Equipment Manual 444

Model 444 Teleprinter

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INTRODUCTION

This issue of Equipment Manual EM 444 contains an outline technical description, maintenance information, and a parts list for the Model 444 Page Teleprinter.

The Manual is divided into seven parts, each identified by a coloured card at the beginning. The front of these coloured cards carries a 'contents' list of the Part it introduces; the rear side carries a 'list of illustrations' where this is practicable.

The seven parts of a standard 'equipment manual' are allocated as follows:

Part 1 — Technical Description, Part 2 — Installation and Operation, Part 3 — Maintenance and Lubrication, Part 4 — Adjustment Instructions, Part 5 — Dismantling and Assembly, Part 6 — Appendices, and Part 7 — Parts List.

In this issue of EM444 these Parts contain the following material:

Part 1: (pink) contains an outline 'principle of operation' of the basic machine, including the Tape Punch, and the Tape Reader, This part also contains a timing diagram, and signals and motor wiring diagrams.

Part 2: (blue) contains instructions for unpacking and installing the machine, and also information on loading paper, ink ribbons, paper tape and operator controls.

Part 3: (buff) contains 'short term' and 'overhaul' maintenance instructions, and the method of lubrication.

Part 4: (grey) contains mechanical adjustments for the assembled machine, and for individual units in 'check and action' form. This form of presentation ensures that only adjustments that actually need attention will be disturbed.

Part 5: (yellow) contains illustrated dismantling and assembly instructions for the complete machine.

Part 6: (brown) This part contains as standard an Imperial/Metric conversion table, a list of ITT Creed lubricants and their recommended equivalents a list of the tools and accessories required to maintain the machine and a fault location guide. In addition appendices covering variations of the standard machine will be included when necessary.

Part 7: (green) contains a series of annotated 'exploded' drawings and photographs from which the individual parts that comprise the basic machine can be identified and their part numbers and a supplement containing a list of standard parts is also included.

References to 'front', 'rear', 'left-hand' and 'right-hand', whether for units or the complete machine are based on the operator's view of the machine unless otherwise stated.

EM444 Issue 3

AMENDMENT RECORD SHEET

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SECTION A – OUTLINE DESCRIPTION

1. RECEPTION (Fig. 1.1)

Signals from the distant teleprinter are received on a polarized electromagnet whose armature moves between 'marking' and 'spacing' stops in response to reversals in line current that compose the incoming code combination.

The 'start' signal releases the Selector Unit cam sleeve which makes a half-revolution during which it converts the subsequent movements of the electromagnet armature into a static code setting on five two-state latches. Towards the end of this revolution, the Selector Unit releases the Main Cam Shaft, and is itself brought to rest immediately afterwards by the 'stop' signal.

The Main Cam Shaft now transfers the code established sequentially on the Selector Unit latches to the Link Unit and Code Control Unit where it is latched and stored in parallel. Once this has been done the Selector Unit is free to accept another code combination.

In the Code Control Unit the stored code is conveyed simultaneously to the print sectors that select the required type from the type basket, and to the Function Unit where it is inspected to determine whether it is a 'printing' code or a 'functional' (non-printing) code such as 'line-feed'. If the code is found to be a 'printing' code, the appropriate type bar is activated by a print bail, and its character is impressed on the paper; the 'carriage feed' operation follows automatically. If the code is found to be a 'non-printing' functional code, the print and feed operations are automatically inhibited, and the appropriate function is carried out.

2. TRANSMISSION (Fig. 1.1)

Operation of the keyboard sets up the mark/space combination of the selected key on five groups of comb bars, and simultaneously activates a trip bar common to all keys, which releases the transmitter cam sleeve to make one revolution. During this revolution the transmitter mechanism inspects this code setting sequentially, and converts it into the train of mark/space electrical signals that make up the 5-unit code for the depressed key. The transmitting mechanism, which electrically consists of a single, side-stable, change over contact, automatically inserts the 'start' and 'stop' signals at the appropriate time, and also switches the send/receive switch to 'send' before beginning a transmission and returns it to 'receive' when the transmission is concluded.

SECTION B – TECHNICAL DESCRIPTION

1. INTRODUCTION

The Sections that follow outline the principle of operation of the major units of the Model 444 Teleprinter. After listing these Units under the heading 'General' below, and describing briefly the distribution of mechanical power, the 'Principle of Operation' is given under the following main headings:

Keyboard	Ribbon Mechanisms
Transmitter	Automatic Motor Switch
Selection	Answer Back
Translation	Tape Punch
Two-Colour Printing	Tape Reader

2. GENERAL

The Model 444 is a heavy duty, page printing teleprinter designed to operate at speeds up to 75 bauds. It is of unit construction, and consists (in addition to the Main Base and Left-hand and Right-hand Side Frames) of the following major units and assemblies:

Keyboard Unit
Transmitter and Answer Back Unit
Main Cam Shaft
Link Unit
Code Control Unit
Function Unit
Type Carriage Unit
Carriage Feed Unit
Platen Unit
Motor
Lay Shaft
Automatic Motor Switch
Tape Punch
Tape Reader

These units are identified and their general location is given on the Pictorial Index in the Parts List. A signals circuit is provided in Fig. 1.19 in this section; circuits for governed and synchronous motors in Fig. 1.22.

3. DRIVE

The standard machine is powered by a 3000 rev/min. synchronous motor which drives, via a lay shaft, a main drive shaft which in turn drives two units directly;

1. the Selector Unit, through a friction clutch, and
2. the Carriage Feed Unit, by gears.

The combined Keyboard Transmitter and Answer Back Unit is driven from the lay shaft, by gears.

The main drive shaft also has a cam sleeve which performs the 'translation' and printing operations, and provides power to operate the non-printing functions. The Tape Punch is driven by cam-riding levers from the main cam sleeve, the Tape Reader by a toothed neoprene belt from the transmitter drive shaft.

4. KEYBOARD UNIT

4.1 General (Fig. 1.2)

The purpose of the keyboard unit is to produce from the depression of a single key a trip action to activate the transmitter, and also five simultaneous comb bar settings which are then interpreted by the transmitter into the electrical signals that make up the 5-unit code of the selected key. The main components of the keyboard are shown in Fig. 1.2; to avoid congestion on the illustration, only one of the five pairs of comb bars is shown, at A and B. Keybars C and D are held in a comb (not illustrated) and are pivoted at the rear end. At rest they are held above the comb bars by leaf springs E, as shown.

4.2 Code Setting (Fig. 1.2)

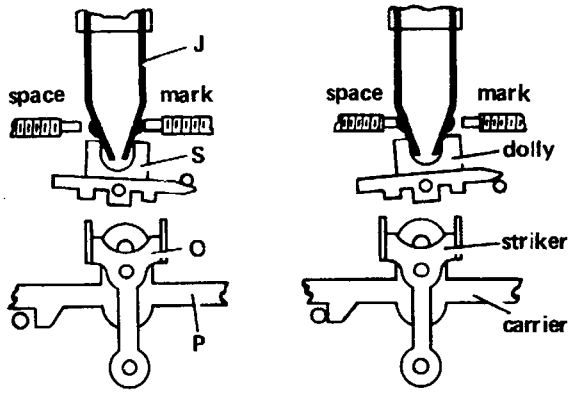
Operation of keybar C will press it down on the top edge of each of the five pairs of comb bars A and B, which are linked together at each end by the T-shaped levers G. The depressed keybar engages a tooth on comb bar A so depressing the bar and, at the same time, raising the other comb bar B which has a cut-out at this point. Levers G then turn counter-clockwise, so sliding link bar H to the right. (Because of the rocking action of these pairs of comb bars, and the interference of their teeth, the operator cannot depress two keys simultaneously). Depending on the position of the teeth and cut-outs on the

other four pairs of comb bars, their associated links H will slide to the left to set up a 'mark' condition, and to the right for a 'space' condition. The underside of the depressed keybar C also operates trip bar F which lies beneath all keys, sliding trip link I to the left. This movement releases the transmitter unit cam sleeve.

4.3 Case Shift (Fig. 1.2)

Shift bar J, can be positioned to block either 'letters' keys, or 'figures and symbols' keys. It is moved to the left (to block 'letters' keys) when the 'Figures' keybar acts on tooth K, and to the right (to block 'figures' keys) when the 'Letters' key acts on tooth L. Leaf spring M retains the shift bar in the position to which it was last set.

5. TRANSMITTER UNIT



STRIKE TO 'SPACE' STRIKE TO 'MARK'

5.1 Trip Action (Fig. 1.3)

As described in Paragraph 4, the operation of a Keyboard key causes link bars H, Fig. 1.3, to move to the left for 'mark', and to the right for 'space'. These movements bring the top ends of the associated selection levers A to one side or the other of lock frame B. A simultaneous movement to the left by trip link C turns lever D clockwise, so pushing the step in the lower arm of trip latch E against trip lever F. The upper extension of lever F is thus pulled away from the right-hand end of detent G which turns clockwise to release clutch moving arm I. Arm I carries one end of a spring-steel band which is loosely wound around a continuously-driven drum. The other end of this band is anchored to the clutch back plate, a part of the transmitting cam sleeve. When arm I is released, a spring draws the clutch band tight around the drum, and the cam sleeve starts to rotate.

5.2 Code Transmission (Fig. 1.3)

When the transmitting cam sleeve is at rest, the transmitter tongue J is at 'mark' and the send/receive switch tongue at 'receive'. As soon as the sleeve starts to revolve, lever K is moved out and pivots toggle L to move its contacts to 'send'. Cam M then lowers frame B to lock the code set up on levers A, and, in so doing, locks the keyboard. Normally common frame N is urged clockwise by its spring to rest against the sequential levers O. An extension at the rear of frame N positions carrier P, and hence the Y-shaped striker Q, as shown in the above illustration. As the cam sleeve rotates further, the first rise on cam R pushes striker Q up against the right-hand side of dolly S, which pivots counter-clockwise to move the contacts from 'mark' to 'space', and so initiate the spacing 'start' signal. Dolly S is retained in this position by a spring loaded jockey roller Z. Twenty milliseconds later cam R lifts striker Q again, and by this time the first of the sequential cams on cam pack T will have presented a flat to sequential lever O. If lever A is set to 'mark' i.e. top-to-right, sequential lever O will be able to follow its cam, and so turn counter-clockwise to push common frame N to the left. At the instant striker Q operates, frame N and carrier P will have moved the striker to the left, so that it will hit the left-hand side of dolly S. The dolly then turns clockwise to bring the transmitter tongue to 'mark'.

5.3 One or other of the space/mark actions is repeated for each of the remaining operations of the striker, the movements of the transmitter tongue being dictated by the position of common frame N. A sixth sequential lever O, which has no lever A, turns counter-clockwise at the end of each cycle to make the last operation of the striker produce the stop 'mark' signal. Near the end of the revolution of the transmitter cam sleeve, the vertical arm of detent G is pushed to the right by a reset cam built into the clutch back plate, so lowering the left-hand end of the detent into the path of the clutch moving arm I. As arm I engages the detent, the overshoot of the cam sleeve causes the clutch band to unwind and slacken its grip on the drum. Retention lever Y then turns counter-clockwise to wedge the clutch in the rest position.

5.4 Send/Receive Switch Delay (Fig. 1.3)

Since the first 'start' strike occurs some 10 milliseconds after the beginning of the 150 millisecond transmitting cam sleeve revolution, at the end of which the send/receive switch returns to 'receive', the 'stop' signal would be cut short on switched simplex circuits if some means were not provided to hold the send/receive switch tongue on 'send' for a short time after the transmitting sleeve has come to rest. This extension is achieved as follows:

(a) During the transmission of the fourth code element, cam M turns lever V clockwise, so lowering its right-hand end into the path of the rear extension of send/receive lever K to block its return to 'receive', The same movement of lever V lifts a detent W (fixed to lever V) out of a cut-out in delay disc U, which is driven counter-clockwise by a friction clutch, independently of the transmitting cam sleeve. Cam U takes about 75 milliseconds to make a half-revolution during which time the transmitting cam sleeve has reached the end of its cycle and come to rest.

(b) Detent W still rides on the periphery of cam U, however, and holds lever V down in the path of lever K's extension until the 'stop' signal has been extended to the required 30 millisecond duration, after which detent W falls into a cut-out in cam U so allowing lever K to return the send/receive switch to 'receive'.

5.5 Trip Reset (Fig. 1.3)

As detent G pivots clockwise to release the clutch, its rear extension treads on the top arm of trip latch E, so moving the step on its lower arm away from the extension of trip lever F which then restores. If the operator releases the depressed key while the transmitting cam sleeve is revolving, trip lever D will be restored by the spring link C, allowing latch E and the trip lever to restore. If the operator holds the key down longer than the transmitter revolution, trip lever F is able to restore and bring the cam sleeve to rest because trip latch E is displaced as described above.

5.6 Run-Out (Fig. 1.3)

To repeat continuously the last code set into the keyboard comb bars, the operator depresses the 'Run-Out' key. This action pushes link X to the right and simulates the action of trip latch E on trip lever F, turing it counter-clockwise to release the detent, and holding the detent out to produce continuous 'run away' transmission. Detent F restores and transmission comes to an end when the 'Run-Out' key is released.

6. SELECTION OPERATIONS

6.1 General (Fig. 1.4)

The vertical armature of the side-stable polarized electromagent A, Fig. 1.4, moves to the right for 'space' and to the left for 'mark'. The illustration shows the armature in the 'mark' position. The selector cam sleeve (cams C, Q, G, R, and the cam associated with lever I) is urged in a clockwise direction by two felt discs driven continuously from the main shaft, but normally held at rest by the lower arm of detent B engaging stop cam C. The pivot of detent B can be moved around the edge of stop cam C by rotating knob D. This action advances or retards the sensing operations of the Selector Unit with respect to the beginning of the 'start' signal, and so provides a means for estimating the teleprinter's 'margin'.

6.2 Selection (Fig. 1.4)

Receipt of the spacing 'start' signal moves armature E to the right, so withdrawing support for trip lever F. Lever F allows detent B to move away from the stop cam C, and the selector cam sleeve starts to revolve. As it does so, five flats on cam pack G are presented in sequence to the five sequential levers H which then pivot inwards. In the same time sequence, recesses in the read cam allow lever I, in conjunction with bail lifting lever J, to lower read bail K, if it is free. Whether read bail K is free to move or not depends on the position of armature E. If the armature is at 'space', i.e. to the right, the downward movement of read bail K is blocked, although lever J can still lower 'space lock' lever L down the left-hand side of the armature to prevent it returning prematurely to 'mark'. In the 'space' position, read bail K will not affect sequential levers H, which just pivot in and out beneath it in response to their cams.

If the armature is at 'mark', read bail K can move down, so engaging the lower arm of sequential lever H as it pivots inwards beneath bail K. The subsequent downward movement of lever H moves the projection at its top end away from the associated storage latch lever M, which then slides to the right to lock lever H down. The downward movement of read bail K also causes its sensing extension to pass down the right-hand side of the armature, so locking it against premature return to 'space'. The five sequential levers H operate at 30, 50, 70, 90, 110 milliseconds respectively from 'start'; they are driven down for 'mark', and remain at rest for 'space'. At the end of the fifth element, the fleeting 'blocked or free' responses of the sequential levers have been converted to a static code setting on storage latches M, whose left-hand ends enfold the five code transfer levers N. When a storage latch M is at 'space', i.e. to the left, the upper cranked end of its associated transfer lever N is positioned opposite link O in the Link Unit. If latch M has been allowed to move to the right for a 'mark' signal, the top of its transfer lever will be opposite link P.

6.3 After the end of the 5th code element, the 'stop' signal will move the armature back to 'mark'. Reset cam Q then rotates detent B to bring its lower arm into the path of stop cam C to arrest the cam sleeve, and at the same time rotates trip reset lever F counter-clockwise. The angled end of lever F displaces armature E slightly as it rises, but not sufficiently to move it to 'space'. The armature then moves back beneath lever F to maintain detent B in the stop position. At the end of this 'selection' cycle, cam R turns trip lever S clockwise, so withdrawing the step from beneath the horizontal arm of detent T, which lifts to release ratchet clutch coupling U and connect power to the main cam sleeve which carries a series of cams one of which is cam V.

6.4 Code Transfer and Selector Reset (Fig. 1.4)

A hump on the rear vertical face of cam V now presses lever X and linkage Y to the right. This movement causes frame Z, which is compliantly coupled to the left-hand end of linkage Y, to turn clockwise and press levers N against the links P and O. By this means, the code established on transfer levers N is passed to the Link Unit, where it is latched and stored. Cam V then rotates lever W counter-clockwise to press all the storage latches M to the left, so resetting the latches of any sequential levers H that had been set to 'mark'. The Selector Unit is now ready to respond to the next 5-unit code group, while the main cam sleeve is translating the code set up on the Link Unit.

6.5 Link Unit (Fig. 1.5)

The Link Unit consists of five pairs of links similar to R and S, Fig. 1.5, and a shift link (shown at R on Fig. 1.8, and described in Section 4). The illustration shows link S held in the 'mark' position by latch A. When a transfer lever P takes up a 'space' position opposite link R, and then moves forward, the subsequent inward movement of link R turns latch A clockwise (via pin C) so releasing link S which is then restored to the left by its spring. Latch A is then urged against the bottom of the latching surface (at the end of leader line S) by the spring on link R. A second 'space' strike on link R will be ineffective. When a transfer lever P is set to 'mark' to bring it opposite link S, its subsequent forward movement sets link S to the marking position where it latches, as shown in Fig. 1.5. A subsequent 'mark' strike on link S will be ineffective.

7. TRANSLATION OPERATIONS

7.1 Principle of Printing Code Translation (Fig. 1.5)

The right-hand end of each link S, Fig. 1.5, is connected to a bellcrank D which simultaneously controls (in conjunction with bellcrank F) the **vertical** movement of code slats W which select the required type, and the **horizontal** movement of comb bars H which select the non-printing functions such as 'carriage return'. Code slats W have a channel along their top edges in which run the rollers of the five selector bellcranks K that control the type basket code sectors N, swinging the sectors to the right for 'mark', and to the left for 'space'. Arranged across sectors N are the code seeker bars O, one for each two printing characters. These bars are spring-loaded down on to printing bail Q, which holds them just clear of the sector teeth. All incoming codes are passed to sectors N, but only when it is a 'printing' code will print bail T move to the rear carrying with it typebar bail Q. All the seeker bars are thus lowered on to the code sectors N, but

only one will find a path through the teeth and drop low enough for its notch Y to catch on type bail Q. Further rearward movement of bail Q will swing the required typebar V, via link U, out of the typebasket and up on to the ribbon and paper.

7.2 Principle of Function Translation (Fig. 1.5)

Function control levers, such as J, Fig. 1.5, lie beneath the five comb bars H which are moved to the left for 'mark', and to the right for 'space' by bellcrank D. When a code is set up on the teeth below comb bar H, the control levers J are allowed to turn counter-clockwise by a bail that normally rests on lower arm G of lever J. The upper horizontal arm of levers J then sense the pattern of the comb bar teeth. If the setting on comb bars H is for a 'printing' code, there will be no path across the teeth, and the function control levers will be lowered again. Carriage feed takes place automatically after the printing operation. If the code is that of a non-printing function, a path will open across the comb bar teeth, and the selected function control lever will move up into it. This extra counter-clockwise motion of lever J has three consequences: (1) its lower vertical arm (not illustrated) triggers the appropriate machine function, (2) carriage feed is suppressed on functions other than space, and (3) printing action is suppressed.

7.3 Print and Carriage Feed Control on Functions (Fig. 1.6)

(a) **Print:** The rear horizontal arm of print suppression lever A, Fig. 1.6, is tensioned on to the lower horizontal arms E1 of function control levers E. In this 'unselected' position of levers E, the front end A1 of suppression lever A is positioned above arm D of print bail M. The printing bail is therefore free to operate. When any function control lever E is selected, its lower arm E1 in swinging upwards pivots suppression lever A clockwise to bring its front extension A1 down into the path of arm D, so blocking print channel M and preventing the printing action.

