P A R T I

CONTENTS

LIST OF ILLUSTRATIONS

PART I

A. DATA SUMMARY

1. GENERAL

SIGNALLING

Speed	Alternative models for 45, 50, or 75 bauds, i.e. 60, 66, or 100 words per minute. Optionally available with dual-speed gear-box permitting manual speed change by operator between 45 and 50 bauds, i.e. 60 and 66 words per minute.
Code characteristics	Start signal, five code signals, and stop signal. Start and code signals are each of unit length appropriate to the baud speed; the stop signal is a nominal 1-1/2 units in length.
Mode	Single- or double-current. Multi-contact transmitter adjustable from one mode of signalling to the other.
Voltages and currents	Single-current: 120V, 50 mA. Double-current: +80V, 0, -80V. Line current 20 mA if 2 000 ohms of current limiting resistance is in parallel with a 2 μF capacitor. Without a capacitor the current should be 25 mA.
Circuits	Single-current – Normal loop circuit but local record obtained mechanically. Send-receive switch is used to short-circuit the transmitter contacts during reception. Electromagnet armature is disconnected from the receiver automatically during transmission. Double-current – Switched or two-wire simplex with mechanical local record. No leak resistor is required. Send-receive switch used to disconnect the transmitter contacts from line during reception.

DIMENSIONS (standard cover)

Receiver-only	16 in. wide x 13½ in. deep x 11 in. high (40.6 x 34.3 x 28 cm).
With 4-row keyboard	16 in. wide x 16½ in. deep x 11 in. high (40.6 x 41.9 x 28 cm).
With Reperforating or Tape Reader Attachments	These units fit on the right-hand side of the machine and either or both will increase the overall width to 18½ in. (47 cm). The plinth accommodating the paper tape increases the height to 12½ in. (31.6 cm).

DIMENSIONS (silencing cover)

Keyboard machine	16 in. wide x 21 in. deep x 13 in. high (40.6 x 53.3 x 33 cm).
With Reperforating or Tape Reader Attachments	Width increased to 21 in. (53.3 cm).

APPROXIMATE WEIGHTS (including cords and paper roll)	
Receiver-only	36½ lb (16.5 Kg).
Transmitter-Receiver	45¼ lb (20.5 Kg).
With Reperforating Attachment and tape drawer	Add 10 lb (4.5 Kg).
With Tape Reader Attachment	Add 2 lb (0.9 Kg).
With Silencing Cover	Add 23 lb (10.4 Kg).

2. RECEIVER

MARGIN	
50 bauds	Greater than ±40%.
75 bauds	Greater than ±35%.

PAPER	
Standard width	8½ in. (21.6 cm).
Margins	With 8½ in. wide paper, margins are adjustable independently between 0.5 and 0.8 in.
Size of roll	Standard teleprinter roll is 3½ in. (8.9 cm) in diameter. Slot provided at rear of machine to permit larger externally-mounted roll to be used.
Feed action	Machine may be fitted with either a friction-feed only platen, or dual-purpose friction/sprocket-feed platen with retractable pins. Machine may be converted from sprocket to friction-feeding and back again by operating a lever.
Sprocket paper	Width - edge to edge - 8½ in. (21.6 cm). Horizontal distance between centres of holes - 8 in. (20.3 cm). Vertical separation of holes - centre to centre - ½ in. (12.7 mm).
Paper exhaust alarm	Alarm contacts can be provided for both standard page roll and sprocket feed paper.

PRINTING	
Characters	Capital letters at 1/10 in. (2.54 mm) pitch.
Line length	69 - 74 characters, adjustable.
End-of-line indicator	May be preset to light a neon lamp visible through the machine front panel (and/or operate an externally connected alarm) anywhere between the 15th and 74th character from the beginning of the line.
Line spacing	Set by the operator to either single-line spacing of 1/6 in. (4.2 mm) or double-line spacing of 1/3 in. (8.5 mm).
Multiple copies	At least 5 carbon copies may be obtained. For greater numbers a stencil can be cut.
Printing pressure	Light or heavy printing pressure by operator setting.

INK RIBBON

Type	Standard typewriter ribbon, ½ in. wide, with a small stud to operate reversing mechanism, and wound on a flanged spool.
Spool dimensions	Diameter of flange 2 in. (52.8 mm). Overall width 5/8 in. (15.8 mm) max. Diameter of central hole 0.156 – 0.160 in.
Life	Approximately 100 hours of operation at 66 wpm.

MOTOR

Types	(a) Series-wound, a.c. governed motors for any single voltage in range 100 – 125V, 200 – 250V. (b) Series-wound, d.c. governed motors for voltages as in (a), plus 160V. (c) Shunt-wound d.c. governed motors for 28V and 48V. (d) Synchronous motors for voltage range as in (a).
Frequency	Type (a). Single-frequency motors for 40, 50 and 60 cycles. Dual-frequency motor for 50/60 cycles. Type (d). Single-frequency motors for 50 and 60 cycles.
Speeds	Governed motors 4 200 rpm. Synchronous motor – 3 000 rpm for 50 cycles, 3 600 rpm for 60 cycles.
Governor	Centrifugal governing action with provision for adjusting the operating point. Speed can be checked visually by viewing stroboscopic bands on governor housing through a 140 dvs tuning fork (Creed Tool TA1117/40, see Fig.6.1, item L).
Speed stability (governed motors)	±0.5% for voltage variations of ±10% about nominal. Effect on speed of temperature variations in the range 40 – 100°F is negligible.
Starting time	With the mains voltage at nominal value, the motor runs up to full speed in less than one second.
Power consumption	Types (a), (b) and (d) – less than 100 watts. Type (c) – less than 50 watts.

AUTOMATIC START AND STOP SWITCH

Facility	Motor starts automatically on first mark-to-space transit of the electromagnet armature. Will start on receipt of a signal of half-element length at any speed up to 100 wpm. Auto-start not generally fitted to parallel input machines.
Start from keyboard	Motor may be started by the depression of any key.
Stop delay	60 – 70 seconds, adjustable.

ELECTROMAGNET

Construction	Two 110 ohm coils in series, with a combined inductance of 4½ H measured at 50 c/s, 40 mA. Centralising springs used to increase sensitivity.

Single-current working	Additional pair of springs used for single-current operation. These are permanently anchored to the selector unit and require only to be hooked into position to change from double- to single-current operation. Simple manual adjustment obtains correct single-current bias.

PARALLEL INPUT

Code solenoids	50% rated code solenoids for parallel operation (5-wire + trip) for 12 volts, 24 volts, 50 volts, and 100 volts can be provided. Resistance of these solenoids is 25.5 ohms, 92.6 ohms, 390 ohms, and 1495 ohms respectively. The 50 volt version requires an additional 680 ohms series resistor, the 100 volt version a 2.2 kilohm series resistor.
Trip magnet	A standard electromagnet modified with special coils of 50 ohms (12V), 200 ohms (24V), 55 ohms (50V), or 220 ohms, (100V).

ORIENTATION DEVICE

Construction	Orientation device provided for measuring tolerance of the receiver to incoming signals in the absence of a Distortion Measuring Set. Also used to centralise the margin of the machine. Adjustment of the device changes the position of the selector cam detent and hence the rest position of the selector camsleeve.
Range	±70% of a signal element length.
Clutches	New type of clutch mechanism fitted to Mark 4 machines ensures a low, almost constant pick-up time and high torque transmission.

TYPEHEAD

Construction	Types mounted on vertical cylinder in four rings, each containing up to sixteen characters.
Movement	The typehead has four degrees of movement – vertical and rotary to bring the selected character opposite the printing point, forwards for printing and horizontal to move to the next character position.
Print action	No typehammer used – the typehead itself strikes the ink ribbon and platen.
Visibility	Typehead moved clear of printing position after each character is printed.

AGGREGATE MOTION MECHANISM

Construction	Vertical and rotary motions of the typehead controlled by cam-driven link-type aggregate motion mechanism.

3. KEYBOARD AND TRANSMITTER

CONSTRUCTION

Keyboard	Motorised keyboard linked mechanically to the translator unit provides a 'mechanical' local record.

Transmitter	Multi-contact construction. May be used for either single- or double-current transmission after readjustment. Transmitter may also be arranged to give a 5-unit parallel output with trip signal.
KEYS	
Layout	3-row or 4-row layouts with full or partial shift-lock facility available.
Dimensions	Stroke – 1/4 in. (6.3 mm). Pressure – 7 oz. (198 grammes) approximately. Pitch of keys in same row – 3/4 in. (19 mm). Vertical pitch of rows – 9/32 in. (7.14 mm).
Key buttons	Green buttons with white lettering are standard. Alternative colours available are Green, Red, Black or Blue for the shell with White, Yellow, Red, or Black lettering.
Function keys	Carriage Return, Line Feed, Bell, Letters, Figures, Run Out, Space, Who-Are-You?, Here Is, Manual Carriage Return.
Timing	Keys released about one-third of the way through the transmitting cycle so permitting the next key to be depressed. This gives the operator a measure of freedom to type irregularly about the cadence speed of the keyboard.
TRANSMITTER	
Construction	Transmitter contact assembly mounted on top of transmitter unit. Contacts actuated by cams on translator cam shaft. Individual contacts provided for the five code elements and for start and stop elements. Assembly can be adjusted for either single-current, double-current, or 5-wire parallel operation.
Electrical connexions	Electrical connexions to the transmitter contacts are made through an 18-way plug and socket which permits the transmitter assembly to be easily removed.
Send-receive switch	Forms part of transmitter contact assembly and is operated by the lag weight and a crawler clutch mechanism mounted on the selector unit. The tongue of the switch moves to the send contact immediately a key is depressed but its return to the receive contact is delayed until towards the end of the next cycle.
LAG WEIGHT	A spring-operated weight forming part of the Translator Unit that is released whenever a key is depressed. The subsequent movement of this weight releases the translator camshaft after a time delay of some 15 ms on 75-baud operation. This delay is required to extend the 6½-unit cycle of the translator camshaft to 7½-units when the translator (i.e. receiving) camshaft is being used for transmitting. Automatically reset at the end of the cycle.

4. OPTIONAL FEATURES

ANSWER-BACK

Facilities	Normally transmits 20 characters (but see below). May be fitted to either a transmitter-receiver or a receiver-only version of the teleprinter. In the latter case, receiver must be fitted with a transmitter contact assembly. On receiver-only machines, unit operates on receipt of a 'Who-are-you?' signal. On transmitter-receiver machines, either on receipt of WRU? signal or on depression of the 'Here is' key.
Number of characters	May be adapted to transmit any number of characters from one to twenty.
Release delay	Automatically inserted between the end of the fifth element of the received 'Who-are-you?' signal and the beginning of the start element of the first answer-back character. Delay is 165 ms minimum for 50 baud operation, 138 ms minimum for 75-baud operation.
Inhibition	Home answer-back unit is automatically inhibited when operator depresses 'Who-are-you?' key. Keyboard inhibited while machine is transmitting from the answer-back unit.
Who-are-you?' contacts	Transmission or receipt of the 'Who-are-you?' signal closes a pair of contacts which may be used to operate an external alarm.

REPERFORATING ATTACHMENT

Facilities	Fitted on right-hand side of the machine. Provides a record of outgoing and/or incoming messages on a 5-track, 11/16 in. (17.5 mm) side paper tape. Fully-punched tape only.
Controls	'Perforator On/Perforator Off' knob, and 'Back Space' button.
Inhibition	Perforating action can be automatically inhibited when certain combinations are registered, e.g. Bell and WRU? functions are not normally punched in tape for communications work.
Tape reel	A standard 1 000-foot reel of tape is housed in a shallow drawer beneath the main base. Access by sliding drawer towards the front of the machine.

