TELEGRAPH AUTOMATIC MACHINES AND ATTACHMENTS

CONTENTS

Issue 1.0, 6/67

THE PERFORATOR

INTRODUCTION

The perforator has a keyboard similar to that of a teleprinter, and the depression of a key, or the space bar, causes a paper tape to be perforated in accord with the 5-unit code for that particular character. The five code elements for a character are arranged transversely on the paper tape with a hole, or perforation, corresponding to a mark element and absence of perforation corresponding to a space element. A feed hole, necessary for the subsequent passage of the tape through a transmitter, is punched in the tape at the same time as the code combination. A specimen length of tape labelled with the characters and signals represented by the perforations is shown in Fig. 1. The tape in general use has

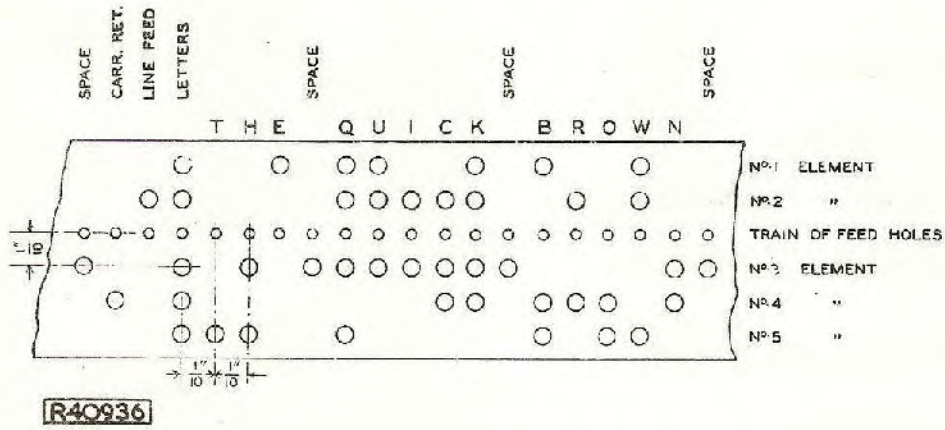


Fig. 1

an overall width of $\frac{11}{16}$ in. and is treated to give it a parchment like quality to facilitate perforating. The start and stop signals are the same for each character and the stop signal has a duration of one and a half elements, consequently to facilitate both the design of the perforator and the transmitter these signals are generated automatically by the transmitter.

The earlier type of perforators employed an electromagnet to operate the punching mechanism which perforated the tape in accord with a combination set up manually by the depression of a key. The present standard perforator, the Perforator No. 45, has a motor-driven mechanism which is both more reliable and allows for a higher speed of operation.

OUTLINE OF OPERATION

A general view of the Perforator No. 45 is shown in Fig. 2, and a view of the machine with the cover removed is shown in Fig. 3.

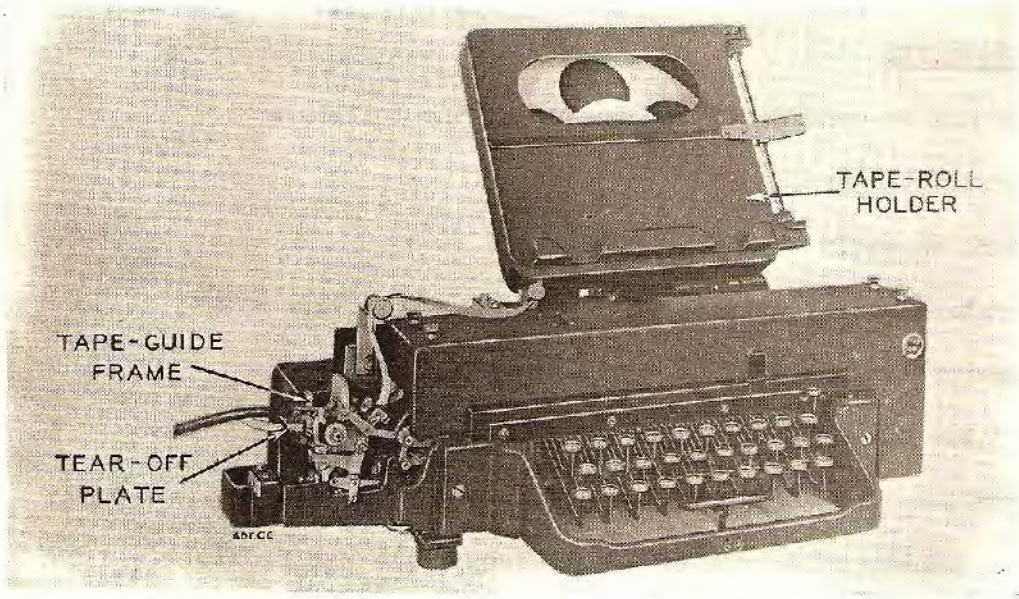
The motor is controlled by a separate switch and is running continuously whilst the machine is in use. When a key is depressed the keybar positions the combination bars and moves a saw-toothed trip bar to the left. The lateral movement of the trip bar causes the perforator-control unit to engage with a shaft driven by the motor and to,

(i) lock the combination bars to guard against the depression of another key before the complete operation of the perforator mechanism, and

(ii) move the perforator operating bar to the left and so cause the perforator mechanism to engage with the driving shaft.

A cam in the perforator mechanism is turned by the driving shaft and acts on the punch block, the movement of which in conjunction with the setting of the combination bars causes the tape to be perforated.

The arrangement of the cams on the driving shafts of the machine is such that when the perforator mechanism returns to normal, the control unit is also back to normal and the machine is ready to handle the next character.



R40943

Fig. 2

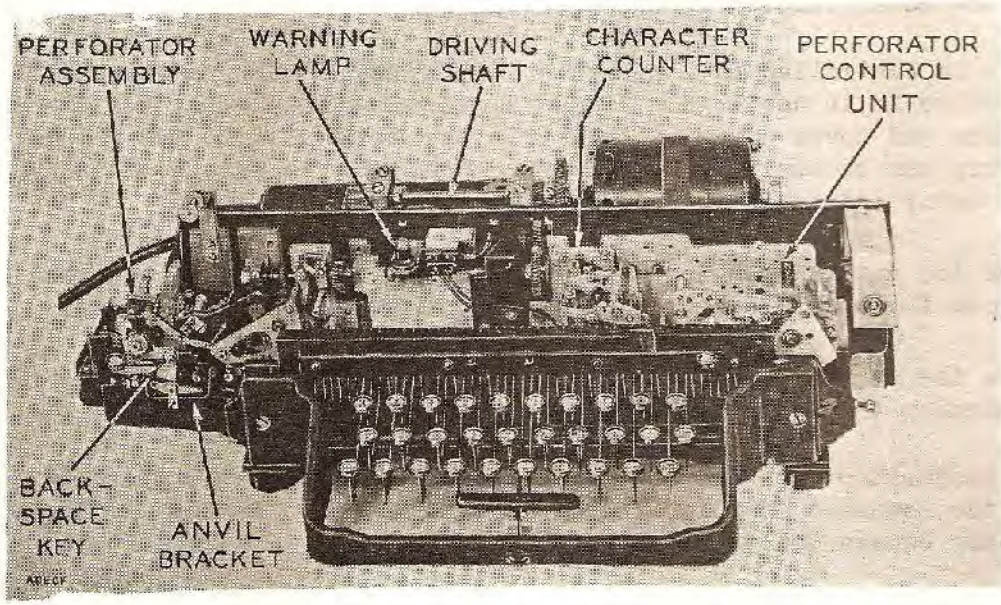


Fig. 3

MECHANICAL ARRANGEMENTS

The machine may be considered to consist of the following

The driving motor

Keyboard assembly

Perforator control unit

Perforator link unit

Perforator assembly

Tape roll-holder unit.

A character counter unit is also provided but will not be described in this pamphlet.

Driving Motor

The motor may be either an a.c. model or d.c. model. The a.c. motor is of the four-pole induction type suitable for use on the normal 50 Hz main supplies; the motor speed is 1450 rev/min and is not governed. The d.c. motor is series wound and designed for use on a 160 volt supply; it is fitted with a standard teleprinter governor unit and has a running speed of 1500 rev/min.

The main drive from the motor runs across the width of the machine and is suitably geared to the drive shafts of the perforator control unit and the perforator assembly, both of which run at right-angles to it.

Keyboard Unit

Selecting Mechanism

There is a combination bar for each of the five elements of the signal. The bars are notched so that when a key is depressed the bars associated with space elements for the particular character move to the left and those associated with the mark elements remain stationary. A chart showing the notches in the bars immediately under the characters R, V, Y and SPACE is shown in Fig. 4. The bars are moved to the left when the depressed keybar engages the inclined left-hand side of the notch. The inclined right-hand side of the notch in a bar which is to remain stationary (mark) returns that bar to normal after being moved for the previous character.

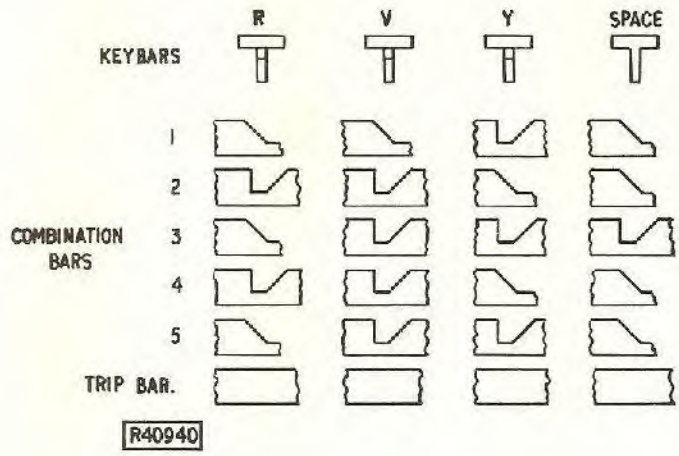


Fig. 4

The saw toothed trip bar is moved laterally to the left by the action of the key bar on the sloping edge of a tooth (Fig. 5). The movement of the combination bars sets up selector bars in the perforator assembly and selecting levers, which form part of a keyboard locking arrangement, in the perforator-control unit. The operation of the trip bar causes a detent release latch in the control unit to operate and so start the cycle of operations.

An explanatory diagram of the linkage arrangements between the keyboard unit and the perforator assembly and perforator-control units is shown in Fig. 5. Consider the combination bar to be associated with the first element of the signal. The depression of the R key causes the No. 1 combination bar to move to the left and turn both connecting levers in a clockwise direction, thus for a space element the selector bar is moved to the right and the selecting finger moved upwards. When the signal element is a mark, as is the first for the letter Y, the combination bar is not moved, consequently the selector bar and the selecting lever finger remain normal, that is as shown in Fig. 5. From the foregoing it follows that when a key is depressed those selecting fingers associated with space signal elements will be moved upwards and so form a V with those associated with mark signal elements. It is sufficient at this stage of the explanation to appreciate that the selector bars associated with the space elements move to the right and the remainder stay normal.

It should be noted that the combination bars are not spring-loaded. The combination bars remain in the positions proper to the last key depressed, and are rearranged to the necessary combination when another key is subsequently depressed.

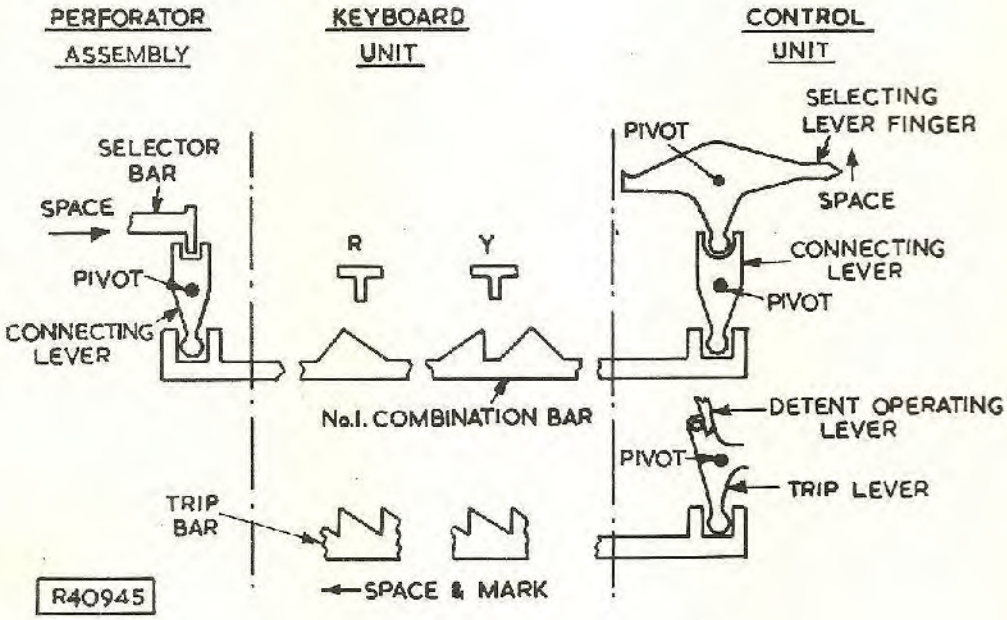


Fig. 5

Perforator Control Unit

The perforator control unit may be considered to consist of two separate sections, the release mechanism and the operating mechanism.

The mechanical arrangement of the release mechanism is shown in Fig. 6.

When a key is depressed, the consequent movement of the trip bar to the left is transmitted through the trip lever to turn the detent operating lever in an anti-clockwise direction. A projection on the detent operating lever engages with a step in the detent release latch and, because this latch is fixed to the detent control shaft, the trip detent is lifted from the clutch ratchet. When the trip detent is raised, the clutch ratchet is forced by a coiled spring into engagement with the driving ratchet and the control cam-shaft turns in a clockwise direction. The driving gear and ratchet are driven continuously by the main shaft and when normal are free to rotate on the control cam-shaft.

When the control cam-shaft has turned through a quarter of a revolution the resetting cam engages with the detent release latch. The latch is turned on its pivot and disengages from the detent operating lever, consequently the anti-clockwise movement of the detent-control shaft stops. The tension of the trip detent restoring spring turns the control shaft back in a clockwise direction until the cylindrical projection at the end of the trip detent engages with the path of the radial cam surface on the clutch ratchet. The shape of the cam surface is such that the clutch ratchet is disengaged from the driving ratchet when the cam-shaft has completed half a revolution.

The subsequent reoperation of the key, or the operation of another key, causes the release mechanism to repeat the cycle of events already described. Thus for each operation of a key the control cam-shaft turns through half a revolution.

