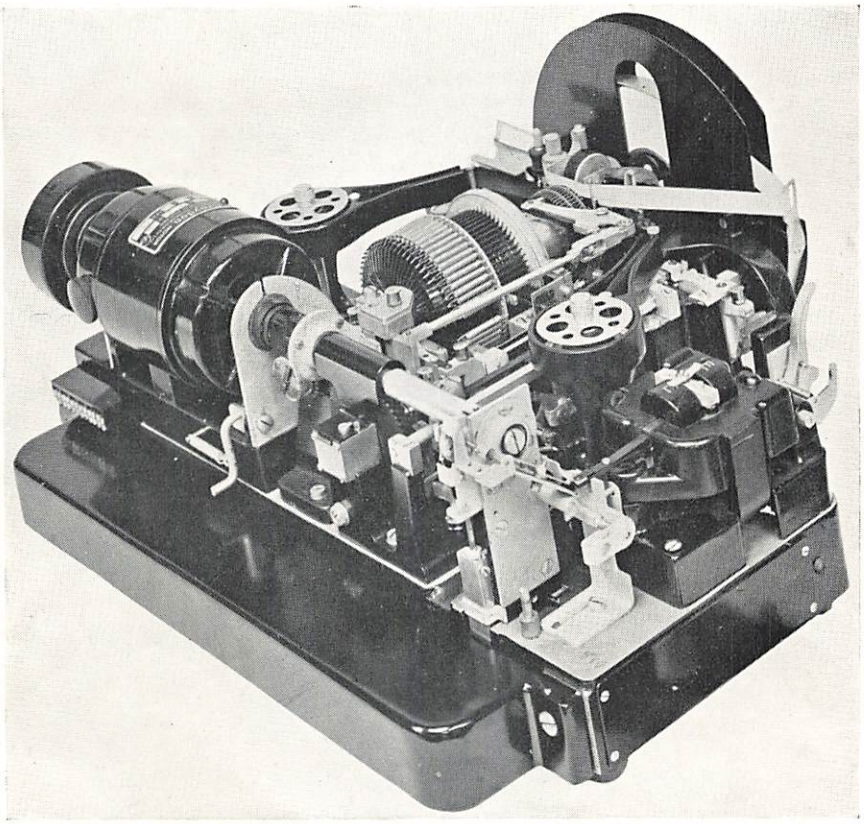
REAR VIEW OF NO. 7 PAGE TELEPRINTER
WITH PAPER CARRIAGE WITHDRAWN FROM PRINTING CONTROL LEVERS.
FIGURE 4.



FRONT VIEW OF NO. 8 TAPE TELEPRINTER WITH COVER REMOVED.
FIGURE 5.

Double brushes are provided as well as a special fan which ensures that even when the printer is totally enclosed within a silencing cover the temperature is always maintained within safe limits.

For use where mains supplies are not available shunt wound motors can be provided for operating from D.C. supplies lower than 40 volts.

RADIO INTERFERENCE SUPPRESSORS.

Where the machines are to be operated in close proximity to radio receiving equipment means can be provided to reduce the interference produced to a low level.

TYPEWRITER RIBBON INKING.

Printing is effected by means of an ordinary typewriter ribbon.

THE PAPER CARRIAGE AND CHARIOT.

The paper carriage is unique in that it is a self-contained unit which can be removed by pressing a latch and then lifting it off a large pivot in the main base. The platen is mounted on ball bearings and is provided with an adjustable dashpot.

Another novel feature is a travelling chariot for the paper roll. This moves from side to side with the paper carriage and thereby maintains proper alignment of the paper.

MOUNTING.

This Teleprinter may be mounted on any table, as it requires no screws to fix it in position and it is not necessary to cut the table in any way. The plug sockets through which the electrical connections are made may be fastened either to the table or a wall. The standard connecting cords are $4\frac{1}{2}$ feet long.

As the paper is carried in a chariot, the size of paper roll which it is possible to use is limited. In exceptional cases where a larger reserve is required, provision can be made for mounting a larger roll of paper below the table top.

SILENCING COVER.

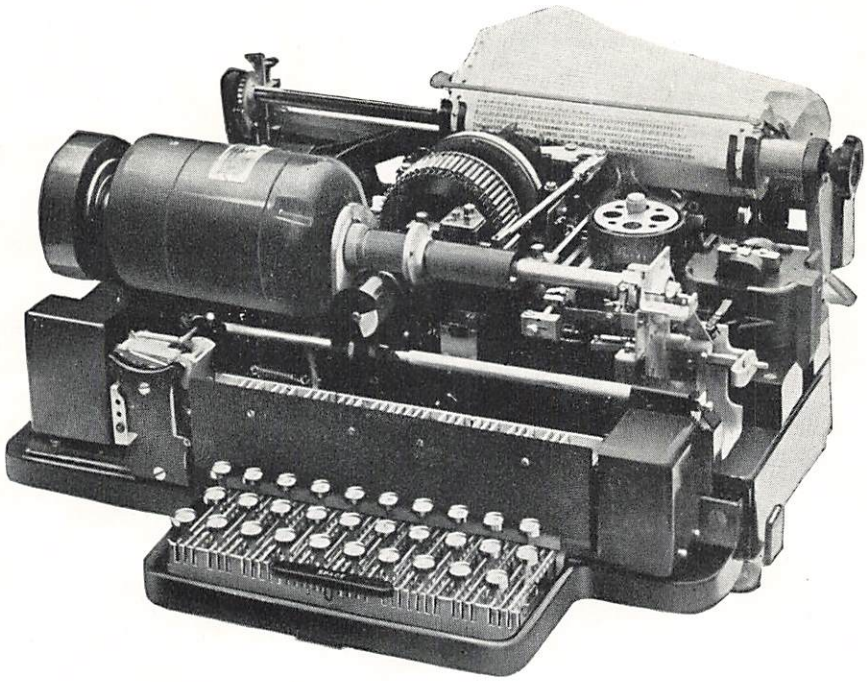
Where quietness is of considerable importance, the machine may be fitted with a special silencing cover instead of the standard dust cover.

DIMENSIONS.

The overall dimensions of the machine including its dust cover are :—
Width, $19\frac{1}{2}''$. Depth, $23\frac{1}{2}''$. Height, $10\frac{1}{2}''$.

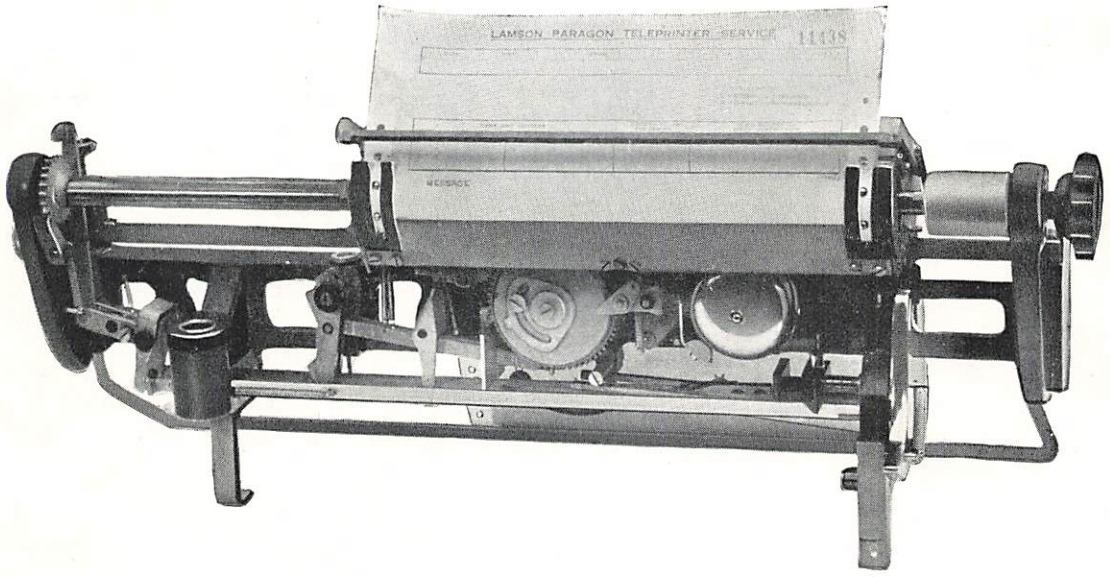
WEIGHT.

Complete with Keyboard and Page or Tape Attachment, 67 lbs. approximately.



TELEPRINTER MODEL 7 WITH SPROCKET FEED CARRIAGE.

FIGURE 6.



SPROCKET FEED CARRIAGE.

FIGURE 6a.

SIGNALLING CODE.

Like all other Teleprinters, this machine employs a 5-unit selecting code in which the current permutations forming each character are all of equal length.

		CODE ELEMENTS. (START ○ · 1 2 3 4 5 · ● STOP)
A		●●○○○
B	?	●○○●●
C	:	○●●●○
D	WHO ARE YOU?	●○○●○
E	3	●○○○○
F	OPTIONAL CHARACTERS	●○●●○
G	OPTIONAL CHARACTERS	○●○●●
H	OPTIONAL CHARACTERS	○○●○●
I	8	○●●○○
J	BELL	●●○●○
K	(	●●●●○
L	)	○●○○●
M	.	○○●●●
N	9	○○●●○
O	9	○○○●●
P	0	○●●○●
Q	1	●●●○●
R	4	○●○●○
S	'	●○●○○
T	5	○○○○●
U	7	●●●○○
V	=	○●●●●
W	2	●●○○●
X	/	●○●●●
Y	6	●○●○●
Z	+	●○○○●
CARRIAGE RETURN		○○○●○
FIGURES		●●○●●
LETTERS		●●●●●
LINE FEED		○●○○○
SPACE		○○●○○

ELEMENTS WHICH CAUSE THE SETTING OF TELEPRINTER COMBINATION DISCS OR PERFORATION OF REPERFORATOR TAPE ARE SHOWN THUS ●. THEY ARE OFTEN REFERRED TO AS MARKING ELEMENTS WHILST THOSE OF THE OPPOSITE KIND ARE KNOWN AS SPACING ELEMENTS.

EACH GROUP OF CODE ELEMENTS IS PRECEDED BY A START SIGNAL AND SUCCEEDED BY A STOP SIGNAL. THE LATTER MAY BE OF 1 OR 1½ UNITS DURATION.

THE START-STOP CODE.
FIGURE 6.

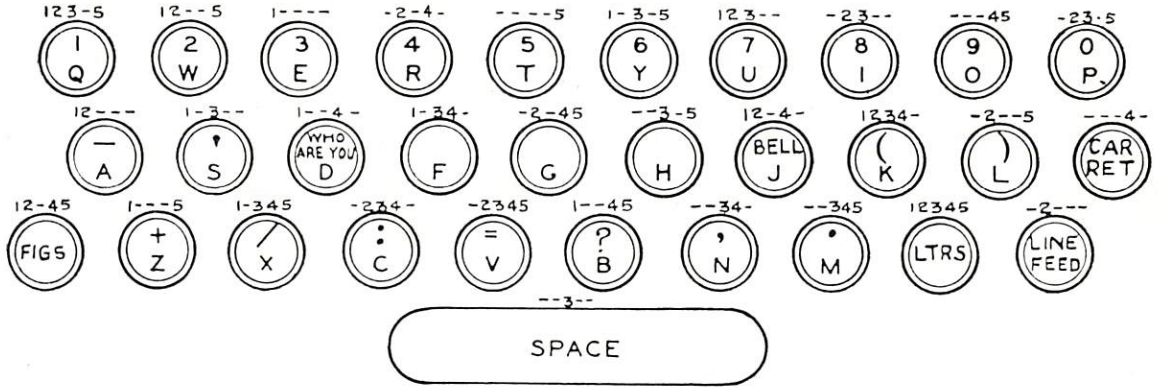
Every 5-unit signal permutation is preceded by an impulse which releases the receiving printer and is followed by an impulse which brings the printer to rest again. In this way the instruments at each end of the line get a fresh start for each character, and the effect of any slight differences between the speeds of their driving motors cannot accumulate.

The signalling code used by the standard model is shown in Figure 6.

In this arrangement the characters have been allocated to the various combinations in accordance with the recommendations of the C.C.I.T. The secondaries of letters F, G and H have been left free for allocation to any desired characters to meet local requirements.

In order to avoid confusion the two types of signal elements which are arranged in groups of five to form the signal combinations are referred to as starting and stopping impulses respectively.

The impulses, which are of the same type as that which starts the printer cam, permit the corresponding combination setting levers in the printer to remain unmoved.



TYPICAL KEYBOARD LAYOUT.
FIGURE 7

Those, which are of the same type as the impulse which brings the printer cam to rest, cause the corresponding combination setting levers in the printer to be moved out of their normal position.

CODE CHARACTERISTICS.

Creed Teleprinters have hitherto always been designed to employ a signalling code consisting of $7\frac{1}{2}$ units or impulses per character. The first unit of every combination moved the armature of the operating magnet to the starting position and released the receiving printer cam. This unit was the same length as the five selecting units which followed it, but the final, or "stop," impulse was $1\frac{1}{2}$ units long. The receiving printer cam was arranged to reach its rest position after one unit of the stop impulse, the receiver cam remaining at rest during the period of half an impulse before the commencement of the next character.

The first model of the No. 7 Teleprinter (Model 7a), was designed to operate in this manner.

In 1932 the C.C.I.T. decided to standardize, for Arythmic (start-stop) systems, an operating code of seven impulses of equal duration. When receiving from transmitters sending seven equal length impulses, there is a loss of operating margin with the No. 7a Teleprinter as the rest period is lacking.

In view of the large number of these machines already in service the British Post Office decided to adopt a universal model known as the Model 7b Teleprinter. This is arranged to transmit $7\frac{1}{2}$ impulses, but is designed to receive from 7 unit transmission without loss of operating margin. The receiving printer cam in this model is arranged to come to rest approximately in the middle of the seventh impulse, thus restoring to the receiving cam its half impulse rest period.

In order to meet completely the 1932 requirements of the C.C.I.T., a third model (the No. 7c Teleprinter) is available to transmit 7 equal impulses.

The receiving printer cam on this machine has the same characteristics as that of the 7b Model.

In 1934 the C.C.I.T. recommended that in special cases a prolonged stop signal be used and that in some cases it should be permissible to use a stop signal of $1\frac{1}{2}$ impulses duration. The Model 7b meets this requirement.

The Code characteristics of the three models can be summarized as follows :—

Model.	Angular divide of Transmitting Cam.	Angular divide of Receiver Cam.	Will operate with	Cadence speed at 50 Bauds.
7a	$7\frac{1}{2}$	7	7a, 7b or previous Creed Teleprinters	66 w.p.m.
8a		7		
7b	$7\frac{1}{2}$	$6\frac{1}{2}$	7a, 7b, 7c, Teletype, Lorenz, Siemens & Halske and previous Creed Teleprinters	66 or 72 w.p.m. according to whether the transmission is $7\frac{1}{2}$ or 7 unit.
8b		$6\frac{1}{2}$		
7c	7	$6\frac{1}{2}$	7b, 7c, Teletype, Lorenz or Siemens & Halske.	72 w.p.m.