TAPE READER ATTACHMENT

Position	Mounted on the right of the machine with the tape feed from the front to rear.
Facilities	Reads fully-punched 5-track paper tape 11/16 in. (17.5 mm) or 7/8 in. (22.2 mm) wide with either centre or advanced feed holes. Local copy provided as tape is transmitted. Unwanted parts of the tape can be skipped.
Controls	Single three-position knob controls the Reader. Position 1 – Reader inoperative. Position 2 – Read and feed tape.

Position 3 - Reader skips one character each time keyboard is operated.

Reader automatically arrested if tape breaks or tightens.

Off-normal contacts

Off-normal contacts may be fitted to provide switching for external circuitry.

TWO-COLOUR PRINTING

Provides means of differentiating between incoming and outgoing traffic. Incoming traffic printed in black or red, as required; outgoing traffic is then in opposite colour. Solenoid operation of the colour change mechanism can be provided.

OPERATION COUNTER

Facility

Provides visual indication of number of characters registered (transmitted or received) by teleprinter in units of 10 000 characters. A unit is thus equivalent to 25 minutes of continuous operation at 50 bauds.

Use

The counter is used to determine when the machine is due for overhaul or other maintenance attention.

AUTOMATIC CR/LR FEATURE

Carriage may be arranged to return automatically to the beginning of the line and to line feed when it has reached a predetermined point on the line without receiving the signals for these functions. Operating is adjustable from 69 - 74 characters from the beginning of the line.

COMBINED CR/LR FEATURE

Normal carriage return function bar may be replaced by one which combines the functions of the carriage return and line feed bars. In these circumstances the normal line feed bar is removed so that line feed signals are ignored.

Use

Used to prevent overprinting on circuits where there is a danger of spurious carriage return signals. Does not interfere with normal operating procedure.

SPECIAL VERSIONS FOR COMMUNICATIONS USE

Signal regenerator

As incoming signals to the teleprinter electromagnet are automatically re-transmitted in sequential form, the machine may be adapted to provide regenerative repeatering of signals on long omnibus circuits.

Combined parallel/sequential output

While retaining normal sequential transmission and reception, an additional parallel output may also be obtained. This can be used to feed a relay tree and thereby control either internal or external special facilities. Typical examples of these would be - motor stop, change of printing colour, function inhibition, external switching functions, and the operation of selective-calling equipment.

SPECIAL FACILITIES FOR DATA TRANSMISSION

Examples

Among the special facilities which can be provided are:- Sequential to parallel and parallel to sequential signals conversion. Print, character feed, line feed and perforator inhibition. 11½ character per second print-out from a parallel input. Combined sequential/parallel output or input.

FORM FEED

This device automatically feeds printed sprocket-feed stationary to a pre-determined point on each form. It is operated either from incoming signals or from depression of a key button. Contacts provided for control of external equipment while the forms are being fed. Form length is at present 51 line-feeds long.

B. OUTLINE OF OPERATION

RECEPTION

Signals from the distant teleprinter are received on a polarised electromagnet whose armature moves between the marking and spacing stops in response to the reversals of line current (double-current working), or the current and no-current elements (single-current working), which compose the incoming code combination.

The start signal releases the selector unit camshaft which then makes one revolution during which it converts the movements of the electromagnet armature into a static setting on five two-state selecting pins in the translator unit. Towards the end of this revolution the selector unit releases the translator shaft and is brought to rest immediately afterwards by the stop signal.

While the next character is being processed by the selector unit and transferred on to a second group of five pins, the translator unit, acting through the aggregate motion mechanism, positions the typehead in accordance with the code established on the first group of pins. The typehead them impresses the selected character on the paper and afterwards comes to rest until released at the end of the next selection cycle.

TRANSMISSION

Operation of the keyboard sets up the code combination of the selected key on five combination bars and simultaneously depresses a trip bar common to all keys. Each combination bar is mechanically linked to one of the five code selecting pins in the translator unit; the trip bar is linked to the translator clutch release mechanism. The single act of depressing a key will thus create the appropriate code combination, convey this code to the translator unit, and then release the translator unit clutch.

The transmitter unit is located above the translator unit and consists of two banks of contacts which are mechanically independent but electrically interconnected as shown in Fig. 1.7. One bank is made up of five changeover contact sets which reflect the code setting on the selecting pins, and which operate simultaneously. The other bank consists of seven make contact sets which operate sequentially; five of these are linked to their associated changeover code contacts, and the remaining two contacts produce the start and stop signals.

Once the code for the depressed key has been established on the selecting pins and the translator clutch has been released, the changeover contact bank takes up the code setting. The seven sequential contacts, which are driven by cams on the translator shaft, then scan this setting at the appropriate intervals and so transmit the required sequence of start signal, five variable code elements, and the stop signal to line.

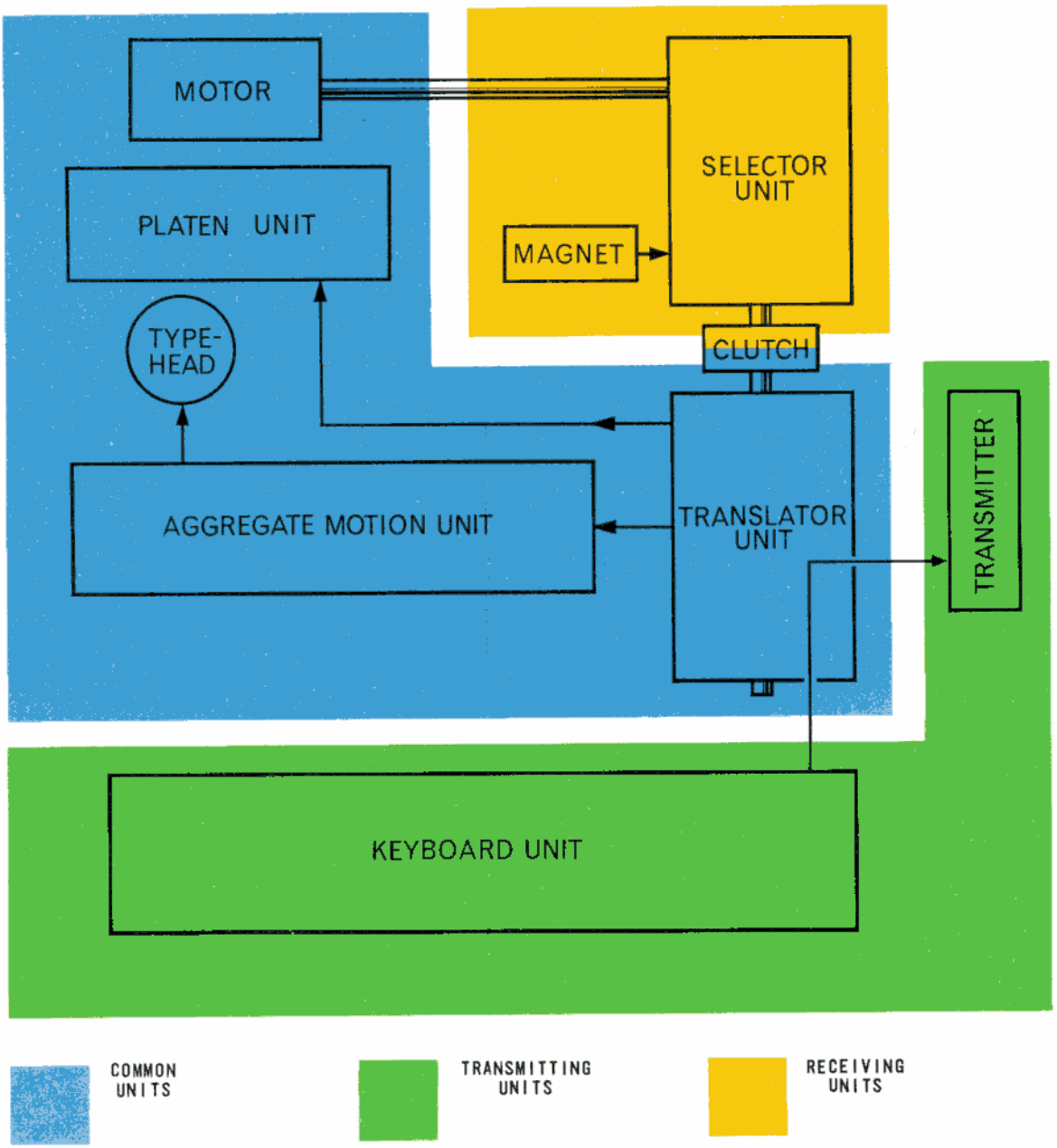


Fig. 1.1 MODEL SEVENTY-FIVE — BLOCK SCHEMATIC

C. TECHNICAL DESCRIPTION

1. INTRODUCTION

Since the Creed Model Seventy-five Teleprinter was introduced in 1958 more than ten thousand machines have been produced. Both the standard telecommunications version and its data processing variations are in service in more than 50 countries and because of this wide distribution the general operating principles are by now fairly well known. This section of the manual therefore deals only briefly with the operating principles of the machine although some of the more novel features such as the aggregate motion translation mechanism are described in more detail.

Technical courses for maintenance engineers covering all aspects of the operation and maintenance of the Model Seventy-five machine are available at the Company's Training School in Sussex, England. Applications to attend these courses should be addressed to the Training Manager.

2. CONSTRUCTION

The machine is of unit construction and consists of 16 units listed below and identified in Fig. 1.5, except for the Aggregate Motion Unit which is shown at B, Fig. 7.2.

1. Main Base Unit
2. Motor Unit
3. Electromagnet
4. Selector Unit (includes most of the operating mechanism of the Automatic Motor Switch, although the actual motor switch is located underneath the main base).
5. Translator Unit
6. Typehead Unit
7. Aggregate Motion Unit (links Translator Unit to Typehead Unit)
8. Ribbon Unit (carried on typehead carriage casting)
9. Platen Unit (carries paper roll and paper transport mechanism)
10. Transmitter
11. Keyboard
12. Selector Frames Unit (links Keyboard to Translator Unit and Transmitter)
13. End-of-Line Indicator and Carriage Return Spring Drum
14. Reperforating Attachment (with machines fitted with a Reperforating Attachment, a dummy plinth which stores the reel of paper tape is located underneath the main base).
15. Answer-Back Unit
16. Operation Counter

Drive

The receiver has two camshafts - a selector shaft, and a translator shaft. Both are linked through friction clutches to the main drive shaft which is driven continuously by the electric motor. Power for the keyboard is derived from the translator camshaft which also operates the multi-contact transmitter unit.

3. UNIT FUNCTIONS

Electromagnet

This is a miniature polarised electromagnet of conventional design with a side-stable vertically-pivoted armature which executes a series of movements between its marking and

spacing stops for each incoming character. A pair of centralising springs is linked to the armature for double-current operation to reduce the side-stable forces and increase the magnets, sensitivity. For single-current operation a second pair of springs is connected to the armature and tensioned so as to bias the armature against the spacing stop during 'no current' elements of incoming signals. The frame on which the single-current springs are carried can be moved manually to vary the degree of mechanical bias on the armature.

The first mark-to-space transit of the armature has two simultaneous effects: it trips the motor switch so starting the motor, and it releases the selector unit clutch allowing the selector camshaft to make a single revolution.

Selector Unit

The main function of the selector unit is to convert the incoming signal combination into a static setting on one or other of two sets of five pins (item X, inset, Fig.7.16) located in the translator unit. The selector unit consists primarily of a striking mechanism for these pins, together with a means of traversing this striking mechanism along the line of pins. Both mechanisms are driven by cams on the selector camshaft. An interposer controlled by the receiving electromagnet can block the striking action and so prevent a particular pin from being set.

If the first code element is a mark the interposer (a hook mounted on block CU, Fig.7.20) permits the striker to push the first pin inwards where it is retained by a spring. If the signal is a space, however, the interposer will block the forward movement of the striker and so prevent the pin from being set. While the striker is moving across to take up position in front of the next pin, the next code element is being received and the decision as to whether it is a mark or space is taken. After the fifth code element has been registered, a trip linkage operated from the selector shaft retention lever releases the translator camshaft.

