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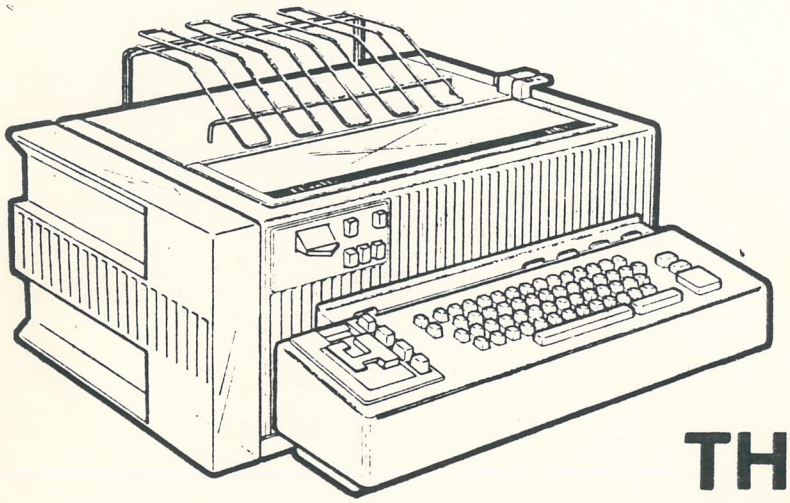


THEORY of TELEGRAPHY and MECHANICAL OPERATION for Te 315

STAC code : 907.49.2.1

Printed in Italy

THEORY of TELEGRAPHY and MECHANICAL OPERATION for TE 315

Publication code : 907.49.2.1

Updating code : 02

July 1974

This is a text book, used for the 1L training course for teleprinter service technicians particular for the Te315. Instructions for the use of the book are found in the Lesson Plans, code 315.86.2.1.

The operative characteristics, but not the way of operation of connection boxes and power supply units are illustrated.

The equipments dealt with in this book are:

Te315	Teleprinter
A063	Telegraphic power supply unit
A011÷A014	Connection boxes

The subject matter dealt with for these equipments can also be used for other similar machines.

GENERAL POINTS

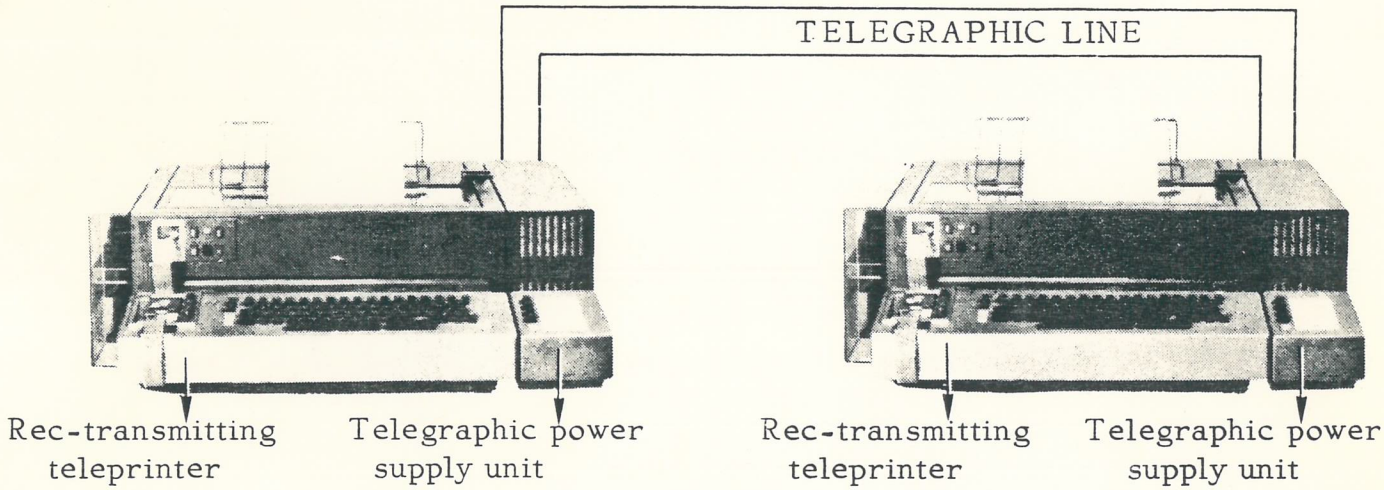
Index

TELEGRAPHY

Telegraphy realizes transmission and reception of messages at a distance, with the aim of supplying the receiver with the correct reproduction of the message, in the form of a printed document; distant transmission is realized by means of electrical signals.

POINT-TO-POINT TELEGRAPHIC CONNECTIONS

The diagram below shows the basic elements which make up a "point-to-point" telegraphic connection.



These are:

1st - Rec-transmitting teleprinter (in Transmission it PRINTS and TRANSFORMS the letters, numbers, and various symbols into electrical signals.
In Reception it TRANSFORMS the electrical signals into letters, numbers and various signals and PRINTS them.)

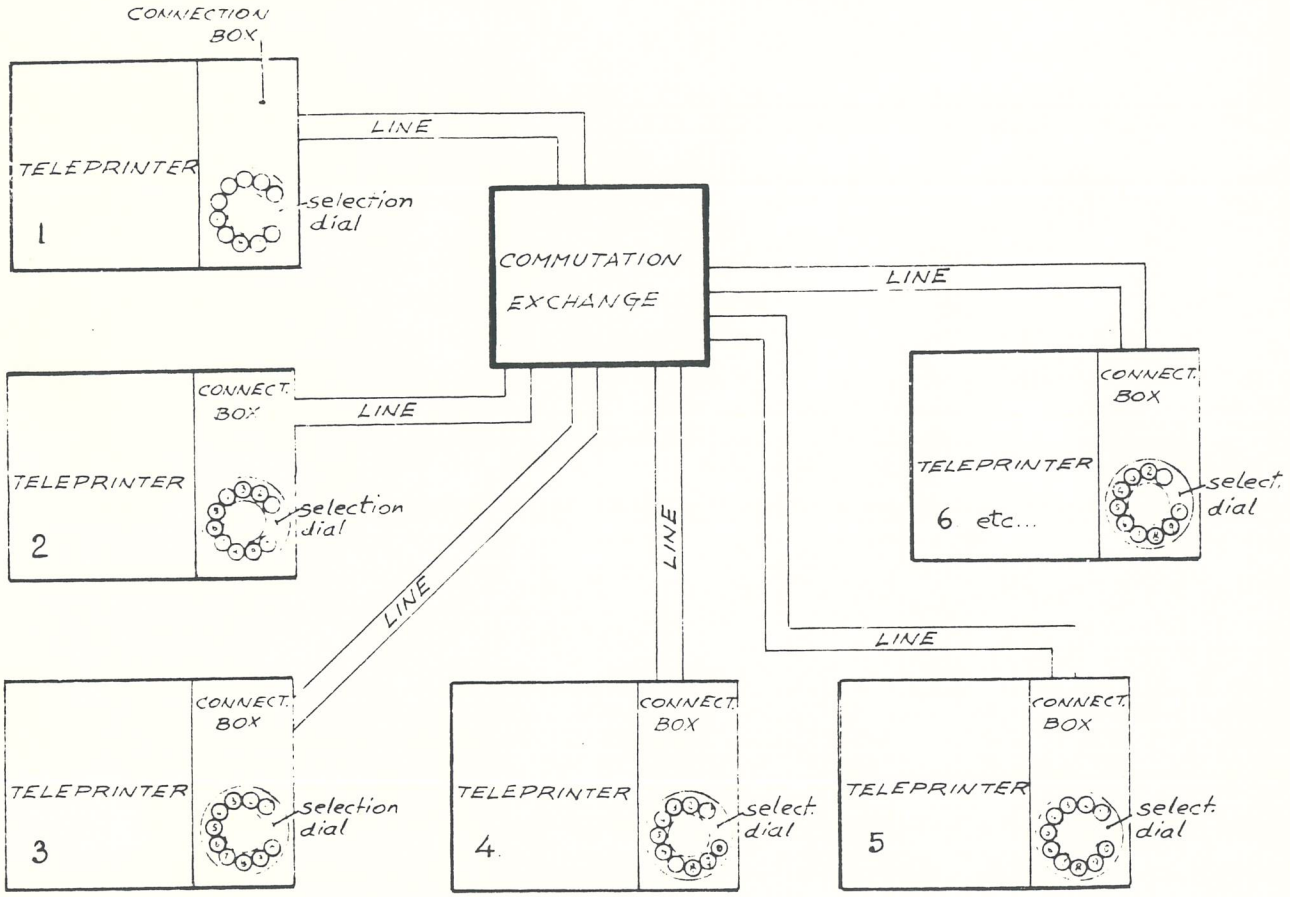
2nd - Telegraphic power supply unit (supplies the current for transmission and reception at a distance of the electrical signals.)

3rd - Telegraphic line (is the support on which the electrical signals "travel"; it connects, at a distance, the two teleprinters.)

Note - This type of connection allows the exchange of messages only between two users, since the Telegraphic line connects the two teleprinters directly.

CONNECTION WITH COMMUTATION EXCHANGES (COMMUTED LINES)

The diagram below shows this connection.



With this system it is possible to connect teleprinter 1 with all the others, teleprinter 2 with all the others, and so on.

To make the connection, the teleprinter user who wishes to send a message need only dial on the connection box selection disc the correspondent's number.

The exchange then connects the corresponding line to the two teleprinters.

(N.B. - A telephonic system operates likewise)

The commutation exchange may be manual or automatic.

The telegraphic lines system is also called "telegraphic network".

The teleprinter may be supplied with a tape perforating device through which messages are memorized.

These messages can be transmitted subsequently by means of a tape reader.

The perforator and the reader may be units which are connected to the teleprinter, or incorporated in the latter.

To conclude:

the basic elements which make up a telegraphic connection are:

- Teleprinter (also called TERMINAL)
- Telegraphic power supply unit (for fixed lines)
- Connection boxes (for commuted lines)
- Commutation exchange
- Telegraphic line
- Tape perforator
- Tape reader.

PRINCIPAL APPLICATIONS OF TELEGRAPHY

1) Public service

A telegraphic organization, which owns offices, apparatus, and lines, generally state-owned, but sometimes private, receives from the member of the public a message written on a suitable form, and undertakes to transmit it and deliver it to the addressee.

2) Private services

In this case, the technical means of transmission may belong to telegraphic organizations (state-owned or private), but the user, by hiring, has the sole use of this for variable periods of time. The most important of these services is the:

Telex Service, in which the user has exclusive use of one or more terminal sets (made up of telegraphic apparatus and of a connection box) and moreover has the use of the lines and exchanges of a world-wide network, operated by state-owned or private organizations. By use of the necessary operations the user can be connected, through this network, to another subscriber to this service.

There may be:

Private networks, with manual or automatic commutation, formed by lines hired for a long period or owned by the user and using exchanges, usually belonging to the user.

Point-to-point connections between two sets for teleprinters situated far apart and connected by their own hired lines. In this case the hiring of the lines may be limited to only a few hours of the day.

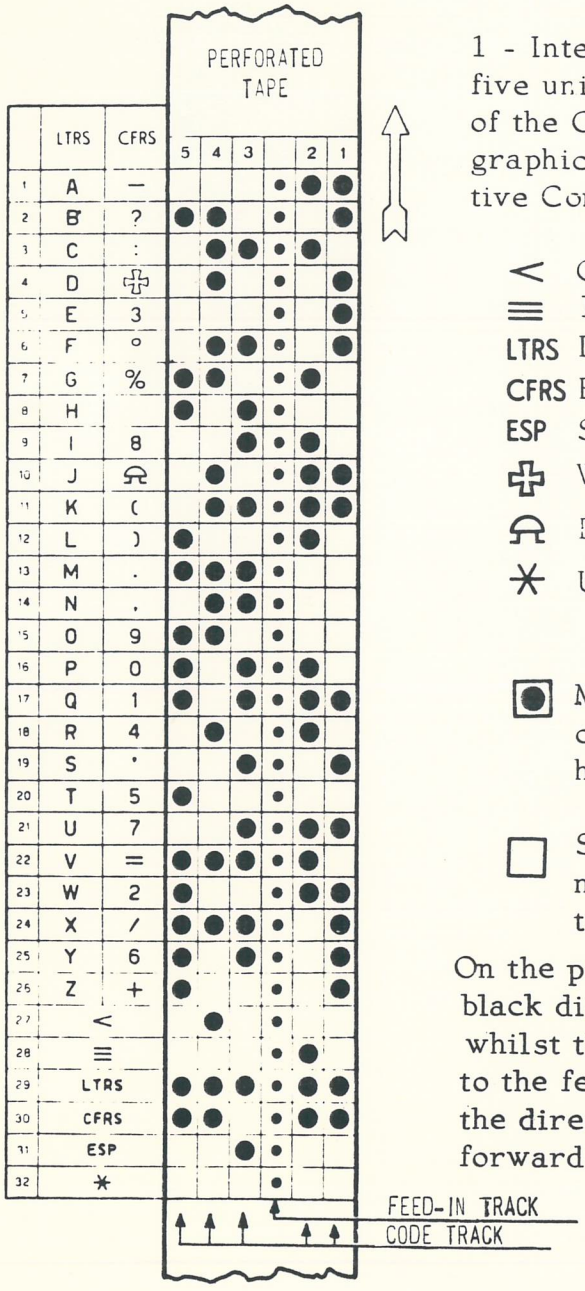
3) Special services

They have special purposes, and are characterized by the fact that generally they are not used for communication between one single subscriber and another, but, for example, for sending certain information to a group of users, or to communicate, on request, certain information accumulated in special memory units, etc. Printing agencies and agencies for collection and distribution of meteorological data belong to this service; in the latter agency there is in one part a network for the collection of information from the periphery to the centre, and another for distribution of this information by the centre, to a number of receiving users: there are also agencies for reservation of places on boats, aircraft or trains, for distribution of information about the stock exchange, etc.

BIT-CODE

The combination of electrical signals used to compose letters, numbers, and various symbols is called CODE. A single electrical signal (pulse) is called BIT.
The bit may or may not carry current.
Usually a 5 bit code is used for teleprinters.

5 PULSE CODE



	LTRS	CFRS	5	4	3		2	1
1	A	—				•	●	●
2	B	?	●	●		•		●
3	C	:		●	●	•	●	
4	D	✠		●		•		●
5	E	3				•		●
6	F	°		●	●	•		●
7	G	%	●	●		•	●	
8	H		●		●	•		
9	I	8			●	•	●	
10	J	🔔		●		•	●	●
11	K	(		●	●	•	●	●
12	L	)	●			•	●	
13	M	.	●	●	●	•		
14	N	,		●	●	•		
15	O	9	●	●		•		
16	P	0	●		●	•	●	
17	Q	1	●		●	•	●	●
18	R	4		●		•	●	
19	S	'			●	•		●
20	T	5	●			•		
21	U	7			●	•	●	●
22	V	=	●	●	●	•	●	
23	W	2	●			•	●	●
24	X	/	●	●	●	•		●
25	Y	6	●		●	•		●
26	Z	+	●			•		●
27	<			●		•		
28	≡					•	●	
29	LTRS		●	●	●	•	●	●
30	CFRS		●	●		•	●	●
31	ESP				●	•		
32	✳					•		

1 - International code no.2 with five units, according to the rules of the CCITT (International Telegraphic and Telephonic Consultative Committee) of Geneva.

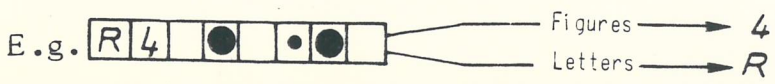
< Carriage return
≡ Line feed
LTRS Letters
CFRS Figures
ESP Space
✠ Who are you?
🔔 Bell
✳ Unused combination

● Mark pulses (presence of current - positive pulse) hole in tape

□ Space pulses (no current - negative pulse) no hole in tape.

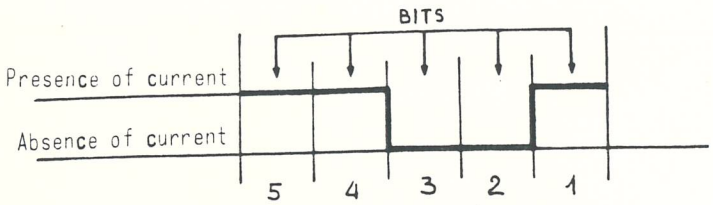
On the perforated tape, the larger black discs correspond to the holes, whilst the smaller ones correspond to the feed holes: the arrow indicates the direction in which the tape moves forward.

In the 5 bit alphabet two signs are coupled to each character. The Figures or Letters service characters establish which of the two signs should be printed.

E.g. 

To print IVREA 145 it is necessary to type:
LETTERS/IVREA/SPACE/FIGURES/145

For example, letter B has tracks 5-4-1 perforated.
We will show electrical code B with a diagram.



Presence of current is called BIT at 1.
Absence of current is called BIT at 0.

As can be seen in the diagram, a BIT has a certain length; this length is equal for all the BITS (time of a BIT).

With 5 BITS (or tracks) 32 different combinations can be obtained.

- (2^5= 2x2 = 4x2 = 8x2 = 16x2 = 32)

WEIGHTS ⟶ 16 8 4 2 1
BITS-TRACKS ⟶ 5 4 3 2 1

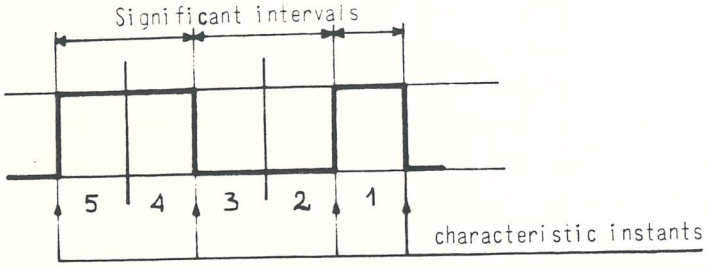
Each BIT is given a fixed binary value called WEIGHT as shown in the diagram, therefore it can be said that:
- weight 1 = bit 1 : Weight 8=bit 4.

The binary weight of the code is expressed by the sum of the binary weights.

e.g. binary weight 19 = weight 16 +weight 2 + weight 1 = letter W.

By adding all the possible weights 31 combinations are obtained; the 32nd combination does not correspond to any perforated track (WEIGHT =0).

CHARACTERISTIC INSTANTS-SIGNIFICANT INTERVALS



Let us re-examine electrical code B.

The characteristic instant corresponds to the variation of the current from space to mark or vice-versa.

The significant intervals correspond to the lack of current variation.

In practice, the passage of the space condition into the mark condition and vice-versa is never very fast but, for theoretical study, we will consider the flow of the signal in EMISSION as a rectangular diagram.

LINE

By the word 'line' we mean the physical support which makes the connection between two points, between which information is to be exchanged.

Ideally, between the two points which are to exchange information there should be a pair of wires as long as the space between the two points. In reality this condition only occurs under particular conditions.

The most commonly used supports for lines are:

AERIAL TYPE (the most simple wires - poles)

COMMON CABLES used for short distances in urban centres; they concentrate a large quantity of conductors (pairs of wires) in a small section.

CO-AXIAL CABLES used for greater distances because they have decidedly better characteristics.

RADIO BRIDGES are used for long distances.

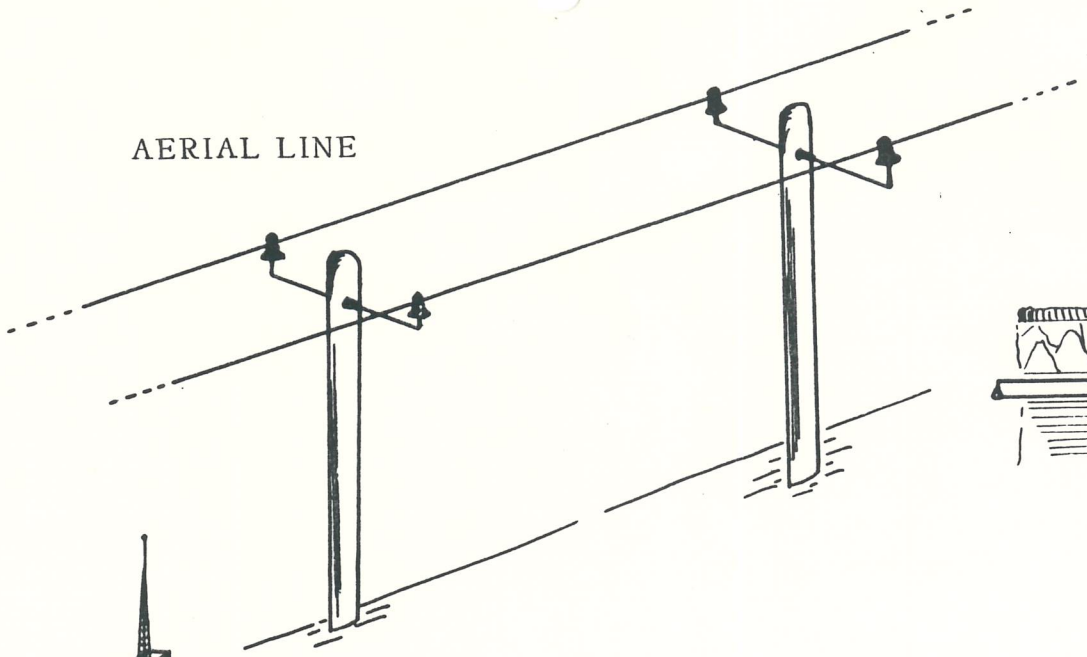
TELEGRAPHIC AND TELEPHONIC LINES

The TELEGRAPHIC LINES are used for direct current transmission (single or double); they have ohmic continuity.

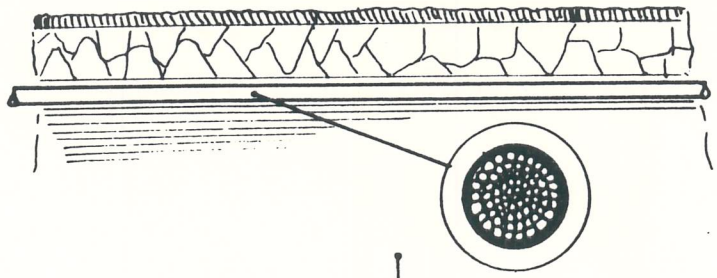
They are not adapted for long distances, because they are subjected to different types of distortions and consequently to VELOCITY(BAUD).

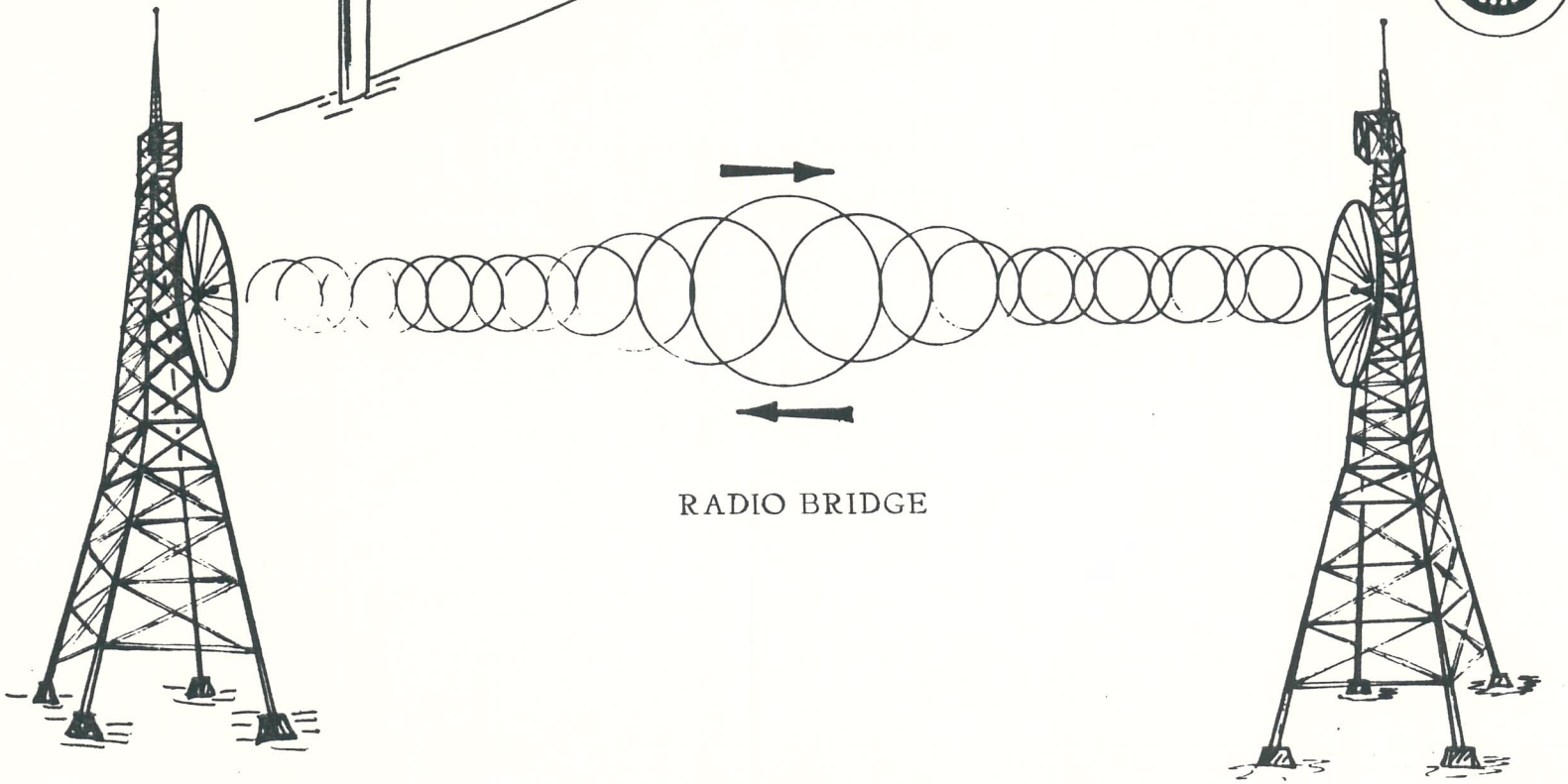
The TELEPHONIC LINES are used for transmission in alternating current; they are used for medium and long distances because they are less subject to distortions and thus greater velocities can be obtained.

AERIAL LINE



CABLE





RADIO BRIDGE

LINES SERVICE APPARATUS

AMPLIFIER is used to regenerate the signals which have been ATTENUATED along the line.

FILTER is used to distinguish different frequencies.

IMPEDANCE ADAPTORS

N.B. Impedance is the resistance which a variable current meets in a circuit.

The Impedance Adaptor is used to adapt the impedance of the charge to that characteristic of the line, in order to have maximum transfer of power from the line to the charge.

In this way the ATTENUATION and DISTORTION will be minimal.

AUTOMATIC SWITCHBOARDS are used to select the correspondent's line.

CONCENTRATORS - their main purpose is that of concentrating on a single line information received from several lines.

MODEM AND ACOUSTICS transform the binary code in modulation into alternating current.
They transform the modulation in alternating current received in binary code.
The most commonly used are with FREQUENCY SHIFT and with PHASE SHIFT.

LINE ADAPTER transforms the binary code in double direct current modulations.
It transforms the double direct current modulation received in binary code.

TELEGRAPHIC POWER SUPPLY UNITS supply current to the line.

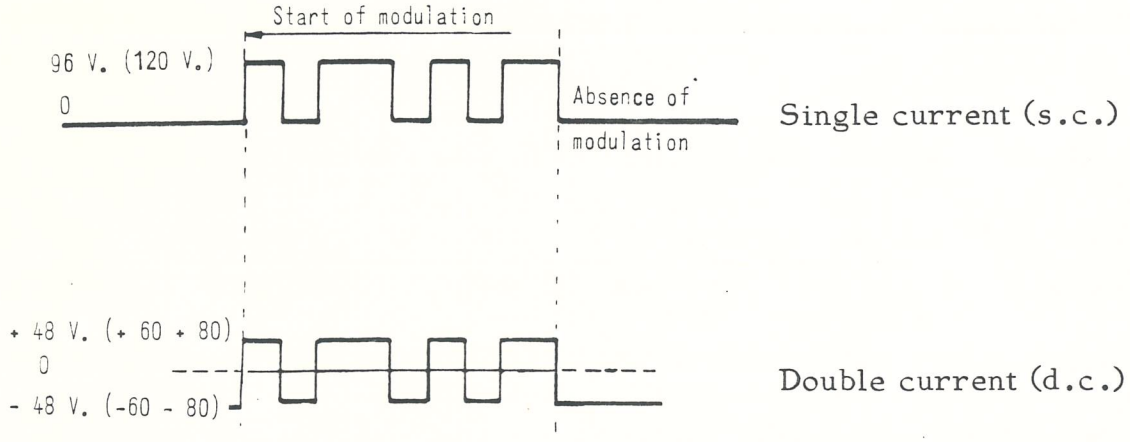
CONNECTION BOXES connect 2 teleprinters by means of an exchange.

MODULATION

We define as telegraphic modulation a sequence of elementary pulses corresponding to the two different significant states.

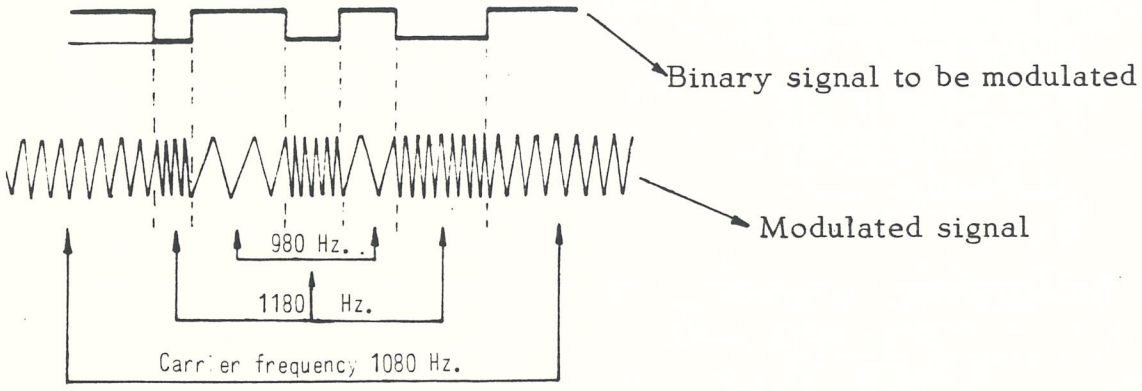
There are two types of modulation - in DIRECT CURRENT (DC)
in ALTERNATING CURRENT (AC)

The modulation in direct current can be in single or double current.



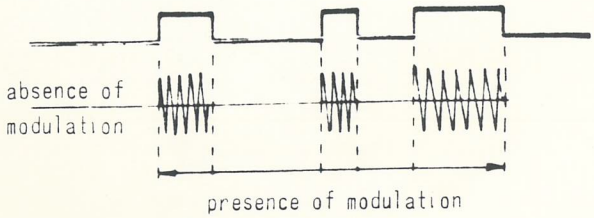
The most commonly used is modulation in Double Current (d.c.) because it allows us to distinguish absence of modulation because of line interruptions by a 0 level bit, (N.B. -48V corresponds to a BIT at level 0), which is not possible in single current.

Modulation in alternating current can be with FREQUENCY SHIFT (frequency variation) (N.B. the frequency is measured in HERTZ = Hz = periods per second).



In this case an alternating current "travels" on the line; this is called CARRIER and has a frequency of, for example, 1080 Hz; when the electronic unit sends a à level bit there is a variation (+100 Hz) from the nominal frequency = 1180 Hz; when the emittor sends a 1 level bit there is a -100 Hz variation from the nominal frequency and that is : 980 Hz etc.

ON-OFF

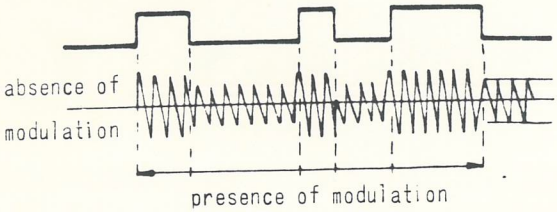


Binary signal to be modulated

Modulated signal

When a 1 level bit is transmitted there will be modulation with a certain frequency.
(This is a little-used system since BIT at 0 = absence of modulation, thus it is difficult to distinguish between of modulation and BIT = 0).

in AMPLITUDE

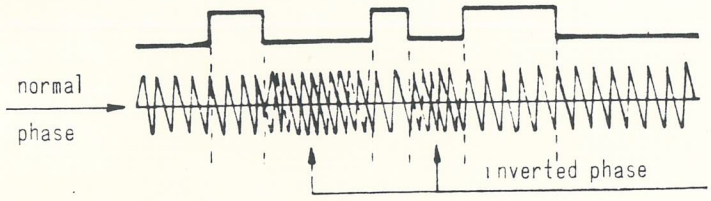


Binary signal to be modulated

Modulated signal

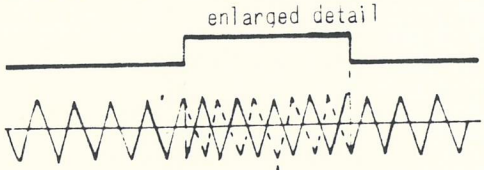
this type is not used often

PHASE



This is not used often for low and medium velocities because it is very expensive.
However, it is practically the only one used for high velocities.

Let us see this in an enlarged form.



the dotted line represents the normal phase

BAND : is the frequency field included between the two limited frequencies used for a connection.
E.g. Acoustic band (telephone) is included between 300 Hz and 3400 Hz.

CHANNEL : is a telegraphic or telephonic connection established by two determined frequencies.
E.g. there may be different channels from 1200 Hz to 1800 Hz in a band.

TELEGRAPHIC VELOCITY

The duration of the elementary pulse determines the telegraphic velocity, and this is defined as the reciprocal of the elementary pulse duration.

Telegraphic velocity is the number of BITS per second. If a bit lasts 1 second, the telegraphic velocity will be 1; therefore 5 seconds are needed to transmit a code (5 BITS).

If the velocity is 100 BITS per second, a BIT will have a time of:

$$\frac{1}{100} = 0{\cdot}01 \text{ secs.} \qquad 0{\cdot}01 \text{ secs.} = 10 \text{ msecs. (milliseconds)}$$

to transmit a code with a velocity of 100 BITS per second, 10 x 5 = 50 msecs. will be used.

The velocity is expressed as BAUD = BIT/sec.

The maximum telegraphic velocity is 200 BAUD.

The standard velocities are: 50 - 75 - 100 BAUD.

CHARACTERISTICAL PHENOMENA OF TRANSMISSION ON TELEPHONIC AND TELEGRAPHIC LINES

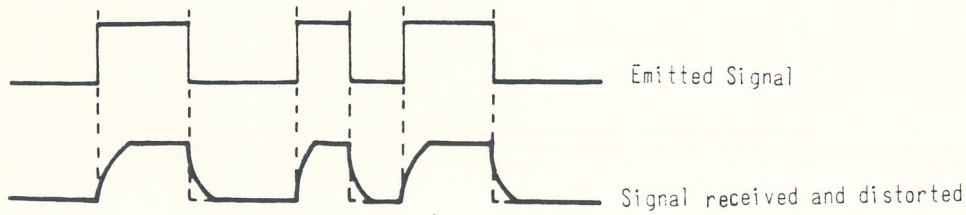
ATTENUATION

This means a decrease in the level of the signal.
E.g. if it starts as 10V after 15Km. it may be 6V. (see fig.).
Attenuation depends on the length of the line, on the electrical characteristics of the line and on the transmission velocity.
Attenuation is measured in DBm. (Decibel).
The DECIBEL expresses the ratio between the voltage of the signal at the beginning of the line and that at the end, a ratio multiplied by a certain co-efficient.

N.B. the electrical characteristics of the LINES are: resistance-capacity-inductance.

DISTORTION

This is the variation which the signal undergoes, particularly on the fronts, after running across a section of the line.
It depends on the characteristics of the line and on the telegraphic velocity (expressed in Baud).
According to the type of connection, to the type of line used and to the transmission velocity to be attained, different methods of sending the signals into the line, also called MODULATIONS, have been conceived.
To MODULATE a message means to transfer the characters of the message on the line, according to the formats anticipated by the particular connection.
To DEMODULATE a message means to transfer the characters of the message on the line to the Receiver input unit.
MODULATION and DEMODULATION are done by particular apparatus called LINE ADAPTER and MODEM (MODulators DEModulators).



The distortion is measured in % with respect to the theoretical signal.

$$\text{distortion } d = \frac{\text{maximum variation}}{\text{theoretical time}} \times 100$$

TYPES OF DISTORTION

In telegraphic connections it is important to know the total distortion but, in order to find its origin, it is useful to be able to analyze it in the various elements of which it is composed.

The following types of distortion can be distinguished:

- unilateral distortion
- accidental distortion
- characteristical distortion
- cyclic distortion

Each type has its origins in specific causes and is shown in particular forms.

Unilateral distortion

Unilateral distortion consists of a constant lengthening or shortening of the mark or space pulses. Generally the lengthening or shortening of the space pulse takes place at the cost of the mark pulses and vice-versa, so that the total time of two different pulses is constant.

This type of distortion is usually due to mal-adjustment of a system unit, as for example: teleprinter emission contacts, repeater relay contacts.

Accidental distortion

Accidental distortion is the distortion generated by accidental elements which disturb the modulation. These elements do not follow any law, they appear at random and for this reason, unlike the other types of distortion, accidental distortion cannot be foreseen.

Accidental distortion occurs for various reasons, as for example, induction, line noises, imperfect balancing of artificial lines, random oscillations in the velocity of the emission units in the teleprinters, bouncing by the emission contacts of the teleprinters or relays.
Two factors are of notable importance in the measuring of distortion:

- time: distortion increases when the observation time is increased. In fact, if the measurement is made for a limited time, the probability that all the possible causes of accidental distortion will occur is lessened.

- accuracy of the observation: since the variations due to accidental distortion occur less frequently than those due to other forms of distortion, the observer may not pay sufficient attention, thus supplying a less than accurate reading of the distortion zone.

Characteristical distortion

Characteristical distortion consists of deformation of the pulses caused by the electrical characteristics of the line.

The electrical properties of the line can incline the front of a signal in a way so sensitive that it does not allow the final value to establish itself between the time interval corresponding to the elementary pulse. It follows that the passage curve to the other significant state is conditioned by the effective value attained by the current.
Thus the distortion depends on the number of elementary pulses of the same sign which precede the front and thus on the particular sequence of signals which is transmitted.

Cyclic distortion

This is the deformation of the signal which is repeated regularly with each cycle and is due to imperfections in construction or in the functioning of the emission units; a badly cut cam could cause the incorrect length, for example, of every third code pulse.

Effect of velocity on the distortion

In a telegraphic connection, when the teleprinter does not work at the prescribed velocity, it is as if the pulses were affected by a special distortion, which varies with the place that the pulse occupies in the modulation.

If, for example, a transmitter operates at a velocity 5% higher than the nominal one, the emitted pulses will be 5% shorter and, if there is a 50 Baud modulation, the duration of the elementary pulse becomes 19 ms. The shift of the significant instant is added with each pulse, and the end of the 5th pulse will no longer take place 120 ms from the start, but at 114 ms with a variation of 6 ms. (Fig. A).

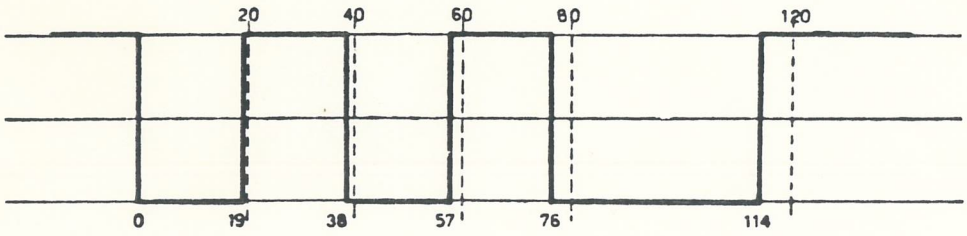


Fig. A

The arhythmic distortion of this modulation is:

$$d = \frac{\text{maximum variation}}{\text{theoretical time}} = \frac{6}{20} \times 100 = 30\%$$

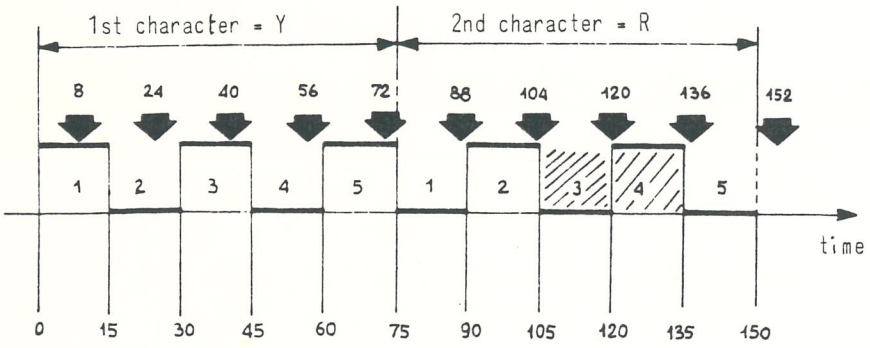
The distortion of the single pulses grows in a linear direction by 5% with each pulse (10% at the first pulse and 30% at the stop).

When, in a telegraphic connection, it is the receiving teleprinter which does not operate at the prescribed velocity, there is the same effect as if a distorted signal was being received.

In fact, if the receiver operates for example at a velocity 5% higher than the nominal one, the interval between one sensing instant and the subsequent one will be about 5% shorter, or 19 ms instead of 20 ms. The sequence of sensing instants will thus be anticipated with respect to the one prescribed, with the same result that there would be if the modulation was affected by a distortion.

START - STOP - SYNCHRONOUS - ASYNCHRONOUS

During consecutive transmission of several characters on the line it happens that, if the reception unit velocity is slightly different from that of the transmission unit, there is disparity between the transmitted characters and the received ones.



Let us suppose that the BITS of the received characters have a 15 msec. duration (the character will be of 75 msecs.).

Let us also suppose that the reception unit has BIT = 16 msec. time.

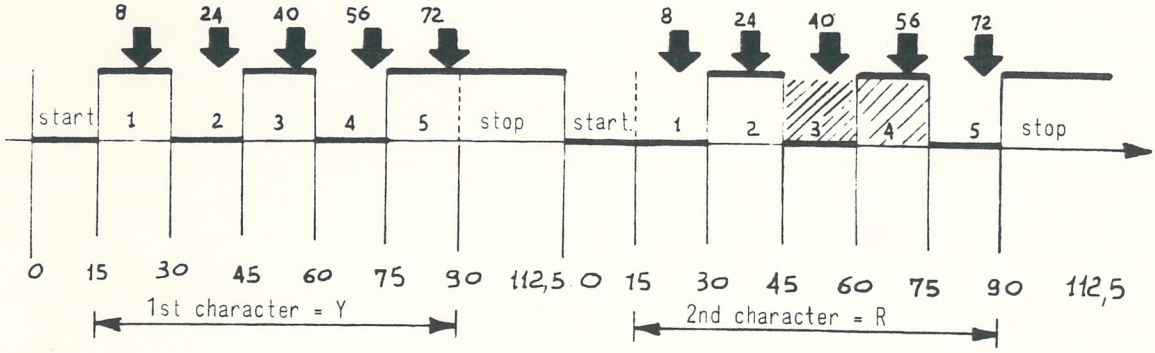
When the reception unit receives the 1st BIT it starts off a timer which should be set for 15 msecs. (that is, equal to the BIT received; in the case of the diagram the reception unit has BIT = 16 msec. time.).

The reception unit, half-way through its BIT time, senses the received BIT and records its relative value (1 or 0).

As can be seen in the diagram, the 1st character is read well; the 2nd is not since the 3rd and 4th BITS of the 2nd character would not be read; thus in place of character R another character would be read and sent into the reception unit.

It is evident that there are errors even when the BIT time of the receiver is shorter than that of the transmitter.

To obviate this defect, by adding a START BIT at the head of each character and a STOP BIT at the tail, the timing of receiver BITS on the arrival of each character is started and stopped.



The START (which is a BIT equal to the others) has level 0.

The STOP (which in telegraphy has duration 1 + 1/2 BITS) has level 1, consequently a character is formed of 7.5 BITS.

START and STOP are added to the code by the serializer.

START and STOP are eliminated by the parallelizor.

In fact, the mechanics of the teleprinter use only the 5 BITS of the CODE.

N.B. The teleprinter checks the single CODE BITS.

This type of transmission is called ASYNCHRONOUS or ARHYTHMIC because with each START we give a synchronism to the receiver.

The STOP is normally made up of 1 + 1/2 BITS for mechanical reasons concerning the teleprinter.

In SYNCHRONOUS or RHYTHMIC transmission the START and STOP BITS are lacking; however, the transmitting and receiving units are electronic.

SYNCHRONOUS transmission is not used for teleprinters.