OPERATING FEATURES.

The Model No. 7 Teleprinter may be operated by any typist and prints the message either on a roll of paper $8\frac{1}{2}''$ wide, on packs of printed forms or on a paper tape, according to the kind of printing attachment employed.

Figure 7 shows a representative Keyboard layout.

Where a Page attachment is used and more than one copy is required, carbon-backed paper in manifold books of separate sheets interleaved with carbons may be employed, and up to six copies can be obtained.

The Model No 8 Teleprinter is employed where reception only is required, such as in News Distribution and Ticker services.

A Model No. 8 Teleprinter can be converted into a Model No. 7 Teleprinter by the addition of the Keyboard Unit.

Where operation is upon a single current basis, the minimum line current required is 30 m.a. according to the voltage employed. When double current operation is employed, the minimum line current required is 25 m.a.

A single transmitting armature is used, which ensures that all signals have the same characteristics.

The transmitting armature is controlled by an accurate timing mechanism which limits the transmission distortion to less than that permitted by the C.C.I.T., and the construction of the contact mechanism is such that armature rebound is obviated.

The same high grade polarized receiving electro-magnet is used as on previous models, so that the Teleprinter can be operated over long distances without the use of a supplementary line relay. This electro-magnet has two windings, type E, connected in series, each having a resistance of approximately 100 ohms.

SEND-RECEIVE SWITCH.

Where telegraph apparatus is operated on a double-current Simplex basis (transmission in one direction at a time), it is necessary to provide a switch for changing over from the sending to the receiving condition and vice versa.

An automatically operated switch is provided on the Teleprinter Transmitter to effect this change-over either directly or by controlling relays with a delayed action.

AUTOMATIC MOTOR AND SPEED CONTROL.

A simple automatic switch is provided to disconnect the Teleprinter motor circuit should no signals be transmitted for approximately $1\frac{1}{2}$ minutes and to reconnect the motor on the receipt of the first signal after the pause.

The motor speed is maintained constant within $\pm 0{\cdot}5\%$ by means of a governor which requires no operating adjustments and negligible maintenance.

" ANSWER-BACK " DEVICE.

To meet the requirements of Teleprinter Exchange services the machine is fitted with an "answer-back" device the function of which is to enable a calling subscriber to verify that the Exchange Operator has established the correct line connection.

On depressing a key marked " Who-are-you ? " a signal combination is transmitted which causes the " answer-back " device on the " wanted " subscriber's machine to repeat back its Exchange number to the " calling " subscriber.

Therefore, even when the wanted office is unattended, messages can be transmitted with the assurance that they are being sent to the correct subscriber and that his Teleprinter is operating satisfactorily.

MAINTENANCE.

Models Nos. 7 and 8 have been designed with the object of reducing maintenance costs to the absolute minimum.

Although they are only required to operate at a maximum speed of 72 words per minute, all the laboratory tests have been carried out at a speed 25% higher. As wear and tear is approximately proportional to the square of the operating speed, it will be evident that a very wide margin of safety has been provided and that the machine should have a long life.

The introduction of unit construction greatly facilitates field maintenance as it ensures strict interchangeability of parts. In the event of a fault developing, the complete unit with which the particular part is associated can be changed immediately with little need for readjustment of the machine.

LUBRICATION.

The extensive use of ball bearings has eliminated the need for frequent lubrication.

Small lubrication cups are provided for the few parts which require lubrication more frequently, and these prevent the possibility of superfluous oil being scattered over the instrument.

OPERATION.

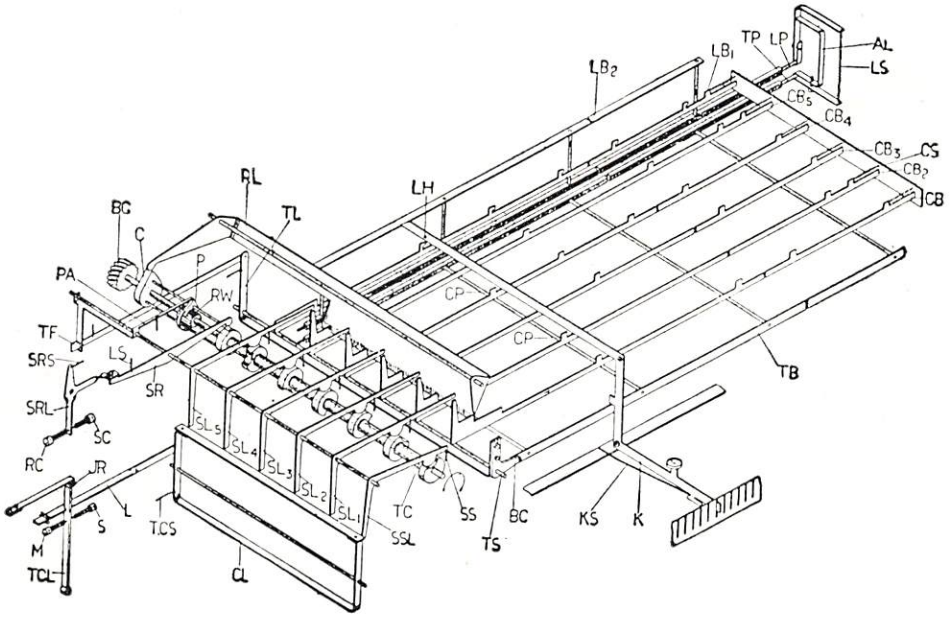
GENERAL PRINCIPLES.

There are a number of well-defined stages between the depression of a key and the impression of the selected character on the paper in the distant printer. The operation of the mechanism involved in each of these stages is considered in detail after the following general outline of the principles of operation.

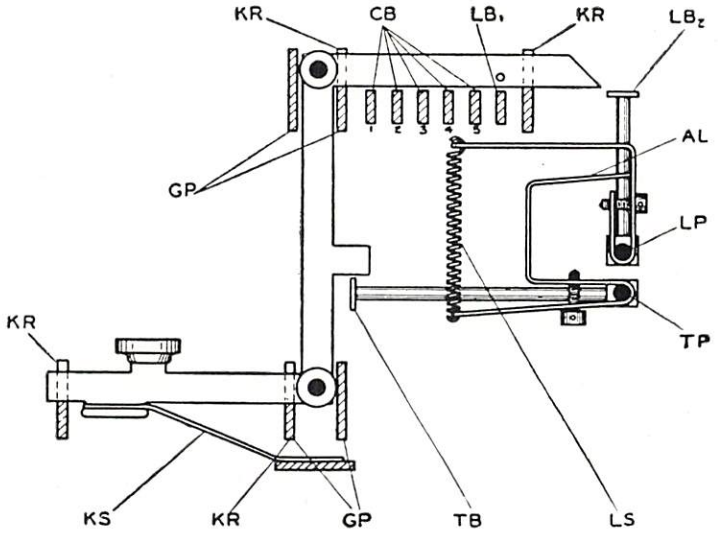
Every character is allotted a combination of five units, each of which may possess one of two characteristics and this combination in various forms is passed through the system between the transmitter and the printer. Thus, when a signal combination is transmitted over the line, it is distributed over five successive equal intervals of time, during each of which either current or no current may be flowing in the case of single current operation, or current at either a positive or negative potential in the case of double current operation.

In the case of operation over voice frequency channels the impulses are intervals of " tone " or " no tone."

When a key is depressed it engages a clutch to which is coupled a series of cams controlling the sequence of the transmitting operations. Under the control of one of these cams the depressed key is immediately locked down, and all the other keys in the keyboard are prevented from moving until the selected character has been transmitted. The depression of each key is designed to arrange, in a particular manner, five bars



THE TRANSMITTING MECHANISM.
FIGURE 8.



KEYBAR AND LOCKING BAR MECHANISM.
FIGURE 9.

which may be moved longitudinally. A displaced bar corresponds to a " stopping " impulse and an unmoved bar to a " starting " impulse. Under the control of the cams each of these bars determines, in correct sequence, the characteristic of one unit of the combination transmitted.

In addition to the impulses forming the particular character combination, two additional impulses are automatically transmitted every time a key is depressed. One of these impulses precedes the character combination and serves to engage a clutch through which the printer selecting mechanism is driven, while the other, which is the last to be transmitted, causes this clutch to be disengaged after the signal has been translated. These impulses are termed the " start " and " stop " impulses respectively.

The five unit combination initially set up in the transmitter and then transmitted over the line as a series of impulses is reconstructed in the receiver by the setting of each of a group of five combination setting levers in one of two positions.

Each of these levers corresponds to one of the signalling impulses and a setting pin is moved past them in sequence so that the pin is opposite the centre of each lever during the central portion of its corresponding signalling impulse.

The setting operation is carried out by a striking mechanism which is thrust toward the pin in synchronism with the centres of the signal time intervals.

Whether the thrust results in the setting of the lever or in its remaining unmoved depends upon the operation of the electro-magnet which, through the medium of a control shaft, either permits the striking mechanism to hit the pin or deflects it out of its path, according to whether a " stopping " or a " starting " impulse is received.

The " stopping " and " starting " impulses are sometimes termed " marking " and " spacing " respectively to correspond with the established method of naming telegraph signalling impulses.

The last stage in the selection of the character to be printed is carried out by an application of the principle of the combination lock, by means of which one of a series of radial latches is caused to drop and thereby stop a rotating typehead in such a position that the required type is interposed between a small hammer and the paper. The hammer is operated during the latter part of the selection cycle for the next character and the impression is thus made on the paper.

In the five unit code there are thirty-two different combinations available, and since the keyboard is invariably required to include a much greater number of characters than this, two combinations are appropriated for the operation of figure and letter "shift" mechanism. The printer apparatus is so arranged that all combinations received between the receipt of a " letter shift " signal and a " figure shift " signal cause letter shift characters to be printed. Conversely, between the receipt of a " figure shift " signal and a " letter shift " signal, figure shift characters will be printed.

THE KEYBOARD TRANSMITTER.

The transmitting mechanism is divided into two units : the keyboard and the transmitting head. These units, together with the "answer-back " unit, are mounted on a casting which may be detached from the base of the machine by removing two screws. The " answer-back " unit is an auxiliary feature and will be described later.

Figure 8 shows the keyboard and the type of transmitting head which was fitted to Model 7 Teleprinters until January, 1939. An improved transmitting unit which was then introduced is shown in Figure 10.

The keybars K (only one is shown) are free to move vertically between two pairs of guide plates GP (Figure 9), a pair of rollers being fitted to each key to reduce friction. The keys also pass through slots in the four racks KR (Figure 9) which prevent lateral movement. Each key is fitted with a spring KS which resets it after operation. Two of the racks KR serve a double purpose, as they also act as guide plates GP (Figure 9).

A series of six bars pass under the rear ends of the keybars, one of which, LB 1, serves to lock any depressed keybar during the transmission ; the other five bars CB (comb bars) each control one unit of every combination transmitted.

The comb bars, CB to CB 5 (Figure 8), and the locking bar, LB 1, are supported in a rack at either end, and have springs CS tending to draw them to the right, but they are normally held to the left by the lever RL. One end of this lever is held in contact with the cam C by the springs CS through the bars CB. Immediately the cam commences to rotate, the tail of the lever RL is free to move to the right, and the six bars LB 1 and CB to CB 5 are then under the control of the springs CS.

The five bars CB to CB 5 each select one unit of the character combination, those bars which correspond with a " starting " impulse being prevented from moving by a projection CP engaging the bottom edge of the depressed keybar. Thus, when, for example, the " H " key is operated, comb bars 3 and 5 will move to the right immediately they are released, but comb bars 1, 2 and 4 will be prevented from moving by the projections CP. A character combination is built up in this manner under every keybar.

When the locking bar LB 1 is moved to the right, one of the hooked projections engages with the hole LH in the depressed key and locks it in the operated position until the locking bar is reset by the lever RL, when the cam C has completed its revolution.

In addition to the locking arrangement necessary to retain a key depressed whilst transmission is taking place, a locking bar LB 2 is provided to prevent the depression of a second key before the first has been released. A spring LS tends to turn a pivoted rod LP (Figures 8 and 9) about its pivot, and thereby bring the bar LB 2 under the ends of the keybars. This action is prevented by the lever AL while all the keys are raised, but immediately a key has depressed the trip-bar TB, the shaft TP is turned and the lever AL releases the locking bar, allowing it to be drawn under the ends of all the keybars except the one that has been depressed. No other key can now be depressed until the first key has been released and the cam has completed its revolution. It is thus impossible to interfere with the combination by depressing a second key.

The left-hand ends of the comb bars CB to CB 5 have raised extensions which in the rest position shown are under the right-hand ends of five corresponding selecting levers SL 1 to SL 5.

Thus, when a selection is set up on the comb bars by the depression of a key, certain of the extensions are moved to the right from beneath their selecting levers.

TRANSMITTING UNIT (OLD TYPE).

The operation of any key depresses the trip bar TB which is free to turn about the pivot TP (Figures 8 and 9), as described above. The end of the trip bar is coupled to the trip bell-crank BC (Figure 8) which, in turn, causes the member TL to turn about the spindle TS, thus drawing the trip finger TF to the right.

The cam TC takes the form of a sleeve, through the centre of which passes a constantly revolving shaft carrying a ratchet wheel RW. A pawl P is pivoted on the cam, with a spring tending to hold it in engagement with the ratchet.

The pawl is normally kept out of engagement with the ratchet wheel by the pawl abutment PA, but when the trip finger is moved, as a result of the depression of a key, the pawl abutment is disengaged from the pawl, thus allowing the latter to engage with the ratchet. The cam sleeve is in this way coupled to the ratchet shaft and commences to revolve. When it has completed half a revolution, the cam C depresses the trip finger TF and disengages it from the pawl abutment PA. The latter is thereby reset in the path of the revolving pawls and brings the cam to rest at the end of one revolution.

The cam TC has six tracks with angularly spaced notches to permit the successive fall of the selecting levers SL 1 to SL 5 and SSL under the action of springs SS.

A lever CL is pulled by spring TCS, so that its upper edge is held against the lower ends of the selecting levers.

A link L pivotally connected to the lever CL engages with the transmitting contact lever TCL.

In the position shown the selecting lever SSL, which has no associated comb bar, is pulled down under the tension of its spring SS into the notch of the cam, so that its lower extremity turns the lever CL anti-clockwise against the tension of spring TCS. The link L thereby holds the transmitting contact lever TCL on the contact M. A jockey roller JR holds the lever firmly against the contact.

When the cam TC commences to revolve, the selecting lever SSL rises ; lever CL follows under the tension of spring TCS ; the transmitting contact lever TCL is carried over to the contact S and the " start " impulse is transmitted.

As the cam TC continues to revolve the notches are brought successively under the selecting levers SL 1 to SL 5 which are pulled down by the springs SS unless prevented by the extensions of the corresponding comb bars.

The transmitting contact lever is thus rocked from one contact to the other in accordance with the combination set up on the comb bars.

Finally the cam comes to rest in the position shown with lever SSL holding the contact lever against the contact M.

TRANSMITTING UNIT (STRIKER TYPE).

CONSTRUCTION.