(b) **Carriage Feed:** When a printing code is set up on the comb bars that lie above the function control levers E, no lever is selected; carriage feed trip lever G (black) is thus free to turn counter-clockwise, horizontal arm G1 passing over the top of the upper horizontal arms of levers E. The lower vertical arm of lever G then moves forward, sliding link H to the right to displace latch I from beneath arm J1 of carriage feed clutch detent J. Ratchet clutch K then engages its driving member, and rotates the feed shaft L through a half-revolution during which the type carriage is fed along $^1/_{10}$in. When a non-printing functional code is set up on the comb bars, one of the control levers E will be selected, and will move counter-clockwise. The upper horizontal arm of lever E will thus move up into the path of arm G1, preventing carriage trip lever G from rotating, and thus inhibiting the 'carriage feed' operation.

(c) **Letter Space:** The 'letter space' operation on receipt of the SSMSS code is a special case of a 'function' that requires 'feed' but not 'print'. A special 'space' function control lever F is provided to produce this effect. When selected by the 'space' code, its lower horizontal arm engages print suppression lever A, turning it to block print channel M and so prevent printing, but lever F is located too far to the right for its upper horizontal arm to affect the carriage trip lever's arm G1. Lever G can therefore operate normally, and feeds a trip action to detent J to initiate a 'carriage feed' operation.

7.4 Carriage Movements (Fig. 1.7)

(a) **Feed Action:** As explained in paragraph 7.3b above, the carriage feed detent J, Fig. 1.7, is released for any printing code, and for 'space', so permitting ratchet clutch C to engage and drive the carriage feed cam sleeve for a half-revolution during which it feeds the type carriage along one character space. The cam sleeve carries two cams A and B whose high points are 180 degress out of phase. These cams drive two feed levers D, each carrying a feed pawl E, spring-loaded against the feed rack F that is assembled on the type carriage casting assembly. On one half-revolution of the cam sleeve the front pawl E will remain at rest, while the rear pawl moves to the right, drawing the carriage with it, until the front pawl moves into the next tooth on the rack to retain the feed movement. In the next revolution of the cam sleeve, the carriage is retained on the rear pawl while the front

pawl E draws the carriage to the right. End-of-line indication is given by an adjustable roller on plate H, mounted on the type carriage casting. This roller depresses a plate mounted behind the Transmitter Unit, and so operates a microswitch to light a signal lamp for the opertor.

(b) **Carriage Return:** The type carriage can be returned at any point along the line either on receipt of the 'carriage return' code from line, or by local operation of the 'Manual Carriage Return' key. Receipt of a 'carriage return' code SSSMS creates a common slot across all comb bars K into which control lever I pivots counter-clockwise. Its lower horizontal arm moves forward into the cranked end of link L, allowing the link to rise (leaf spring beneath) so that its projection moves into the path of lever M as it is driven clockwise by cam N. The subsequent right-to-left movement of link L rotates frame O and turns withdrawal lever P counter-clockwise. A pin Q, carried on lever P, depresses both pawls E, so releasing the type carriage which is then returned to the beginning of the line by spring T. The rotation of lever P brings its peg S under the latch on the inside of frame R, so ensuring that the pawls E cannot re-engage the rack while the carriage is in transit. When the carriage reaches the beginning of the line, projection H turns frame R counter-clockwise, releasing peg, S, and so allows the twin pawls E to re-engage. Depression of the 'MAN CAR RET' key simulates the selection of function control bar I, by pushing link L to the rear manually, so operating frame O and lever P as described above.

7.5 Case Shift Mechanism (Fig. 1.8)

Since the majority of the type bar slugs carry both 'letters' and 'figures' characters, the type bar segment A (Fig. 1.8) must be able to take up two positions; 'up' to print 'letters', and 'down' to print 'figures and symbols'. The vertical position of segment A is determined by tube B (itself part of shift beam assembly C) along which the segment runs, maintaining contact by means of a skid above the tube, and a plate below it. At the left-hand end of casting C is fixed an inverted Y-shaped arm which runs on a shift cam D fixed to a gear wheel E that meshes with quadrant F. Figure 1.8 shows the shift mechanism in the 'letters' position, i.e. segment A raised. If a 'figure shift' code MMSMM is now received, the 'figures' function control bar H is selected and rotates counter-clockwise, so moving the step on its lower vertical arm away from the projection on function bar I (black) which then moves down into the path of power bail J. The subsequent movement of bail J draws function bar I to the rear, and so turns quadrant F counter-clockwise, rotating gear E and cam D to lower bar B and consequently typebar segment A. Segment A is maintained in its new position when function control lever H resets at the end of the cycle, by jockey plate G. Selection of the 'letters' function control lever K, lowers the 'letters' function bar L on to power bail J. Subsequent movement of bail J turns quadrant F clockwise to raise rod B and segment A to the 'letters' position. Code combinations that have a printing character in one case, and a machine function in the other, e.g. Who Are You?, must have their function control levers (similar to H and K) blocked so that they do not select in 'letters'. This is done by shift bar S, which is moved to the left for 'letters', and to the right for 'figures' by cam M, operated through linkage N by an arm O clamped to spindle P that rotates with casting C. This shift bar S lies at the rear of the five code comb bars (shown at H on Fig. 1.5). Bellcrank Q conveys this mark/space setting on bar S to link R in the Link Unit for the benefit of the Tape Punch Unit described in paragraph 12.

7.6 Line Feed Operation (Fig. 1.9)

The selection of the line feed function control lever A, Fig. 1.9, in response to an incoming line feed code allows function bar B to be lowered into the path of the power bail C and so driven to the rear by cam D. The subsequent counter-clockwise motion of rod E draws link F downwards. A pin at the top end of link F pivots frame G (black) counter-clockwise causing feed pawl H, carried on the other side of frame G, to feed ratchet wheel I and hence platen J counter-clockwise by one line feed. The extent of the rotary movement conveyed to platen J by feed pawl H is determined by the manual setting on the line feed change lever K which can align the pin at the top of link F with one of the three notches in frame G; these notches (reading high to low) correspond to line feeds of $^1/_6$in. $^1/_4$in. and $^1/_3$in. respectively. Change

lever K also determines the position of masking lever L against which feed pawl H rests when not operating (this feature enables the platen to be turned both clockwise and counter-clockwise without difficulty) and consequently the point at which the feed pawl engages the ratchet when it makes its downward movement.

7.7 Paper is normally held against platen J by pressure roller N. Depression of manual release lever M swings the spindle of roller N away from the platen so enabling paper to be threaded easily.

7.8 Sprocket Platen (Fig. 1.9)

This platen though basically similar to the standard unit is equipped with retractable sprocket pins equally spaced around the circumference at the two extreme ends of the platen. Retraction is obtained by two independently controlled cams which can be held stationary while the platen is rotated. Right angled extensions to the sprocket pins pass through slots cut in the respective cam. The slots are angled towards the centre and when the platen is moved in relation to the cam the sprocket pins are withdrawn. The cams are locked by manually controlled levers which engage in vee's cut in the cams external circumference.

8. TWO-COLOUR PRINTING FACILITY

8.1 General (Fig. 1.10)

The standard Model 444 machine has a mechanism, shown in Fig. 1.10, for varying the height to which the ribbon jumper rises when transmitting, and receiving. This mechanism, coupled with the use of a two-colour ribbon, enables the operator to distinguish between messages originating from the local keyboard and tape reader (generally printed in red), and messages received from the distant station (generally printed in black).

8.2 Operation (Fig. 1.10)

When the machine is at rest, ribbon jumper H is held down below the printing line by a pin 4 (inset) that links the twin arms F, and lies beneath projection 1 (inset) of the jumper arm bail D. As the type bail C moves forward to print, bail D follows, its upper angled projection 1 (inset) lifting the ribbon jumper H carried on arms F and stop arm G; all tied together by the pivot of roller E and pin 4 (inset). When the machine is **receiving**, bail J is positioned as shown permitting maximum lift, before the lower level of stop arm G touches bail J, so arresting jumper H with the black portion of the ribbon aligned with the printing line.

8.3 When any **transmitting** key is operated, cam I on the transmitting cam sleeve rotates lever A which treads on trip lever K, so lifting its rear end out of a step in lever L. Lever L then rotates clockwise under spring action until stop arm M touches top screw N. This motion of lever L draws link O downwards and turns bail J inwards so that it lies vertically above the projection at the end of jumper stop arm G. The subsequent upward movement of jumper H is thus arrested at a lower level than before, and so brings the 'red' portion of the ribbon to the printing line. The mechanism is reset to black at the end of every printing cycle by cam P on the main cam sleeve. This cam rotates lever Q which pivots around shaft S, counter-clockwise. Lever R, fixed to shaft S, is spring-loaded against the back lever Q. The consequent counter-clockwise motion of shaft S rotates lever L so that trip lever K can fall into its step again to set up the 'black print' condition.

8.4 Answer back condition (Fig. 1.10)

Shaft S is also capable of a lateral movement which is used to convey the **Answer Back trip action** to the transmitter. When the Who Are You? function control lever B is selected, function bar T (black) is lowered into the path of power bail U, which then moves towards the rear. The subsequent clockwise motion of bellcrank V draws shaft S to the left against compression spring W. Arm M then slides trip pawl X (part of transmitter) to the left to initiate an Answer Back cycle.

9. RIBBON UNIT

9.1 General (Fig. 1.11)

Figure 1.11 shows the two-way ribbon drive

and feed changeover mechanism. Ribbon spools S1 and S2 are connected to their respective drive plates by a peg that passes through an off-centre hole in the spool. Ribbon tension is maintained by arms A1 and A2, which are spring-loaded away from the jumper, and to their lower ends are anchored one end of clutch bands P1 and P2. These bands pass round the drum part of ratchets H1 and H2 and are anchored at the other end to the retention pawl pivots. Springs joining these two anchor points urge them together, but when the ribbon tightens, the light pull on tension lever A1 or A2, slackens the grip of its associated band and allows the spindle and spool to rotate. The purpose of these band clutches is to prevent over-running of the spool from which ribbon is being unwound; this would otherwise cause a slack loop that may become entangled with the type bars.

9.2 Feed Action (Fig. 1.11)

In the illustration (Fig. 1.11), the left-hand spool and its vertical shaft are free to unwind since the associated feed pawl G1 and retention pawl J1 are held away from ratchet wheel H1 by projections on the left-hand end of link K. Similar projections on the right-hand end of link K are displaced so far to the left that the right-hand spool's feed and retention pawls G2 and J2 engage the teeth of ratchet wheel H2. During the printing action, type bail B moves to the rear, rotating feed levers C1 and C2 and so moving their associated links D1 and D2 towards the front of the machine. Bellcranks pivoting around spindles F1 and F2 cause whichever of the feed pawls G1 or G2 is in contact with its ratchet, (G2 in this case) to move round to take up another tooth. When bail B restores after printing, the rearward movement of links D1 and D2 causes the engaged feed pawl (G2) to rotate its ratchet one tooth; the movement being retained by its associated retention pawl (J2). The movement of the displaced feed pawl (G1) is ineffective.

9.3 Changeover Action (Fig. 1.11)

Link K, which determines which of the feed and retention pawls will be in contact with their ratchet, is tensioned to the right by a spring. Its position is determined by a pin N tensioned against a star wheel M whose pivot passes through a slot in the link, and into the casting beneath. When the star wheel is rotated by the ratchet wheel beneath it to a position where the pin is presented to a recess between the arms of the star wheel, link K will move to the right, displacing pawls G2 and J2, and allowing pawls G1 and J1 to engage their ratchet wheel.

When all the ribbon has been transferred from one spool to the other, the full spool, in continuing to feed, will draw the ribbon tighter and tighter, so turning arm A2 clockwise; a pin on its lower arm R rotates changeover lever L, so moving its lower arm to the left and extending spring Q. The other end of spring Q draws link D2 to the left so that a cut-out in its left-hand edge, which normally misses the ratchet beneath star wheel M, is now in line with the ratchet. The next rearward movement of link D2 will cause the cut-out to engage the ratchet (see inset diagrams on Fig. 1.11) and turn it 1/8th of a revolution; the left-hand projection on link D2 acting as an overshoot stop for the ratchet. This movement of the ratchet and star wheel M causes link K to move to its alternative position, and so transfer the drive from the full spool to the empty one.

10. AUTOMATIC MOTOR SWITCH

10.1 General (Fig. 1.12)

This mechanism, an optional extra on Model 444, is illustrated in Fig. 1.12. It automatically switches off the motor power approximately 70 seconds (50 baud working) after the end of the last message, and will switch it on again when there is an incoming message, or the local operator presses the 'Letters' key.

10.2 'Switch Off' Action; No Signal Incoming

Cam C, part of the continuously-rotating main cam sleeve drive ratchet, acting through lever D, causes pawl lever assembly E to feed ratchet wheel I round one tooth; feed being retained by pawl L. Since ratchet I is larger than ratchet J, and the two feed pawls G and H are pinned together in line, for nine feeds out of ten the movements of assembly E do not affect the smaller ratchet J. Every tenth tooth of the ratchet is, however, deeper than the others, so when pawl G passes into one of these, pawl H can move down far enough to feed its ratchet

wheel J one tooth. Ratchet wheel J consequently rotates in the same direction as wheel I, but much more slowly; ultimately after about 70 seconds, a stud on ratchet wheel J picks up a projection on link plate M, and slides the plate to the rear to set the motor on/off switch stud X to 'off'.

10.3 Motor Running: signals incoming, or keyboard being operated.

When the receiver is operating, cam B on the main cam sleeve is rotating, so turning pawl release lever R clockwise. Arm R2 is thus lifted once each half-cycle, so disengaging the twin feed pawls G and H, and the twin retention pawls K and L from their respective ratchet wheels. The feed movement of assembly E is thus made ineffective while signals are incoming.

10.4 'Switch On' by Operation of 'Letters' Key

Depression of 'letters' key T, via linkages U, V, W and X, turns trip lever Q counter-clockwise, so releasing trip plate P which swings to the rear under the action of spring Y, using the right-hand end of lever O as a fixed pivot. The centre section of plate P acts on the shoe R1 of lever R, pivoting the lever clockwise. Extension R2 lifts the feed and retention pawls out of their ratchets, and allows plate M, which has been holding the motor switch at 'off', to be moved forward by spring Z. As plate M moves forward, it acts on the right-angled lower extension S1 of lever S, turning the lever counter-clockwise. Extension S2 now turns plate P clockwise around lever O so that the right-hand end of plate P can re-engage the latch surface of lever Q.

10.5 'Switch On' by Incoming Signal

Consider the motor to be switched off, with stud J pressing link plate M to the rear, and the right-hand end of plate P latched on lever Q, The electromagnet armature N is at 'mark', and lever O is resting on top of it. On receipt of a 'start' signal, armature N moves to 'space'. i.e. to the right, so withdrawing support for lever O. Plate P then swings clockwise around lever Q as a pivot. The center section of plate P acts on lever R1 pivoting it clockwise so that extension R2 can disengage the feed and retention pawls of both ratchets J and I. Link plate M now restores towards the front of the machine, allowing the motor switch operating stud X to move to 'on', and simultaneously turning lever O counter-clockwise so that its long, horizontal arm moves back on to the top of armature N.

11. ANSWER BACK FACILITY

11.1 General (Fig. 1.13)

The drum of the Transmitter Unit Answer Back mechanism can be coded to carry up to 20 pre-set characters or functions, usually the machine's station identification. Receipt of the 'Who Are You?' enquiry MSSMS triggers this mechanism which then rotates a coded drum in front of the sequential levers (item U, Fig. 1.13), simulating the action of the keyboard comb bar selecting levers to generate the required sequence of 5-unit code signals, and send it to line. The Answer Back mechanism can also be triggered locally by operating the 'Here Is' key. Measures are taken to prevent the operation of the local 'WRU?' key from releasing the local Answer Back mechanism via the 'local record'.

Note: The following points regarding the construction of the latch assembly (items X, C, A, B and J) at the rear of the Transmitter Unit should be noted before reading the 'sequence of operation' that follows. Trip pawl X is spring-loaded clockwise around rod H carried on frame A, and rests on arm J1. Frame A is free to run around rod D, but is sprung to stop-lever B, itself clamped to rod D. The pivot of lever J and catch C is fixed. Latch C is tensioned clockwise; its left-hand end normally rests against the underside of rod H.

11.2 Release of Answer Back Mechanism by Incoming 'WRU?' Signal (Fig. 1.13)

(a) **Trip action:** As described in Paragraph 8 (Fig. 1.10), the receipt of a WRU? signal causes release arm M, Fig. 1.13, to be drawn to the left. The consequent pressure on trip pawl X causes frame A, stop lever B, and shaft D to rotate together in a counter-clockwise direction until the vertical arm of lever B touches the casting; any further movement of arm M then extends the torsion spring linking frame A to lever B. Lever E, clamped to the front end of shaft

D, rotates drum detent lever F clockwise, so lifting arm F1 out of the cut-out in disc O, and at the same time causing the roller on arm F2 to tread on lock lever N, moving it down far enough to engage latch AG. The vertical arm of lever N is thus moved to the right, simultaneously displacing trip lever P to release clutch detent Q, and rotating lock bail S clockwise. The lower surface of bail S thus moves all the selecting levers T clear of the ends of their sequential levers U, and in so doing prevents any keyboard operations from interfering with the Answer Back transmission (see Part 2, Section B).

(b) **Maintenance of trip condition:** Until the end of the first cycle of cam sleeve R, this 'trip' condition is maintained (after arm M has restored) by latch C which, as frame A moved down, was able to turn clockwise to wedge its left-hand end against the inside edge of rod H, so holding frame A in the 'operated' position. As cam sleeve R starts to revolve feed cam Y turns lever Z counter-clockwise so feeding ratchet AC one tooth counter-clockwise. This movement simultaneously presents the first line of teeth on ward drum AD (teeth entire for 'space'; broken out for 'mark') to the top ends of the five sequential levers U, and rotates disc O so that its cut-away moves away from arm F1.

(c) **Read action:** Further rotation of cam sleeve R causes sequential levers U to move forward in turn to sense the pattern of teeth across the ward drum; the 'blocked' and 'free' conditions they encounter controlling the common frame and the striker (items N and Q, Fig. 1.3) to produce the required mark/space electrical conditions and convey them to line, as described in Section 2.

(d) **Transfer of trip holdout:** During the 'stop' signal of the first Answer Back character, the WRU? inhibition lever V turns counter-clockwise (selector lever AB being withdrawn by frame S), its left-hand extension treading on pin J2 to turn lever J momentarily counter-clockwise. This movement of lever J lifts arm J1 so that latch G can pass beneath it, and, simultaneously, urges latch C counter-clockwise to restore its left-hand end to the rest position beneath rod H. Frame A can now restore clockwise, so transferring the maintenance of the 'detent' trip' from latch C to arm F1 which moves down to run on the edge of disc O.

(e) The subsequent upward motion of release arm M (a by-product of the 'reset to black' movement of shaft S, Fig. 1.10, around which arm M is clamped) at the end of the main cam sleeve half revolution, pivots latch G clockwise, so allowing lever J to restore to the rest position shown in Fig. 1.13. The movement of inhibition lever V which raises arm J1 on to latch G at the end of each reading cycle, and the subsequent disengagement of latch G by arm M, is repeated for the remaining 19 characters, but is ineffective.

(f) **Conclusion of transmission:** The 'feed and read' operation is repeated for the remaining characters on ward drum AD until the cut-out on disc O is presented to extension F1 on the 20th character. Lock lever N then restores to normal (the roller on the right-hand end of the horizontal arm of lever F displacing latch AG at it rises) allowing detent Q to arrest cam sleeve R, and frame S to move counter-clockwise away from selector levers T.

(g) **Twenty-first feed:** On conclusion of the Answer Back transmission, it is necessary to rotate drum AD one more position to bring an 'all blank' position opposite the reading ends of sequential levers U, so enabling control of these levers to pass back to the keyboard, This additional feed action is produced by the spring-loaded pawl AF which, during the 20th 'read off' cycle, is displaced by stud AC and then moves back beneath it. As lever Z moves clockwise to restore after the 20th counter-clockwise feed operation. pawl AF pushes up on this stud, and so moves the ward drum round to the 'all blank' position. This same movement of lever Z also raises feed pawl AA into the next tooth of the ratchet wheel ready for another Answer Back operation.