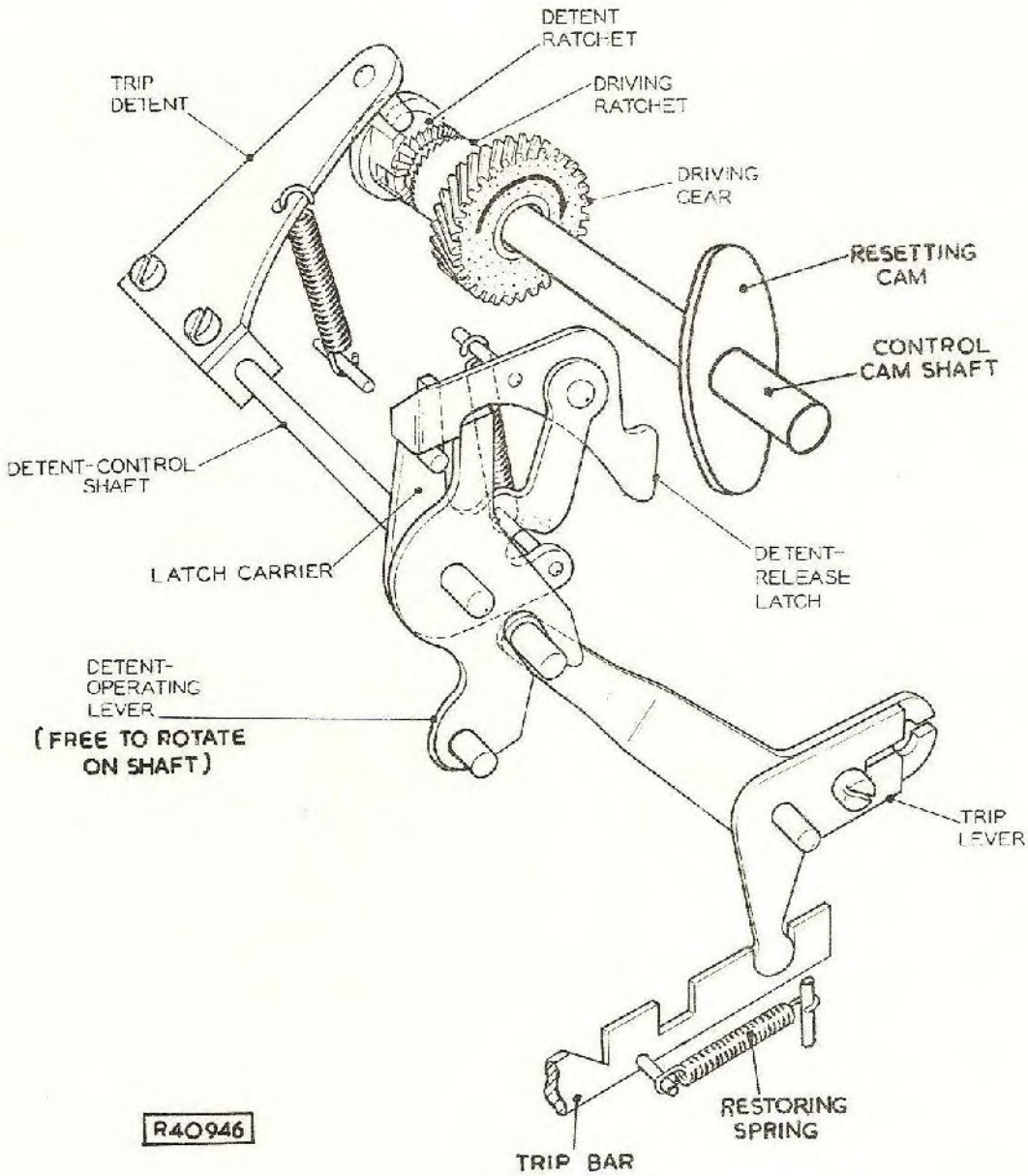


Fig. 6

The mechanical arrangement of the operating mechanism is shown in Fig. 7, it should be noted that the control cam-shaft is the same as that in the release mechanism. During the half revolution of the control cam-shaft the operating mechanism locks the combination bars against the premature operation of another key or release of the depressed key, and initiates the operation of the perforating mechanism. When the control cam-shaft moves from the normal position the shape of the locking cam allows the blade of the locking frame to move, under the tension of a spring, into the V formed by the selecting levers of the combination bars. The blade remains in the V and so prevents movement of the combination bars, until the locking cam moves the frame away at the end of the half revolution.

The shape of the perforator-release cam is such that early in the movement of the cam-shaft, the perforator and counter-operating lever turns in an anti-clockwise direction sufficient to move the perforator operating bar to the right. The action of the bar in the perforator mechanism is described later.

The retention lever acts on its cam and holds the control cam-shaft in the normal position between operations of the perforator-control unit.

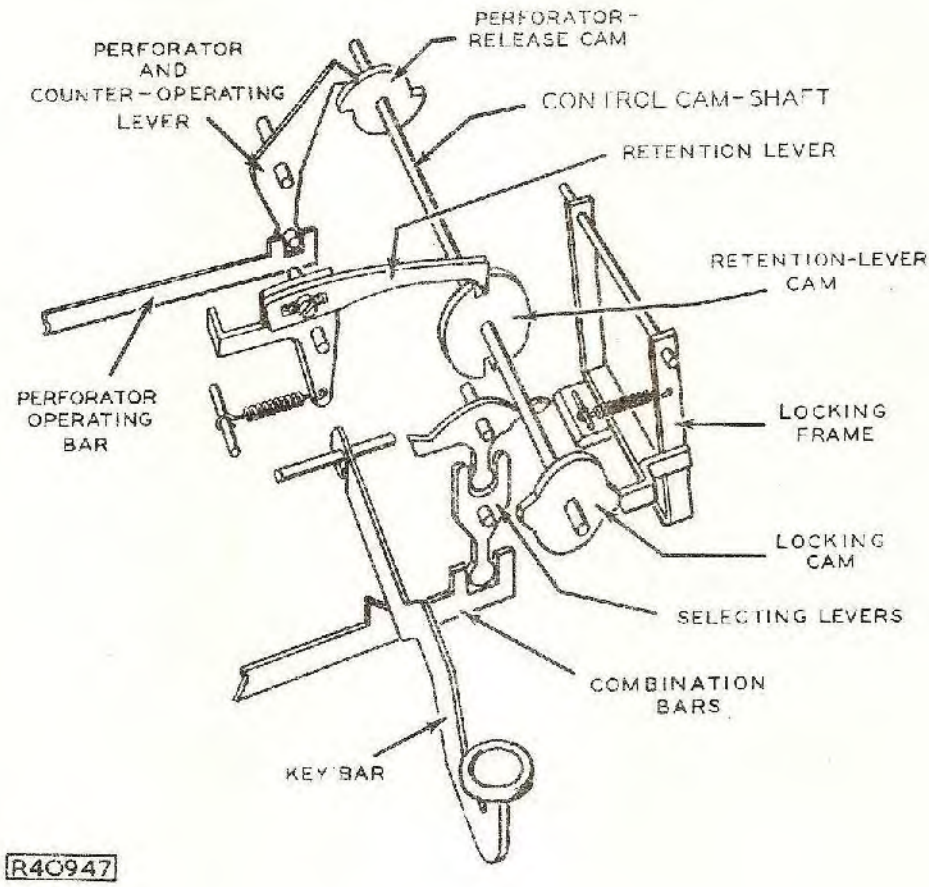
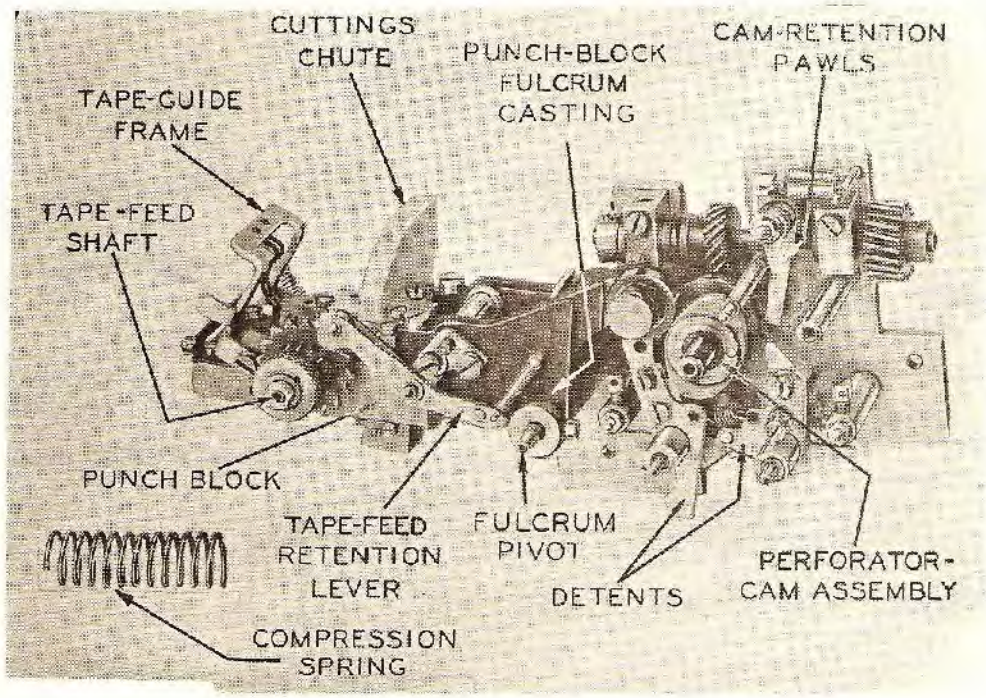


Fig. 7

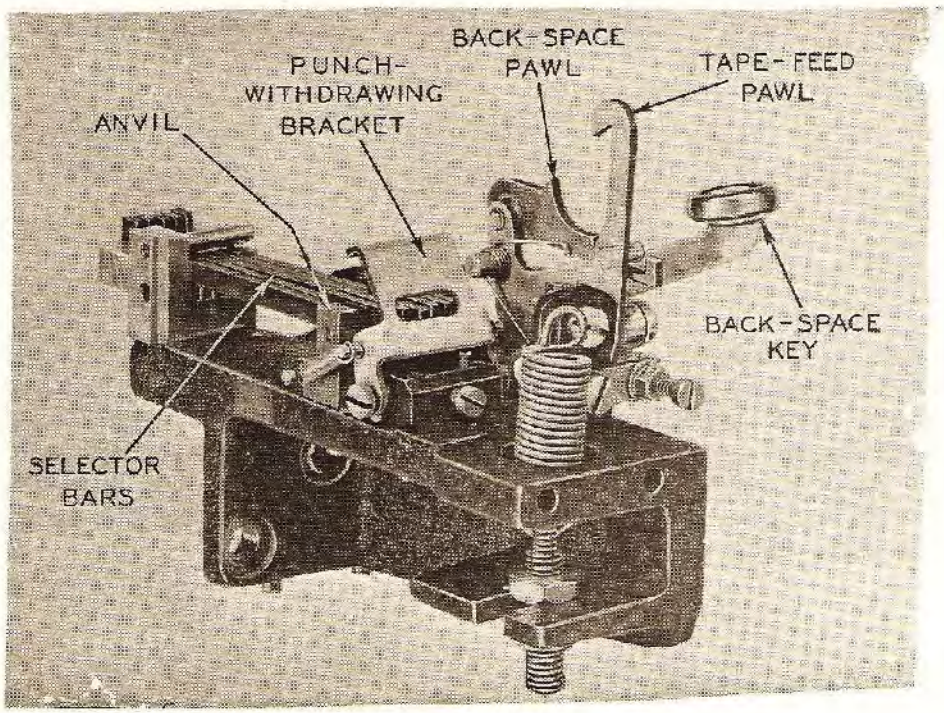
Perforator Mechanism

The perforator mechanism consists of an anvil bracket assembly and a perforating unit, photographs of which are shown in Figs. 8 and 9 respectively. A general arrangement drawing of the mechanism is shown in Fig. 10.



R40948

Fig. 8



R40949

Fig. 9

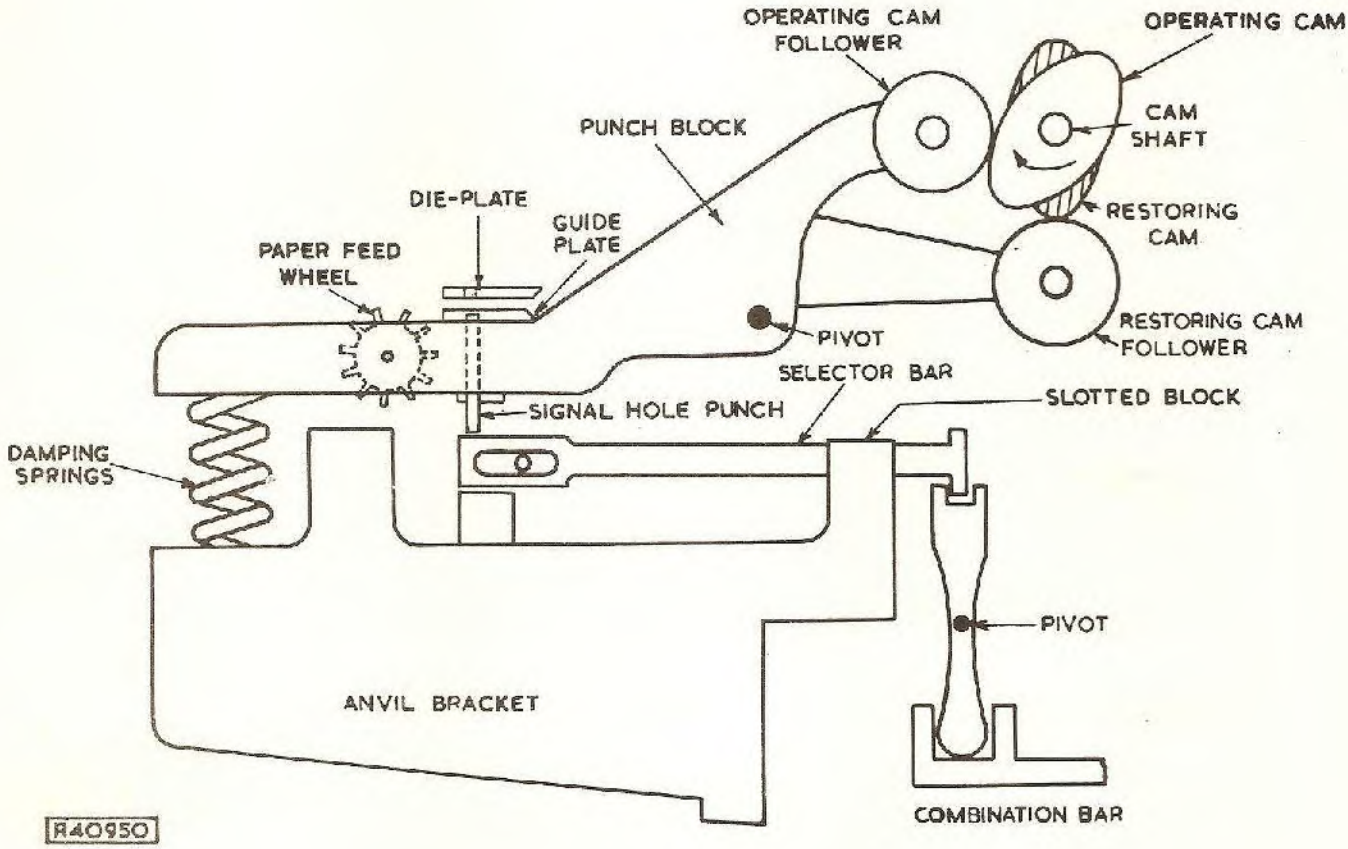


Fig. 10

The anvil bracket is secured to the keyboard casting and carries the five selector bars which are located in the slotted block but free to move laterally. When a key is depressed those selector bars associated with space signal elements are moved to the right by the action of the combination bars as already described. The movement is just sufficient to withdraw the appropriate selector bars from beneath the signal hole punches. The selector bars associated with the mark signal elements remain in the position shown in Fig. 10.