The transmitting cam TC (Figure 8) is released and the selecting levers SL1 to SL5 and SSL (Figure 8) are operated in the manner described in the preceding section.

The construction of the operating head (refer to Figure 10a) is also similar in that the downward extensions of the selector levers (SL1 to SL5 and SSL, Figure 8 ; E, Figure 10a) lie in the same plane as the insulated edge F of the operating lever frame which is pivoted on the pin S in the Insulation Base. This frame is also biased as before by the spring T, which tends to keep the top insulated edge to the right, but mounted on the top of the frame is the striker C freely attached by the screw U and guided by a slot cut in the end of the striker lever D. The striker lever has, as one of its components, an adjustable stop plate H which determines the movement of the striker. The striker lever also comprises an insulated extension A which is operated by a cam R on the transmitting cam shaft. The striker lever, stop plate and striker lever extension are pivoted on pin V mounted in the pivot adjustment W. The striker lever is secured to the mounting block X by the screw B and is adjustable in a vertical direction.

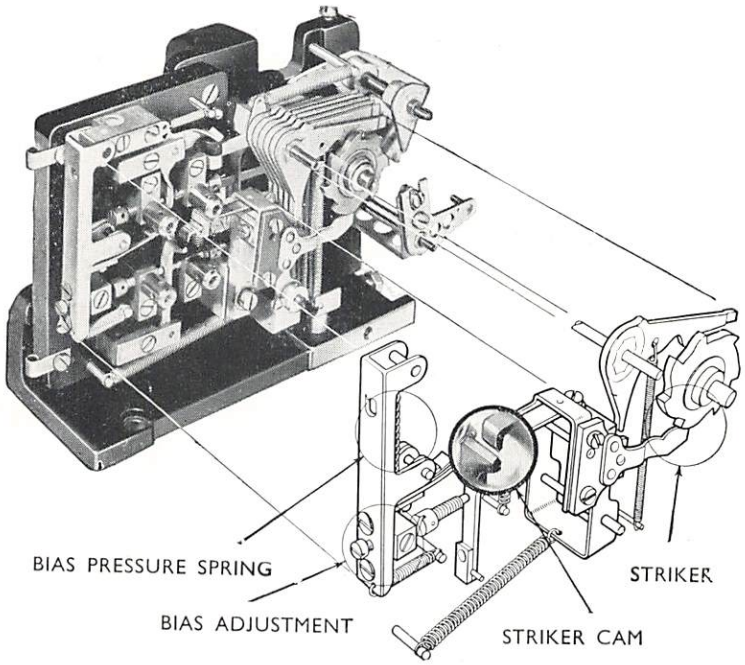
The contact lever is held firmly against either contact by means of a jockey roller O as on the original model, but the mechanism for adjusting the bias has been improved.

The roller is mounted on a spring blade which, with its backing strips, is secured to a small bracket, which is pivoted on Q. The jockey roller is kept in contact with the tongue by means of the spring Y and the whole assembly pivots on Z.

The jockey roller is located laterally by the adjusting screw N which, to avoid backlash, operates in conjunction with the spring AA.

PRINCIPLE OF OPERATION.

When a key is depressed the transmitting cam is released and the combination bars are selected.

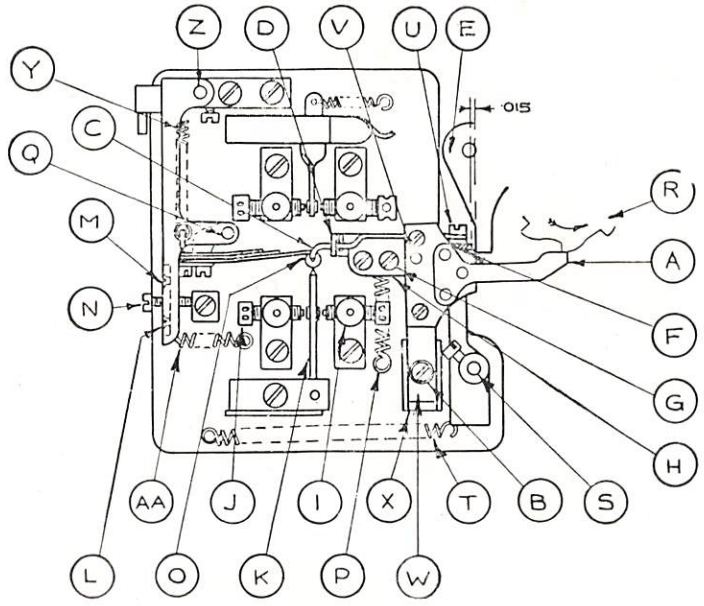


TRANSMITTING UNIT (STRIKER TYPE).
FIGURE 10.

The start-stop selector lever is raised by the cam and the insulated edge F of the contact operating lever is allowed to move to the right under the action of spring T, carrying the knife edge of the striker C to the right of the knife edge on the contact lever K. By this time the cam R has rotated sufficiently in an anti-clockwise direction to permit the striker lever extension A to rise sharply, under the tension of spring P, into a hollow cut into the periphery of the cam, thus bringing the striker down on to the knife edge of the contact lever and forcing the latter over to the left-hand or spacing contact.

(Note.—The positions of the marking and spacing contacts are reversed to those shown in Figure 8, the marking contact being now on the right-hand side of the contact lever. The wiring of the Teleprinter is, however, unaffected by this change).

Assuming the transmission of the letter Y (+ — + — +), the striker will be lifted by its cam as the latter continues to rotate and the first of the selector levers E will commence to fall at the same time. When the striker is fully lifted the vertical arm of the first selector lever will have reached the insulated edge of the contact operating lever and, as the selector lever continues to fall, the operating lever will be moved to the left carrying the striker with it. The striker cam is so cut and its speed of revolution is such that 20 milliseconds after the striker was allowed to fall the first time, it will again be allowed to fall, but this time it will force the contact lever over on to the right-hand or marking contact. The first selector lever will now commence to rise and as the next signal is a spacing signal the second selector lever will be prevented from falling and the top of the contact operating lever will be pulled to the right under the tension of the spring T. After a further period of 20 milliseconds the striker will again be released and the contact lever forced to the left-hand or spacing contact. It will be seen, therefore, that depending upon the selection set up on the combination bars the contact arm is moved either to the marking or the spacing contacts at precisely 20 millisecond intervals, this timing being determined by the striker lever cam R, and not by the movement of the contact operating lever. After the transmission of the 5th signal impulse, the start-stop lever again falls with a resultant movement of the contact lever to the marking contacts. The cam is then brought to rest in the normal manner upon the engagement of the pawls with the pawl abutment.



TRANSMITTING UNIT (STRIKER TYPE).
FIGURE 10a.

AUTOMATIC "SEND-RECEIVE" SWITCH.

For Simplex double current operation it is necessary to provide a switch for transferring the line from the printer to the transmitter.

An automatic switch is provided on the Teleprinter for this purpose. It may be used either direct or in conjunction with delayed action relays, the latter being necessary if trouble is experienced due to the capacity discharge from the line influencing the receiving magnet when the switch passes from "send" to "receive."

The connections for double current operation with a direct operating send-receive switch lettered SRL are shown in Figure 11.

If desired, a hand-operated switch may be used in place of the automatic switch fitted to the machine.

The automatic switch operates in the following manner, reference being made to Figure 8.

Contact levers TCL and SRL are normally in the positions shown, i.e., against contacts M and RC respectively, the line being connected to the printer.

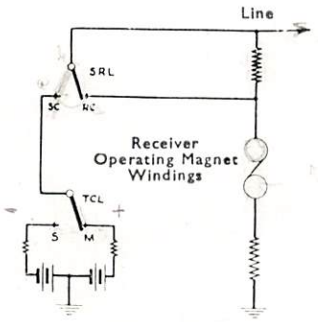
The send-receive switch lever is controlled by the lever SR which is held in contact with a cam by the spring LS.

The spring SRS is normally permitted to hold the lever SRL against the " receive " contact RC, but immediately the cam commences to revolve, the lever SR is allowed to turn about its pivot under the action of the spring LS, and the send-receive switch lever is moved to the " send " contact SC, in which position it remains until the revolution of the cam is completed, when it is returned to the " receive " contact RC.

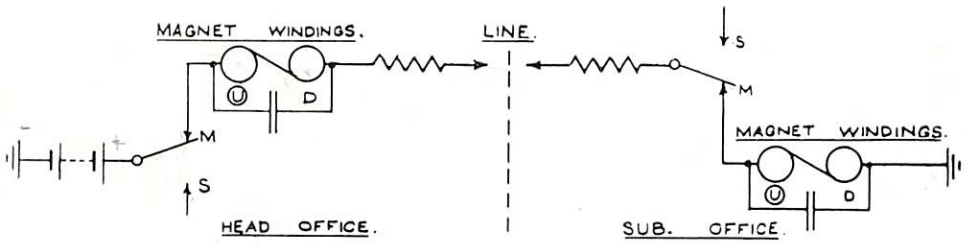
The send receive mechanism of the striker type of transmitting unit operates in the same manner.

For single-current closed-circuit operation, the send-receive switch is not required and connection is made directly to the transmitting contact lever, as shown in Figure 11a.

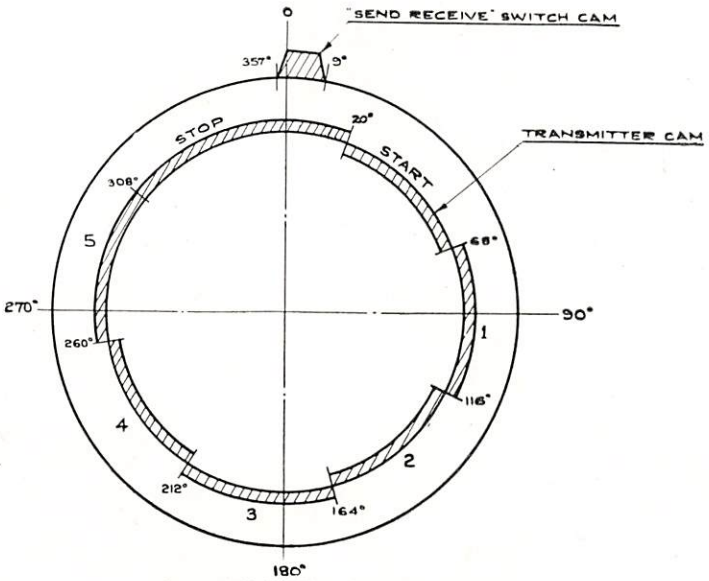
The timing of the various functions of the $7\frac{1}{2}$ unit transmitting cam are shown diagrammatically in Figure 12, and that for the 7 unit transmitting cam in Figure 12a.



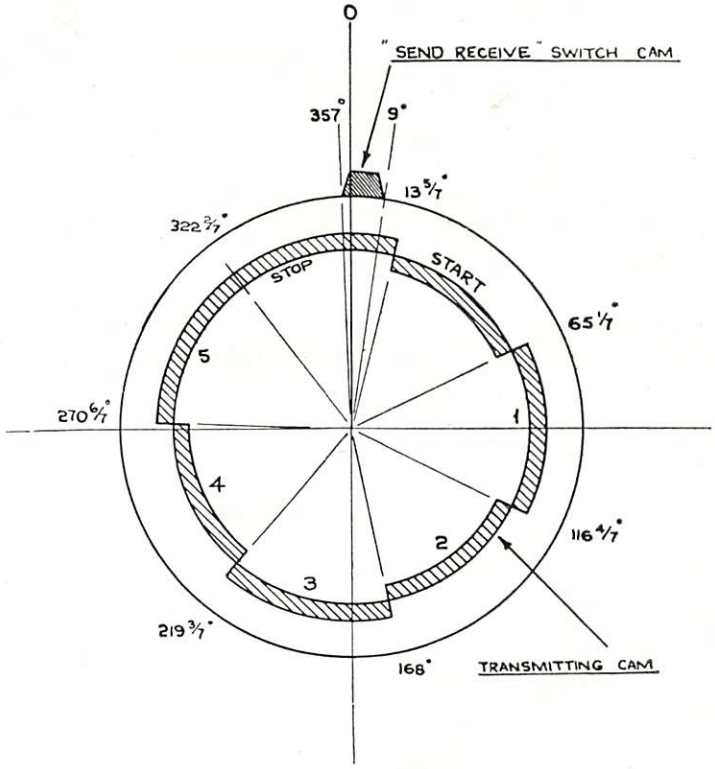
SCHEMATIC CONNECTIONS FOR DOUBLE CURRENT OPERATION.
FIGURE 11.



SCHEMATIC CONNECTIONS FOR SINGLE CURRENT CLOSED CIRCUIT OPERATION.
FIGURE 11a.



$7\frac{1}{2}$ UNIT TRANSMITTING CAM.
FIGURE 12.



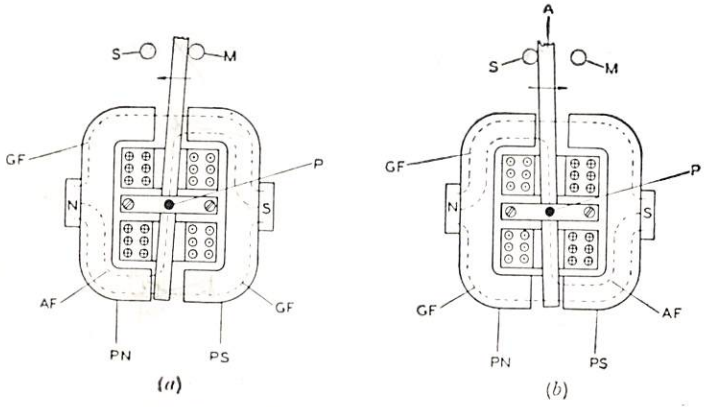
7 UNIT TRANSMITTER CAM.
FIGURE 12a.

THE PRINTER.

THE OPERATING MAGNET.

The received currents flow through the E Type windings (100 + 100 ohms) of a polarized electro-magnet the armature of which controls the selecting mechanism of the printer. Figure 13 shows the magnetic circuit in schematic form.

PN and PS are laminated pole pieces which are polarized by a permanent magnet of which the poles N and S are shown. The laminated armature A is pivoted at P.



MAGNETIC CIRCUIT IN ELECTRO-MAGNET.
FIGURE 13.

Figure 13a shows the normal position of the armature, the paths of the flux between the poles of the magnet being represented by the dotted lines. A proportion of the flux passes straight across the air gaps, as indicated by the lines GF, but the greater amount traverses the armature, as indicated by the line AF. The flux passing through the armature holds it firmly against the stop to which it was last moved, even if no current is passing through the windings.