11.3 Suppression of Local Answer Back Response When 'WRU?' Code is Transmitted (Fig. 1.13)

(a) **General:** It is necessary to prevent the local Answer Back mechanism from being

activated via the 'local record' when the local operator depresses his WRU? key to enquire the identity of a distant station, otherwise both the 'local' and 'distant' Answer Backs would be released simultaneously. This double operation is prevented by breaking into the trip linkage from release arm M to shaft D, so making the right-to-left movement of arm M ineffective.

(b) **Keyboard components:** The mechanism that produces this effect is controlled initially by the WRU? key on the keyboard. Comb bar O, Fig. 1.2, (at the rear of the comb bar assembly) is normally depressed by the operation of any key other than the WRU? key, so maintaining link P to the right; depression of the WRU? key D, however, engages the single tooth on comb bar N and depresses it to slide link P to the left.

(c) **Suppression action:** The right-hand end of link P, Fig. 1.2 controls a special selector lever which appears at AB on Fig. 1.13. This lever is normally hooked over the tail of inhibition lever V, except when the WRU? key is operated, in this instance lever AB then moves away to permit lever V to follow its cam. When the 'stop' signal of the WRU? enquiry is being transmitted to line, lever V turns counter-clockwise. Its left-hand extension treads on pin J2, raising arm J1 on to latch G. In so doing, arm J1 pivots pawl X counter-clockwise so that the subsequent movement of arm M to the left (in response to the 'local record' interpretation of the transmitted WRU? signal) is ineffective, as the arm passes into cut-out AH. At the end of the main cam sleeve cycle, the 'reset to black' movement of arm M pivots latch G clockwise to restore pawl X to its normal position.

11.4 'Here Is' Action (Fig. 1.13)

The local Answer Back can be brought into operation by a manually-operated 'Here Is' key located above the teleprinter keyboard. Operation of this key simulates the movement of lever E by turning drum detent F clockwise via a direct mechanical link to the rear of the key assembly; thereafter the mechanism operates as described above.

12. TAPE PUNCH UNIT

12.1 General (Fig. 1.14, 1.15)

The Tape Punch Unit and its associated drive arm is mounted on the left-hand side of the machine, within the cover. The Unit produces fully-punched five-track paper tape at the max. speed of the associated teleprinter, and feeds this tape out towards the operator from beneath a V-shaped tear-off face. The Unit is controlled from the receiver Link Unit described in para. 6.5. It therefore records received messages directly, and transmitted messages indirectly via the electrical 'local record' path. Code combinations are punched in the same cycle as they are printed. Provision is made for automatic suppression of the punch and tape feed actions on up to four codes, which can be in either or both shifts. Two of these codes are usually 'J Bell' and WRU?; the other two can be used for mechanical control of the PERF ON and PERF OFF keys. These ON and OFF keys can also be controlled remotely via electromagnets. When required, the 'suppression' mechanism can be inhibited, and all 32 code combinations punched.

Note: The following points regarding the construction of the tape punching, tape feed, and on/off control mechanisms shown in Fig. 1.14 and 1.15 should be noted before reading the description which follows:

(a) Figure 1.14 — Items E, H, and G all pivot freely around spindle F. Clutch drive boss E (black) has a single dog which fits into the rear end of the L-shaped slot in clutch plate H. Cam plate G (black) has two similar dogs which fit into the other end of this slot, one on each side of spindle F. To expose clutch plate H, cam plate G has been exploded to the left. Drive arm C and reset arm Q are both clamped to spindle D; drive casting B pivots around spindle W. The on/off key assembly has been moved forward to expose the drive boss and cam plate (shown in black); on/off roller M, carried on frame J, has therefore been shown twice. The 'entire' leader line from letter M shows the true position of this roller. Frame J pivots around spindle L. The horizontal slot in link O, through which pin P2 passes, permits the link and its arm Q to follow the rocking motion

of drive arm C without disturbing latch lever P (which pivots around spindle R), whose face P1 is normally held against latch S by spring U.

(b) **Figure 1.15** – Cam plate G provides power for two actions; punching, and tape feed. As these actions are separated in the illustration plate G has been shown twice. The roller at the top of plate G moves in a curved slot in drive plate L, fixed to punch operating frame K; for clarity, plates G and L have been exploded to the left.

12.2 Drive for Punch and Feed Actions (Fig. 1.14, 1.15)

Through drive casting B, Fig. 1.14, the twin cams A on the receiver main cam sleeve impart a continuous rocking motion to drive arm C. The top rear end of arm C carries a horizontal roller C1 that controls the code reading levers (A Fig. 1.15), and a link C2 that operates the punch suppression lever reset frame (C3, Fig. 1.15). The front end of arm C connects with a trunnion block which converts this rocking motion into rotary motion of boss E (black) around spindle F. Boss E has a dog which fits into the L-shaped slot in clutch plate H. In the OFF position, plate H is urged towards the front of the machine by leaf spring I so that this dog simply moves up and down in the vertical part of the slot without conveying its motion to clutch plate H or cam plate G, whose dogs lie in the horizontal part of the slot. Depression of the ON key turns frame J clockwise around pivot L, so causing roller M to push clutch plate H towards the rear, where it is held by the action of latch K on the top arm of frame J. This movement of plate H brings the dog of boss E into the horizontal part of the slot in plate H (as shown in the inset) where it joins the two dogs of cam plate G. Plate G is thus temporarily linked to boss E, and so takes up its rocking motion. The roller at the top of cam plate G provides power for the punching action; the vertical slot generates the tape feed action. Both these actions are illustrated in Fig. 1.15.

12.3 'Off' Action; 'Manual' and 'Remote' (Fig. 1.14)

(a) **Manual;** Operation of the OFF key lifts latch K, Fig. 1.14, to release frame J and allow roller M to withdraw from clutch plate H. At the end of the cycle, plate H is moved towards the front of the machine by spring I, so bringing its vertical slot into line with the dog on boss E, where the subsequent up and down movement of the dog is ineffective. Plate G is thus brought to rest.

(b) **Remote:** The unit can be switched off remotely by energising relay T, Fig. 1.14; this relay is shown at RM in the signals circuit diagram in Fig. 1.19.

12.4 Operation of the ON key results in frame J turning clockwise and being retained by latch K. Link N is thus moved to the rear to bring it close to the vertical arm P1 of latch lever P, normally held against latch S by spring U. Because of the horizontal slot in link O, latch lever P is not disturbed by the to and fro movement of the link arising from the rocking motion produced in arm Q by drive arm C. When relay T is energized, latch S is depressed (by the vertical rod) below face P1, so allowing frame P to follow the next forward movement of link O. Arm P1, drawn by spring U, engages the rear vertical surface of link N, and moves the link towards the front of the machine, so upsetting latch K. The consequent counter-clockwise motion of frame J withdraws roller M, so breaking the link between boss F and plate G to bring the punch to rest.

12.5 Punch Selection Actions (Fig. 1.15)

(a) **Code hole punches:** The pattern of holes that will be punched through the tape for a particular code combination is determined by the lateral positioning of the five 'active' links (one shown at S, Fig. 1.15) in the Link Unit, whose lower projections are sensed by the five code reading levers A, Fig. 1.15, which control punch anvils B. The projections along the top edge of links S are similarly sensed by up to four punching suppression levers, of which D is typical.

(b) **Operation:** At the point in the reception cycle when the code is about to be passed from the Selector Unit to the Link Unit, the front end of drive arm C moves down. Sleeve C1, carried on arm C, urges the code reading lever A away from projection E; linkage C2 turns frame C3 counter-clockwise,

to lift roller C5 and hence suppression lever D away from projections F. Links S are now free to accept the new code setting. Once the new code is established on links S, drive arm C turns counter-clockwise, withdrawing sleeve C1 to allow code reading bars A to rise and sense projections E. Links that have been set to the right for 'mark' allow bars. A to pass up the left-hand side of projections E; punch anvil bars B, which are tensioned by spring H against the retreating lower end of reading levers A thus move the the rear to bring projection I beneath the associated punch J. A subsequent upward movement of punch operating frame K, which carries the five code punches J and the feed hole punch, produced by the action of the roller of cam plate G in plate L (part of frame K), causes a hole to be punched in the tape for this particular code element. When punch operating frame K is lowered again, withdrawal frame M pulls any 'marking' punches out of the paper. Links S that remain at rest in the 'space' position (as shown in Fig. 1.15) leave their projections E in the path of the rising reading levers A, and so prevent the associated anvil bars B from moving to the rear. The cut-out to the rear of projections I on anvil bars B thus remains beneath the punches, which are not therefore affected when frame K is raised.

12.6 Feed Hole Punching and Tape Feed Action (Fig. 1.15)

The feed hole punch anvil bar N, Fig. 1.15, which is carried in frame K along with the five code hole punch anvil bars, is normally tensioned to the rear against bar P2 in suppression frame P. In this position the entire part of bar N lies beneath the feed hole punch, so that when frame K is raised, a feed hole is produced in the tape. As cam plate G turns clockwise to lift frame K, its internal cam track turns feed lever O counter-clockwise so lifting feed pawl Q into the next tooth of ratchet wheel assembly R, which also carries the tape feed pin wheel. The downward movement of pawl Q, produced when cam plate G restores, rotates assembly R one tooth, so drawing a further 1/10in. of tape through the die assembly.

12.7 Punch and Feed Suppression

For some applications it is a requirement that the codes for 'Who Are You?' and 'J Bell' should not appear in the perforated tape. To provide for this requirement, up to four punch suppression levers, (such as D, Fig. 1.15), can be fitted. These levers operate as follows:

(a) As the front end of drive arm C rises, roller C5 on frame C3 lowers suppression levers D to sense projections F. If the code is a 'normal' one, levers D will each be blocked by at least one projection F. When a code that requires to be suppressed is set up on links S, however, a gap will open across all five links, and the selected lever D will move down into it. (A sixth link, shown at R on Fig. 1.8, and operated from the case shift control mechanism (paragraph 7.5), enables levers D to discriminate between codes such as 'D/Who Are You?' which are 'normal' in the 'letters' shift, but require to be suppressed in the 'figures' shift).

(b) The subsequent counter-clockwise motion of the selected lever D causes its face D1 to pivot latch frame T clockwise, so disengaging its latch T1 from the lower arm of suppression frame P. Urged by spring P1, frame P now turns counter-clockwise; rod P2 pushes the lower ends of any 'marking' code reading levers A forward to the 'space' position. Rod P2 also moves the feed hole anvil bar N forward so that its cut-out lies beneath the feed hole punch; extension N1 displaces tape feed pawl Q. The next upward movement of punch operating frame K will therefore be ineffective as the code and feed hole punch anvils have all been set to 'space', and feed pawl Q has been displaced, so effectively suppressing the code established on links S.

(c) When drive arm C subsequently turns clockwise to lower the punch operating frame, eccentric roller C6 rotates suppression-frame P so that it can re-engage latch T1 and so restore control of the anvil bars B to reading levers A.

12.8 Punch ON/OFF on Receipt of Selected Code (Fig. 1.15)

A special suppression lever, similar to D, Fig. 1.15, can be fitted which, when selected, causes its face D2 to push link N, Fig. 1.14, forward releasing latch K and frame J to bring the Punch Unit to rest. Face D1 on this lever

suppresses the 'off' code by acting on rod P2 in the manner described above. Another suppression lever can be used to operate linkages that act on extension V of frame J (Fig. 1.14) to simulate depression of the ON key.

12.9 Tape Loading (Fig. 1.14)

Depression of the TAPE RLSE key raises retention arm U, Fig. 1.15, and the pressure roller that holds the tape down on to assembly R, to enable the tape to be threaded easily over the pin wheel.

12.10 Back Space (Fig. 1.14)

The first part of the 'back space' key movement disengages pawl Q Fig. 1.15, from the ratchet wheel assembly R, and engages a 'back feed' pawl with reverse ratchet V. Further movement causes this 'back feed' pawl to turn assembly R counter-clockwise by one tooth. Retention arm U maintains the pin wheel and the tape in its new position.

12.11 Suppression Control Knob (Fig. 1.15)

The punch suppression action of levers D, Fig. 1.15, is inhibited in one position of control knob W, Fig. 1.15. This knob has two other positions, one which suppresses upper case D(WRU) and J(Bell), the other is used when the suppression mechanism is being adjusted. These three settings are indicated by 1, 2 and 3 stripes respectively on three adjacent faces of the hexagonal knob, and correspond to the following condition:

(a) **One stripe to top:** This is the 'normal' position, as shown in Fig. 1.15, All code reading levers A, and suppression levers D are free to operate; upper case D(WRU?) and J(Bell) are suppressed and so do not appear in the tape.

(b) **Two stripes to top:** This setting blocks the movement of all the code reading levers A and the suppression levers D; it is only used when the suppression mechanism is being adjusted. If the Punch is switched on with the control knob in this position, only feed holes will be punched in the tape.

(c) **Three stripes to top:** In this setting, the suppression levers D are blocked, but the code reading levers are allowed to operate normally. All received code combinations, including 'Bell' and 'WRU?' are therefore recorded on the tape.

13. TAPE READER UNIT

13.1 General (Fig. 1.16, 1.17)

The Tape Reader Unit, which is located at the right-hand side of the keyboard panel, will read 5-track, $^{11}/_{16}$in. fully-punched or chadless tape at the maximum speed of the associated teleprinter. The Unit has its own striker transmitter of identical design to the one employed in the Keyboard Transmitter and Answer Back Unit (paragraph 5), but uses the send/receive switch of the keyboard transmitter.

13.2 Two manually-operated keys, labelled TAPE TRANS ON, and TAPE TRANS OFF, control the Reader mechanism, which is illustrated in Fig. 1.16 and 1.17. The 'tape out' and 'tape gate open' conditions bring this mechanism to rest automatically, and signal the condition to the controlling equipment by an 'alarm' microswitch (AL, Fig. 1.19). Another microswitch (TR, Fig. 1.19) indicates when the Reader is ON. The reader can be brought to rest remotely by energizing a 'Reader Off' electromagnet shown at TM on Fig. 1.19.

Note: The following points regarding the illustration concerning this Unit should be noted before reading the 'sequence of operation' given below.

(a) **Figure 1.16:** Shaft A is tensioned clockwise by a spring I; for convenience this is shown on lever B, although it is actually located on lever J. Lever B is clamped to shaft A; lever C pivots around this shaft; lever D can turn around the shaft, but is tensioned counter-clockwise against a block clamped to the shaft; lever J can also turn around this shaft, and is tensioned clockwise against a block clamped to the shaft. Detent reset lever assembly F is urged counter-clockwise by spring O.

(b) **Figure 1.17:** Arm H is clamped to the spindle of plate F, and the whole assembly is urged counter-clockwise by spring O.

13.3 Rest Condition (Fig. 1.16)

Figure 1.16 shows the Reader mechanism in the

rest condition, with both control keys at 'normal'. Arm G1 of detent G is holding clutch assembly L and N open, being maintained in this position by arm K2 interposing on arm G2. Arm J is raised to block any counter-clockwise motion of trip lever K, so holding the ON key inoperative. Clutch driving member N is being driven continuously counter-clockwise by belt M from the transmitter drive shaft.

13.4 Loading Tape (Fig. 1.16)

When tape is loaded and the tape gate latched down, the 'tape out' lever R, Fig. 1.16, is depressed, so rotating shaft A counter-clockwise. This movement urges latch D down on to face 1 of lever E, and moves arm J down clear of start trip lever face K3.

13.5 Starting Procedure (Fig. 1.16)

A horizontal pin on the OFF key lever turns stop reset lever P counter-clockwise, lifting link Q to rotate stop lever E counter-clockwise. Arm E1 now latches on arm D, and face E2 is thus held down clear of the lower end (F2) of lever F. Lever F now turns counter-clockwise; detent G is still held on extension K2. When the ON key is depressed, a similar horizontal pin depresses arm S to tread on Z-lever T, so upsetting the trip linkage from the keyboard to the keyboard transmitter detent U. The same pin turns lever K counter-clockwise; arm K3 operates the 'on' microswitch, arm K2 releases detent G which lifts to allow ratchet clutch I to engage its drive N.

13.6 Transmission (Fig. 1.17)

Cam sleeve V now begins to turn counter-clockwise. Cam A, Fig. 1.17, rotates frame B, draws link C to the right, and so sets the keyboard transmitter's send/receive switch toggle D to the 'send' position. Further rotation of the cam sleeve causes a 'start' lever similar to E, but not associated with a pecker G, to turn counter-clockwise. A projection on lever E moves plate F (black) clockwise against spring O and causes arm H to slide carrier I to the right. A subsequent upward movement of lever J causes striker K to turn dolly L counter-clockwise and so connect positive polarity to line for the spacing 'start' signal. During the transmission of this 'start' signal, reset rack M turns clockwise, allowing the five peckers G to rise (leaf springs at N) and sense the pattern of holes in the tape. A pecker G that can move up through a hole (mark condition) moves its lower vertical arm into the path of the associated sequential lever E; a pecker held down by entire paper (space condition) does not move far enough clockwise to block its lever E, which can therefore follow its cam.

13.7 Towards the end of the 'start' signal, a flat on code element No. 1 cam is presented to a sequential lever E, which attempts to turn counter-clockwise. If its movement is blocked by a 'marking' pecker G, plate F will be free to turn counter-clockwise under the action of spring O, and lever H will slide carrier I to the left. The next upward movement of lever J and striker K, which occurs 20 milliseconds after the first 'start' strike, will then turn dolly L clockwise to connect negative 'marking' battery to line.

13.8 If the second code element is a 'space', the associated sequential lever E will be free to follow its cam, and, having a stronger spring than O, will tilt plate F clockwise, sliding carrier I to the right to align striker K in the 'space' position. The next upward movement of striker K will then turn dolly L to connect positive 'spacing' battery to line.

13.9 These actions are repeated for the 3rd, 4th and 5th code elements; the position of peckers G dictating whether a 'mark' or a 'space' will be transmitted. When the 5th element sequential lever E has restored, the cam sleeve holds all levers E (including the 'start' lever) down, allowing plate F to turn counter-clockwise and move carrier I to the left. The last upward movement of lever J and striker K then sets the dolly to connect negative 'mark' polarity to line for the 'stop' signal.

13.10 Tape Feed Action (Fig. 1.16)

A fork in the rear arm of lever W, Fig. 1.16, enfolds a pin carried on feed pawl assembly X, which pivots freely around the pin wheel spindle. During the 'stop' signal, feed cam lever W is turned clockwise by its cam, so urging the feed pawl assembly to the right. The nose of the feed pawl works directly into the pins of the pin wheel, which acts as a ratchet, and feeds the wheel round 1/10in. each cycle. The pin wheel is retained by a friction clutch around

its pivot, when the pawl moves back (during the 'start' signal of the next cycle) to take up the next pin.

13.11 Continuous Transmission (Fig. 1.16)

During the 5th code element, a detent reset cam acts on the horizontal arm of lever F, Fig. 1.16, turning it clockwise. This action causes arm F1 to press detent G1 momentarily down into the path stop surface on clutch L. The reset cam, however, falls away and allows detent face G1 to rise again before the stop surface on clutch L reaches it. The clutch therefore runs through, and transmission continues until one of three circumstances arise:

(a) the Reader senses 'tape out', or the tape gate is opened

(b) the operator presses the TAPE TRANS OFF key

(c) the external equipment energizes the 'stop' magnet.