THE TELEPRINTER: BASIC BLOCK DIAGRAM

This consists of 2 principal parts:

EMITTER which is made up of:

Keyboard with parallel mechanical output of the code BITS.

Serializer transforms into serial electrical pulses the codes received in parallel from the keyboard; moreover, it adds the START and STOP to the CODE and transmits this into the line.

RECEIVER which is made up of:

EM reception electromagnet transforms into mechanical pre-settings the electrical pulses received from the line, passing them to the PARALLELIZOR.

Parallelizer receives the mechanical pre-settings from the EM and parallelizes the code by eliminating the START and STOP.
N.B. The START is used to make the mechanical cycle of parallelization start; the STOP, to make this same cycle stop.

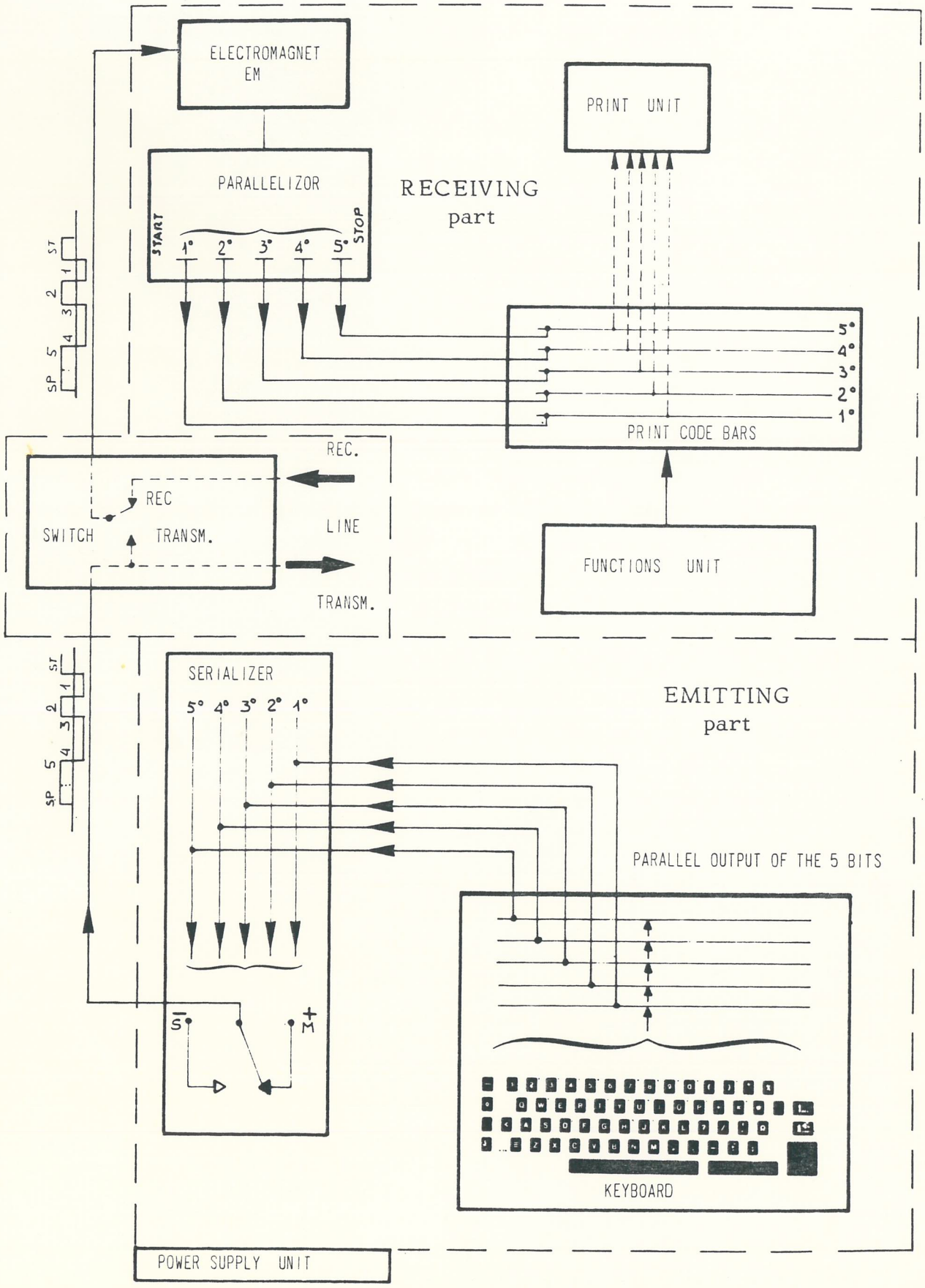
Print code bars receive the code in parallel from the parallelizer.

Functions unit decides, according to the code present on the print code bars, the execution of the function relative to the code itself. Example: it prints a printable character or operates the interline etc.

Print unit is the character printing unit.
The power supply unit, as already seen, supplies the telegraphic line with power, i.e., supplies the serializer emission contacts.

The switch connects the EM electromagnet with the transmission or reception line; in transmission for off-line printing of the transmitted text, in reception for printing of the received text.

MAIN TELEPRINTER DIAGRAM



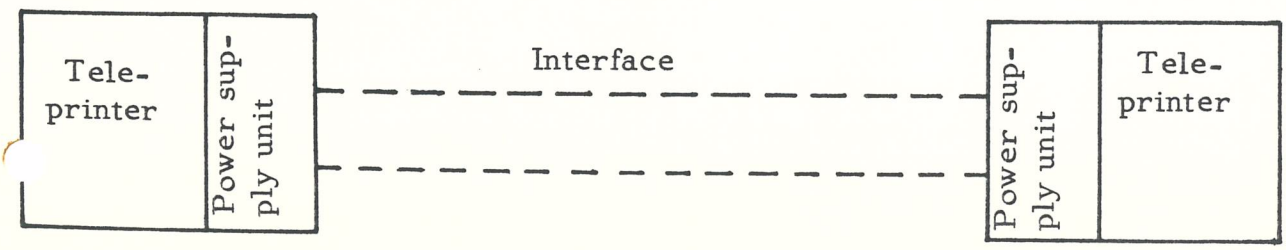
TELEGRAPHIC INTERFACE

C.C.I.T.T.(International Telegraphic and Telephonic Consultative Committee)

Mechanical coding	MARK	SPACE
Binary value	1	0
Perforation on tape	Hole	No hole
Single current (s.c.)	+ 60V +80V +120V	No current (circuit open)
Double current (d.c.)	+ 48V + 60V	- 48V - 60V

US-UK (United States-United Kingdom)

Mechanical coding	MARK	SPACE
Binary value	0	1
Perforation on tape	Hole	No hole
Single current (s.c.)	+96V +120V	No current (circuit open)
Double current (d.c.)	+48V +80V	-48V -80V



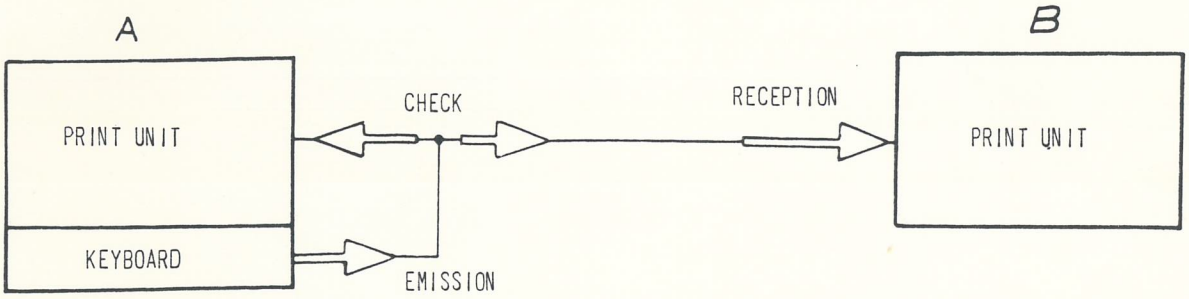
CONNECTIONS AND TELEGRAPHIC TRAFFIC

Index

CONNECTIONS - TELEGRAPHIC TRAFFIC

Unidirectional traffic or simplex

There is a unidirectional connection between two users when the telegraphic messages are permanently emitted from one side and received (only) by the other.

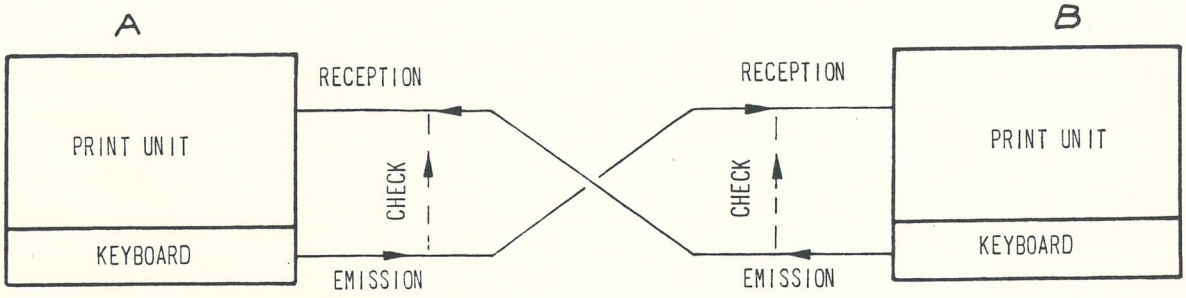


User A emits (by means of a typewriter keyboard) and checks the printing of the message being sent out; simultaneously user B receives, through the line, the information in arrival.

These connections generally take place between printing agencies (emitting station) and newspaper centres, between stock exchanges and banking offices etc.

Alternate traffic or half-duplex

There is half-duplex (alternate) when the exchange of messages between two users is done alternately.

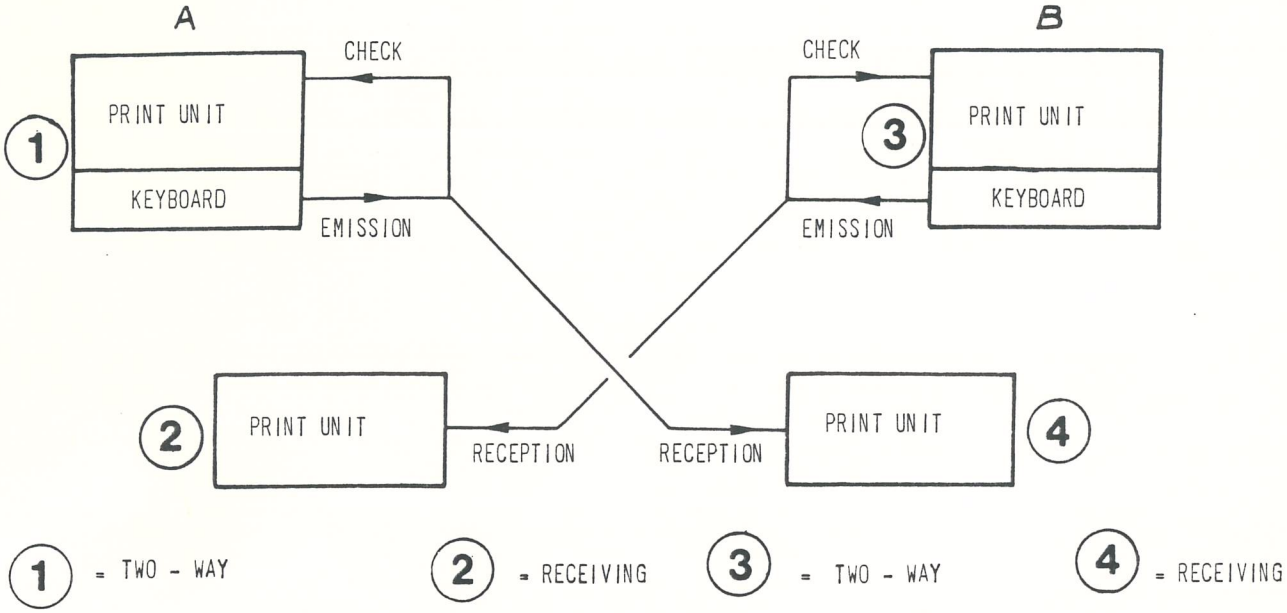


User A emits and checks, user B receives.
The same thing takes place in the opposite direction, but not simultaneously.

Simultaneous traffic or duplex

Connection in duplex consists of two unidirectional connections, independent of each other, for each user.

Therefore this connection needs 4 machines (two TWO - WAY and two RECEIVING only).



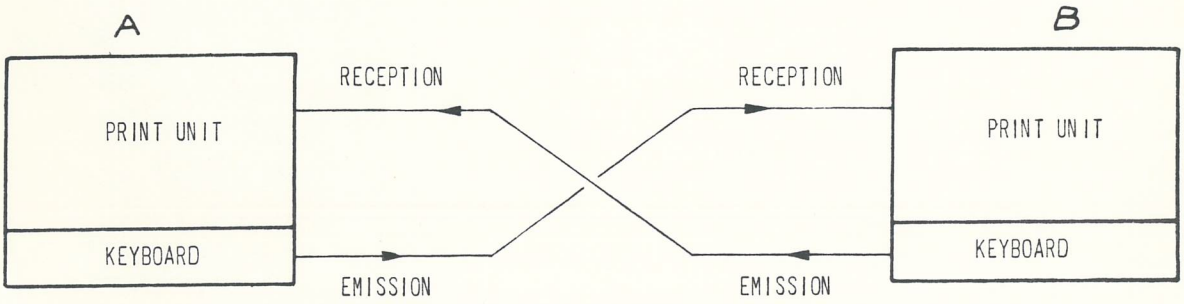
User A emits and checks on the print unit of his two - way machine.

Simultaneously he receives the message coming from B on the second machine.

This procedure applies for user B.

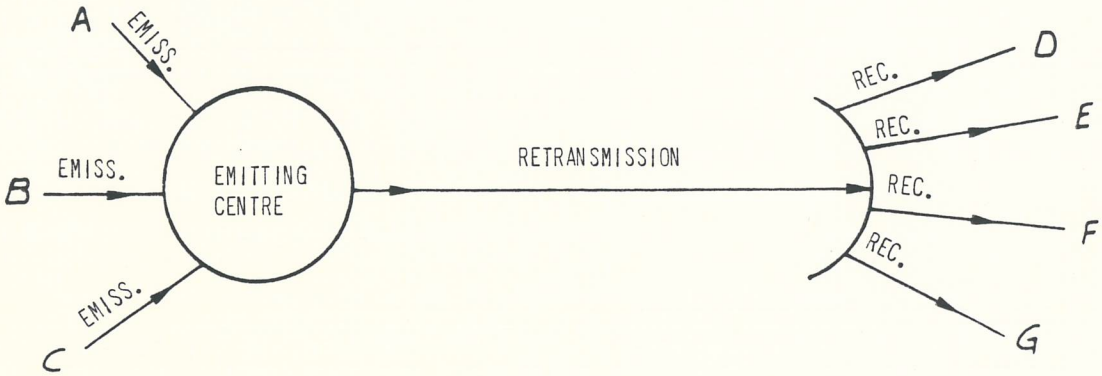
Duplex traffic (without control)

If a simultaneous connection between two users is required, with only two machines available, a duplex without control is effected.
User A emits towards B, simultaneously its print unit records the messages coming from B.
It is obvious that the operator cannot check the accuracy of the emitted text, but must rely only on his typing capabilities.
If the visible signal of the print unit position is missing (i.e. print unit linked to the correspondent), to command the return to the beginning of the line and interline of the print unit, it is necessary to keep count of the number of strikes made.



Unidirectional traffic (for diffusion)

When a telegraphic set emits to several users simultaneously, there is a connection with unilateral traffic, which is more correctly called diffusion.
An emitting station (printing agency, stock exchange, meteorological centre etc.) emits a certain amount of news accumulated from information sets to receiving users.



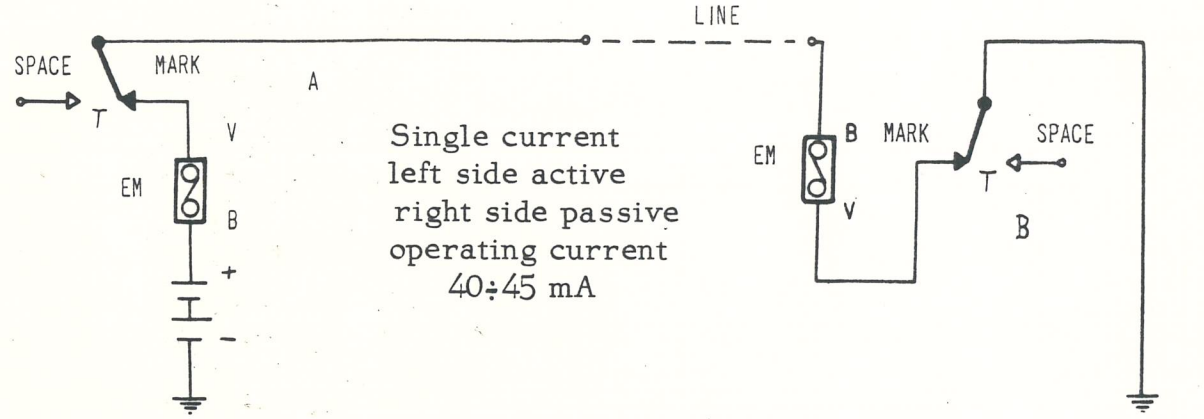
A-B-C could, for example, be printing agency correspondents.
The emitting centre (Agency) distributes the collected news to users D-E-F-G-H (Newspaper centres).

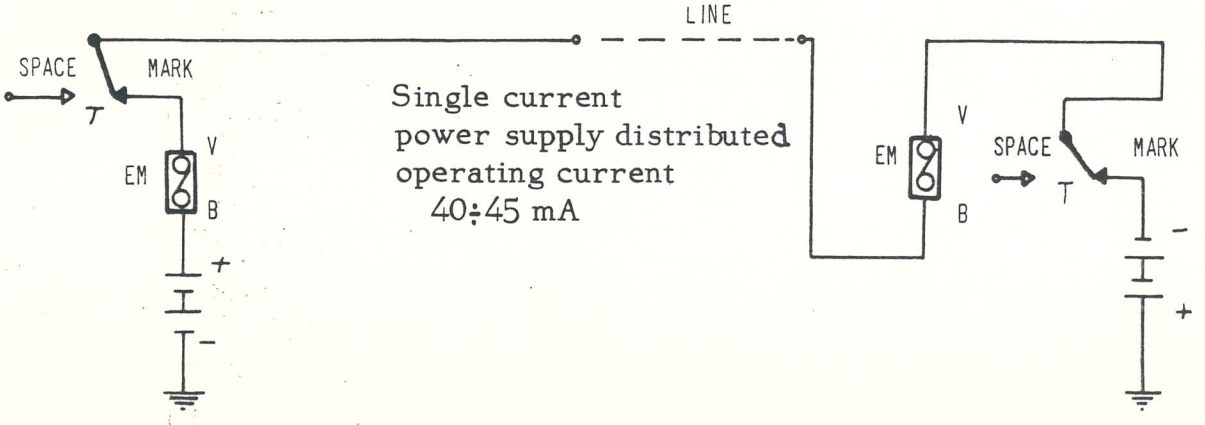
CONNECTIONS - BASIC DIAGRAMS

Operation in single current with half-duplex traffic

2 WIRES - or 1 WIRE and common return with earth.
The units of both the machines, that is emission contacts T and the EM reception electromagnet, are connected in series with the power supply source.
When there is no transmission in the circuit, a holding or mark current passes.
The emission determines the opening and closing of the emission contact and consequently, in the circuit, the interruptions which represent the space pulse.
Only station A is directly supplied with power, therefore it is called the active side; station B is the passive side.
When the line is well isolated, that is, when there is no dispersion of current to earth, the power supply is available in one station only and the operating current is of the same value in both stations.
In lines with strong dispersion however, the current would be unbalanced; to make the regular operating current reach the passive side, the active side must supply, not only the normal current, but also that which the line is dispersing constantly to earth. To avoid over-loading of one side, the power supply is made available in both stations.

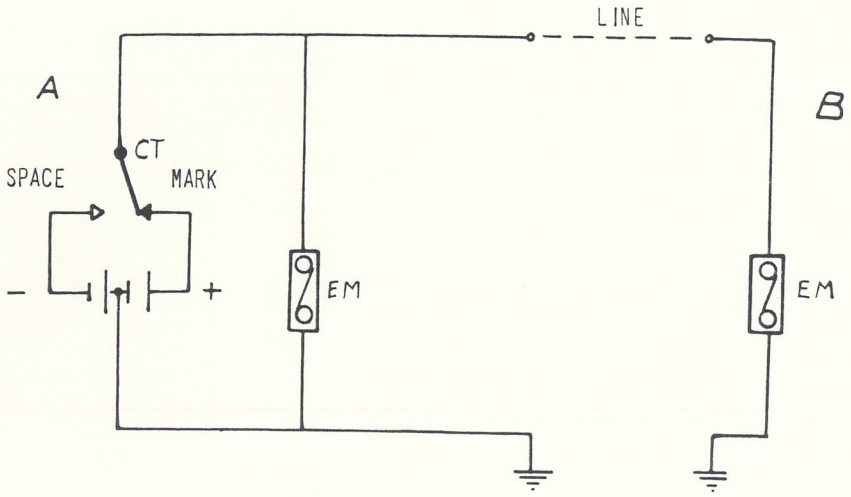
Characteristics - The presence of a mark holding current prevents the disturbing currents, generated for induction on the line, from causing the machine to start. Because of the presence of the holding current, the system consumes power even when it is not operating.
Single current is used on aerial lines for connections up to about 100 Km.





Operation in double current with simplex traffic

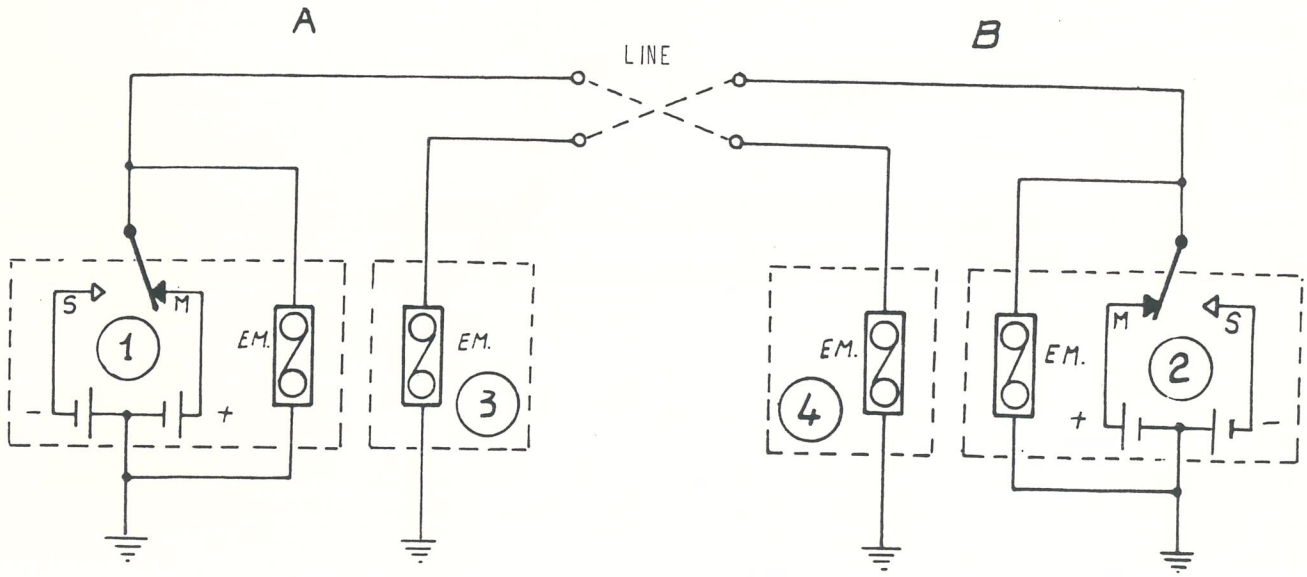
2 WIRES - or 1 WIRE and common return with earth.



The line between teleprinters A and B is made up of a sing wire with return to earth.
Transmission contact CT of teleprinter A, when it rests on the mark contact (machine at rest or mark bit), connects the + pole of the battery to the line, determining the current's circulation direction.
The latter reverses its circulation direction when contact CT commutes on the space contact (space bit).
The EM electromagnets of teleprinters A and B will therefore be polarized according to the direction of the current.
The line current is 25÷30 mA.

Operation in double current with duplex traffic

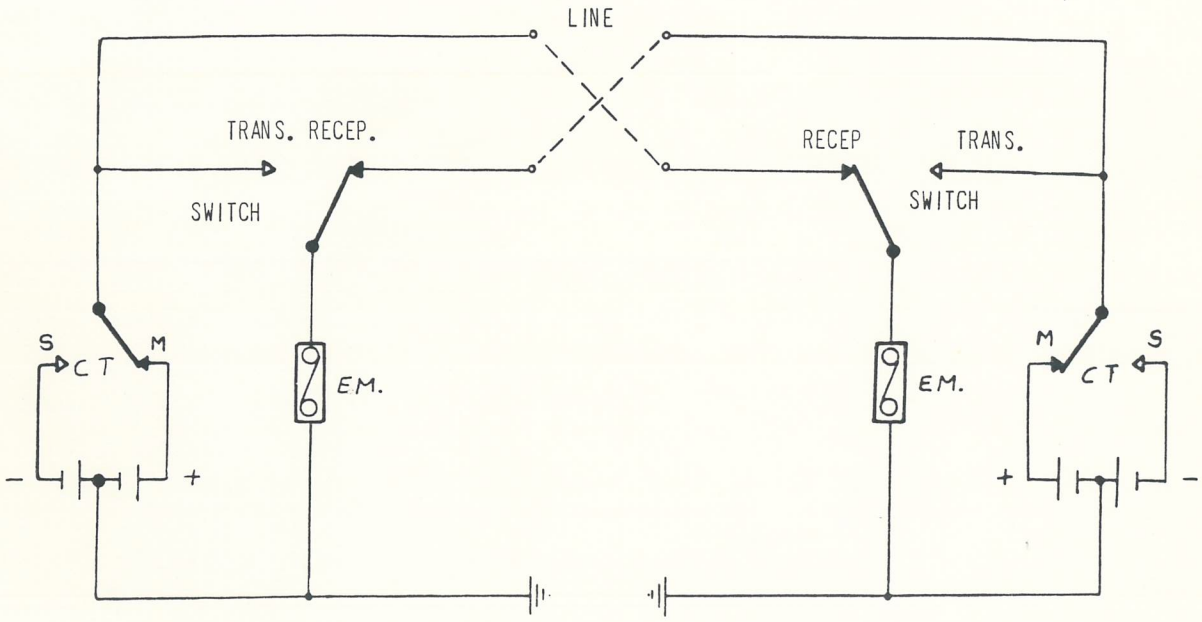
4 WIRES - or 2 WIRES with common return to earth.



User A has available teleprinter 1 (two - way) and teleprinter 3 (receiving only).
User B makes use of teleprinters 2 (two - way) and 4 (receiving only).
Power is supplied by the 2 batteries and the line is made up of 2 wires with return to earth.

Operation in double current with half-duplex traffic

4 WIRES or 2 WIRES and common return, through earth.



With the machine at rest the switch is in reception, and this connects electromagnet EM with the reception line coming from the other teleprinter.

When the teleprinter goes into transmission, its switch commutes and its EM is connected for off-line control; when the transmission is finished the switch returns to reception.

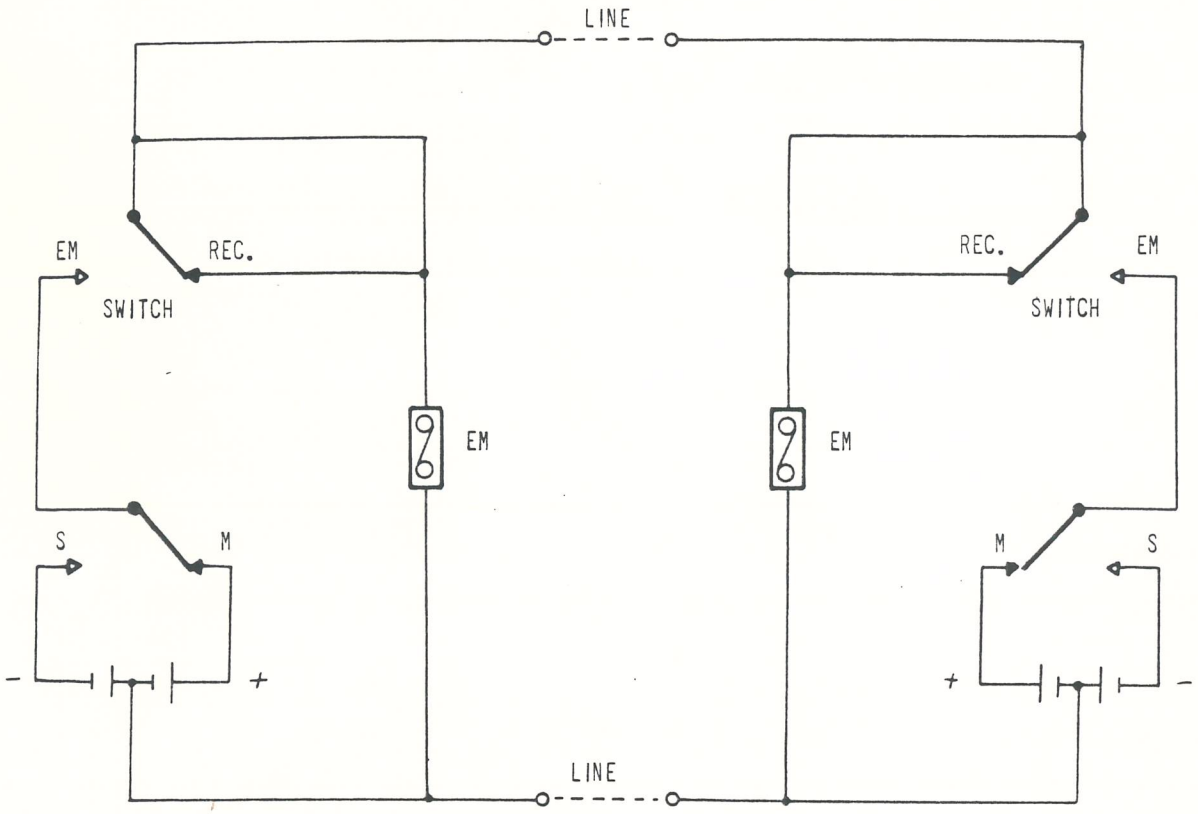
Thus the switch has the task of connecting its EM in off-line control for the transmission; on-line for the reception.

Characteristics - Connection in double current is used on lines with strong dispersion where it gives better results than those given by connection in single current.

Connection in double current is also used on aerial lines which, if in good condition, give efficient transmission for up to 400 Km.

Operation in double current with half-duplex traffic

2 WIRES



In this case, with the machine at rest, there is no circulation of current, therefore the armatures of the electromagnets are maintained in the mark position by the permanent magnetic field of the electromagnet itself.

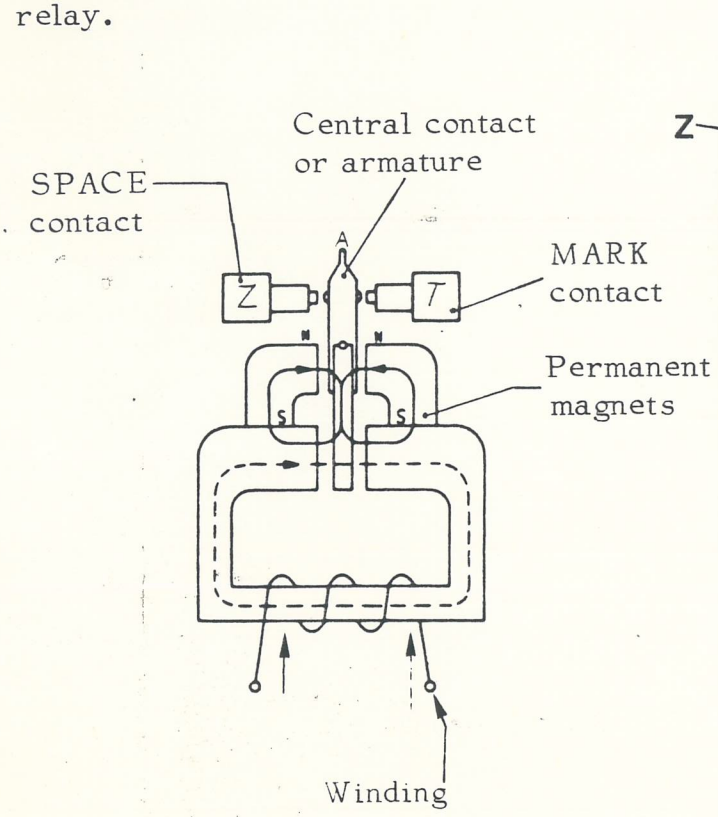
TELEGRAPHIC RELAY

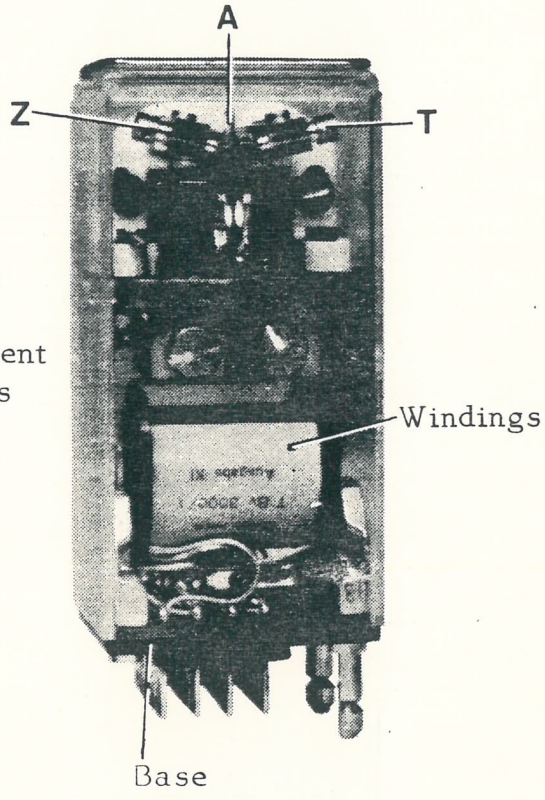
The telegraphic relay may be used in telegraphic circuits with s.c. or d.c. power supply.

In this description we will refer always to the SIEMENS relay, normally used in the Olivetti telegraphic apparatus.

The operating principle of this relay is similar to that of a polarized electromagnet, with the difference that it makes an armature move between two limited positions which may be supplied with power.

The figure shows the basic diagram of the SIEMENS telegraphic relay.



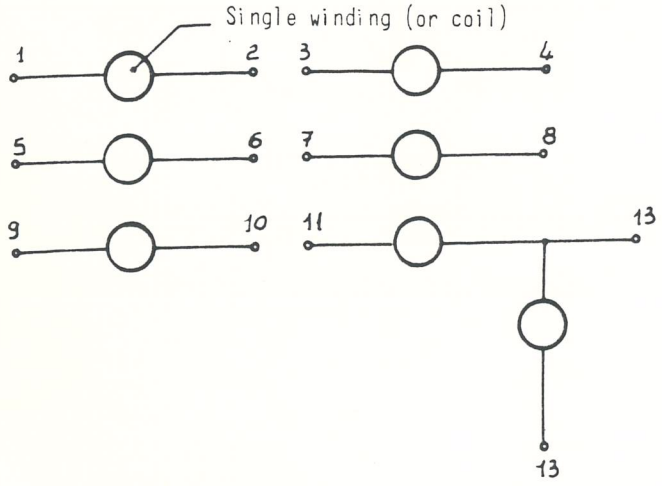


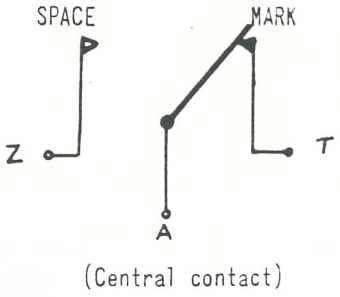
The current which runs through the winding according to its direction determines the shifting of the central contact on fixed points T and Z.

The central contact, when current is lacking in the winding, keeps its last assumed position, maintained by the magnetic force generated by the two permanent magnets.

The telegraphic relay, in order to adapt to the different circuits, (s.c. and d.c.) is provided with several windings; in this case the shifting of the armature or central contact depends on the results of the forces generated by the single coils, when current runs through them.

The windings of the SIEMENS relay are represented schematically in the figure.





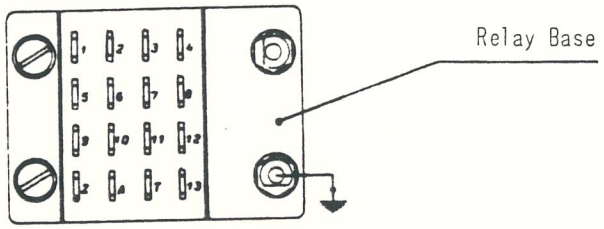
1 - 2
3 - 4
5 - 6
7 - 8
} Turns 1250 - 120 Ω

12 - 13 Turns 5000 - 2000 Ω

9 - 10
11 - 12
} Turns 300 - 26 Ω

When the current runs through the windings in the 1→4, 8→5, 9→12 - 13 direction, the central contact is carried onto side T (Mark), vice-versa onto side Z (Space).

The numbers and letters which indicate the windings and the contacts are carried back onto the relay base.



N.B. In our applications windings 9-10 11-12 12-13 are not normally used.

Use of the telegraphic relay

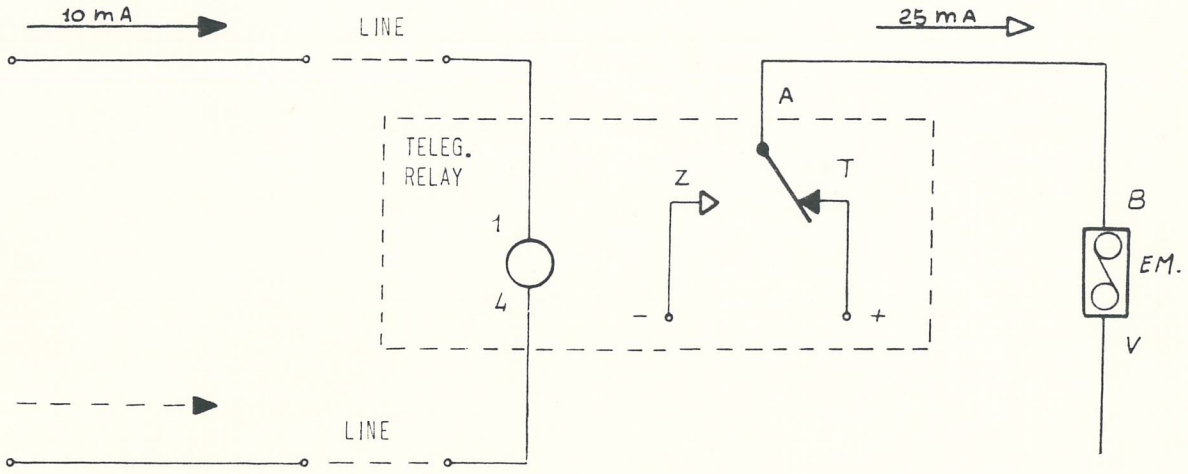
We will now see the classic use of the relay as a line auxiliary. If, in a telegraphic circuit, for example in d.c. with half-duplex traffic, the current which flows along the reception line is of a lower value to the d.c.'s nominal value (25 + 30 mA), there corresponds a bad restitution of the electromagnet with reduction of the teleprinter's margin.

Since the line current (when it has a lower value than the nominal one) cannot directly drive the teleprinter electromagnet, the relay is inserted before the electromagnet.

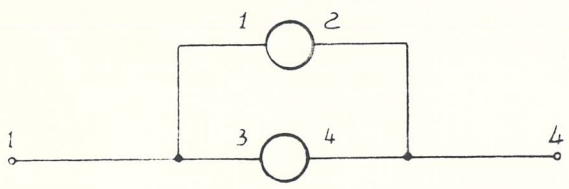
A very important characteristic of the latter is that it can operate correctly with very low current values; with the variation of the current on the line it detects a local voltage which it applies directly to the machine's electromagnet.

When the current runs through the relay windings in the 1 → 4 direction, it carries central contact A onto T. Given the positive voltage applied to counter T we will have a nominal (local) current of 25 mA which runs through the windings of the machine electromagnet.

When the line current reverses direction, running through the windings 4 → 1, central contact A is carried to side Z. In this case there will be a negative current of 25 mA.

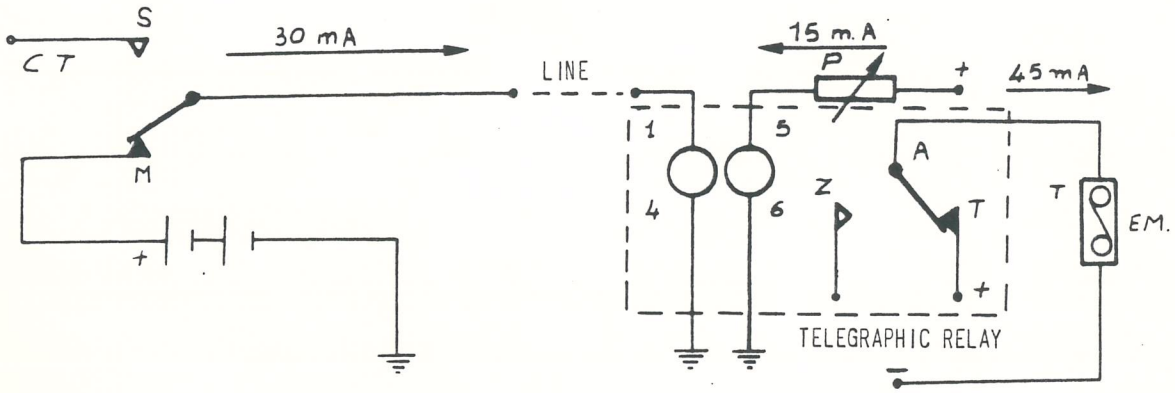


Windings 1 - 2, 3 - 4 are connected stably in parallel and in conformity.



Since they are applied on the telegraphic circuit, these two windings are known as 1 - 4 on the terminal board.

Telegraphic relay in single current



To be able to operate in s.c. the telegraphic relay must be equipped with a mechanical or electrical unbalance, which guarantees the shift of central contact A onto Z when there is an interruption of current on the line.

Whilst in the teleprinter electromagnet the unbalance was obtained by means of a mechanical aid (spring), in the telegraphic relay a winding is used in opposition to the one through which line current runs.

So that the transit of the central contact is balanced as an exchange force, the current which runs through the unbalance winding must be exactly half the line current.

Example: with line current equal to 30 mA, unbalance current 15 mA.

There is still the inconvenience of circuits in s.c., that is, if the line current varies, the unbalance current does not, therefore according to the variation of line current by 30 mA more or less, transits to MARK or vice-versa will be preferred.

A 15 mA fixed current, regulated by potentiometer P, runs through winding 5 → 6 and carries central contact A onto Z.

With contact CT on M (mark), closed circuit, 30 mA run through windings 1 → 4.

As we saw before, if the current goes in the direction shown 1 → 4, the central contact detaches from Z and goes onto T.

Since the two currents are simultaneous, the resultant of the two forces: 30 mA from Z → T and 15 mA from T → Z carries central contact A onto T with a force of 15 mA.

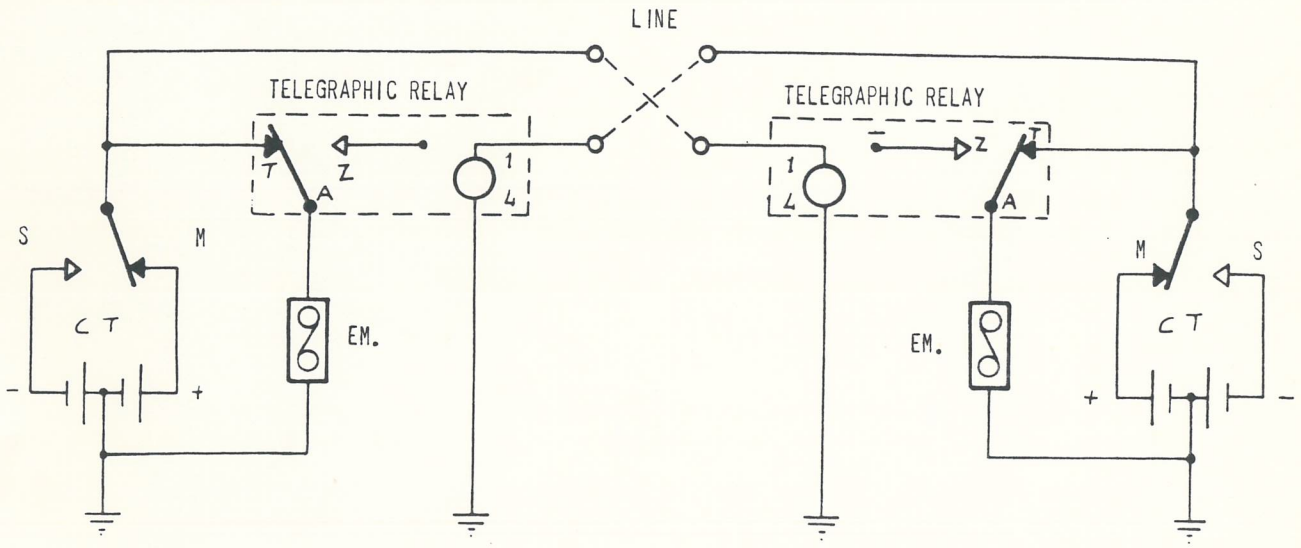
When contact CT passes to the SPACE (S) side, the circuit is interrupted, the 30 mA of line current are missing, however the fixed 15 mA remain, which, given the unvaried 5 → 6 direction, carry A onto Z.