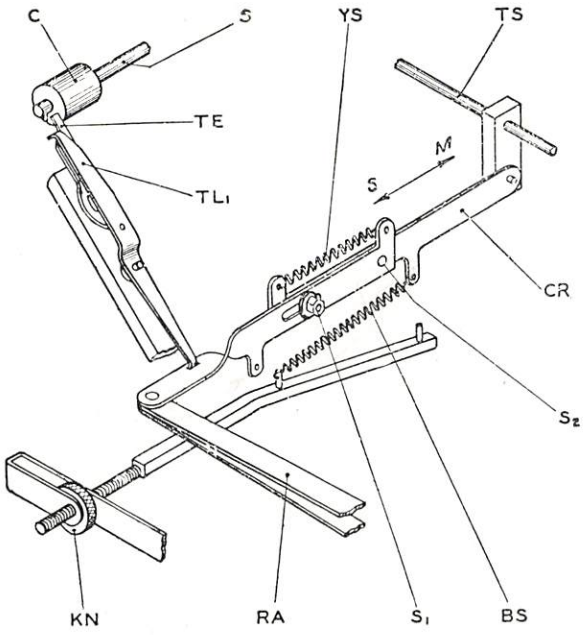
A current passing through the windings in the direction shown in Figure 13a, i.e., a " starting " impulse, tends to make the upper end of the armature a south pole, with the result that it is moved over to the " starting " stop S. When this movement takes place the path of the flux between the poles is altered to that shown in Figure 13b and the armature is therefore held firmly against the "starting" stop until a "stopping" impulse is received, as shown, when the reverse operation takes place.

When single current operation is employed, a biasing spring BS (Figure 14) is fitted to the side of the armature, its strength being such that when no current is passing through the windings, the armature is held against the " starting " stop. The line current for single current operation must therefore pass through the magnet windings in a " stopping " direction.

THE SELECTING MECHANISM.

The operating magnet armature RA is connected by means of a link CR (Figure 15) to a crank arm attached to the trip shaft TS. This link may for the moment be treated as a rigid rod. It is dealt with in greater detail below.

As this link oscillates in response to the incoming signals, the trip shaft is turned into one of two positions corresponding with these signals.



THE MAGNET ARMATURE LINK.
FIGURE 14.

The cam sleeve RCS is fitted with a clutch, of a type similar to that attached to the transmitting cam sleeve, and when no signals are passing, the clutch pawls are held out of engagement by the detent D. On receipt of the " start " signal the trip shaft TS turns in the direction indicated by the arrow A, and withdraws the detent from the path of the pawls.

The camshaft is driven from the main shaft MS through the gear CG at such a speed that the cam completes one revolution during each signal combination received. Each revolution terminates during the reception of the seventh or " stop " signal and as this impulse is of " stopping " polarity, the detent D is reset in the path of the pawls, and the clutch is disengaged until the next " start " signal is received.

A retaining lever RL holds the cam stationary while the clutch is disengaged but does not impede the motion of the cam when engagement takes place.

The arrangement of the coupling between the operating magnet armature and the tripshaft used prior to the beginning of 1939 is shown in Figure 14.

The link CR was constructed in two sections coupled by means of a pair of studs S1 and S2, each of which was rigidly attached to one section of the link, and engaged in a slotted hole in the other section.

This arrangement was provided to meet a special condition met with in early Teleprinter exchange systems and which now has ceased to exist.

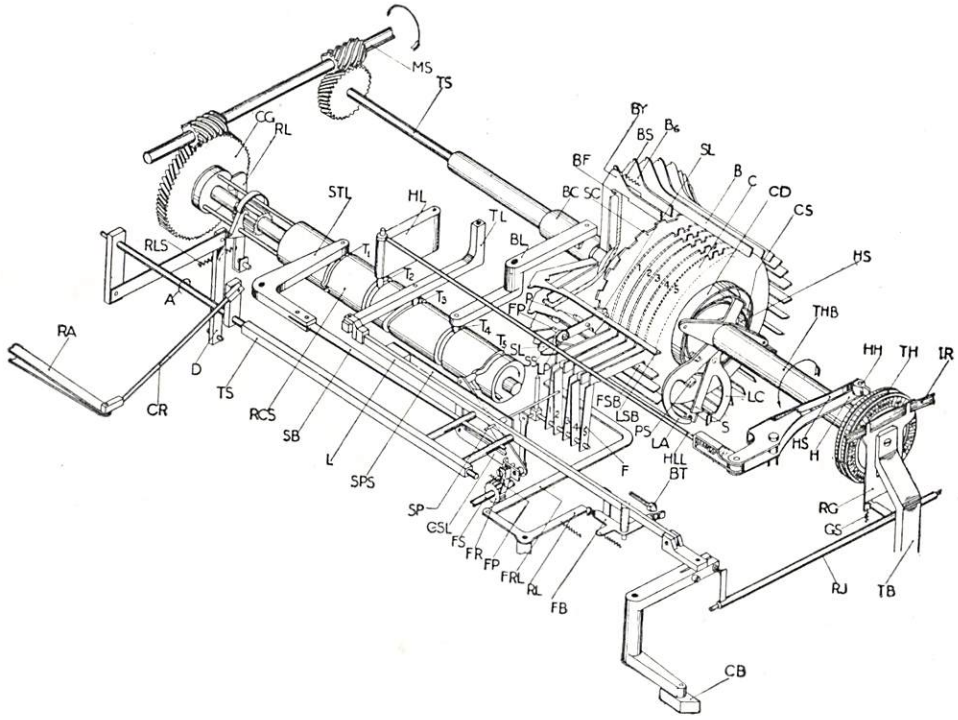
Normally the link was made solid by the introduction of additional washers under the nuts on studs S1 and S2, and could then be regarded as a single piece.

Since the beginning of 1939 a solid link has been fitted.

When single current closed circuit operation is employed, a definite spacing bias is required. This may be obtained by suitable adjustment of the spring BS (Figure 14).

For double current operation the spring BS (Figure 14) is disengaged from its adjustment rod and anchored in the adjacent free hole in the link.

The correct sequence of the selecting operations is ensured by the five tracks in the cam sleeve RCS (Figure 15), in each of which there runs a roller controlling the movement of a lever.



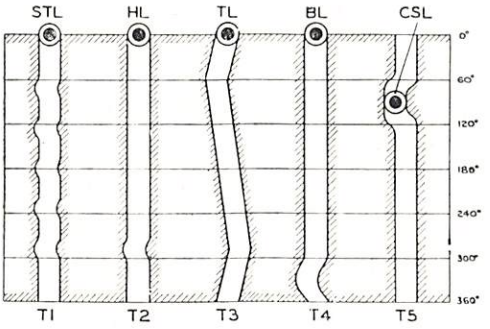
PRINTER MECHANISM.
FIGURE 15.

A development of the five cam tracks of a 7 divide receiver cam is shown in Figure 16 and the rollers attached to the cam levers are shown in the positions which they occupy in the tracks when the cam is held stationary by the pawls.

The traversing lever TL is attached to a link L to which it imparts a reciprocating movement. This link carries a pin SP which is normally held against the link by the spring SPS, but may move away from it when struck by the striker blade SB.

Opposite the end of the striker pin SP are five fingers F, pivoted at their lower ends on a spindle which may be moved vertically by the operation of the bellcrank CSL.

In the rest position the pin SP is opposite the middle finger F3.



THE PRINTER CAM TRACKS (DEVELOPMENT).
(7 DIVIDE RECEIVER CAM.)
FIGURE 16.

When the cam sleeve revolves, the link L is drawn first to the left until the pin SP is opposite the finger F1, then to the right until the pin is opposite finger F 5, finally returning to its normal position as the cam completes its revolution. During the movement of the traversing lever to the left, the finger resetting bellcrank FB turns the lever RL about its pivot, thus causing the resetting link FRL to draw back all the fingers into similar positions to those occupied by fingers F 2 and F 4. The screw BT is so adjusted that the bellcrank FB is tripped out of engagement with the lever RL at the instant when the fingers have been moved into their correct position.

Simultaneously with the resetting of the fingers by the link FRL, the right-hand end of the lever CSL is depressed by the action of the cam, and the spindle carrying the five fingers is lowered into such a position that the upper ends of the fingers are opposite the end of the setting pin.

As the traversing link moves to the left, the striker lever STL and consequently the striker blade SB remain stationary ; during the motion of the traversing link to the right, the striker blade is moved forward and backward in timed relation to the movement of the pin SP past the fingers F.

The end of the striker blade moves in a pair of guides attached to the trip shaft TS. The blade itself is made of light spring steel and is depressed below the level of the pin SP, when the trip shaft moves in a " starting " direction, as indicated by the arrow " A."

Each of the fingers F corresponds with one unit of every character combination received, and the movement of the striker pin SP past each of the fingers is timed to take place while the corresponding unit is being received from the transmitter. A " stopping " impulse causes the pin SP to be struck by the striker blade when it is pushed forward and a " starting " impulse causes the blade to pass below the pin, without moving it. Thus the combination set up on the comb bars of the transmitter, is reproduced on the five fingers F, a " stopping " unit being represented by a finger which has been moved by the pin SP, as shown at F 1, and a " starting " unit by an unmoved finger, as shown at F 2.

The fingers F are supported in guide slots in a block, each slot being fitted with a friction spring which ensures the retention of the finger in its correct position.

The combination in which the fingers are shown set is that for the letter Y.

THE TRANSLATING MECHANISM.

The types are mounted horizontally in a cylindrical cage TH, which is coupled to a revolving shaft TS through a friction clutch CD. Each type is free to move parallel to the shaft TS, when struck by the hammer head HH and is returned to its normal position by a spring.

Attached to the typehead boss is a stop S which is arrested by any one of the bellcranks B which is moved into its path. Each of the bellcranks corresponds with one character in the typehead and when it arrests the movement of the typehead it causes this type to be interposed between the hammer head HH and the paper. The translating of the combination set up on the fingers F thus resolves itself into causing one only of the bellcranks B to be released by each combination.

The bellcranks are pivoted on an annular fulcrum BF about which they tend to turn under the action of the springs BS, thus exerting a pressure on the five combination " combs " C and the shift comb SC about which they are arranged. The combs are mounted on a stationary hollow cylinder with the typehead spindle TS passing through its centre. They are free to turn slightly about their bearing and are fitted with springs which tend to turn them in an anti-clockwise direction.

When the setting of the fingers F to the required combination has been completed, the level BL is turned by the cam so that it moves the collar BC towards the typehead and pressing on the tails of the bellcranks lifts them from the edges of the combs.

The spindle on which the fingers F are mounted is then lifted by the lever CSL and all the combs, under the extensions of which a finger is set, are turned slightly about their centres. As the revolution of the cam is completed, the bellcranks are released by the restoration of the lever BL to its normal position, but the fingers remain lifted until the commencement of the next revolution.

A series of notches is cut round the periphery of each of the combination combs in such a manner that, for every combination into which the combs are moved, a slot is opened up under one pair of adjacent bellcranks. Each of these pairs of bellcranks consists of one corresponding with a character in the " letters " shift and one corresponding with a character in the " figures " shift.

The shift comb SC determines which one of a pair will drop.

This comb has a serrated edge, the pitch of the teeth being equal to double the pitch of the bellcranks. It is free to turn about the same bearing as the combination combs and its permissible movement is equal to one bellcrank pitch. Thus in its movement from one position to the other it prevents one bellcrank in each pair from moving, but places the other under the control of the combination combs. Generally, one combination therefore results in the operation of one bellcrank only, the position of the shift comb determining whether this bellcrank is in the " Figures " or " Letters " group. In a few cases, such as carriage return, line feed, and space, which have to operate on both shifts, two adjacent bellcranks fall, but only one is effective as the second has part of its end cut away and therefore cannot arrest the typehead.

The movement of the shift comb is effected by two bellcranks FSB and LSB.

When a " Letter " shift signal is received, the bellcrank LSB moves under the action of its associated spring and depresses the top shoulder of the lever SL, thus turning the lever about its pivot P and moving the shift comb into the " Letters " position. When the " Figures " shift signal is received the reverse operation takes place.

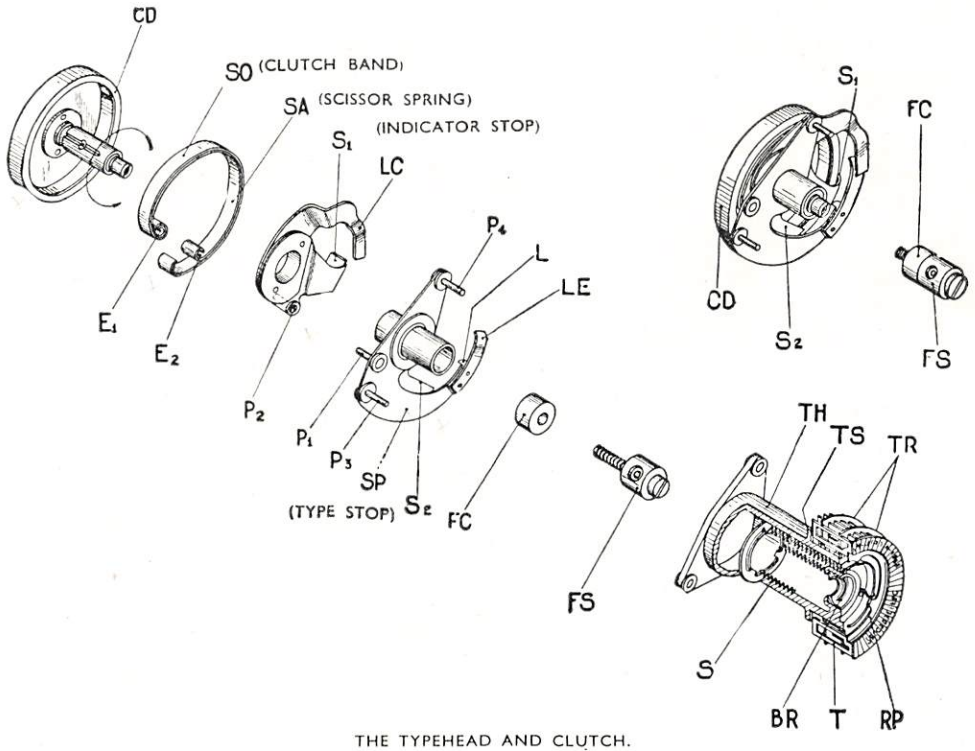
The spring SS replaces the jockey roller, which is usually fitted to this type of movement, and retains the shift comb in the position in which it was last moved. The pin LP is attached to the lever while the pin FP is rigidly attached to the frame of the machine, the spring being compressed when it is placed in position.

THE TYPEHEAD AND CLUTCH.

The typehead, which is driven through a friction clutch, is arrested by the end of the selected bellcrank.

CONSTRUCTION AND OPERATION OF CLUTCH.

Figure 17 shows the clutch with its separate parts extended along its axis of rotation in their correct relative positions. A view of the assembled clutch is also given, the screw FS and collar FC being detached in order that they shall not obscure important details.



THE TYPEHEAD AND CLUTCH.
FIGURE 17.

The clutch drum CD is screwed on to the typehead spindle, and the various components of the clutch are held in position by the screw FS and collar FC. Two holes in the typehead TH engage with two pins P 3 and P 4 which are secured to the stop plate SP. The stop plate is thus rigidly connected to the typehead.

The assembly of the clutch parts takes place in the order in which they are illustrated, the two springs SA and SO (the Scissors and Clutch Spring respectively) being compressed so that they provide a frictional coupling with the inner surface of the clutch drum CD which is lined with " balata."