13.12 Stop Action on 'Tape Out' (Fig. 1.16)

Under 'continuous transmission' conditions, stop lever E, Fig. 1.16, is latched against arm D; face E2 is thus held down out of the path of detent lever F. When a 'tape out' or 'gate open' condition occurs, arm R and consequently shaft A are turned clockwise by spring I. This same movement lifts arm D to release stop lever E, which is then turned clockwise by its torsion spring to bring face E2 up against the tail of lever F. (If this condition occurs later in the cycle, face E2 may pass up the inside of face F2). When detent reset lever F is subsequently turned clockwise by its cam (against the tension of the spring on detent G) face E2 moves up to block the **counter-clockwise** motion that would otherwise occur as the detent reset cam falls away. Detent face G1 thus remains in the path of clutch member L, which is then pressed back out of engagement with drive member N to bring the mechanism to rest in the 'alarm' condition. The operator then presses the OFF key to restore the mechanism to normal.

13.13 Stop Action when 'Off' Key is Operated

Assume that the Reader is running continuously with the tape gate down, so that stop lever E is latched on arm D; the ON key is held depressed by latch lever Z, and arm K2 is held up clear of detent arm G2. Once each cycle, reset lever F pushes detent G1 down into the path of the clutch, but allows it to rise again before the clutch stop surface can reach it. If the operator now presses the OFF key, latch lever Z (black) is lowered to release the ON key and consequently lever K, which then tries to turn clockwise under the action of the spring on its lower vertical arm. Depending on the instant in the cycle at which the OFF key is operated, arm K2 will now either rest on the top of arm G2, or pass down the left-hand side of it. In either case, the next time detent face G1 is moved down into the path of clutch L by lever F, it will not be allowed to rise again because arm K2 will have blocked the path of arm G2. The mechanism is thus brought to rest again.

13.14 Remote Control Stop Action (Fig. 1.16)

When the stop magnet is energized from some external source, lever Y, Fig. 1.16, withdraws the support for arm C1 of magnet lever C, allowing the lever to follow its cam V which ultimately turns it clockwise. Arm C2 lifts arm D, so freeing stop lever E which then turns clockwise to bring the mechanism to rest as described above. Cam V then relatches arm C1 on to lever Y ready for the next remote stop action. In common with the 'Tape Out' stop action, this is an 'alarm' condition which is reset to normal by the operator depressing the OFF key.

13.15 Extension of the 'Stop' Signal (Fig. 1.17)

Although the reader cam sleeve has a revolution time of 150 milliseconds, some 10 milliseconds, elapse before the first 'start' strike. This leaves only the 20 millisecond period from 130 milliseconds to the end of the cycle for the 'stop' signal, less the time taken by cam A, Fig. 1.17, to reset the send/receive switch to 'receive'. On switched simplex circuits this would cause an unacceptable shortening of the 'stop' signal, so arrangements are made to hold the send/receive switch on 'send' until a 'stop' signal of the required 30 millisecond duration has been transmitted. The mechanism used for this purpose is shown on Fig. 1.17.

13.16 During the 4th code element, cam P rotates lever Q counter-clockwise to tread on an arm R fixed

to the pivot of the send/receive delay lever S (also shown at V, Fig. 1.3). Lever R is thus turned clockwise; this causes the right-hand end of lever S to move down into the path of an extension to the send/receive switch operating lever W, so preventing it returning to 'receive' when linkage C restores; the left-hand end of lever S is lifted out of a cut-out in the friction-driven disc V (item U, Fig. 1.3; described in paragraph 5.4 under the heading 'Send/Receive Switch Delay') and runs on the periphery of this disc for approximately 75 milliseconds, after which it passes into another cut-out. The delay disc then maintains the block on lever W for this period, which is sufficient, if it is the last cycle of the mechanism, to extend the 'stop' signal to at least 30 milliseconds If however the mechanism is cycling continuously, the delay mechanism holds the send/receive switch on 'send' long enough for lever Q to rise and fall again. The switch is therefore held on 'send' continuously; the 20 millisecond 'stop' signal at the end of the cycle then runs on to the 10 millisecond delay before the first 'start' strike without a break, so producing the required continuous 30 millisecond 'stop' signal.

13.17 End of Cycle (Fig. 1.16)

When the cam sleeve comes to rest on detent G, Fig. 1.16, at the end of a transmission, the operator will press the OFF key. This action lifts extension S to free the keyboard transmitter, and allows trip lever K to turn clockwise. Extension K2 blocks detent G; extension K3 is blocked by arm J when the tape is removed; the rest of the mechanism then returns to the state illustrated in Fig. 1.16.

14. EXTERNAL CIRCUITS

Figs. 1.23, 1.24, 1.25, 1.26 and 1.27 show the suggested alternatives for external circuit interconnections employed in private wire teleprinter networks.