Other mechanisms carried on the selector unit include

(a) the greater part of the automatic motor switch operating mechanism,

(b) a device used on single-current working for automatically disengaging the electromagnet from the selector, and

(c) an orientation device by means of which the selection instant can be varied by ±70% of a code element length.

For dual-speed machines the selector unit can also incorporate a manually-operated two-speed gear-box.

A time delay device comprising crawler clutch BA, Fig.7.19, is linked to the translator unit lag weight mechanism by shaft AT. These parts, whose operation is outlined below in the section headed 'Translator Unit', act to hold the send-receive switch tongue in the send position if the keyboard operator is transmitting at a speed approaching that of cadence speed, and also to delay the return of the switch tongue to receive by at least 20 milliseconds after the last character has been transmitted.

Translator Unit

The main function of the translator unit is to examine the code setting created at the pin-box by the traversing pecker controlled from the selector unit, and then to convey the result of this examination to the aggregate motion unit which decides on the basis of this information which of the types in the typehead will be impressed on the paper.

Simultaneously with the examination of the pin-box setting on behalf of the aggregate motion unit, another examination of the pin-box is taking place to establish whether the particular code setting corresponds to any of the non-printing functions such as 'carriage return'. If this second inspection shows the code to be a functional one the printing and feeding actions are automatically inhibited, and the appropriate function is carried out. The typehead is of course positioned for every incoming character, but in the case of non-printing functions a blank type is brought round to face the paper.

The following mechanisms also form part of the translator unit

(a) linkages to operate the non-printing functions such as 'carriage return', and also prevent the typehead feeding or printing on receipt of the 'all space' combination,

(b) the transmitter contact bank, including the send-receive switch,

(c) the case shift control mechanism,

(d) the lag weight mechanism, and

(e) the cam which provides the power to reset the keyboard combination bars and to drive the operation counter.

The translator unit also provides power and controls for the reperforating attachment and the tape reader attachment, if fitted.

The lag weight mechanism referred to in paragraph (d) above is rendered necessary because the same 130 ms revolution time camshaft is employed to drive both the transmitting and the receiving sections of the machine. With a conventional teleprinter there are separate drive shafts for transmission and for reception, the receiving shaft being driven faster (130 ms cycle time) than the transmitter (150 ms cycle time) to maintain synchronism with the distant station. If this synchronism is to be maintained in a similar manner with the Model Seventy-five Teleprinter, the stop signal, which would otherwise be only 10 ms long, must be lengthened by a device which operates independently of the translator shaft. This is done by introducing a time delay of some 20 ms between the depression of any key on the keyboard, and the subsequent release of the translator clutch.

When a key is depressed the pivoted lag weight assembly (DJ and DH, Fig.7.17) is released and turns clockwise under the action of its spring. After a pre-determined time delay (20 ms at 50 bauds) which depends upon the inertia of the weight and the tension of the spring, the lag weight assembly reaches the limit of its clockwise motion and there releases the translator shaft clutch. The lag weight is then slowly returned to its original position by a cam on the translator shaft, taking 130 ms to do so. If another key depression occurs before 130 ms have elapsed, the returning lag weight will find its retaining latch already withdrawn by the depression of this key. The weight will now be controlled solely by the contour of its slow reset cam which, have returned the weight to its original position, drops sharply away so allowing the lag weight to rotate and after the 20 ms delay, release the translator shaft again. It can now be seen that however quickly the operator depresses a particular sequence of keys a 20 ms delay will be added to the natural 130 ms cycle time of the transmission mechanism by the inertia of the lag weight mechanism.

Now that the cycle time of the translator shaft has in effect been extended, all that is now necessary to do is to ensure that the send-receive switch remains set to send for the full 150 ms period required for 7½ unit, 50 baud transmission. Since the send-receive switch itself is controlled by an arm forming part of the lag weight assembly, if other arrangements were not made the tongue of the switch would return to receive at the same time as the lag weight was reset and so mutilate the stop signal by clipping it short.

The crawler clutch referred to in the last paragraph of the Selector Unit section above enables the send-receive switch to be moved from receive to send by the lag weight within 20 ms of the operation of the keyboard, but in the reverse send-to-receive direction the crawler clutch, which is driven direct from the motor, will maintain the tongue in the send position until at least 20 ms after the translator shaft has come to rest. This delay will thus extend the stop signal already established some 10 ms before the shaft came to rest until, under the normal keyboard operating conditions, the next key is depressed. If no further keys are operated the send-receive switch tongue will slowly move back to receive after the translator shaft has come to rest and take some 80 ms to do so.

Aggregate Motion Mechanism

This mechanism is located on the main base between the translator unit and the spring drum unit. It consists of two similar but independent arrangements of links and rods which

act together so as to control the lift and rotation of the typehead and so bring the selected type round to face the paper. Both mechanisms are illustrated in simplified form on Fig. 1.6.

The **vertical movement** of the typehead is under the dual control of a pre-set case shift mechanism, and of linkages associated with element No.2 of the code combination created on the translator unit pin-box by the incoming signals. These two elements acting together cause the typehead to be positioned so that one of its four layers of types is brought up to the printing point.

The components concerned include rack A, idler gear B, gear C fixed to splined shaft D, gear E and rack F, links G, H, J and KT, and rods L and M. The two rods L and M are controlled by individual operating levers of which lever N is typical. Levers N are in turn operated by cams carried on the translator shaft P. Spring O, acting through links H and J, urges rods L and M to the right so holding levers N on their cams.

In the rest position of shaft P the operating levers N are at their maximum lift, and rods L and M are consequently at the limit of their movement to the left. The position which floating pivot Q now takes up corresponds to the top layer of types on the typehead being in line with the printing point. When shaft P is released at the end of the selection cycle, the levers N attempt to turn under the action of spring O. Whether they are in fact able to do so depends on the position of case shift latch R and of the selecting pin associated with element 2 of the incoming code combination (this pin is not illustrated here, but shown at X and Y on Fig. 7.16). If latch R is in the 'figures' position (as illustrated) and selecting pin No.2 is at space, both levers N will rotate and rods L and M will both move to the right. If latch R is in the 'letters' position (i.e. blocking the path of lever N), and pin No.2 is at space, only rod M will move and link KT will turn counter-clockwise around what has now become a fixed pivot at the end of rod L. The reverse of this action takes place if rod M is blocked and rod L is free to move.

The purpose of linkages KT, J, H and G is to combine the movements of rods L and M into a single movement of rack A. Since pivot Q is sited on link KT so that length K:T:: 2:1 and since the range of movement of shift rod L and code No.2 rod M is the same, there will be four possible positions of pivot Q disposed equally as shown in Fig. 1.2.

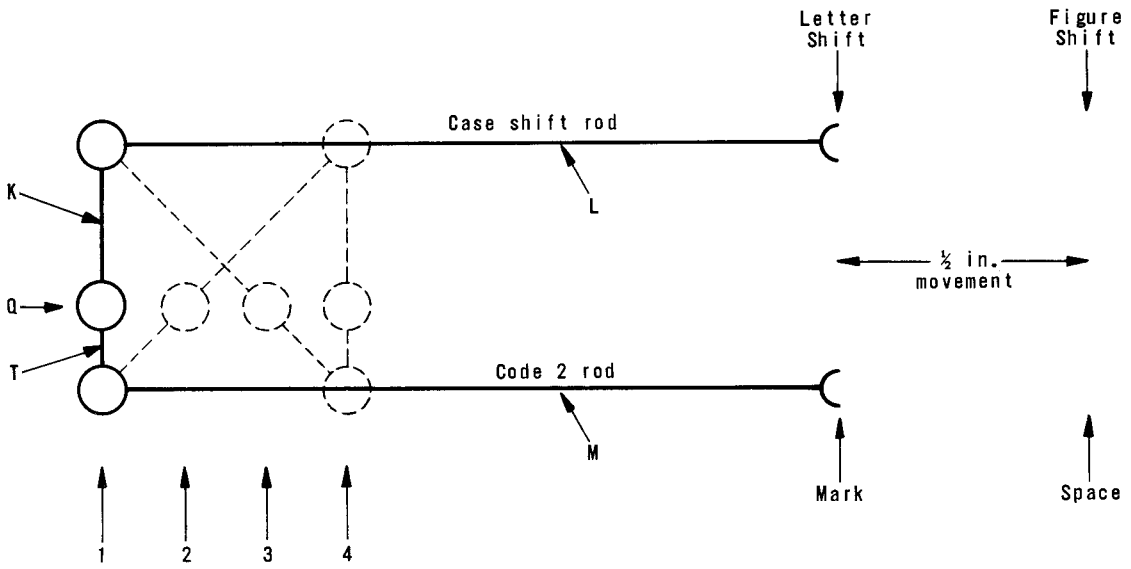


Fig. 1.2 AGGREGATE MOTION—LIFT LINKAGES

The positions of pivot Q correspond to four degrees of lift at rack F and it is this motion which is used to bring the required layer of types up to the printing level. The effects of the various movements of the shift rod L and code 2 rod M are summarised in Fig. 1.3 below.

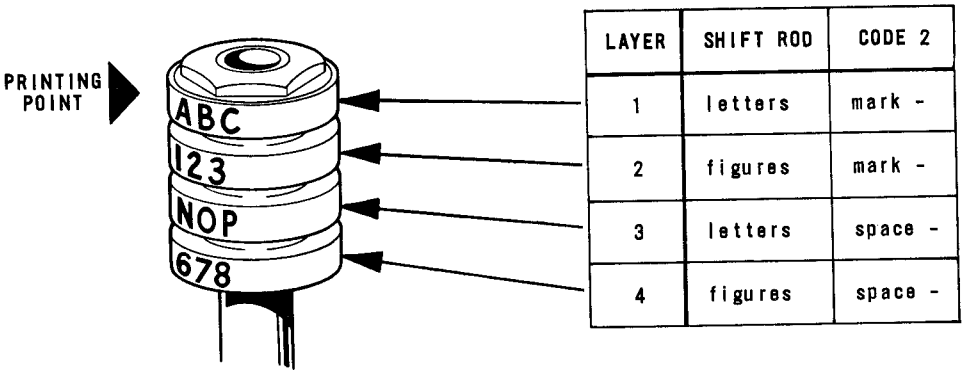


Fig. 1.3 TYPEHEAD — LAYER SELECTION

The rotating movement of the typehead is controlled by another arrangement of links similar to the one used for the selection of the type layers. It consists of four operating levers U with their associated cams on shaft P, the four selecting pins for code elements 1, 3, 4 and 5 (element 2 was used to control lift), links V, W, X and Y, links AA, AB, and AC connected via AD to AE, rack AF and splined shaft AG linked by bevel gears to the vertical splined shaft AH which controls the rotation of the typehead. The bevel gear associated with splined shaft AG, and spur gear E associated with splined shaft D are of course free to slide along their respective shafts as the typehead traverses the printing line.

The cams on shaft P that control the rods associated with code elements 1, 3 and 4 each produce a half-inch left-to-right movement when a space setting is read off the selecting pins. The cam associated with rod Y differs from the others in that it gives only a quarter-inch movement when a space is registered on pin 5.

Since each of these four rods associated with typehead rotation can have marking (i.e. blocked) or spacing (i.e. free to move) actions there are sixteen possible positions all of which combine at lever AE. Rack AF and splined shafts AG and AH convey the setting on lever AE, converting it in so doing into clockwise or counter-clockwise rotation of the typehead so bringing one of the sixteen types on a particular layer round to the printing point.

The direction and degree of movement that each of these rods can impart to the typehead is set out in Table 1 below. In this table, and in the explanation that follows, a clockwise rotation is considered as being positive, and a counter-clockwise rotation is considered negative.