One end of each spring is bent to form an eye E 1 which engages with the pin P 1. A second eye E2, with which the pin P2 engages, is formed on the end of the scissors spring SA.

The clutch drum CD revolves in the direction indicated by the arrow and this motion is normally transmitted to the stop plate SP through the clutch springs.

When a bellcrank is selected, it drops into the path of and arrests the movement of the Indicator Stop S1. The stop plate SP and the typehead continue to revolve and their momentum is partially absorbed by the flexure of the scissors spring SA. At the same time, the outward pressure of this spring is removed from the spring drum and the friction which tends to keep the typehead in motion is reduced.

After a small amount of independent movement, the stop plate is arrested by the engagement of the Type Stop S2 with the back edge of the stop S1 and the typehead is brought to rest in the position required by the selected bellcrank.

Just prior to the arrest of the stop plate, the scissors spring SA has flexed to such an extent that the eye E2 comes into contact with the end of the clutch spring SO. This causes the retarding influence on the typehead to be increased, as both springs are now being compressed, and also completely disengages the friction clutch as the typehead comes to rest.

Simultaneously, the latch extension LE moves under the spring LC, causing the latch L to engage with the selected bellcrank. Recoil due to the tendency of the clutch springs to expand is thus prevented.

When the selected bellcrank is reset, the stop S1 commences to revolve under the action of the scissors spring SA, carrying with it the spring LC. This releases the latch L and thus permits the re-engagement of the clutch.

CONSTRUCTION OF TYPEHEAD.

The construction of the typehead itself may be seen from the sectional view given in Figure 17.

The type characters are engraved on pads T, carried in two racks TR, which permit movement of the types parallel to the axis of the typehead.

A retaining plate RP held in position by three springs S, exerts a pressure on all the types, normally keeping them in contact with the back stop TS. When a type is struck by the hammer, it moves forward, carrying one edge of the retaining plate with it, but immediately the type is released, the retaining plate restores it to its normal position.

A ball race BR houses a ball cage which is supported by the bracket TB (Figure 15). The end thrust of this bearing keeps the typehead in engagement with the driving pins on the clutch. The bearing also assists in maintaining accurate alignment of the type.

THE TYPE HAMMER.

The hammer H (Figure 15) is operated during the selection of the subsequent character, the type impression being made just prior to the resetting of the combs.

The hammer head HH of the hammer is pivotally mounted in order to prevent breakage of the types should the hammer be moved forward while the typehead is revolving. The hammer head is held in position by the spring HS.

The hammer is actuated by the lever HL through the link HLL.

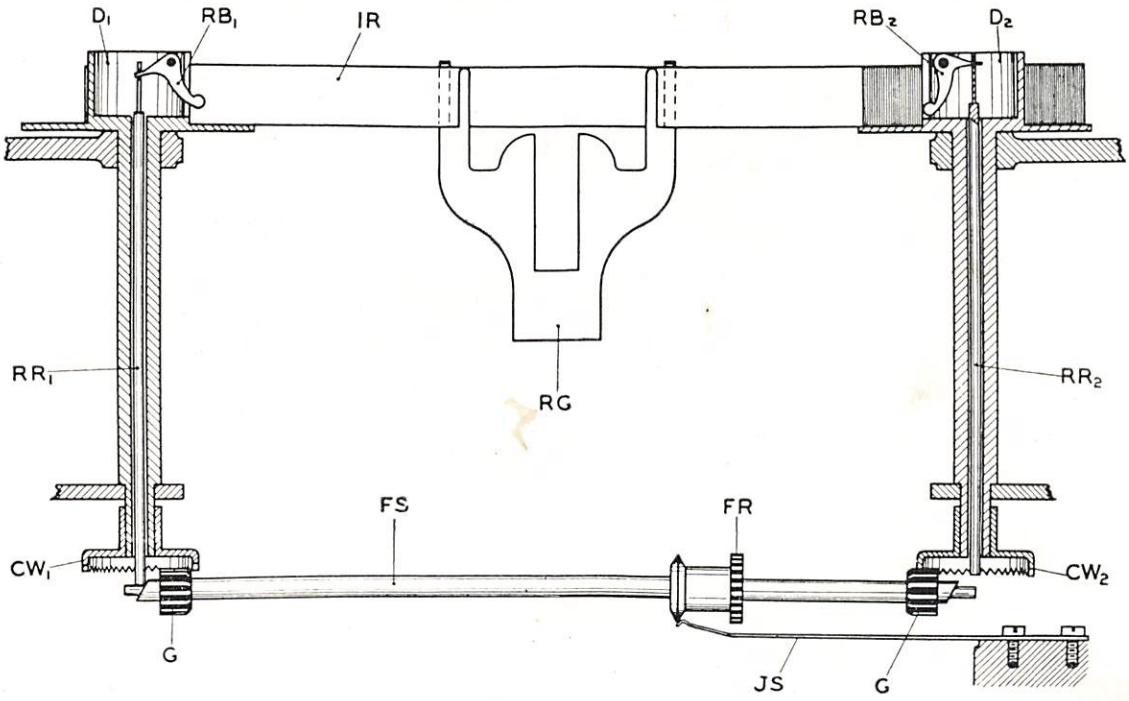
INK RIBBON JUMPER.

In order to render visible the last letter printed, the ink ribbon which is interposed between the type and the paper when an impression is made, is lowered as each revolution of the cam is completed. For this purpose it is threaded through a jumper RG (Figure 15), which is moved vertically in slots in the typehead bearing support TB. A spring GS holds the jumper against an extension of shaft RJ.

The ribbon jumper is operated by the traversing link L, the ribbon being lifted to its maximum height when the traversing link reaches the right-hand limit of its movement. This occurs when the cam has turned through 298°, and practically coincides with the operation of the type hammer (see Figure 19a).

INK RIBBON FEED.

A pair of small drums is provided for housing the ink ribbon which is fed forward one step after each character has been printed. The feeding of the ribbon is effected by the shaft FS (Figure 15), which is revolved by the engagement of the pawl FP with the ratchet FR. The essential parts of the feed mechanism are shown in Figure 18. D1 and D2 are the two drums between which the ribbon travels and the feed operating spindle FS may



THE RIBBON FEED MECHANISM.
FIGURE 18.

be seen passing underneath. This spindle is free to move longitudinally and is retained by the spring JS in the position in which it was last moved.

When the shaft is in the left-hand position, as shown, it is coupled to the drum D 2 through the gear G and the crown wheel CW2, the ribbon thus being wound off drum D 1 on to D 2.

The mechanism is shown at the moment when the last turn of the ribbon has just begun to unwind from the drum D 1.

Each of the drums has passing through its centre a rod RR, which is suspended from the horizontal arm of a bellcrank RB and tends to turn it about its pivot. The bellcrank is normally prevented from turning by the ribbon with which it comes into contact through a slot in the boss of the drum.

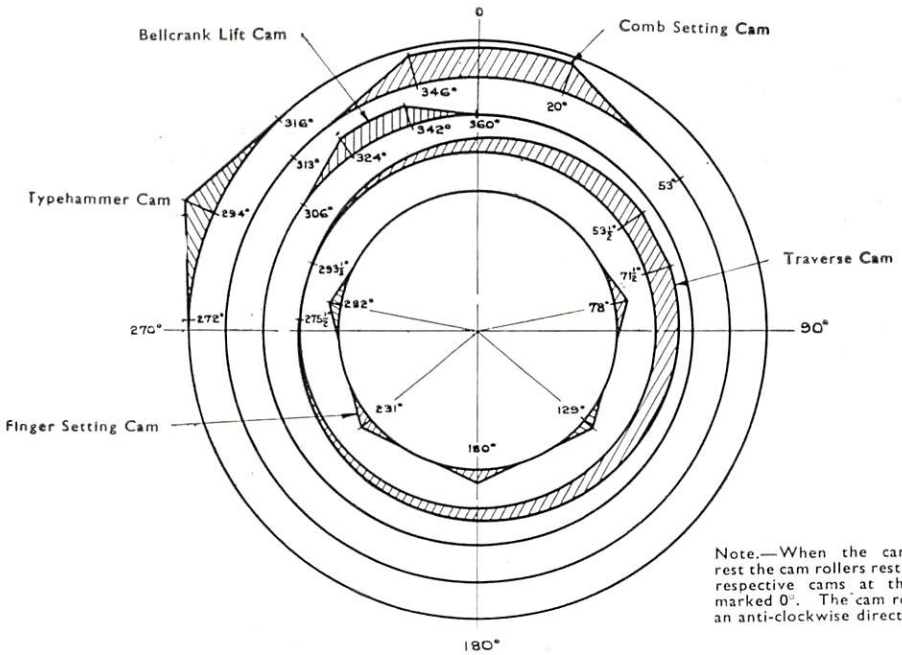
When this slot is uncovered, as the last turn of the ribbon unwinds, the rod and bellcrank are allowed to drop as shown at RR1 and RB1.

The ends of the shaft FS are cut obliquely and it is so arranged that as the shaft FS revolves, the inclined face engages with the lower end of the rod RR1 and thrusts the shaft to the right, thus throwing the drum D2 out of engagement and engaging the drum D1.

In this manner the ribbon feed is reversed and the ribbon commences to rewind on to the drum D 1. When the supply of ribbon on the drum D 2 is exhausted the operation is reversed and the ribbon is thus kept constantly in motion between the two drums.

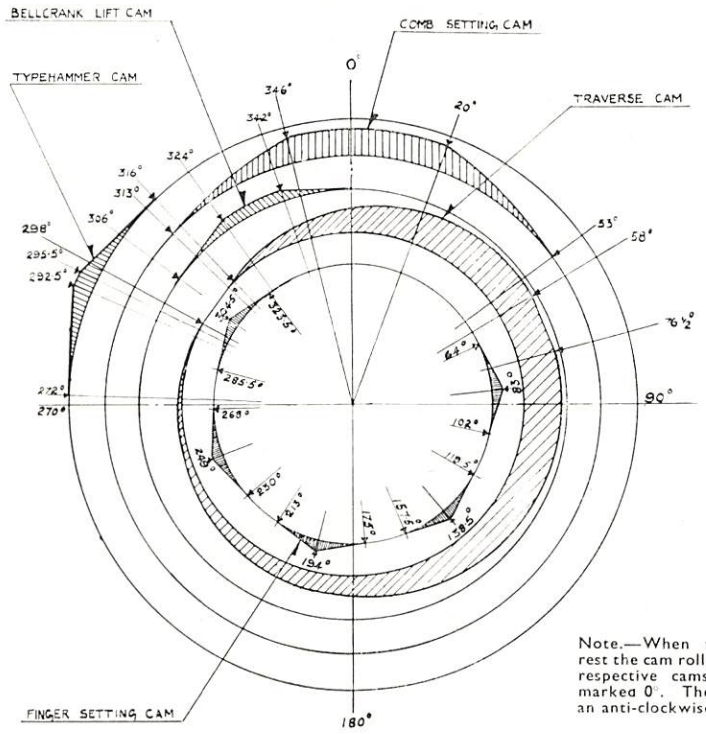
TIMING OF RECEIVING OPERATIONS.

The timing of the various operations of the 7 divide receiving cam is shown in Figure 19, and that of the $6\frac{1}{2}$ divide receiving cam in Figure 19a.



Note.—When the cam is at rest the cam rollers rest on their respective cams at the point marked 0°. The cam rotates in an anti-clockwise direction.

7 DIVIDE RECEIVER CAM.
FIGURE 19.



Note.—When the cam is at rest the cam rollers rest on their respective cams at the point marked 0°. The cam rotates in an anti-clockwise direction.

6½ DIVIDE RECEIVER CAM.
FIGURE 19a.

PAPER FEED ATTACHMENT.

Teleprinters Numbers 7 and 8 have been so designed that they may be adapted readily for tape or page printing.

The Page and Tape printing attachments are interchangeable and may be removed by first operating a latch at one end of the main frame and then lifting the attachment from the vertical stud by which it is supported.

THE STANDARD PAGE PRINTING ATTACHMENT.

The Standard Page Printing Attachment Unit comprises a main casting and guides on which the platen carriage and paper chariot (paper holder) are moved from right to left as a line is printed.

The main casting accommodates the mechanism for feeding the paper and a bell to give warning to the operator when it is necessary to depress the carriage return and line feed keys.

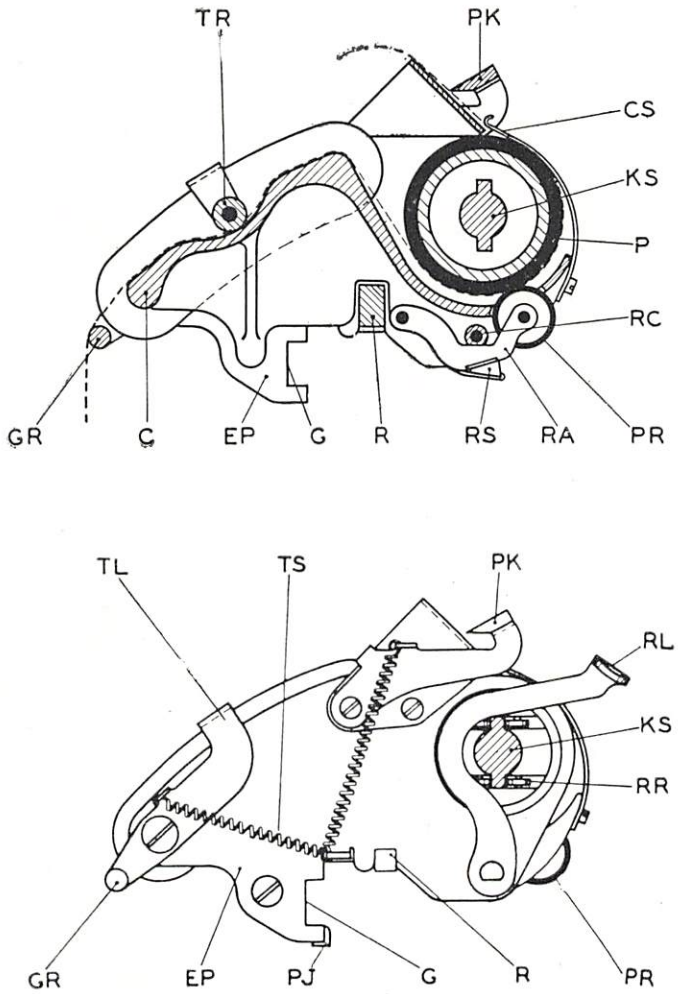
The platen carriage carries the platen and plates for guiding the paper past the printing position.

The paper chariot is attached to the platen carriage and holds the paper roll which is thus moved with the carriage and so obviates the trouble experienced with stationary rolls.

THE PLATEN CARRIAGE.

Figure 20 shows a section through the platen carriage. This illustrates how the paper is guided round the platen on which printing takes place. An end view of the carriage is also given.

The carriage is mounted on the main casting by means of a running bar, along which the grooved portion G of the frame slides, and a keyed spindle KS which passes through the centre of the platen P.



THE PLATEN CARRIAGE.
FIGURE 20.