Electromagnet EM is driven to MARK with a local current of 45 mA, (+ of contact T of the Relay - on the EM), to SPACE by means of the unbalance spring.

N.B. - the "-" of the EM and the "-" of contact Z of the Relay have the same potential, therefore the current does not circulate in the Relay.

Telegraphic relay - in double current with half-duplex traffic

In this case the Relay can replace the teleprinter switch in its operation.



With the machine at rest the current which runs through the line (holding current) is earthed by windings 1 → 4.

Therefore central contact A is maintained on contact T supplied by c act CT.

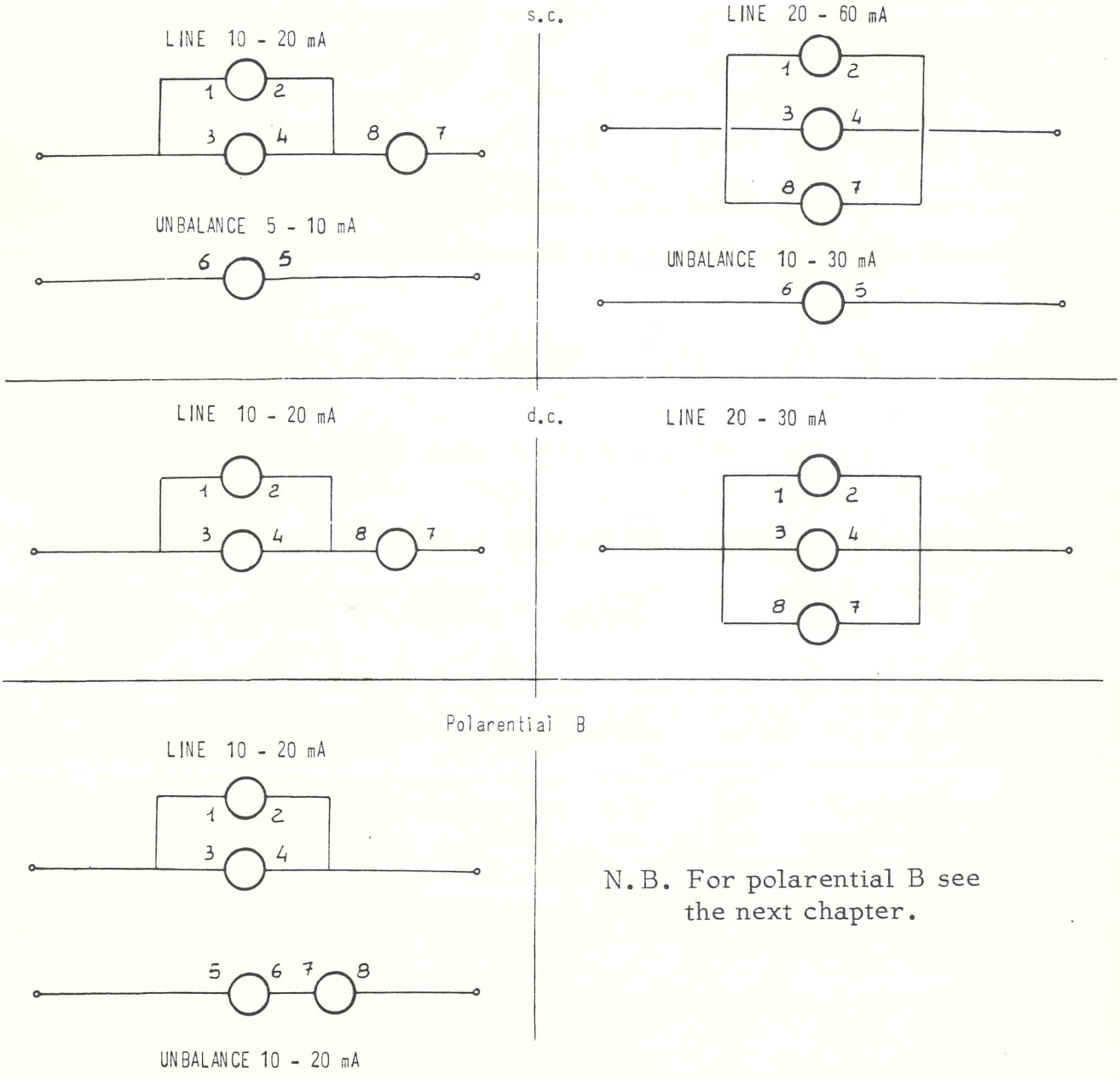
In transmission the positive and negative currents of contact CT do not run through windings 1 → 4 of the transmitting set, whereas they run through windings 1 → 4 of the receiver.

The correspondent carries contact A onto Z when it sends a negative current which runs through the windings in the direction 4 → 1.

In reception the power supply of the EM is given by:

- BIT received MARK = + contact CT
- BIT received SPACE = - contact Z

To maintain the value of the current which runs through the windings of the telegraphic Relay at nominal levels, the windings may be connected in series or in parallel, as shown in the diagrams,according to the line currents:

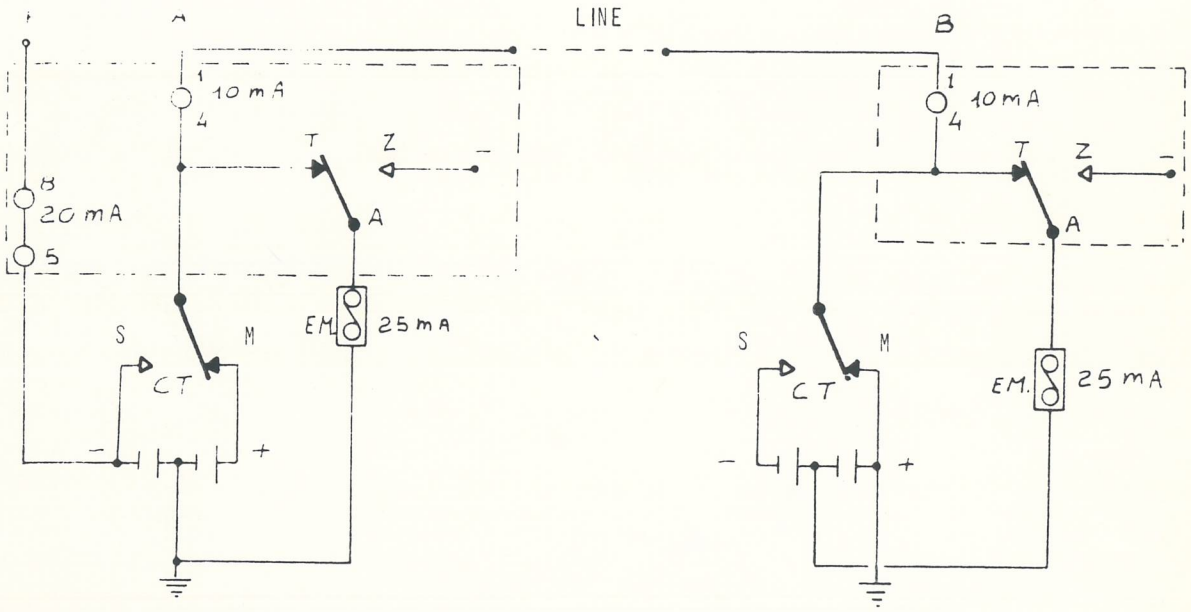


N.B. For polarential B see the next chapter.

The necessary changes to be made on the telegraphic Relay windings are made after the base, therefore the Relays may be replaced on any circuit without altering the characteristics of the latter.

POLARENTIAL B

Half-duplex connection, polarity + at rest - 1 wire - common return.



This system appears as a hybrid of single current and double current.

For OFF-LINE control electromagnets EM of teleprinters A and B work in double current.

The Relay of machine B works in double current.
The Relay of machine A works with variation of current intensity.

In rest conditions the 10 mA line current (+ contact R machine A ⏚ contact R machine B) runs through the Relay of machine B in the direction 1 → 4 and maintains contact A on T.

The line current always runs through the winding of machine A in the direction 4 → 1 (10 mA); a 20 mA current runs through the windings in the direction 8 → 5.

The current which runs through 8 → 5 pushes contact A onto T, current 4 → 1 pushes contact A onto Z; contact A is therefore carried onto T.

To avoid distortions, the current which runs through windings 8 → 5 must be double the value of that which runs through windings 4 → 1.

When terminal A transmits, terminal B receives a ± 10 mA current; its contact A shifts from T to Z and vice-versa.

For OFF-LINE control of machine A, contact a will always be on T, in fact:

for the SPACE BITS 20 mA 8 → 5 + 10 mA 1 → 4 = 30 mA
for the MARK BITS 20 mA 8 → 5 - 10 mA 4 → 1 = 10 mA
} A on T

When terminal B transmits, terminal A receives:

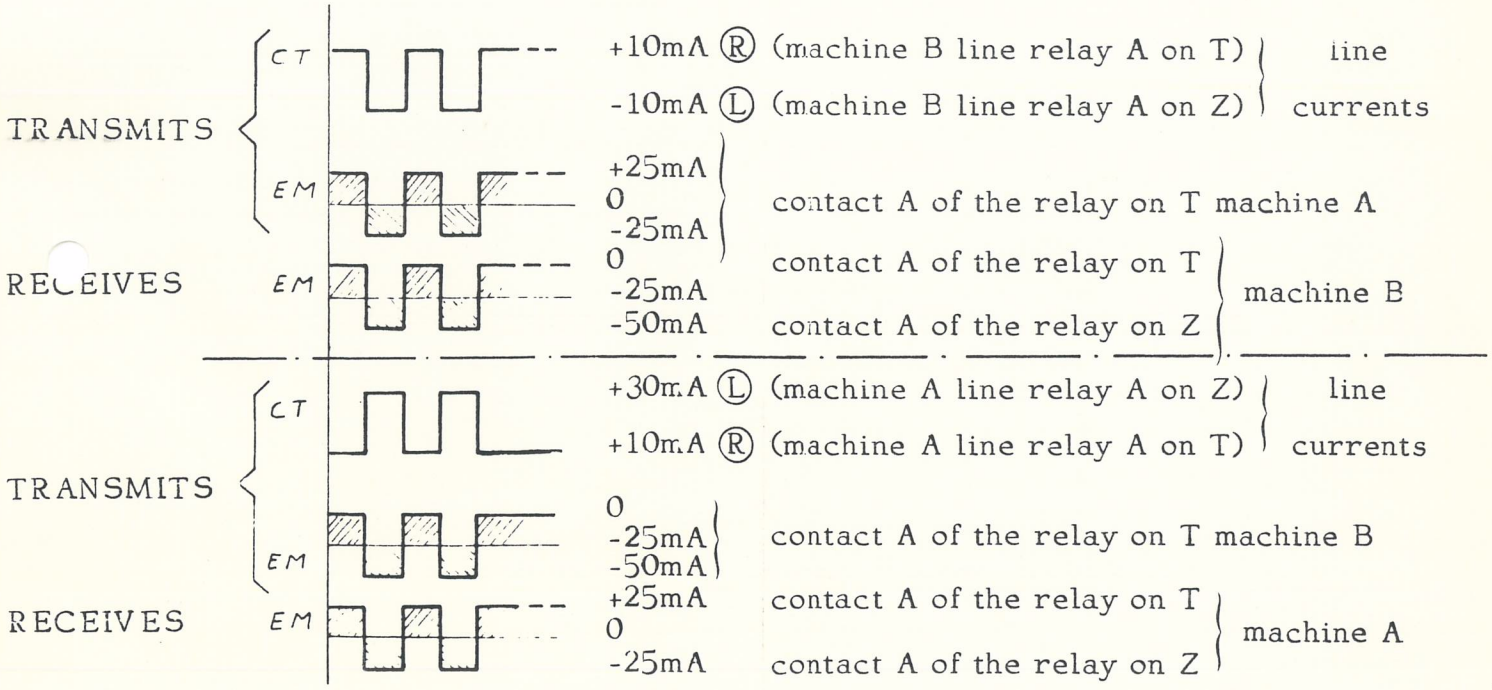
- SPACE BIT = - 30 mA due to - of battery B + of battery A.

The -30 mA which run through Relay windings 4→1 of machine A in opposition to the fixed + 20 mA of windings 8→5 take armature A onto contact Z.
Contact Z is supplied by negative voltage, electromagnet EM of machine A is carried to the work position.
OFF-LINE control of machine B is maintained by the 30 mA of windings 1→4 which maintain contact A on T.

MARK BIT = - 10 mA due to the + of the battery of machine A and the earth of the battery of machine B.

The -10 mA which run through Relay windings 4→1 of machine A are annulled by the +20 mA which run through windings 8→5; therefore armature A returns to contact T; the electromagnet EM of machine A is carried to the MARK position.

Characteristics - The polarential system has the advantage of having a holding current which means that the connection is not very sensitive to the effect of the disturbance currents; it lends itself to being used with satisfying results on single-wire lines with strong dispersion, where all the other connection plans give a rather poor performance, when there is in fact any performance.



ADVANTAGES AND DISADVANTAGES OF THE s.c. and d.c. SYSTEMS

s.c. systems with current at rest (C.C.I.T.T.)

Advantages:

a) Any fall of the line signalled by the reception units.
b) Simplicity of the system.

Disadvantages:

a) Great waste of energy due to the permanence of the current on the line, even during rest periods.
b) Necessity of accurate regulation of the unbalance of the reception electromagnet.
c) Only slight sensitivity.

d.c. systems, polarity + at rest (C.C.I.T.T.)

Advantages:

a) High sensitivity (very weak signals can be received and thus the currents involved may be small, and for this reason the disadvantage of the ever-present current is reduced to negligible levels).
b) Possibility of signalling of the fall of the line, thus there is no risk of loss of messages.
c) Security in communication due to the absence of accurate regulations on the reception units.

Disadvantages:

a) Complexity of the system (it requires a source of double power supply).
b) Necessity of another symmetrical system to make bidirectional traffic possible.

CONNECTIONS IN ALTERNATING CURRENT

In order to make possible transmission of telegraphic signals at a great distance and to increase the efficiency of the communication channels, the use of alternating currents with determined acoustic frequencies has been introduced into telegraphy; that is, frequencies which are included in the range transmitted by normal telephonic connections.

Acoustic telegraphy offers the following advantages:

- the telegraphic signals, made up of currents of the same nature as telephonic currents, may be put into telephonic communication channels, amplified by telephonic type amplifiers and transmitted via radio;

- the telegraphic signals, being characterized by currents of well-determined frequencies, may be separated, by means of filters, from any other current which has a different frequency; thus on the same transmission channel a telegraphic and a telephonic communication, or several telegraphic channels which use different frequencies, may be supérimposed without the different communications interfering with each other.

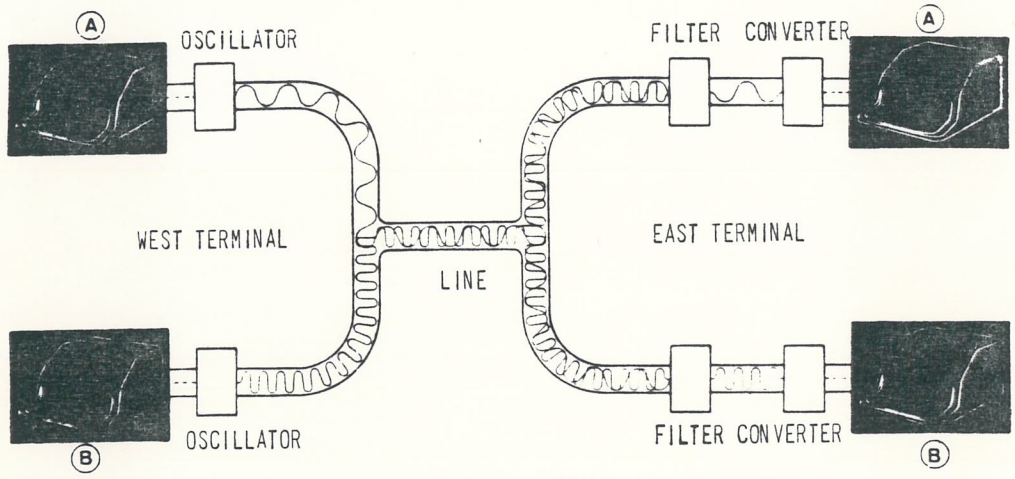
Harmonic channels for multiple telegraphy

These consist of several simultaneous telegraphic transmissions, conveyed on a single connection, obtained by modulating frequencies which are sufficiently distant from one another so that they do not interfere with each other.

The users sets are connected in direct current to the telegraphic terminal, which is an apparatus which converts the direct current pulses coming from the single teleprinters into as many wave trains which have a different frequency for each teleprinter; these frequencies are at 120 Hz distance from one another.

The wave beam thus obtained is conveyed on a single communication channel and received at the other end by another terminal which, by means of filters, separates the original frequencies and sends them individually, after re-converting them into direct current, to the corresponding users sets. The operation is shown schematically on page 19.

A complex of channels meeting at a terminal is called a "system", generally the systems carry up to 18 channels and are used for connections on cables or via radio.



OPERATING PRINCIPLES OF MULTIPLE TELEGRAPHY WITH ACOUSTIC FREQUENCIES

The WEST terminal oscillators convert the direct current pulses, emitted by teleprinters A and B, into two pulse trains which have different frequencies and thus convey them on the same connection line.

On arrival at the EAST terminal the frequencies are sent to the two filters, each of which allows the frequency of its own calibration to pass, whilst it opposes the passage of all the remaining ones.

The frequencies which have crossed the filters are reconverted by the two converters into direct current pulses and sent to the teleprinters.

Machines A-A and B-B communicate between themselves as if they were connected by means of distinct lines.

In the harmonic channels systems, up to 18 different frequencies may be conveyed along the same communication channel.

The frequencies are at 120 Hz distance from each other and cover the 300-3000 Hz telephonic band.

At present harmonic telegraphy also makes great use of co-axial cables, recently put into use, in which the conductors, rather than being adjacent, are arranged concentrically one in the other and kept at a distance by isolating washers.

This arrangement grants the cables electrical qualities which allow a very high number of channels to be simultaneously put into a single connection.

The notable advantages offered by co-axial cables outweigh their greater cost and justify their present increasing use in the telecommunications field.

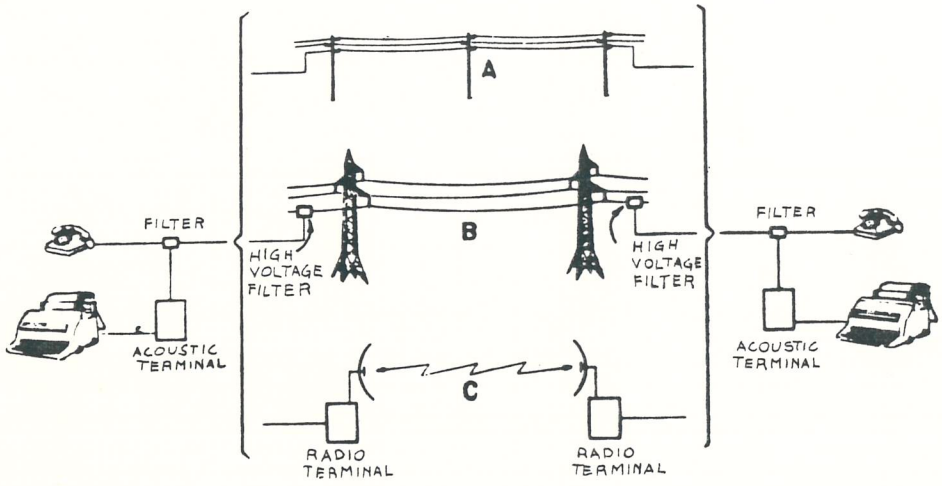
Single channel

For telegraphic use of telephonic connections, characterized by lack of metallic continuity and thus suitable for conducting only alternating currents with acoustic frequency, the "monoacoustic" system is used, which consists of a single channel which uses acoustic frequency currents, in the range of a telephonic band; a narrow frequency range is assigned to the telegraphic channel, whilst the remaining frequencies are used for telephonic communication.

In this way a "simultaneous" telegraphic communication is obtained which does not interfere with the pre-existing telephonic communication.

The telegraphic connection onto which the telegraphic communication is superimposed may be a normal telephonic line, a radio connection, or a telephonic connection made on high voltage electrical energy lines; in the latter case it is called "conveyed waves connection".

The diagram shows the different cases schematically.



Simultaneous connectionon a pre-existing telephonic communication by means of acoustic frequency. The communication may take place on normal telephonic line A, on conveyed waves connection B, and through radio bridge C, characterized by the directional aerial.

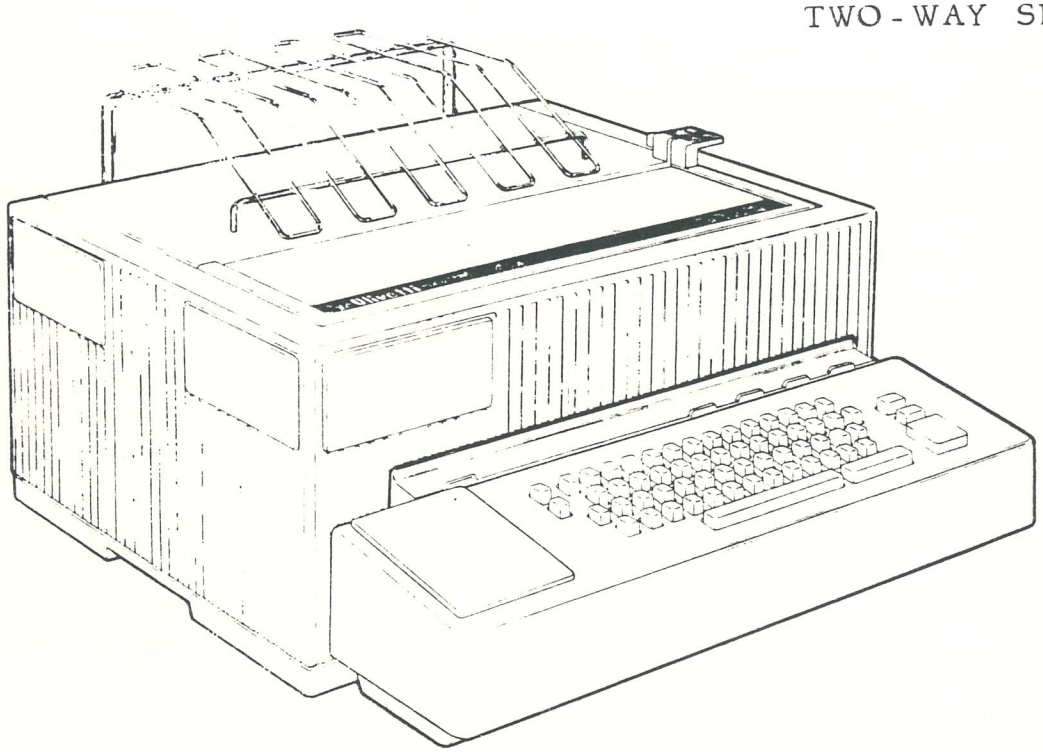
INDEX

OPERATION PRINCIPLES

FUNCTIONING

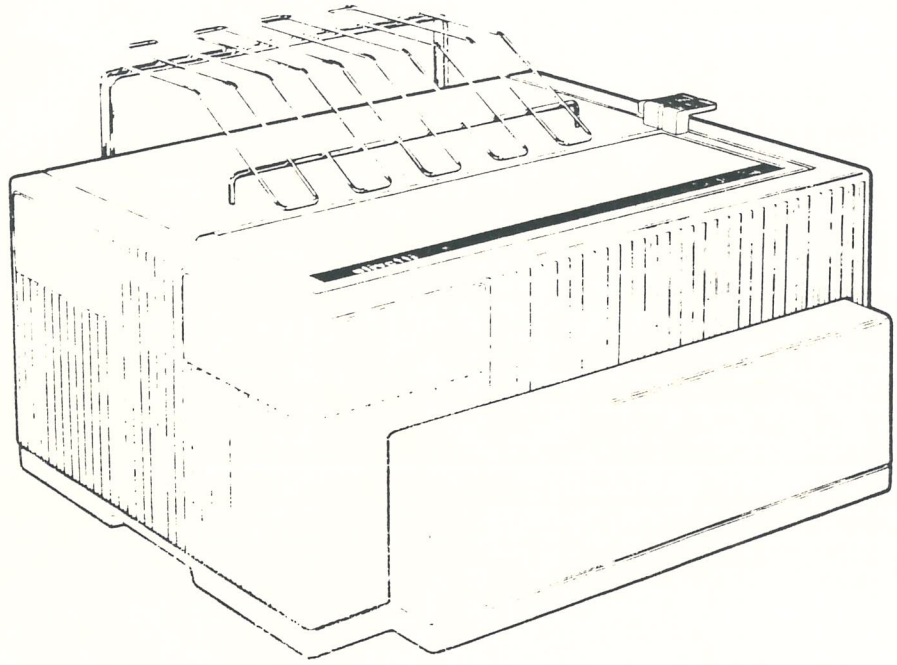
Te 315

TWO-WAY SET



Re 315

RECEIVER



EMISSION

The emitting part is made up of two principal units:

The keyboard, after the pressing of a key, carries out the movement of the 5 code bars, each one in the M/S position according to the code combination of that key.
It transfers the characters to the serializer.

Serializer commands the change from the mechanical condition to the electrical condition, through the moving of one transmission contact according to the condition of the bars, that is, of the bits constituting the code combination.

It adds the START and STOP bits which are not codified by the keyboard.

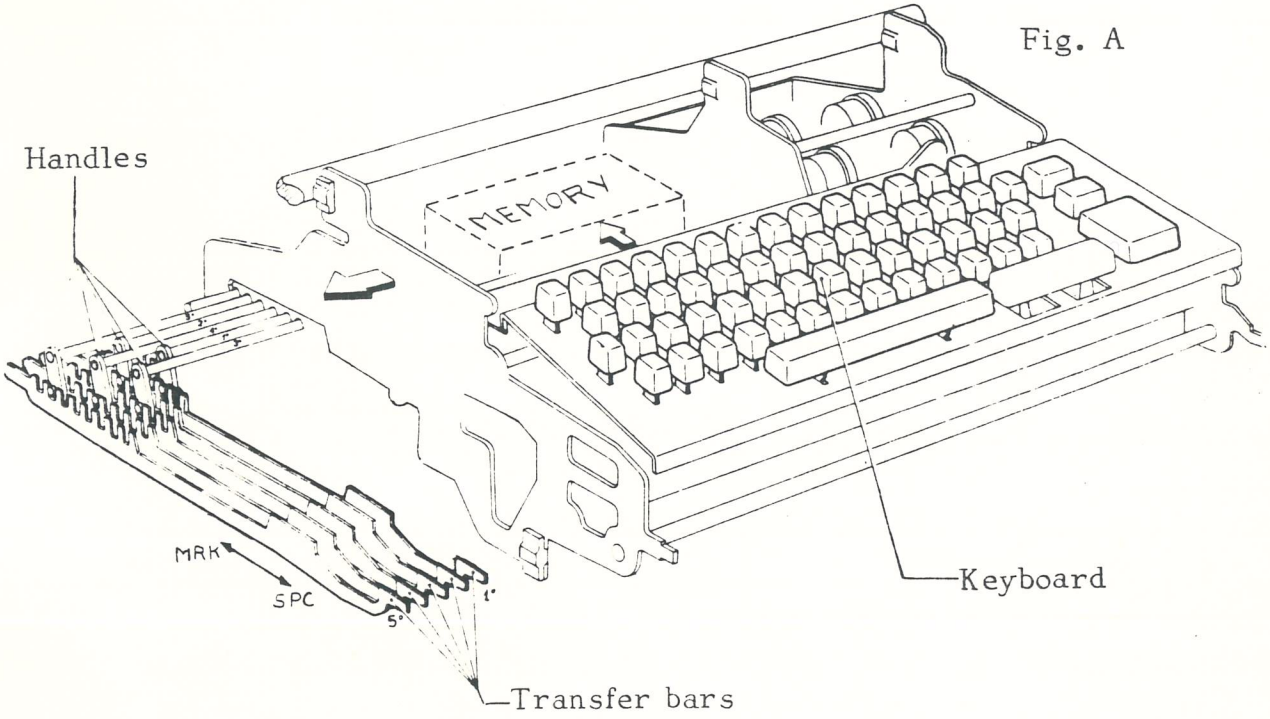
It modulates, in series, the bits on the line.

CODING BY THE KEYBOARD

The pressing of a key causes, through the mechanics of fig. B, the rotation of the code bars.
The latter may assume two positions, called "Mark and Space".
The code bars command (during their rotation) the introduction of the code thus parallelized, into a mechanical memory.
The contents of the memory, during the extraction phase, command the handles and the transfer bars of fig. A.

The function of the memory is to absorb the maximum points of typing velocity and in this way to release the casual rhythm of the keyboard printing from the constant rhythm with which the characters must be transmitted.

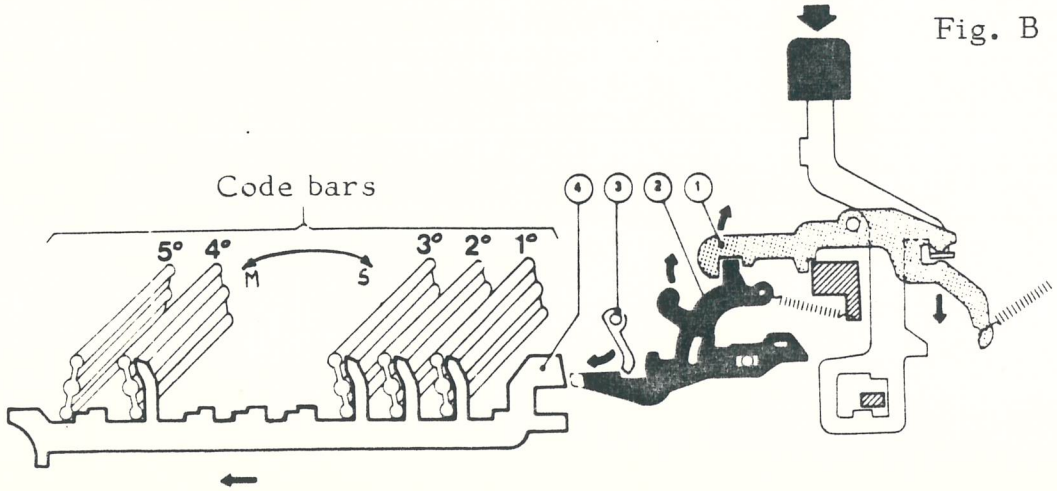
Fig. A



Keyboard mechanics

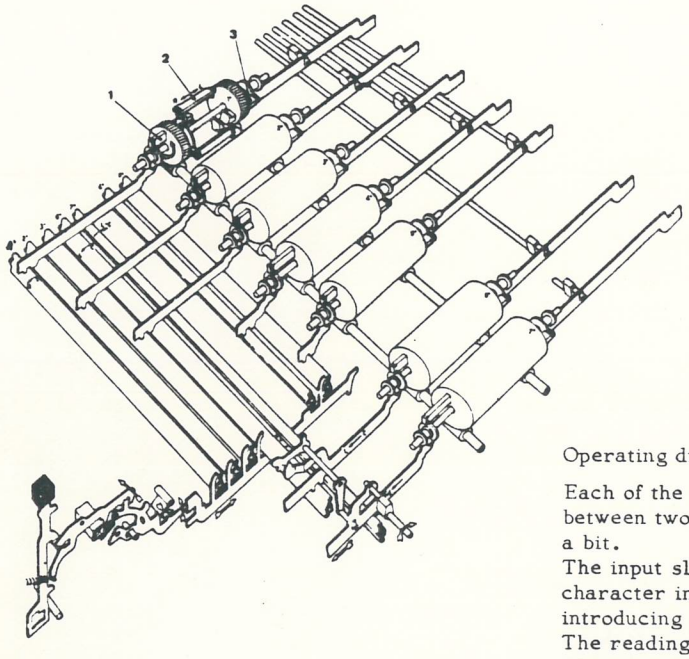
Lever 1, moved by the pressing of the key, releases lever 2.
Bail 3, commanded by the motor, carries lever 2 forward against coding slide 4 which carries the keyboard code bars into the position corresponding to the coding of the character to be transmitted.

Fig. B



MEMORY

1 entry slide
2 memorizing peg
3 reading slide



Operating diagram of a memory cell

Each of the twelve pegs of the cell, moving between two different positions, memorizes a bit.
The input slide advances by one step for each character introduced into the keyboard, introducing one character bit on one peg.
The reading slide follows the input index, advancing by one step for each character transmitted into the line, and reads the bits memorized on the pegs.
If the velocity of introduction into the keyboard exceeds the transmission velocity, the reading slide is set at a distance from the input slide.
The memory is empty when the two slides are aligned.
The memory is full when the two slides are at ten steps distance from each other.

THE MEMORY

The memory is a mechanical unit made up of seven cells, each of which is able to memorize ten bits.
Five cells, connected to the five keyboard code bars, memorize the five bits of each signal.
The sixth cell is connected to the fourth bar and memorizes a bit which indicates if the character memorized in the first five cells belongs to the Letters or to the Figures category.
In the seventh cell a 1 bit is introduced each time the fourth bar changes position, that is, each time that on the keyboard there is a change from typing of "Letters" keys to typing of "Figures" keys or vice-versa; on the other hand a 0 bit is introduced on all the other occasions.
Each time a key is pressed a character is introduced into the memory, one bit per cell.
If the memory is empty, the character thus introduced is immediately re-presented at the output: the contents of the first five cells are transferred to the serializer, whilst the contents of the other two cells go to command the automatic cycle device.
If several characters are sent into the memory with a higher velocity than the transmission velocity, in the memory there will be an accumulation of characters equal to the difference between those put in and those put out in the same period of time. This difference is calculated by a differential system which detects the timing difference between input and output.
When a difference of ten characters is reached, that is, when ten memory positions are occupied, the keyboard is locked whilst the memory is unloaded onto the serializer.
The operator can unlock the keyboard with the appropriate key only when the memory is completely unloaded.

SERIALIZATION (fig. C)

This operation is carried out by rocker arm 4 integral to the transmission central contact.
The commutation of the latter is determined by the angular positioning and by the rising of arm 3.

The time for which the central contact is supported on one or the other of the two fixed contacts is equal to the duration of the pulse.
The number of pulses which can be sent into the line is determined by the velocity of the serializer motion shaft and by the shaping of the lobe cam.

As shown in the previous chapter, each time a key is pressed there is the formation of a character on the transfer bars.

The serializer shaft is started (through the closing of the clutch) each time there is a character coming from the keyboard and it stops after the sending of a stop bit. One character corresponds to a cycle of 360°.
The bars are arranged with their planes G and H under ends A and B of the cross levers.

The motion shaft, through the cam and the copying frame, commands the height of the transfer bar.
According to the position of the bars (ROL) the cross levers struck by plane G or H transfer the character onto the slides and onto the runners which are rigidly connected to the former.

When the copying frame returns to the lower position, the transfer bars are free for acceptance of a new character.
The slides and consequently the runners maintain the position given to them by the copying frame, through the positioner blade.
This blade is lowered after a copy has been made and re-rises before another one is started.

The rotating blade, integral to the serializer wheel and transported by the gear integral to the motion shaft, scans the runners situated on its trajectory.
The rotating blade carries two wedges which are arranged at 180° from one another.
It rotates 180° for each character, therefore it reads the runners pre-set on the sector in this order: (Fig. C/1)

1st character	2nd character	3rd character	
C1=START-1-2-3-4-5 C2=STOP	C1=STOP C2=START-1-2-3-4-5	C1=START-1-2-3-4-5 C2=STOP	etc.

According to the position of the runners the serializer wheel moves axially and through bracket 1 and articulated joint 2 it angularly positions arm 3.
Corresponding to each vertex of the lobes cam, arm 3 is pushed up and goes to strike against tab E or F with its end C or D.
The continuity of the support of the central contact by the fixed contacts (during downward movement of arm 3) is assured by spiral spring 5. The START and STOP pulses are not variable, therefore on the circular sector which carries the runners, those inherent to START and STOP are mounted in a fixed position (see panel fig. C/1).

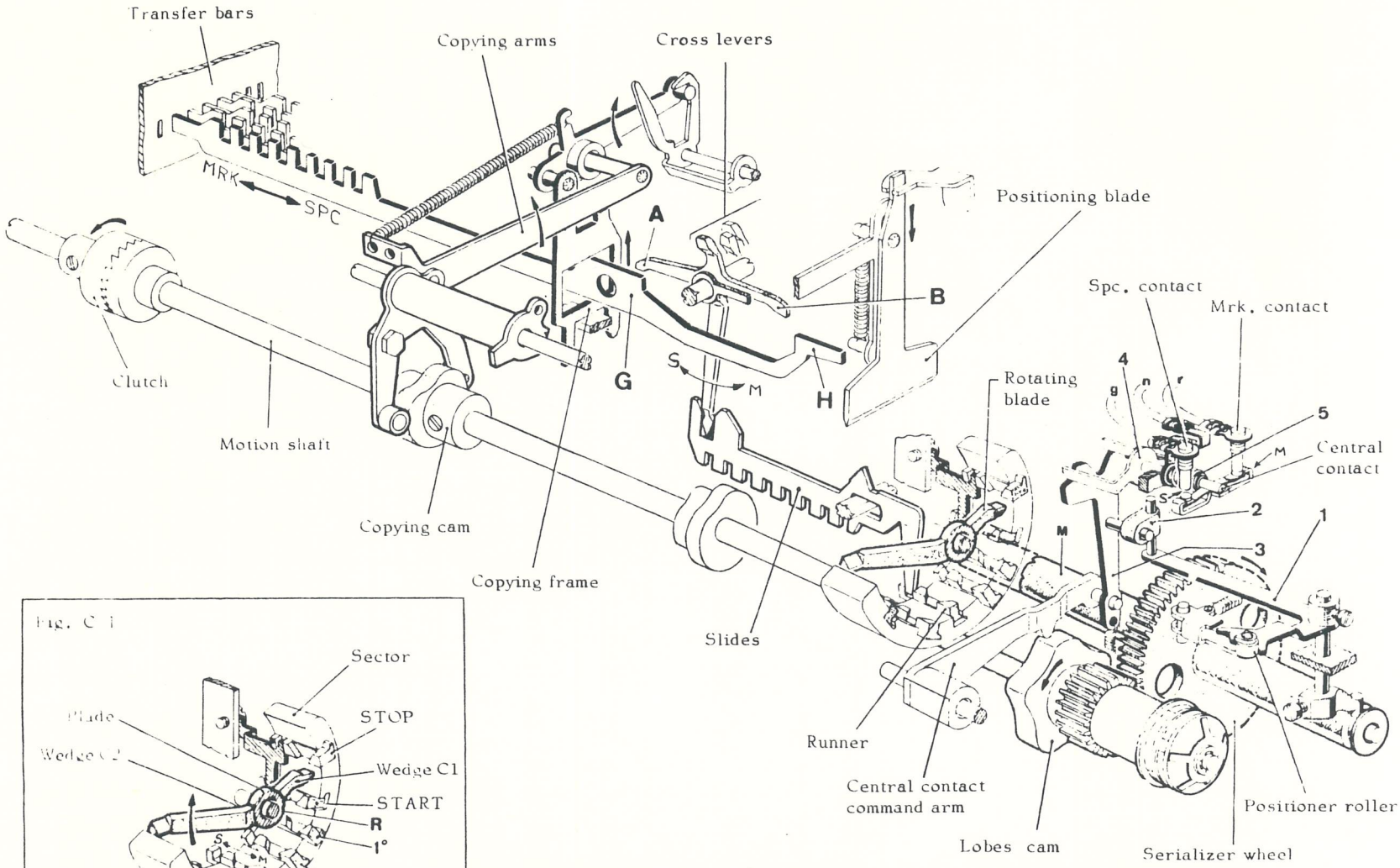
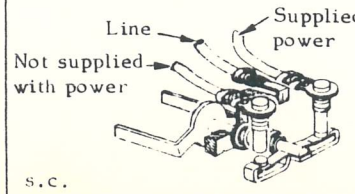
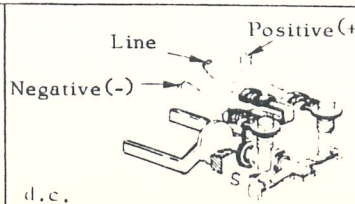
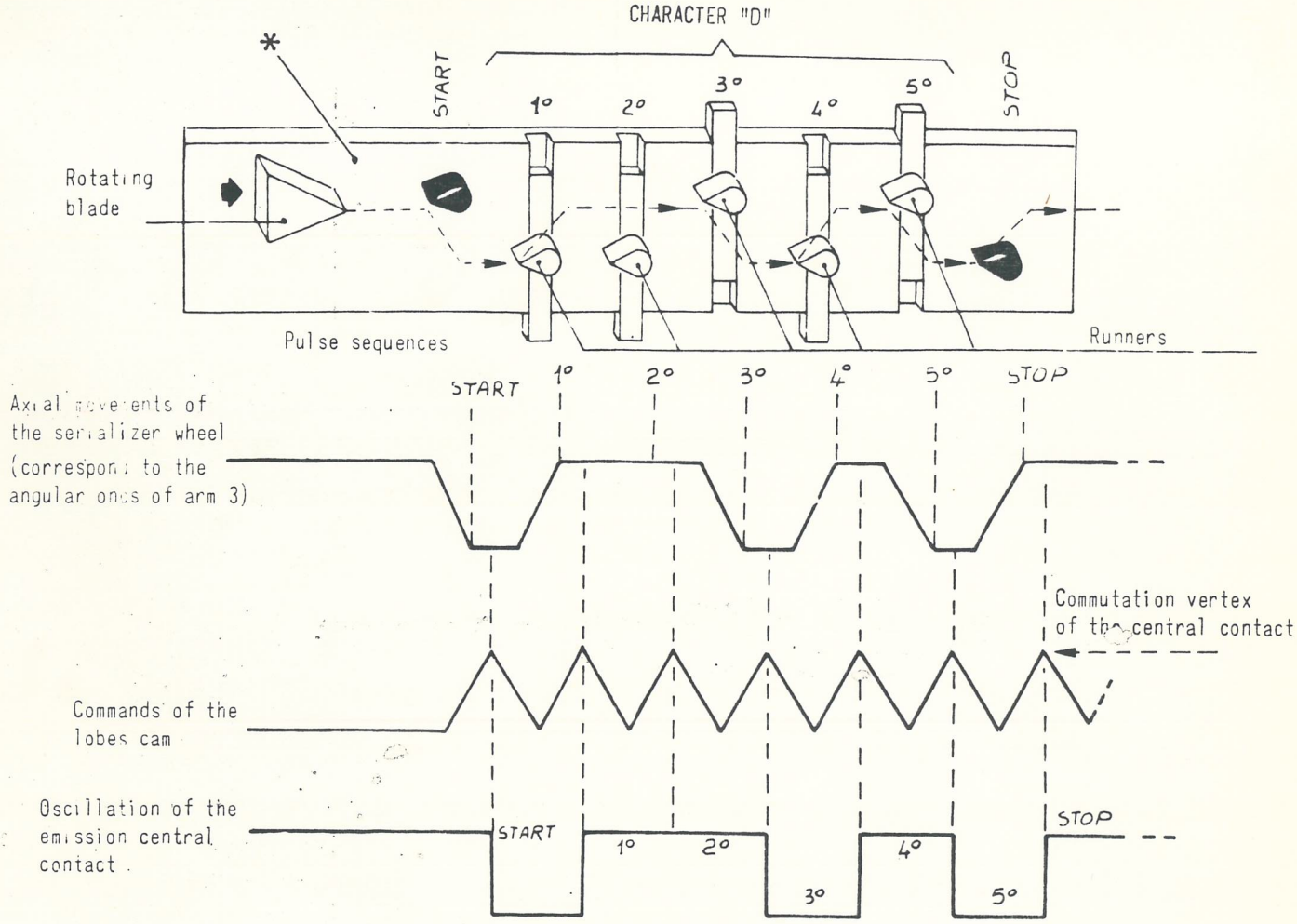


Fig. C 1

POWER SUPPLY IN s.c. AND d.c. OF THE TRANSMISSION CONTACTS







In the diagram shown above the different serialization phases are indicated. The top diagram shows the axial movements of the serializer wheel with respect to character "D" entered on the runners.