Table I

Code	Movement on space	Typehead rotation	Degree of movement
1	½ in.	CW	+4 characters
3	½ in.	CCW	-8
4	½ in.	CW	+2
5	¼ in.	CW	+1

CW = clockwise CCW = counter-clockwise

Reference to Fig. 1.6 will show that it is only on spacing elements of the code that the control rods V, M, W, X and Y can move to the right. Consider, for example, the combination for letter 'B' which is mark, space, space, mark, mark. Element No. 2 can be disregarded in this context as it is associated with the lift operation, and so also can

elements 1, 4 and 5 as they are marks and consequently do not permit their associated control rods to move. The only effective element from the rotational point of view is therefore the space on No. 3. Table 1 above shows that a half-inch movement on this rod will produce a counter-clockwise rotation equivalent to eight radial positions on the typehead.

Fig. 1.4 below shows that the position in which the letter 'B' is located is 180 degrees from the printing point. The 'minus 8' movement brought about by the half-inch left-to-right movement of rod M has now therefore brought letter 'B' round to face the paper.

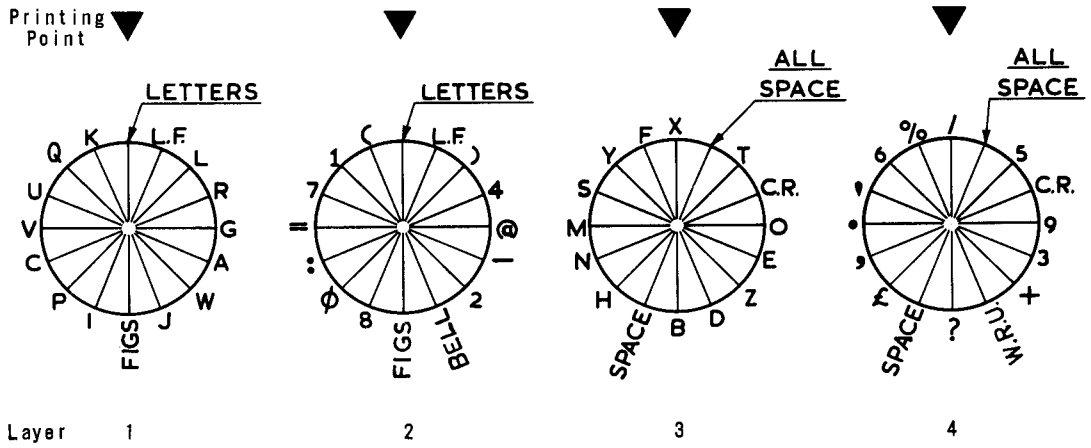


Fig. 1.4 TYPEHEAD — LAYER ARRANGEMENT (C.C.I.T.T. NO.2)

When more than one spacing element occurs among elements 1, 3, 4 and 5 of a particular code combination, the subsequent movement of the typehead can be determined by taking the algebraic sum of the individual effects of the 'spacing' control rods concerned.

As an example consider the code for letter 'Z' which is mark, space, space, space, mark. Disregard element 2 and all the marks. Element 3 and element 4 are spaces and cause -8 and +2 movements respectively. The algebraic sum of these two movements is -6. Reference to the typehead layout chart above will now show that a counter-clockwise rotation of 6 type positions magnitude will bring the letter 'Z' round to the printing point.

Although the vertical and rotational movements of the typehead have been described separately, they are produced by the same camshaft (P, Fig. 1.6) and therefore occur together. The combined effects of both the lift and rotation mechanisms can be assessed by combining the information given in Tables 2 and 3 which are based on the C.C.I.T.T. International Telegraph Alphabet No. 2.

Table 2

Code -2---	Shift	Typehead lift (in layers)	Layer brought up to printing point
-M---	letters	0	1
-M---	figures	1	2
-S---	letters	2	3
-S---	figures	3	4

Table 3

Code 1-345	Typehead movement in characters	Character brought to printing point			
	layer →	1	2	3	4
m-mmm	0 CW	ltrs	ltrs	X	/
m-mms	1 CW	K	(	F	%
m-msm	2 CW	Q	1	Y	6
m-mss	3 CW	U	7	S	‘
s-mmm	4 CW	V	=	M	.
s-mms	5 CW	C	:	N	,
s-msm	6 CW	P	0	H	£
s-mss	7 CW	I	8	space	space
m-smm	8 CCW	figs	figs	B	7
m-sms	7 CCW	J	bell	D	WRU
m-ssm	6 CCW	W	2	Z	+
m-sss	5 CCW	A	-	E	3
s-smm	4 CCW	G	@	0	9
s-sms	3 CCW	R	4	car ret	car ret
s-ssm	2 CCW	L	)	T	5
s-sss	1 CCW	line feed	line feed	all space	all space

* Type positions indicated by the ... are blank, as they correspond to non-printing functional codes.

Keyboard and Transmission

For transmission the machine can be fitted with a keyboard for mechanically selecting the 5-unit code appropriate to the depressed key, and a transmitter for converting this code selection into a sequence of five pulses to which are automatically added the start and stop signals before the complete sequence is transmitted to line via the send-receive switch.

An original feature of this type of keyboard – referred to as the K-type – is that it has no separate transmitter or transmit camshaft associated with it, but employs the receive camshaft to drive a multi-contact transmitter located above the translator unit.

The Keyboard unit illustrated in Fig.7.32 consists of an arrangement of keybars S pivoted above and at right angles to a group of five combination bars carried in assembly Q. Each combination bar is urged to the right by a spring, but held at rest on a latch assembly common to all five bars. This latch is released by the depression of any key so allowing the combination bars, which have a series of irregularly-disposed square teeth along their upper edges, to slide to the right.

Combination bars required to set up a **space** condition are prevented from moving by one of their teeth engaging the left-hand side of the selected key. A **mark** combination bar, on the other hand, does not have a tooth at the point immediately preceding the selected keybar and can, therefore, slide to the right. This sliding movement operates a bellcrank linked to one of the six vertical rods FT, Fig.7.34.

Linkages shown at B, Fig.7.1, convey the movement of these vertical rods to the translator unit pin-box and cause the associated pin to be pushed inwards to record a mark condition. The front vertical rod is pushed up by a trip bar whenever any key

is depressed, and it is the movement of this rod which releases the lag weight and thus the translator shaft clutch.

The code setting established on the translator unit pin-box is then sensed by levers BS, Fig.7.16, and it is the blocked or free movements of the associated levers CA which determine the mark or space condition on the transmitter contact assembly B, C, D and E, Fig.7.37.

Answer-Back

The location of the answer-back unit, which is an optional facility that can be fitted to both transmitter-receiver and receiver-only machines is shown in Fig.1.5. This unit takes no part in the operation of the machine until activated by an incoming Who-are-You? signal. It then automatically signals the call sign of the home station back to the enquiring machine, so assuring the calling operator that he is connected to the correct station and that it is operating correctly. The facility can also be used to obtain a form of receipt for a message sent to an unattended machine.

The answer-back unit has capacity for up to 20 printing or functional characters, generally allocated as follows: CARRIAGE RETURN, LINE FEED, LETTER OR FIGURE SHIFT, up to 14 letters or figures comprising the station call sign, CARRIAGE RETURN, LINE FEED, LETTER SHIFT. The individual characters are generated from the interchangeable contoured coding elements shown at M, Fig.7.36, (referred to as 'wards') which are carried on a drum L which is ratchet fed from the translator unit. The drum is rotated so as to present each ward in turn to a series of sensing levers AH which take over control of the transmission mechanism at a point adjacent to rods FT, Fig.7.34, and simulate the movements of these rods so as to set up on the translator pin-box the combination dictated by the contour of the ward. The answer-back unit then automatically releases the main translator shaft which subsequently revolves once to transmit the character to line. The answer-back then repeats this sequence a further 19 times to transmit the remainder of the call sign to line, before coming to rest and relinquishing its control of the translator mechanism to the keyboard. A table giving a list of the various wards available is given on page 75 of Part 7.

The local answer-back unit can also be brought into operation by depressing the 'Here Is' key on the keyboard. The unit then transmits the home station call sign and comes to rest. The 'Here Is' key is linked directly to the answer-back trip mechanism and does not transmit a character to line.

Reperforating Attachment

This optional attachment can record incoming and outgoing messages on an 11/16 in. wide paper tape, simultaneously with the production of the equivalent page copy. The perforated tape forms a permanent record of all the code signals involved in a particular message in a form suitable for storage and for subsequent retransmission by a tape reader. The mechanical local record facility of the Model Seventy-five machine enables it, when fitted with this Attachment, to function as a keyboard perforator and also to produce a printed check copy of the material perforated in the tape, without it being necessary to provide a signalling battery.

The reperforating attachment employs a fixed punch block beneath which code selecting bars operated from the translator unit are positioned in accordance with the code combination registered on the pin-box. Once these selecting bars have been positioned they are lifted by a punching arm driven from an eccentric block carried on the translator shaft. Marking selecting bars now engage their associated punches to drive them through the paper tape; spacing bars are withdrawn clear of their punches which therefore remain at rest. The return stroke of the punching arm provides power to withdraw marking punches from the paper, and also to operate the ratchet which drives the tape feed mechanism.

4. INTERNAL CIRCUITS

The internal signals wiring of the Model Seventy-five Teleprinter is shown in Fig.1.7.

The receiving electromagnet consists of two 110 ohm coils which are wired in series and have a combined inductance of 4½ henries measured at 50 cps, 40 mA. The leads from

the electromagnet are taken to terminals 1 and 4 of terminal block TB1 and thence to line via pins J and G on the 12-way signals plug.

Operating currents and voltages are 120V, 40 mA for single-current circuits, and +80V, 0, -80V, 20 mA for double-current circuits if 2 kilohms of the current limiting resistance is shunted by a 2 μF capacitor. Without this capacitor the current must be at least 25 mA.

The mark, tongue, and space code contacts are wired individually via plug G back to terminal block TB3 (located beneath the main base) whose straps link the tongues to the associated moving element in the sequential contact bank. The fixed contacts in the sequential bank are commoned at the transmitter and go to line on pin B of the 12-way signals plug L via terminal block TB4 and the RIS unit. The send-receive switch is linked to terminal block TB4 via plug G and goes to line on pins F, D, and E for send-receive and tongue respectively.

Fig. 1.7 shows the code contacts 1, 2, 3, 4 and 5 in the position which they take up when the translator shaft is at rest. All the tongues are resting on their spacing side and are electrically connected via straps on terminal block TB3 to the moving blades of the associated sequential contacts. The space code contacts (the lower ones on Fig. 1.7) are in parallel with each other and with the moving blade of the start contact; the mark code contacts (the upper ones on Fig. 1.7) are similarly in parallel with each other and with the moving blade of the stop contact which is always made at rest.

Shortly after the translator camshaft starts to rotate, the five moving blades of the code contact bank move to the mark contacts and then either return to space or remain at mark depending upon the code combination established on the selecting pins. This action takes place while the initial stop and start signals are being transmitted. The code contacts them remain in the positions to which they have been set for the remainder of the cycle, during which other cams on the translator shaft operate the sequential contacts. Marking code contacts are finally returned to the rest spacing position about 2 ms after the translator shaft comes to rest.

It is important with double-current circuits to ensure that the transmitter sequential contacts are adjusted so that there is a short interval between the opening of each contact and the closing of the next. If this is not done, it is likely that the signalling supply will be momentarily short-circuited during transmission. Although this momentary condition is unlikely to damage the supply it may result in the transmission of a code combination that has been mutilated by the discharge of smoothing capacitors in the signalling rectifier set. A protection lamp in each leg of the signalling supply will safeguard the supply and slow down the discharge of any capacitors.