Attached to the carriage is a letter feed rack R which engages with a toothed wheel on the main casting. The line feed is accomplished by rotating the keyed spindle which passes through the platen. Friction between the shaft and the platen is reduced to a minimum by the four rollers RR, which serve as a pair of keyways.

The principal components of the carriage are a light casting C, a pair of end plates EP which provide bearings for the platen P, and a pair of rollers PR which are carried on pivoted arms RA and held in contact with the platen by a pair of flat springs RS. Each of the rollers PR extends practically half the length of the platen, to ensure the application of uniform pressure throughout the width of the paper. Both the platen and the pressure rollers are covered with a compressed cork composition which ensures regular feeding and is unaffected by oil or stencil solvents.

INSERTING A NEW ROLL OF PAPER.

The dotted line in the sectional view indicates the path of the paper through the carriage. When inserting a new roll of paper in the machine, place the roll in the paper chariot so that it unrolls from underneath and fold the corners of the end of the paper to produce a point approximately in the centre. Then depress the rod GR thus turning the lever TL in opposition to the spring TS and raising the tension roller TR. Thread the paper under this roller and replace it, then push the pointed end of the paper down behind the platen, and turn the knurled knob at the end of the platen spindle KS. This will feed the paper round to the front of the platen, and it will then only be necessary to pass the pointed end under the paper knife PK.

The pressure on the rollers PR should now be released by operating the lever RL (this depresses the arms RA by means of the cams RC) thus allowing the paper to be drawn over the back of the carriage and adjusted until the edges line up exactly with the edges of the roll in the paper chariot. As this ensures that the paper is passing squarely through the carriage, the pressure may now be restored and the paper torn off at the paper knife PK.

In order that the paper may be kept in close contact with the platen at the point at which printing takes place, a pair of narrow springs CS are fitted, one at either end of the platen.

THE CARRIAGE OPERATING MECHANISM.

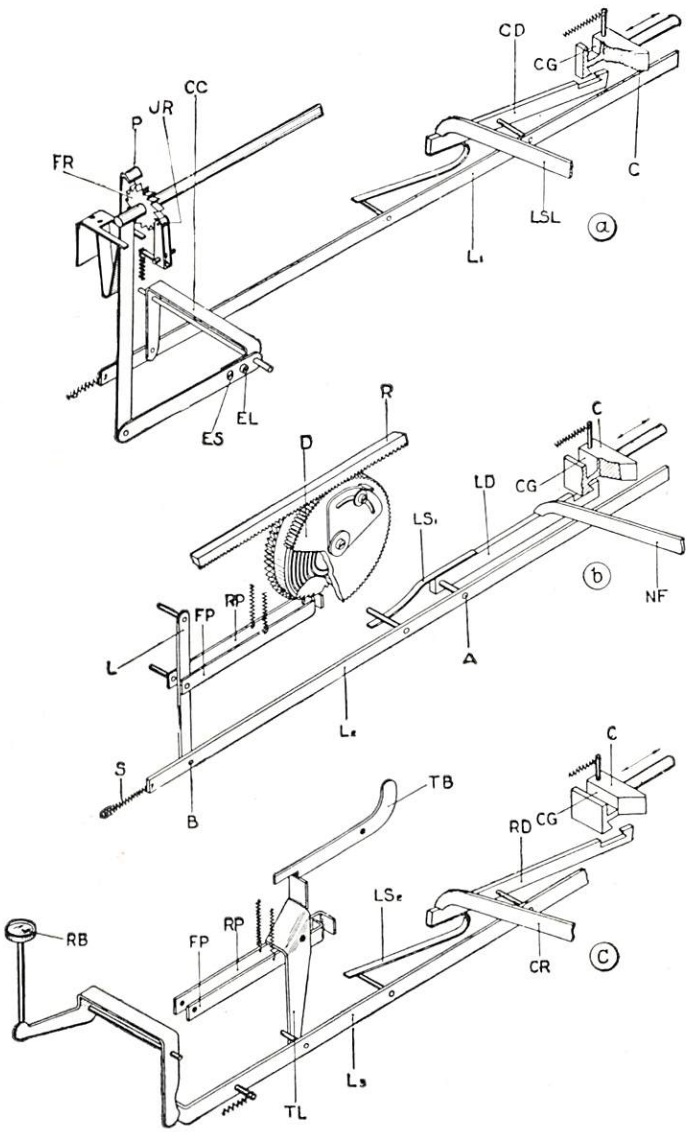
The mechanism effecting the carriage movements is mounted on the main casting and may be divided into three sections — the Letter Feed Mechanism, the Carriage Return Mechanism and the Line Feed Mechanism. Figure 21 shows separately the mechanism associated with each section.

An oscillating movement is transmitted to the carriage mechanism through the crosshead C (Figure 21) by the block CB (Figure 15), which slides in the groove CG in the crosshead. This provides the power necessary for the various movements, while three control levers LSL, NF and CR operated by the combination head bellcranks serve to engage or disengage the various mechanisms as required.

THE LETTER FEED MECHANISM.

Figure 21b shows the letter feed mechanism. The crosshead C is common to each section of the control mechanism and makes one complete oscillation, as indicated by the arrow, for every revolution of the camshaft. The crosshead is normally in its mid position and its first movement takes place to the left ; it next moves to the extreme right and finally comes to rest in its mid position again.

The letter feed dog LD is pivoted on the link L2 at A and is normally held in engagement with the crosshead by the spring LS1. At the other end of the link L2 is a spring S which is anchored to the casting. As long as the feed dog LD is engaged with crosshead C, the combined action of the crosshead and the spring S causes the link to follow the movement of the crosshead.



THE CARRIAGE OPERATING MECHANISM.
FIGURE 21.

The link L2 has attached to it at B a lever L which is pivoted at its upper end to the main casting. By means of this lever the feed pawl FP is first moved back into engagement with the next tooth of the ratchet attached to the spring drum D ; then as the link L2 is drawn to the right, the feed pawl revolves the spring drum a sufficient distance for the retention pawl RP to engage with the next tooth of the ratchet.

A rack toothed wheel also is attached to the spring drum, and this engages with the feed rack R on the carriage. Thus the carriage is fed forward one letter space every

time a character is printed, and this movement gradually winds up the spiral carriage return spring which is contained in the spring drum. The retention pawl RP is pivoted to the main casting and is held in engagement with the ratchet by the spring shown.

Certain combinations, however, such as the erase, bell and shift signals, cause the camshaft to rotate, but do not cause a character to be printed. In these circumstances it is not desirable for the letter feed to be operated, hence a " non-feed " lever NF (Figures 21 and 24) is fitted which, when operated, disengages the feed dog LD and thereby the link L 2 from the crosshead.

THE CARRIAGE RETURN MECHANISM.

The carriage return dog RD (Figure 21c) is pivoted on link L3 and is normally held out of engagement with the crosshead by the spring LS2. It is raised into engagement by the control lever CR (Figures 21 and 24) whenever a carriage return signal is received.

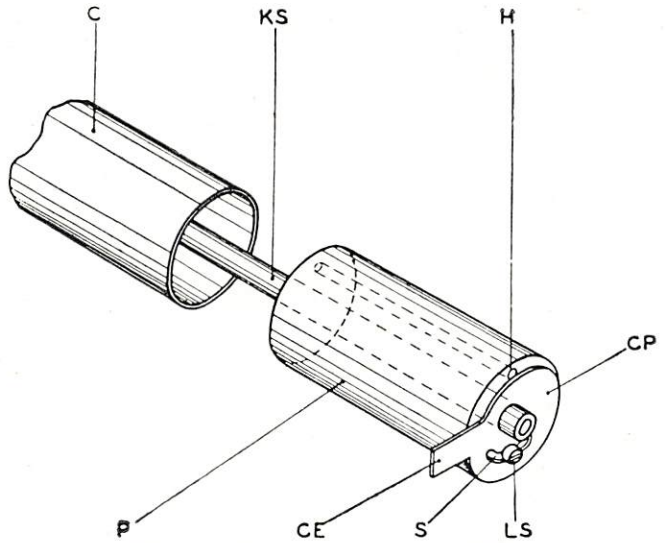
The pawl throwout lever TL is pivoted with its lower end to the right of a pin fixed in the link L3. On the movement of the link to the right, the lever TL is turned slightly about its pivot, thus disengaging the feed and retention pawls FP and RP from the ratchet which is attached to the spring drum. This permits the spring drum to rotate and return the carriage to the beginning of the line.

When the lever TL has moved sufficiently to disengage the pawls, its upper extension falls behind a shoulder in lever TB, which prevents its return and the consequent re-engagement of the pawls until the right-hand end of lever TB is depressed by projection PJ (Figure 20), as the carriage comes to rest at the beginning of the line.

A carriage return button RB (Figure 21) is fitted to the left-hand end of the unit. This may be depressed when it is required to operate the carriage return mechanism by hand.

An adjustable air dashpot is fitted to the carriage to absorb the shock when the carriage is returned.

The adjustment is varied by changing the position of coverplate CP (Figure 22), which by varying the size of aperture H controls the escape of air from the dashpot.



THE CARRIAGE PISTON AIR VENT ADJUSTMENT.
FIGURE 22

THE LINE FEED MECHANISM.

The line feed mechanism is illustrated in Figure 21a. The line feed link L1 is controlled in a similar manner to the carriage return link by lever LSL (Figures 21 and 24), and is drawn once to the right and returned every time a " line feed " signal is received. The line feed link L1 by means of the crank CC, operates the pawl P and revolves the platen spindle, thus feeding the paper through the carriage in preparation for the commencement of the next line of printing.

Correct spacing between the lines is ensured by a jockey roller JR which rides on the feed ratchet FR.

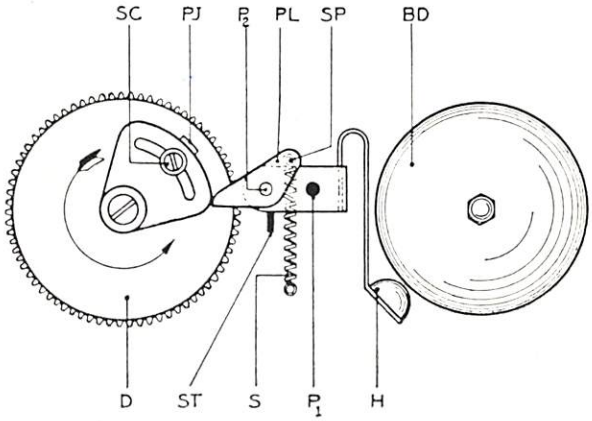
If desired an adjustable stop can be fitted to enable the platen to be fed either $\frac{1}{3}''$ or $\frac{1}{6}''$ for each operation of the line feed pawl P.

The stop comprises an eccentric pin, the eccentric portion of which projects in front of the line feed pawl P. This pin can be moved into either of two fixed positions, in the first of which the line feed pawl engages with the ratchet tooth which lies below it in Figure 21, while in the second position, the line feed pawl is pressed backward so that it engages with the next tooth. The feed is thus restricted to one tooth instead of two.

THE CARRIAGE BELL MECHANISM.

In order that the operator may receive warning as the end of the line is approached, a bell is fitted which rings once, fifteen characters before the end of the line is reached.

The bell, which is illustrated in Figure 23, is operated by a projection PJ from the carriage spring drum D. The hammer H is pivoted at P1 and is normally held against the stop ST by the spring S.



CARRIAGE BELL MECHANISM.
FIGURE 23.

The pawl PL is pivotally attached to the tail of the hammer at P2, and may move in an anti-clockwise direction relative to the hammer. The pin SP, to which the spring S is attached, prevents the movement of the pawl in a clockwise direction ; hence when the projection PJ engages with the pawl as the drum moves in the direction of the arrow, the hammer and pawl together turn about the pivot P1.

As the drum continues to revolve, the hammer is suddenly released and, moving under the tension of the spring S, strikes the bell dome BD.

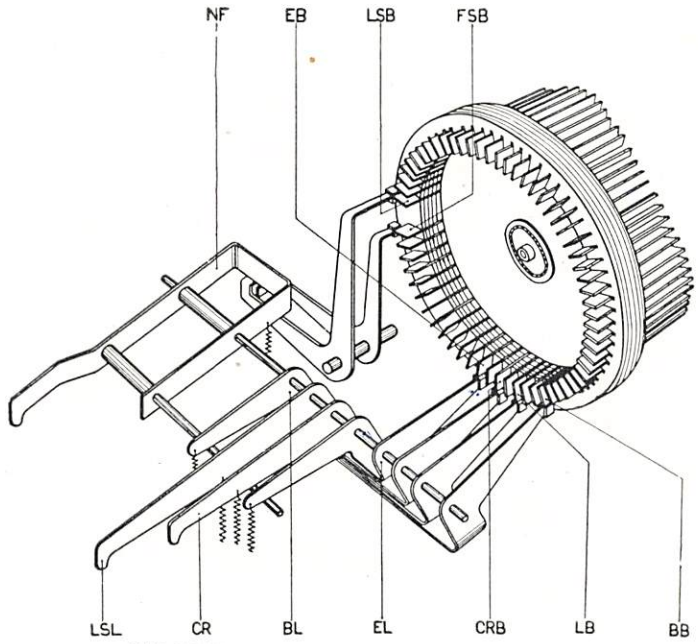
When the carriage is returned, the direction of rotation of the drum is reversed. and since the hammer is prevented from moving by the stop ST, the pawl turns about its pivot P2, and is reset by the spring S when the projection PJ has passed.

PRINTING ATTACHMENT CONTROL LEVERS.

Figure 24 shows the connection between the control levers and the combination head bellcranks ; the bellcranks shown are :—Letter Shift LSB, Figure Shift FSB. All Negative EB, Carriage Return CRB, Line Feed LB and Bell BB.

When any one of these bellcranks is operated, it depresses, through the medium of the lever with which its end is in contact, the lever NF, and disengages the letter feed LD (Figure 21).

The levers CR and LSL also operate the carriage return and line feed mechanism respectively, as described above.