The central diagram shows the ascending and descending phases of the arm placed on the lobes cam. The lower diagram shows the commutation of the central contact and consequently the pulses sent into the line.
The time which the central contact uses to detach itself from a fixed contact, to reach the opposite one, is called "transit time".

NOTE: the support indicated by the asterisk has been represented in a linear way, so as to make it easier to understand the relationship between the runners and the serializer wheels.

In effect, the support shown above has a semi-circular form as indicated in fig. C/1.

RECEPTION

The receiving part is made up of 4 principal units:

Electromagnet: this has the function of transforming the electrical pulses coming from the line into as many mechanical movements.
The electromagnet repeats with serial mechanical movements the electrical variations which follow one another at its input.

Parallelizer: this unit has the purpose of carrying back into parallel the serial mechanical movements coming from the electromagnet.

Functions unit: this recognizes the characters entered on the reception code bars and according to the character present it provides for the realization of the corresponding function.

Print unit: this prints the character on the sheet of paper.

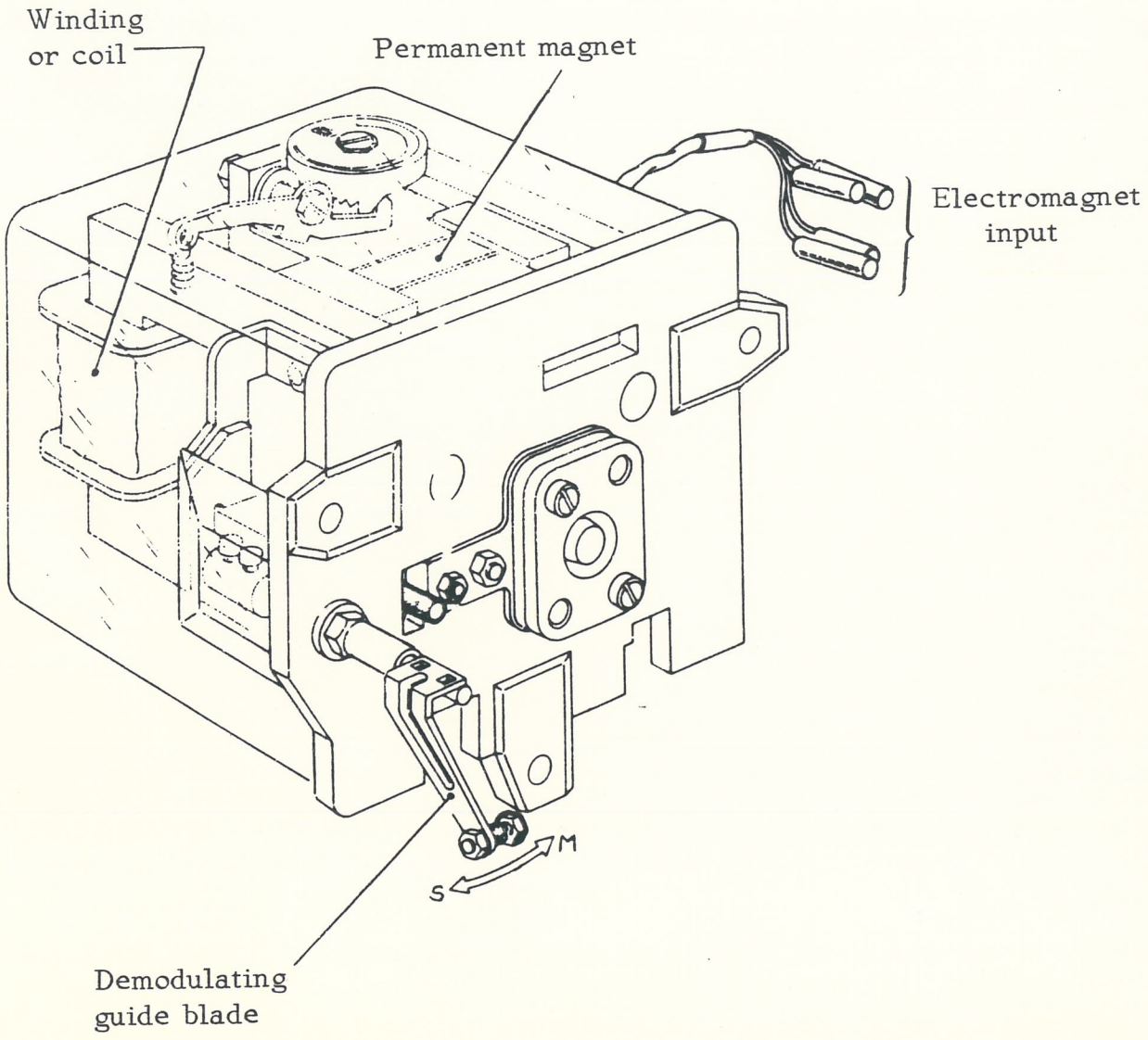
ELECTROMAGNET

As previously seen, for the composition of a telegraphic code (corresponding to one character of the alphabet) we use a series of electrical states, labelled Mark and Space.

To translate these codes of an electrical nature into graphic characters, the teleprinter needs a similar coding, but of a mechanical nature.
The unit concerned with this variation is the electromagnet.

This function is realized mechanically by making a demodulating guide blade move each time there is an electrical variation at its input.
The force which controls the movement of the armature is a magnetic field generated by two permanent magnets and by two windings which have current running through them.
Through the demodulating guide blade integral to the armature, the commands in output from the electromagnet are brought to the parallelizer.

In the figure below, a type of electromagnet mounted on the Te 315 and Re315 teleprinters is shown.



Operation

When the soft iron armature, fixed at the centre, is attracted by the two permanent magnets and by the magnetic field generated by the two coils B1 and B2, it moves within the range of its air gap (fig. D).

The two limit positions of the armature are called mark and space, in relation to the electrical states of the telegraphic code.

Let us now analyse the electromagnet's circuit, bearing in mind that a coil with current running through it will behave like a magnet, that is, it generates a magnetic field at the end of its own core.

The attraction forces of the armature are given by the magnetic fluxes:

F1 and F2 = generated by two permanent magnets
F3 and F4 = by coils B1 and B2.

When the permanent flux (F1-F2) and the variable one (F3-F4) have like poles on the same diagonal (with respect to the armature fulcrum), the attraction force is doubled.

Vice-versa, with opposite poles the attraction force becomes almost nothing.

Therefore the armature rotates towards the reinforced diagonal which in Fig. E equals D1 (N-N and S-S).
When the circulation direction of the current in coils B1-B2 varies, there is reinforcing of the opposite diagonal D2 and consequently the armature is supported on the other side.

The electromagnet must restore two mechanical positions, either th ts power supply works by exchange of polarities (d.c.) or by current interruption (s.c.) (fig. F).

In the first case, i.e., in d.c., by applying reverse polarities to the electromagnet input, variation in the direction of the current's path is obtained.
The latter creates in the windings the two variable magnetic fields which make the armature commute.

In single current, when there is current interruption (space pulse), a counter-acting force (spring) is needed, by which to take the armature to the work position.

According to the value of the current which maintains the armature at rest, the counter-acting spring must be set (see fig. D) and thus the exchange forces which work on the armature will be balanced.
This setting is made through knob K (fig. D).
The electromagnet is represented graphically with this symbol:

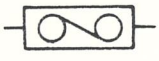
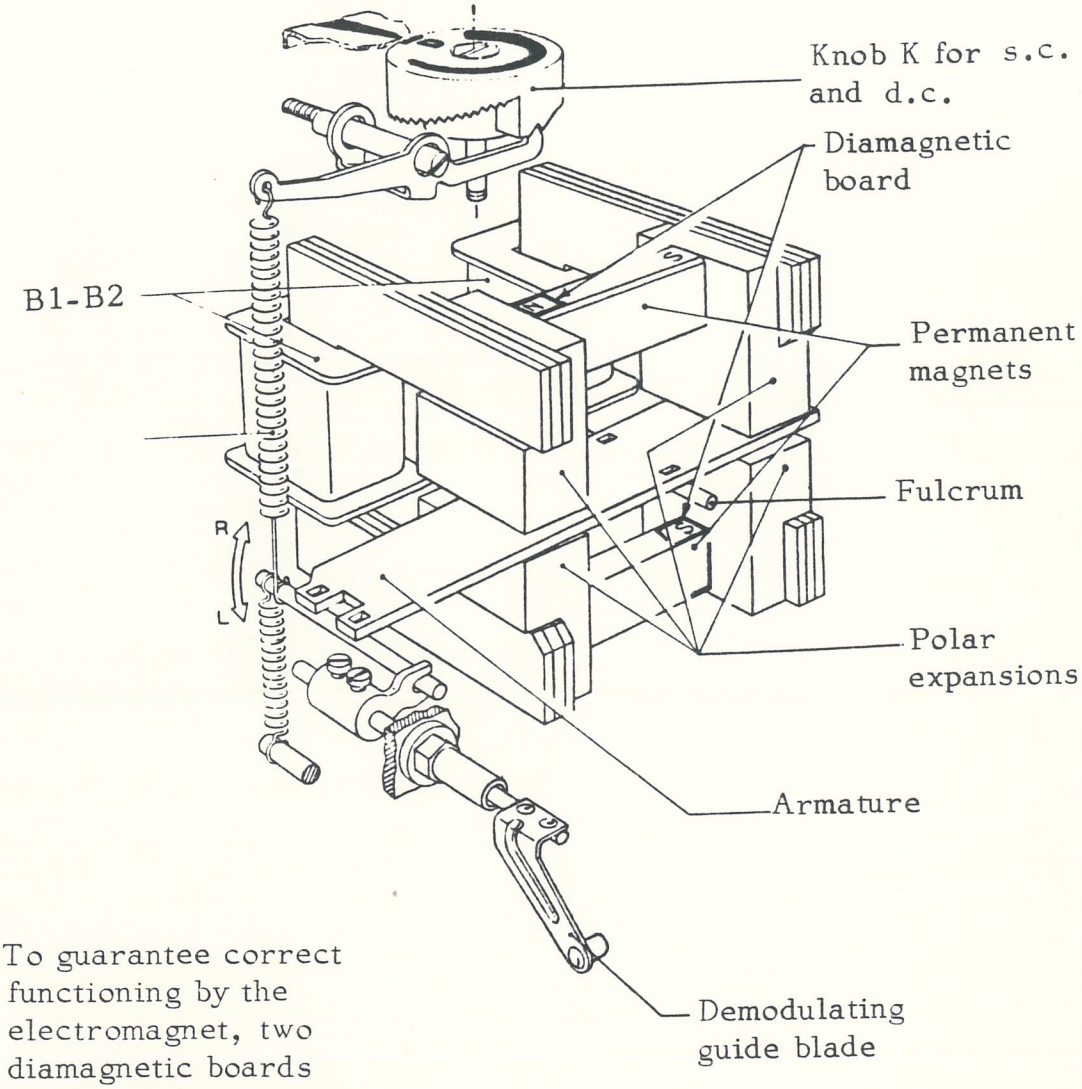


Fig. D



N.B. To guarantee correct functioning by the electromagnet, two diamagnetic boards have been mounted for the permanent magnets and the cores of the two coils (see fig. D).

Fig. E

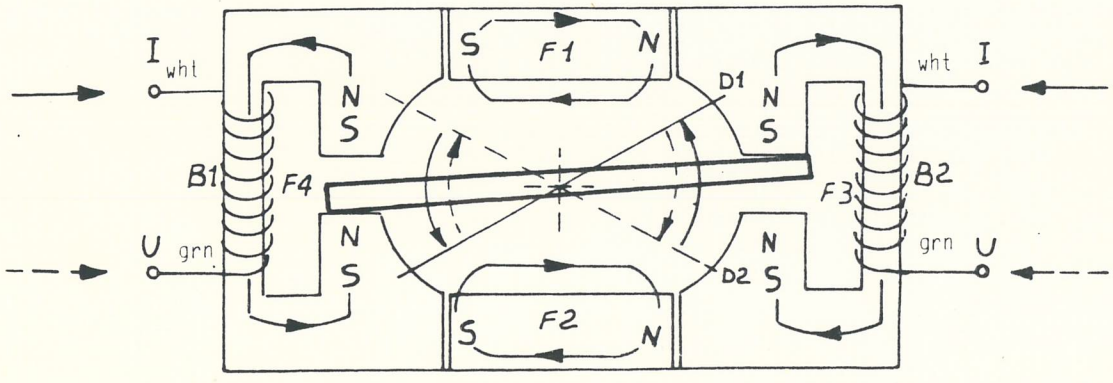
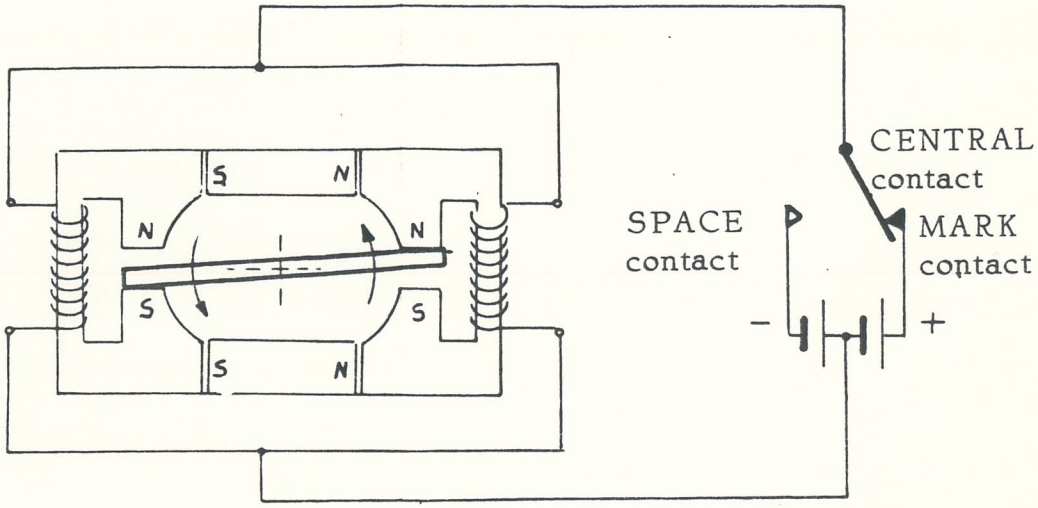
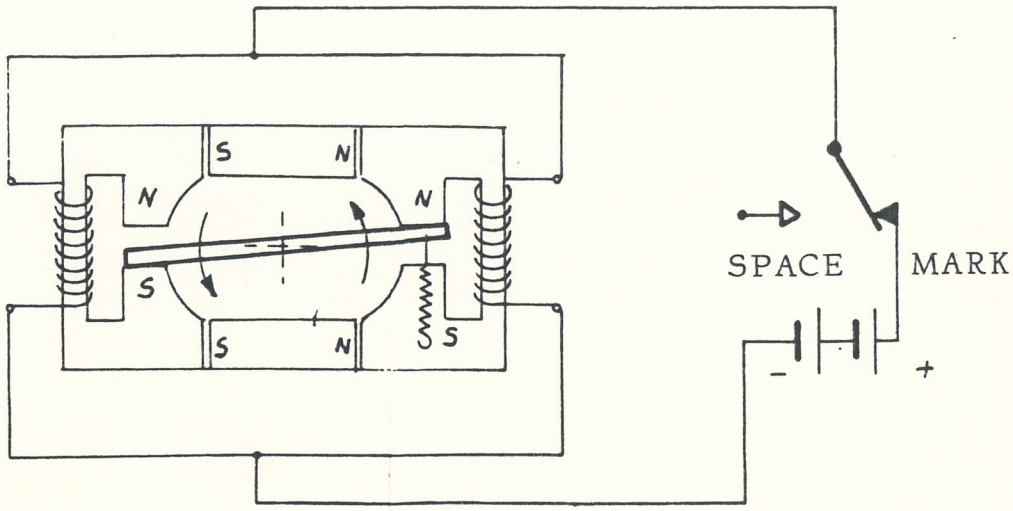


Fig. F

Connection in d.c.



Connection in s.c.



PARALLELIZOR (Fig.G)

This parallelizes the serial character coming from the electromagnet, through the demodulating guide blade on the five code levers.

The START pulse starts the parallelizor, the STOP halts it.

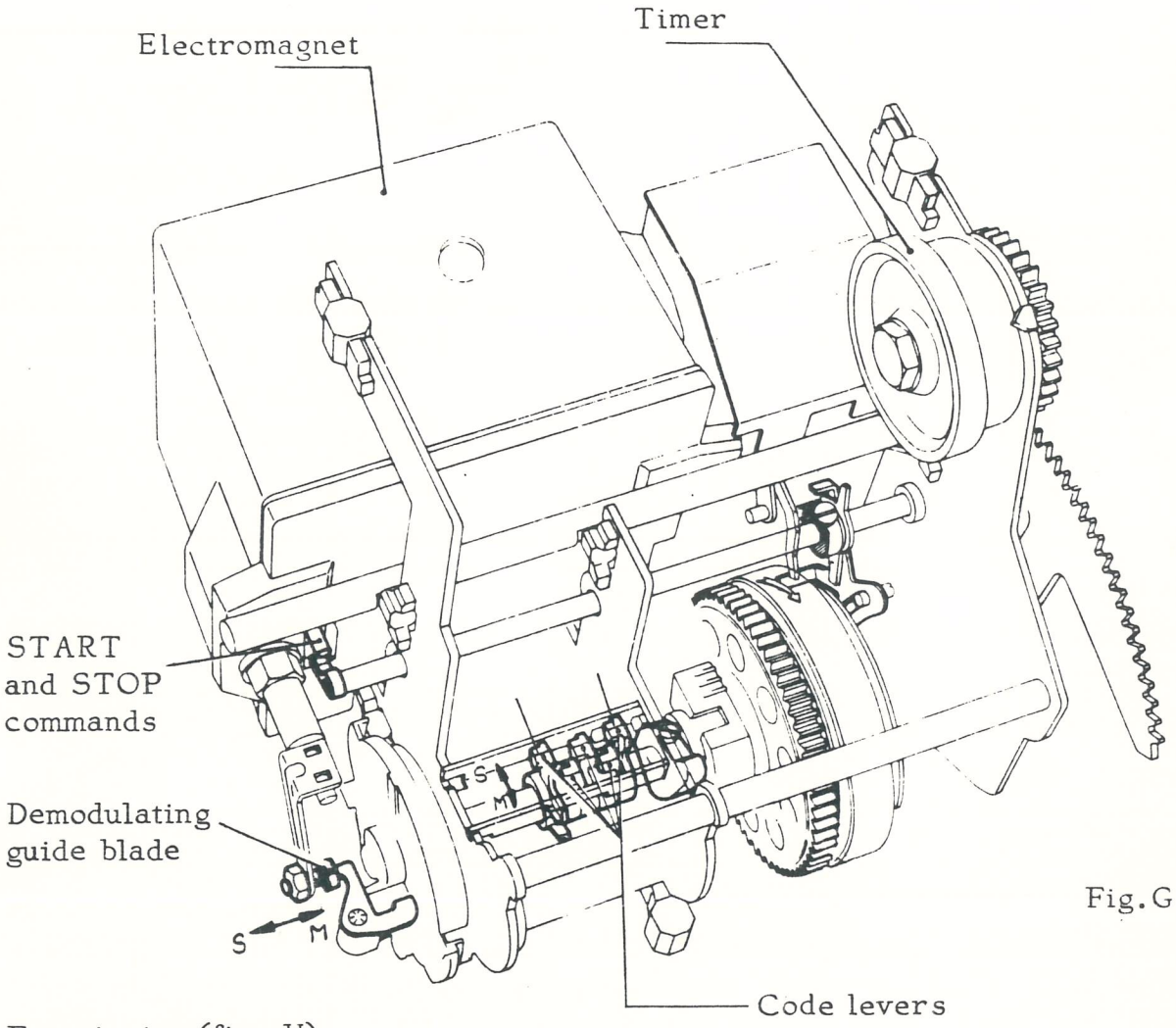


Fig.G

Functioning (fig. H)

Each electrical variation at the heads of the electromagnet causes, through its armature, the shifting of the demodulating guide blade.

Disc 1, integral to motion shaft 2, makes arm 3 and bracket 4 (mounted on the disc itself) rotate.

The shank of lever 4 is placed in any angular position of disc 1, in correspondence with the screw of the demodulating guide blade.

Therefore:

- mark bit; the guide blade pushes bracket 4 which carries the entry wedge towards the exterior of disc 1.
- space bit; the guide blade abandons bracket 4. Arm 3, brought back by spring 5, carries the entry wedge towards the interior of the disc.

Fig. I

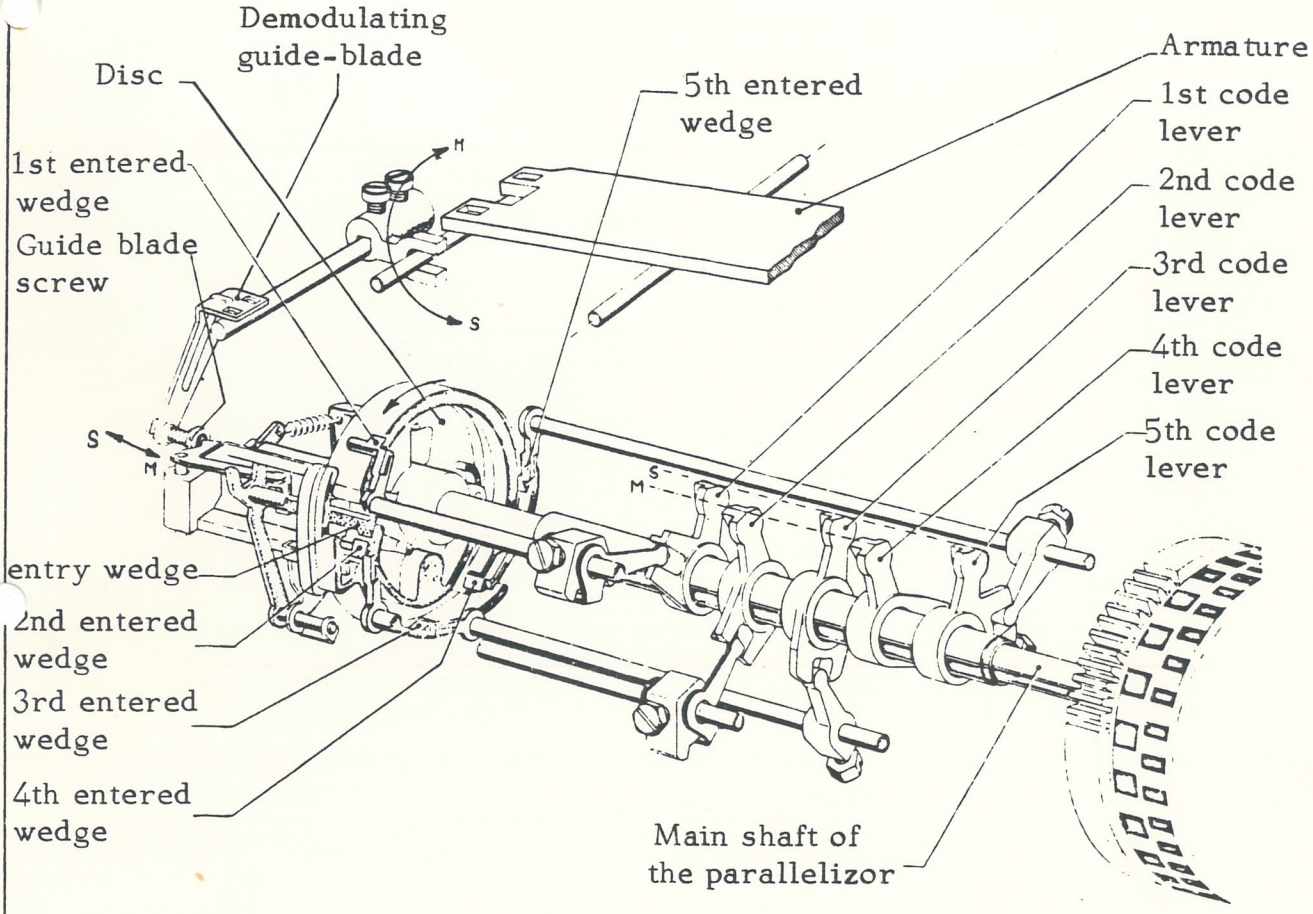
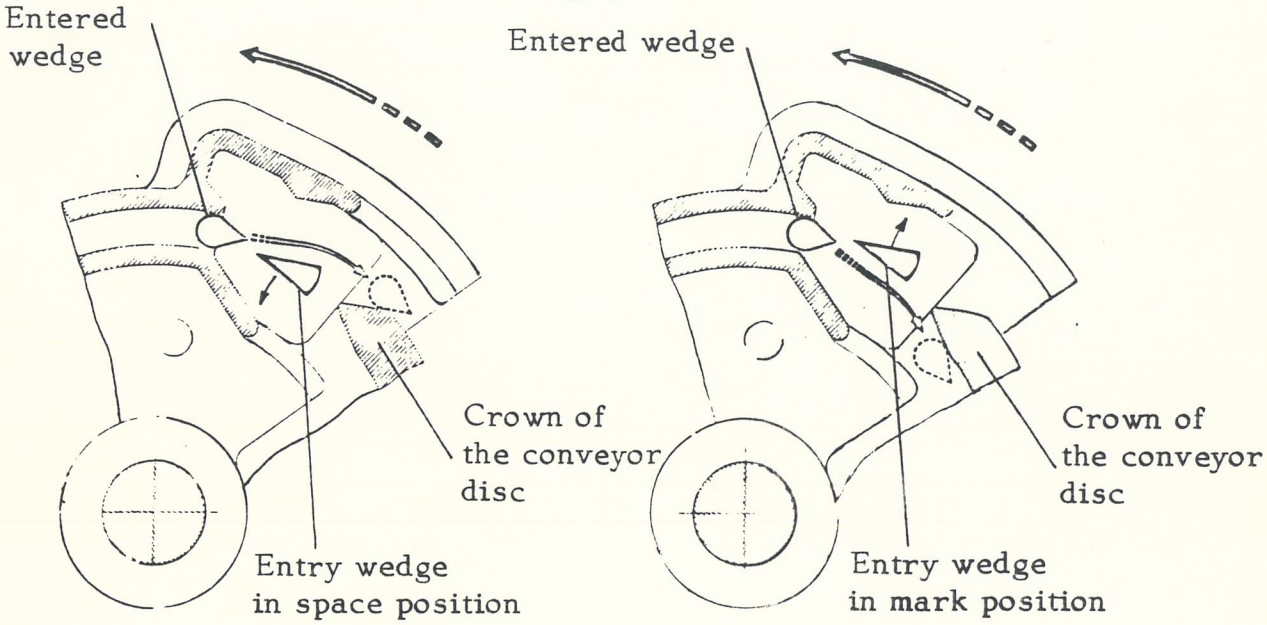

Demodulating guide-blade
Disc
1st entered wedge
Guide blade screw
5th entered wedge
Armature
1st code lever
2nd code lever
3rd code lever
4th code lever
5th code lever
M
S
S
M
S
M
entry wedge
2nd entered wedge
3rd entered wedge
4th entered wedge
Main shaft of the parallelizor

Fig. J


Entered wedge
Crown of the conveyor disc
Entry wedge in space position
Entered wedge
Crown of the conveyor disc
Entry wedge in mark position

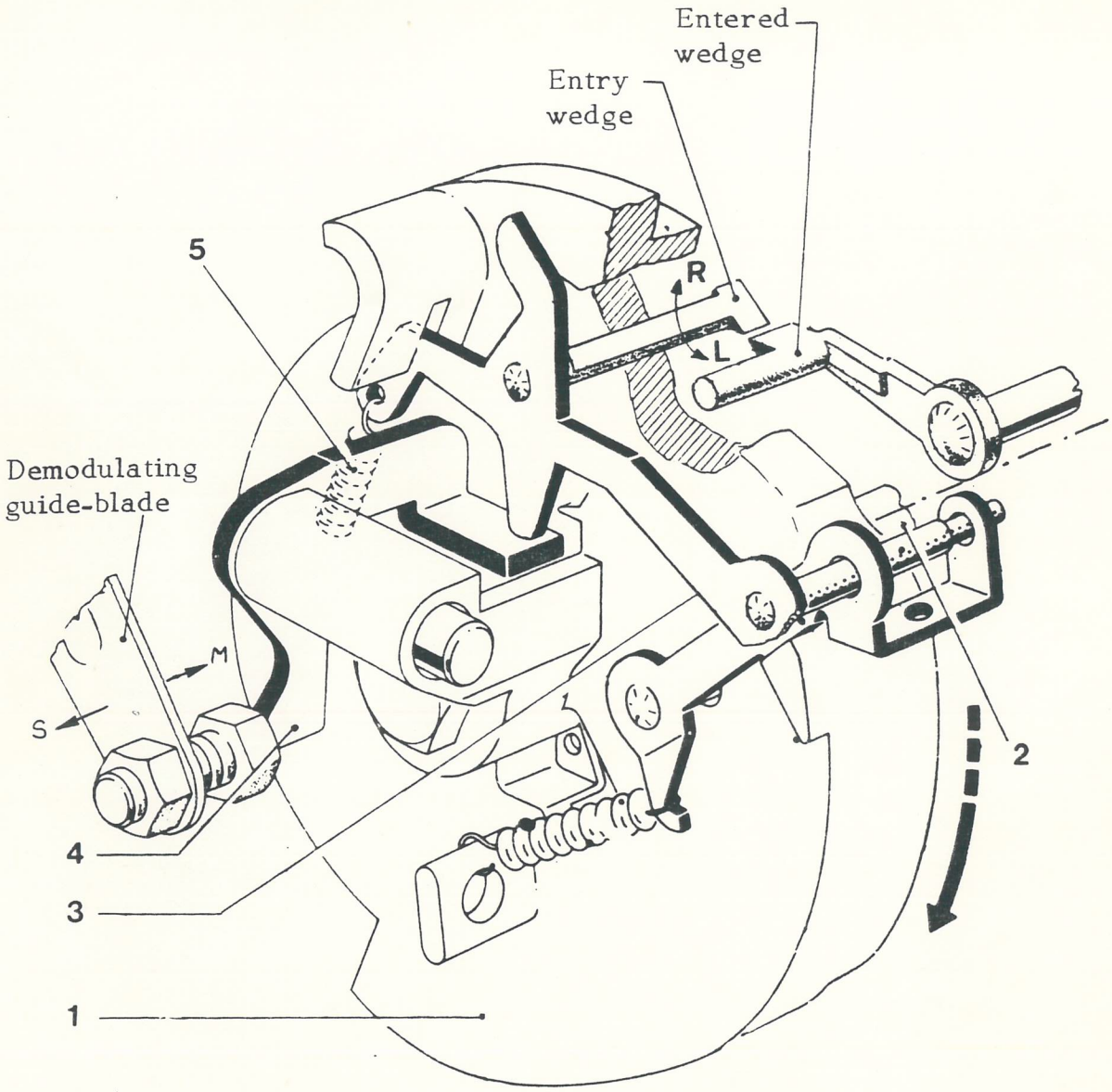


Fig. H

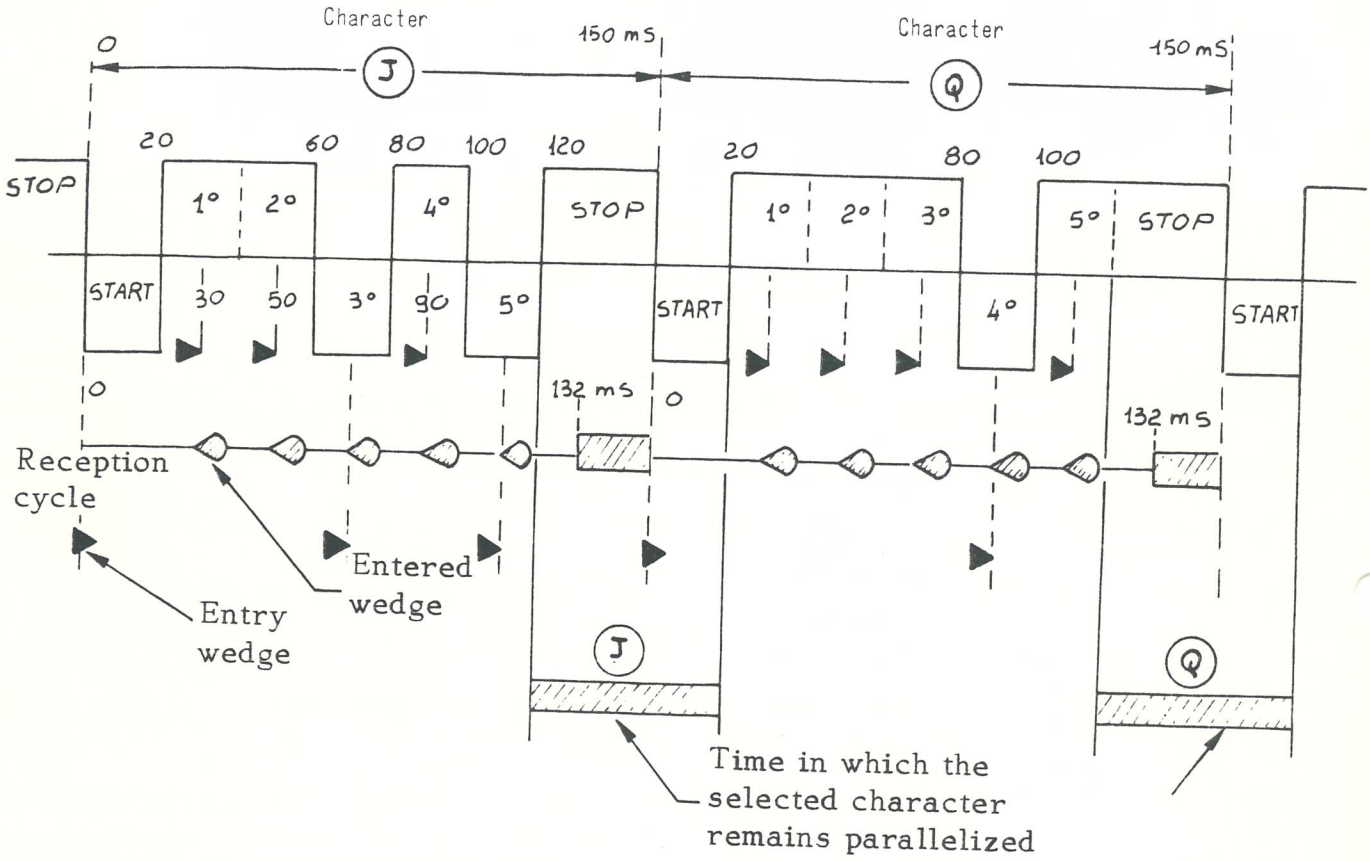
Mechanics of parallelization (fig. I)

On reception of a character, the parallelizor is started with a START pulse; the disc integral to the motion shaft starts to rotate and at regular intervals (equal to the duration of the pulses) it selects the five entered wedges.

According to the angular position of the entry wedge, the five entered wedges are conveyed to the interior or exterior of the disc (fig J.).

Each entered wedge directly commands the respective code lever since, after the selection of the 5th lever, the code is parallelized.

The STOP pulse stops the parallelizor after the selection of the 5th code pulse.



In the diagram shown above the various phases necessary for parallelization of the serial character coming from the line.

The diagram refers to 50 Baud telegraphic velocity.

- The START pulse of character (J) starts the Reception cycle.
- At intervals of 20 ms. (duration of the elementary pulse), the entry wedge meets and selects the entered wedges.
- The STOP pulse halts the reception cycle.
- Character (J) stays parallelized in the interval which passes between the end of the selection of the 5th entered wedge and the beginning of the selection of the 1st wedge of the subsequent character, in this case (Q).
- The START pulse of character (Q) starts the reception cycle of the second character and parallelizes it in the way already described for character (J).

Timer (fig. G)

This detects the mechanical margin of reception, that is, the teleprinter's aptitude to correctly receive the distorted pulses.

The timer anticipates and delays (through the knob of fig. G) the entry wedge with respect to the five entered wedges.

ARHYTHMICAL MEASUREMENT OF DISTORTION

The reception units of the arhythmical machine start, as already stated, with the start pulse and stop at the end of each cycle. Whilst the electromagnet's armature follows the modulation, moving in correspondence with the real characteristic instants, the reception units of the machine recognize the nature of the pulses in correspondence with certain instants (called sensing instants) whose rhythm is determined by the machine itself.

If the machine is constructed and regulated for a 50 Baud telegraphic velocity, the sensing instants are distributed during the time at regular intervals of 20 ms. and the first of these, if the timer index is at the centre, takes place 30 ms. after the characteristic instant of the start. Note the dependence of the sensing on the beginning of the start.

Thus the machine, at regular intervals, recognizes and records the position of the reception electromagnet armature. In order to have correct recording of the signals, it is sufficient to make sure that the sensing instants take place inside the corresponding pulse; therefore it is the value of the variations which determines the good quality of an arhythmic modulation - variations taken at absolute value and measured inside the considered code combination - and it is the measurement of these variations which determines the possibility of correctly recording the signal. Theoretically these variations need only be, in absolute value, always lower singularly than 50% of the duration of the elementary pulse.

Arhythmical distortion is measured by relating the maximum variation to duration "t" of the theoretical elementary pulse; in percentage:

$$d = \frac{\text{maximum variation}}{t} \times 100$$

E.g., let the maximum variation be 2 ms. with respect to the elementary pulse of 20 ms.; the distortion is:

$$\frac{2}{20} \times 100 = 10\%$$

The variations are considered code by code, taking, as the origin of the times, the characteristic instant of the start pulse, which is also the zero instant of the sensing.

The modulations of codes "A" and "U" are shown in fig. 1 .

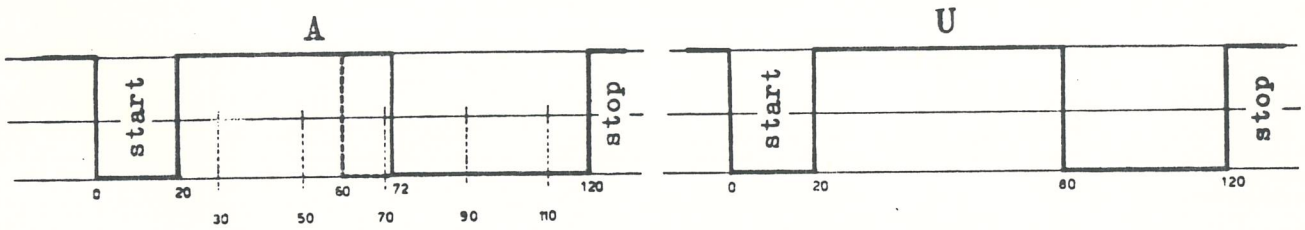


Fig. 1

Whilst the 3rd sensing instant of letter A takes place by construction, with the timer at the centre, at time 70, the characteristic instant, which ought to take place in the theoretical modulation at time 60, instead takes place at time 72, that is, when the sensing has already taken place. Therefore, the third selecting lever, instead of "sensing" a space pulse, in fact "senses" a mark pulse and the teleprinter thus records the sign "U" rather than sign "A".

The variation between the 3rd real characteristic instant (72) and the theoretical instant (60) is 12 ms.; therefore the distortion percentage is:

$$d_a = \frac{12}{20} \times 100 = 60\%$$

APPARATUS FOR MEASURING DISTORTION

Arhytmical distortion-meters

To measure arhythmical distortion of a modulation. it is necessary, as seen already, to measure the variations of the characteristic instants with respect to the start.

Therefore we need a unit which starts operating with each 'start' and which takes this instant as a reference for measuring the variations of the other characteristic instants; the system must start up straight away and should not present inertia of any kind.

This is easily realisable with electronic systems such as those shown as follows: the first built by A.T.E. (England) and the second, S.R.C.T. type (France).

On a cathode ray tube, a luminous point marks a spiral, using 20 ms. to pass round each turn of the spiral. The characteristic instant of the start pulse commands the start of the luminous point, and stronger lighting of the scan signals the other characteristic instants.

If the modulation to be checked does not present distortions, all the luminous points corresponding to the radius passing through the origin of the spiral should be seen (Fig. A).

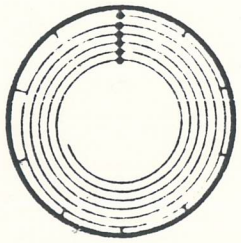


Fig. A

If the modulation being checked shows distortion however, the luminous points appear before or after this line, according to whether the variations of the characteristic instants are negative or positive.

The modulation of figure B appears on the distortion-meter tube as shown in figure C.

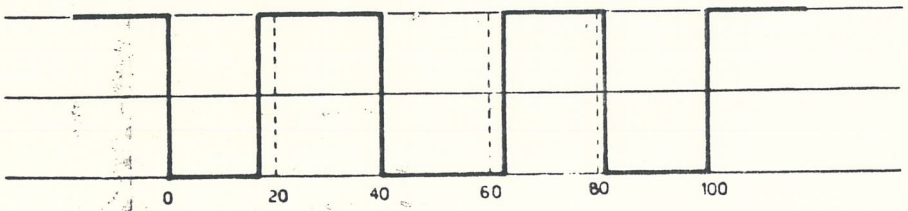


Fig. B

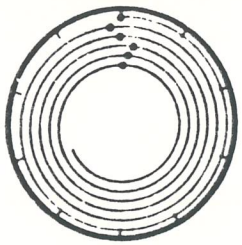


Fig. C

On the French S.R.C.T distortion-meter a luminous point describes 6 horizontal traces of 20 ms. duration (Fig. D). The first trace ends 30 ms. after the start. The subsequent characteristic instants cause the lighting of a point which should be found, if there is no distortion, halfway along the relative traces. In this case all of the points corresponding to the characteristic instants are on the median vertical line through the six traces.

If there is distortion, the luminous points appear to the left or right of the median, according to whether the variations of the characteristic instants are negative or positive (Fig. E).

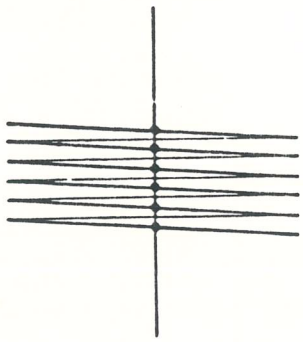


Fig. D

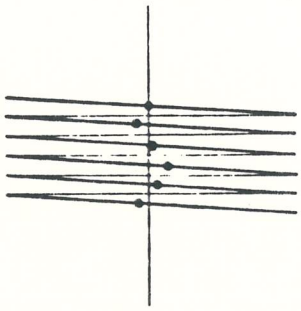


Fig. E

Even in the arhythmical distortion-meters the scale is graduated in percentage in order to have direct reading of the distortion; moreover, we can see which pulses are introducing the distortion, whilst rhythmic distortion-meters only give a total measurement. This performance makes possible intervention to eliminate the causes of the distortion.

THE MARGIN IN THE TELEPRINTERS

In a connection between two teleprinters the modulation received at the receiving terminal is always affected by distortion; the sum of the distortions introduced by the transmitting terminal and by the line which connects the two machines.

If the modulation presents a grade of distortion higher than a certain limit, the apparatus which receives it makes a mistake and records a code which is different from the one transmitted.

The maximum distortion of a modulation which still gives exact recording of all the codes is defined as the "margin" of a telegraphic apparatus.