5. EXTERNAL CIRCUITS

General

When external circuits for the Model Seventy-five Teleprinter are being designed or modified the following special features of the machine should be considered.

(a) Since the contacts of the transmitter are driven from cams carried on the main translator camshaft, and read off the code combination direct from the code selecting pin-box, these contacts are operating **while the machine is receiving** as well as while it is transmitting. It is therefore necessary to inhibit the transmitter electrically during reception to prevent re-transmission of received signals.

(b) **As a mechanical local record is always present** when the Model Seventy-five is transmitting, whatever local record circuitry was required previously must be disconnected when a Model Seventy-five is installed. With a conventional double-current switched simplex circuit, for example, this can be done by simply omitting the leak resistor, but with single-current loop circuits that have two or more transmitters and electromagnets in series, the electrical local record cannot be dispensed with so easily as the line current passes through every electromagnet in the circuit.

To cater for these single-current applications all standard Model Seventy-five machines are fitted with an armature throw-out facility which can be adjusted so that the trip action from the keyboard to the translator unit will automatically disconnect the electromagnet armature from the selector unit before the combination for the selected key can be transmitted. The electromagnet can now respond to the signals transmitted through it, but the movement of its armature will not be conveyed to the selector. The armature is automatically reconnected to the selector within 130 ms of the end of the transmission. This armature throw-out facility is of course normally adjusted to an inoperative position for double-current applications.

(c) The implications of this mechanical local record feature should also be considered when a fault has to be located. With the Model Seventy-five an accurate local copy is not necessarily proof of accurate transmission. The mechanical local record feature also precludes the use of duplex circuits.

(d) The armature throw-out mechanism mentioned in paragraph (b) above also controls the send-receive switch. The tongue of this switch moves to send immediately a key is depressed, i.e. before the start signal is transmitted, and returns **slowly** to receive after the end of the stop signal. This delayed return of the send-receive switch tongue to receive, unlike the armature throw-out facility, **cannot** be made inoperative.

The effect of this slow return feature on a switched simplex circuit should not be overlooked. If on a one-wire circuit of this kind the transmitting operator maintains a keyboard speed which closely approaches cadence speed, the send-receive switch will remain in the send position until either the operator reduces speed or the transmission ends. Because of this continuous send condition it is not possible for the distance station to break in on the home station's transmission.

(e) A mechanism is provided to protect the machine from damage that could occur if an operator attempts to break in on an incoming message by operating his keyboard. The danger occurs when the local operator releases the local translator unit by operating the keyboard at the instant when his selector unit is in the act of setting up a marking combination in the pin-box. The subsequent traversing movement of the pin-box which occurs at the very beginning of the translation cycle could cause the pecker to be trapped against the side of an adjacent selecting pin which happened to be in the space position.

This combination of circumstances is guarded against by a **break-in mechanism** which will automatically set the selecting unit retention hook (part of item CU, Fig.7.20), up to the space position and hold it there until the crawler clutch resets. Although this mechanism will not prevent the release of the translator unit while the selector unit is responding to incoming messages, it does prevent the pecker striking forward and so eliminates the possibility of a foul between it and a spacing selecting pin in the traversing pin-box.

The components involved in this protection device are shown at U, Fig.7.19, and at ER, ES and ET on Fig.7.21. It is an extension arm riveted to the pivot of the lag weight assembly DH, Fig.7.17, acting on the underside of the horizontal arm of item ER, Fig.7.21, which pivots trip shaft AT, Fig.7.19, counter-clockwise. The inside edge of cam ET, Fig.7.21, treads on extension arm U, Fig.7.19, so lifting the forked arm T and hence the retention hook to the spacing position.

(f) The electromagnet armature is fitted with a pair of centralising springs that increase the sensitivity of the electromagnet by reducing the changeover force and reducing the impact on the stops which limit the movement of the armature. The anchor points for these springs are on an adjustable plate which is positioned so as to produce a neutral bias on the armature. A second pair of springs is connected to the armature for single-current applications. These are anchored on an adjustable carrier which is set manually to produce the required degree of mechanical bias. For double-current working, this second pair of springs is disconnected at the armature end and left hanging from the carrier.

(g) The transmitter contacts are adjusted differently for single- and for double-current working. To eliminate bias distortion on single-current circuits the closing times of the sequential contacts should be adjusted so that one closing time begins just when the preceeding one ends. In practice, these single-current closing times are often adjusted to overlap slightly to ensure that there will be no breaks in á block signal.

For double-current applications the closing times are adjusted so there is a distinct break between the opening of one contact and the closing of the next. If this were not done, the signalling supply may be momentarily short-circuited. While a short-circuit of this duration is unlikely to damage the supply, it may cause a character to be corrupted by the discharge of smoothing capacitors in the signalling rectifier. It is good practice to include a protection lamp in each side of the signalling supply. This will not only protect the supply and the transmitter contacts but also reduce the chances of a corrupted signal by slowing up the discharge of the smoothing capacitors.

Single-Current Operation

The external wiring for a typical single-current loop circuit employing 120V, 40 mA signalling is shown in Fig. 1.11.

The electromagnet must be mechanically biased to space and the armature throw-out mechanism adjusted to the operating position so as to prevent the electromagnet from tripping the selector unit, and so corrupting the mechanical local record.

The send-receive switch is used to prevent received signals from being re-transmitted along the send leg of the circuit. Its tongue and receive contacts are connected across the transmitter and the send contact disconnected. Thus although the received signals are continuously reproduced on the transmitter, none of the signals can affect the line circuit. Note too that the five space code contacts and the start contact are all left disconnected for single-current working.

The 0.5 μF + 330 ohm network wired to terminal block 1 should not be used on single-current circuits.

Double-Current Operation

A typical double-current 2-wire simplex circuit is shown in Fig. 1.12, and a typical switched simplex circuit in Fig. 1.13. In both circuits the convention of negative battery to line for mark is used. No leak resistors are required as the local record is obtained mechanically.

In the 2-wire circuit in Fig. 1.12, the send-receive switch and transmitter contacts are interconnected so that, although during periods of reception the transmitting contacts are operating continuously, a nearly-continuous mark signal is transmitted to the distant electromagnet. This arrangement has been adopted to prevent the slow return of the send-receive switch in the send to receive direction from leaving the send line without a signal and so creating a possible half-tone condition on voice-frequency line equipment.

The 0.5μF + 330 ohm spark quench circuit can be used, if required, on these two double-current circuits.