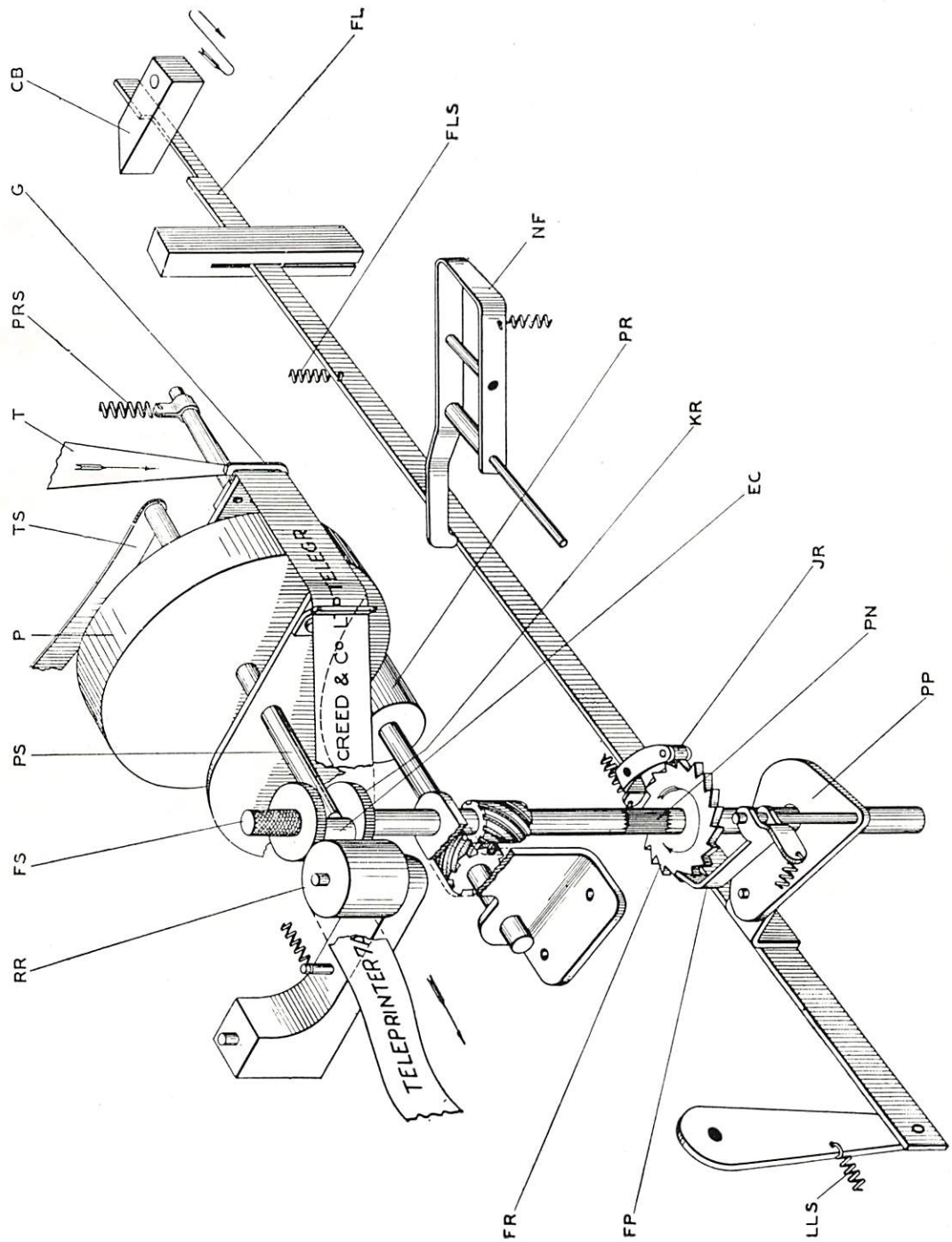
THE PRINTING ATTACHMENT CONTROL LEVERS
FIGURE 24.

THE SPROCKET FEED PAGE PRINTING ATTACHMENT.

The construction of this attachment is similar to that of the standard page attachment, with the major exceptions that the platen is provided with two rows of equally spaced radial pins, one at each end, to engage in corresponding holes in the paper, and the paper chariot is of a different type.

As the paper is fed by the sprocket pins no pressure rollers are provided, the paper being guided round the platen by a set of curved springs which can be swung away from the platen to permit the paper to be fed into the carriage.

As the sprocket paper is supplied in packs and not rolls, the normal chariot is replaced either by a simple guide which is used if the paper is located in a separate bin behind the machine, or by a chariot arranged to hold one of the packs.



TELEPRINTER TAPE ATTACHMENT.
FIGURE 25.

THE TAPE PRINTING ATTACHMENT.

The Tape printing attachment for Teleprinter 7a is an easily detachable unit interchangeable with the page attachment. The method of mounting is the same as for the page attachment, and the exchange may be effected in a few seconds.

The tape roll is held in a container mounted vertically at the back of the unit. One roll of tape will last for approximately four hours, printing from automatic transmission at 66 w.p.m.

OPERATION.

The unit (Figures 5 and 25) is operated from the receiving cam sleeve on the main base of the machine through the block CB (Figure 15).

The block CB engages with the link FL and makes one reciprocatory movement as indicated by the arrow, each time a character is received. The link is held in engagement with CB by the spring FLS and follows the movements of the block under the tension of the spring LLS.

The plate PP, on which the pawl FP is mounted, is coupled to the feed link FL and pivots about the feed spindle FS. The ratchet FR is thereby rotated one tooth each time a character is received. The roller JR serves as a retention pawl and the tape T, which passes through the guides G in front of the platen P, is fed forward one letter space by the knurled roller KR against which it is pressed by the roller RR.

The platen P is turned by the roller PR which is driven by the feed spindle FS through the gearing shown, and is kept in contact with the platen by the spring PRS.

The platen spindle PS can also move axially in its bearings and the spring TS holds its left-hand end in contact with the eccentric EC. As the spindle FS revolves, the platen, in addition to being rotated by the roller PR, is moved in such a manner that the wear on the platen is evenly distributed.

When signals are received which do not require the feed mechanism to operate (e.g., shift signals), the non-feed lever NF (see also Figure 24) depresses the link FL and disengages it from the block CB. The coupling between the block CB and the feed mechanism is thus removed and the paper is not fed forward.

The non-feed lever is also operated by the page attachment control signals, so that a machine fitted with a tape attachment can be operated in conjunction with a page printer.

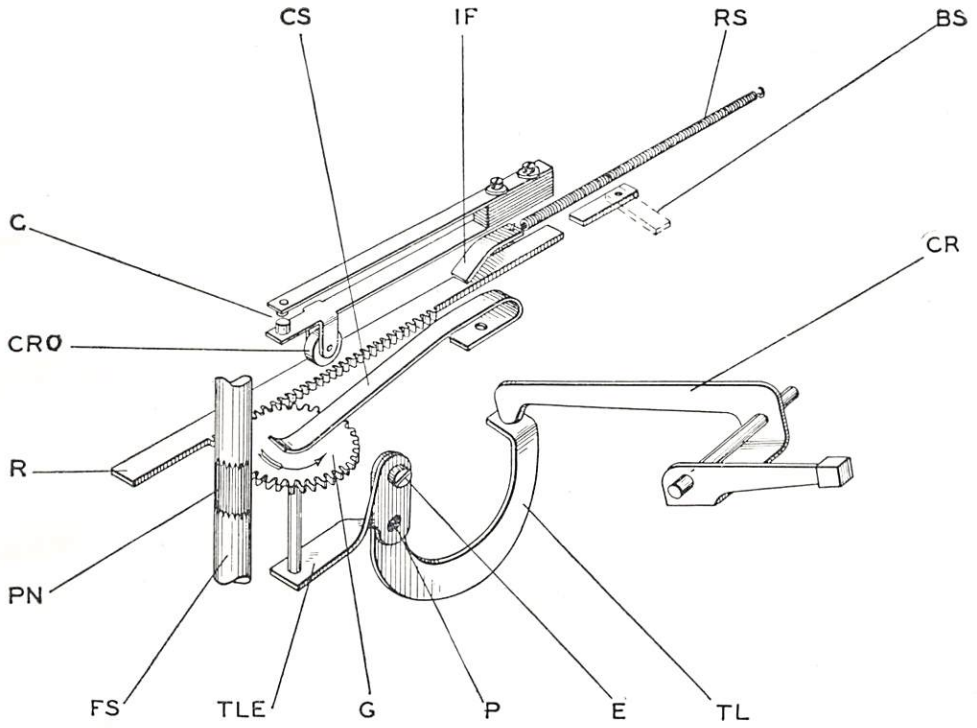
END-OF-LINE WARNING SWITCH.

When a Tape Teleprinter is operated in conjunction with a Page Teleprinter, an indicator is required to warn the operator when to depress the carriage return and line feed keys.

This device is shown in Figure 26 and operates in the following manner :—

Gear teeth PN are cut on the tape feed spindle FS (see also Figure 25), which rotates one tooth each time a signal is received.

Its movement is imparted through gear wheel G to rack R which is moved to the left against spring RS.



END-OF-LINE WARNING SWITCH.
FIGURE 26.

When 55 characters have been printed, roller CRO is thrust upward by the inclined face IF and closes contacts C.

These contacts may be used to light a lamp or ring a bell.

When a carriage return signal is received, the carriage return lever CR (see also Figure 24) depresses the trip lever TL, which turns about its pivot P and causes its extension TLE to lift the wheel G against the spring CS. The wheel G is thus disengaged from the rack R which is free to return to the right under the action of the spring RS.

An adjustable back stop BS can be turned into the position shown in dotted lines if the counter is not required to operate. The rack R is then moved to the right out of engagement with the wheel G.

THE AUTOMATIC STARTING SWITCH.

In order that the Teleprinter may be left unattended, it is fitted with an automatic switch which completes the motor circuit immediately the printer electro-magnet is operated. If an interval of about 1½ minutes elapses without any signals being received, the switch automatically breaks the motor circuit again, and only permits the motor to run during the periods in which signals are actually being received.

Figure 27 shows the essential parts of the switch and its operating mechanism, in the positions which they occupy when the machine is at rest.

The weight W, which is coupled by means of the link to the crank arm CA, tends to turn the spindle S in a clockwise direction. This motion, however, is normally prevented by the engagement of the pin P with one of the holes in the disc SD, towards which it is thrust by the flat spring TS.

When the armature RA (Figure 14) is at rest on its stopping side, the flexible extension TE to the starter trip lever is out of engagement with the starter trip boss C (Figures 14 and 27).

When the first starting impulse is received, the extension is thrust against the boss and moves the shaft S in the direction of its axis, thus disengaging the pin P from the hole in disc SD and permitting the weight W to fall.

During its fall the weight operates the lever TP, which controls a switch mounted in the base of the machine.

Contacts M1 and M2 of the switch complete the motor circuit, and the machine is thus set in motion.

When the weight has dropped, a slot in the boss C comes in line with the extension TE, so that the magnet armature does not have to move shaft S every time it travels to the starting position.

During the reception of signals the pin P, after engaging in a hole in the disc SD and lifting the weight a small distance, is ejected from the hole as soon as the boss C has turned sufficiently to permit the slot to come out of line with the extension TE.

Should the signals cease, the pin remains engaged with the hole and the weight is lifted until the position of lever TP is reversed and the motor circuit interrupted.

During the fall of the weight arm, shroud L covers the holes in the path of pin P and thus ensures that the latter does not re-engage before it reaches the bottom of its travel.

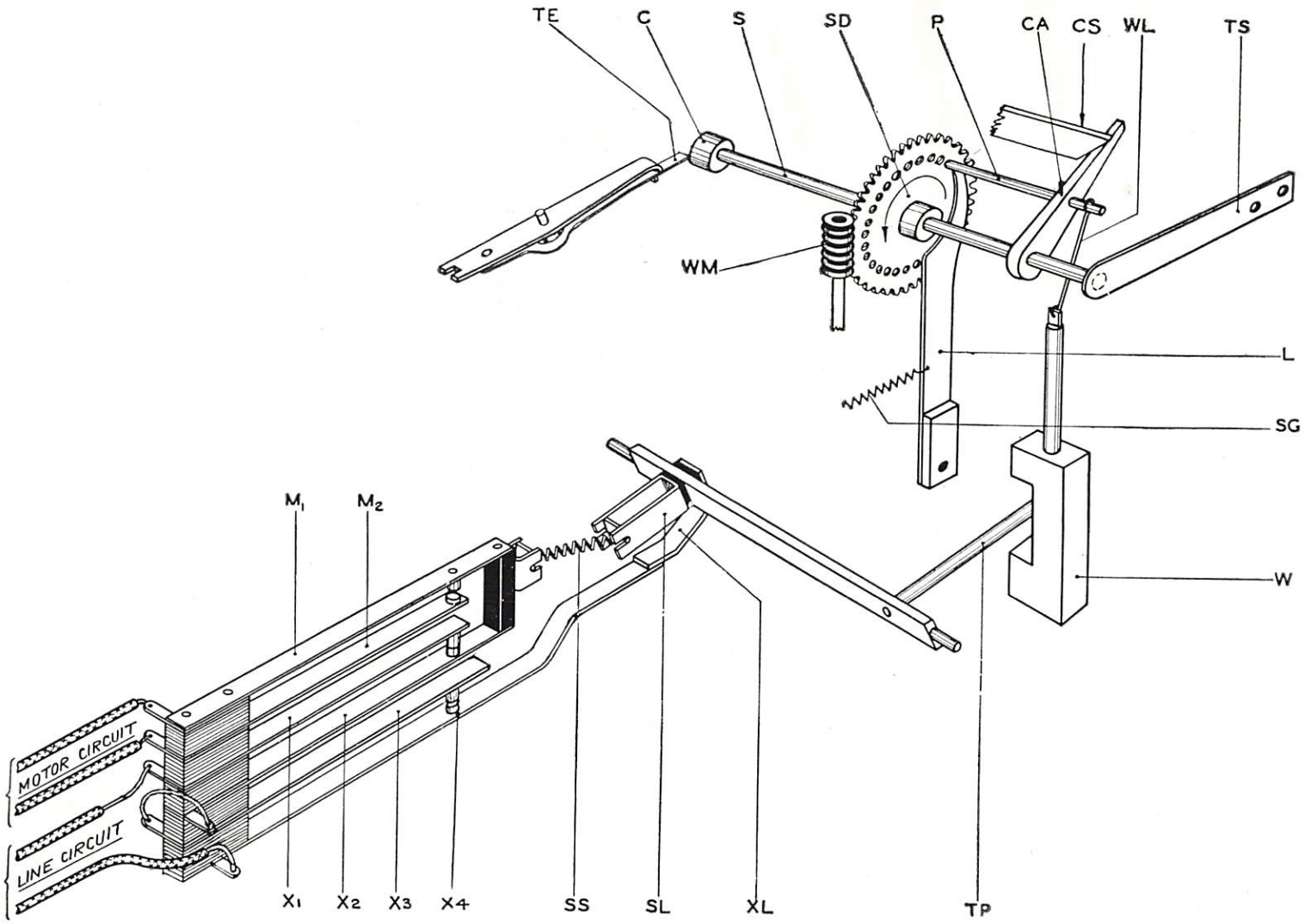
During its rise the pin P, after having engaged in a hole to the left of the shroud, pushes the latter to the right out of its path against the action of spring SG.

Should, for any reason, the motor contacts of the switch be short-circuited, the weight arm will rise until it is disengaged from the driving disc by the camming out face CS. This prevents damage to the mechanism on account of the continued running of the motor.

The detailed construction of the switch which is situated under the base of the machine, is illustrated in Figure 28, but its operation may best be followed from Figure 27.

The switch comprises two sections, one controlled by lever TP, and the second by the answer-back unit (See Figure 29).

In the first section contacts M1 and M2 control the motor circuit in the manner described above. Contacts X1, X2, X3 and X4 are no longer fitted.