The cam shaft and its associated drive mechanism which includes a pawl and ratchet type clutch, is also secured to the keyboard casting. The cams are shaped so that one operation of the perforator mechanism is completed in one half a revolution of the cam-shaft, the principle of the detent arrangement associated with the clutch is shown in Fig. 11. When the perforator operating bar is moved to the right by the action of the operating mechanism, Fig. 7, it engages with and turns the left-hand detent, Fig. 11, about the pivot in an anti-clockwise direction. The action of the detent projection causes the right-hand detent to turn in a clockwise direction about its pivot. The bearing surfaces of the detents move outwards against the tension of the restoring spring and release the clutch pawl from one or other of the normal positions. The release of the pawl operates the clutch and the cam-shaft commences to rotate in a clockwise direction. During the time that the cam-shaft is moving from one normal position to the other the perforator operating bar is moved, back to the normal position by the action of the perforator-release cam, Fig. 7, and the left- and right-hand detents return to their normal positions. At the end of one half a revolution, the clutch pawl engages with one of the detents, thereby releasing the clutch to stop the cam shaft.

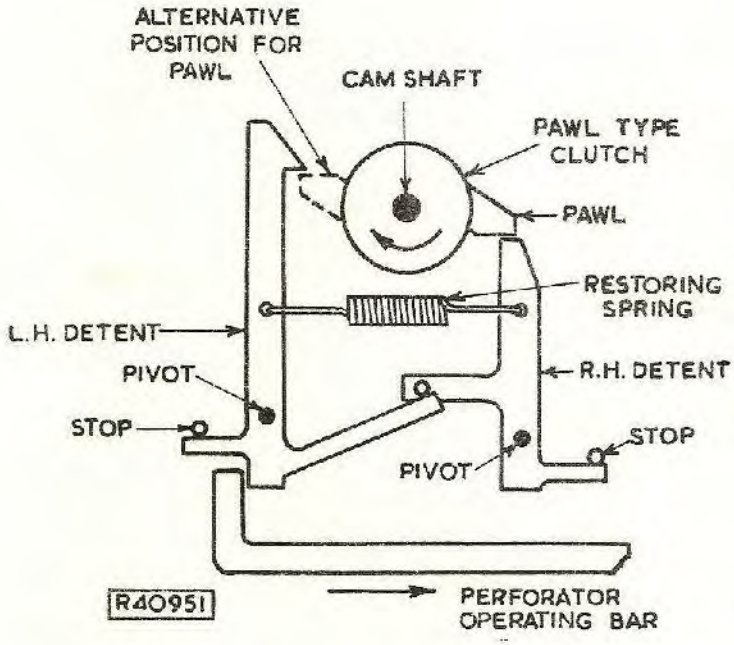


Fig. 11

The punch block includes the five signal hole and one feed-hole punches together with the die-plates and guide plates, and it is mounted on a pivot. During each half revolution of the cam-shaft, the operating and restoring cams in conjunction with the two cam followers, Fig. 10, cause the block to be turned first anti-clockwise and then clockwise back to the normal position. The anti-clockwise and clockwise movements are, for convenience, considered to be downward and upward movements respectively. The damping springs consist of a compression spring and a tension spring, and are necessary for the positive and quiet action of the mechanism.

The punches are normally held below the level of the die-plates by a punch withdrawing bracket which, for the sake of clarity, is not shown in Fig. 10. The bracket is pivoted on the anvil bracket and is held in engagement with the punches by means of springs, a diagram of the arrangement is shown in Fig. 12. The paper tape runs between the guide and die plates and is perforated during the downward movement of the punch block. The punches move down with the block and those associated with the mark signal elements for the particular character engage with their selector bars and remain stationary during the remainder of the downward movement. The selector bars associated with the space signal elements have been withdrawn from beneath the punches as previously described, consequently the corresponding signal punches are free to continue moving with the block. The paper tape is carried down with the block and near the end of the downward movement it engages with and is perforated by the mark signal element punches.

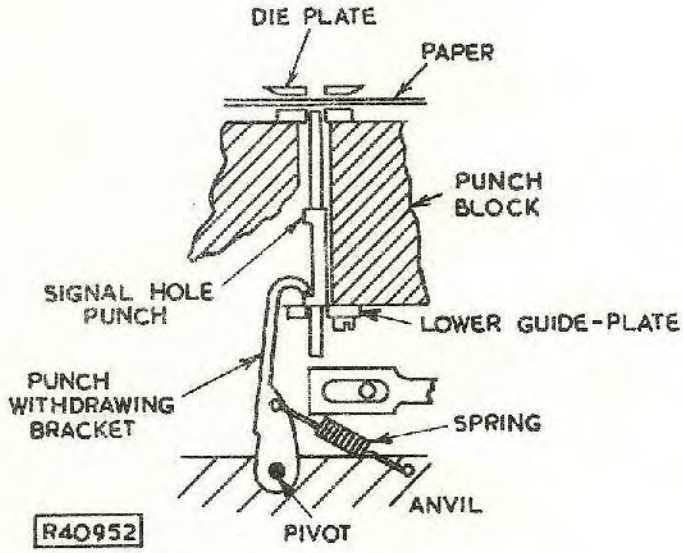


Fig. 12

The feed-hole punch is not associated with a selector bar, but engages with a raised portion of the anvil block so that a feed-hole is perforated for each operation of the perforator mechanism.

The positions of two punches, one associated with a mark element and the other with a space element, when the punch block is at its lowest point, is shown in Fig. 13. When the punch block moves upwards the punches move with it, but during the travel the mark signal element punches engage with the lip of the withdrawing bracket. The action of the bracket is to bring the mark punches into line with the space punches, that is to the normal position, when the punch block reaches the normal position.

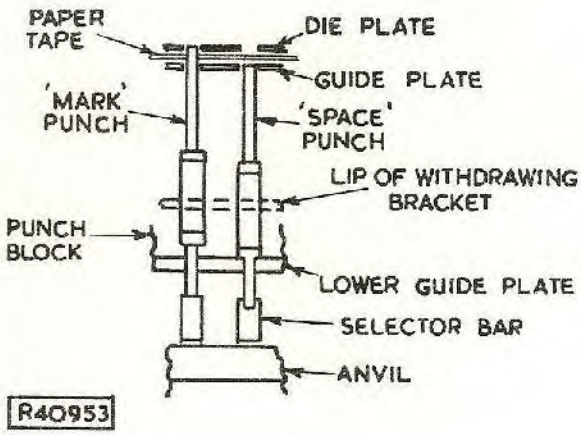


Fig. 13

Paper Feed Arrangements

The roll of paper tape is housed in a shallow box and passes through several guides and a tension device to the perforating mechanism as shown in Fig. 2.

The paper feed holes in the tape engage with the spokes of the paper feed wheel. Late in the restoring movement of the punch block the feed wheel is caused to turn by the mechanism shown in Fig. 14, and so pull the tape forward. The distance moved at each operation provides the spacing between characters, that is $\frac{1}{10}$ in. The feed wheel is positioned after the punches, consequently when preparing a tape it is necessary to manually feed the tape until the feed holes engage the wheel, the SPACE character is normally used during this operation.

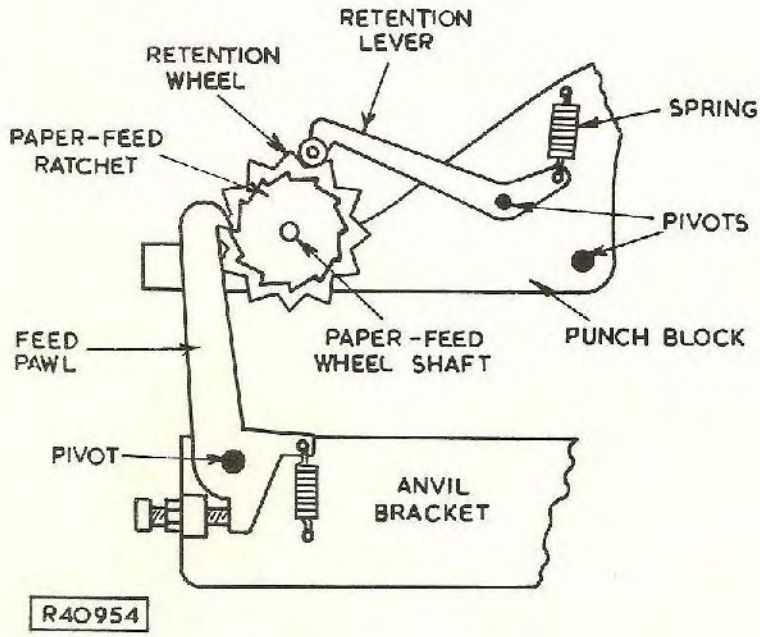


Fig. 14

The mechanism works on the reverse action principle. During the downward movement of the punch block the feed ratchet, Fig. 14, moves down and the feed pawl rides up to the long face of a tooth and engages with the next one. Thus during the succeeding upward movement, the short face of the engaged tooth meets the tip of the pawl and the paper-feed wheel shaft is rotated. The retention wheel and lever arrangement hold the shaft steady between operations of, and during the downward movement of, the punch block.

THE REPERFORATOR

INTRODUCTION

The reperforator is a telegraph machine which receives 5-unit code signals and converts them to perforations in a parchmentized paper tape. The machine consists of the following units mounted on a base casting:-

(i) A driving motor and governor similar to those used on a teleprinter

(ii) An automatic start-stop switch.

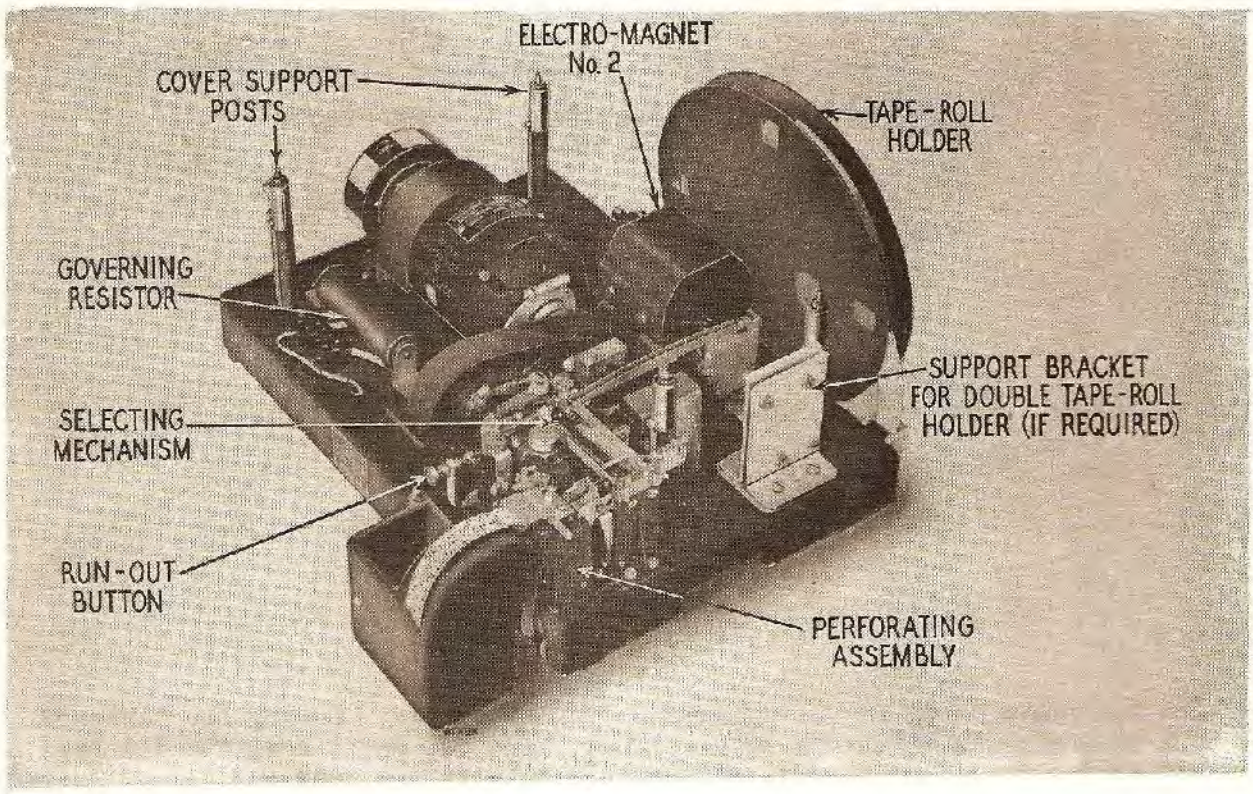
(iii) A teleprinter type electromagnet unit.

(iv) A selecting mechanism.

(v) A perforating head.

(vi) A tape roll holder.

A photograph of a reperforator in general use, the British Post Office Reperforator No. 2, is shown in Fig. 15.



R40966

Fig. 15

OUTLINE OF OPERATION

The signals are received on an electromagnet, the armature of which is linked to a start-stop switch and, in a way similar to that used in a teleprinter, to a trip shaft. The start-stop switch automatically completes the motor circuit on receipt of the first signal combination, and stops it if signals are not received during a period of approximately 30 to 74 seconds.

The movements of the electromagnet armature in response to the received code signals turn the trip shaft and, in conjunction with levers actuated by a number of rotating cam tracks, cause five hammers to be positioned according to the received code combination. After the hammers have been positioned, the frame on which they are mounted is moved forward by means of a cam controlled link and the hammers corresponding to mark elements force punches through the paper tape. A sixth hammer is fitted to the frame and perforates the tape feed holes. The hammer frame is withdrawn by the action of the cam on the link, and as it withdraws the hammers and punches are restored to the normal position. During the period that the hammers are positioned in accord with the code elements, the ratchet wheel in the paper feed mechanism is caused to rotate one step and so move the paper tape forward. It should be noted that, unlike the automatic transmitter head paper feed mechanism, the reperforator paper tape mechanism is of the positive action type.

MECHANICAL ARRANGEMENTS

A schematic diagram of the selecting mechanism and the perforating head is shown in Fig. 16. For the sake of clarity only one perforating hammer and code punch are shown.