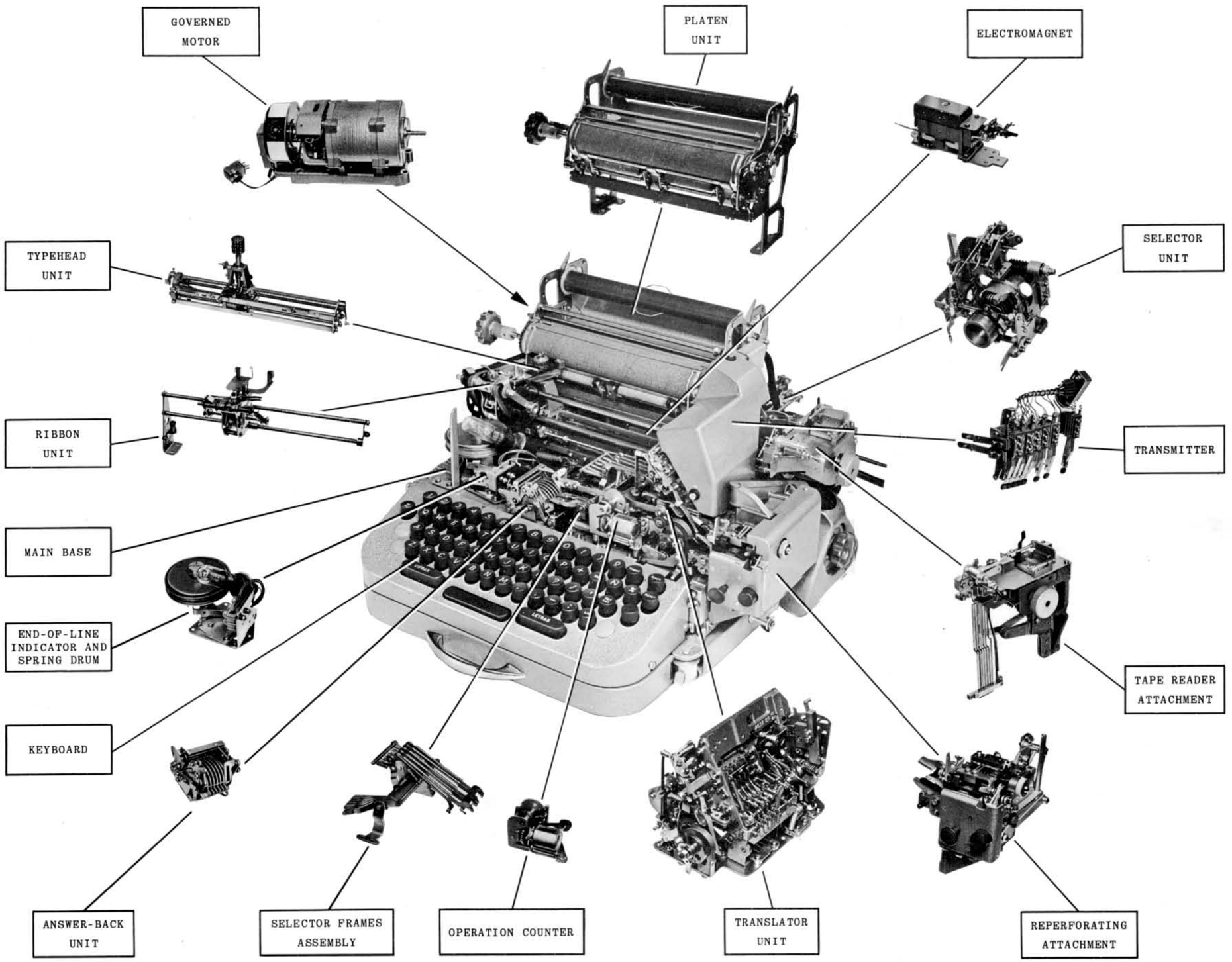


Fig. 1.5 UNIT IDENTIFICATION

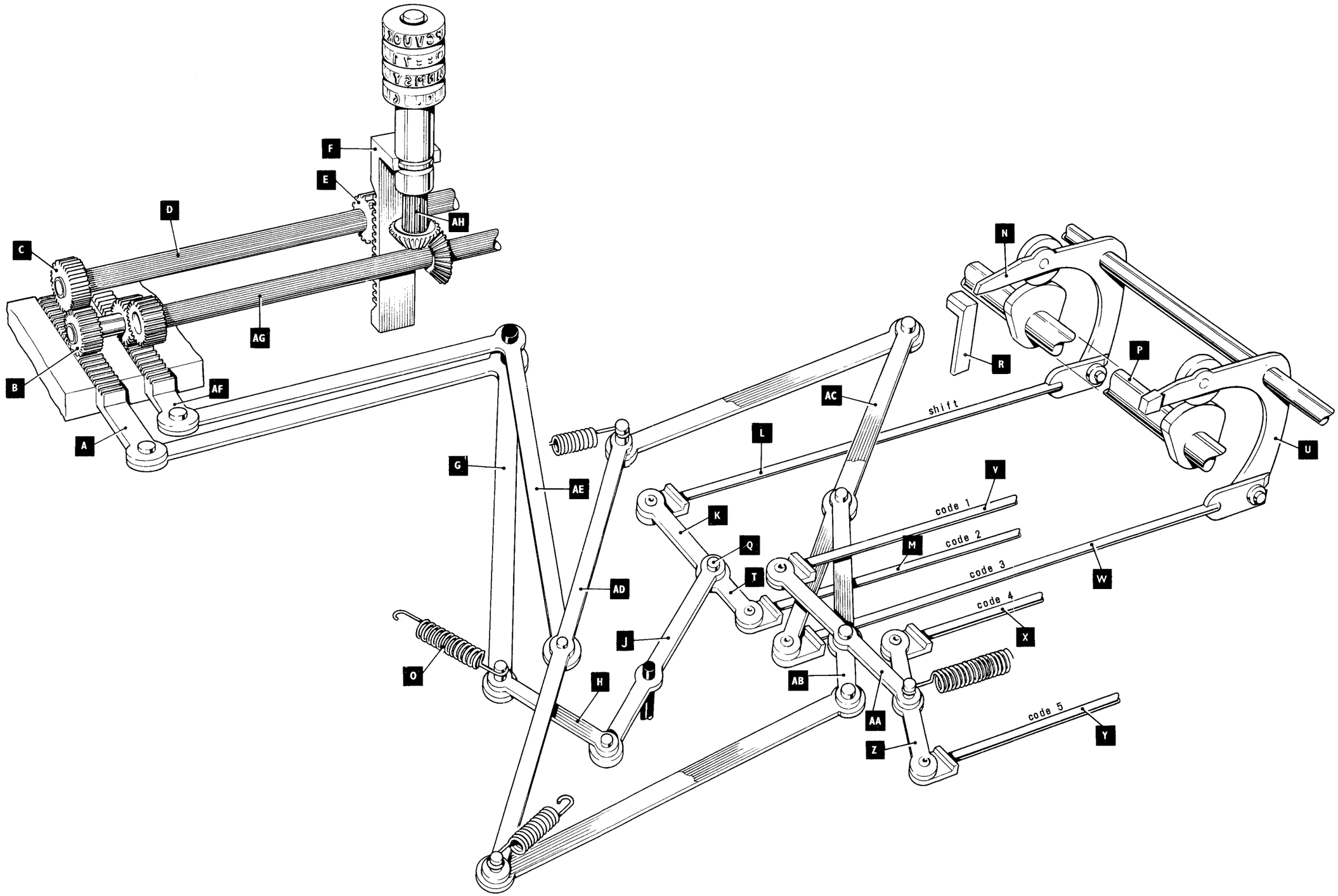


Fig. 1.6 AGGREGATE MOTION MECHANISM

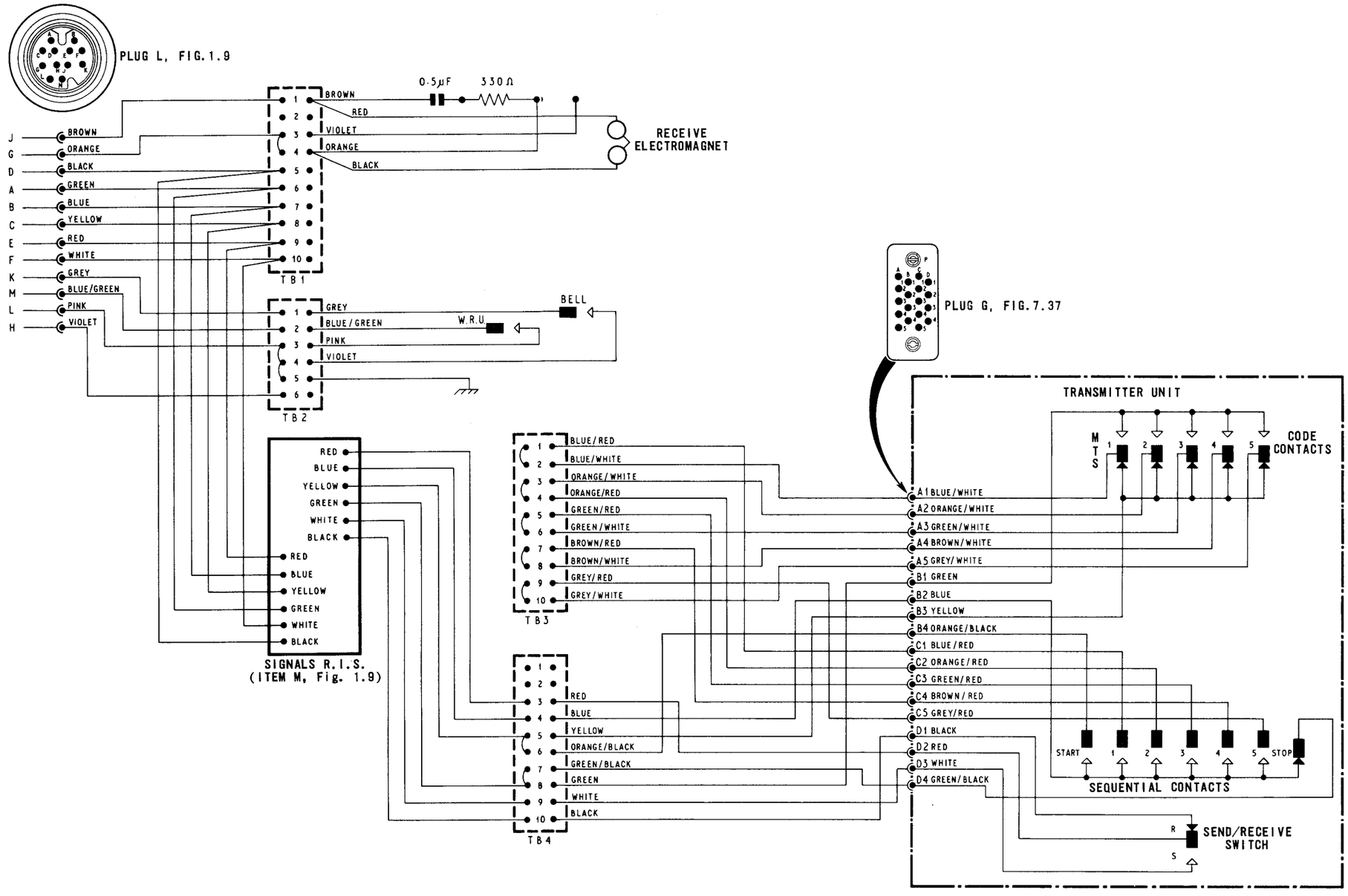


Fig. 1.7 TRANSMITTER-RECEIVER SIGNALS WIRING

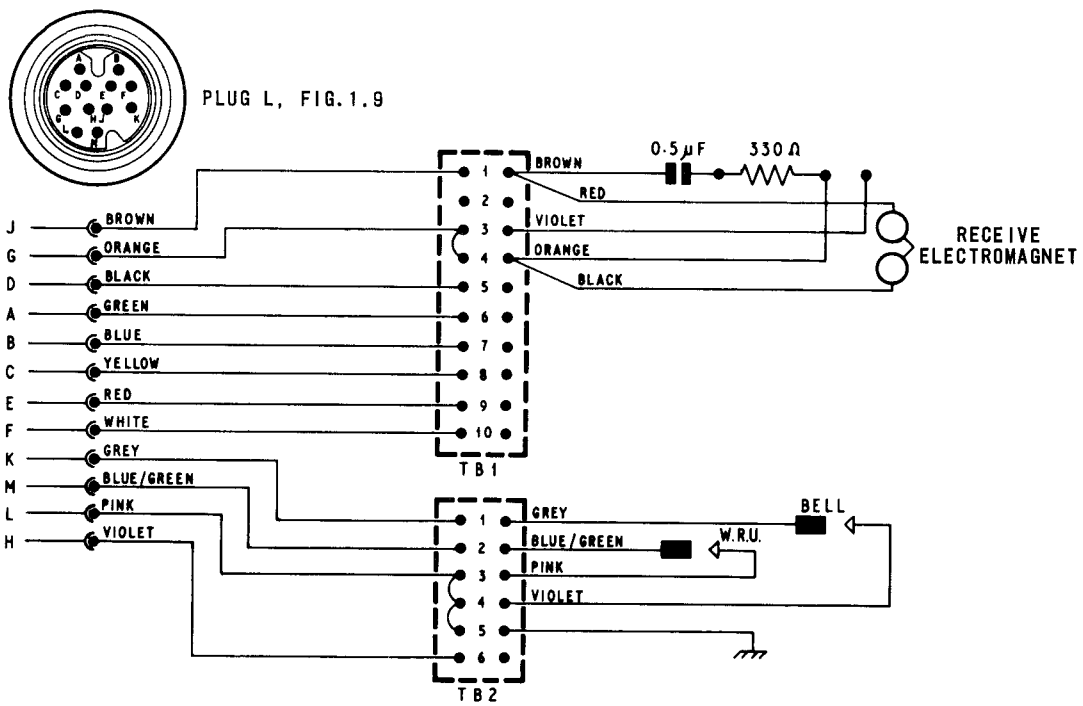


Fig. 1.8 RECEIVER-ONLY SIGNALS WIRING

A Tape Low Microswitch (Reperforating Attachment only)

B Anti-surge Fuse in motor circuit (For values see Figs. 7.9 and 7.11)

C Spark-quench capacitor 1 + 1 μF (see Fig. 1.10)

D Carriage-return dashpot

E Governor Contacts spark quench capacitor (see Fig. 1.10)

F Electromagnet base plate

G Electromagnet spark quench

H Frame earth connexion

J Signals radio interference suppression (R.I.S.) unit

K Automatic motor switch (see Fig. 1.10)

L 12-way Signals plug

M Motor R.I.S. Filter unit

N 3-way Motor power plug

P 4-way motor socket (see Fig. 1.10)

MTB Motor Terminal Block

TB1 Electromagnet and transmitter R.I.S./line connexions

TB2 Alarms

TB3 Transmitter cross-connexions

TB4 Transmitter/R.I.S. unit connexions

TB5, TB6 Miscellaneous terminal blocks, generally fitted to machines modified for parallel input or output