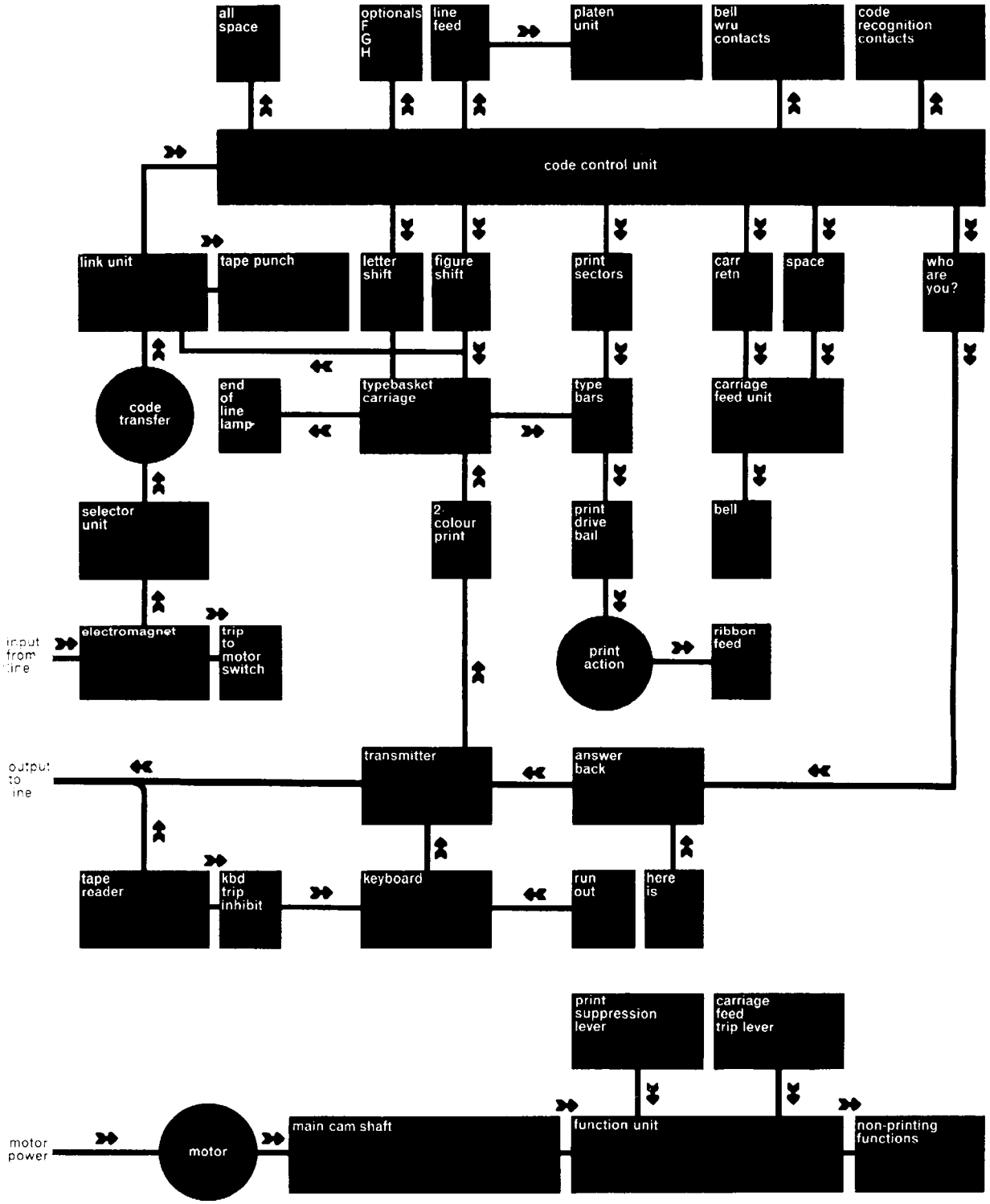


Fig. 1.1 BLOCK DIAGRAM

1·2

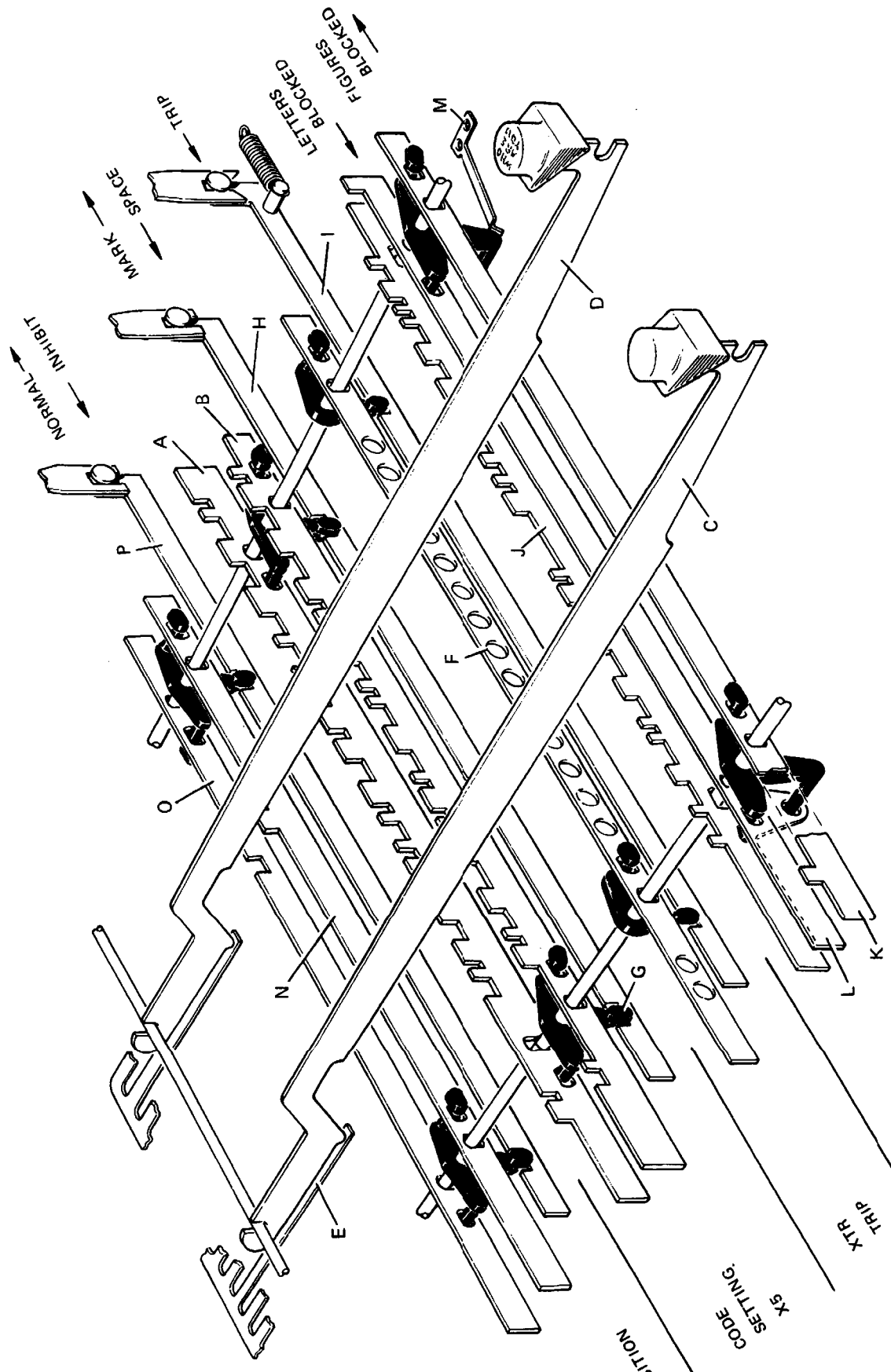


Fig. 1.2 TYPICAL 4-ROW KEYBOARD

1·3

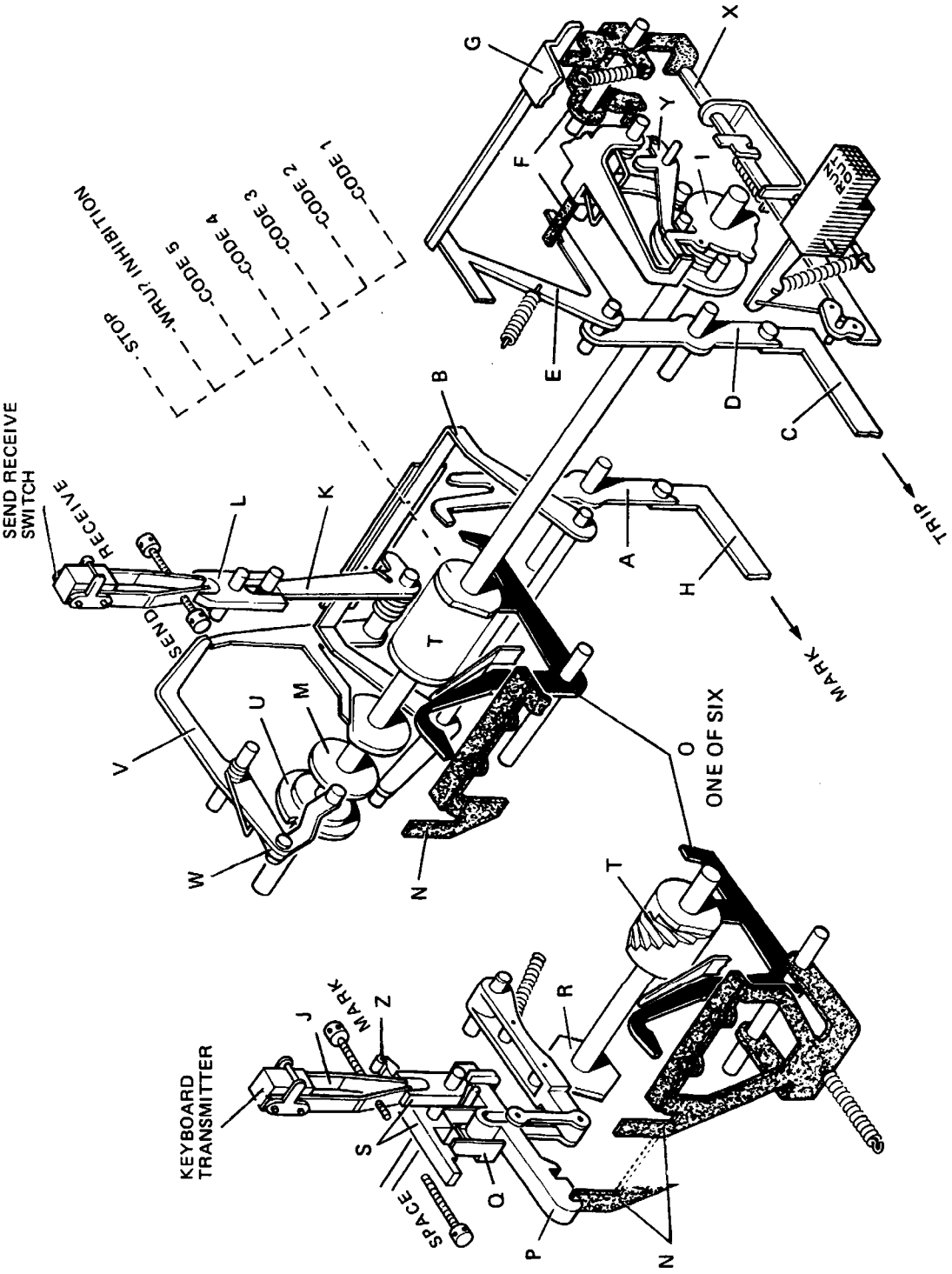


Fig. 1.3 KEYBOARD TRANSMITTER MECHANISM

1•4

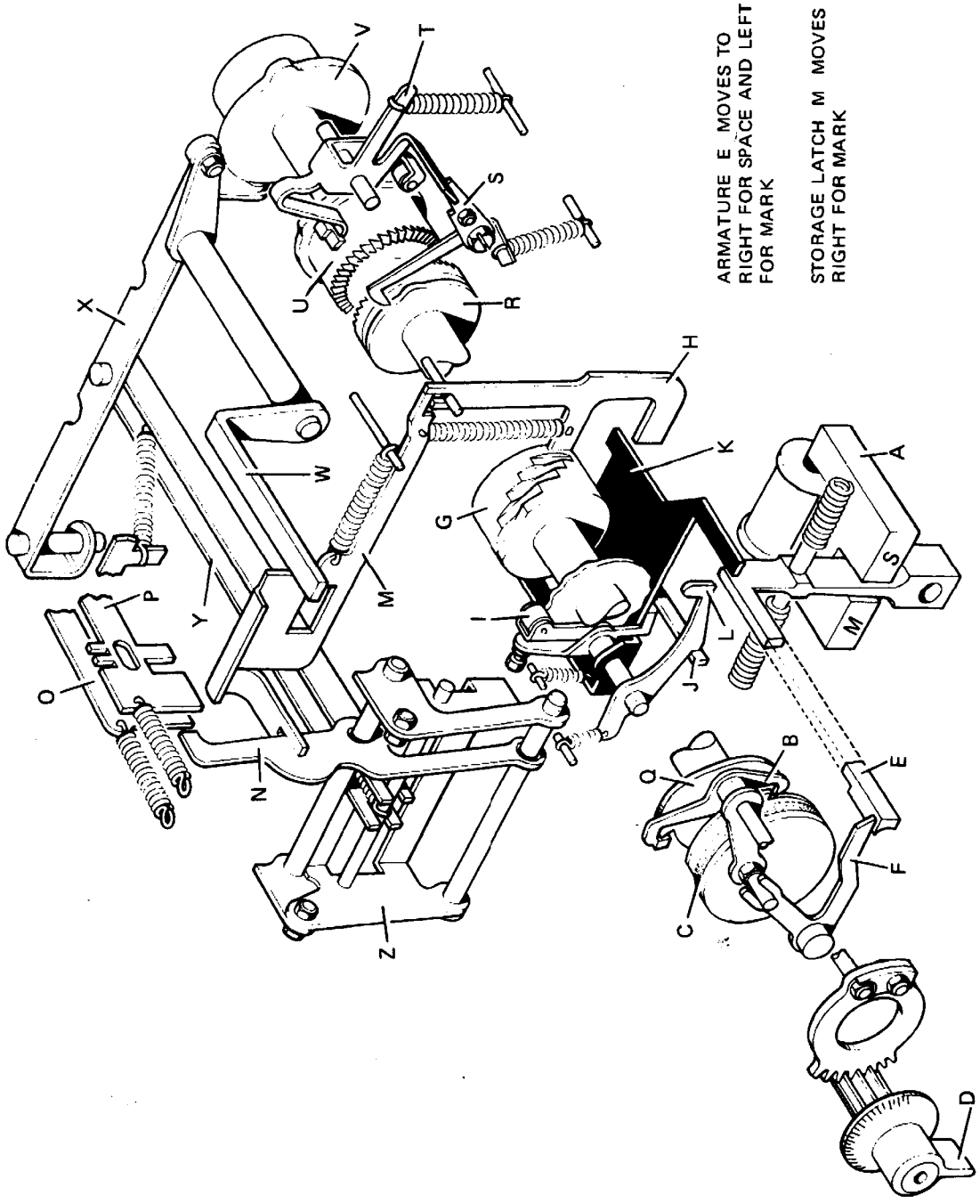


Fig. 1.4 SELECTOR UNIT MECHANISM

1·5

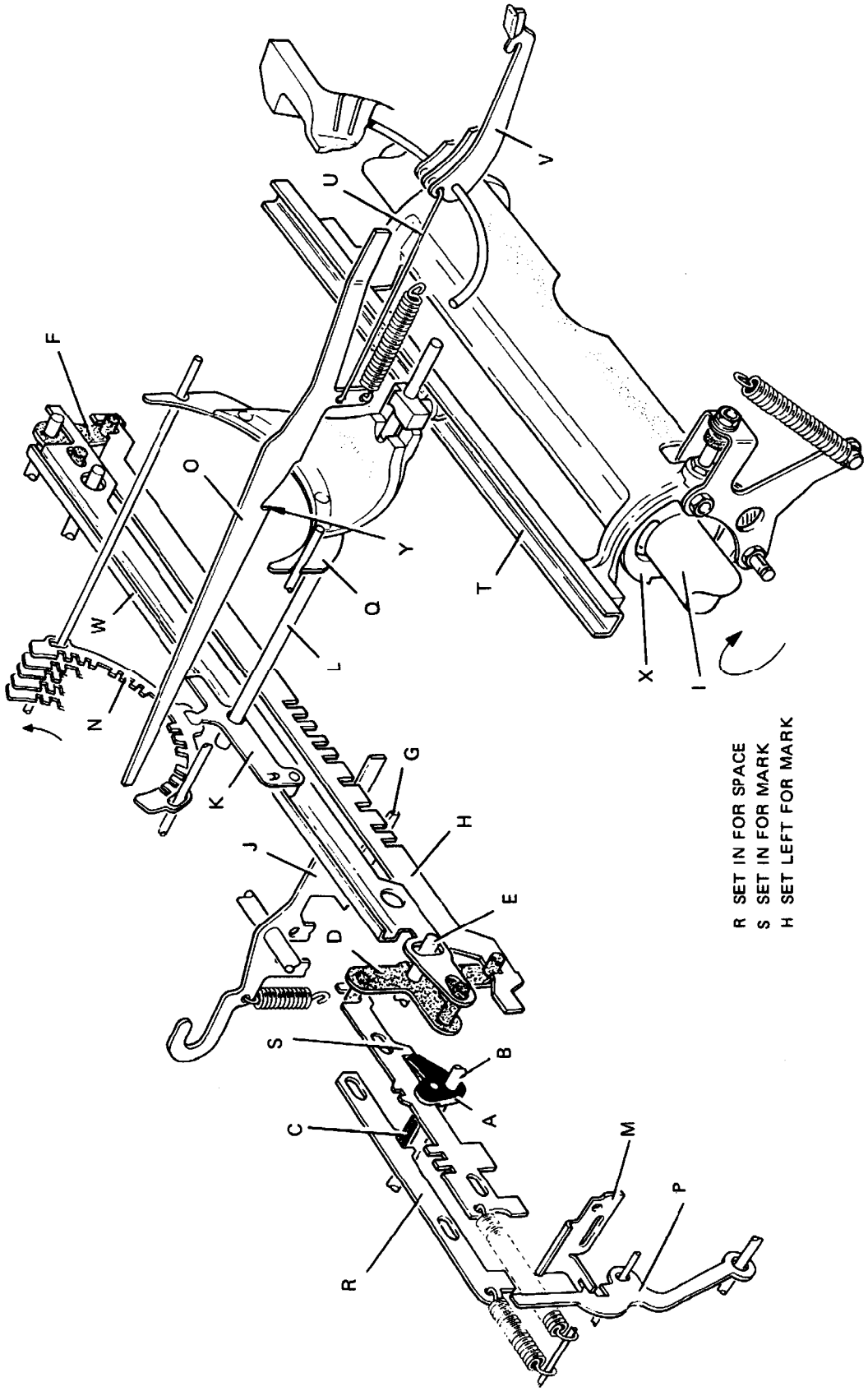


Fig. 1.5 LINK UNIT AND TYPEBAR SELECTION UNIT

1·6

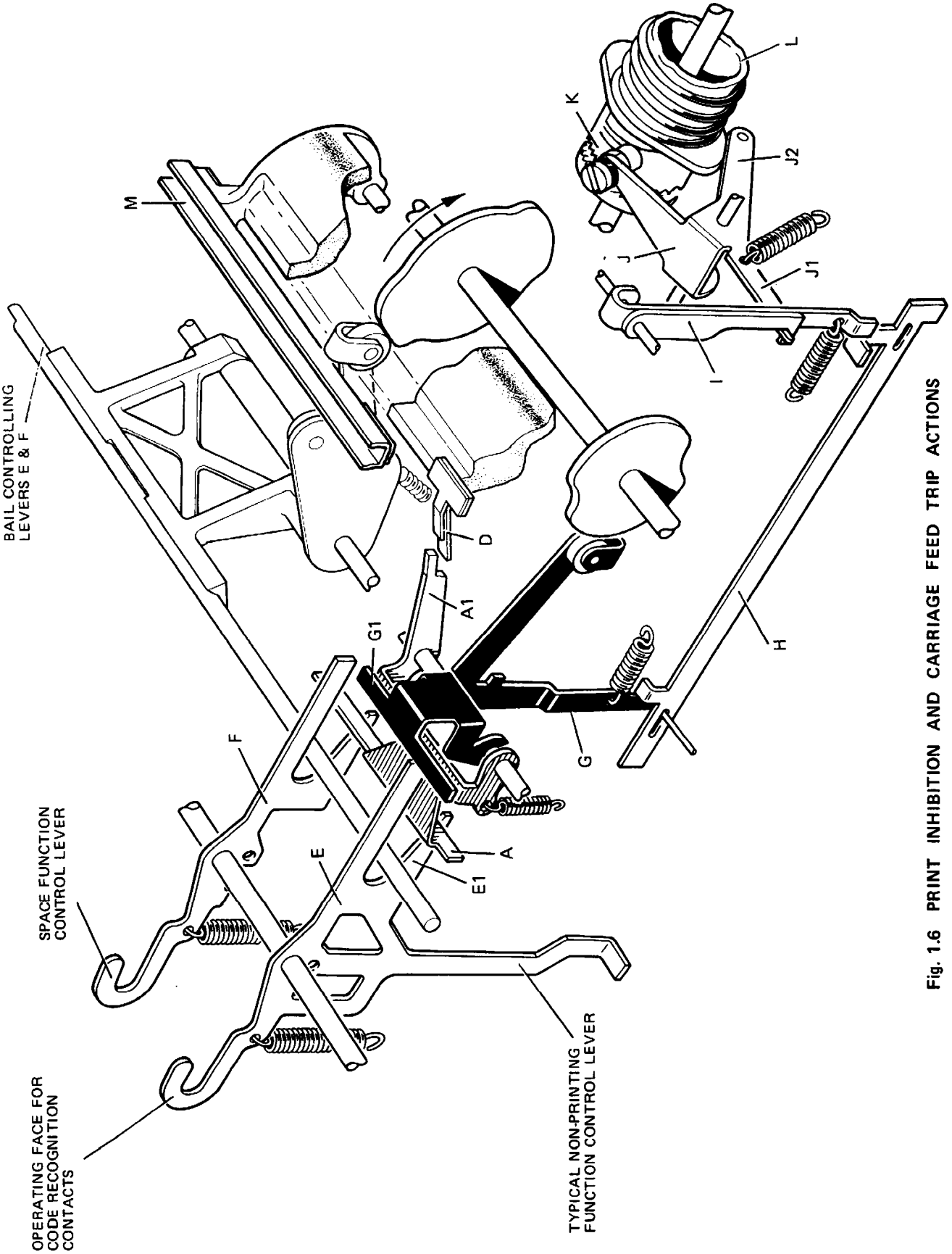


Fig. 1.6 PRINT INHIBITION AND CARRIAGE FEED TRIP ACTIONS

1·7

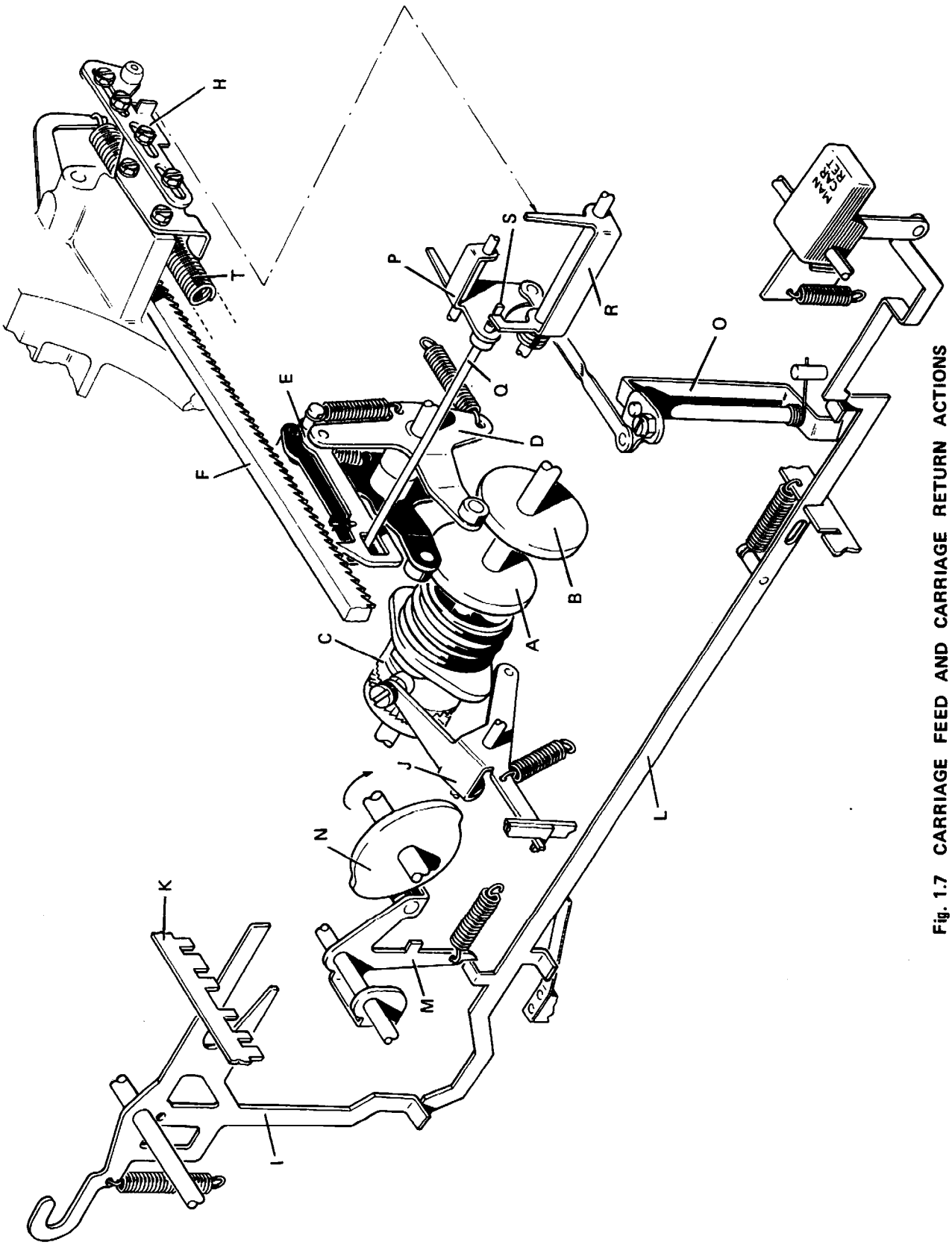


Fig. 1.7 CARRIAGE FEED AND CARRIAGE RETURN ACTIONS