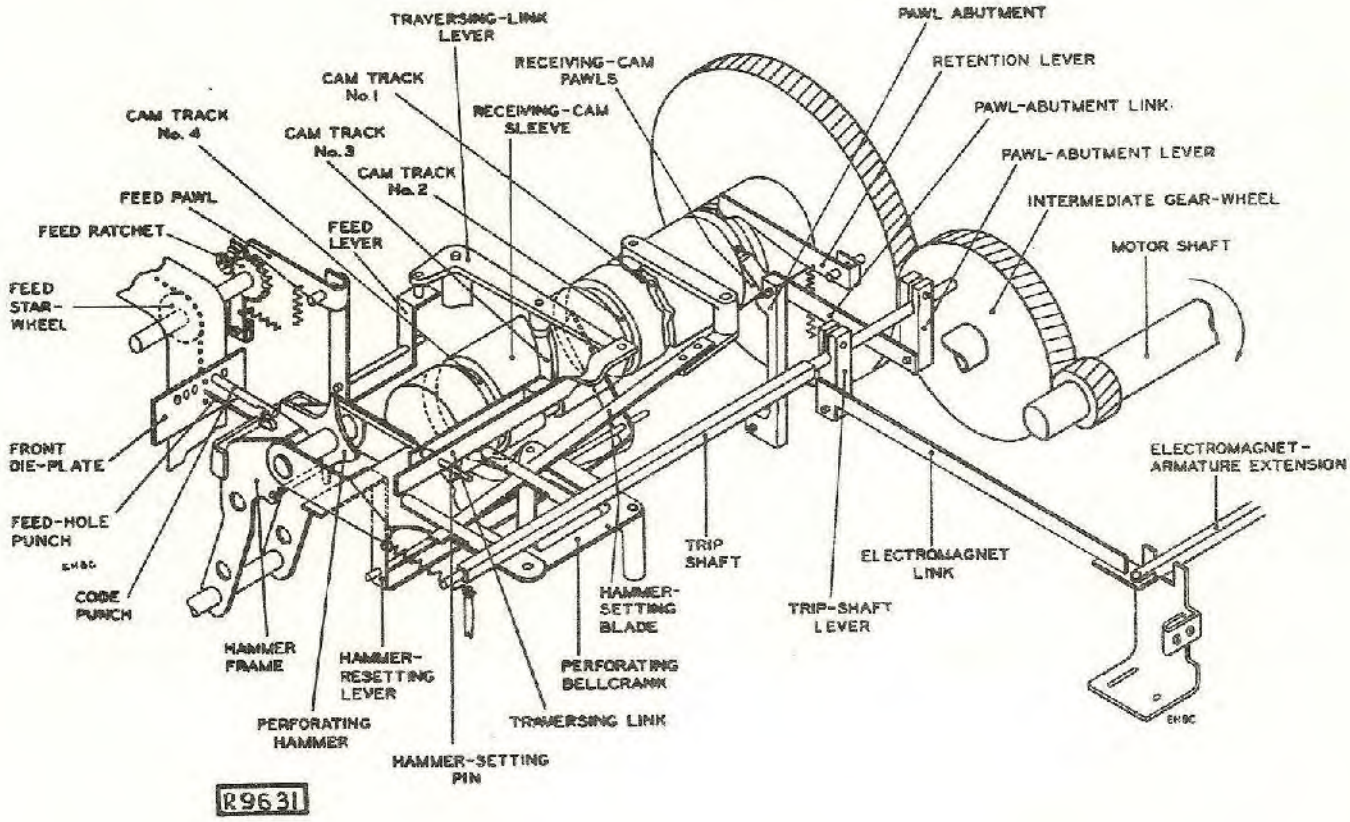


Fig. 16

Selecting Mechanism

The cam-sleeve rotates under the control of a ratchet and pawl clutch which, in turn, is controlled by a pawl abutment linked to the trip shaft. The operation of the clutch mechanism is similar to that of the clutch on the Teleprinter No. 7B. The mechanism concerned in setting up the hammers and operating the hammer frame is actuated by means of four cam tracks. The operations controlled by the tracks, Fig. 16, are as follows:-

(a) Track No. 1 has five indentations, by means of which the hammer-setting blade is moved forwards and backwards in front of the hammer-setting pin five times during each rotation of the cam-sleeve. These movements occur when the setting pin (carried by the traversing link) is central with each hammer, in turn, and are coincident with the mid-point in the period of reception of each code element of an undistorted signal combination. Thus, for marking elements, the blade is in its raised position and it strikes the pin and moves it towards the hammer, whereas for spacing elements, the blade is tilted downwards and passes below the setting pin, which is not moved.

For each marking element, therefore, the pin encounters the hammer and causes it to rotate anti-clockwise so that its horizontal projection is brought opposite the associated punch.

(b) Track No. 2 operates the hammer-resetting lever. During reception of the start signal, the lever is moved into engagement with the lower extension of all those hammers which were set to marking during the preceding selection. The movement of the lever thus restores the hammers to spacing in readiness for the setting up of the next combination.

(c) Track No. 3 operates the traversing lever, which is coupled to the traversing link and paper-feed lever. The lever makes one cycle of movement for each revolution of the cam sleeve, during which period the hammer-setting pin (carried by the traversing link) is moved across the hammers in the following sequence:- from hammer No. 3 to hammer No. 1 (during the reception of the start signal), successively from hammer No. 1 to hammer No. 5 (during reception of the code elements) and then back to hammer No. 3 (during the reception of the stop signal). The reciprocating movement of the traversing lever operates the feed pawl to move forward one tooth on the feed ratchet and then move backwards; the paper is fed forward $\frac{1}{10}$ inch on the return movement of the pawl.

(d) Track No. 4 operates the punching lever and, therefore, the hammer frame once per revolution. This occurs immediately after the setting of the hammers is completed and causes the frame to be moved forward so that those hammers which have been set to the marking position push the corresponding punches forward through the tape. The feed-hole punch is also operated on each combination. The hammer frame is then returned to its normal position; as this occurs, a projection on the hammer frame engages in the slots in the operated punches and withdraws them from the tape.

The Punching Unit and Perforating Head

The punching unit and perforating head comprise a casting on which the punches, die plates and paper-moving mechanism are mounted. The punches are supported by two guide plates which are identical with the die plate into which the punches penetrate after passing through the paper. Slots are provided at the rear end of the code punches to engage with the hammer frame for withdrawing the punches from the paper. A diagram giving the general arrangement of the hammer mechanism is shown in Fig. 17. The punch-hammer frame is pivoted at its lower end and five punching hammers, together with their damping spring assemblies, are located on a spindle fixed to the top of the frame. The five hammers are associated with the five code punches. The feed-hole punch is required to be operated for every combination, it is, therefore, actuated direct by the hammer frame.

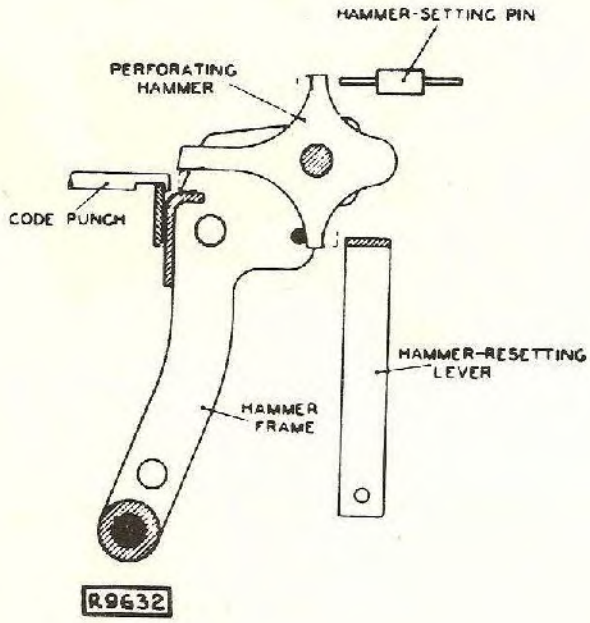
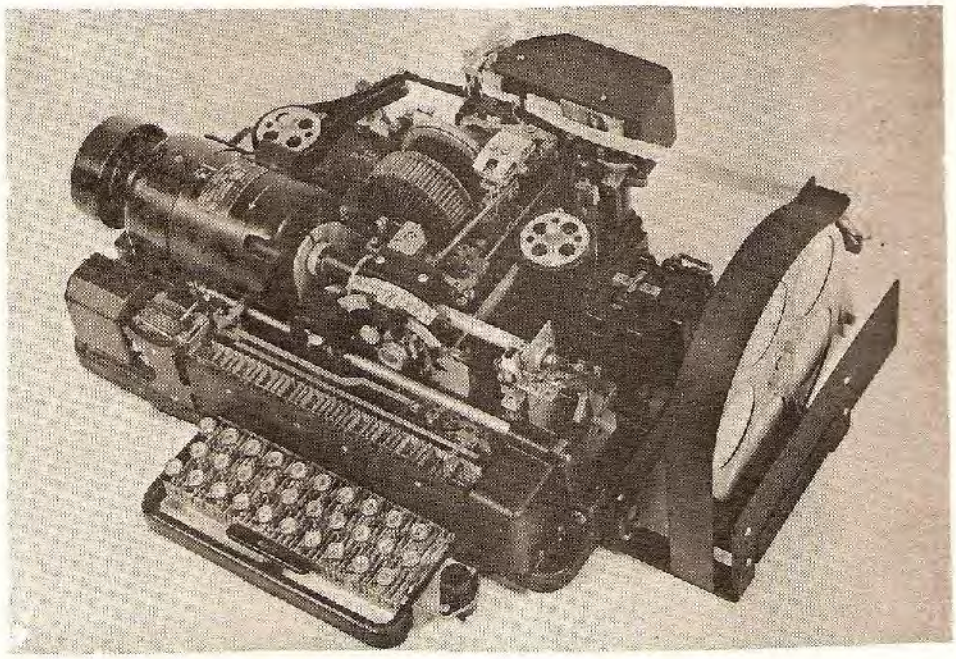


Fig. 17

THE PRINTING REPERFORATOR

INTRODUCTION

The printing reperforator used by the B.P.O. is basically a tape teleprinter with a perforator attachment. There are two types of machine, one with a keyboard and transmitting unit, the Printing Reperforator No. 1, and another, the P.R. No. 2,



R40967

Fig. 18

which has only receiving equipment. Both types of machine perforate and print the received message on a parchmentized tape. The message is printed along the lower edge of the tape and is superimposed on the 4th and 5th code perforations. A photograph of the No. 1 type machine is shown in Fig. 18. The perforating mechanism is adjacent to the type head and perforates the tape such that a printed character is displaced eight printing spaces to the right from its associated perforations. A sample of printing reperforator tape is shown in Fig. 19, the position of the perforations associated with certain words is shown by the printing above the tape.

R40968

Fig. 19

So that the message printed on the tape shall not be mutilated by the code perforations, the tape is perforated by the "chadless" method, in which the code and feed holes are not completely perforated; the small disks - called chads - remain attached to the body of the tape at the leading edges of the holes so that they may rise like small hinged lids in response to the sensing pecker of an auto-transmitter.

The typehead on the machine is of the same design as that used on the Teleprinter No. 7 but is fitted with five extra types which carry symbols for 'carriage-return', 'line-feed', 'all-space', 'bell' and 'who are you'. The symbols are illustrated in Fig. 20 and are necessary so that the operator can read the tape without having a knowledge of the telegraph code.

Fig. 20

OUTLINE OF OPERATION

The operation of the teleprinter section of the machine is similar to that of the Teleprinter No. 7 described in E.P. Draft Series: TELEGRAPHY 4/1.

The timing of the operations performed by the perforating unit is controlled by the receiving cam on the machine. During one complete revolution of the cam,

(i) the perforating unit perforates the tape in accordance with the code combinations set up during the preceding revolution,

(ii) withdraws the punches, this occurs approximately at the time the character is printed,

(iii) the code combination being received is transferred to the perforating unit, this coincides with the operation of the teleprinter comb-setting levers,

(iv) the tape feed mechanism operates.

MECHANICAL ARRANGEMENTS

Transfer of Code Combination

The received code combination sets up the receiving combs in the teleprinter section and is transferred to the perforator section by the comb levers acting on a series of levers and push rods, the arrangement associated with one comb lever is shown in Fig. 21, it should be noted that the punching bar is shown in cross-section. When a mark element is received the appropriate comb extension on the

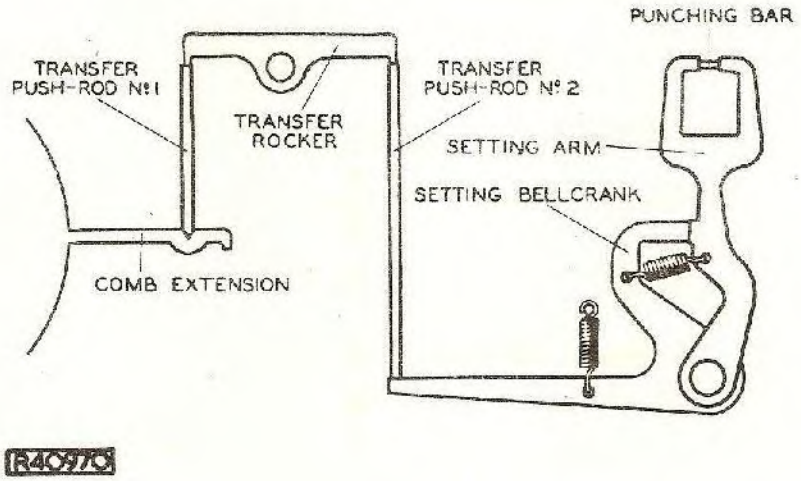


Fig. 21

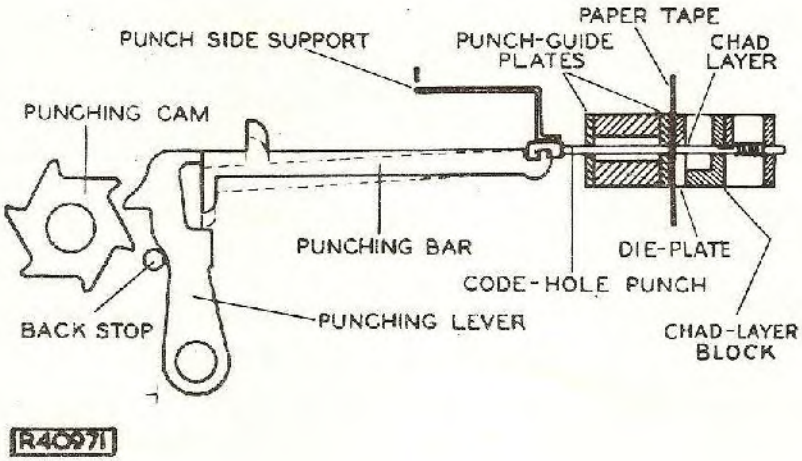
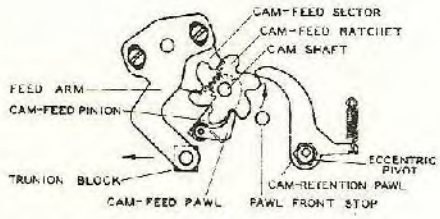
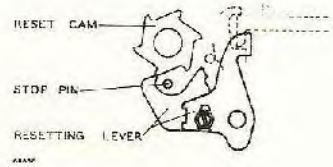


Fig. 22

combination head is lifted by a comb-setting finger. Push-rod No. 1 rises and through the transfer rocker causes push-rod No. 2 to move downwards. The push rod acts on the setting bellcrank and so causes the punching bar to be moved to the left. The movement of the punching bar causes it to move into engagement with a punching lever as shown in Fig. 22, where the punch bar in broken line indicates its SPACE position. The tape is perforated when the punching cam moves through $\frac{1}{6}$ th of a revolution and so causes the punching bar to move forward and force the code-hole punch through the paper tape. The broken line punching bar in Fig. 22 shows that when the punching lever moves forward a punching bar in the SPACE position remains stationary. There is a punching cam associated with each lever and they are arranged on the cam shaft so that the punching levers are operated in sequence, thereby reducing the instantaneous load on the machine motor.