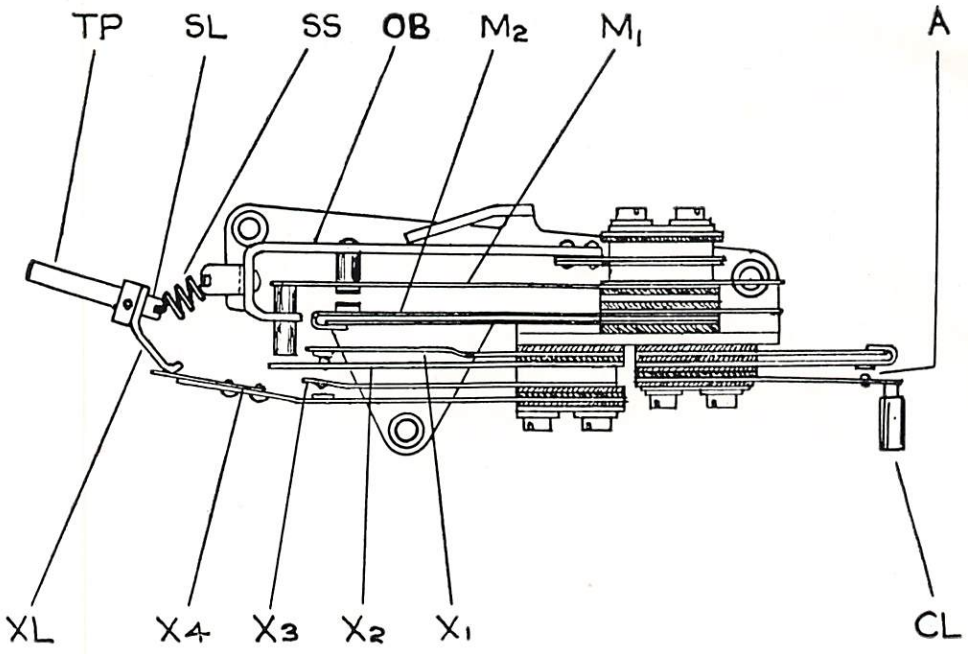
THE AUTOMATIC STARTING SWITCH AND CONTROLLING MECHANISM.
FIGURE 27.

The switch mechanism operates in the following manner :—

When the weight W drops, it strikes lever TP and turns it about its pivot. This movement, operating through a Toggle spring SS, causes the switch operating blade OB to be thrust downwards closing the motor control contacts M1 and M2.

When no signals are being received, lever TP is slowly raised by the weight and the toggle operates the contacts M1, M2 which interrupt the motor circuit.

The contacts in the second section are closed during the revolution of the " answer-back " cam by lever CL (Figures 28 and 29), which is depressed by cam AC (Figure 29).

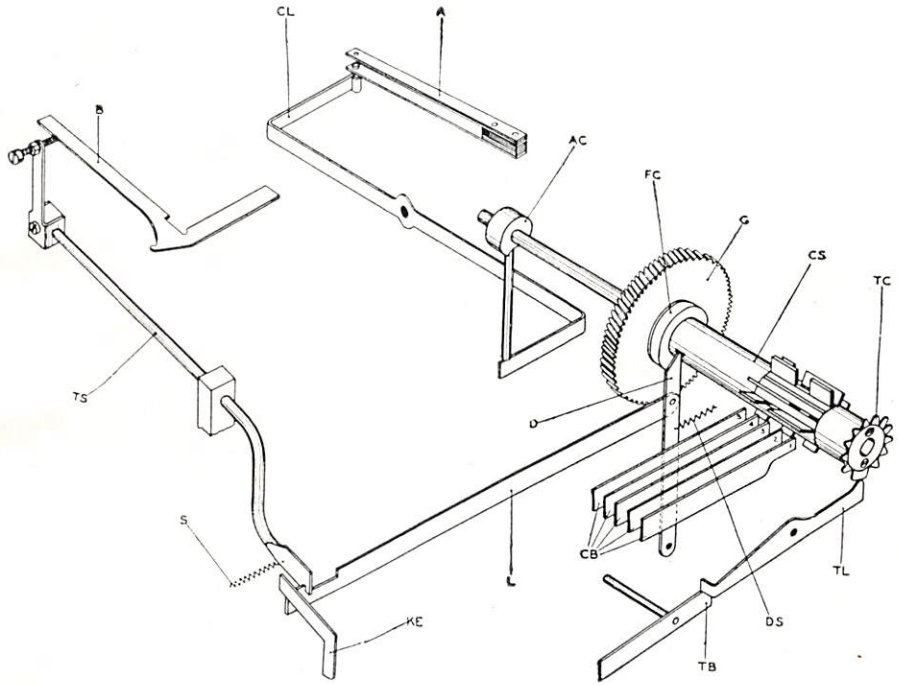


THE AUTOMATIC STARTING SWITCH.
FIGURE 28.

THE "ANSWER-BACK" UNIT.

The " answer-back " unit was primarily designed in connection with Teleprinter Exchange operation, for transmitting automatically the number of the called machine when the calling subscriber depresses his " Who are you ? " key. The unit is nevertheless extremely useful on any circuit as it gives an indication before transmission is commenced that the whole of the apparatus at both ends of the line is in order.

The mechanism associated with the " answer-back " unit is illustrated in Figure 29. A worm constantly rotates the wheel G which tends to turn the shaft CS through the friction clutch FC. This movement is normally prevented by a detent D which is held in engagement with a notch in the sleeve by the spring DS.



THE ANSWER-BACK MECHANISM.
FIGURE 29.

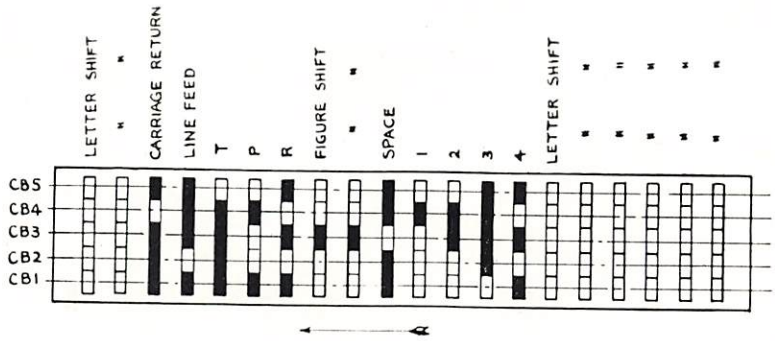
When the " Who are you ? " signal is received, the bellcrank B is operated, and the shaft TS is allowed to turn under the action of the spring S. This spring is sufficiently strong to overcome the spring DS and the detent is thus withdrawn, allowing the shaft CS to commence to revolve.

The shaft CS is mounted at right angles to the comb bars CB, in close proximity to their right-hand ends, and has attached to it twenty rows of projections, each row being so arranged as to represent one of the signal combinations to be transmitted when the unit is brought into action.

Figure 30 shows a development of that portion of the surface of the spindle CS which carries the combination projections. These projections and the ends of the comb bars are represented by the heavy black lines in the diagram.

A lever TL and wheel TC (Figure 29) are so arranged that the trip bar TB (see also Figure 8) is depressed once as each row of projections passes the ends of the comb bars, with the result that the transmitting cam is tripped once for every combination to be transmitted by the " answer-back " unit, and the comb bars, instead of being placed under the control of the keyboard, are controlled by the combinations set up on the shaft CS.

When the " answer-back " unit is at rest, a blank space on the shaft CS is opposite the ends of the comb bars, and the normal operation of the keyboard is unaffected.



TYPICAL ANSWER-BACK COMBINATIONS—DEVELOPMENT.
FIGURE 30.

The speed of rotation of the "answer-back" shaft is such that one set of combinations passes the ends of the comb bars during each revolution of the transmitting cam. The required synchronism is achieved by the operation of the lever TL.

The set of combinations shown in Figure 31, is a typical example for a machine equipped for exchange operation, but by the insertion of different combination wards, the unit may be arranged to transmit any desired group of twenty signals.

Through the medium of the cam AC and the lever CL, the "answer-back" unit is arranged to close a pair of contacts A (Figure 29), while the shaft CS is revolving. These contacts may be utilized to ring a bell and thus give warning that a message is about to be received.

In order to prevent the operation of the local "answer-back" unit when the "Who are you ?" key is depressed, this key is fitted with an extension KE, which prevents the link L from moving while the key is depressed.

This unit is now normally supplied to transmit 20 characters or signals.

THE MOTOR UNIT.

The motor has both ends of its casing turned down to fit tightly into holes in a pair of plates by which it is supported.

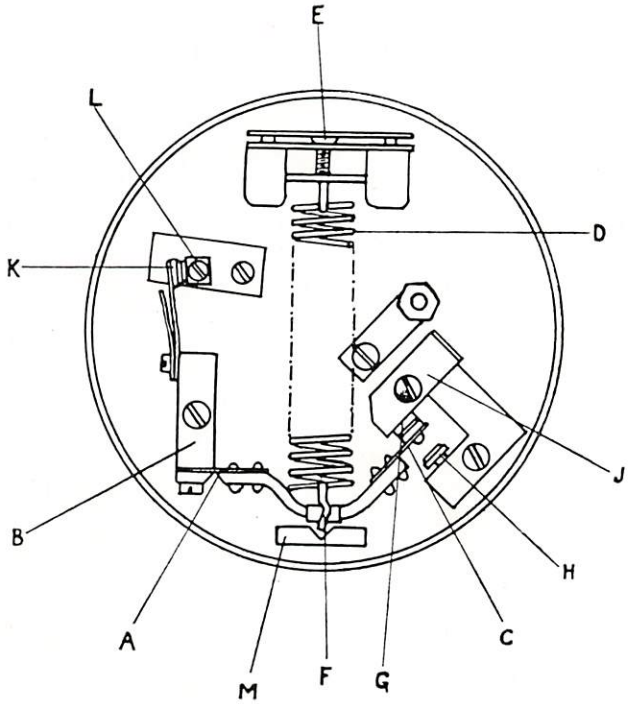
The electrical connections between the motor and the wiring under the base of the machine are made by pins which come into contact with springs through a hole in the base. The motor may be either a series, universal or shunt type.

THE MOTOR GOVERNOR.

The contact arm A (Fig. 31) consists of a central portion of bent steel with a spring extension affixed to each end. The spring on the left-hand end is used to anchor the arm to the contact arm block B and also serves as a pivot for the arm. The spring C on the right-hand end is set at an angle to the anchor spring and carries the governing contact, which is now fixed to the arm by a screw, to facilitate replacement.

The governor spring D is fixed at the top end to an adjustable anchorage E and its lower end is fitted with a loop F which embraces the contact arm.

When the motor is at rest the contact arm is pulled towards the centre and the governing contact is held against the fixed contact G with sufficient force to flex the contact spring slightly.



MOTOR GOVERNOR.
FIGURE 31.

As the motor speed increases towards its governed speed, centrifugal force is balanced against the governor spring force and the contact arm commences to move outwards. During the first part of its movement the flexion of the contact spring straightens out, sliding the moving contact across the face of the fixed contact, with the resulting self-cleaning effect.

As the contact arm continues to move outward, the contacts separate and a resistance is thereby inserted in series with the armature. This causes the motor speed to fall with a consequent reduction in the centrifugal force, and the contact arm moves inwards. As soon as the contacts touch each other, the resistance is short-circuited, but owing to the inertia of the armature, the speed is not immediately affected by the increase in voltage across the armature and the contact arm continues to move inward, thereby flexing the contact spring and wiping the contact faces together.

After a short interval, the speed again increases to a value sufficient to cause the contact arm to move outwards, the wiping action is repeated and the resistance is again inserted in series with the armature.

This cycle of operation continues, whilst the motor is running, at a frequency of approximately 50 periods per second.

The self-cleaning action provided by this design prevents the contact pitting and considerably increases the life of the contacts.

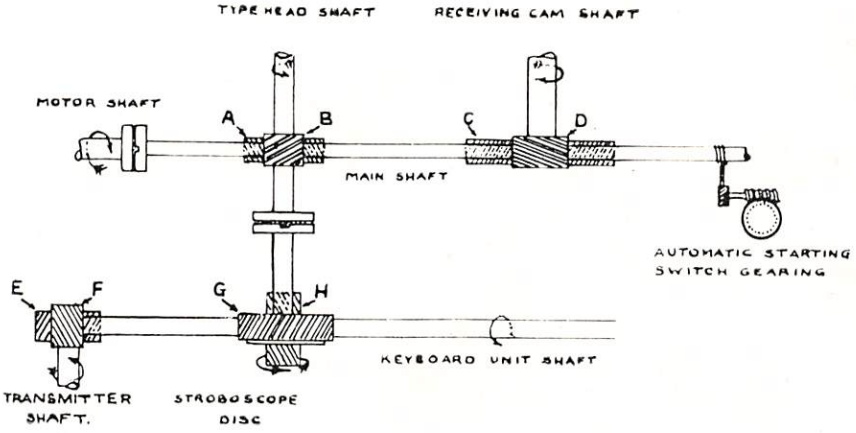
The contacts H, K and L are not provided on standard governors, but can be added when the governor is required to control a shunt-wound motor by controlling the field current. When the motor is at rest the contacts K and L are closed, and so short-circuit the governing resistance on starting. Contact G is replaced by an insulating

stud and contact C is reversed and operates in conjunction with contact H to short-circuit a resistance in series with the field when the motor speed rises beyond its correct value.

When used for governing Creed Teleprinter Motors, this governor will hold the speed constant within $\pm 0{\cdot}5\%$ with voltage variations of $\pm 10\%$ from the normal.

TELEPRINTER SHAFT SPEEDS.

The speeds of the various Teleprinter shafts for a signalling speed of 50 bauds are shown in Figure 32.



50 BAUDS TRANSMISSION.

SHAFT	MOTOR.					TYPEHEAD. STROBOSCOPE.				TRANSMITTING CAM.				RECEIVING CAM.				KEYBOARD.				
GEAR	B		D		SPEED IN R.P.M.	G		A		SPEED IN R.P.M.	E		SPEED IN R.P.M.	UNITS	C		SPEED IN R.P.M.	DIVIDES.	F		H		SPEED IN R.P.M.
MODEL	TEETH	PART NO.	TEETH	PART NO.		TEETH	PART NO.	TEETH	PART NO.		TEETH	PART NO.			TEETH	PART NO.			TEETH	PART NO.	TEETH	PART NO.	
7A	6	1825/4	8	1825/1A	3 000	28	GR 2023	28	GR 2003	642·9	15	GR 2018	400·0	7½	56	GR 2004A	428·6	7	10	GR 2002	30	GR 2001	600·0
8A	6	1825/4	8	1825/1A	3 000	–	——	28	GR 2003	642·9	–	——	—	–	56	GR 2004A	428·6	7	–	——	–	——	——
7B	6	1825/4	10	1825/70	3 000	28	GR 2023	28	GR 2003	642·9	15	GR 2018	400·0	7½	85	GR 2026	461·5	6½	10	GR 2002	30	GR 2001	600·0
8B	6	1825/4	10	1825/70	3 000	–	——	28	GR 2003	642·9	–	——	—	–	65	GR 2026	461·5	6½	–	——	–	——	——
7C	6	1825/4	10	1825/70	3 000	30	GR 2028	28	GR 2003	642·9	15	GR 2018	428·6	7	65	GR 2026	461·5	6½	10	GR 2002	30	GR 2027	642·9

FIGURE 32.

CREED