1·8

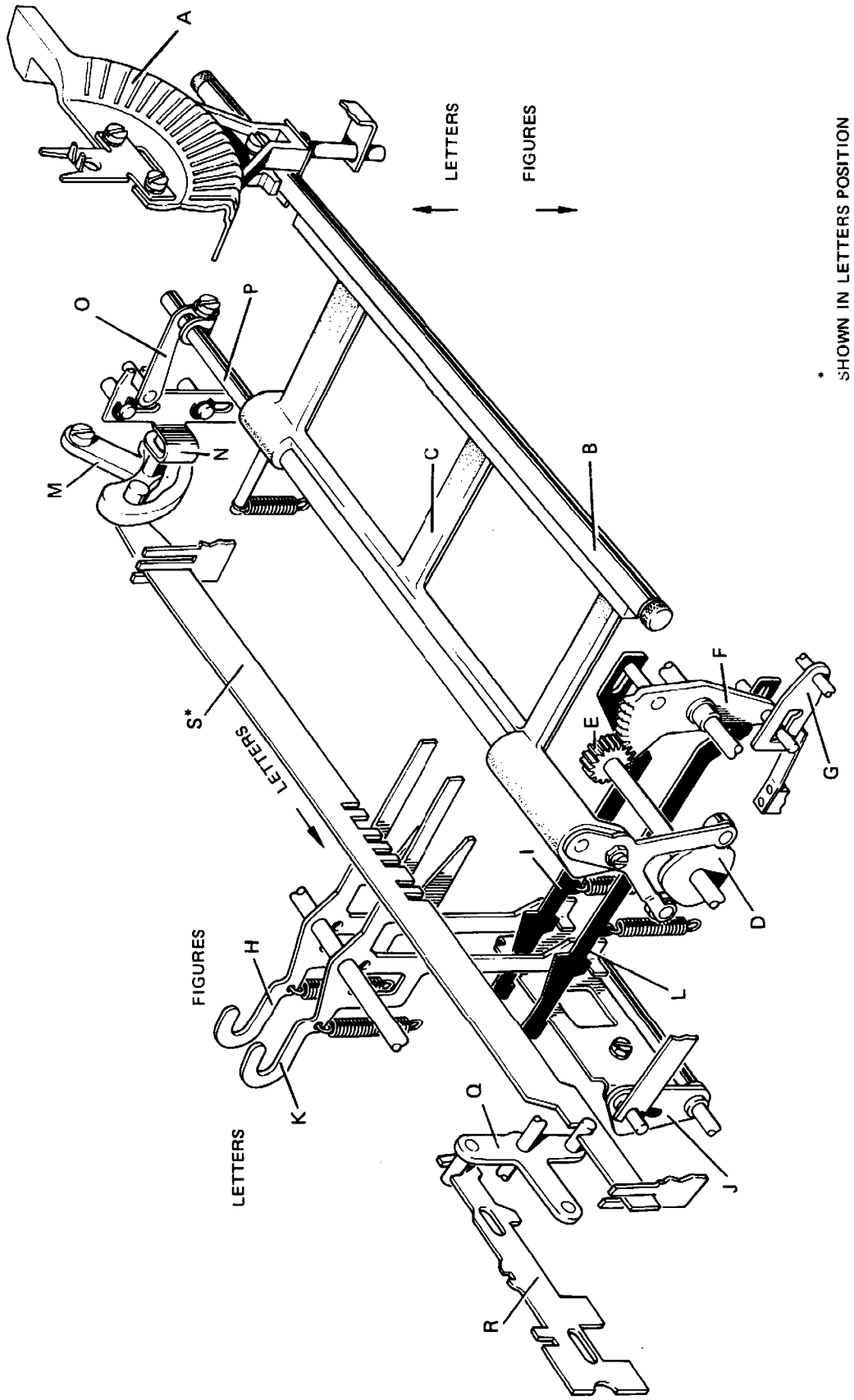


Fig. 1.8 LETTERS/FIGURES SHIFT MECHANISM

1·9

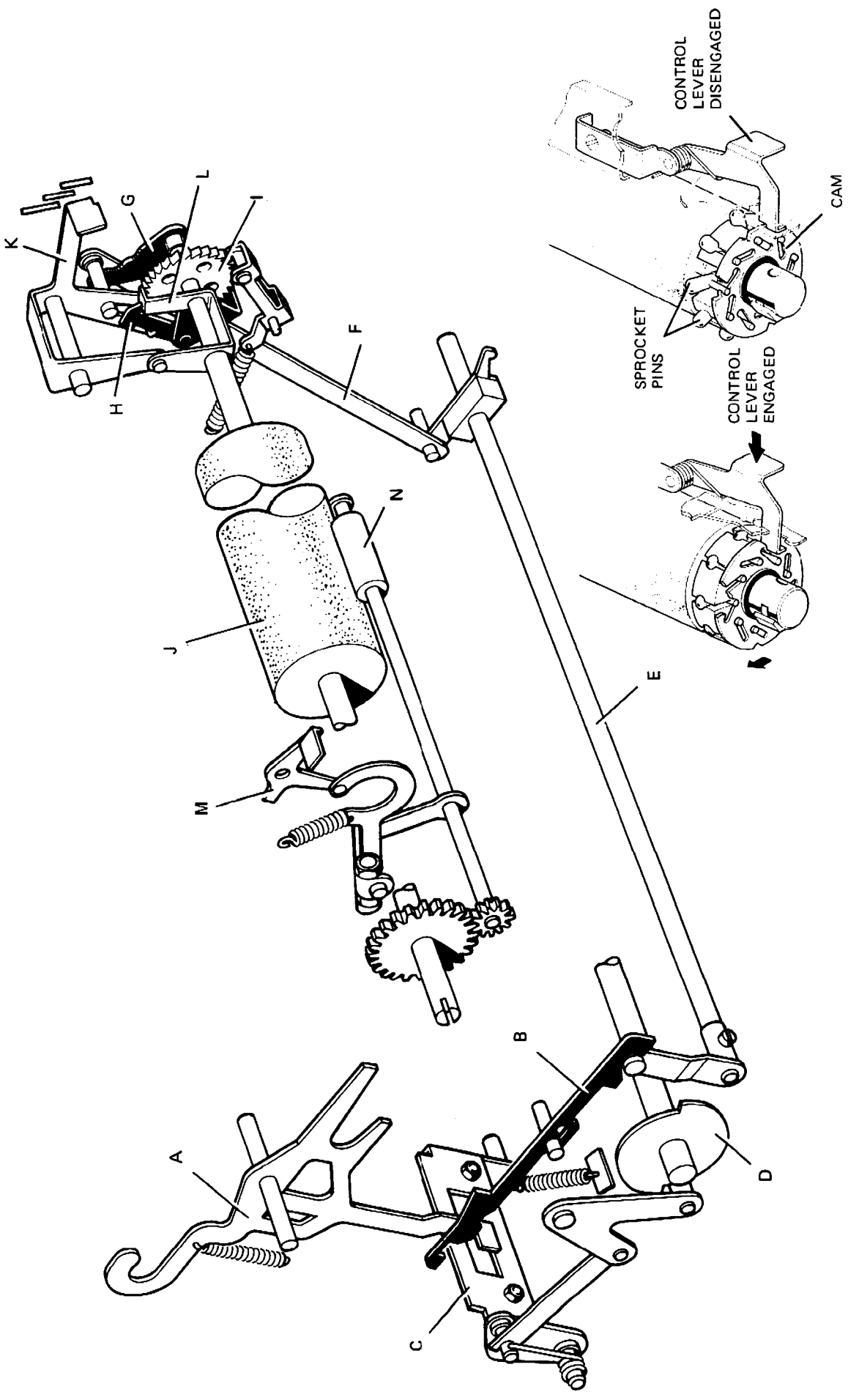


Fig. 1.9 LINE FEED ACTION

1·10

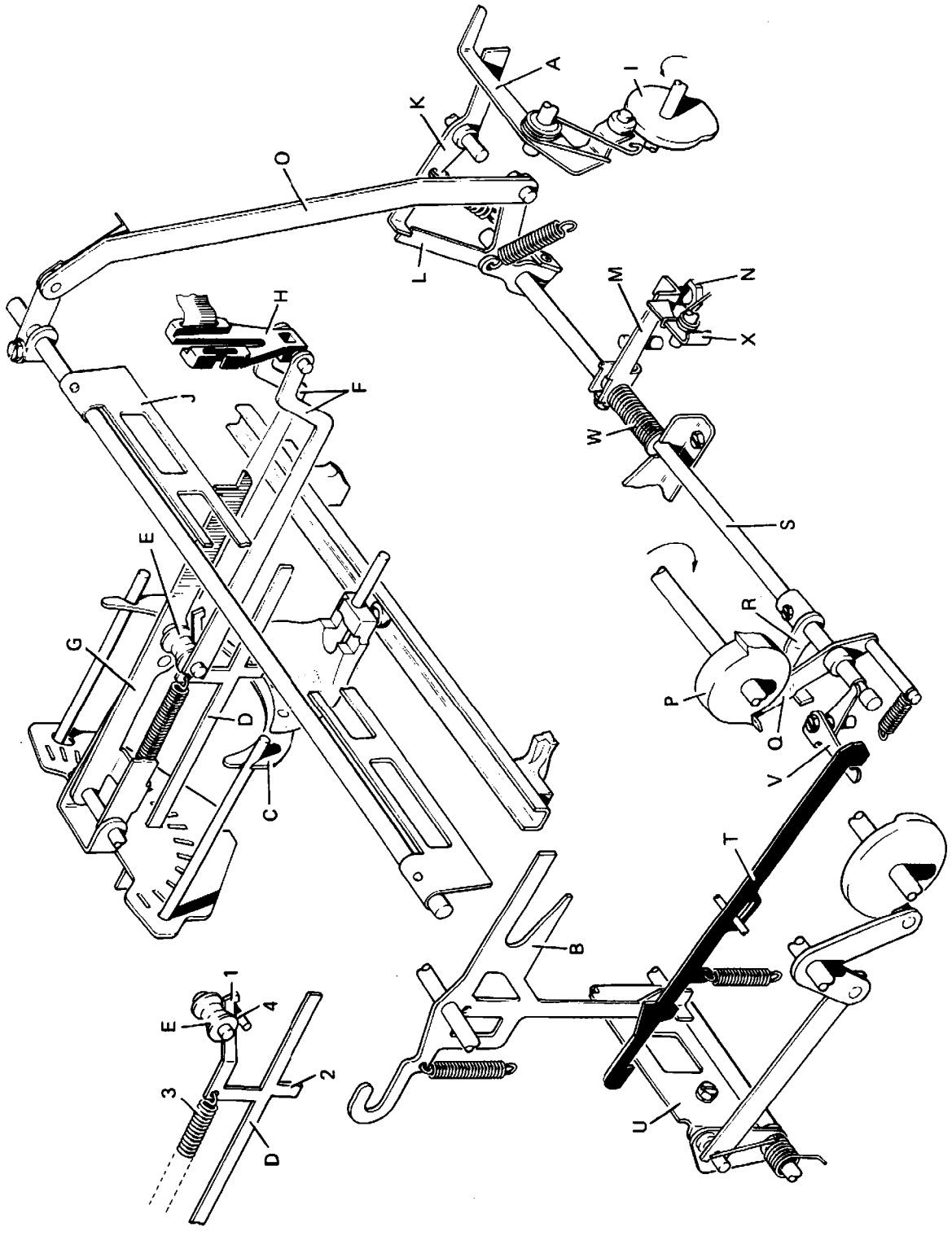


Fig. 1.10 RIBBON LIFT, TWO COLOUR PRINTING, AND ANSWER BACK TRIP ACTIONS

I·II

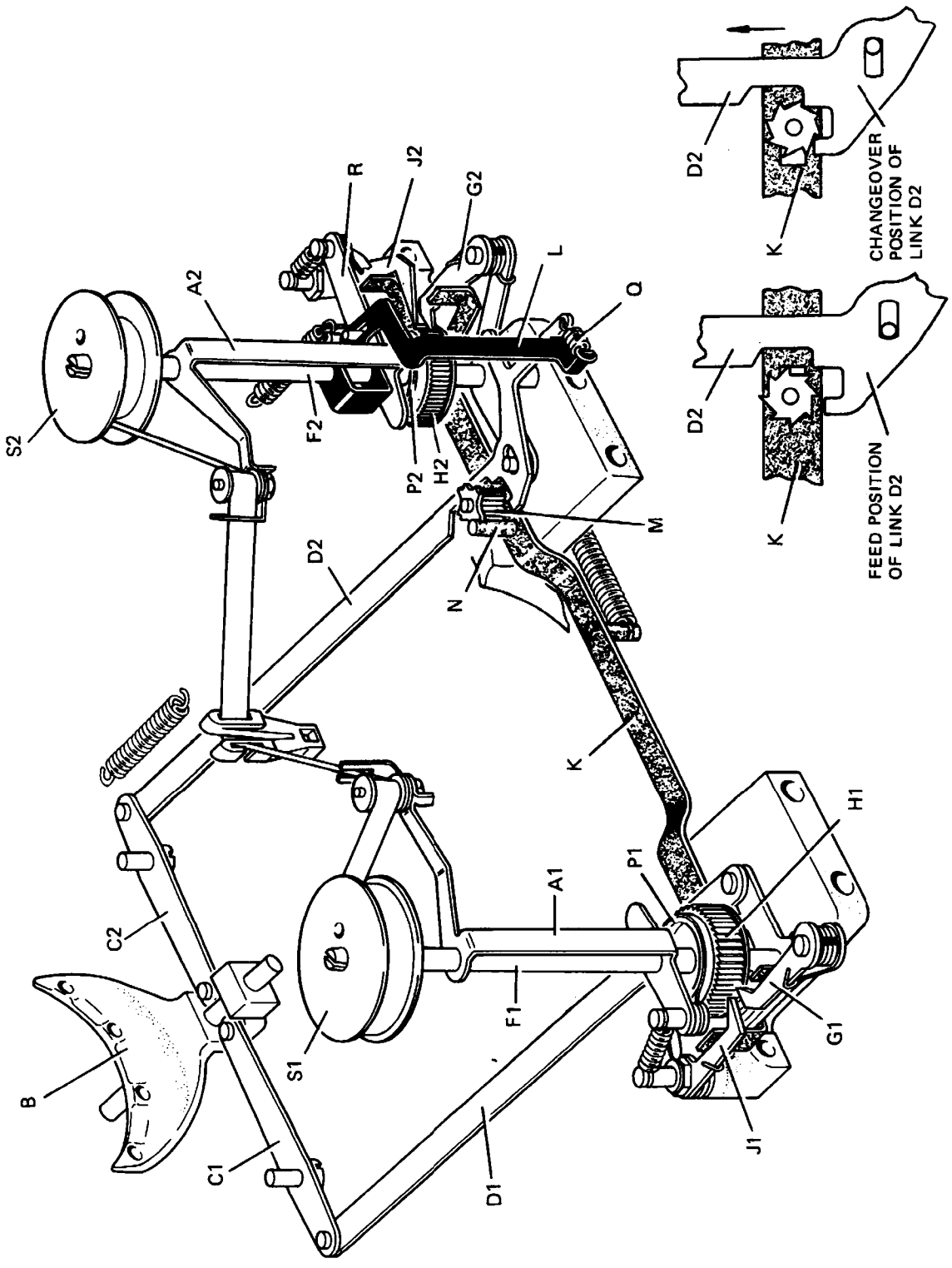


Fig. 1.11 RIBBON FEED MECHANISM

1·12

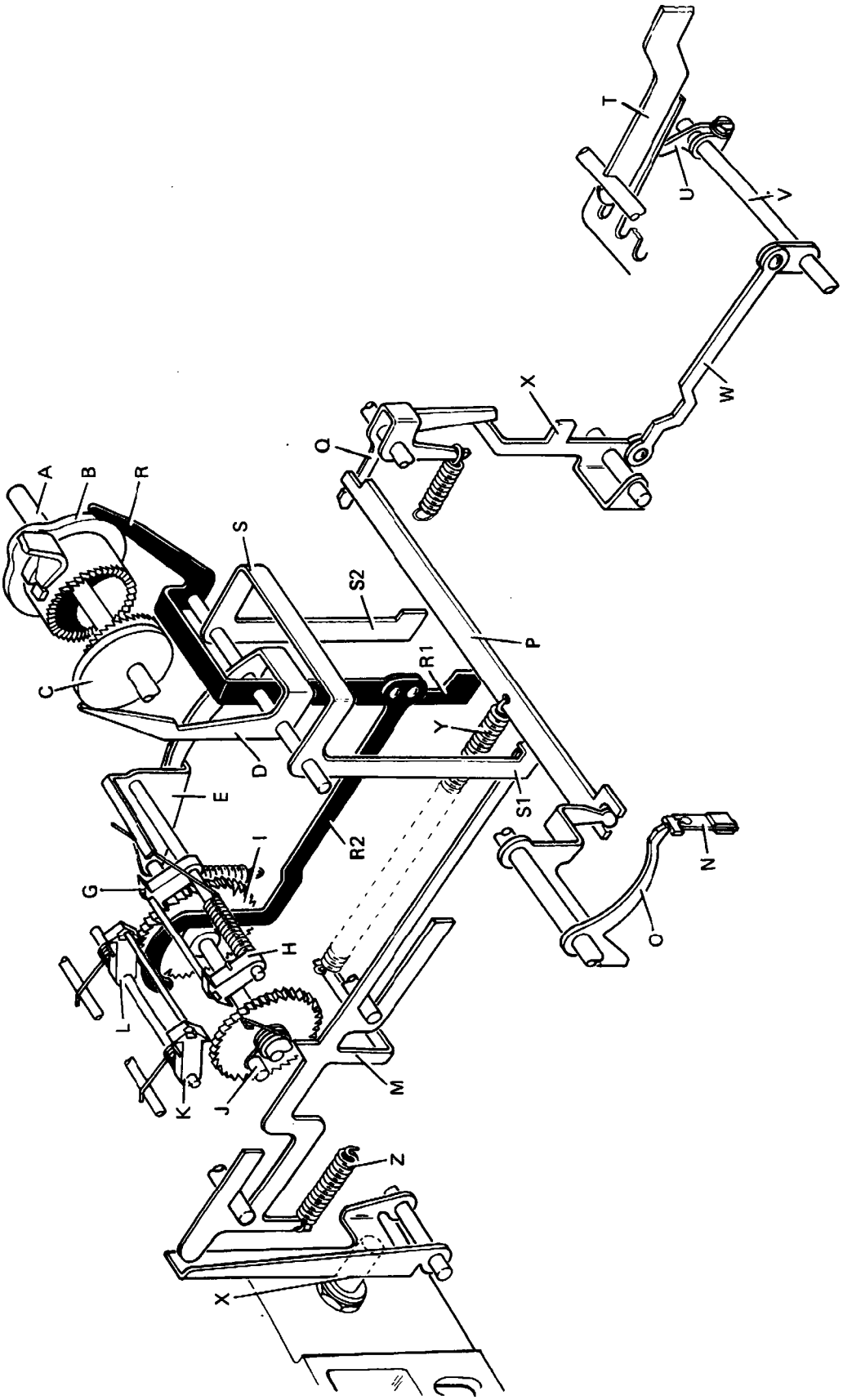


Fig. 1.12 AUTOMATIC MOTOR SWITCH

1·13

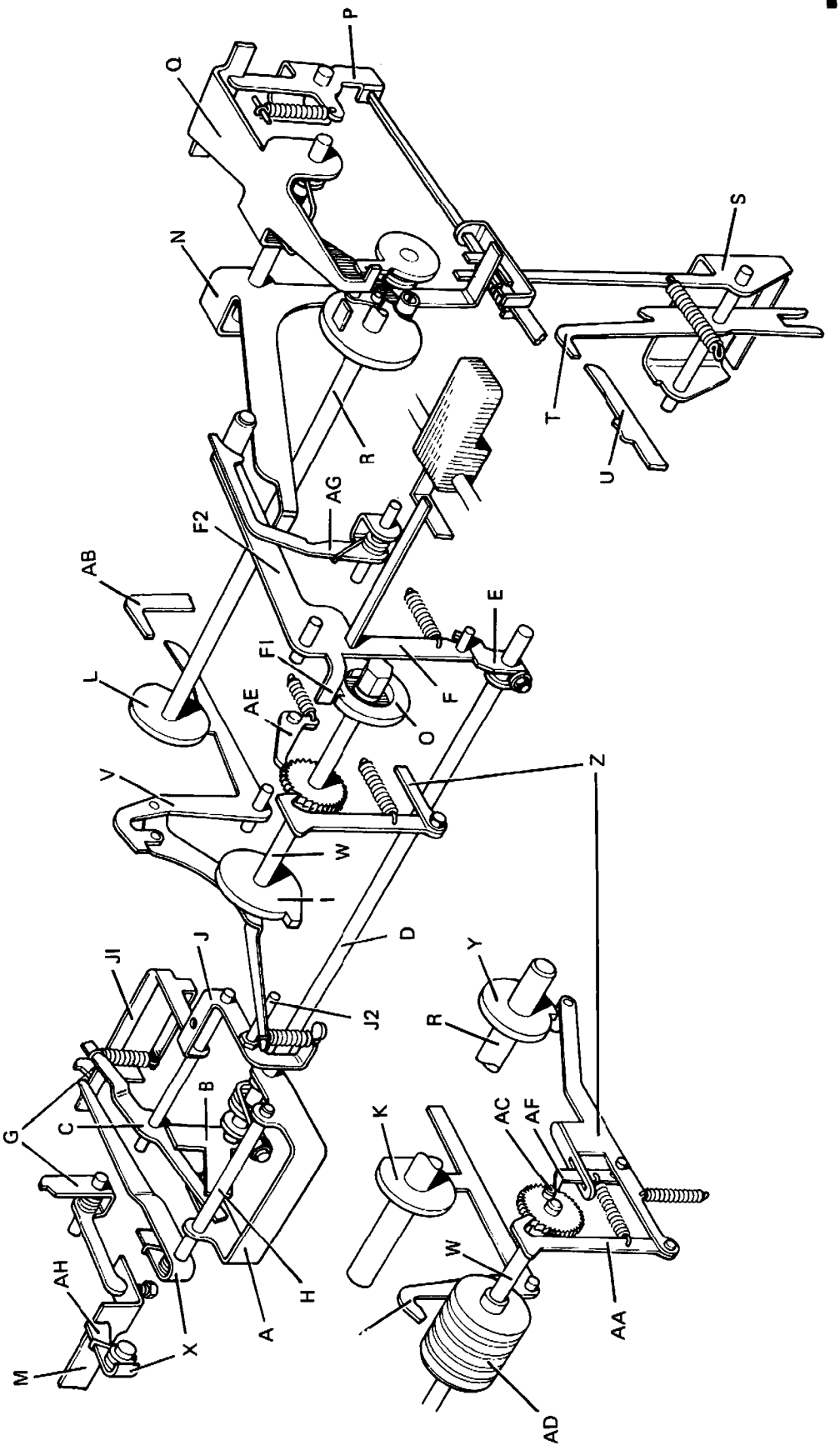


Fig. 1.13 ANSWER BACK OPERATION

1·14

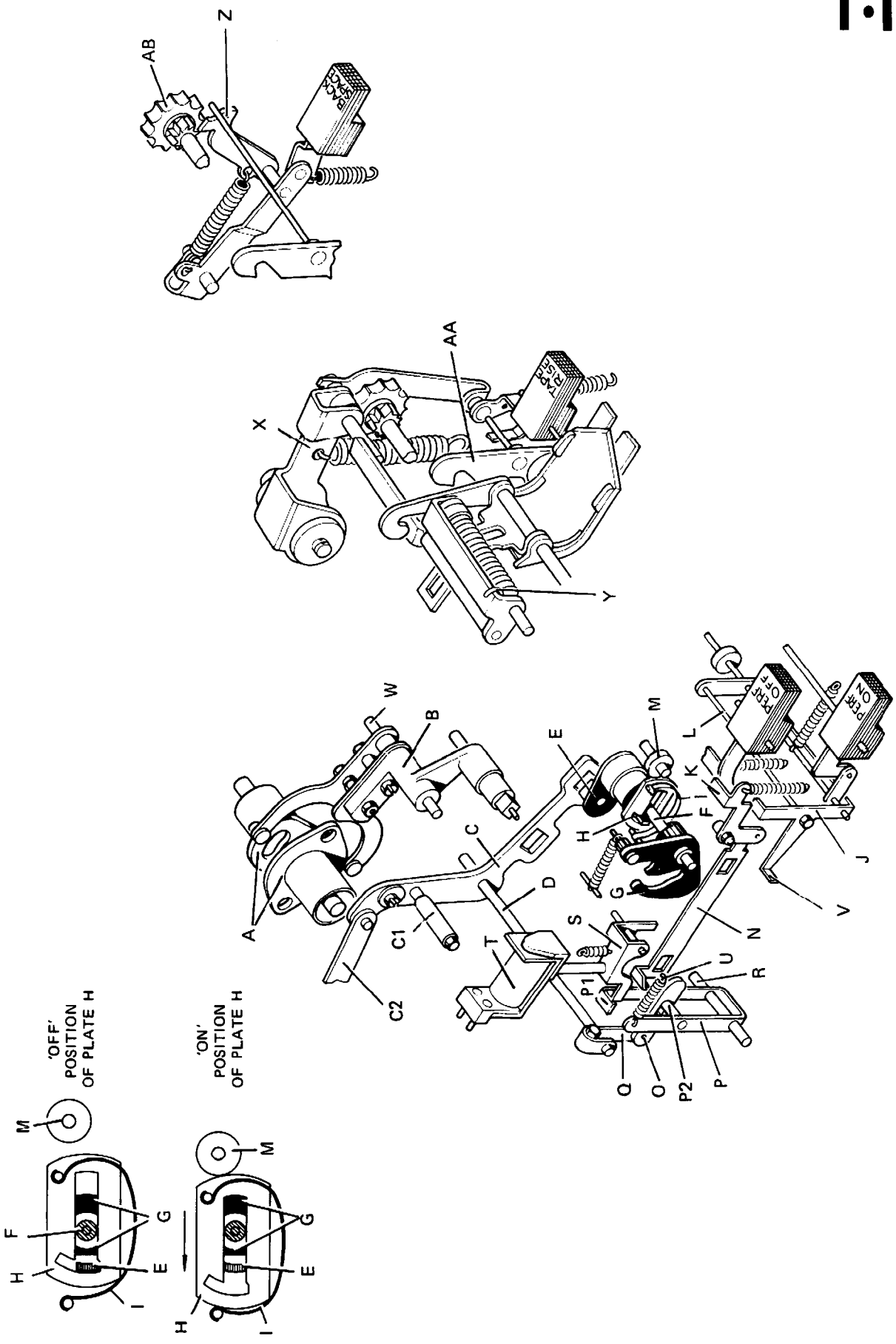