The punching cams are operated from an extension of the traversing link on the teleprinter section. The mechanical arrangement is shown in Fig. 23.





R40972

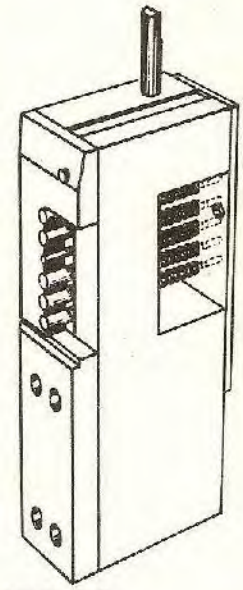
Fig. 23

When the traversing link moves forward during the selection of a character, a feed lever which is coupled to the end of the link acts on the trunion block and turns the feed arm on its pivot as indicated by the arrow. The cam-feed sector turns with the feed arm and turns the cam-feed pinion in an anti-clockwise direction. The pinion is free to turn on the cam-shaft, consequently the cam-feed pawl turns the cam-feed ratchet, the movement of the feed ratchet is $\frac{1}{6}$ th of a revolution. The cam-retention pawl holds the ratchet in position when the feed pawl is withdrawn and drops into an adjacent tooth during the reverse stroke of the feed arm.

The punches are withdrawn by means of a cam operated lever which acts on the projections on the punching bars. The operation approximately coincides with the printing of the character.

Punch Block

The 'chadless' perforations are obtained by the use of a specially-shaped die plate which is cut-away as shown in Fig. 24. The cutting edges of the die plate holes are arcs, not full circles as in the normal punch block, consequently when the punches move forward only arcs are cut in the tape thereby providing chadless perforations.

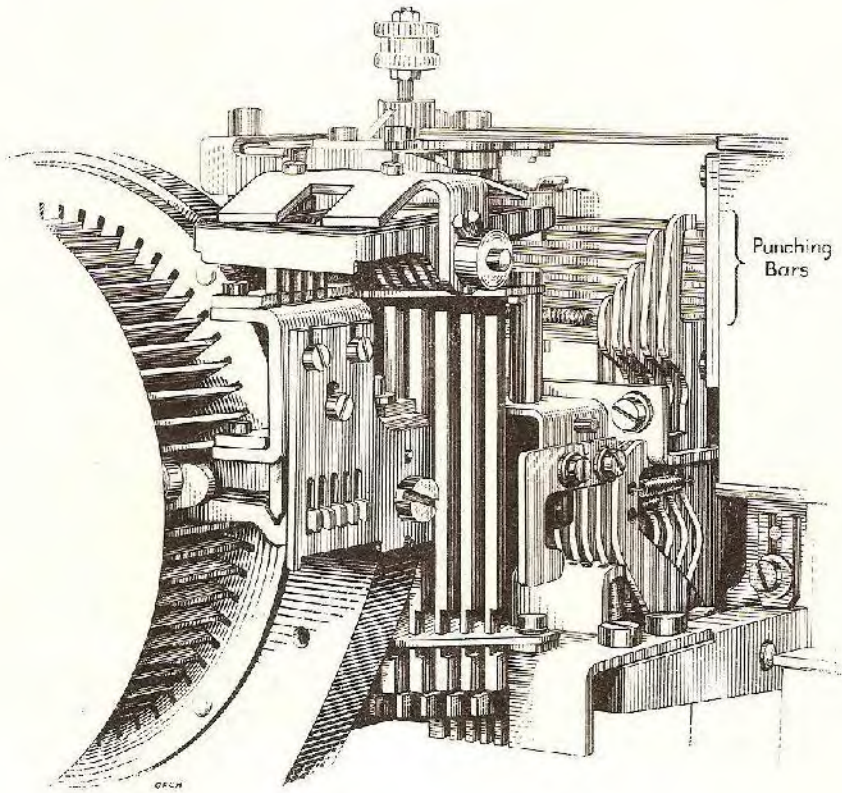


R40973

Fig. 24

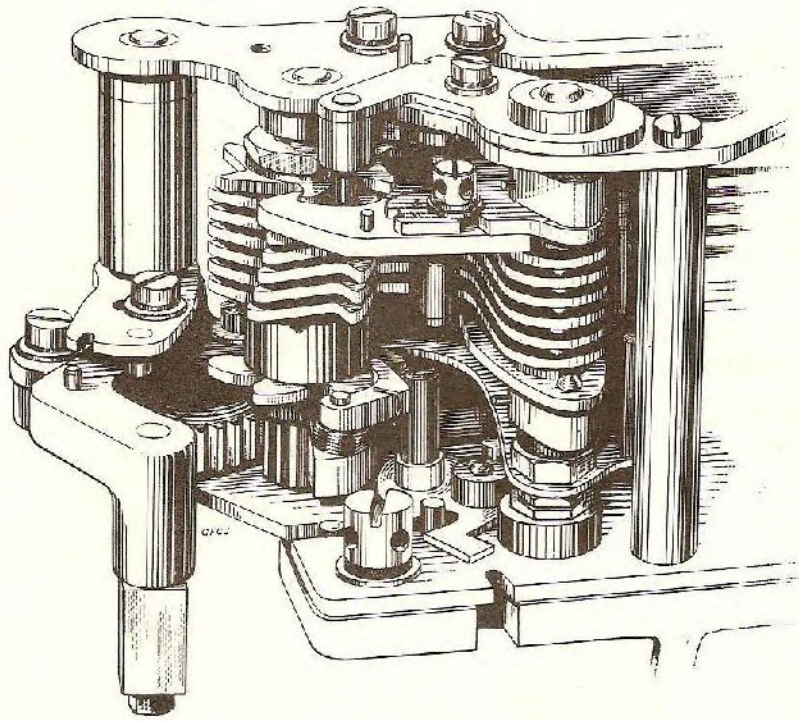
Mechanical Linkage

An appreciation of the mechanical arrangement of the linkage between the teleprinter combs and the perforator unit can be obtained from the line drawing shown in Fig. 25.



R40974

Fig. 25



R40975

Fig. 26

The arrangement of the punching cams and feed arm, which are situated at the end remote from the 'punching bars' label in Fig. 25, is shown in Fig. 26.

THE TELEPRINTER-REPERFORATOR

INTRODUCTION

The teleprinter-reperforator is a telegraph machine which has been developed to perform the duties of a teleprinter, a reperforator, and a perforator. The machine is basically a standard page Teleprinter No. 7B or E fitted with a saw-tooth keyboard, transmitter, and answer-back unit as used on the Teleprinter No. 11, together with a perforating mechanism similar to that used on the Perforator No. 45. A photograph of a typical machine, using a Teleprinter No. 7B receiver, is shown in Fig. 27.

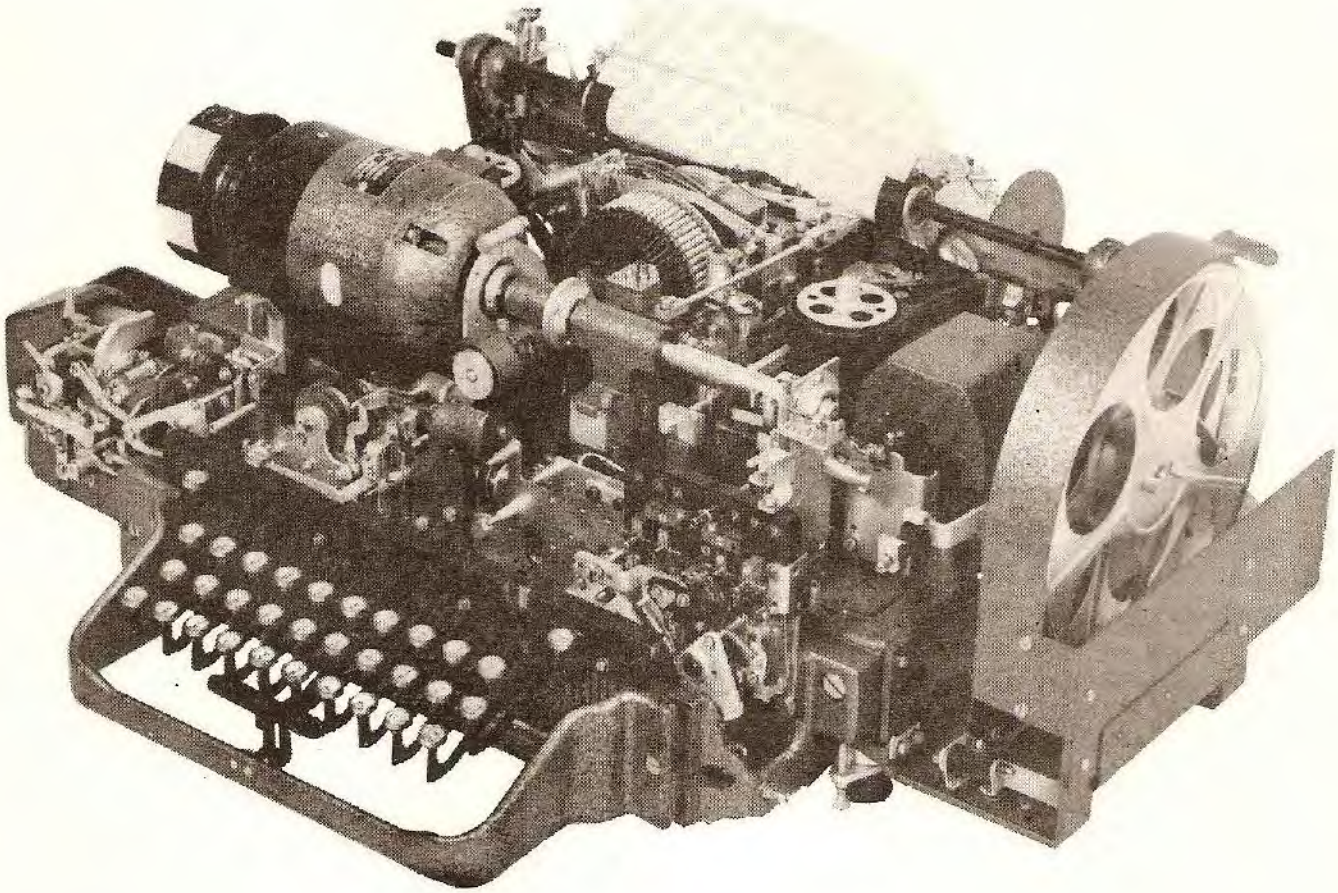
The facilities provided by the machine are as follows:-

(a) Teleprinter working; manual transmission with a page-printed record of local or incoming signals. The perforator section is rendered inoperative by manually moving a 'perforator throw-out' lever to the left.

(b) Reperforator working; producing fully punched tapes in addition to page-printed records. The perforator unit is brought into use by moving the throw-out lever to the right, and produces punched tape for all signal combinations except

(i) 'Who are you' and 'Bell', the preceding figure shift is perforated but the 'WRU' or 'Bell' combination is suppressed.

(ii) 'Answer back', the perforator is suppressed throughout the period when the machine answer-back unit is controlling transmission.



R40976

Fig. 27

(c) Perforator working; the machine is worked in local and works as outlined in (b).

(d) A RUN-OUT key; this provides for the continuous transmission of any character.

(e) A BACK-SPACE key; this provides for the cancellation of punching errors by overpunching with the 'letters' combination, that is five mark code elements.

OUTLINE OF OPERATION

The perforator mechanism is situated to the left of the keyboard as in the Reperforator No. 45, and is controlled by a system of levers and five Bowden cables from the teleprinter combination head, and an extension from the traversing link in the receiving cam-unit.

MECHANICAL ARRANGEMENTS

Code-combination Mechanism

The movements of the comb extensions in the combination head are transmitted to the perforator mechanism by means of the inner cores of five Bowden cables. The arrangement is shown in Fig. 28. The punch-selector bars are spring tensioned

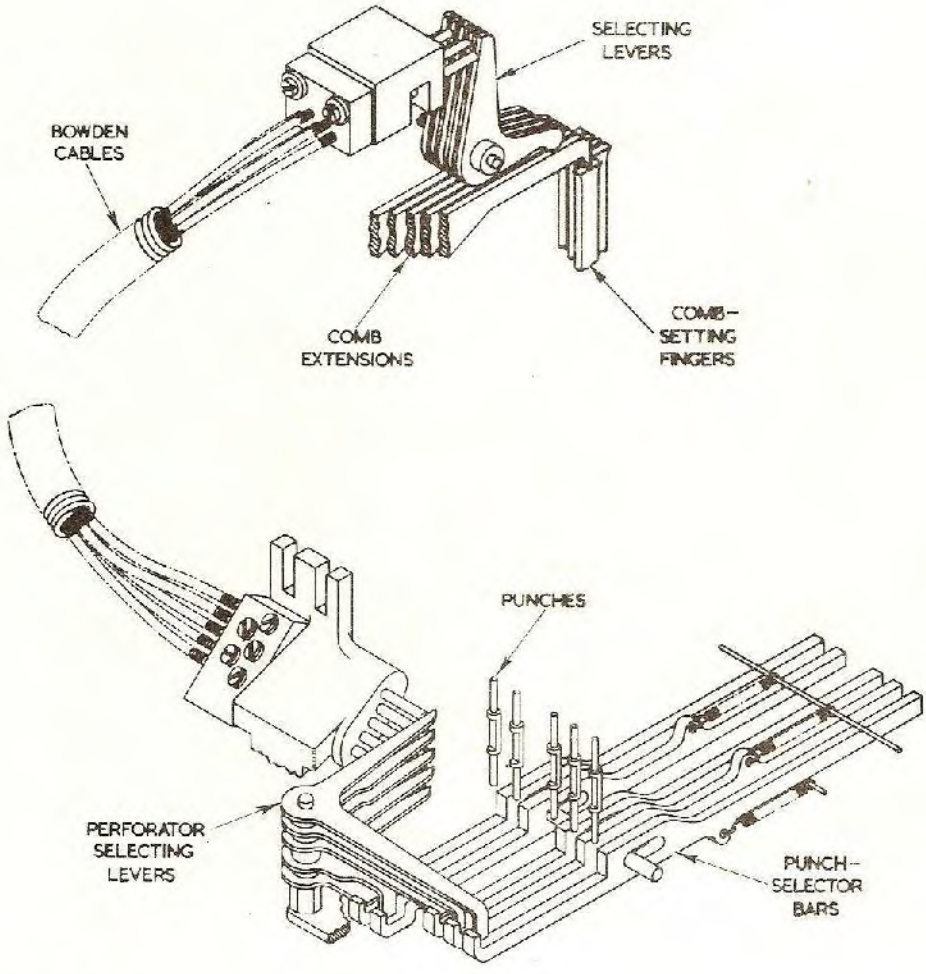


Fig. 28

towards the right and through the perforator selecting levers and cables, hold the selecting levers against the comb extensions. When a comb extension is lifted as for a MARK code element, the movement is transmitted through the selecting lever, cable and perforator selecting lever to move the punch-selector bar to the left. The anvil portion of the bar, therefore, is moved underneath the punch in readiness to perforate the tape. The comb extension is not moved for a SPACE element, consequently the punch-selector bar remains normal and does not engage its punch during the subsequent perforating operation.