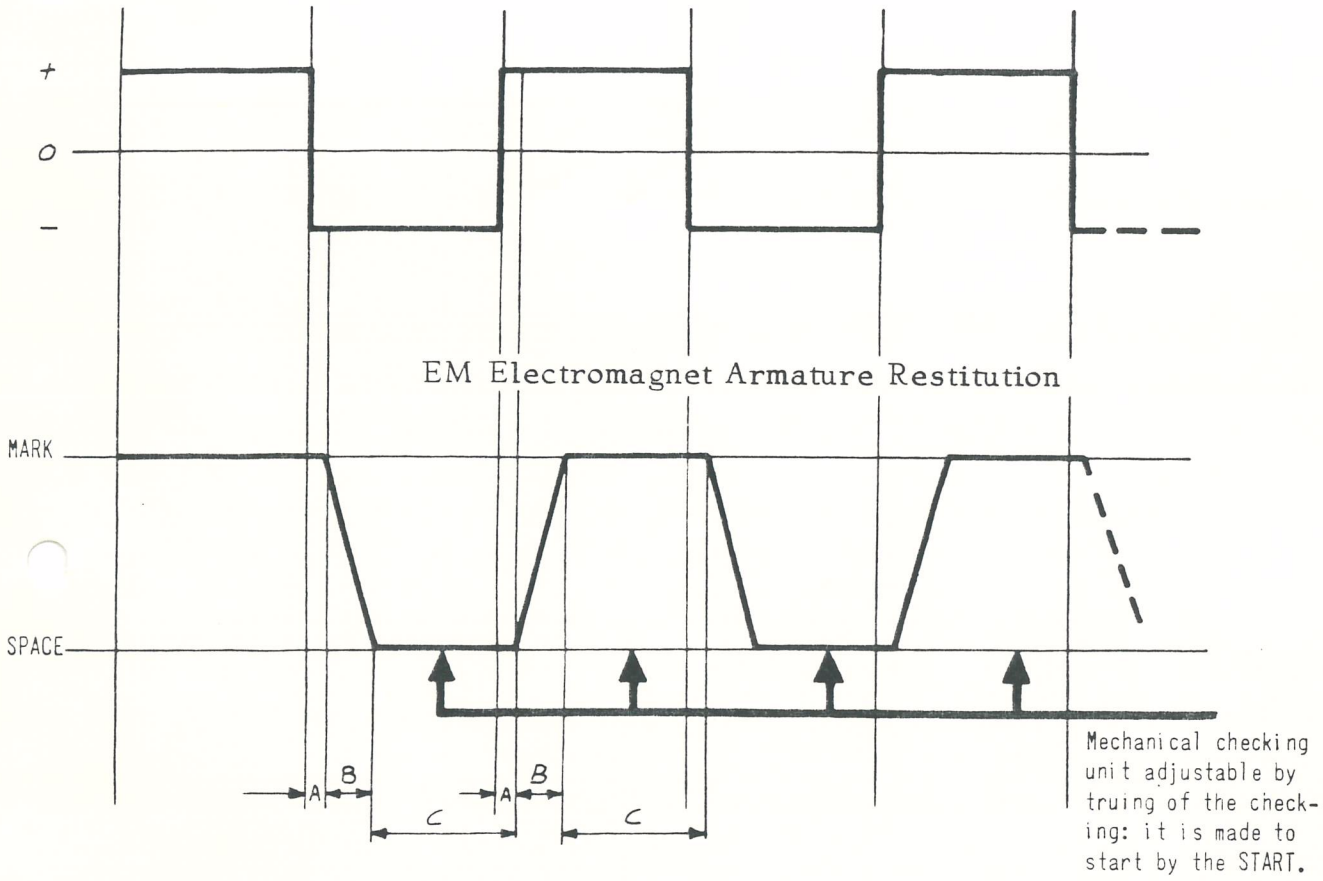
The margin is an index of the apparatus's quality; the higher the grade of acceptable distortion, the more the correct functioning of the telegraphic connec ion is guaranteed.

The margin depends on:

- characteristics of the teleprinter electromagnet;
- correct mechanical functioning of the teleprinter;
- telegraphic velocity;
- distortion of the signal.

EXAMPLE OF DIAGRAM OF EM ELECTROMAGNET RESTITUTION IN DOUBLE CURRENT

THEORETICAL MODULATION DIAGRAM

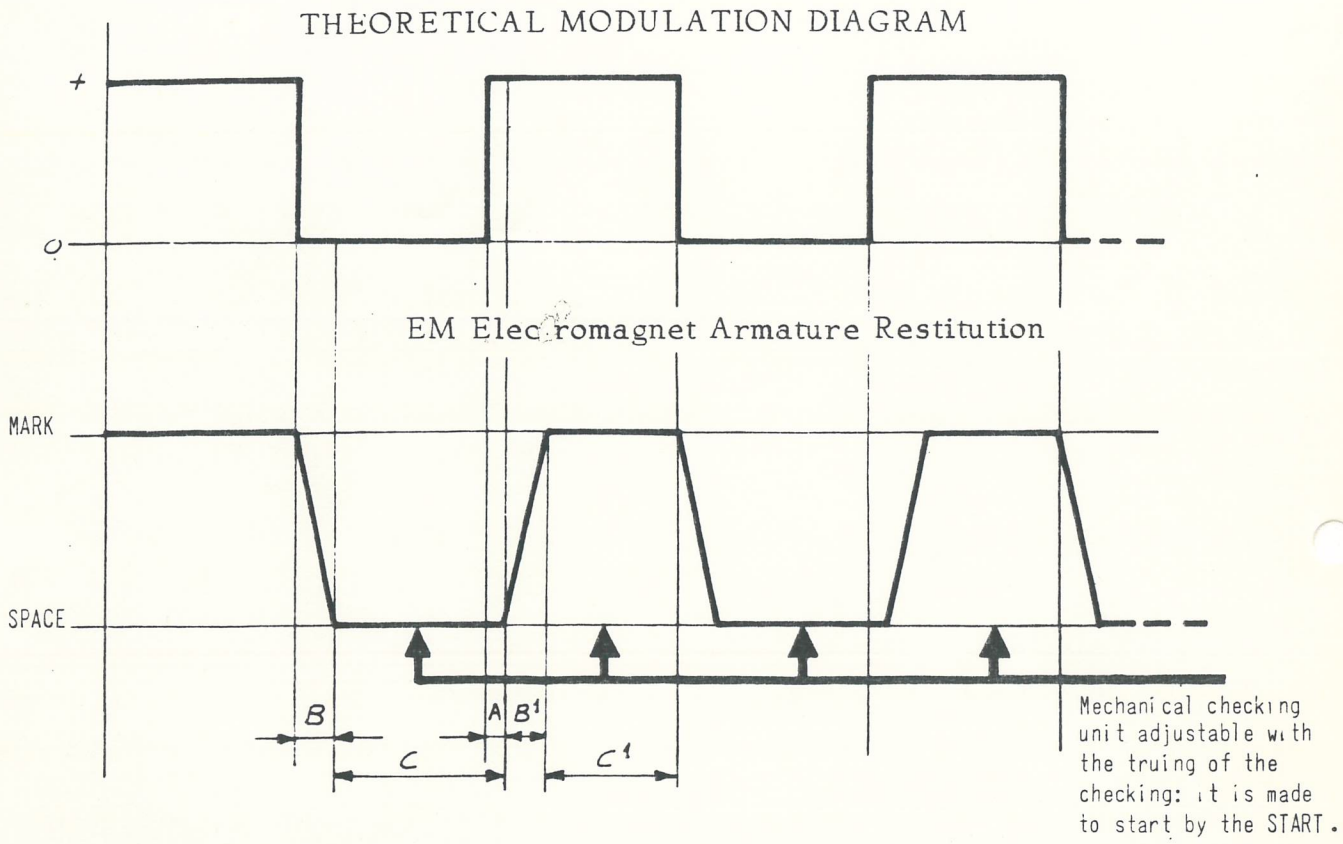


A = Electromagnet armature commutation threshold (time needed by the current to create a magnetic field such as to command the detachment of the armature from its support. Time =~2 msecs.)

B = Transit time from one position to the other (space-mark and vice-versa) (time =~3·5 msecs.)

C = Armature support time, i.e., time useful for the mechanical check. At 50 Baud the Bit is 20 msecs., the time for the mechanical check is 16·5 msecs, i.e., about 80% of the theoretical Bit. At 100 Baud the Bit is 10 msecs. and the time for the mechanical check is 6·5 msecs., i.e., about 65% of the theoretical Bit.

EXAMPLE OF DIAGRAM OF EM ELECTROMAGNET RESTITUTION IN SINGLE CURRENT



B = Transit time from mark to space (about 4 msecs. due to the armature return spring, unbalance spring).

B^1 = Transit time from space to mark (about 4 msecs. due to the magnetic field).
N.B. - Times B and B^1 are mechanically adjustable to make them equal.

A = Electromagnet armature commutation threshold (time needed by the current to create a magnetic field such as to command the detachment of the armature from its support; about 2 msecs.).

C = Time of armature support in space position
C^1 = Time of armature support in rest position
} times for mech. checking

At 50 Baud the Bit is 20 msecs. The time for the mechanical checking is:

Mark = 14 msecs. about 70% of the theoretical Bit
Space = 18 msecs. about 90% of the theoretical Bit

At 100 Baud the Bit is 10 msecs. The time for the mechanical checking is:

Mark = 4 msecs. about 40% of the theoretical Bit
Space = 8 msecs. about 80% of the theoretical Bit.

SENSING INTERVALS

During discussion of distortion it has been seen that in order to obtain an exact recording of the emitted code, it is necessary that the sensing instants, determined by the five sensing levers, should take place inside the corresponding pulse.

The apparatus has been constructed in such a way that the sensing instants, when the timer index is in the central position, follow one another at times 30, 50, 70, 90 and 110 ms., i.e. corresponding to the centre of each theoretical pulse (figure A).

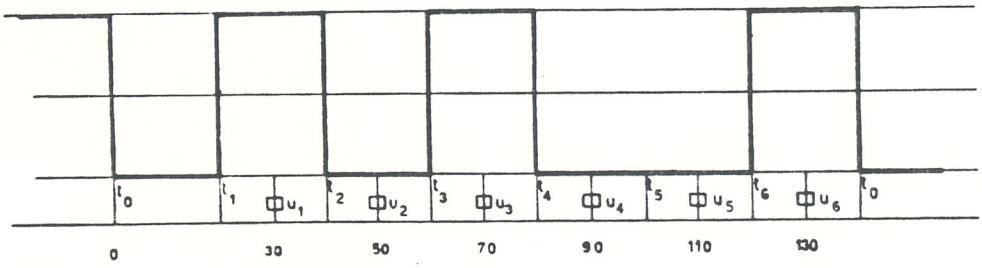


Figure A

In theory the sensing instant, as the term "instant" itself suggests, does not have an appreciable duration. In practice, even if we leave aside the inevitable imperfections in manufacture and stay within the limits of the theoretical characteristics fixed by the manufacturer, the sensing has a certain duration and there are two principal causes for this:

1) The selection device, however fast, needs a certain time to set itself in the required position, since the selection levers must complete a determined movement to "sense" the position of the electromagnet's frame.

2) In a variable and unpredictable way the reception clutch delays its closing and causes a variable delay of the sensing instants with respect to the start instant.

Therefore from now on we will talk about "sensing intervals", which we will call "u". The duration of these intervals depends on the construction characteristics of the apparatus; on average it lasts 2 milliseconds.

INFLUENCE OF THE VELOCITY VARIATIONS ON THE MARGIN

It is permissible for the telegraphic velocity of a teleprinter to vary with respect to the nominal velocity between certain established limits. The rules of the C.C.I.T.T. anticipate a maximum variation of ± 0·75%. In a connection between two teleprinters, whilst still remaining in the tolerance range, there may thus be a velocity difference of 1·5% when both the machines have a velocity different from the nominal one of 0·75% but the two variations have opposite signs.

It has already been seen on page ▽.15 that a velocity difference , with respect to the nominal velocity in an apparatus which emits a modulation, generates a distortion of all the pulses, a distortion which varies with the position that the pulse occupies in the code and which is maximum for the pulse which occupies the last position, i.e., the stop pulse.

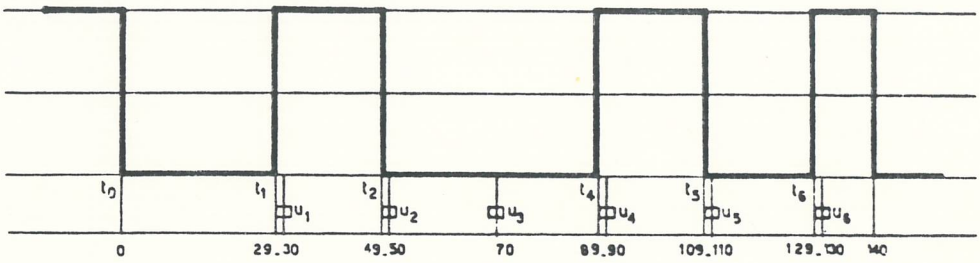


Fig. A_1

Let us now consider the sending, to a teleprinter working at the nominal velocity, of a modulation distorted by 45% by lengthening of the start (fig. A_1) emitted by a generator which also works at the nominal velocity.

Given that the effective margin of the teleprinter is 45%, the modulation is correctly received.

The sequence of the characteristic instants is:

29 - 49 - 89 - 109 - 129

The sequence of the sensing intervals is:

30 - 50 - 70 - 90 - 110 - 130

The sensing intervals follow one another in correspondence with the relative pulses, but are in their limit position with respect to the characteristic instants (the centre of interval u is found at 1 ms. from the characteristic instant) and each subsequent variation, even minimal, would cause an incorrect recording of the code.

Now let us suppose that the teleprinter works at a velocity 5% higher than the nominal one (fig. B). The sensing instants go beyond their limit position, causing incorrect recording of the code; they follow one another at times:

28·5 - 47·5 - 66·5 - 85·5 - 104·5 - 123·5

If we compare figure A with figure B we note that the greater movement of the sensing interval with respect to the characteristic instant takes place in correspondence with the stop pulse since the latter, occupying the last position in the code, is more sensitive to the velocity variations.

The sensing which took place at 130 ms., 1 ms. after the characteristic instant (129 ms.), now takes place at 123·5 ms., i.e., 5·5 ms. before the characteristic instant.

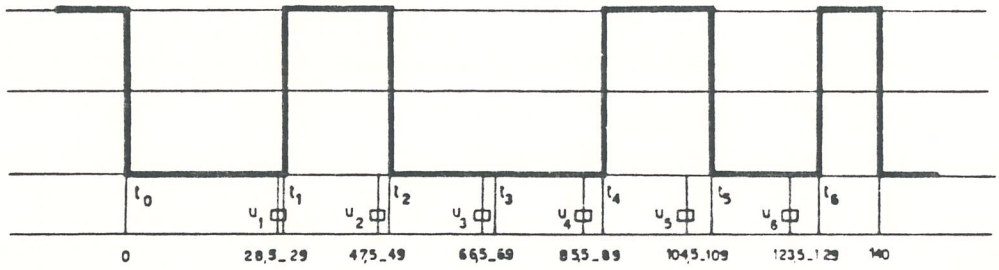


Fig. B

If, despite the velocity variation, we wish the teleprinter to correctly receive the modulation, we must decrease the distortion level of the modulation so as to re-establish the limit condition of good functioning, that is, we must make sure that the characteristic instants take place before the sensing intervals. This condition, when it takes place for the stop pulse which, as already seen, is in the worse condition, will without doubt take place for all the pulses.

So that instant t6 shows up at least 1 ms. before the centre of interval u6, it must take place at time 122·5 which means that the variation of this instant from the theoretical one (120 ms.) must not exceed 2·5 ms., which corresponds to a distortion level of 12·5%.

Thus we may conclude that the effective margin of a teleprinter decreases from 45% to 12·5% if the working velocity is different from the nominal one of 5%. As can be seen, only slight variations are needed to cause higher losses of margin. For example, a velocity difference of 1·5% which re-enters the prescribed tolerances generates a margin loss of about 10%.

TYPES OF MARGIN

Three types of margin can be defined:

1) Theoretical margin: this is the margin determined theoretically, based on construction data about the apparatus in perfect working order. It is calculated on exclusively theoretical data, leaving aside inevitable imperfections in manufacture, wear and play caused by repeated use.

2) Effective margin: this is the margin measured during real operating conditions, bearing in mind all the imperfections of the working machine.

3) Nominal margin: this is the margin used to determine the class of a certain type of apparatus and it represents the minimum limit imposed on the effective margin when the apparatus is in normal working conditions.

The preceding definitions concern all the general telegraphic apparatus. For arythmic apparatus the rules laid down by the C.C.I.T.T. (Comité Consultatif International Télégraphique Téléphonique) specify:

"The margin of an arythmic apparatus is the maximum level of arythmic distortion of the modulation which it is possible to supply to the apparatus itself, without the apparatus ceasing to correctly translate all the signals which it must be able to receive, whether the arhythmic trains which constitute the modulation are emitted singly or following one another continuously".

The margin thus defined can then be seen in two aspects:

a) Net, or normal margin: this is the distortion level, as defined above, when the telegraphic velocity of the modulation supplied to the apparatus is equal to the nominal one.

b) Synchronisation margin: this is the distortion level when the telegraphic velocity of the modulation supplied to the apparatus is that which would result from the emission made by the apparatus being tested if this was emitting and receiving simultaneously. In practice this means that the velocity of the apparatus which emits the modulation and that of the apparatus which receives it are equal.

Theoretical Margin

As already seen, the margin is the maximum level of distortion acceptable by a teleprinter. Thus, to determine the margin, it is necessary to find this distortion level.

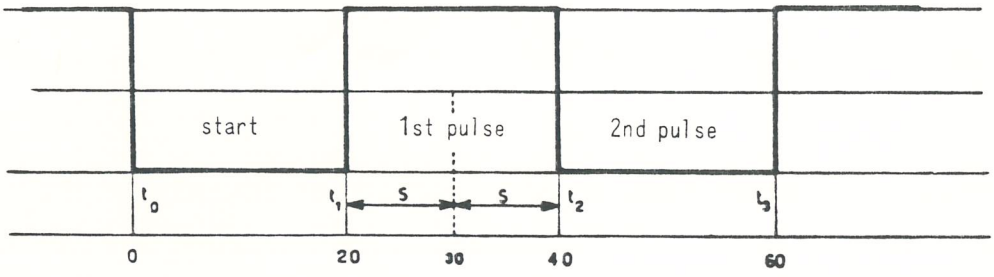


Fig. A

For this purpose, observe what might be the variation field of the characteristic instants of an arhythmic modulation at 50 Bauds, limiting the observation of the variations to the 1st pulse (fig. A). The conclusions drawn from this can obviously be applied to all the other code pulses.

The sensing instant takes place 30 ms. after the beginning of the start. The delay of instant t1 can reach, as the maximum limit, time (t1 + s) because if t1 should exceed this limit, the sensing instant would not take place in correspondence with the 1st pulse, (positive) but would fall during the previous start pulse (negative).

Similarly, by observing the variation field before instant t2, it is seen that the field can move up to the limit (t2 - s) otherwise the sensing instant of the 1st pulse would take place during the 2nd pulse which, in the case being examined, is negative like the start.

In both cases, by exceeding the limits previously stated, the recording of the 1st pulse, and thus of the code which contains it, is wrong. The same conclusions can be reached by examining the subsequent characteristic instants (t2 - t3 - t4 - t5) with regard to the corresponding sensing instants.

The maximum variation "s" of the characteristic instants which is compatible to an exact recording is 10 ms.

The arhythmical distortion corresponding to this variation is:

$$d_a = \frac{10}{20} \times 100 = 50\%$$

Thus we can conclude that the theoretical margin is 50%.
If the distortion level of a modulation exceeds this limit it is impossible for the teleprinter which is receiving it to record it exactly.

Effective margin

The theoretical margin depends on hypotheses which are not realized in practice.

Inevitable imperfections in the manufacture of the apparatus reduce the ideal characteristics anticipated by the project and cause, among other things, a reduction in the margin due to the fact that:

1) the sensing instant does not take place in an instant, but inside a finite interval.

2) The passage from the space position to the mark and vice-versa is not instantaneous and thus the time used for mechanical checking is less than the theoretical time.

The maximum effective margin on the teleprinters is around 40% for a telegraphic velocity of 50 Baud.

MEASUREMENT OF THE MARGIN WITH THE TIMER

One of the systems for measurement of the margin, still widely used especially in connections operating at present, consists in sending to the teleprinter being tested an undistorted modulation and moving the timer to locate the zone beyond which the recording of the characters is wrong.

The timer is a mechanical device, activated manually, which moves the sensing intervals with respect to the start pulse and thus also with respect to the corresponding characteristic instants, which is equivalent to introducing a distortion into the modulation.

During measurement of the margin, the latter is moved forward and backward, looking, with both movements, for the limits of correct functioning of the elementary pulse; the timer is graduated in hundredths of the duration of an elementary pulse.

If, on the timer, we read value 20 in one direction and 100 in the other, the use value (corresponding to the difference of the two values) is 80 and means that the teleprinter can receive a modulation distorted by 40%, since effective margin 40 is 80% of theoretical margin 50.

To correctly measure the margin with the timer it is necessary to have available a generator of undistorted signals which supplies a modulation free from distortion. The margin may also be measured by making the teleprinter work in off-line, operating the keyboard; in this case the margin measured is the synchronisation margin.

For greater simplicity of measuring apparatus, the system of testing with a timer is still widely used, even though it has two disadvantages:

- measurement is not independent of the units to be checked because one of these units is used for the measurement.

- it is not possible to measure the influence which the position of the sensing interval (u6) of the stop pulse has on arhythmic functioning, since this does not vary with the variation of the position of the timer which only operates on the sensing intervals of the code pulses.

MEASUREMENT OF THE MARGIN WITH DISTORTED MODULATION

To avoid the disadvantages of the system in which the margin is measured with the timer, shown in the previous section, a measuring system is used which consists of sending to a teleprinter, which has the timer fixed in the central position, a modulation with a notable distortion. This distortion is increased until the modulation is no longer received correctly: this limit represents the teleprinter's margin.

Special apparatus called "distorted signals generators" supply a modulation of which the distortion level may be varied at will.

The distortion of the signal is obtained by shortening or lengthening the start pulse, at the cost of the stop pulse (all the other pulses keep the theoretical duration); by doing this the characteristic instants move backwards or forwards and a distortion proportional to the variation of the start is introduced. In figure 1 we can see how the sequence of characteristic instants varies in a 50 Baud, 7 pulse modulation with the variation of the start length.

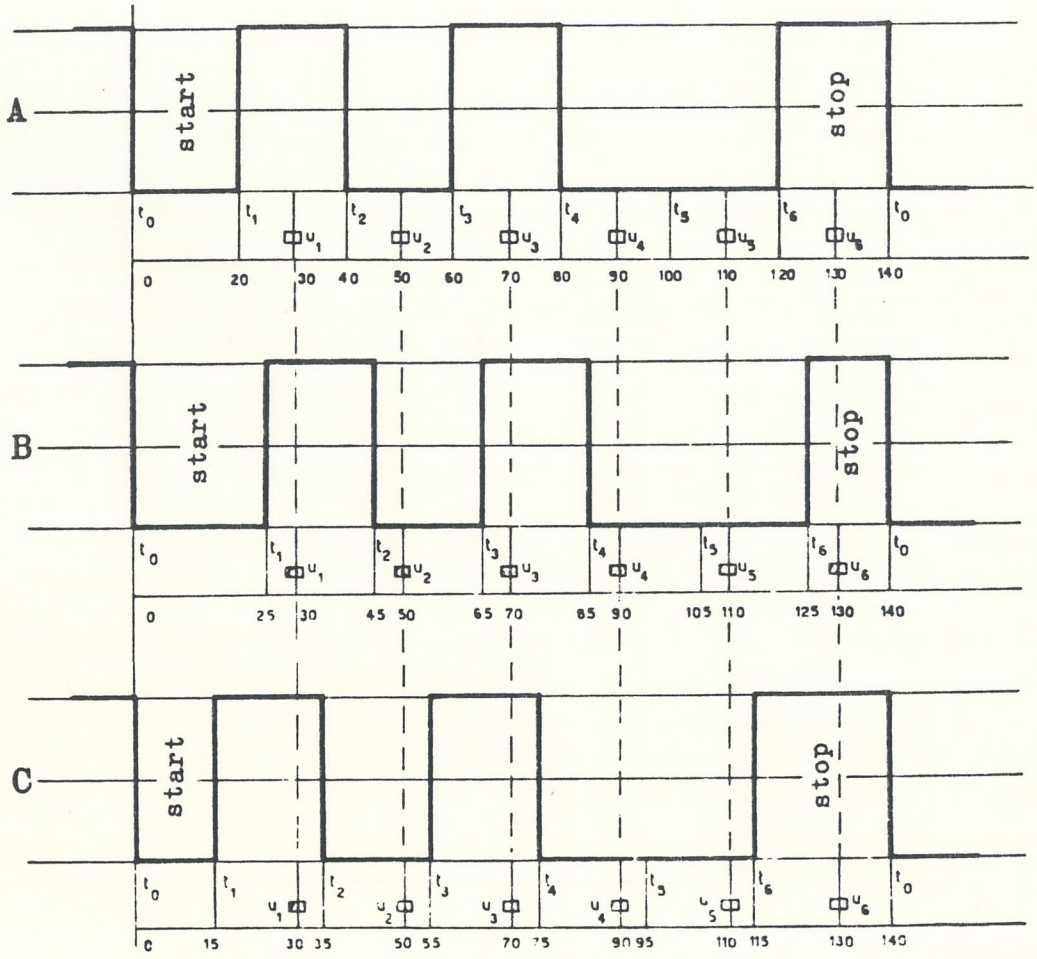


Fig. 1

In fig. 1A the modulation is undistorted and the sequence of the characteristic instants is:

0 - 20 - 40 - 60 - 80 - 120

In fig. 1B the start pulse is extended by 5 ms. Consequently the sequence of the characteristic instants is:

0 - 25 - 45 - 65 - 85 - 125

In fig. 1C the start pulse is shortened by 5 ms. The sequence of the characteristic instants is:

0 - 15 - 35 - 55 - 75 - 115

In both cases the maximum variation from the ideal modulation is 5 ms. The arhythmic distortion is:

$$d_a = \frac{5}{20} \times 100 = 25\%$$

By appropriately varying the shortening or lengthening of the start pulse, arhythmic modulations can be obtained which have a pre-determined distortion.

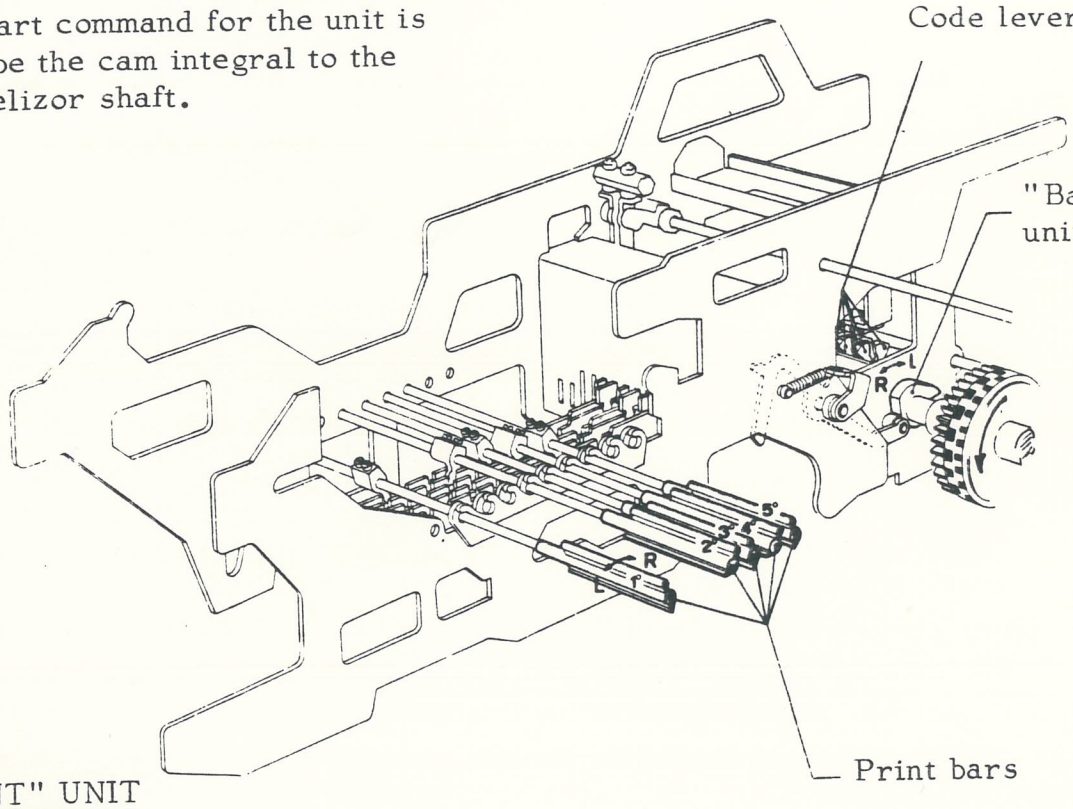
To measure the margin, modulations are sent to the teleprinter which are variously distorted either by the lengthening or by the shortening of the start; the extreme limits of correct functioning mark the value of the margin.

Sometimes the margin is not "centred" on the timer, that is, the limits of correct functioning may not be symmetrical with respect to the central position of the timer. For example, a modulation with a 42% distortion may be correctly received when this is caused by the lengthening of the start by +42%, whilst if the distortion is caused by the shortening of the start this may reach only 38% (-38%). This dissymmetry is caused by the fact that the timer is not centred and if the sensing intervals are suitably anticipated without moving the timer index from the central position, the lengthening or shortening of the start would have equal value, both 40%. The margin is in fact 40%, even if in practice it is said that the margin is included between +42% and -38%.

"BARS SETTING " UNIT

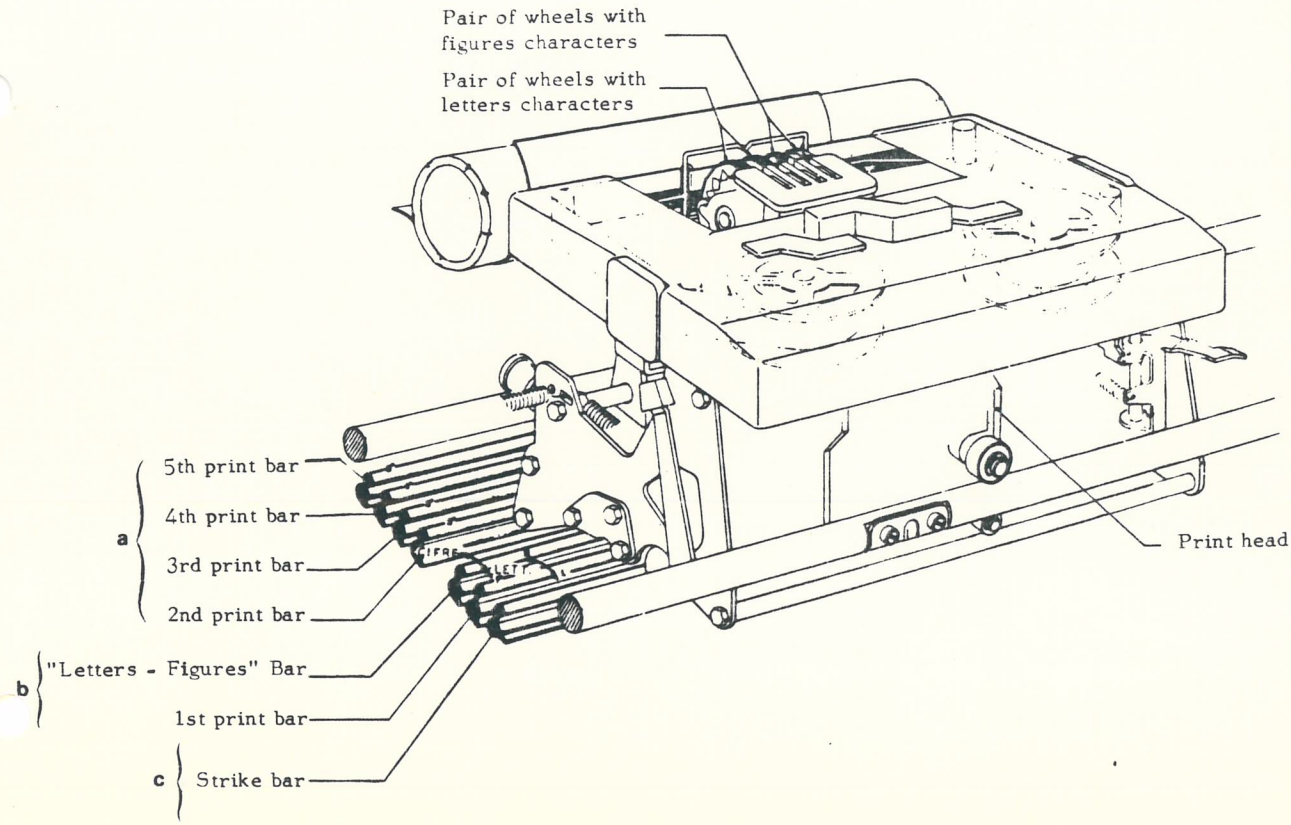
This unit has the task of copying the parallelized characters on the code levers and of transfering them onto the print bars.

The start command for the unit is given be the cam integral to the parallelizor shaft.



"PRINT" UNIT

The keyboard is composed of 4 print wheels, each one having 16 characters.
To print a character it is necessary:
1) to select the character (up to 16 in the range of the wheel)
2) to select the wheel (one of 4)
3) to impress the character on the paper.



CHARACTER SELECTION

The 5th, 4th, 3rd and 2nd bits are used for character selection; with these four bits the sixteen angular positions corresponding to the characters on each wheel are obtained.

($2^4 = 2x2 = 4x2 = 8x2 = 16$)

The operating principle is shown in fig.N.

The mechanism is made up of:

- character wheel 1
- rack 2
- frame 3
- connecting rod 4
- concentric eccentrics E1, E2, E3, E4 which rotate on the respective axes:

  E1 on axis X - E2 on E1 - E3 on E2 - E4 on E3.

Each eccentric rotates 180° at a time.

The eccentrics are commanded respectively by:

E4 by bar B5 - E3 by bar B4-
E2 by bar B3 - E1 by bar B2

and they command the movement of the racks by:

E4, 8 steps = weight 8 - E3, 4 steps = weight 4
E2, 2 steps = weight 2 - E1, 1 step = weight 1.

In figure N, the character wheel is found in angular position "0".
The character received has SPACE bits 5, 4, 3 and 2.
Print bars B5 ÷ B2 are in the Space angular position.

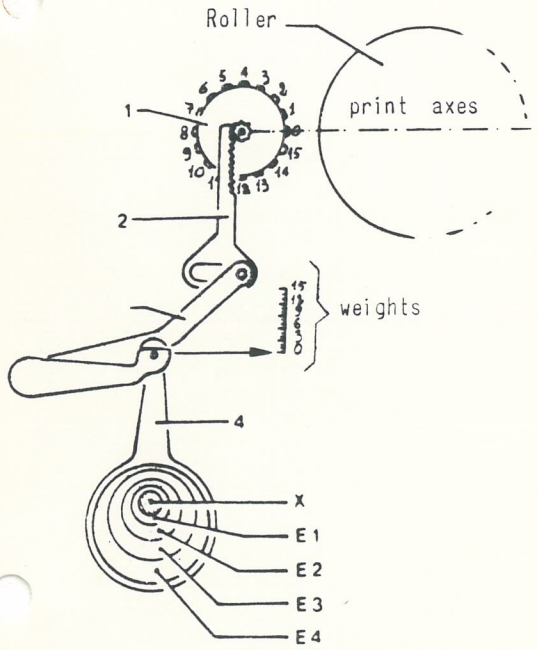
If we make an "R" follow this character, bars B4 and B2 of figure 0 commute in the MARK position.
Through respective clutches 14 and 12 eccentrics E3 and E1 are taken into rotation, (of 180°).
As seen previously, eccentric E3 has weight 4 and eccentric E1 has weight 1; therefore the rack will rise by 5 steps, carrying character "R" onto the print axis.

Figure 0 shows the comprehensive diagram of the character selection mechanism:

- conductor sleeve 5 is continually rotating
- bars B5 ÷ B2 command, according to their angular position, the intermediates of clutches 15 ÷ 12.
  These axial movements make the driven gears rotate by 180°.
- connecting rod 4 (controlled by the relative position assumed by the four eccentrics) commands, through frame 3, the vertical sliding of racks 2.

N.B. the driven gears start when there is an angular variation of the print bar; it is worth noting that, if after the printing of a character, for example R, a second R follows, the driven gears are pre-set for the first character and stopped for the second.

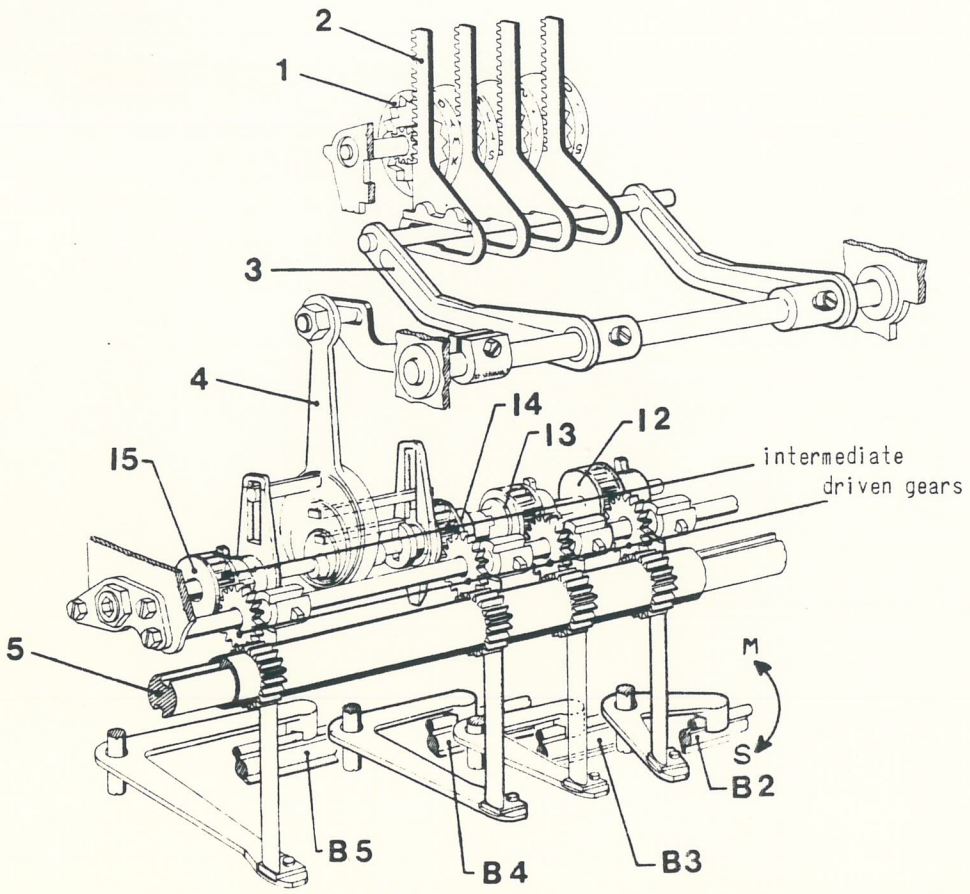
Fig.N



Weights	b_5	b_4	b_3	b_2	b_1	LTRS 0	LTRS 1	CFRS 0	CFRS 1
0	0	0	0	0		*	E	*	3
1	0	0	0	1		=	A	=	-
2	0	0	1	0		>	S	>	'
3	0	0	1	1		I	U	8	7
4	0	1	0	0		<	D	<	₵
5	0	1	0	1		R	J	4	£
6	0	1	1	0		N	F	,	°
7	0	1	1	1		C	K	:	(
8	1	0	0	0		T	Z	5	+
9	1	0	0	1		L	W	)	2
10	1	0	1	0		H	Y	;	6
11	1	0	1	1		P	Q	0	1
12	1	1	0	0		O	B	9	?
13	1	1	0	1		G	↑	%	↑
14	1	1	1	0		M	X	.	/
15	1	1	1	1		V	↓	=	↓
						04	03	02	01

Note : ▭ Characters which are not normally printed

Fig.O



WHEEL SELECTION (Fig.P)

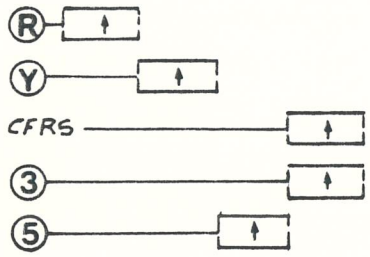
As we saw previously, the print carriage carries 4 character wheels, each of which has 16 angular positions.
Two wheels carry the "Letters" (LTRS) characters, and the other two the "Figures" (CFRS). For wheel selection, two bars are used:

- bar B1 commanded by the 1st Bit and connected to eccentric E5 which rotates on axis X.
  This command determines if the wheel to be made to print is the left or the right of the Figures or Letters group.
  Eccentric E5 commands the movement of the carriage for 1 step (Weight 1).
- bar CFRS/LTRS commanded by the functions unit on recognition of the CFRS and LTRS characters; it selects the wheels unit.
  This bar is connected to eccentric E6 which rotates on eccentric E5.
  Eccentric E6 commands the movement of the carriage for 2 steps (Weight 2).

We will now analyse, with a series of examples, the operating principle of the selection wheel.

If the last character printed was an (R) the print hammer is found in the position shown by the arrow, in the figure at the side.

LTRS 0	LTRS 1	CFRS 0	CFRS 1
*	E	*	3
≡	A	≡	-
>	S	>	'
I	U	8	7
<	D	<	♣
R	J	4	♀
N	F	,	É
C	K	:	(
T	Z	5	+
L	W	)	2
H	Y	H	6.
P	Q	0	1
O	B	9	?
G	↑	%	↑
M	X	.	/
V	↓	=	↓

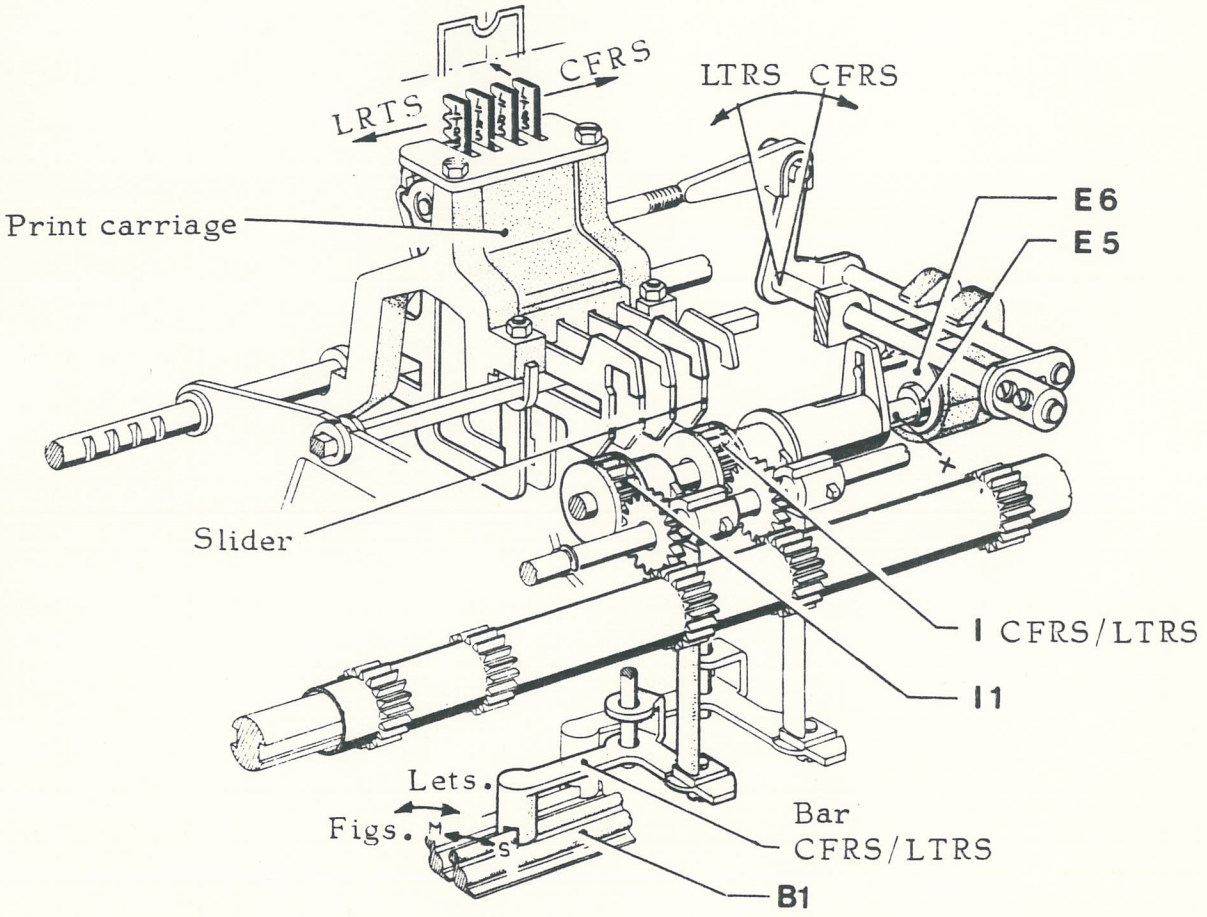


On reception of a subsequent character, for example (Y), the print carriage moves by one step, taking the right-hand wheel (of the letters group) to the printing point.
This movement is due to the variation of the 1st Bit and of the consequent rotation of bar B1.
Let us now suppose that character (3) is to be printed. The latter must be preceded by service character CFRS, since the print carriage's last position is in "Letters". The movement of the CFRS/LTRS bar into CFRS commands the rotation of eccentric E6, for 180°.
The carriage moves two steps, taking the right-hand wheel of the "Figures" group to the printing point.
On reception of character (3) the carriage does not change its axial position.
This is due to the fact that there is no variation of the 1st Bit between the CFRS character and (3).
Conversely (e.g. for character (5)) the print carriage would still be moved by one step.

Figure P shows the comprehensive diagram of the mechanism which realizes axial movement of the head.
Remember that clutches 15-16 rotate by 180° only when bars B1 and CFRS/LTRS complete an angular movement.