Fig. 1.14 TAPE PUNCH ON/OFF CONTROL, AND DRIVE MECHANISM

1·15

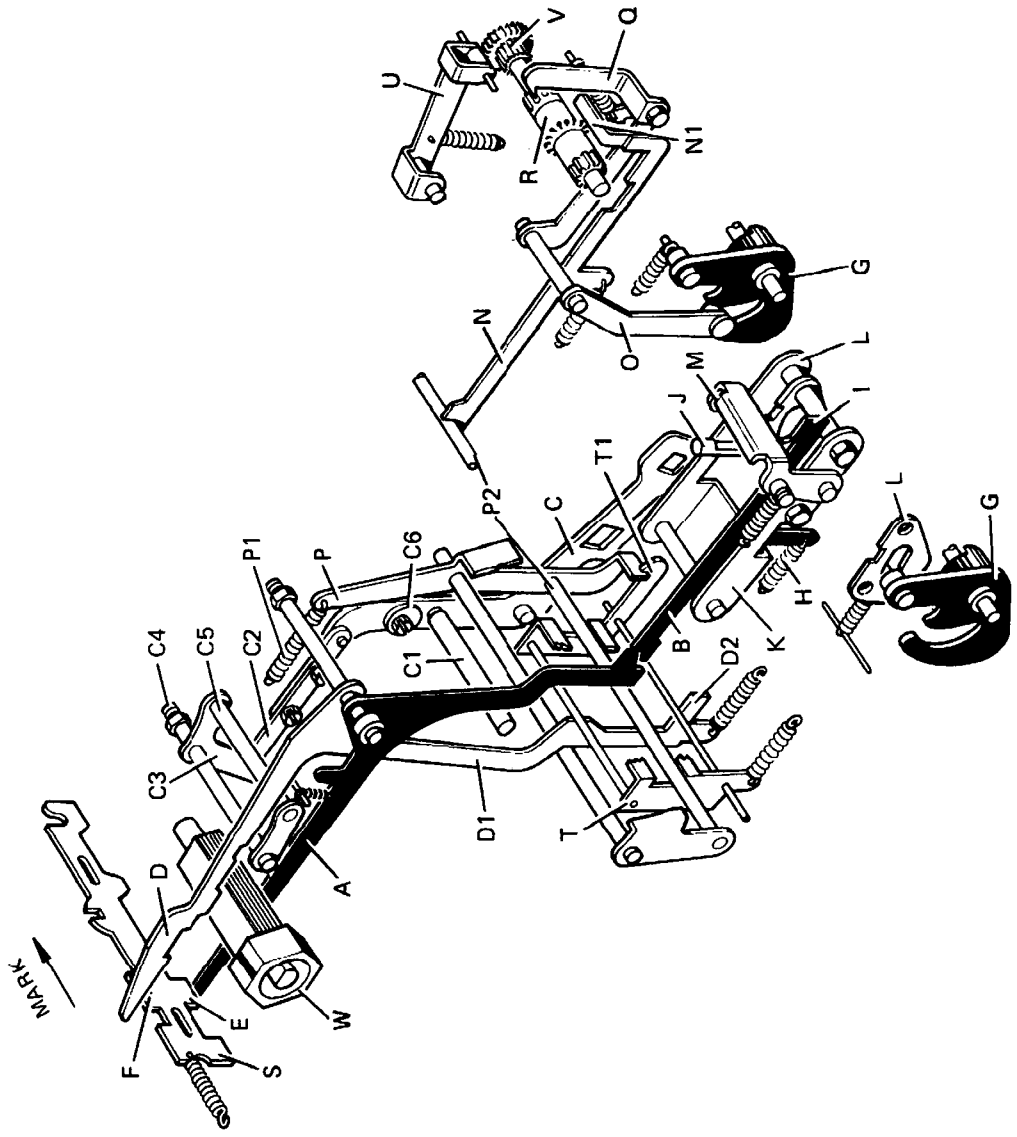


Fig. 1.15 PUNCH CONTROL AND TAPE FEED ACTIONS

1·16

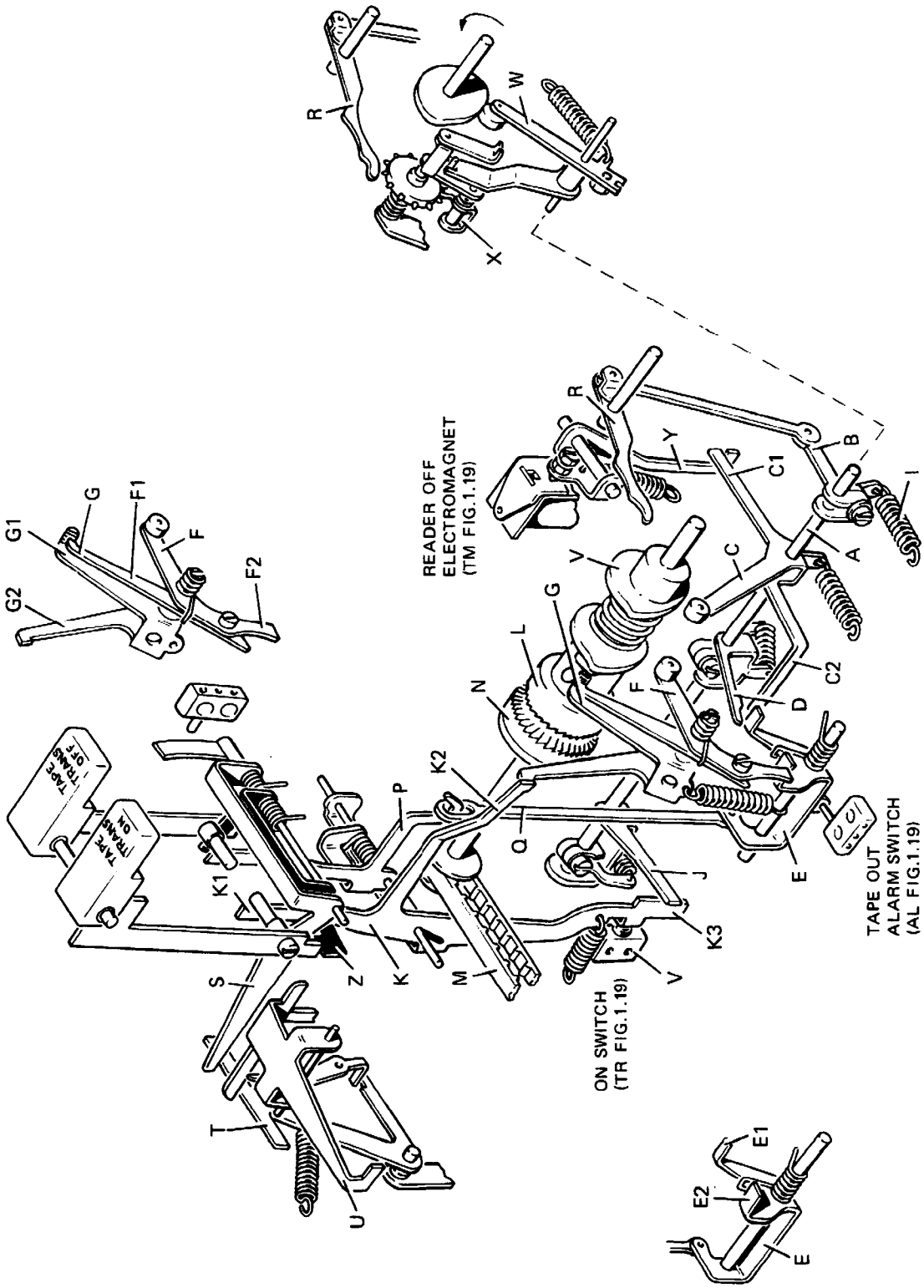


Fig. 1.16 TAPE READER ON/OFF CONTROL AND READ AND FEED ACTIONS

1·17

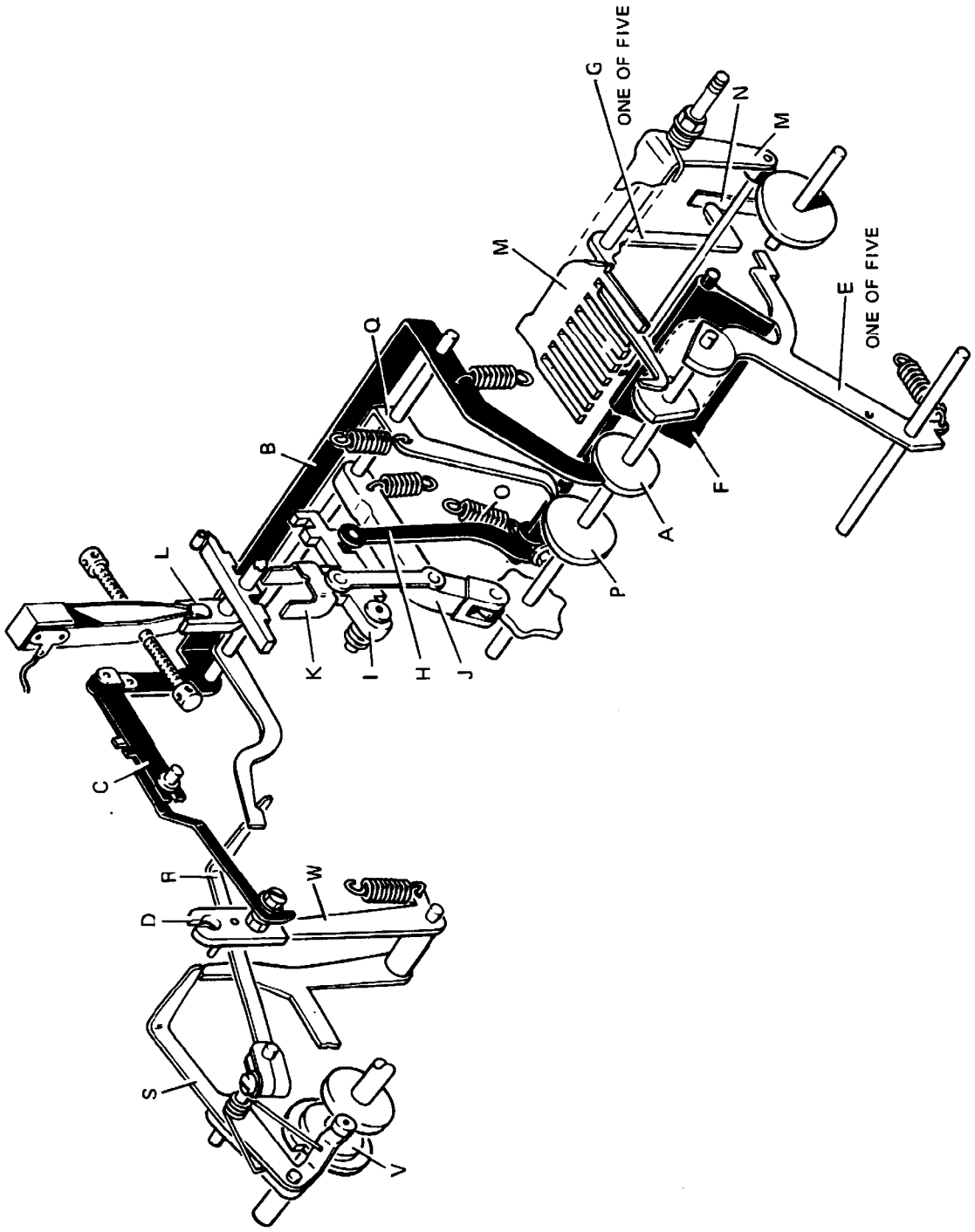
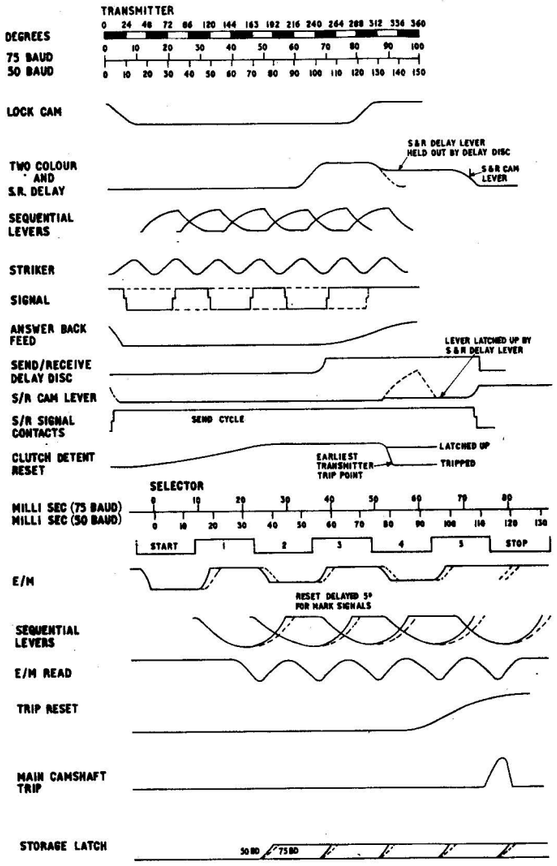


Fig. 1.17 TAPE READER TRANSMITTER AND SEND/RECEIVE SWITCH CONTROL



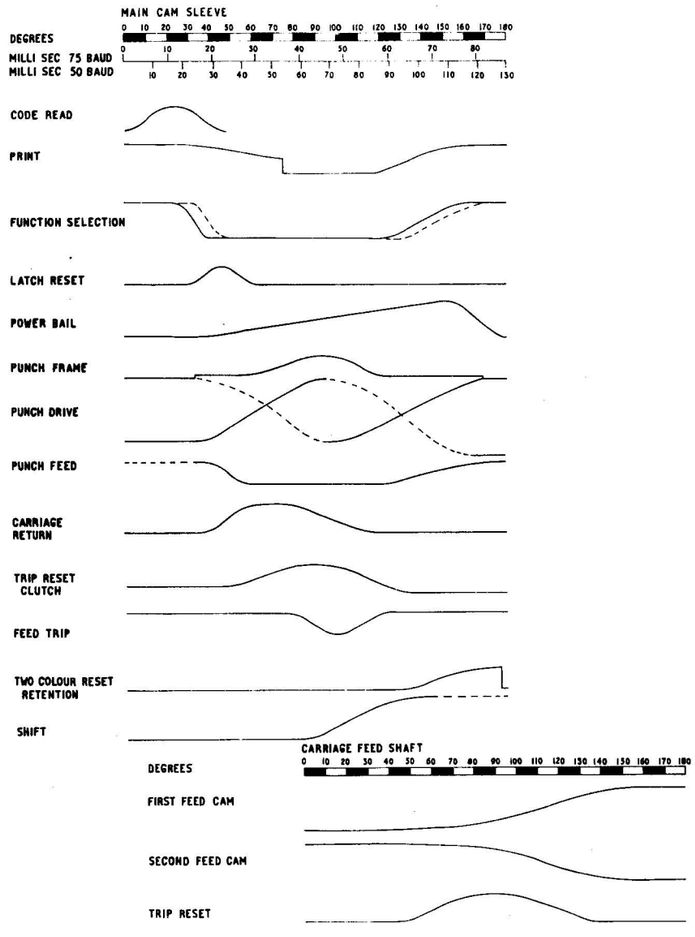


Fig. 1.18 TIMING DIAGRAM

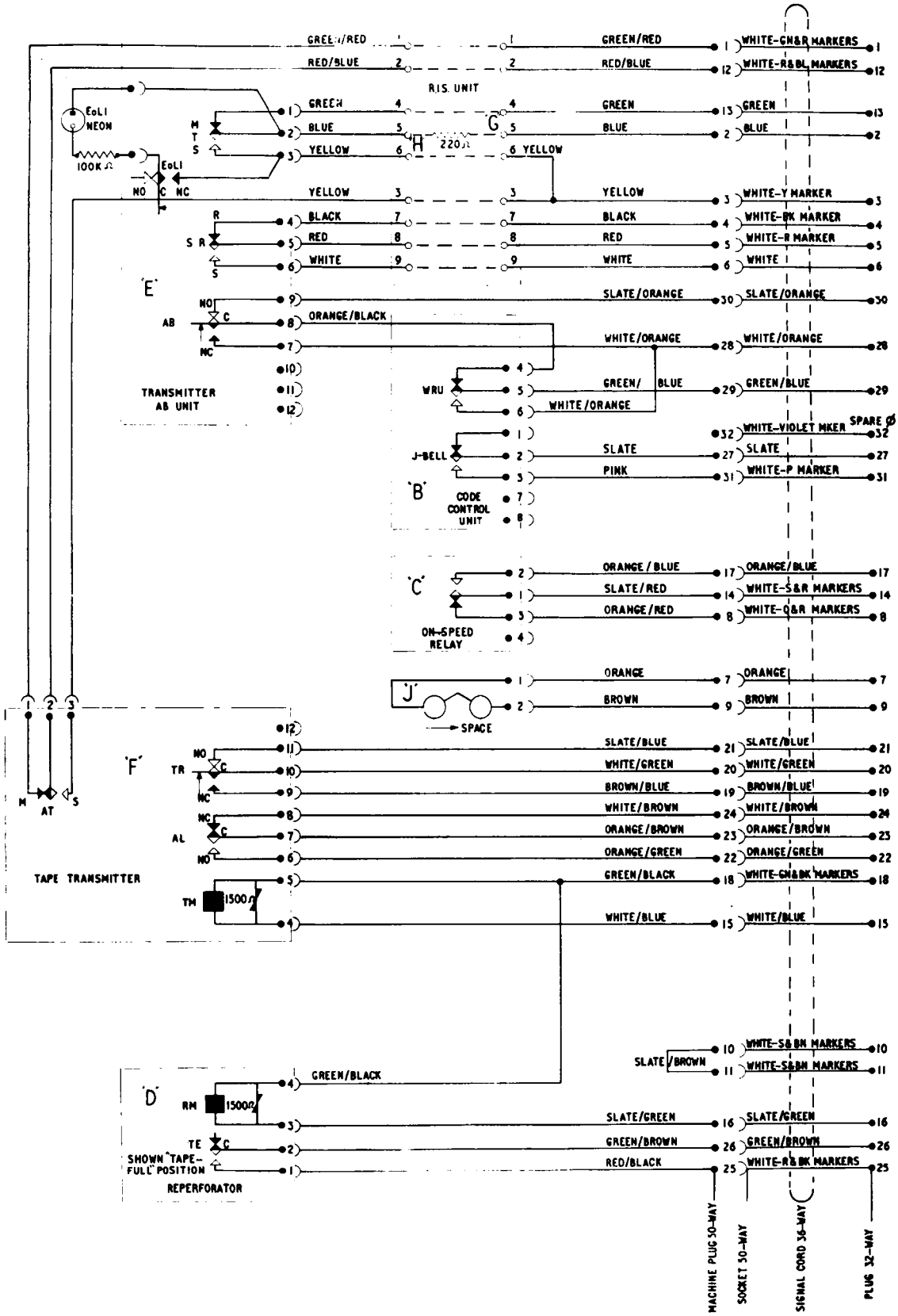
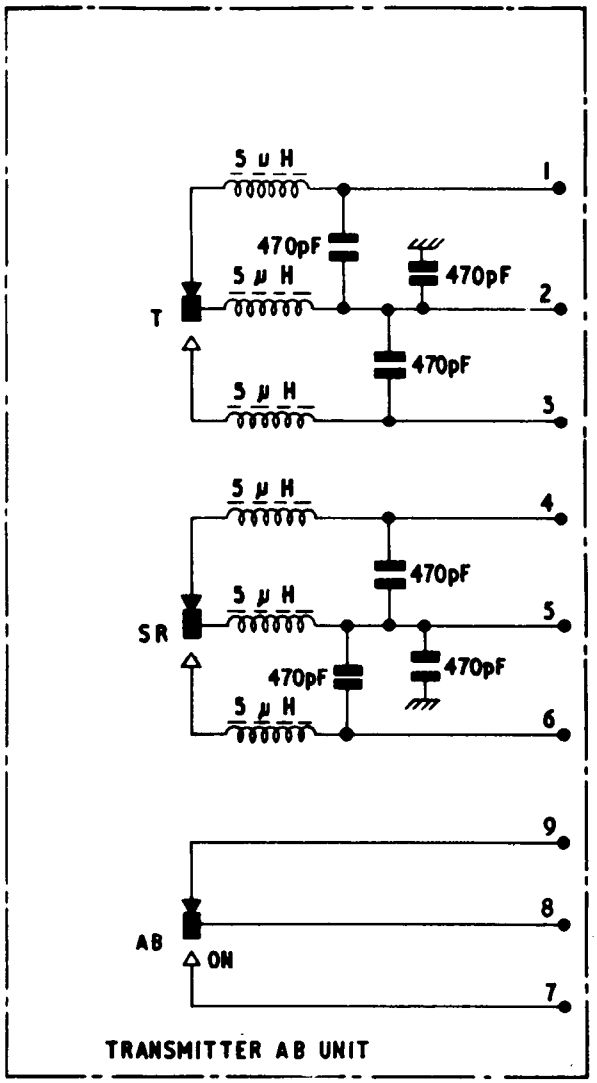