After operation the punch-selector bars and the levers are restored to normal by the tension springs.

Perforator Trip Mechanism

The operation of the perforator unit is initiated by the traversing link on the receiving-cam by the arrangement shown in Fig. 29. When the comb-setting pin

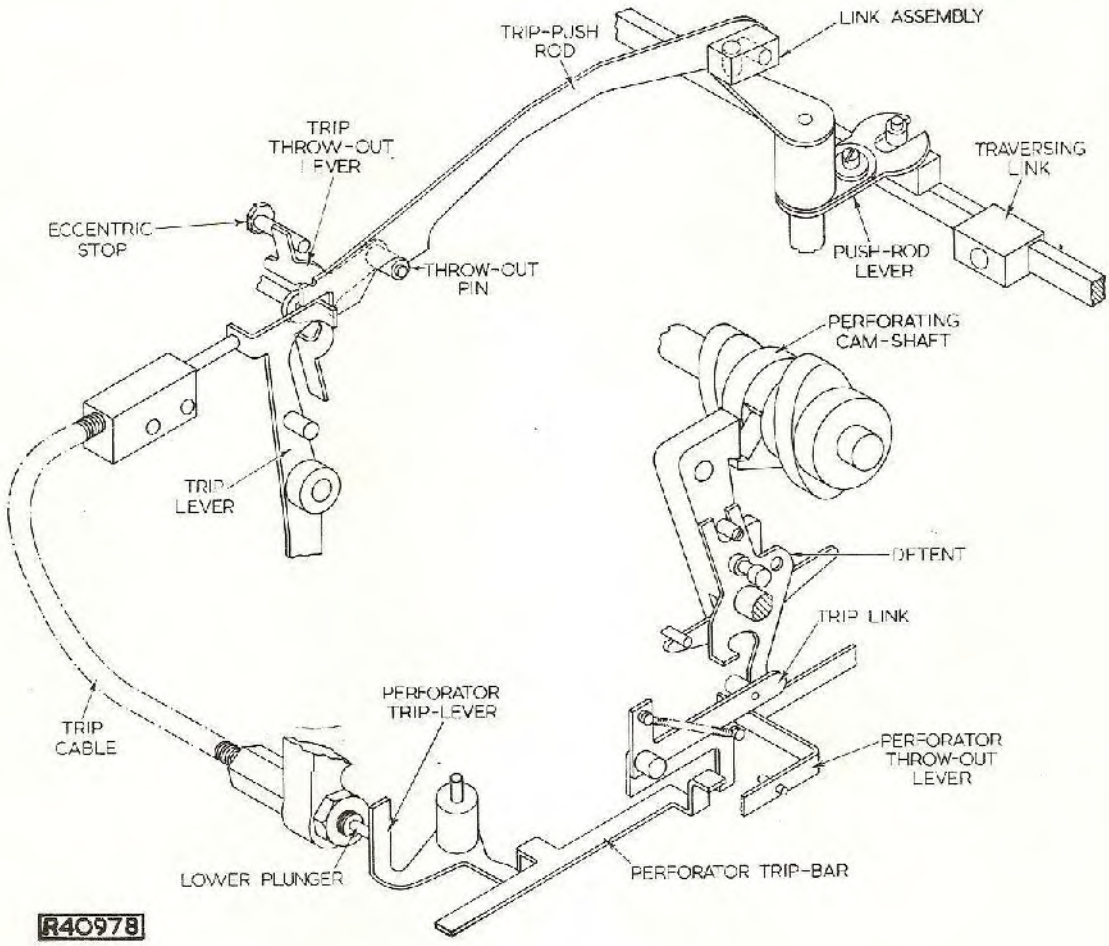


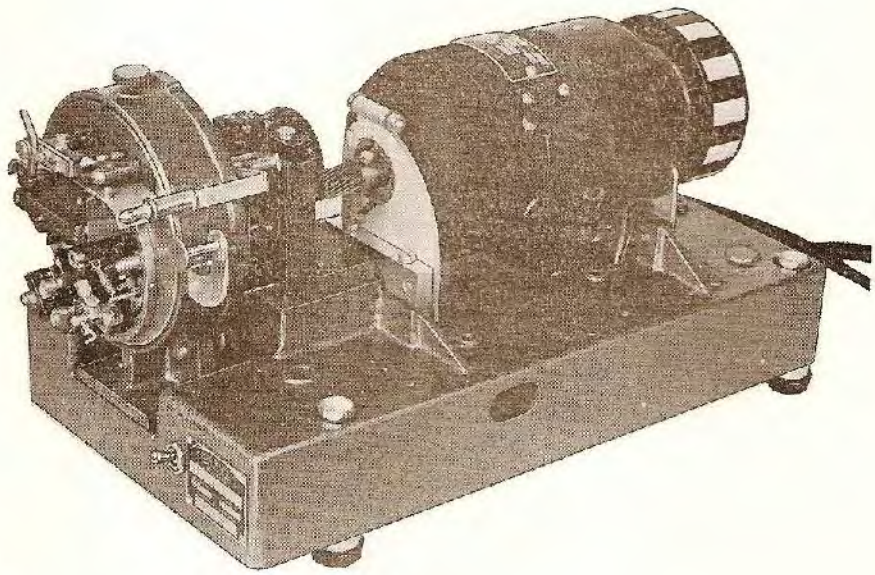
Fig. 29

moves from No. 1 to No. 4 comb-setting finger, the lever and link assembly causes the trip push-rod to move towards the left so that it engages with, and deflects the trip lever. The movement imparted to the trip lever is transferred via the inner core of the trip cable, to a second trip lever located on the perforator unit. The perforator trip-lever moves the trip-bar to the right to disengage the detent from the pawls on the perforating cam-shaft. The cam-shaft rotates and operates the mechanism to perforate the tape with the character set up during the previous operation of the receiving cam-sleeve.

TELEPRINTER AUTOMATIC TRANSMITTER

INTRODUCTION

The teleprinter automatic transmitter is a telegraph machine designed to transmit 5-unit code signals in accordance with perforations in a paper tape which has been prepared by a perforator. The machine consists basically of an a.c. or d.c. motor driving a transmitting head through a pawl and ratchet type clutch which is under the control of a tape-control unit. The transmitting head contains a paper feed mechanism and a set of cams which control the generation of the start and stop signals and the sensing arrangements which convert the conditions on the tape to electrical signals. A photograph of a typical machine with the cover removed is shown in Fig. 30, the tape-control unit is positioned between the motor



R40955

Fig. 30

and the transmitting head. The operation of an elementary machine will first be described after which certain of the refinements embodied in a type of machine in general use will be considered.

OPERATION OF ELEMENTARY MACHINE

Tape-control Unit

To maintain a constant speed of sending, the driving motor must not be coupled to the transmitting head before it has run up to the governed speed. The ratchet and pawl type clutch is under the control of the tape-control unit, and before the motor is switched on the lever is manually placed to the upper position so that the clutch pawls are disengaged from the driving spindle ratchet, as shown in Fig. 31. The retension lever in conjunction with a groove in the clutch sleeve fixes the normal position so that there is suitable clearance between the pawl and other parts of the clutch mechanism.

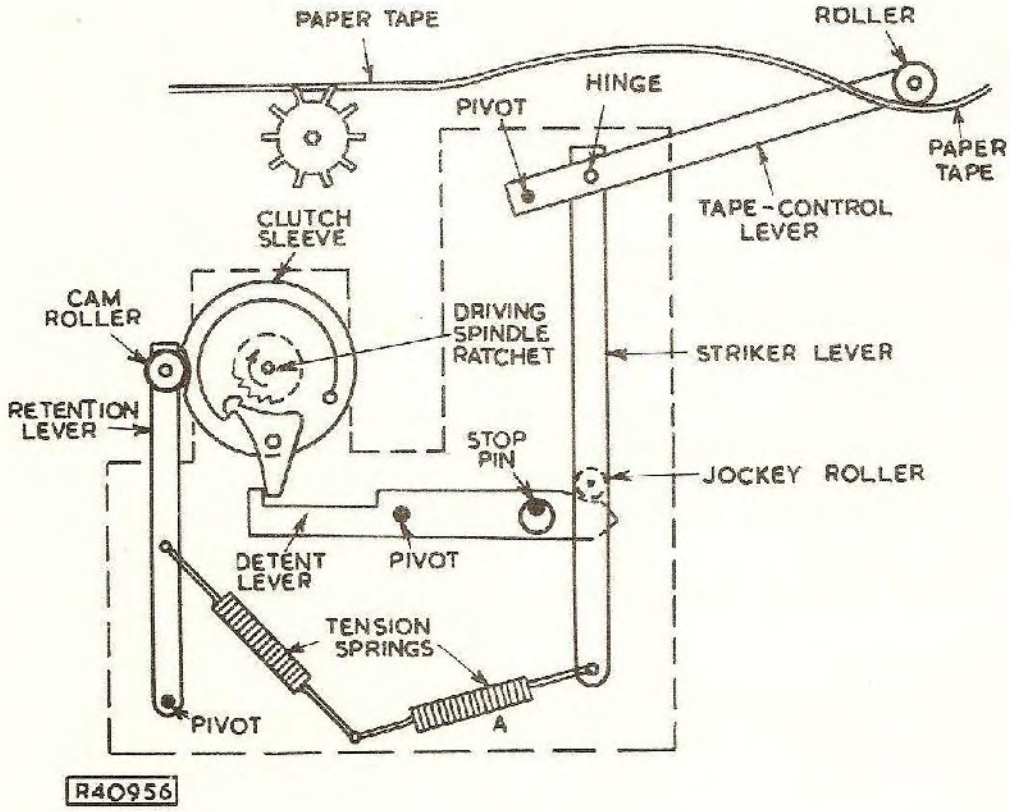

PAPER TAPE
ROLLER
HINGE
PIVOT
PAPER TAPE
TAPE-CONTROL LEVER
CLUTCH SLEEVE
CAM ROLLER
DRIVING SPINDLE RATCHET
STRIKER LEVER
RETENTION LEVER
STOP PIN
JOCKEY ROLLER
DETENT LEVER
PIVOT
TENSION SPRINGS
PIVOT
A
R40956

Fig. 31

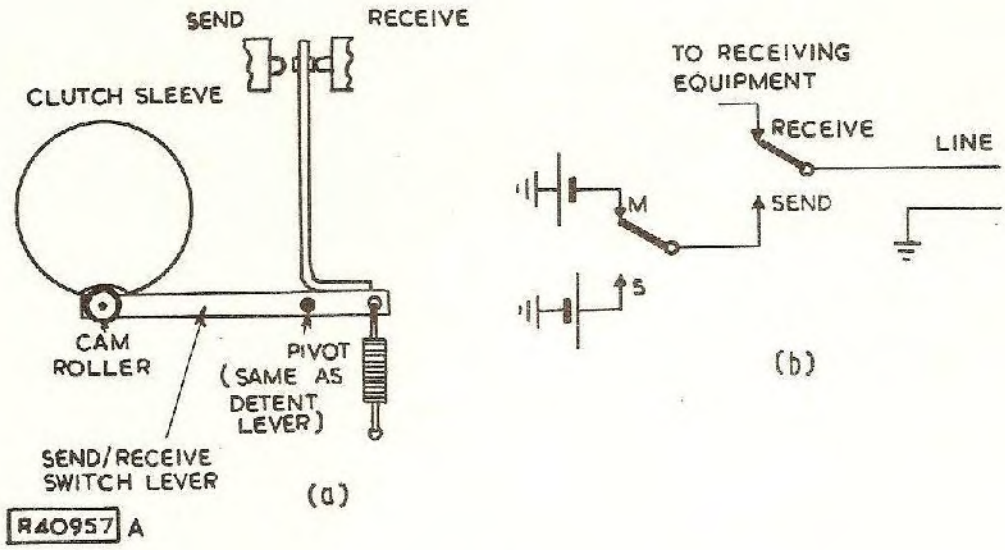

SEND
RECEIVE
CLUTCH SLEEVE
CAM ROLLER
PIVOT (SAME AS DETENT LEVER)
SEND/RECEIVE SWITCH LEVER
(a)
R40957 A
TO RECEIVING EQUIPMENT
RECEIVE
LINE
M
SEND
S
(b)

Fig. 32

The send-receive switch (if fitted) is arranged to be in the receive condition when the machine is at rest, and to move to the send condition when the clutch sleeve moves off-normal. An outline of the mechanical arrangement is shown in Fig. 32(a), the switch lever is mounted on the same pivot as the detent lever and is positioned between that lever and the transmitting head. A diagram of the elementary connections between the line, send-receive switch, and the contact unit in the transmitting head, is shown in Fig. 32(b). The send-receive switch is not normally fitted to B.P.O. automatic transmitters.

The message tape to be transmitted is passed under the roller on the tape-control lever and its feed-holes engaged with the paper feed wheel in the transmitting head, as indicated in Fig. 31. The motor is then switched on, and when it has run up to the governed speed the tape-control lever is moved to the lower position. The striker lever moves down, Fig. 31, and, as the detent lever is held by the stop pin, the jockey roller rides over the tip of the detent lever and bears against its lower inclined surface. The detent lever turns anti-clockwise on its pivot to the limit set by the stop pin, and the movement is sufficient to clear the pawls and allow them to engage the driving spindle ratchet.

With the clutch engaged the clutch sleeve rotates at the normal working speed and,

(i) a cam-shaft and the paper feed wheel in the transmitting head rotate with it, and signals appropriate to one character are transmitted for each revolution of the cam-shaft;

(ii) the send-receive switch moves to the send side immediately and returns momentarily to the receive side at the end of each revolution.

In the event of the flow of tape to the transmitting head being arrested the transmitted signals are likely to be distorted and the tape mutilated by the feed wheel. If the stoppage occurs at a point before the roller on the tape-control lever, the loop of tape in which the roller rests shortens and lifts the control lever. The jockey roller on the striker lever rides up on to the middle inclined surface of the detent lever and causes this lever to arrest the clutch pawls, thereby stopping the drive to the transmitting head. When the stoppage is cleared the weight of the tape-control lever is sufficient to carry the striker lever down so that the jockey roller again bears against the lower inclined surface of the detent lever. The clutch pawls are released and the transmitting head is again coupled to the motor, transmission, therefore, is recommenced.