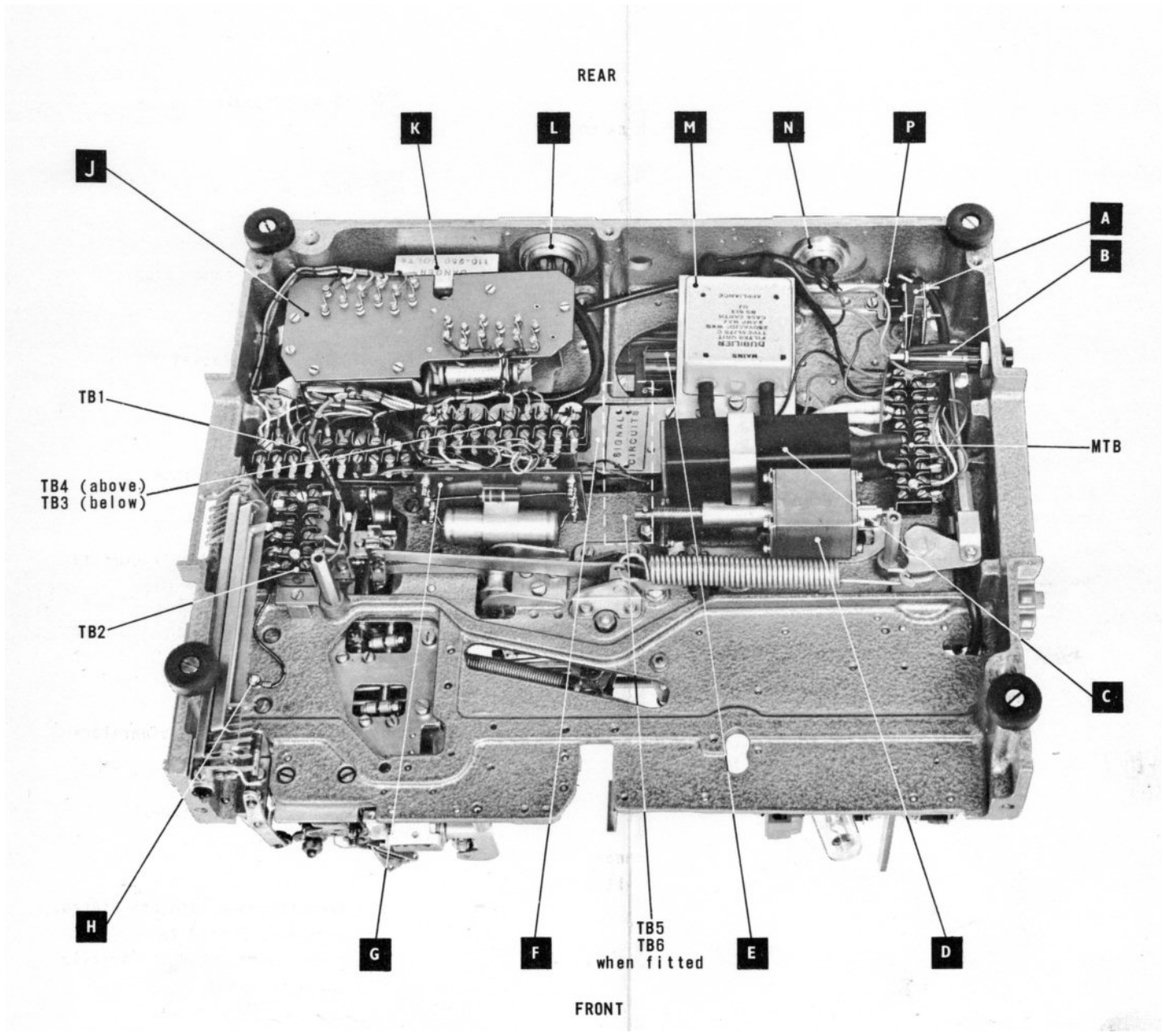
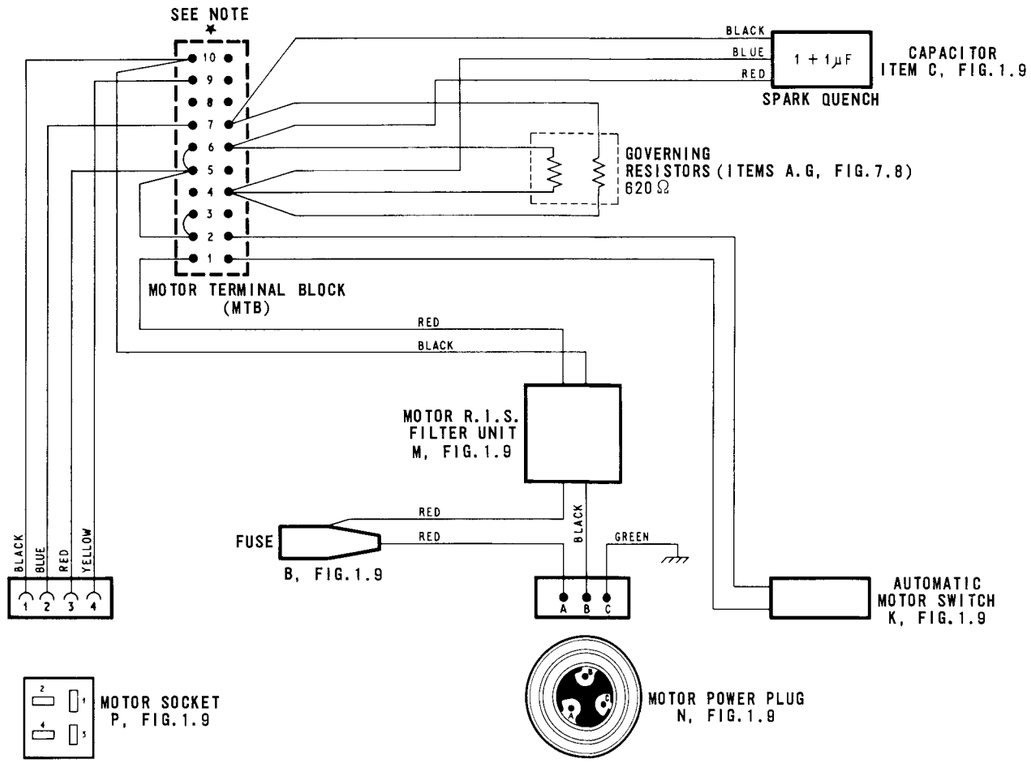
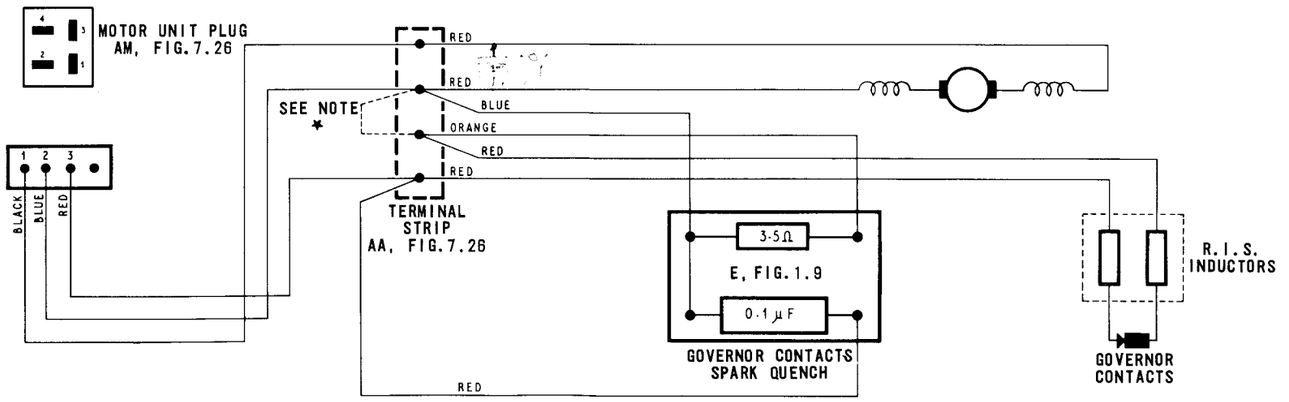
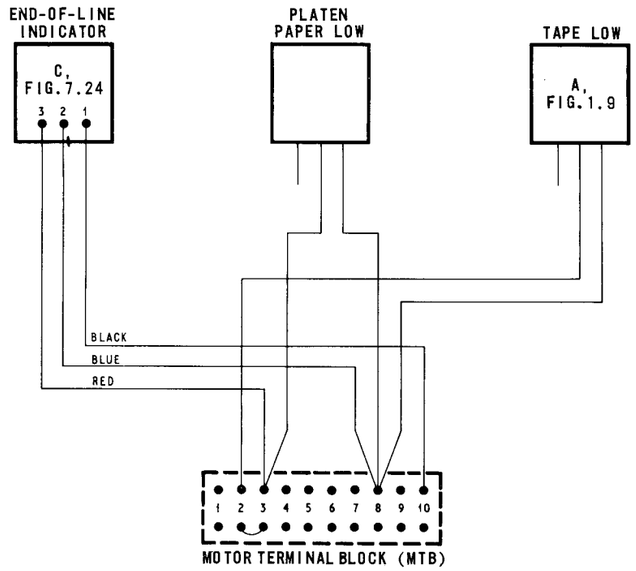


Fig. 1.9 COMPONENT LOCATION







* This diagram shows the straps on the motor terminal block (MTB) and on the 4-way unnumbered terminal strip (item AA, FIG.7.26) as arranged for 220-230V AC operation.

For low voltage (100-125V) working, the governing resistors and capacitors should be arranged in parallel by modifying the straps on the blocks MTB and AA as follows.

MTB ☐ Remove strap between 5 and 6
☐ connect strap between 4 and 5
☐ " " " 6 and 7