Fig. 1.19 SIGNALS WIRING



Inductors are RF 15's

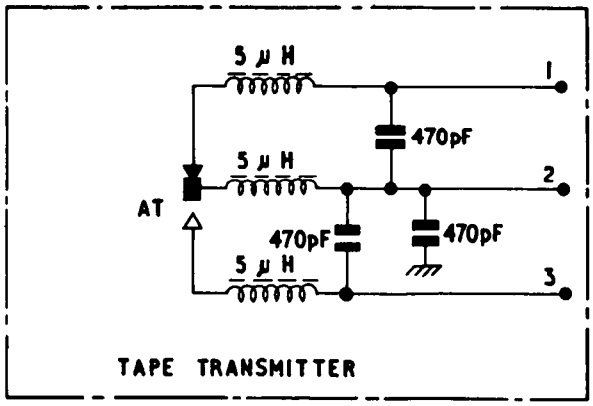


Fig. 1.20 TRANSMITTER CIRCUITRY

1·21

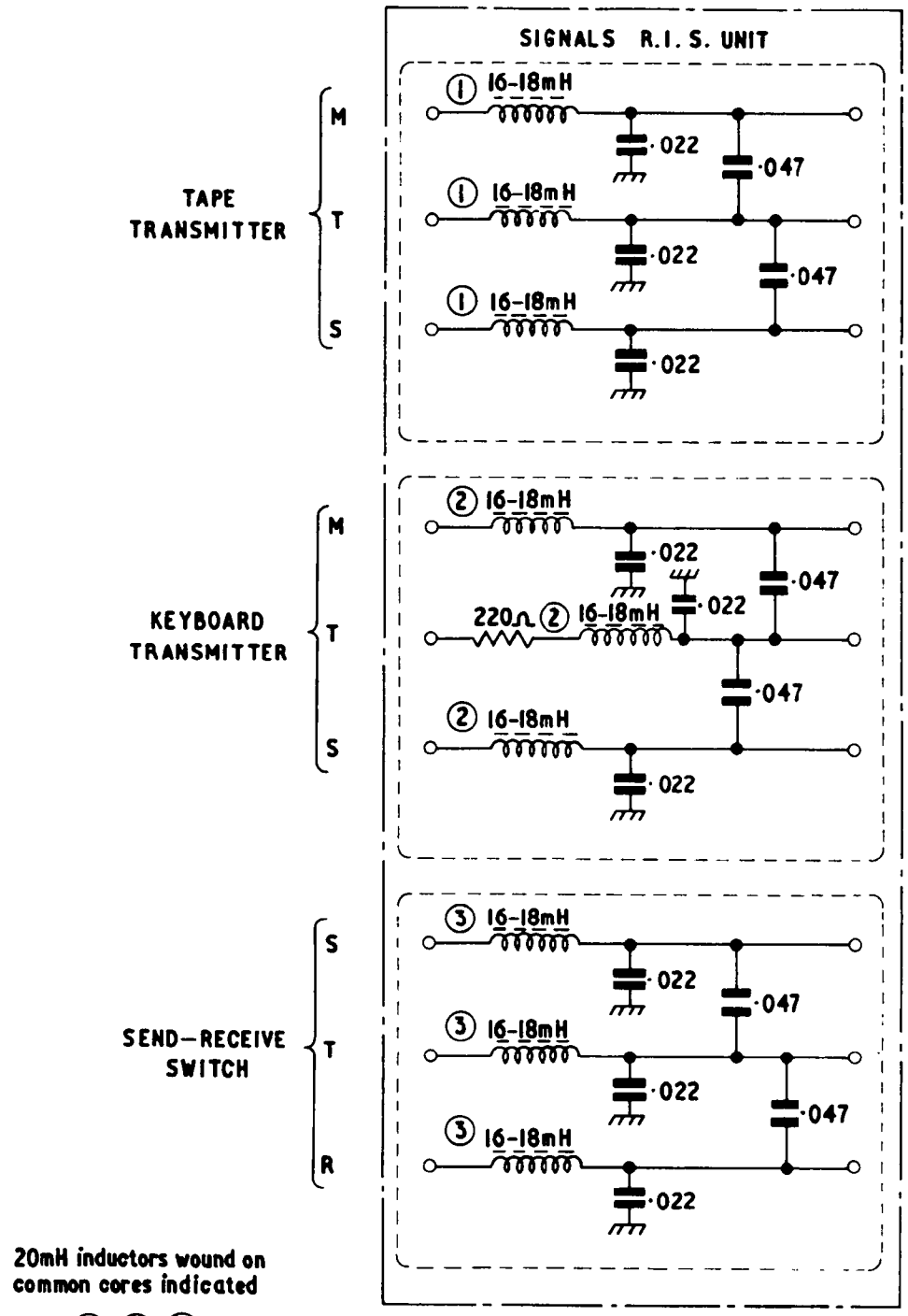
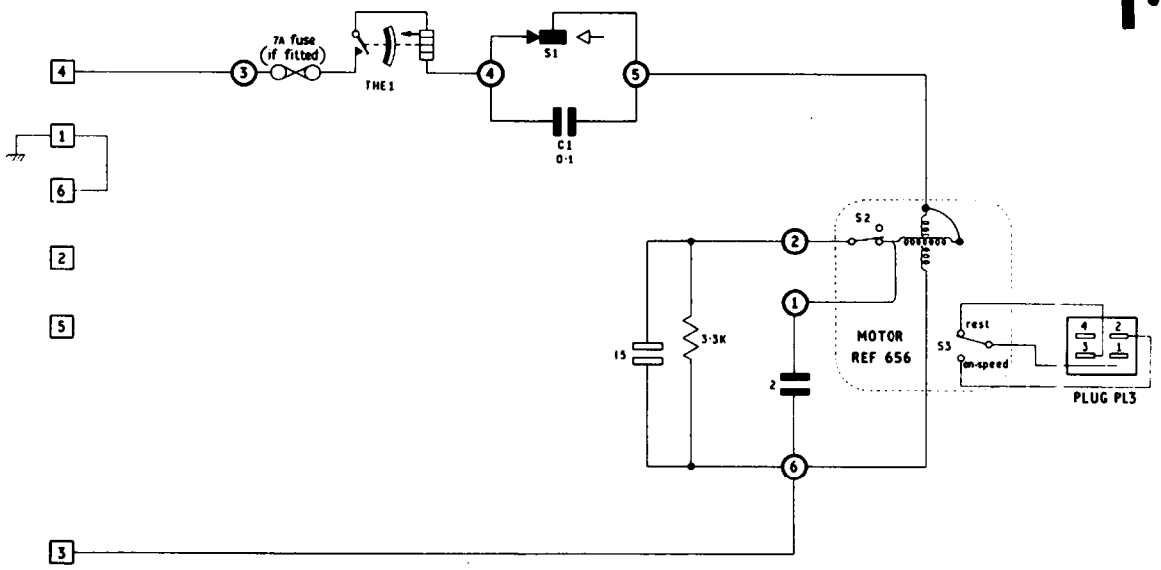
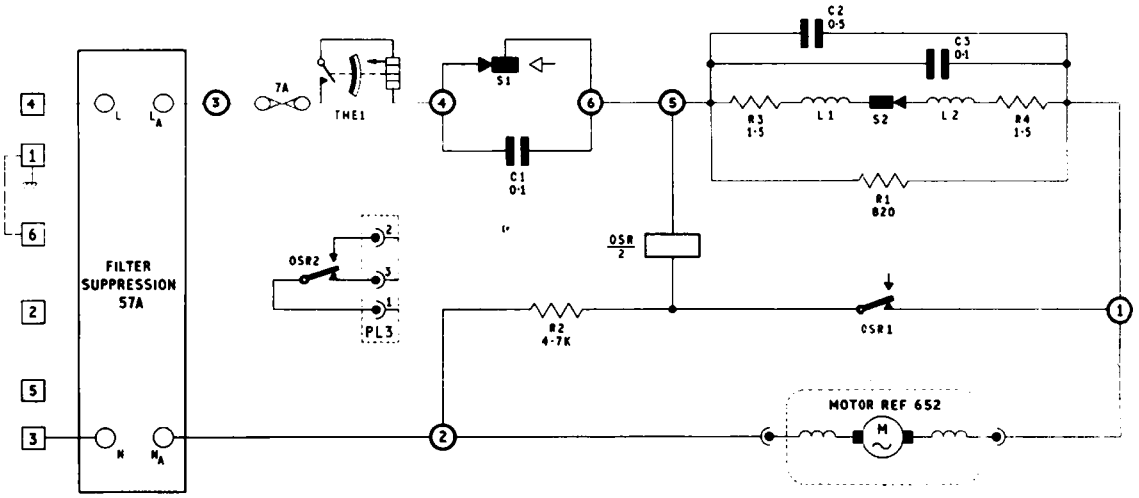


Fig. 1.21 SIGNALS CIRCUITRY



SYNCHRONOUS MOTOR CIRCUIT

□ connections on 6–way motor unit power plug
S1 automatic motor switch
S2 'start' capacitor contacts
THE1 manually-reset motor overload contacts
○ motor unit 6–way tag block
S3 'on speed' contacts
PL3 'on speed' wiring plug



A.C. GOVERNED MOTOR CIRCUIT

□ connections on 6–way motor unit power plug
S1 automatic motor switch
S2 centrifugal governor contacts
○ motor unit 6–way tag block
ORS 'on speed' relay
R1 governing resistor
THE1* manually-reset overload contacts
PL3 'on speed' wiring plug

**for 160V d.c. governed motor, delete THE1 and substitute 850mA 'anti-surge' fuse.*

Fig. 1.22 MOTOR WIRING

1·23
1·24

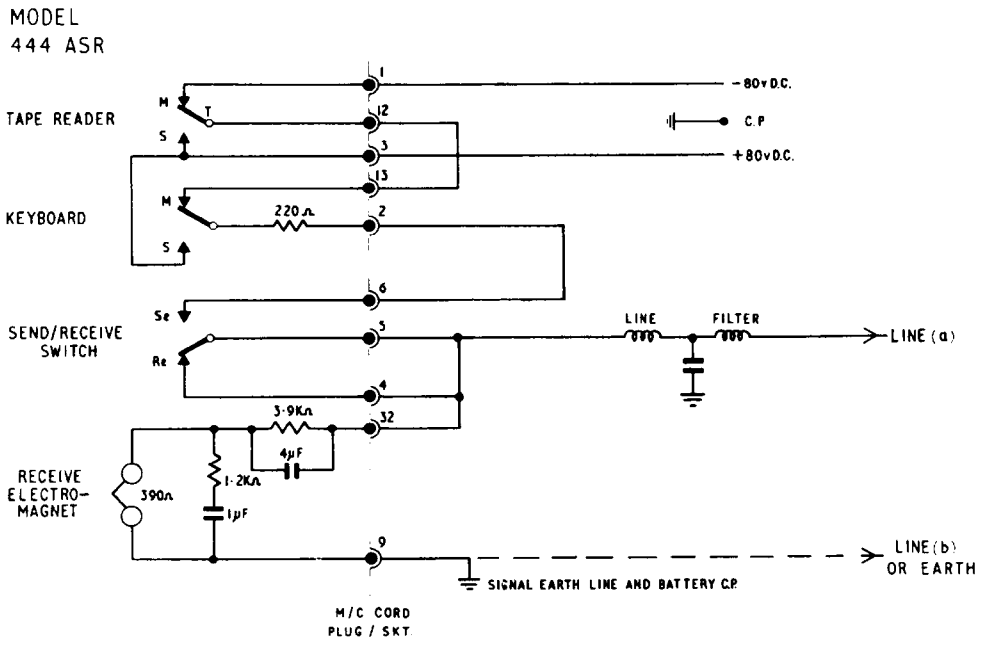


Fig. 1.23 EXTERNAL CIRCUIT, TYPICAL DOUBLE CURRENT – SIMPLEX

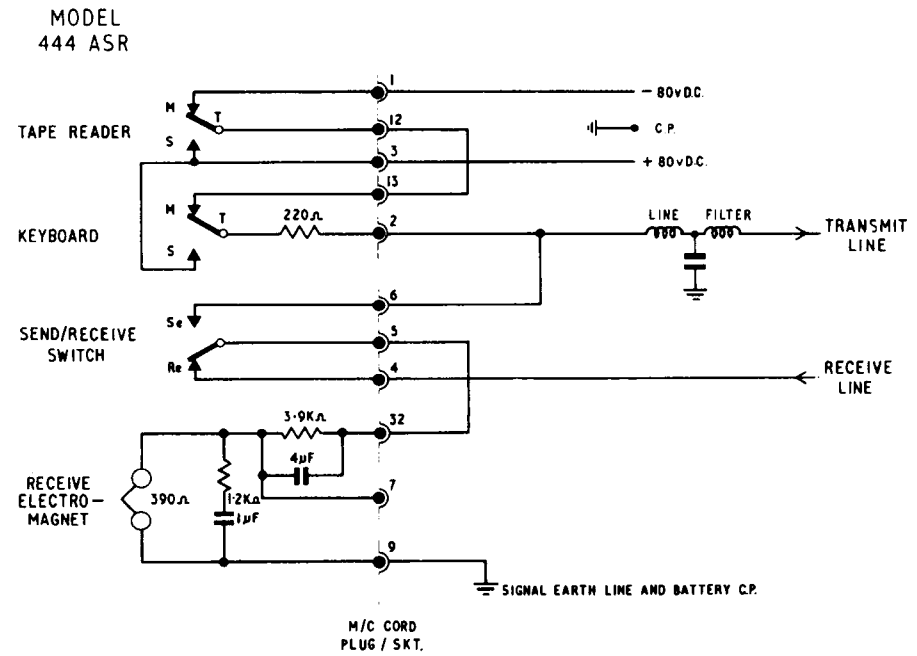


Fig. 1.24 EXTERNAL CIRCUIT, TYPICAL DOUBLE CURRENT – HALF DUPLEX

1·25
1·26

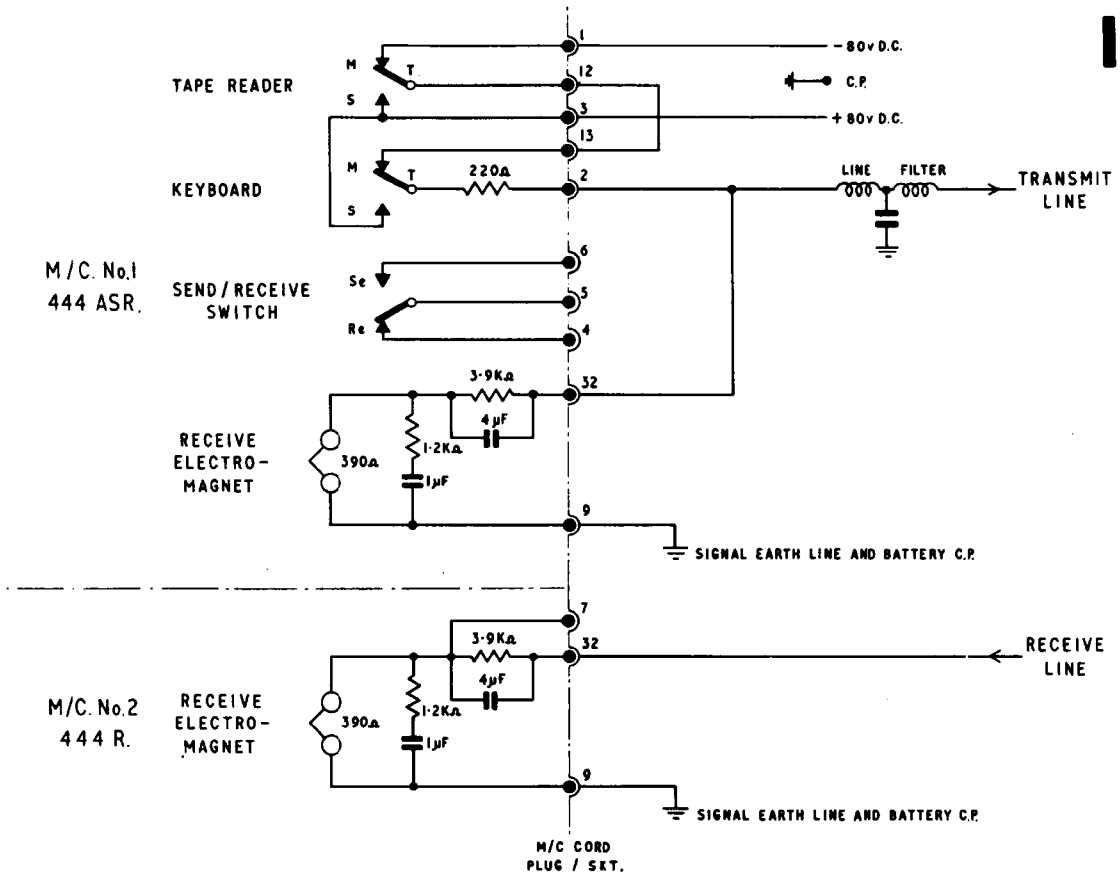


Fig. 1.25 EXTERNAL CIRCUIT, TYPICAL DOUBLE CURRENT – FULL DUPLEX

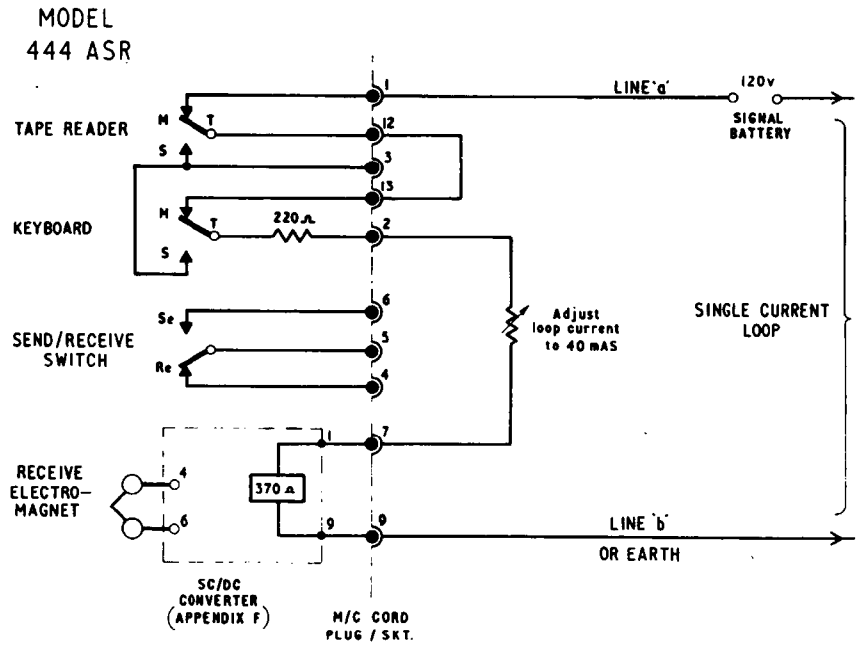


Fig. 1.26 EXTERNAL CIRCUIT, TYPICAL SINGLE CURRENT – LOOP CIRCUIT

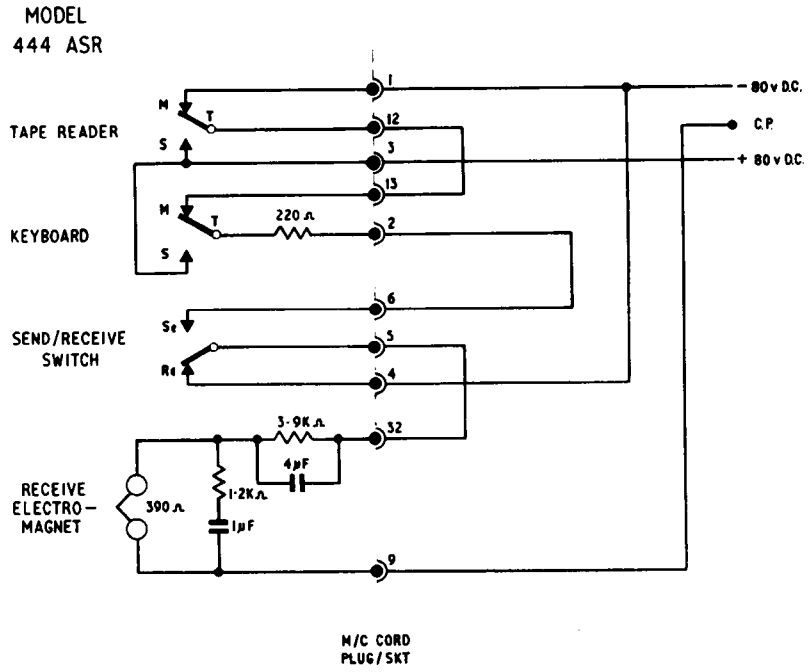


Fig. 1.27 EXTERNAL CIRCUIT, LOCAL OPERATION