The Transmitting Head

The perforated tape is drawn over the upper ends of five vertical rods, or peckers, which are positioned to correspond with the five code elements of a character on the tape. Each pecker is associated with a cam and tension spring and is linked through a common operating lever to a contact tongue as outlined in Fig. 33. The cams associated with the peckers are positioned radially so that in one complete revolution of the cam shaft all the peckers rise and restore in turn.

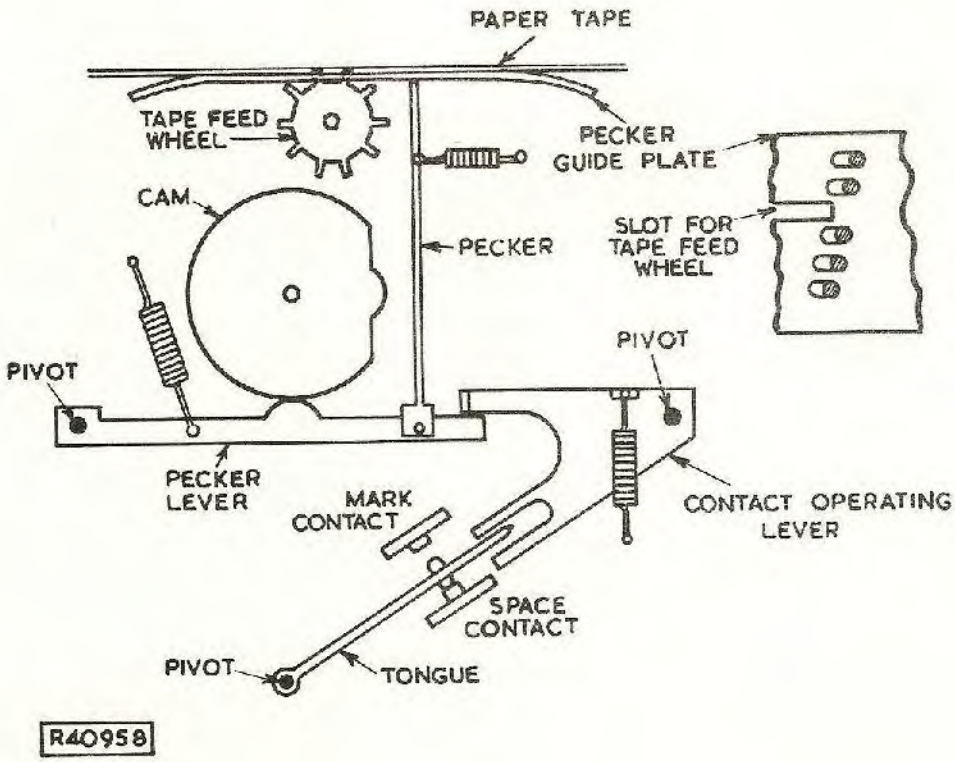


Fig. 33

The tape feed wheel is geared to the cam shaft so that the tape is advanced by one feed hole, that is by one character, for each revolution of the cam shaft.

During the time that a character is above the peckers the cam shaft moves through one revolution and, commencing with the first signal element, each element in turn is sensed by its associated pecker. In an elementary transmitter the holes in the pecker guide plate will require to be elongated and staggered to allow for the forward movement of the tape whilst the elements are sensed. Those peckers associated with MARK signal elements, that is perforated elements, are allowed to rise to their full extent but those associated with SPACE elements are restrained by the paper. A pecker which is allowed to rise, turns the contact-operating lever on its pivot and so moves the contact tongue to the MARK side. If the next pecker is restored by its cam, the contact-operating lever and the contact tongue are,

therefore, maintained in the MARK condition. When the next pecker is associated with a SPACE element, the pecker is in the normal position and consequently the contact-operating lever restores to normal and moves the contact tongue to the SPACE side.

The start and stop signals which are associated with the 5-unit code for each character are generated by means of a cam, which is mounted on the same shaft as the signal element cams, and a start-stop lever which is similar to and mounted on the same pivot as the pecker levers. The positions of the cut-aways in the cams relative to each other and with the start-stop cam at the normal position, are shown in Fig. 34. In practice to minimize the length of the cam shaft the start-stop cam is positioned in the space occupied by the train of feed holes, that is

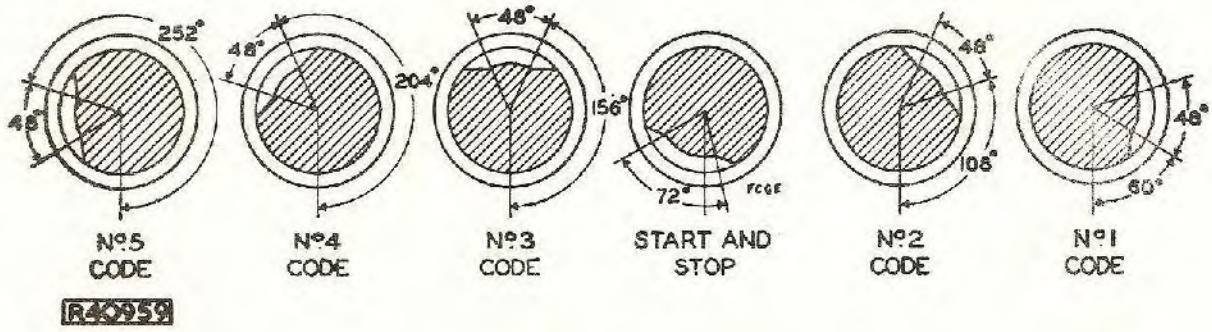


Fig. 34

between the second and third signal elements. The humps on the pecker and start-stop levers coincide with the vertical reference lines when the cam shaft is at the normal position.

At the normal position the start-stop lever is bedded in the recess of its cam, therefore holding the contact lever and therefore the contact tongue, over to the MARK side. When the cam-shaft begins to rotate, the start-stop lever immediately rides out of the recess and allows the contact operating lever to turn under the tension of its spring and move the contact tongue to the SPACE side. When the space condition, that is the start condition, has persisted for an angular movement of the cam-shaft equal to one code element, the recess in the cam associated with the No. 1 code element, Fig. 34, is fully engaged with its pecker lever and

(i) if the No. 1 code element on the tape is marked by a perforation the pecker lever will rise and cause the contact tongue to change over to the MARK side, or,

(ii) if the tape is not perforated the pecker lever is restrained and the contact tongue remains on the SPACE side.

The cam-shaft continues to rotate and at angular intervals equivalent to code element periods, the numbers 2 to 5 code elements are determined in the same fashion as the No. 1 element. At the end of the fifth code element the start-stop lever is engaged with its cam recess and,

(i) if the fifth code element is a SPACE signal the upward movement of the start-stop lever turns the contact operating lever and so causes the contact tongue to move to the MARK side, or

(ii) if the fifth code element is a MARK signal, the upward movement of the start-stop lever maintains the contact-operating lever and therefore the contact tongue, at the MARK position.

The MARK stop signal persists until the cam shaft completes the revolution, and this is equivalent to one and a half code elements. The cam shaft is continuously rotating whilst the tape-control lever in the tape-control unit is in the lower position, consequently the start signal for one character follows immediately the stop signal of the previous character.

End of Message

It is necessary to end a transmission with a stop signal to ensure the correct operation of the distant equipment. At the end of a message the tape-control lever is placed in the upper position before the motor is switched off, thereby ensuring that the stop signal is sent immediately before the mechanism comes to rest at the normal position, Fig. 32(a), and the send-receive switch changes to the receive side.

MODERN AUTOMATIC TRANSMITTER

Introduction

The early type of automatic transmitter closely resembles the elementary machine already considered, modern machines work on the same principle but incorporate the following refinements to the mechanism.

(i) A striker type transmitting mechanism in the transmitting head and pecker levers and cams designed to produce improved signal shape.

(ii) A tape-feed mechanism which provides step-by-step feeding such that the tape remains stationary whilst being sensed.

(iii) A tape control unit which includes an electromagnetic clutch, and a tight tape arrangement.

(iv) A device which detects the absence of tape in the transmitting head.

Note: An automatic transmitter used on a telex circuit also incorporates an "on-speed" motor relay, the contacts of which enable the tongue of the transmitter to be connected to line only after the motor has reached governed speed.

Striker Type Transmitting Mechanism

The cam-sleeve in the transmitting head has a timing cam secured on its rear end which has seven indentations cut in the periphery. The cam is secured to the cam-sleeve so that the indentations are in correct phase relationship with the corresponding flats on the pecker cams. A diagram showing the general arrangements of the mechanism is given in Fig. 35(a), the striker and jockey roller work on separate parts of the contact tongue as indicated in Fig. 35(b). The mechanism is shown in the condition where a pecker has risen through a perforation marking the fourth code element in the tape, and the striker timing lever is just about to enter a notch in the striker-timing cam. The common lever has been turned on its pivot by the pecker, and when the timing lever enters the notch on the timing cam, the striker will be pushed down to move the contact tongue over to the MARK contact. If the next code element is a SPACE signal the appropriate pecker will not rise, consequently when the striker is forced down by the timing lever the contact tongue is moved back to the SPACE contact. The longer tooth on the striker-timing cam is necessary for the stop signal, and at the end of sending a character and its stop signal the point A on the striker-timing cam coincides with the striker-timing lever.

The student should recognize that this mechanism is similar to that employed on the teleprinter.

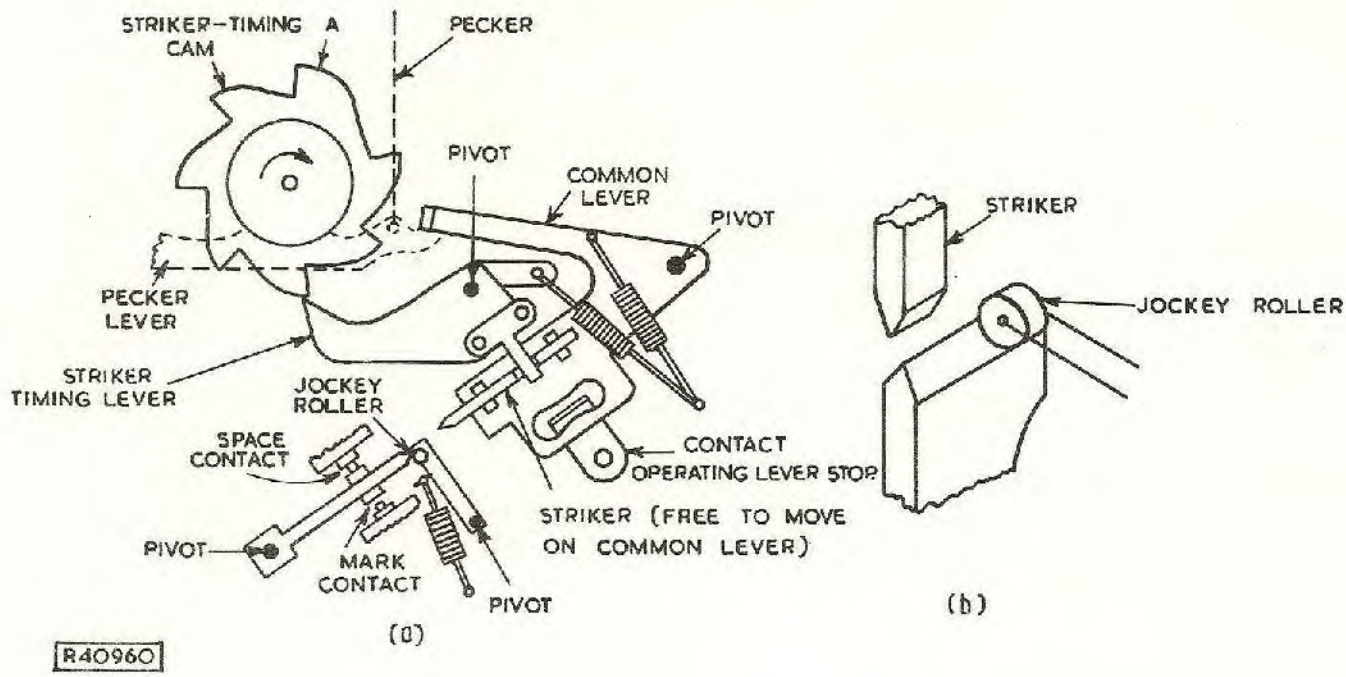
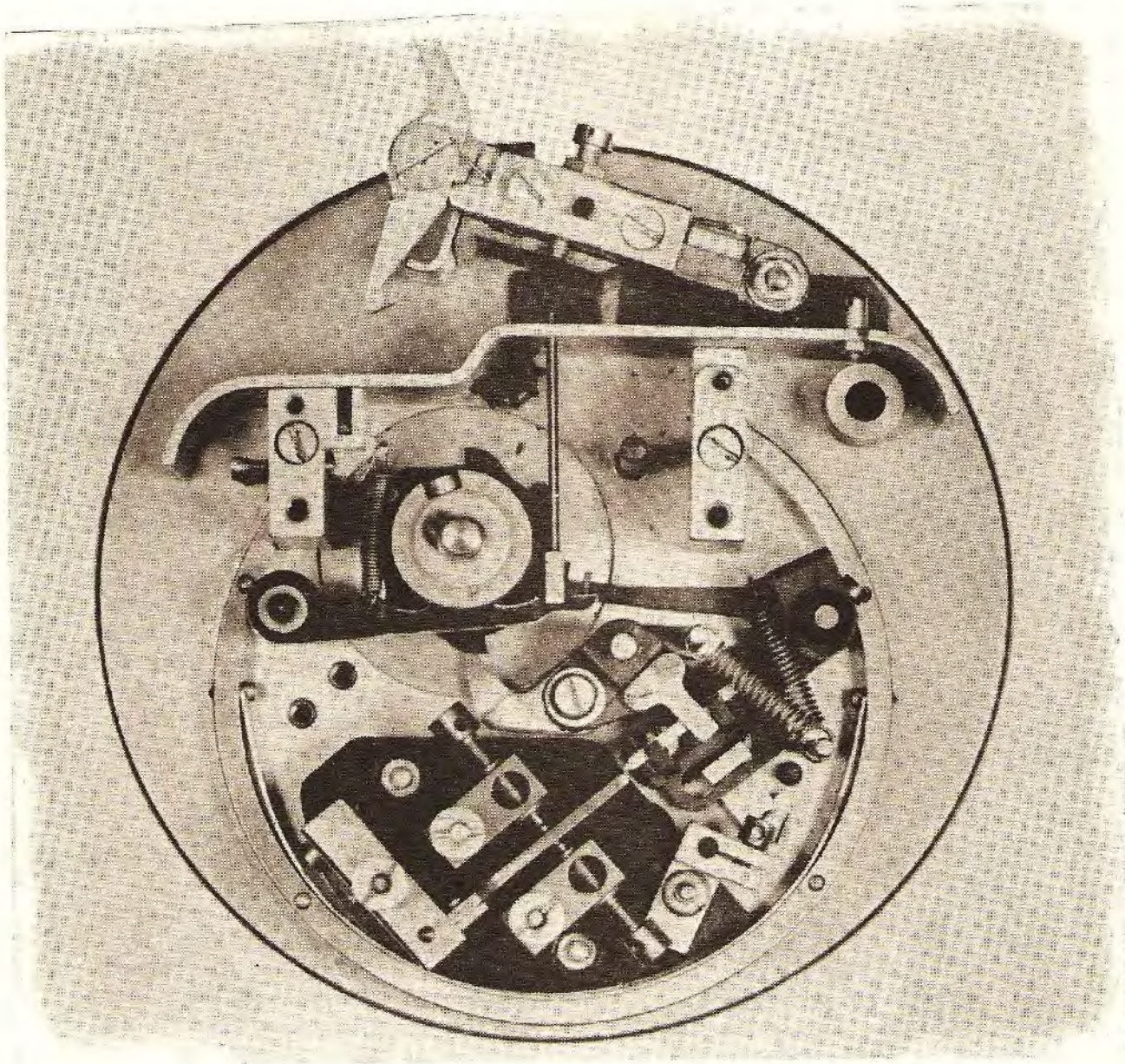


Fig. 35

A photograph of the striker mechanism with the jockey roller removed for clarity is shown in Fig. 36.