Fig. P

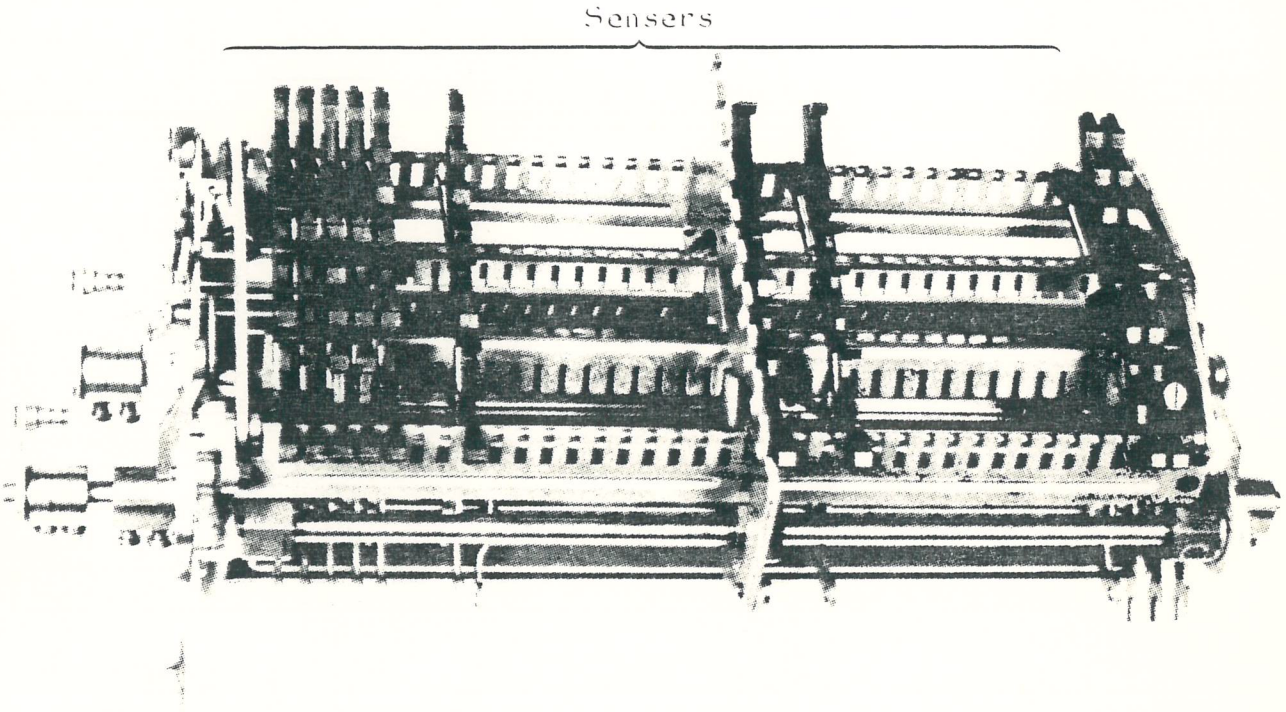
Printing point



CHARACTER PRINTING (Fig. P)

This takes place when the slider which carries the print wheel is activated against the roller.

Fig. Q

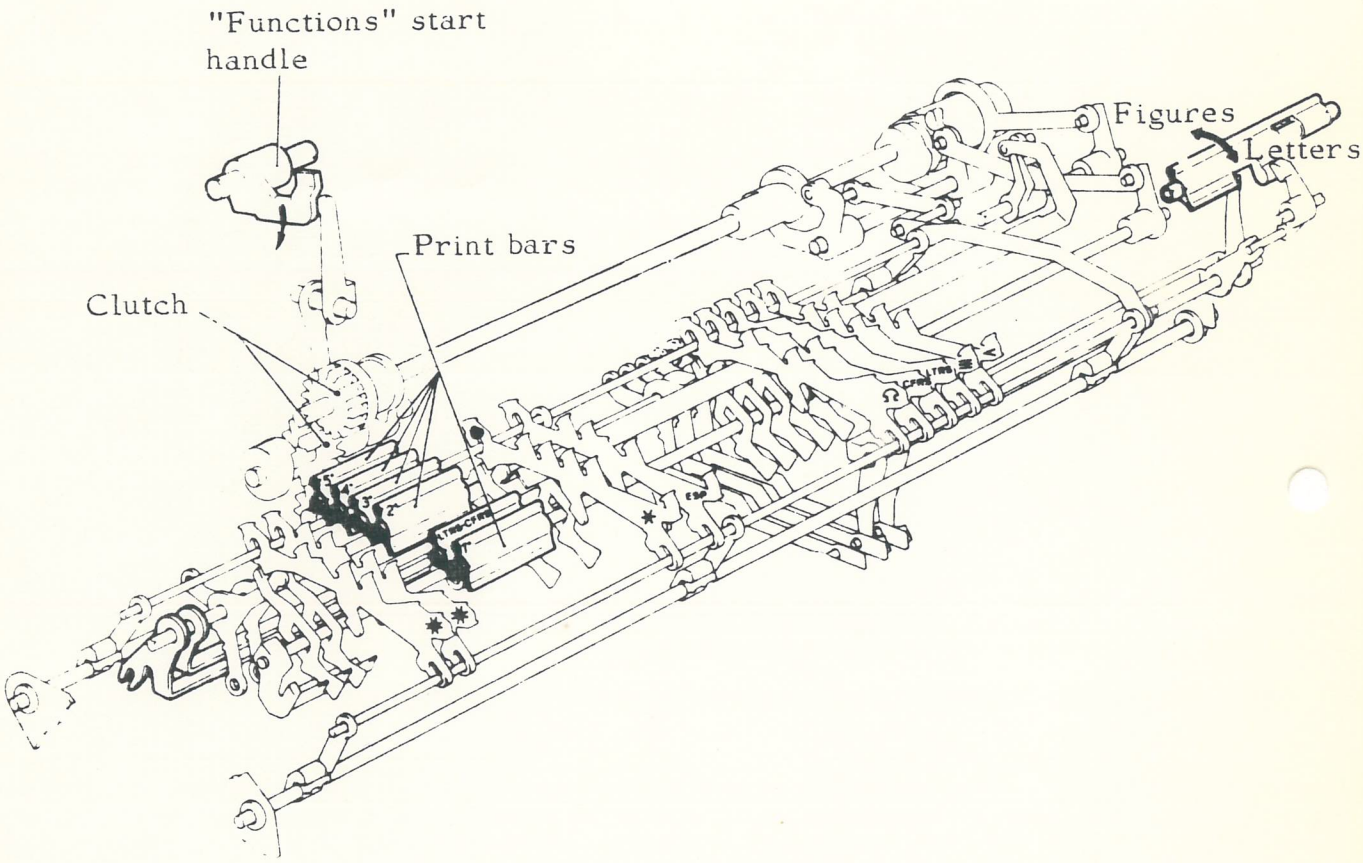


The purpose of the functions unit is:

- To check the print bars.
- To permit the print and forward movement command when the character is to be printed.
- To command a certain function upon recognition of the relative character.

The functions unit consists of a frame with 34 slots into which sensers may be inserted (maximum 34), each one of which has a profile representing the character which it must recognize (fig. Q).

Fig. R



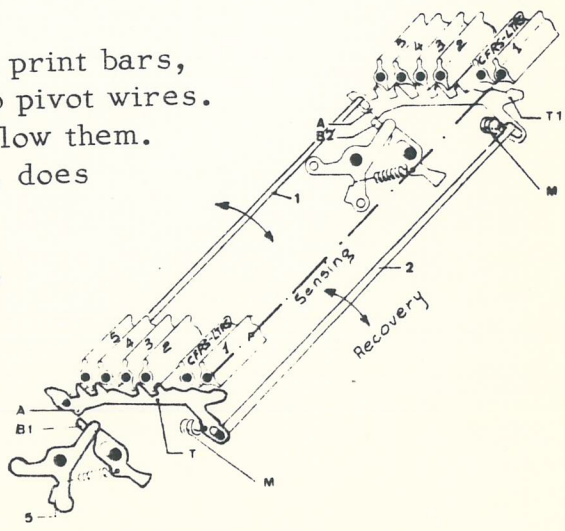
Operating principle (fig R-S)

With each character received the group of sensers, put into movement by pivot wires 1 and 2 and by spring M, check the character present on the print bars.

- Senser T, which is not retained by the print bars, follows exactly the movement of the two pivot wires. Appendix A allows lever B1 to pass below them.
- Senser T1, retained by the print bars, does not allow insertion of lever B2.

When the two pivot wires are recovered, senser T makes lever 5 rotate.
In conclusion, lever 5 (actuator) relative to each senser, is the one which causes the function to be carried out.

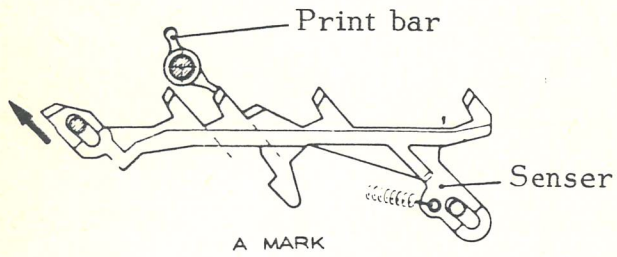
Fig.S

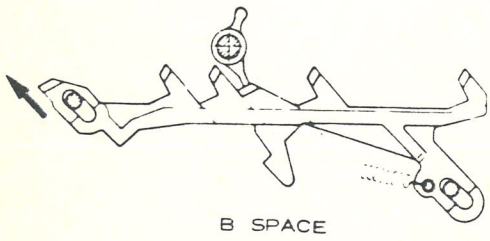


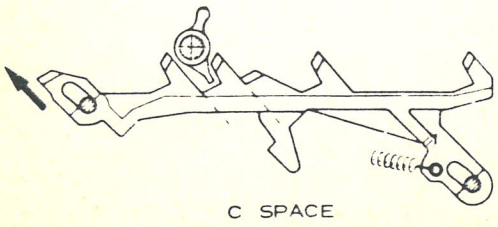
In figure T we can see the cases of stop and passage of the senser with respect to the print bars.

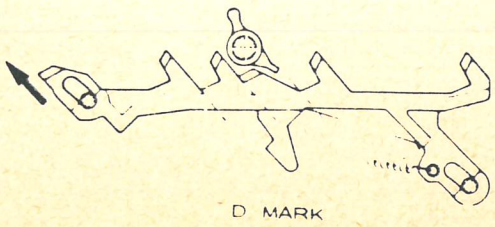
A the bar is in MARK and stops the senser
B the bar is in SPACE and stops the senser
C the bar is in SPACE and frees the senser
D the bar is in MARK and frees the senser

Fig. T

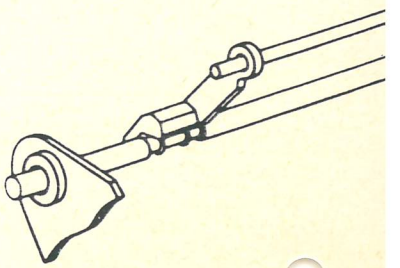






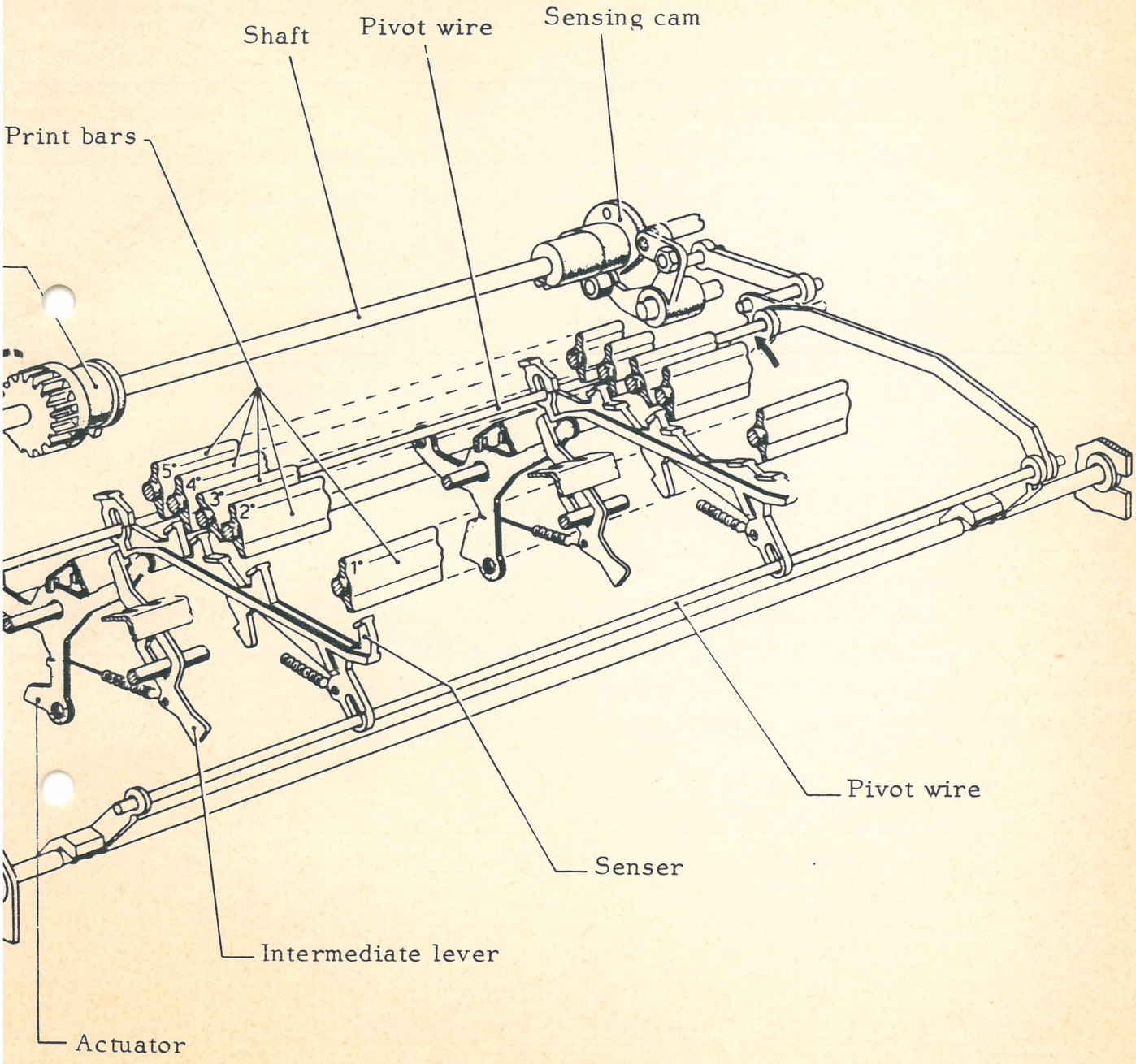


Driven wheel of the clutch



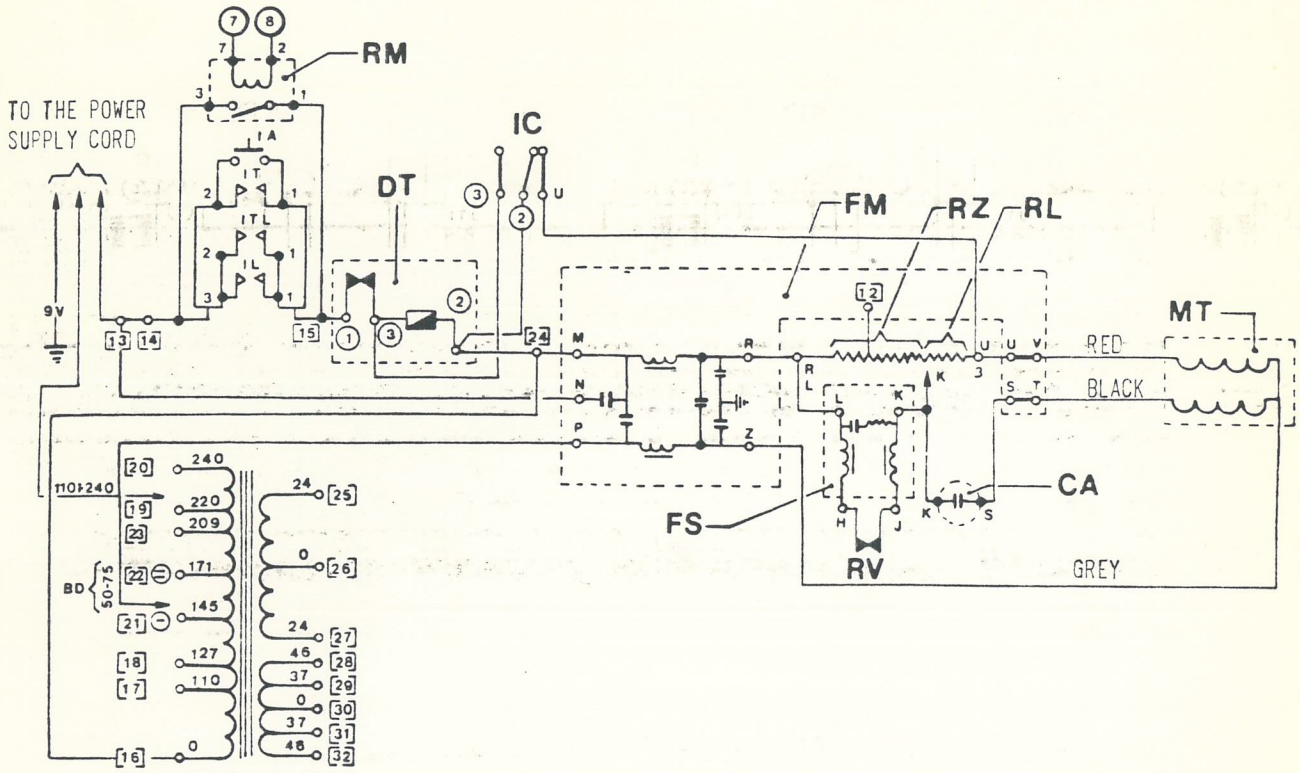
In figure U, the mecha

Fig. U



sm which commands the elevation and recovery of the sensers is shown.

MOTOR CIRCUIT



Comprehensive Electrical Diagram of the Motor Circuit

The electrical circuit should satisfy the following requirements:

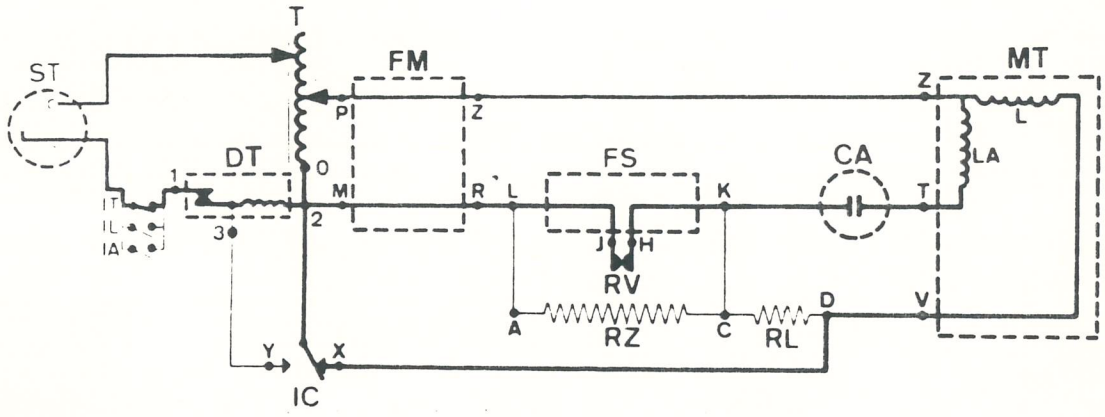
1) Start the motor and bring the motor to the stabilized speed in less than 0·5 seconds, making a strong power supply current pass through the motor (MT) windings the moment the circuit is closed.

2) Keep the stabilized speed constant when the motor transmits the motion to the machine units, increasing or decreasing the current which crosses the motor coils so that such oscillations keep the motor speed practically constant.

3) Protect the motor when it jams under voltage, breaking the power supply current when the current absorbed by the motor surpasses, for a few minutes, the security limit.

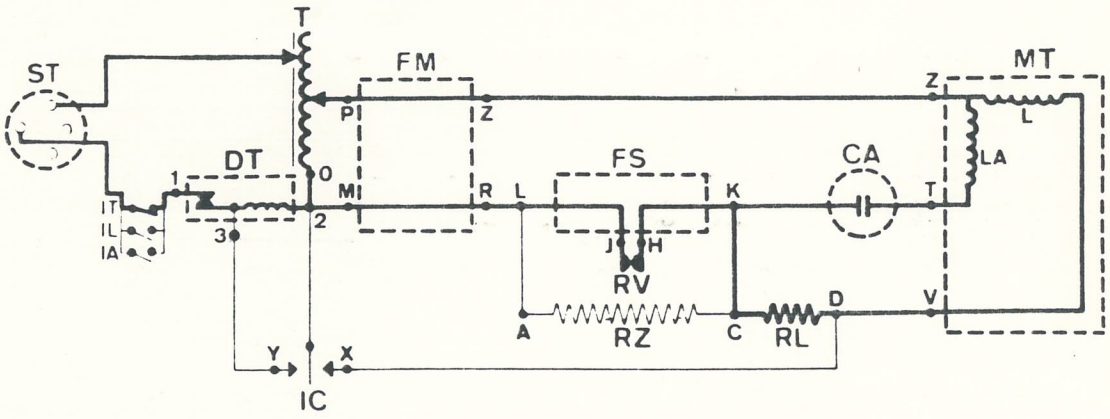
MOTOR CIRCUIT

When the closing of one of the switches (IT, IL, IA) is commanded, auto-transformer T is supplied with power.
The voltage necessary to supply the motor (MT) is drawn from the transformer (T).
This motor is a single-phase asynchronous type, with a speed regulator, two windings (L and LA) and with condenser CA for starting.

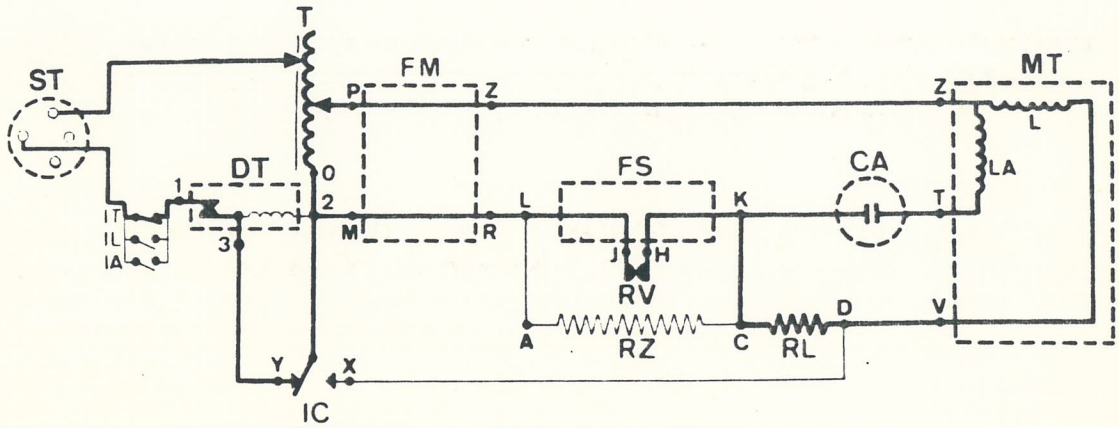


The path of the current from the moment the motor starts up to the speed of 1,800 r.p.m. is shown with the thicker line.

When the motor reaches about 1,800 r.p.m. it commands the release of the central contact of the centrifugal switch (IC) from point X; the circuit is then supplied with power as in the figure.

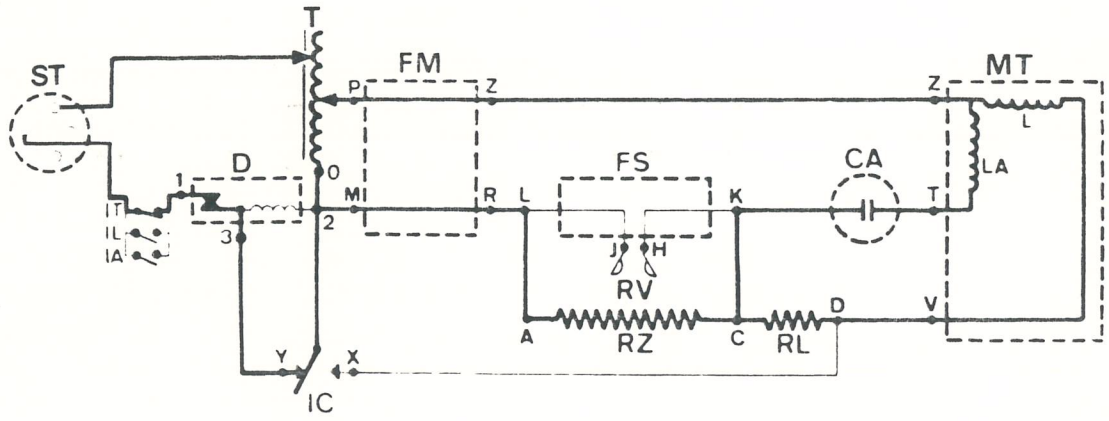


A limiting resistor (RL) is inserted into the circuit and this has the task, once the motor is started, of limiting the power supply current.
When the motor reaches 2,200 r.p.m. the central contact of IC goes to Y; (the circuit is supplied as in the figure).



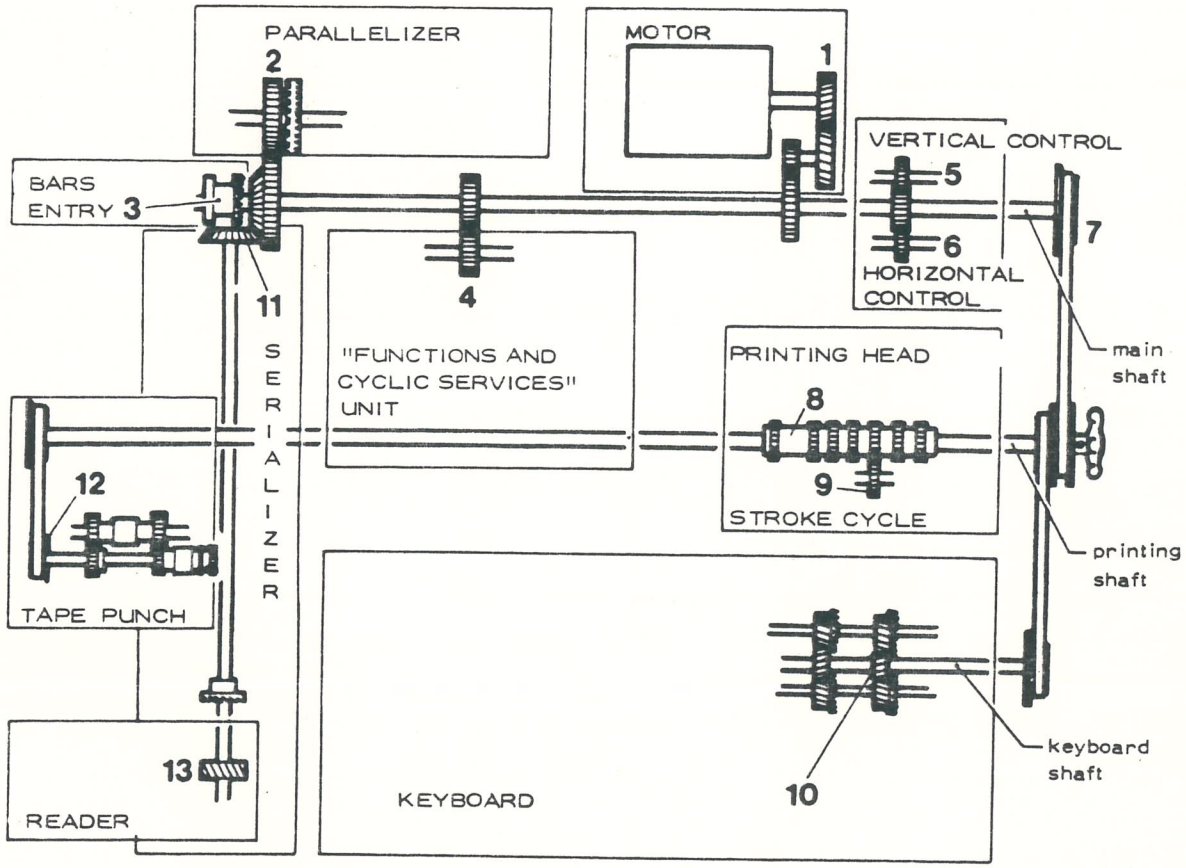
Note that the coil of the thermic circuit breaker (DT) is short-circuited; this means that the circuit breaker may break the circuit only when the motor has a speed less than 2,200 r.p.m.

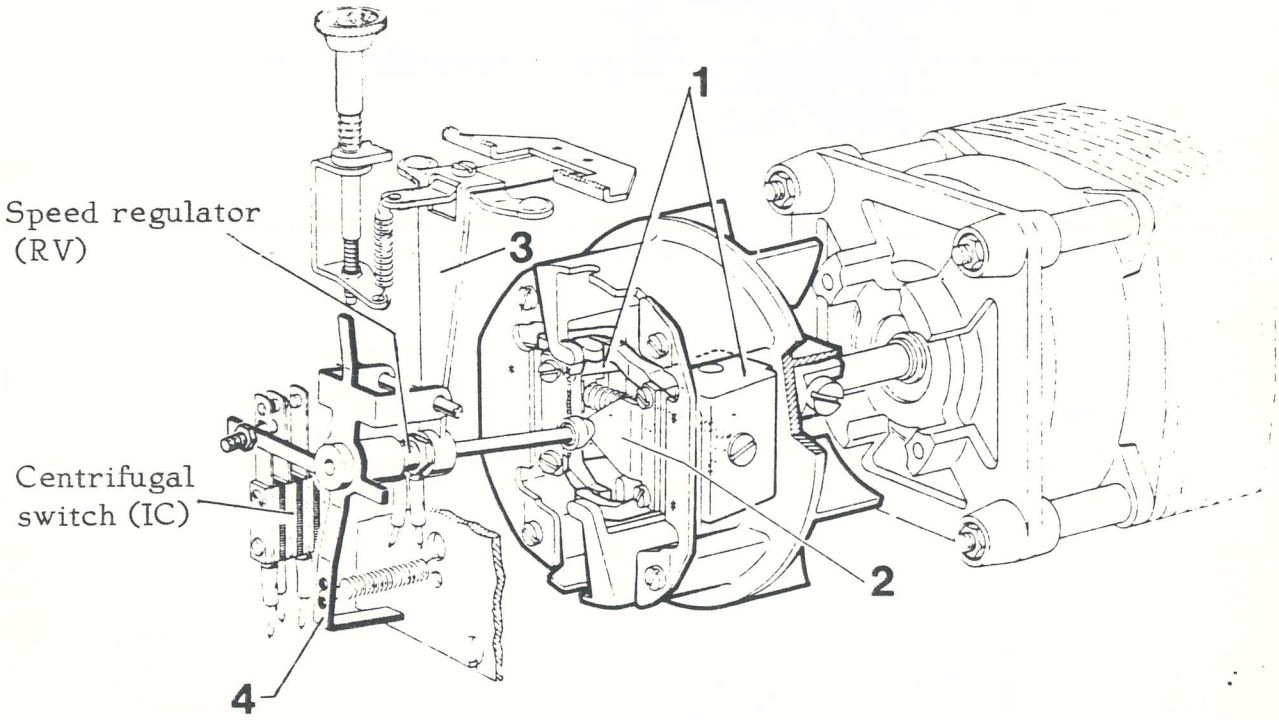
When the motor reaches 2,500 r.p.m. and this limit is exceeded, the speed regulator contact RV is opened, and the circuit supplied as in the diagram.



As can be seen, the ballast resistor (RZ) is inserted, therefore the current which supplies the motor decreases and the motor slows down; as soon as the speed goes below 2,500 r.p.m. contact RV re-closes, thus increasing the current and increasing the motor speed again, until contact RV re-opens. Thus there is a continuous oscillation of the speed around 2,500 r.p.m. which is the stabilized speed of the motor.

MOTION TRANSMISSION GENERAL DIAGRAM

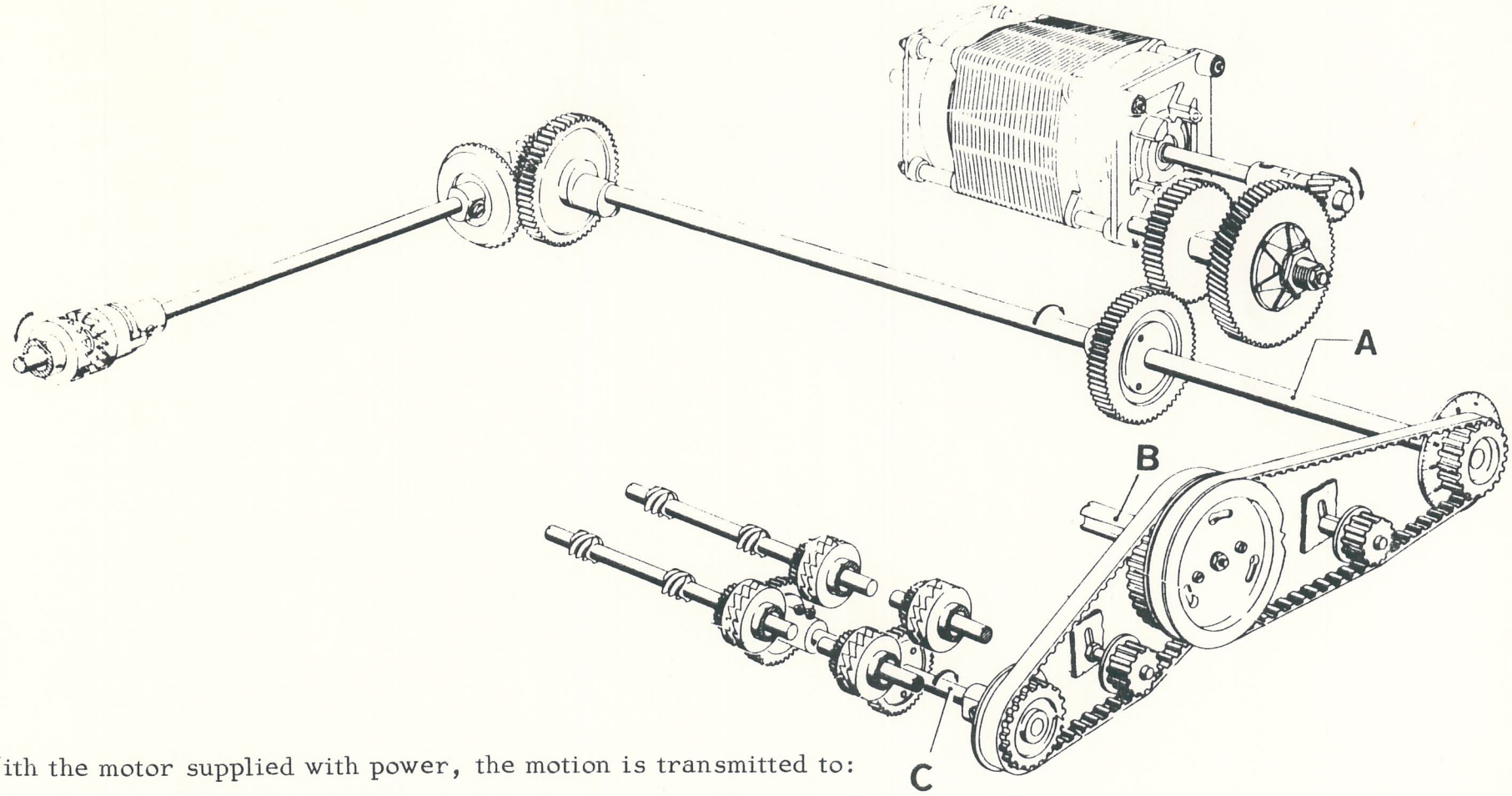




IC AND RV SWITCHES COMMAND DEVICE

When the motor reaches 1,800 r.p.m. the centrifugal switch central contact needs to be taken to the intermediate position which is obtained by use of movement of lever 4 driven by centrifugal masses 1.
When the motor reaches 2,200 r.p.m. the IC central contact is positioned to the right.
When the motor reaches 2,500 r.p.m. it is necessary to open the speed regulator (RV) contacts which is done by use of lever 4 which meets structure A whilst lever 3, driven by the centrifugal masses, continues towards the right.

MOTION TRANSMISSION



With the motor supplied with power, the motion is transmitted to:

1 - Main shaft A for: parallelizor, functions, bars setting and services.

2 - Shaft B for head unit motion.

3 - Shaft C for keyboard unit motion.

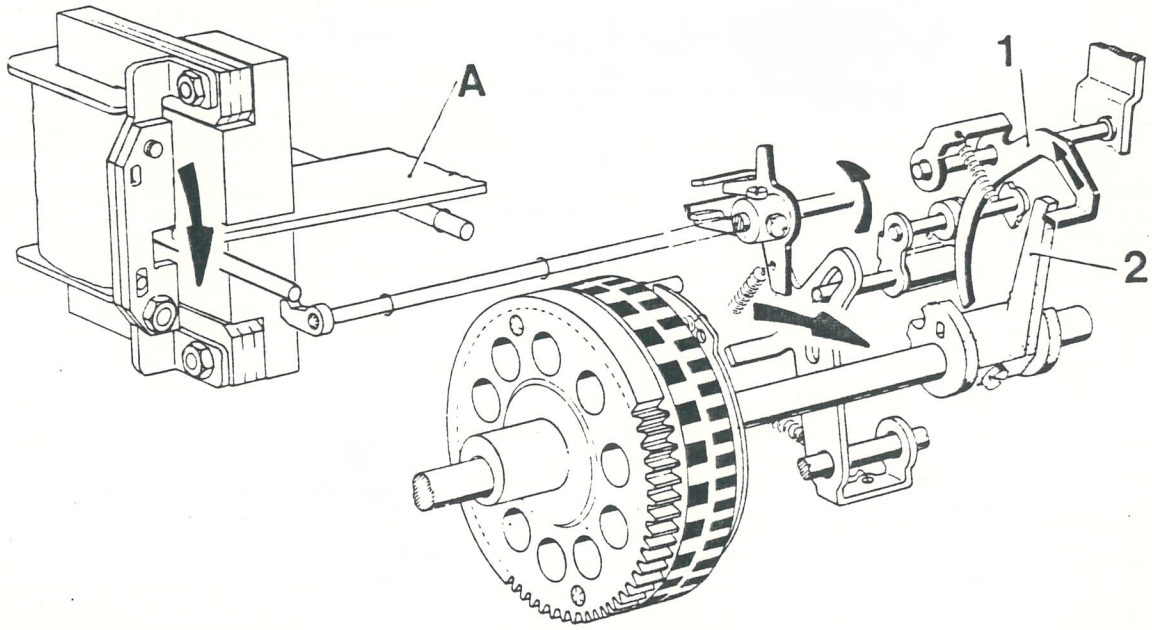
4 - Shaft D for serializer unit motion.

PARALLELIZOR

On reception of a code it is necessary:

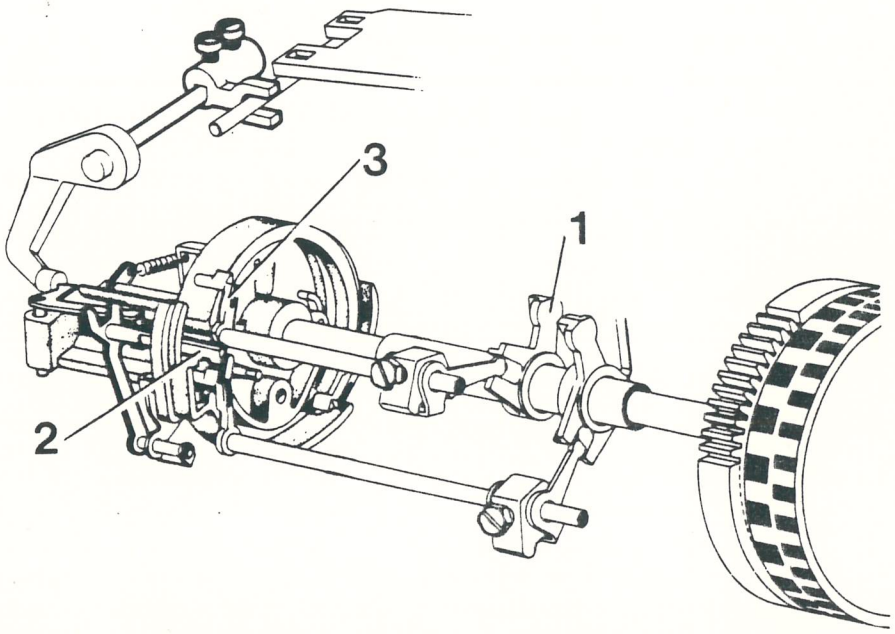
1) to start the parallelizor cycle;
2) to parallelize the code;
3) to stop the parallelizor cycle;
4) to start the subsequent "Bars setting" unit.

PARALLELIZOR START



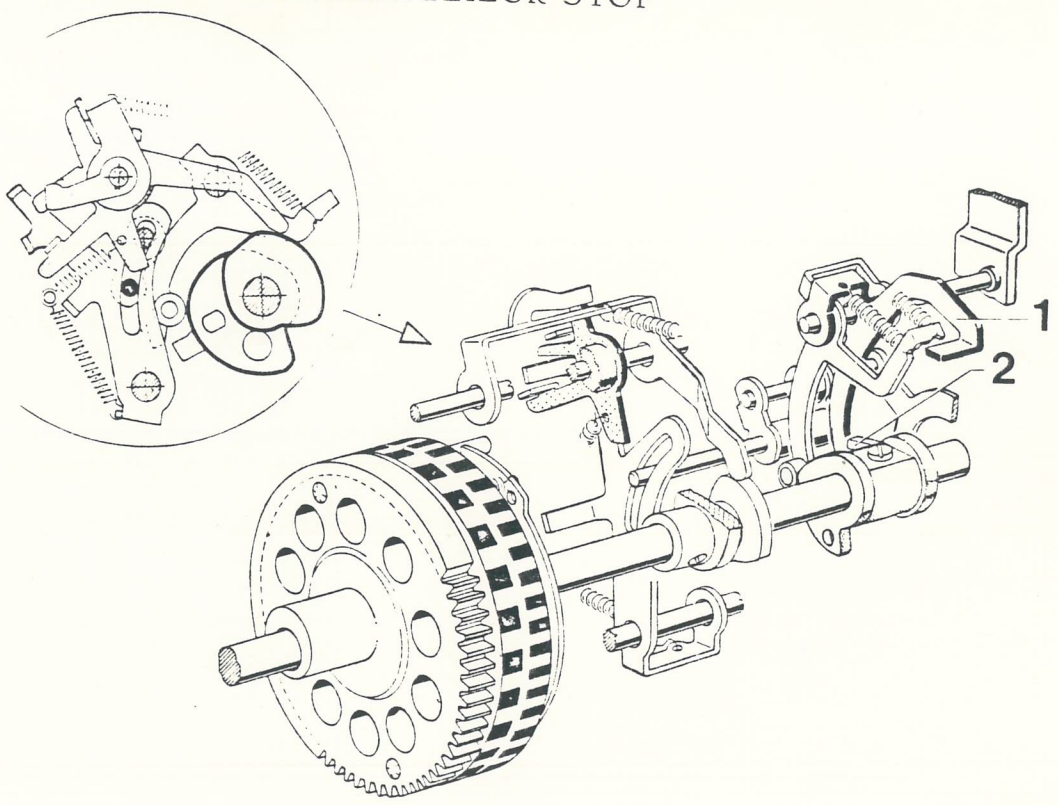
1) To start the parallelizor cycle it is necessary to rotate lever 1 so as to free the stop arm 2. The rotation of lever 1 takes place with the START pulse.

PARALLELIZATION



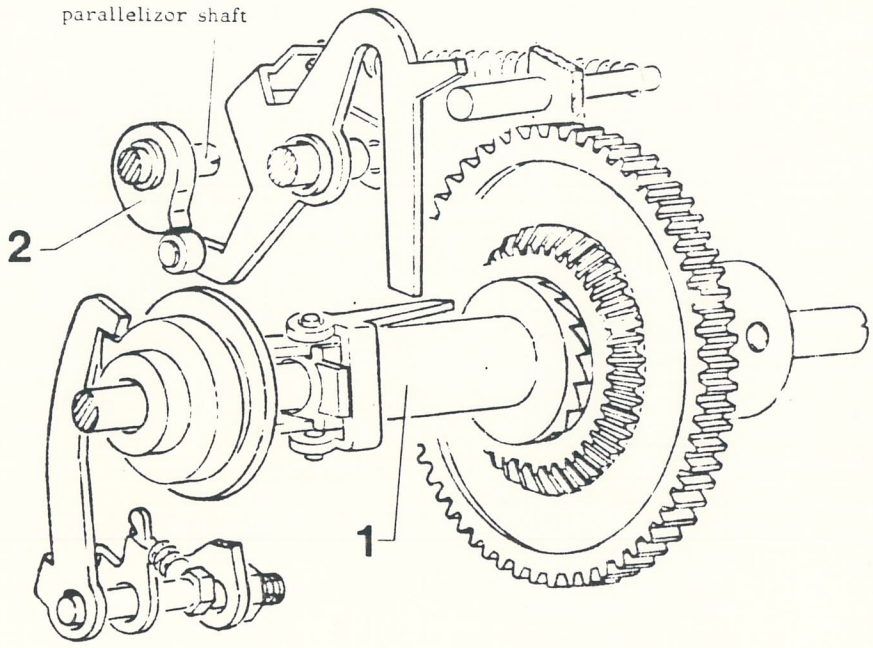
2) To parallelize the code it is necessary to position sensing levers 1 by use of entry wedge 2 and entered wedges 3.