AA ☐ By-pass the 3.5Ω resistor by strapping together the centre two contacts

Fig. 1.10 GOVERNED MOTOR WIRING

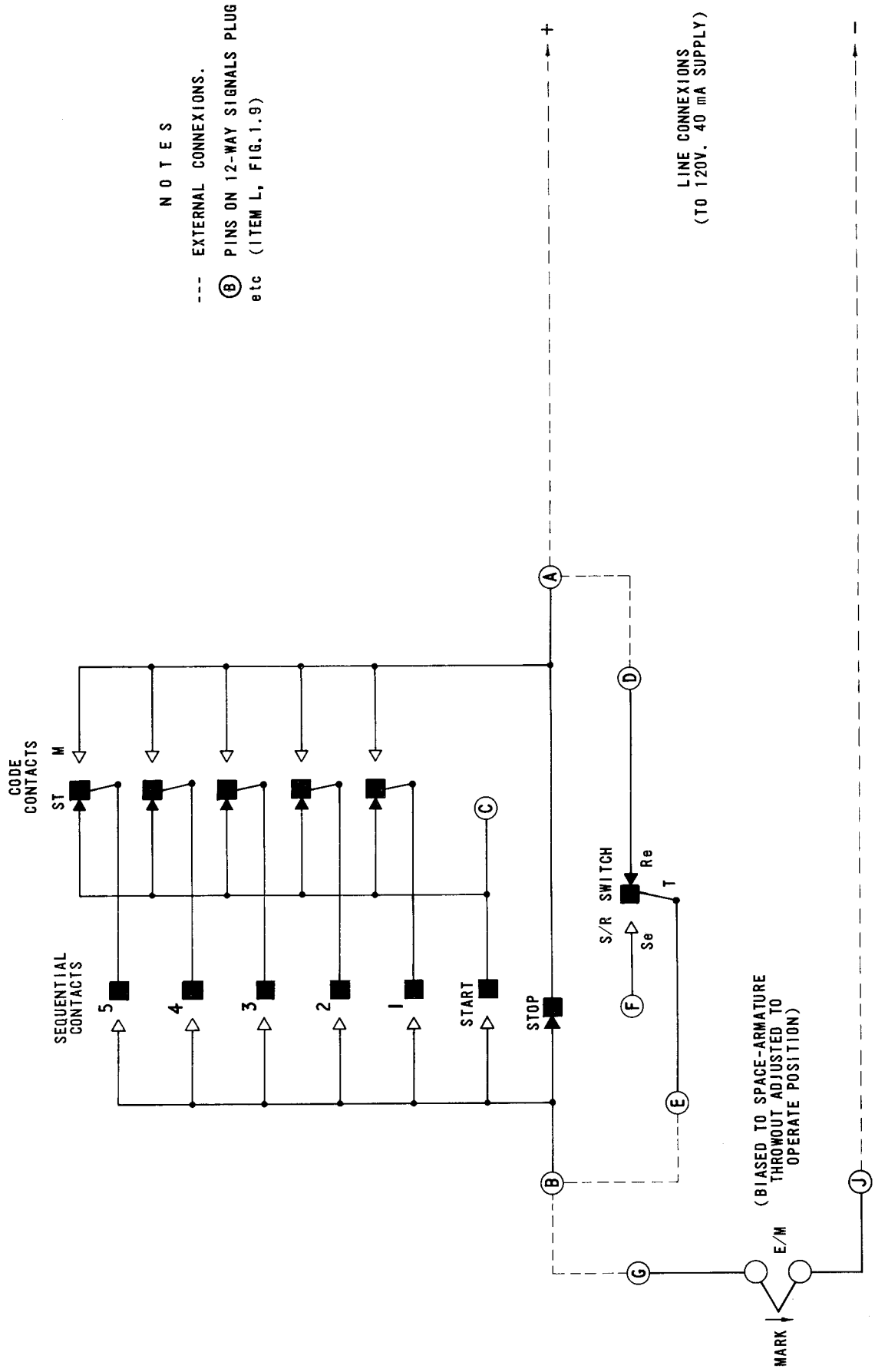


Fig. I.11 SINGLE-CURRENT LOOP CIRCUIT

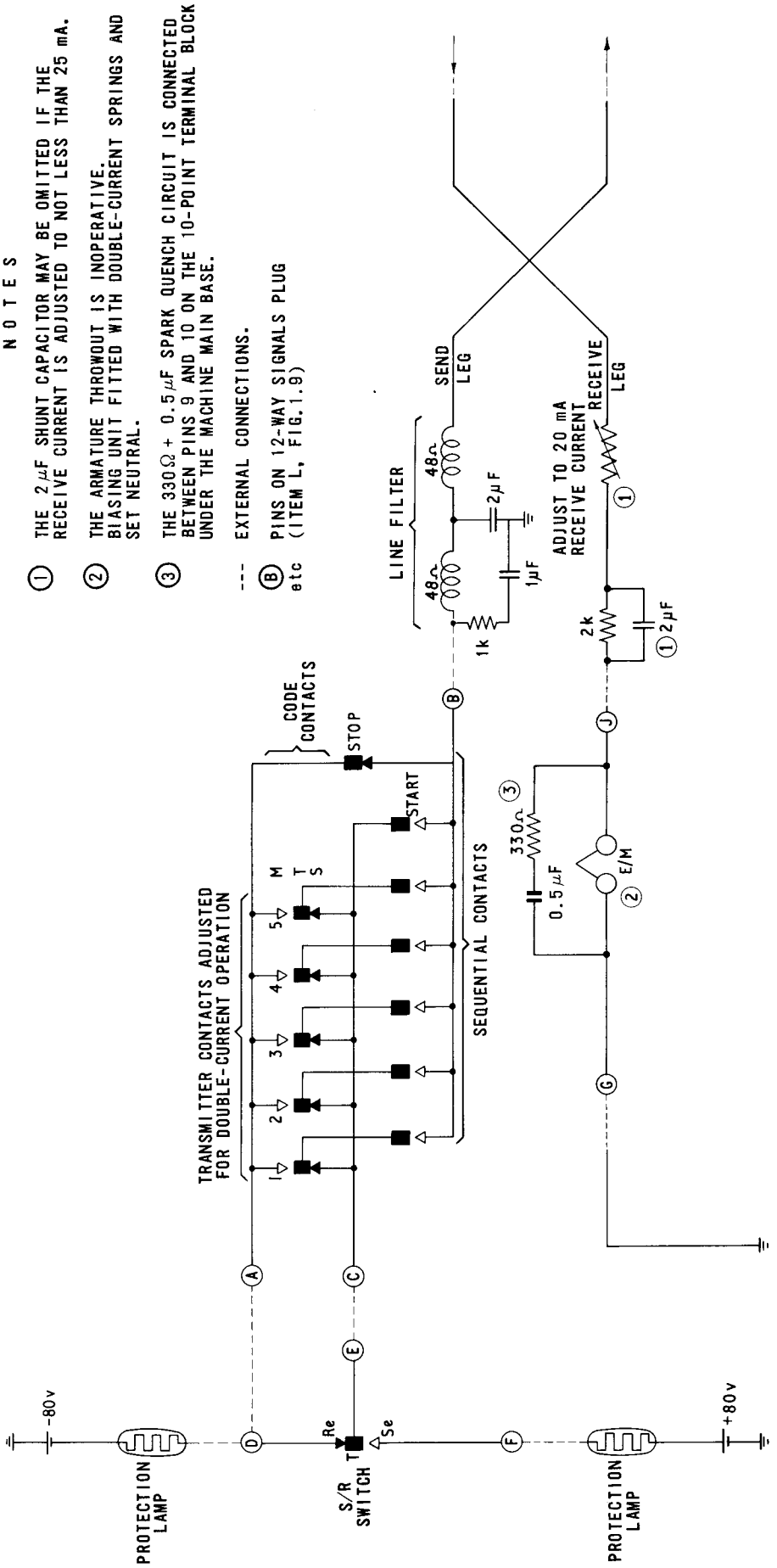


Fig. 1.12 2-WIRE SIMPLEX CIRCUIT

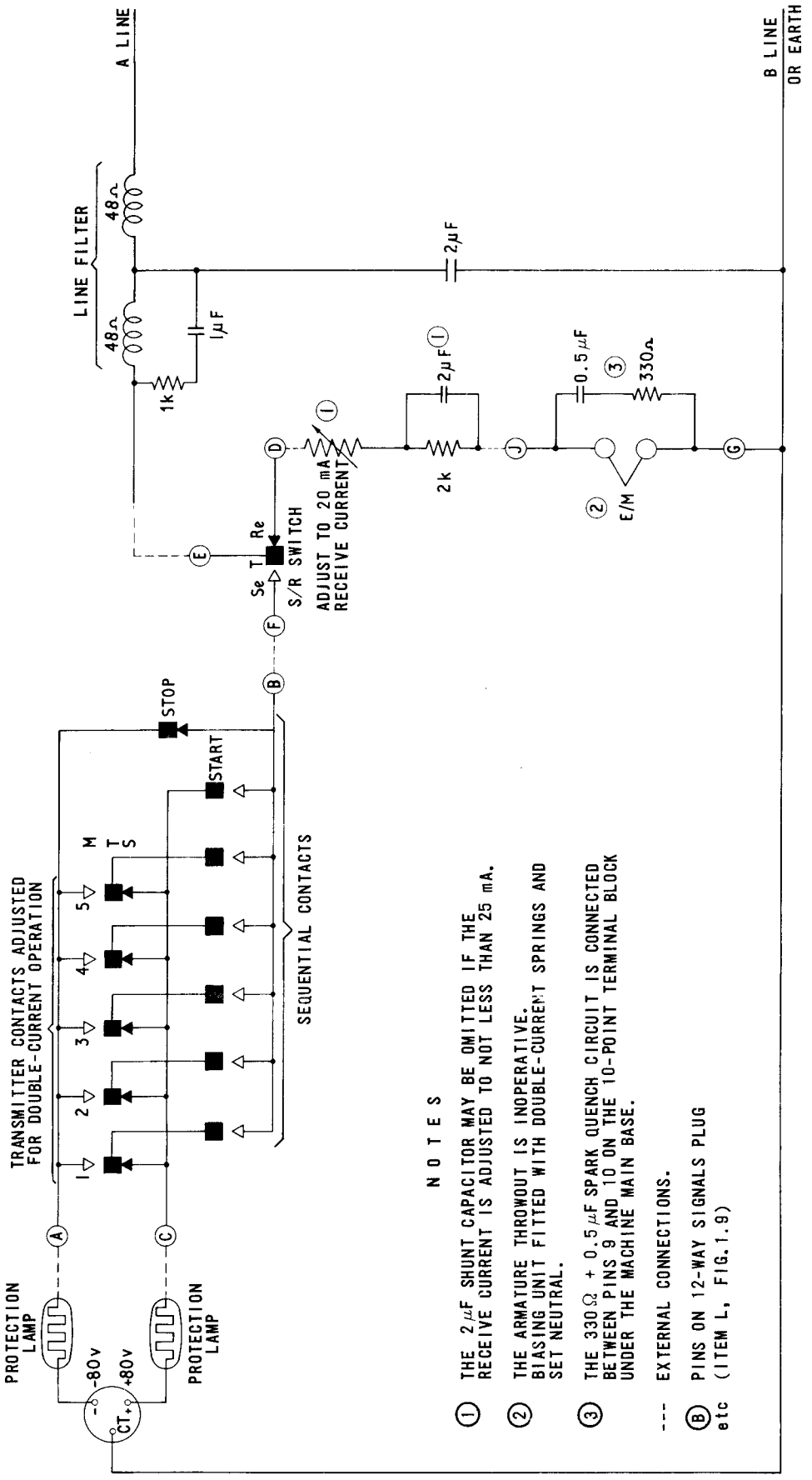


Fig. 1.13 SWITCHED SIMPLEX CIRCUIT

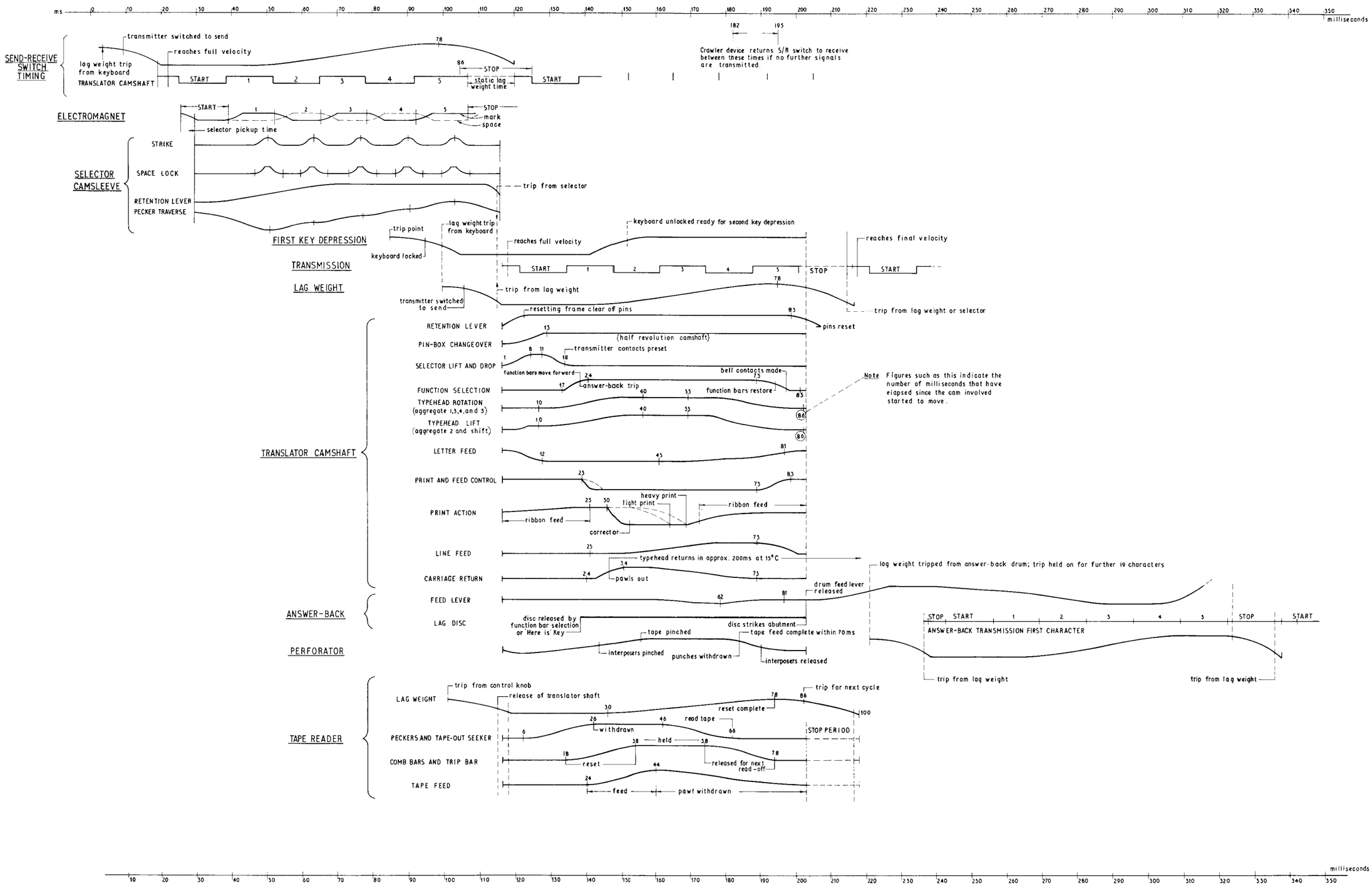


Fig. 1.14 MODEL SEVENTY-FIVE — TIMING DIAGRAM (75 BAUDS)