R40961

Fig. 36

The Tape-feed Mechanism

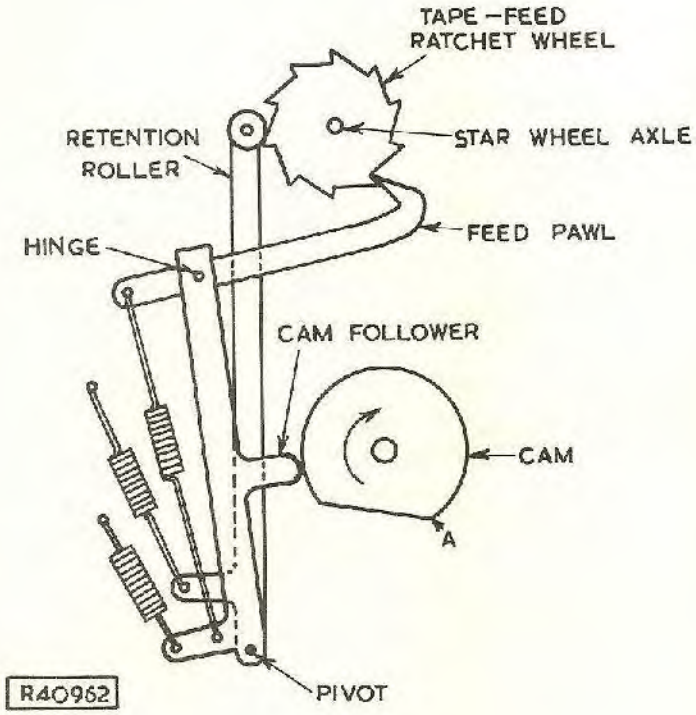


Fig. 37

The paper tape is drawn through the transmitter head one feed hole at a time by means of a star wheel. The wheel is advanced by one tooth during the transmission of each stop signal by means of a ratchet and pawl operated from a cam which is secured to the rear of the cam-shaft. The ratchet and pawl method of stepping means that the tape is stationary while being sensed by the peckers, consequently the holes in the pecker guide plate are not oval and staggered as in the elementary mechanism. The principles of the feed arrangement is shown in Fig. 37. During the stop signal period the flat on the cam allows the cam follower, and consequently the feed pawl, to move forward one tooth on the ratchet wheel. When point A on the cam meets the cam follower, the feed pawl is moved back to the normal position and in so doing turns the tape feed ratchet wheel in a clockwise direction. The star wheel turns with the ratchet wheel and moves the tape forward by one feed hole, that is to the next character. A photograph of the rear of the transmitter head which shows clearly the tape-feed mechanism is illustrated in Fig. 39.

Electromagnetic Clutch

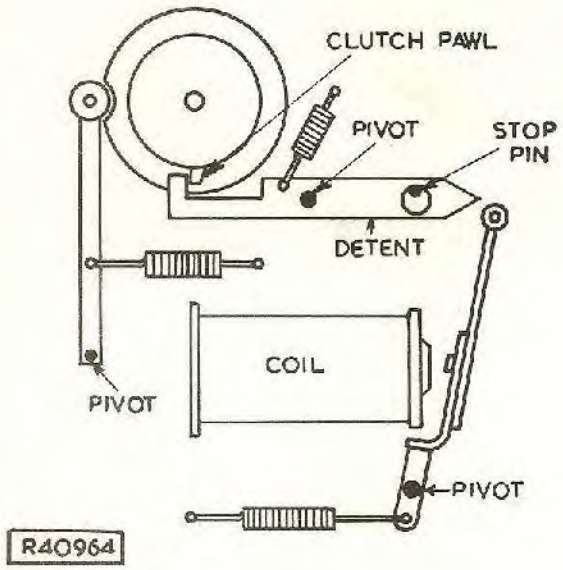
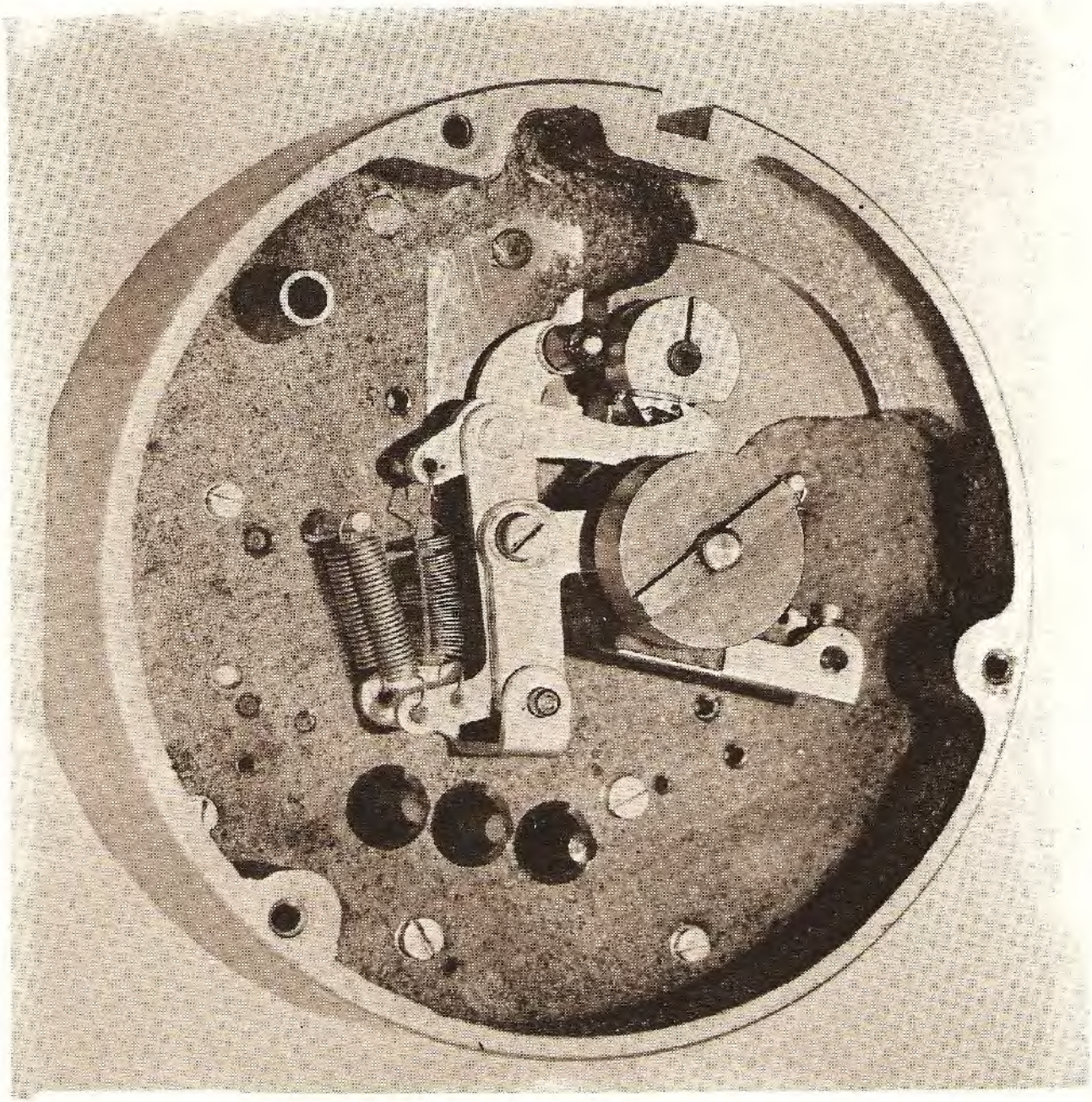


Fig. 38

The clutch detent for releasing and arresting the clutch is controlled by an electromagnet arranged as shown in Fig. 38. In the normal position the magnet armature is clear of the detent which is held engaged with the pawls by spring tension. When the magnet coil is energized the armature is attracted and turns the detent on its pivot so that the clutch pawls are disengaged. The use of an electromagnetic clutch allows for the remote control of the transmitter head and a tight-tape control which includes a switch.



R40963

Fig. 39

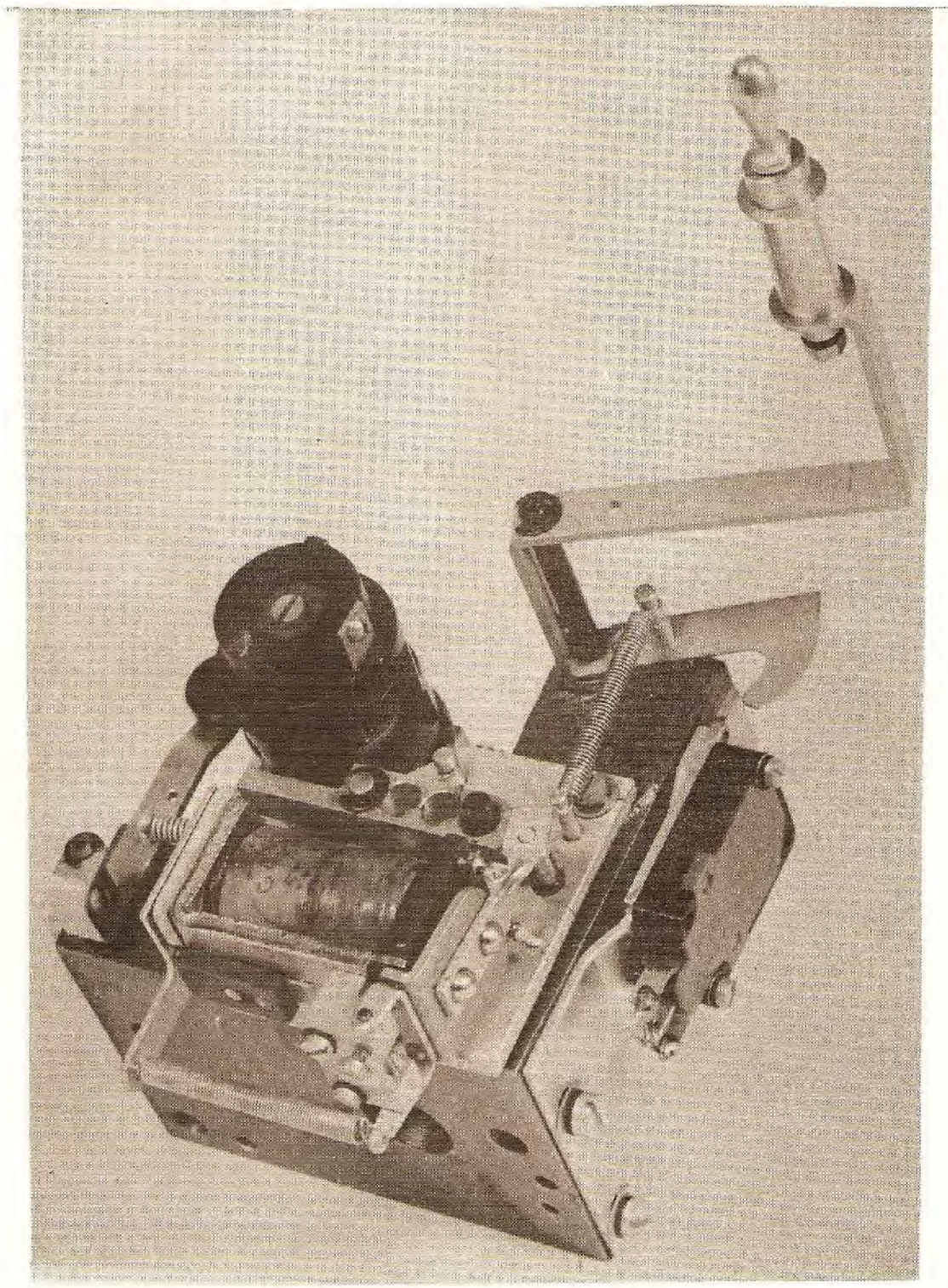
Tight-tape Control

The tape control lever controls a micro-switch in such a fashion that if the tape tightens, a cam plate is moved across and switches the micro-switch to the 'off' position. The switch is in series with the clutch electromagnet; thus when it is moved to the 'off' position the circuit for the magnet is broken, thereby causing the detent to engage the pawls and disconnect the drive to the transmitter head. When the tight-tape condition is removed, the tape control lever drops and the cam plate moves back across the switch and moves it to the 'on' position, thereby completing the circuit for the electromagnet. The detent releases the pawls and so reconnects the drive to the transmitter head. The mechanical arrangements of the tight-tape control and the electromagnetic clutch are shown in Fig. 40.

Tape-cut Mechanism

The mechanism provides a means of detecting the absence of tape in the transmitter head. An additional track which has a flat section cut in its periphery is provided at the front end of the cam track. A 'tape-out' lever is tensioned against the track and connected to a 'tape-out' pecker which is in line with the peckers and opposite the feed wheel. The lever coincides with the flat on the cam once in each revolution and it then lifts the pecker sufficient to pass through the pecker guide plate. If a tape is in the head the pecker is prevented from rising fully, but when the tape runs out the pecker rises to an extent which causes the lever to engage with a latch-control lever, which projects through from the tape-control unit. The latch-control lever turns on its pivot and causes the release of a micro-switch, the contacts of which are in series with the clutch electromagnet. Thus when the tape has run out the electromagnet is disconnected and the head disconnected from the motor drive.

When a new tape is loaded into the head, the tape-out pecker is depressed, but this action alone does not reset the micro-switch. A reset button must be manually depressed to restore the latch mechanism and reset the micro-switch.



R40965

Fig. 40

END

REFERENCES: E.P. Draft Series: TELEGRAPHY 4/1 and 4/2