PARALLELIZOR STOP



3) To stop the cycle it is necessary to rotate lever 1 so that it stops arm 2.

"BARS SETTING" UNIT START



4) To start the subsequent "Bars setting" unit it is necessary to close the clutch 1 by means of cam 2 mounted on the parallelizor shaft.

BARS SETTING

When the cycle relative to the unit starts it is necessary:

1) to copy the sensing levers code and transfer it onto the 1st entry levers.

2) to start the 1st entry.

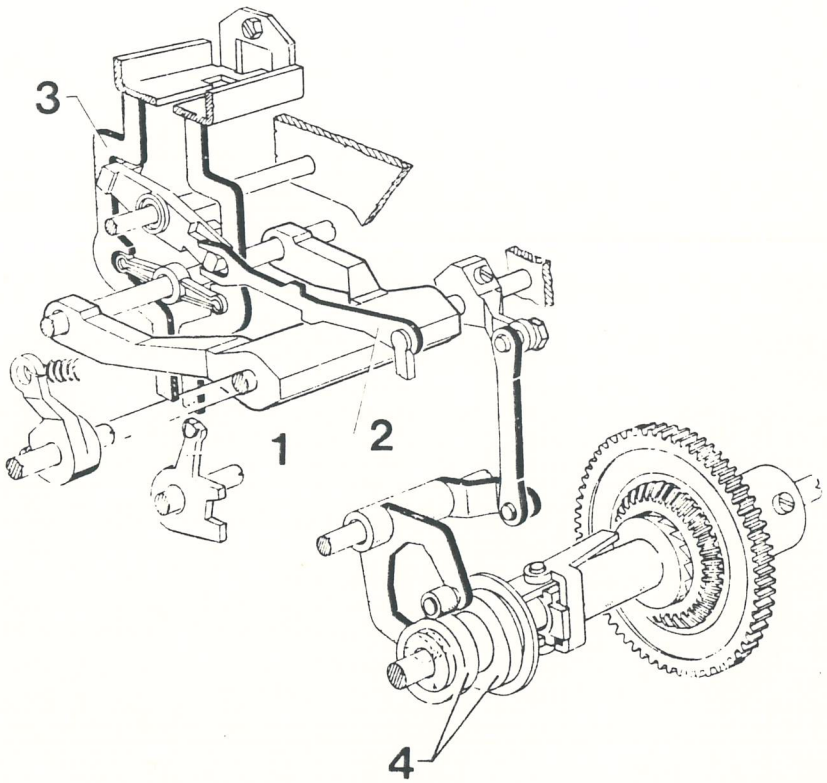
3) to transfer the code from the 1st entry levers to the 2nd entry levers.

4) to start the 2nd entry.

5) to transfer the code from the 2nd entry bars to the writing bars.

6) to start the "Cyclic services and Functions" unit.

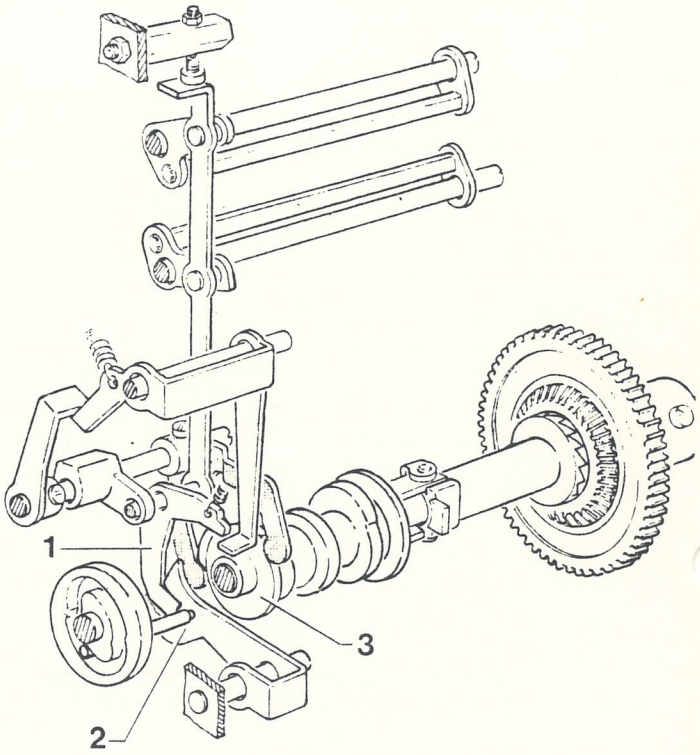
COPYING



1) To copy the code of the 1st sensing levers and transfer it onto the 1st entry levers it is necessary to check the sensing levers with rocker levers 3 commanded by cam 4.

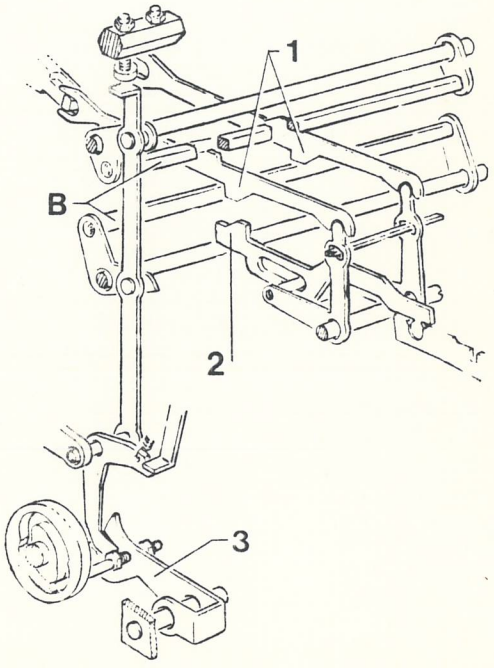
START OF 1st ENTRY

2) To start the 1st entry it is necessary to couple lever 1 to link block 2 through cam 3.



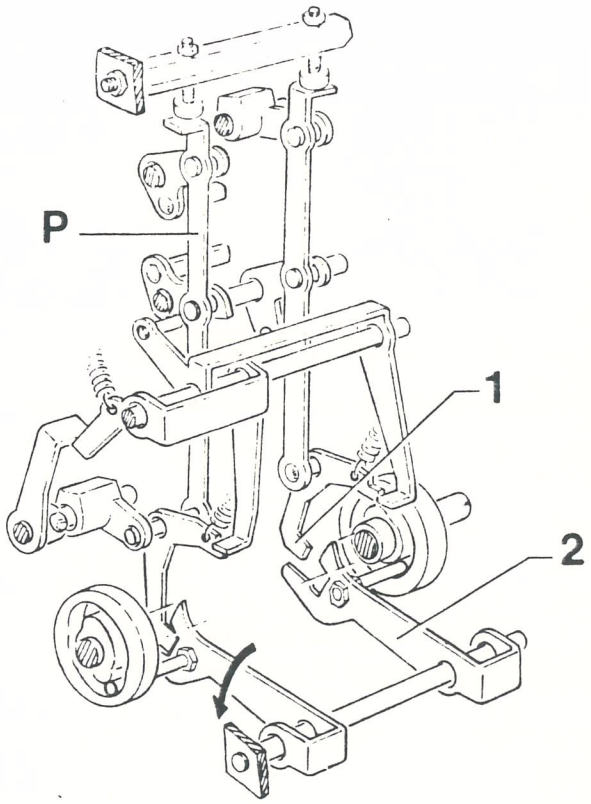
1st ENTRY

3) To transfer the code from the 1st entry levers to the 2nd entry levers it is necessary to rotate bails B by means of link block 3.



START OF 2nd ENTRY

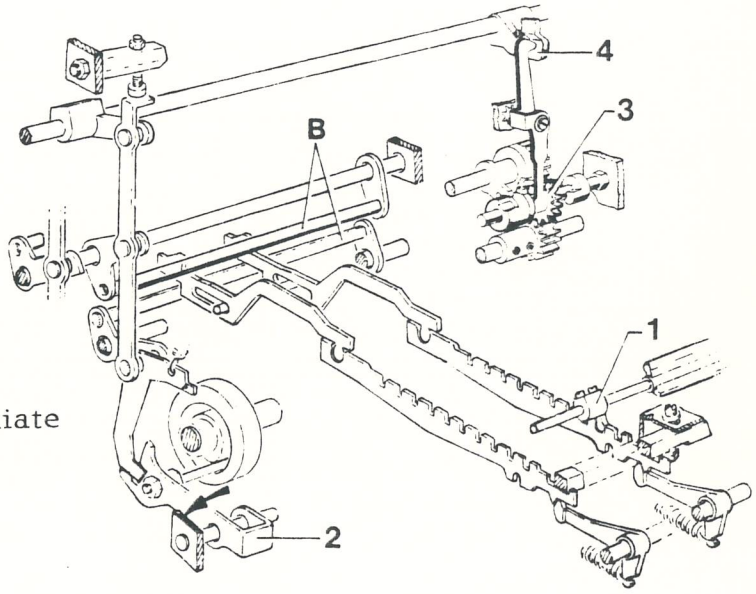
4) To start the 2nd entry it is necessary to couple lever 1 to link block 2 through movement of rod P.



2nd ENTRY AND START OF "FUNCTIONS AND CYCLIC SERVICES"

5) To transfer the code onto the print bars (1) it is necessary to rotate bails B through link block 2.

6) To start the "Functions and Cyclic Services" unit it is necessary to move intermediate 3 by means of handle 4.



CYCLIC SERVICES

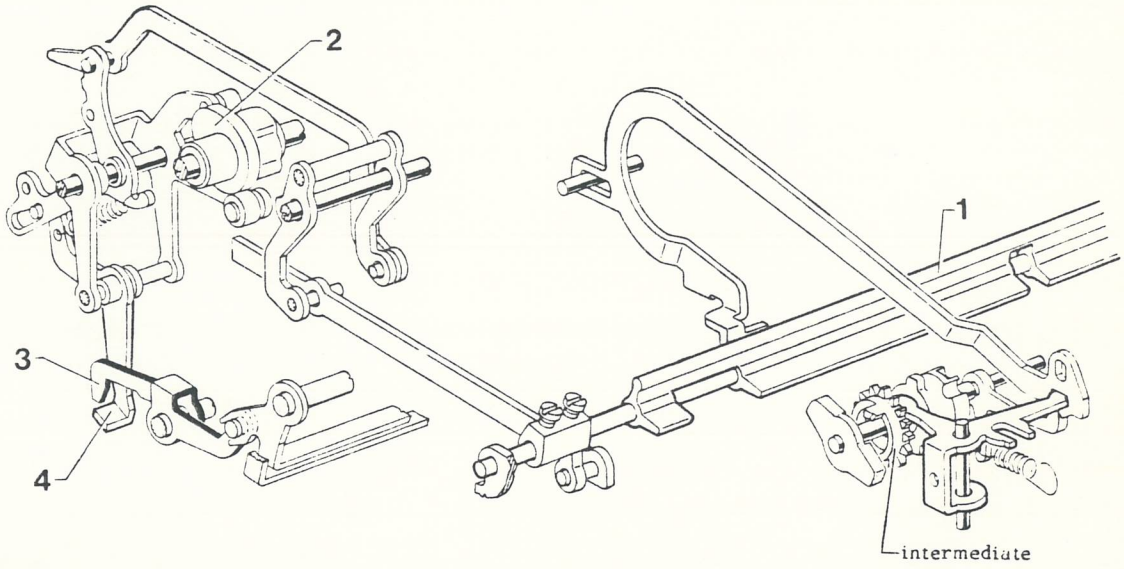
When the "Functions and Cyclic Services" clutch closes, the machine is ready to carry out the following services:

1) Print

2) Forward movement

3) Perforation

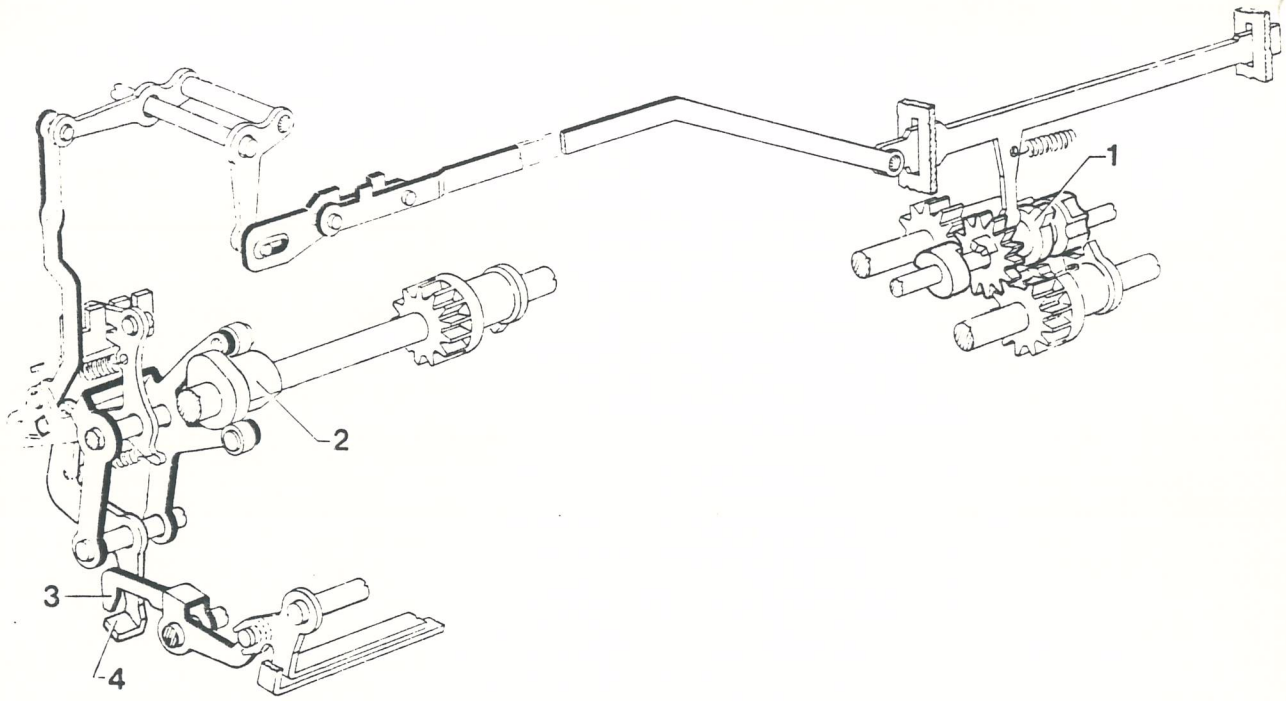
PRINT INTERMEDIATE COMMAND



1) For <u>printing</u> it is necessary to command the print intermediate through print bar 1 commanded by cam 2.

N.B. To cancel the print cyclic service hook 3 should be coupled to tab 4.

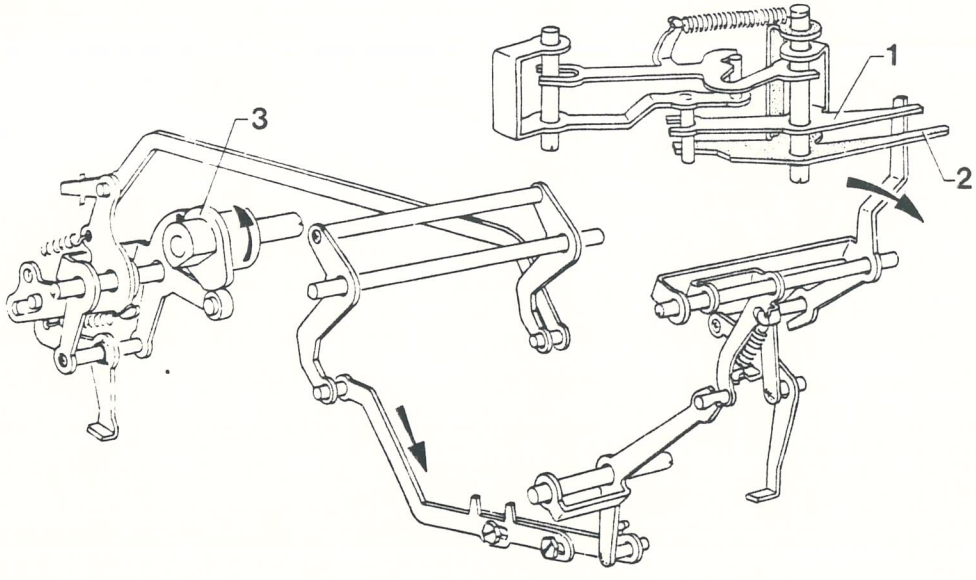
HORIZONTAL GOVERN INTERMEDIATE COMMAND



2) For forward movement it is necessary to command intermediate 1 through cam 2.

N.B. To cancel the forward movement cyclic service, hook 3 should be coupled to tab 4.

PERFORATOR INTERMEDIATES COMMAND



3) For perforation it is necessary to command the perforator intermediates through bridges 1 and 2 commanded by cam 3.

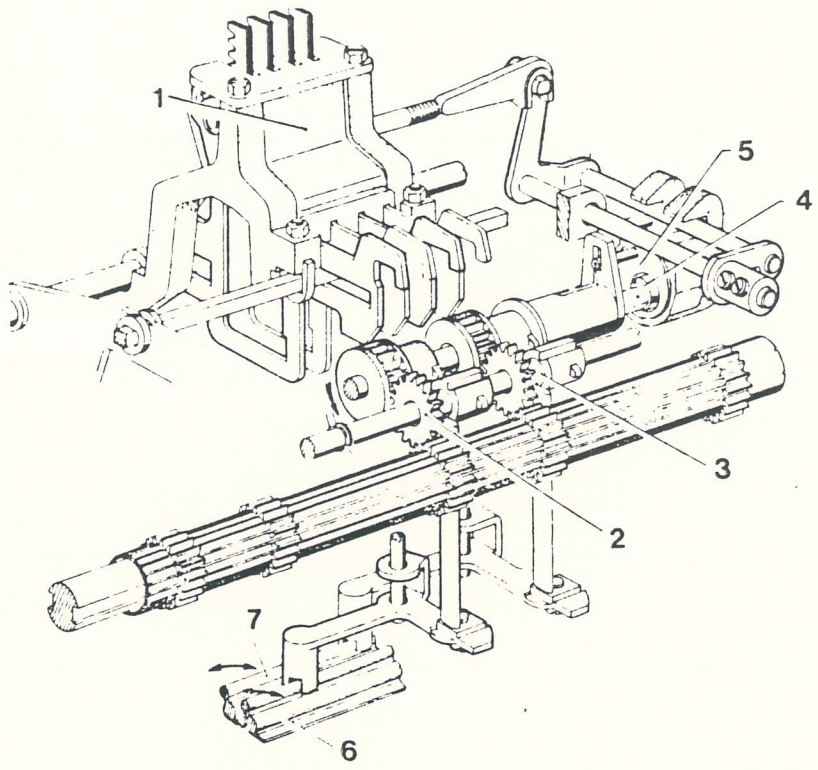
N.B. Cancellation of the perforator service can be seen in study of the perforator.

PRINT UNIT

To print, the machine must:

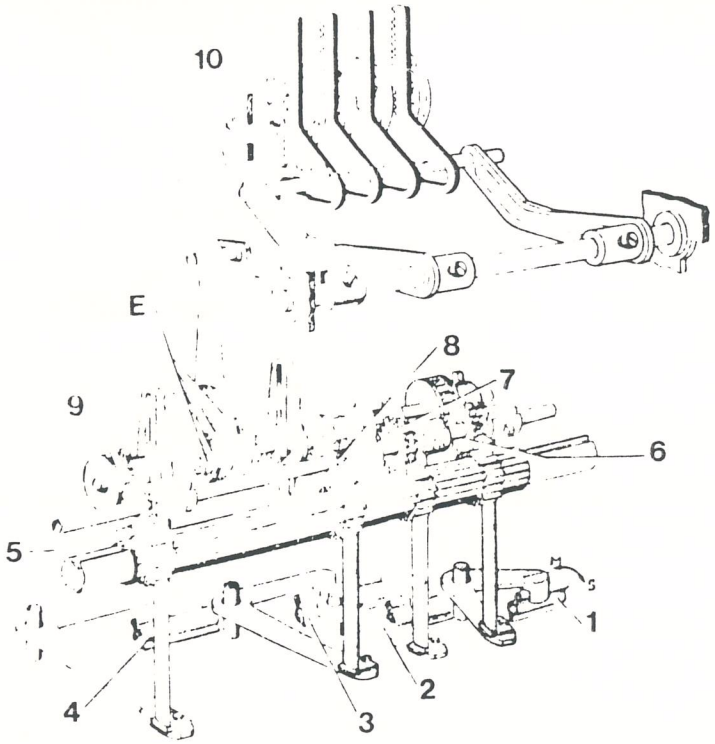
1) select the wheel
2) select the character
3) select the ribbon
4) print the sign
5) move forward by 1 step
6) move ribbon forward
7) possibly reverse the ribbon.

WHEEL SELECTION



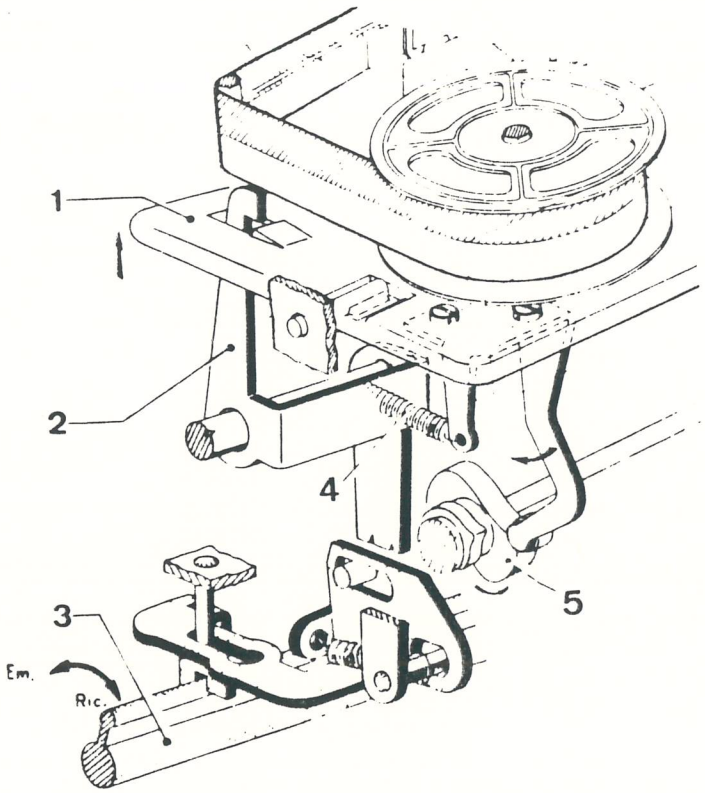
1) To select the wheel it is necessary to move carriage 1 by means of the closing of clutches 2 and 3 which is caused by the movement of the figures/letters bar and of the 1st code bar.

   The movement to the figures/ letters bar is made in the functions cycle; the movement of the 1st code bar is made in the bars setting cycle.



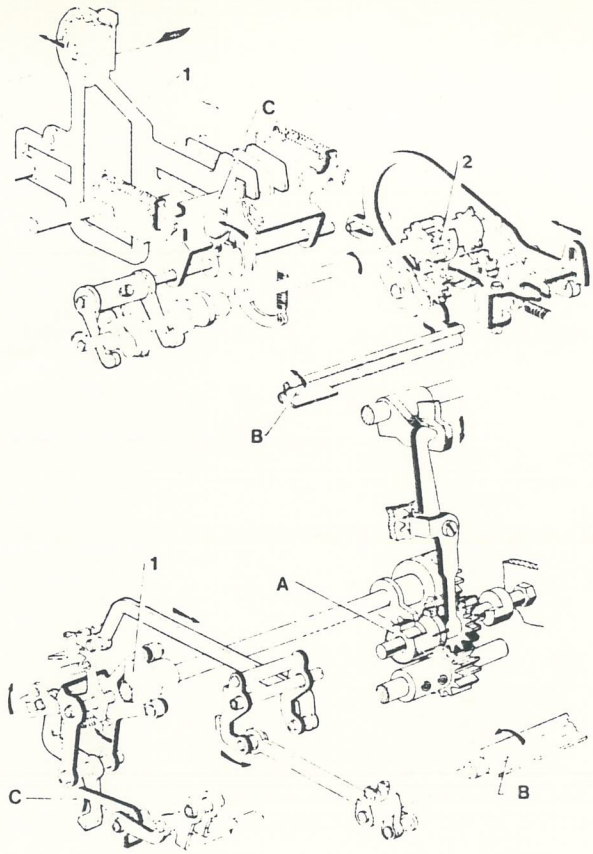
2) To select the character it is necessary to move wheel 10 by means of the closing of clutches 6-7-8-9 caused by the movement of the 4 code bars (2nd-3rd-4th-5th). The movement to the bars is made in the "Bars Setting" cycle.

RIBBON SELECTION



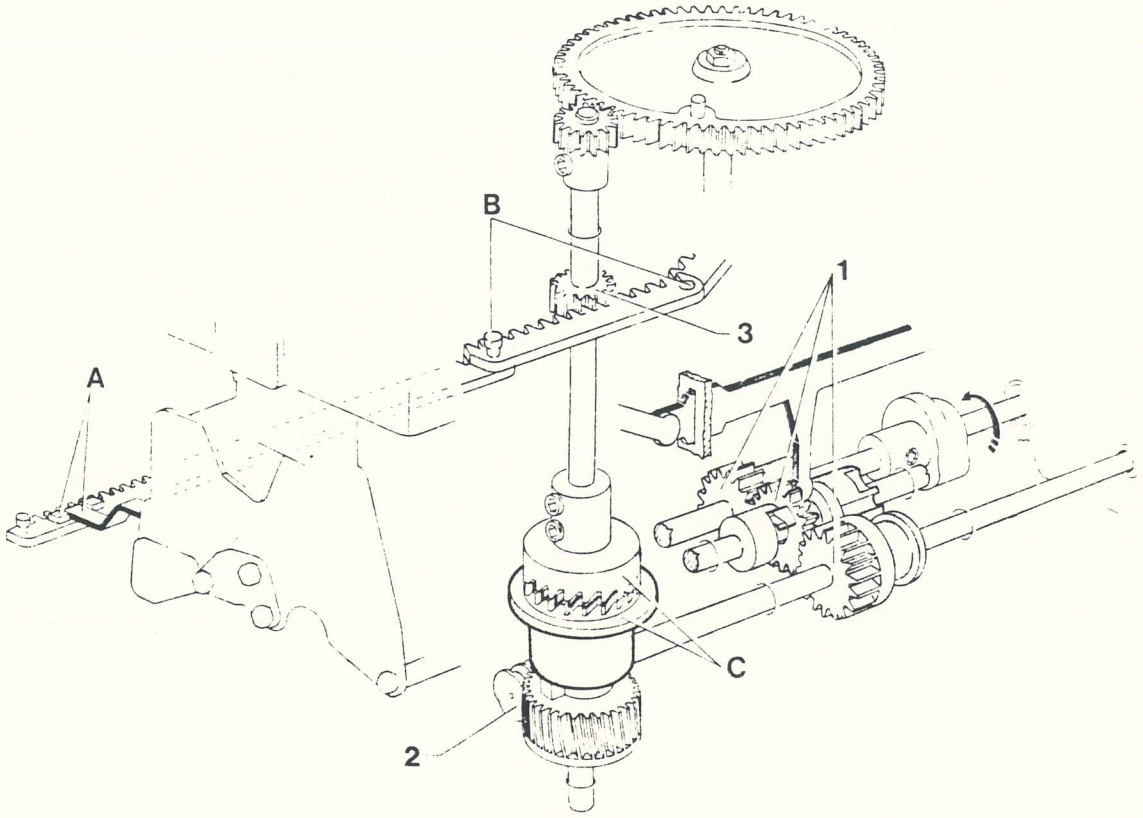
3) Ribbon selection is necessary because the machine prints in black during reception and in red during emission.
- In emission it is necessary to lock board 1 with hook 2 positioned by bar 3.
- In reception it is necessary to free board 1 from hook 2 positioned by bar 3.

PRINTING



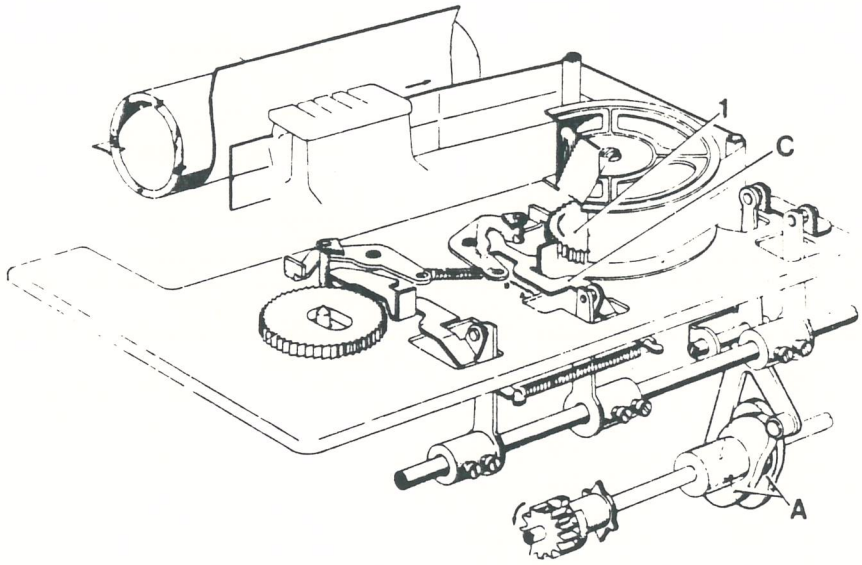
4) To print the sign it is necessary to free print slider 1 by means of closing of print clutch 2.

FORWARD MOVEMENT BY 1 STEP



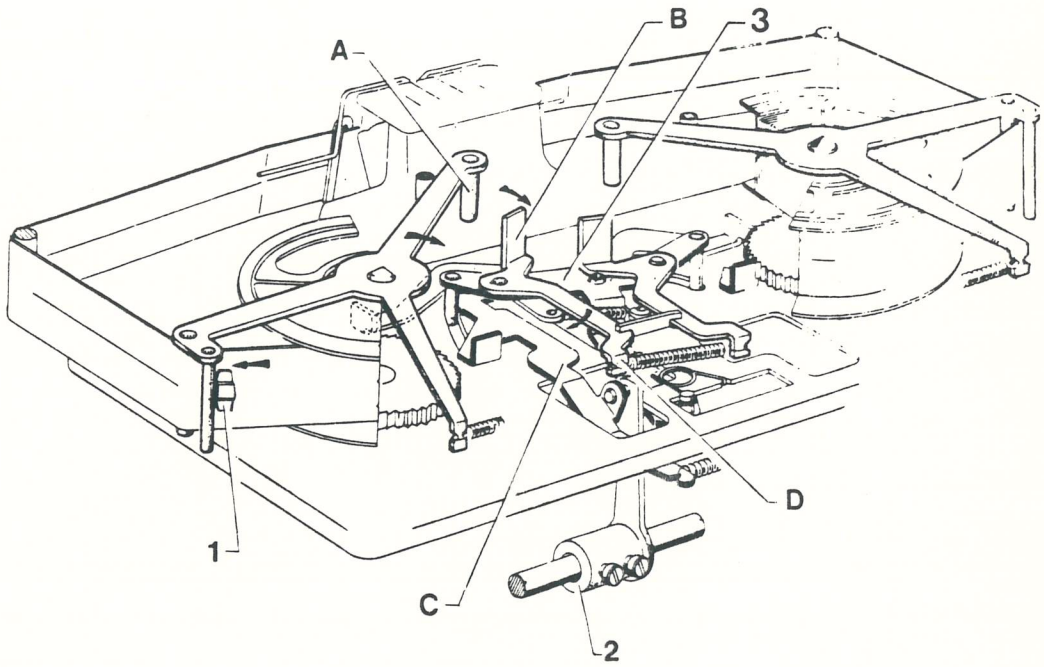
5) To move forward by 1 step the writing head must make the driven gear rotate by 360°.

FORWARD MOVEMENT OF RIBBON



6) To make the ribbon move forward it is necessary to make pick-up spool 1 rotate by means of the movement of slide C which is obtained with the rotation of the print shaft.

RIBBON REVERSAL



7) To reverse the ribbon it is necessary to pre-set tab D in front of part C by means of end of ribbon signalling clip 1 , then rotate lever 3 through handle 2 which is commanded by the print shaft. Thus the driven wheel is set in motion.

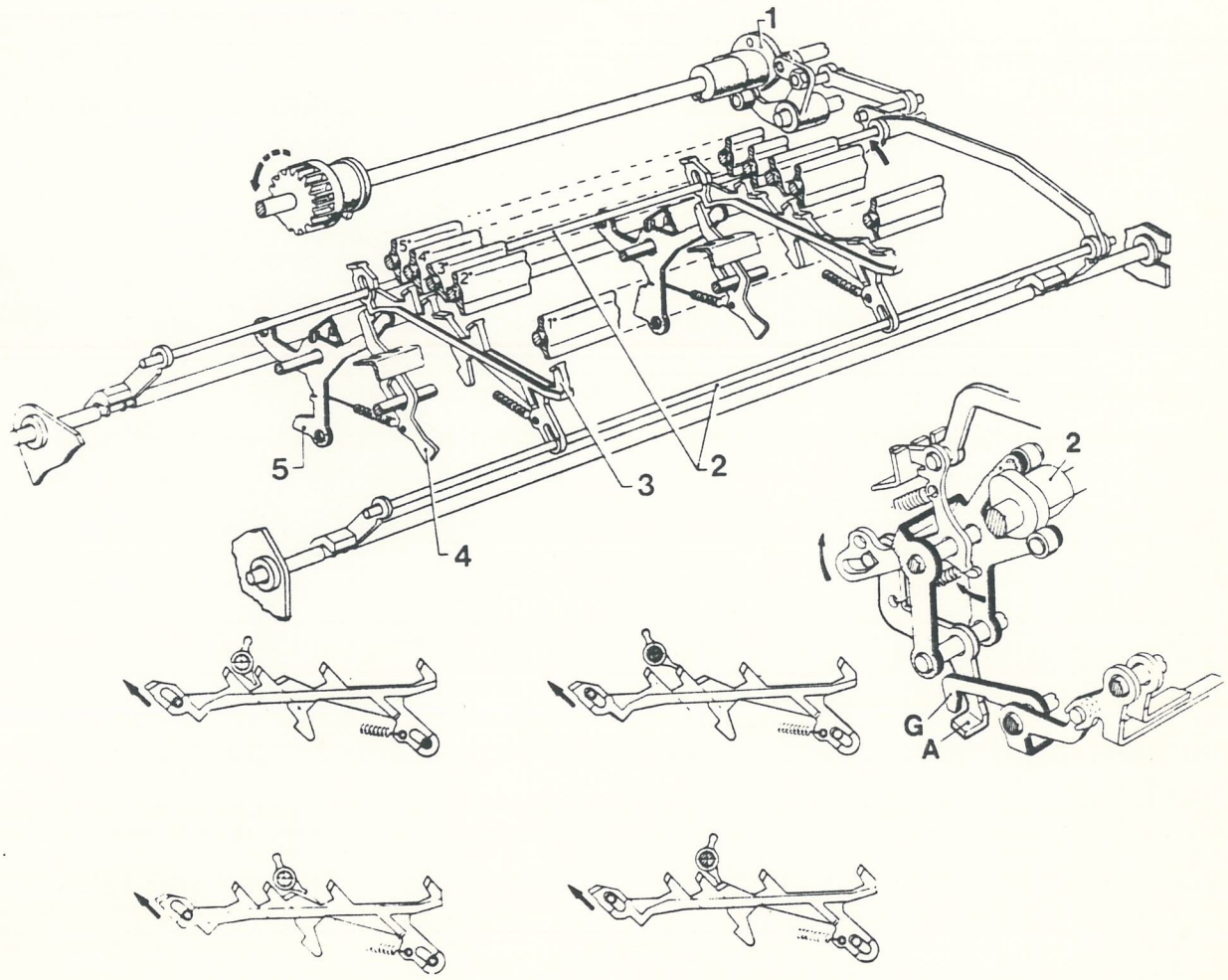
FUNCTIONS UNIT

The functions unit must:

1) recognize the code

2) activate the mechanism relative to the service of which the code is present on the print bars

3) prevent printing and forward movement when the code anticipates this necessity.



1) To recognize the code it is necessary to check the code present on the print bar through the sensers 3 which are left free to rise by frame 2 on the closing of the functions clutch.

2) To activate the mechanism relative to the code present on the bar it is necessary to command the actuator 5 which heads the mechanism. The rotation of the actuator relative to the senser 3 which has risen is obtained by the return to rest of frame 2.

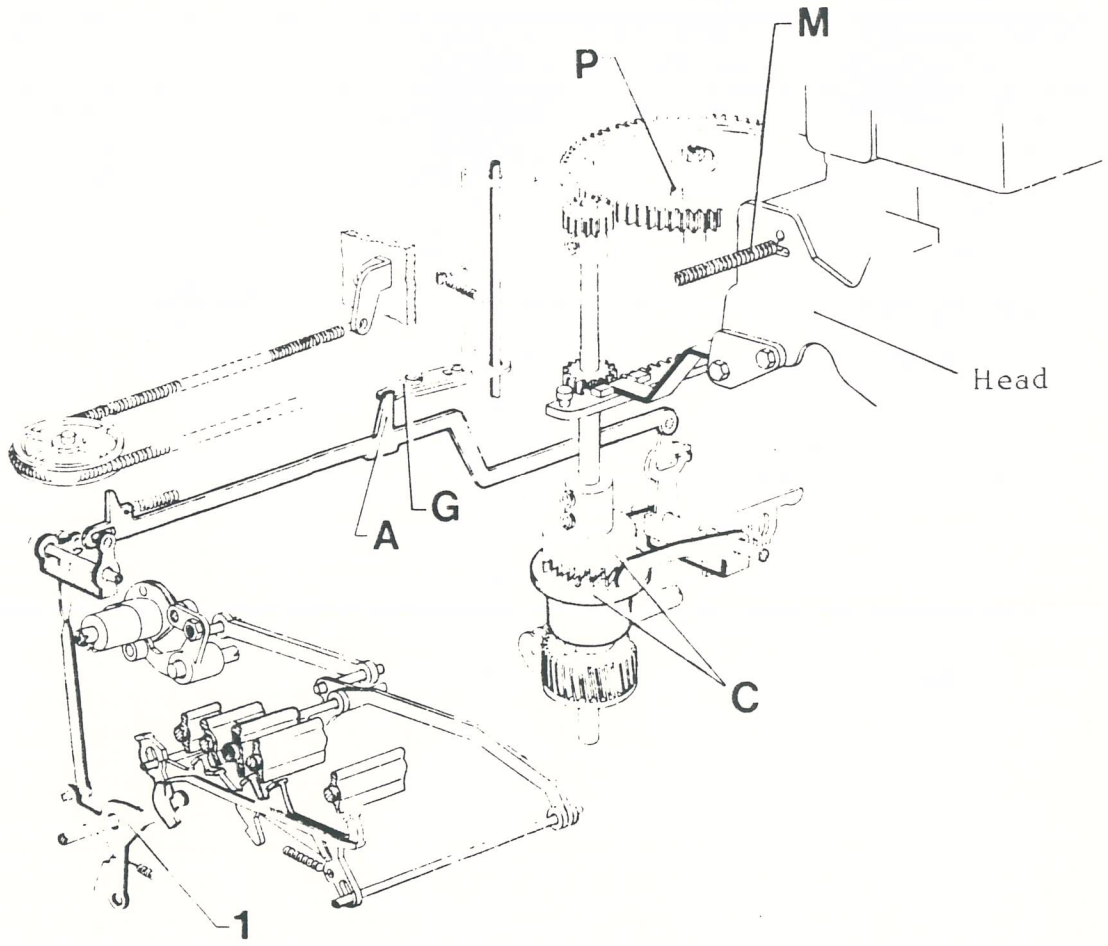
3) To prevent the cyclic services it is necessary to couple hook G to tab A by means of rotation of the actuator.

FUNCTIONS

The main functions found on all the machines are:

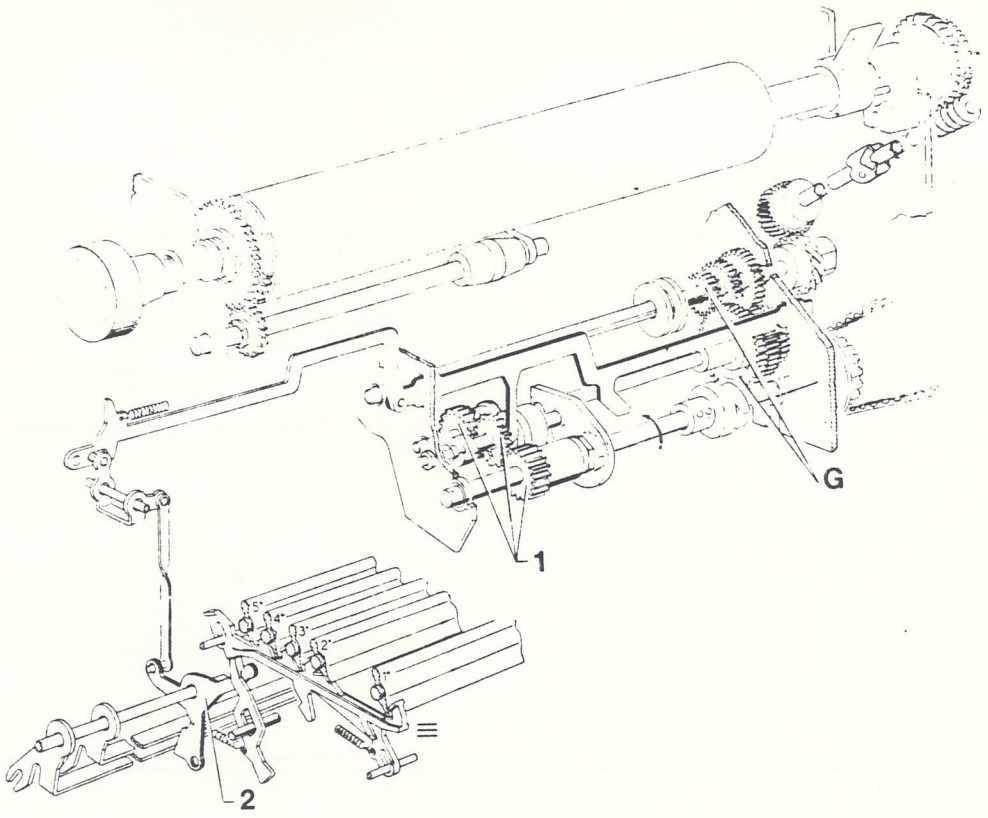
- Return
- Line feed(vertical govern)
- Bell
- Figures/Letters bar setting.

RETURN

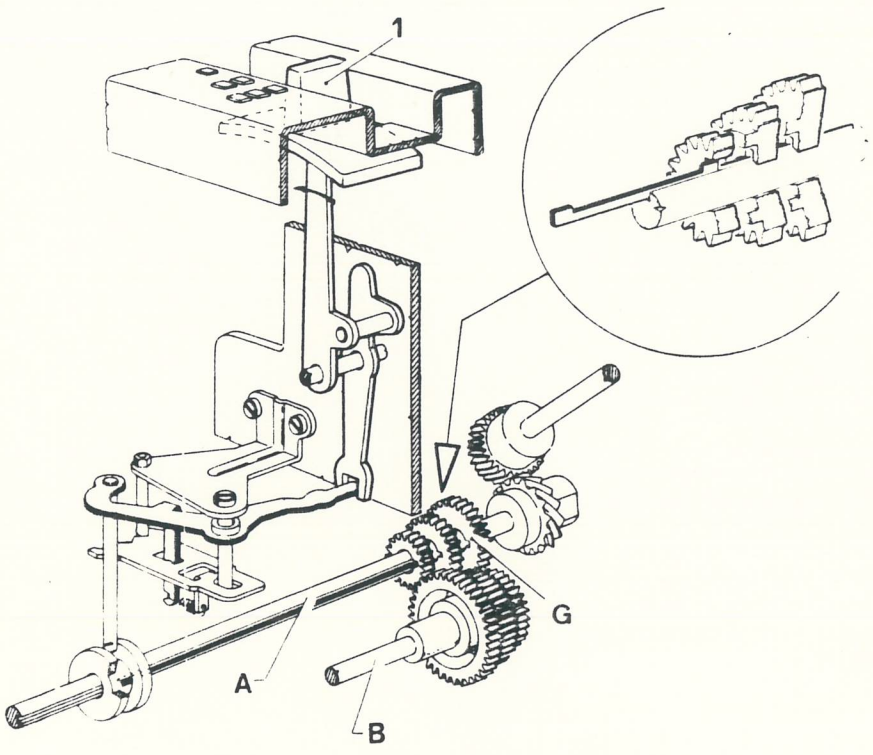


On reception of the return code it is necessary:

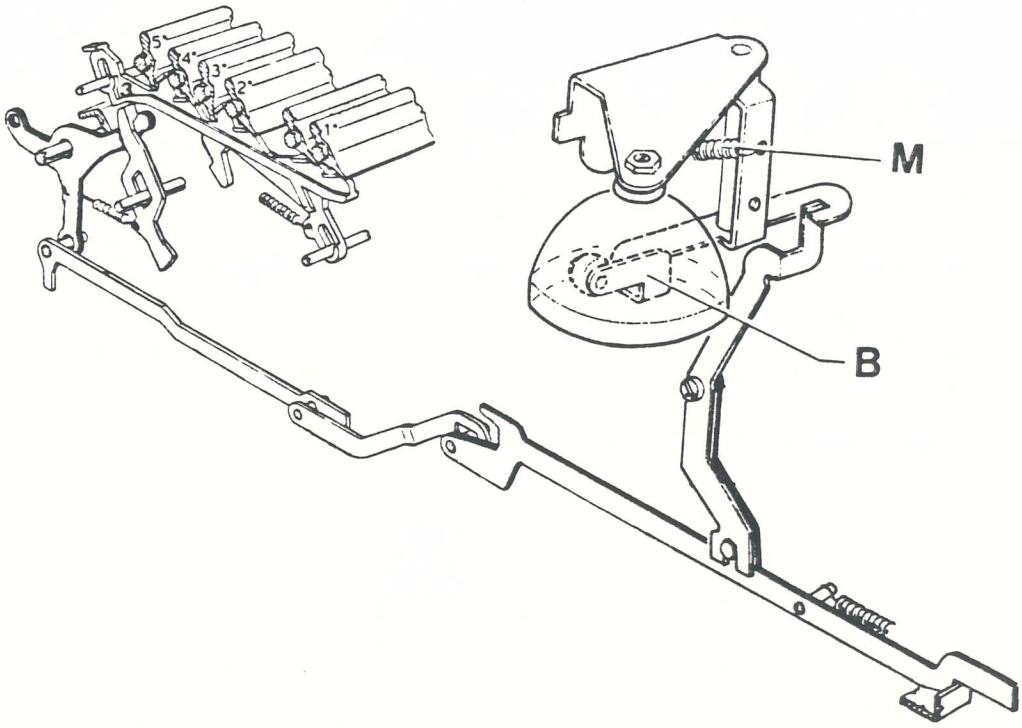
1) to open the cups by means of rotation of actuator 1 so that the head, by means of spring M, can go back to the beginning.
2) to keep the cups open until the head has reached the initial position by means of coupling of tab A on hook G.
3) to allow forward movement of the head in the subsequent cycles by re-closing the cups through pin P which uncouples hook G.



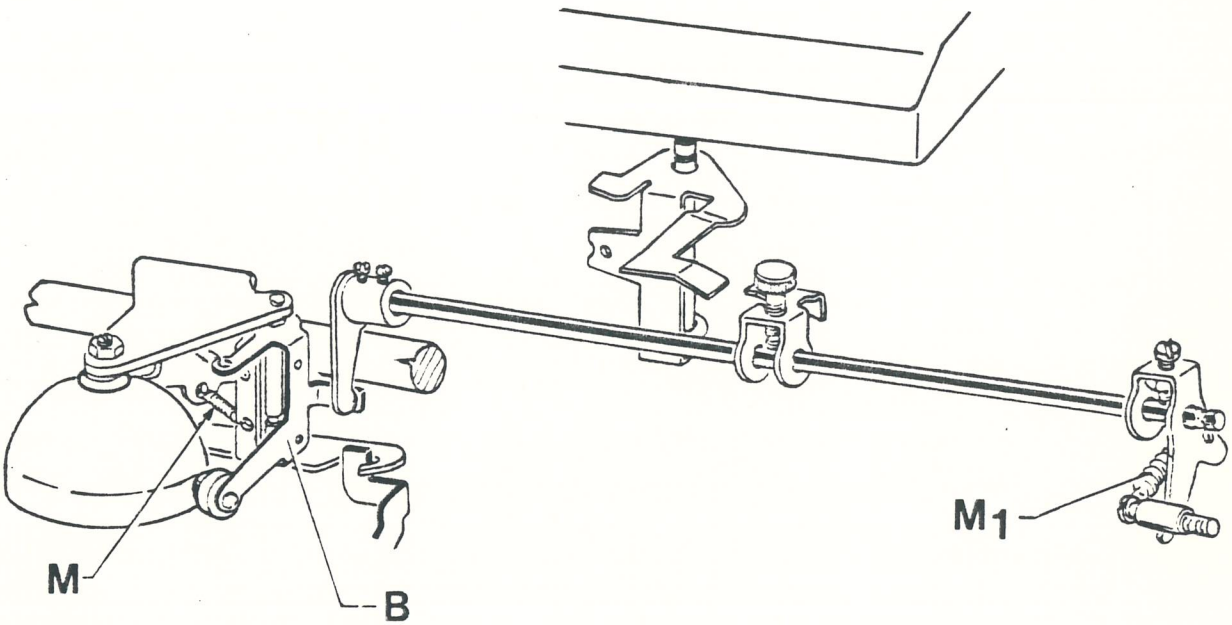
On reception of the interline code it is necessary to make the wheel rotate by an amount which is dependent upon gears G. This is obtained by closing the clutch of interline 1 by means of rotation of actuator 2.



To vary the interlining it is necessary to change the ratio between the two shafts A and B by operating the interline selection lever 1.



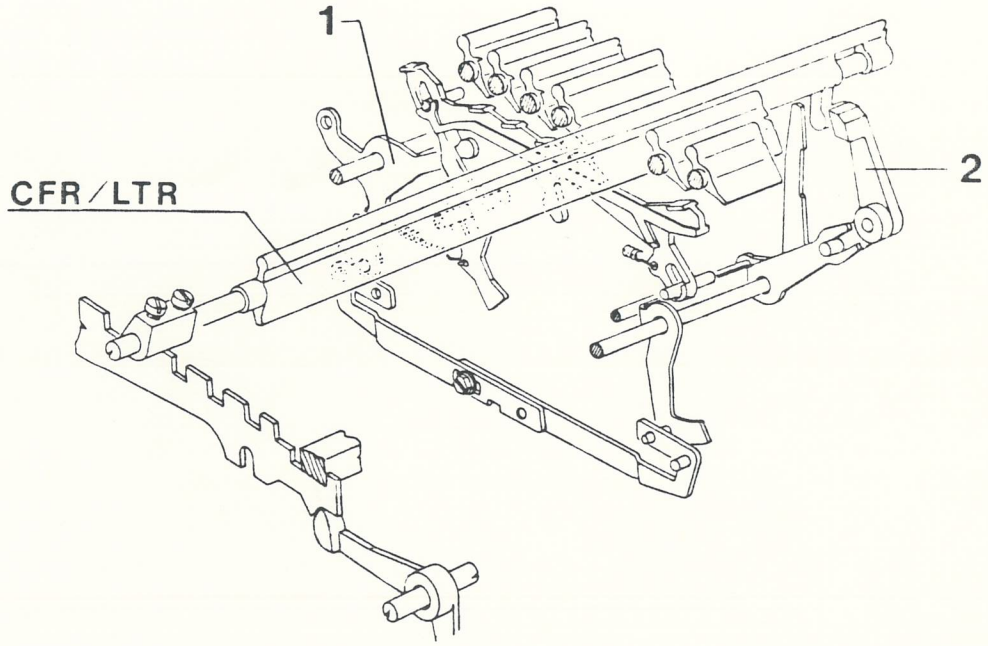
On reception of the bell code it is necessary to make the bell ring by means of the movement of the striker, caused by spring M.



When there is "Near end of line" it is necessary to make the bell ring by means of the movement of the striker caused by springs M and M1.

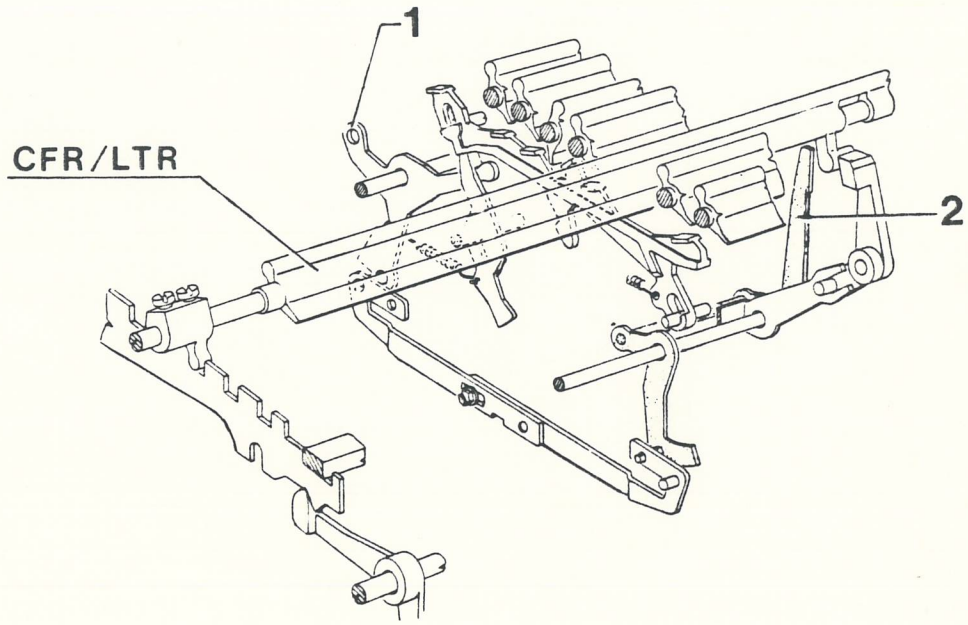
SETTING OF THE FIGURES/LETTERS BAR

command CFR/LTR bar in letters



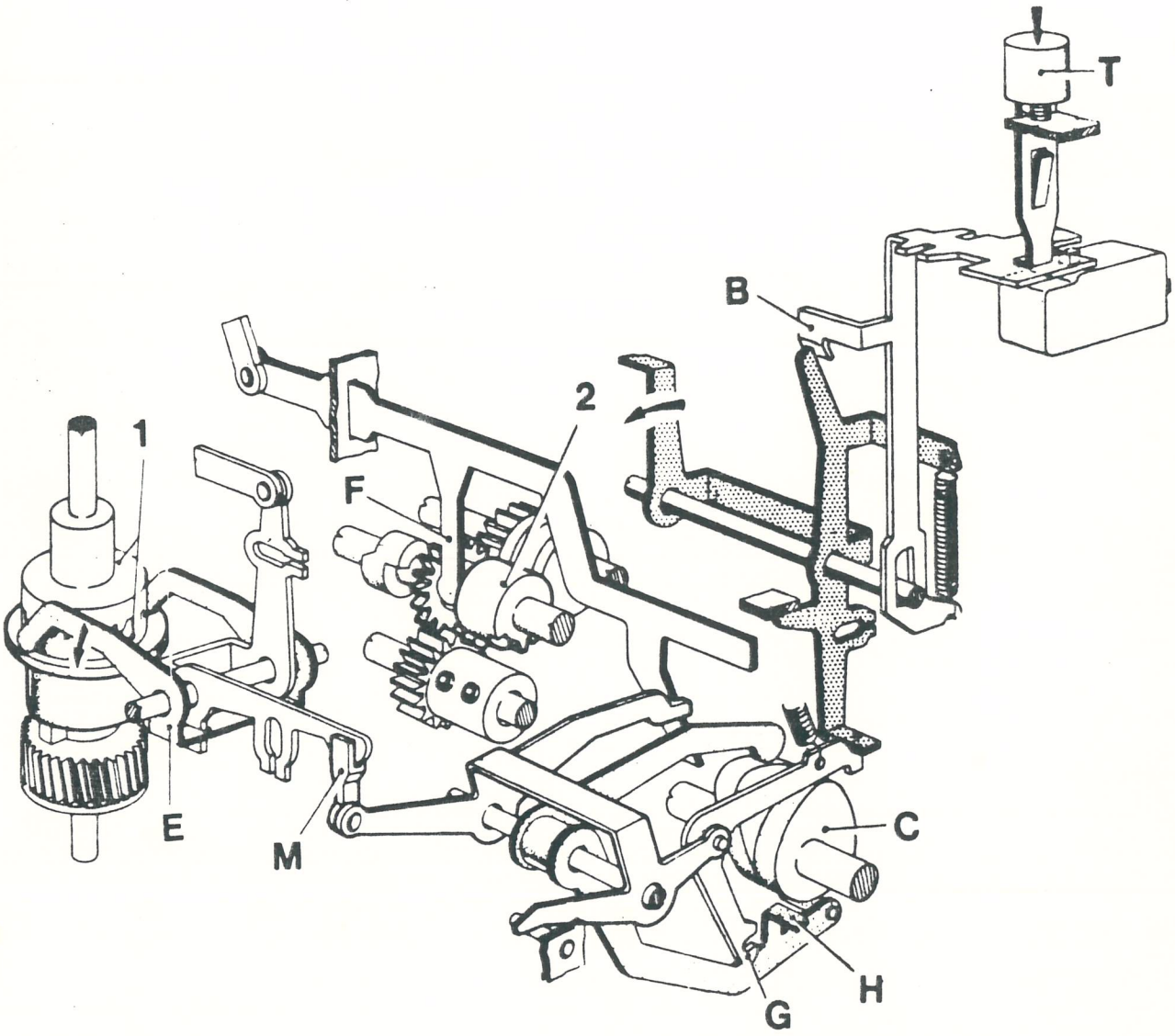
On reception of the letters code it is necessary to position the CFR/LTR bar in letters by means of rotation of actuator 1 of the functions unit.

command CFR/LTR bar in figures



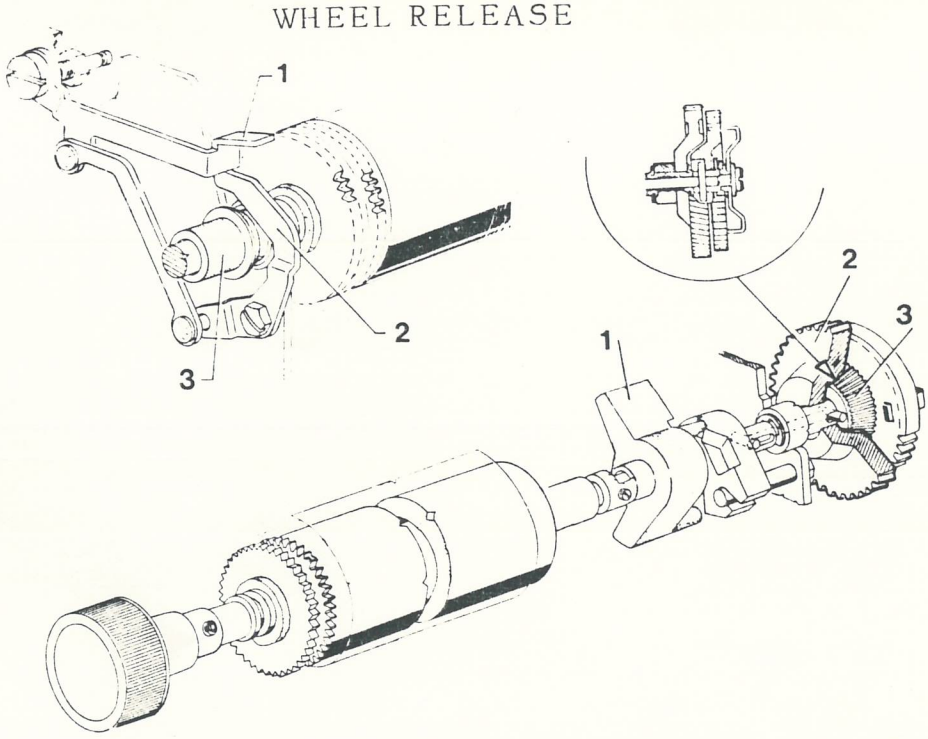
On reception of the figures code it is necessary to position the CFR/LTR bar in figures by means of rotation of actuator 1 of the functions unit.

LOCAL RETURN AND PAPER FEED OUT KEY



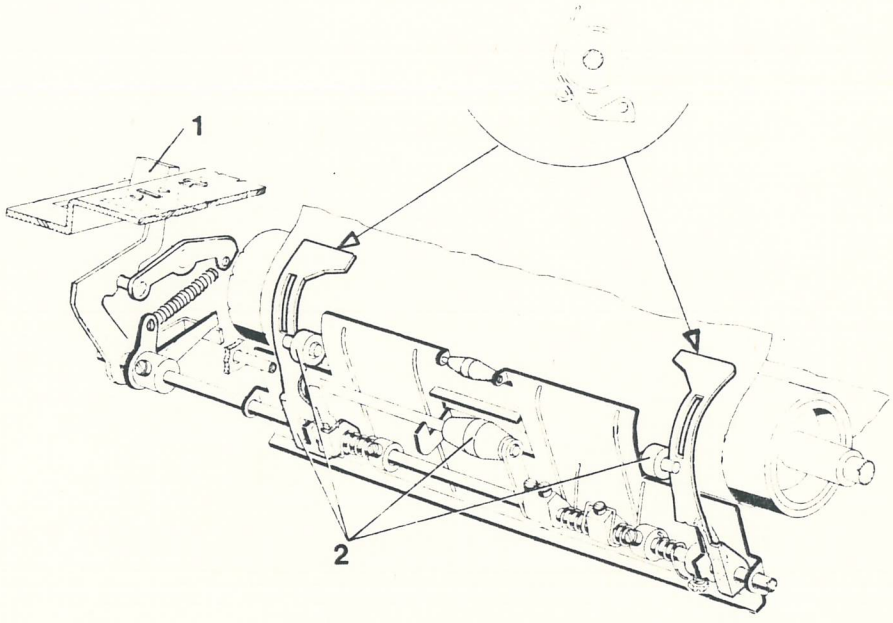
When this key is pressed the clutches of return 1 and line-feed 2 must close by means of the coupling G on H which allows cam C to command clutches 1 and 2 by means of bridge E and lever F.

WHEEL RELEASE



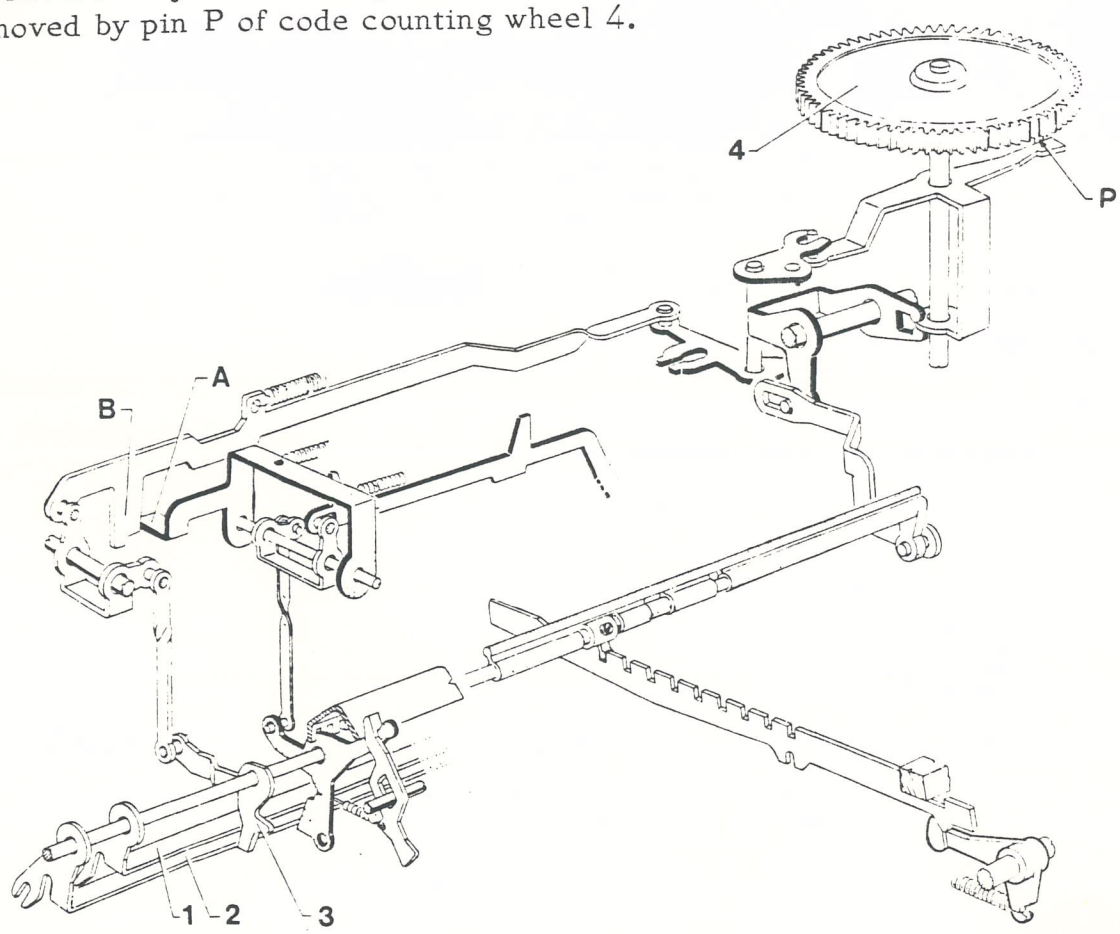
By activating Key 1 it is necessary to free the wheel by uncoupling the two wheels 2 . 3 .

PAPER RELEASE

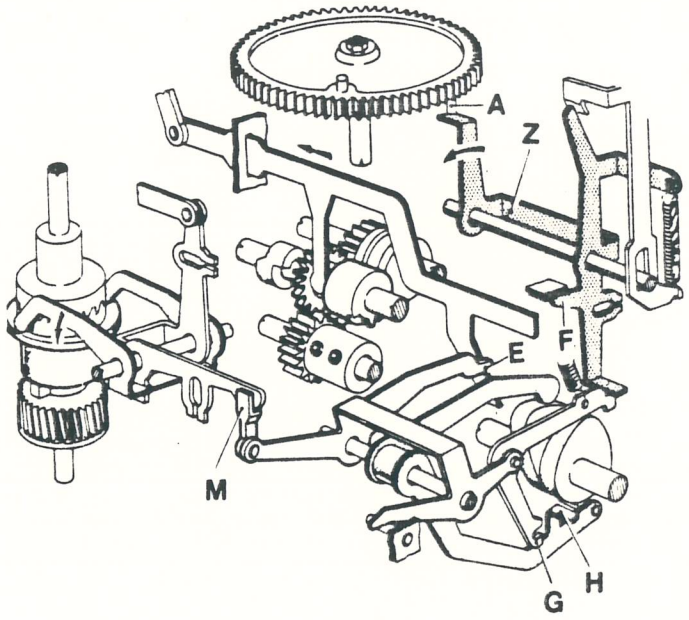


Activating lever 1, it is necessary to free the paper by moving the rollers away from the roll.

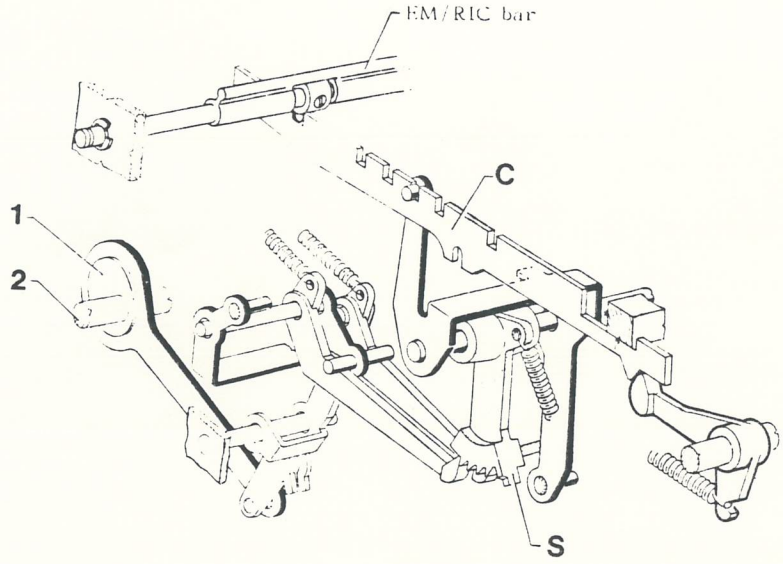
With the machine emitting the printing and forward movement must be prevented by commanding cancelling bridges 1 and 2, by means of lever 3 moved by pin P of code counting wheel 4.



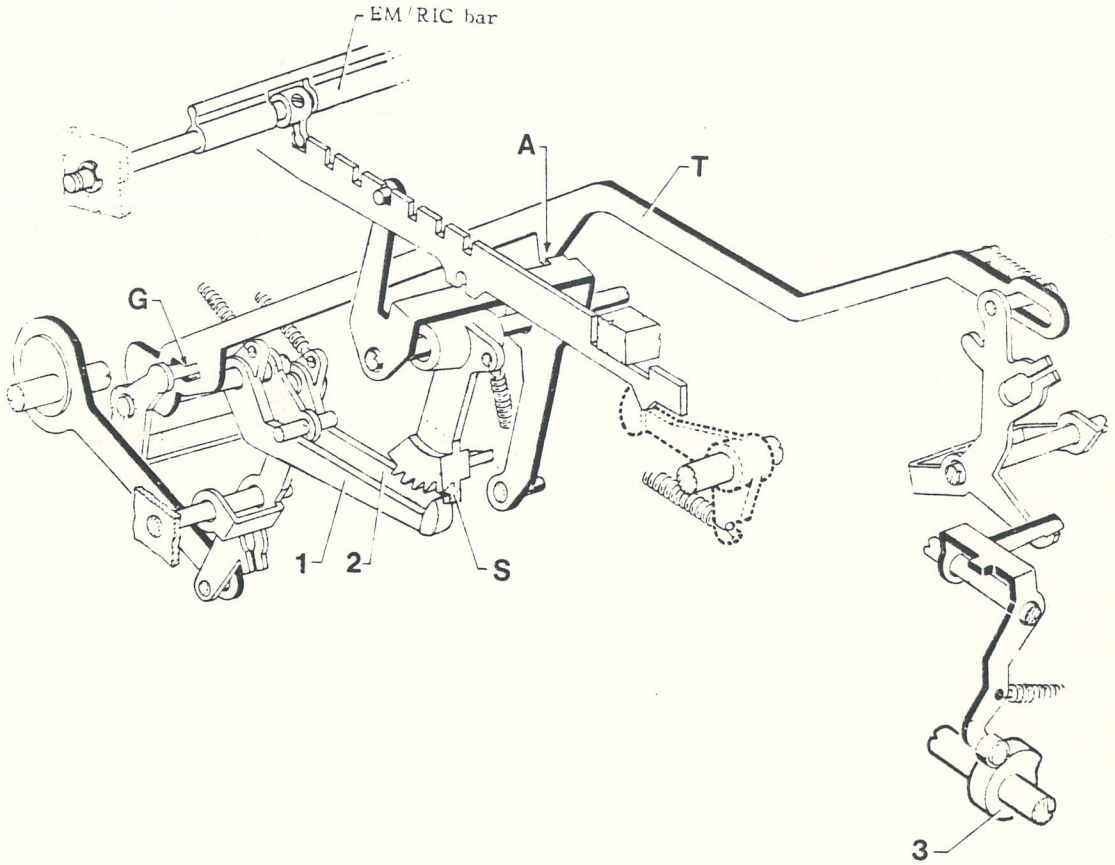
N.B. The cancellings are memorized with the coupling of A on P. Clearing is obtained by commanding the return mechanism chain.



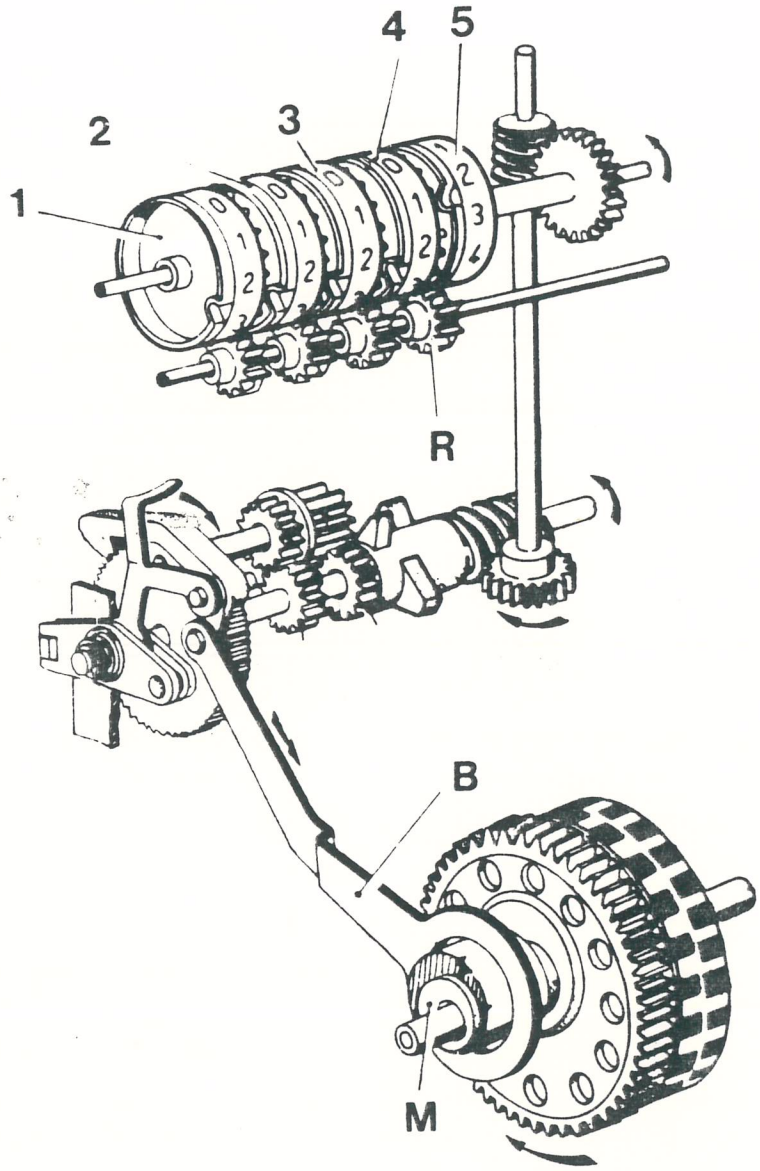
With the machine receiving it is necessary to command the line-feed and return, as already seen for the local return and paper feed-out, by commanding bridge Z through pin A of the code counting wheel.



After 4 cycles of the main shaft it is necessary to take the EM/RIC bar automatically into Reception; this is done by rotation of eccentric 1 of the main shaft which commands the movement of slider C through sector S.

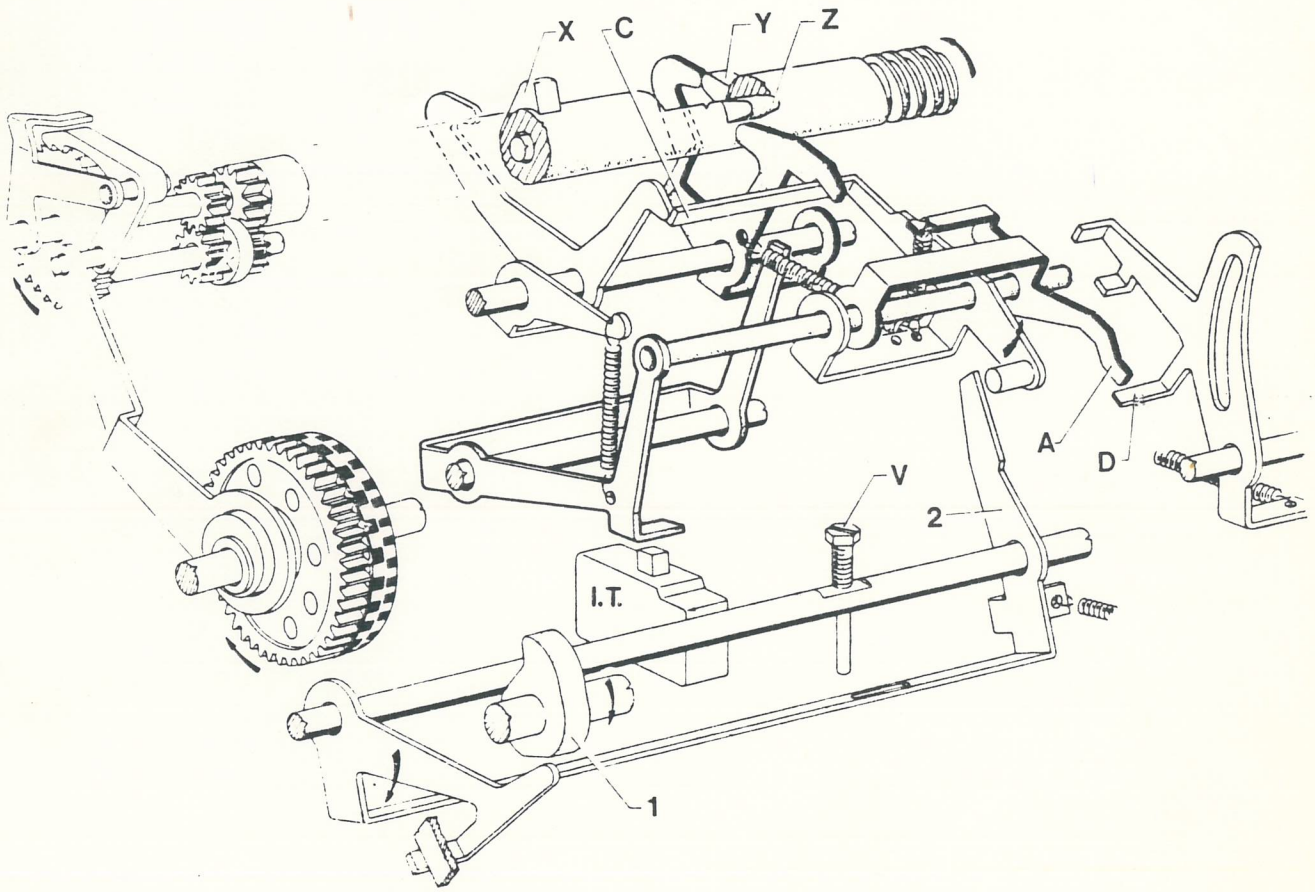


When transmitting it is necessary to take the EM/RIC bar into Emission; this is done by means of cam 3 of the serializer which commands tension bar T, which, with appendix A, positions the bar and, with slot G, lowers levers 1 and 2 so that sector S, even if commanded, returns to the starting position.



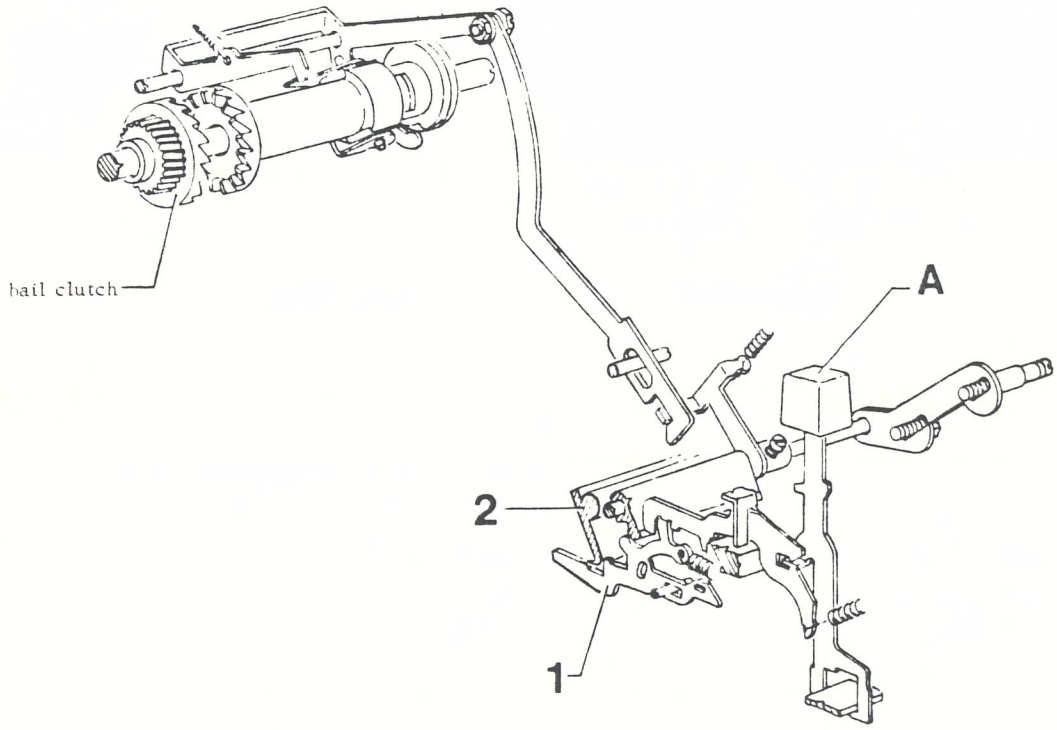
This signals the hours of machine operation by rotating wheel 5 which, after a complete turn by means of the tooth of gear wheel R, makes wheel 4 turn by one step.

The motion is given by connecting rod B which is activated by eccentric M which rotates when the motor is started.

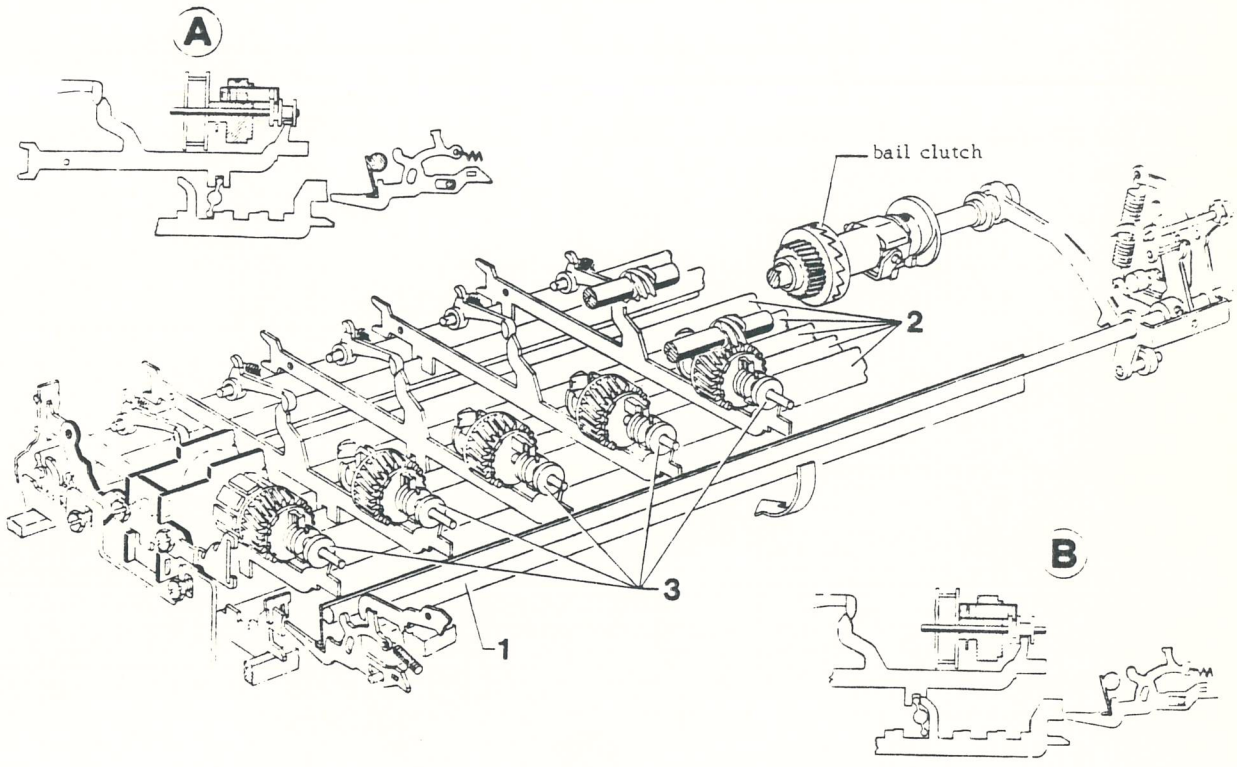


After the machine has been at rest for 45 ÷ 68 seconds it is necessary to cut off power supply to the motor by commanding switch IT.

KEYBOARD

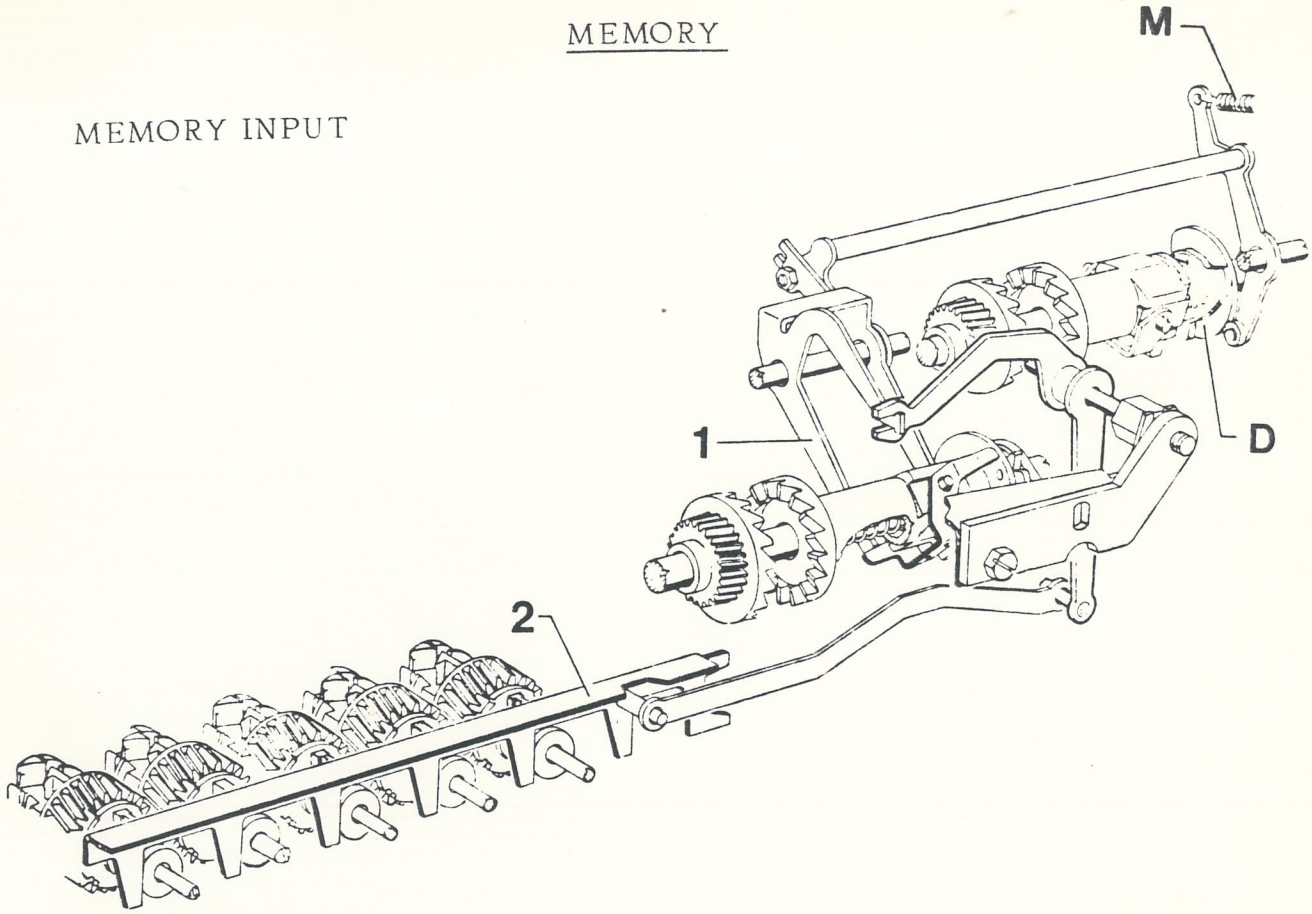


When a key is pressed by means of rotation of intermediate lever 1 it is necessary:
- to close the bail clutch
- to couple intermediate lever 1 to setting bail 2.



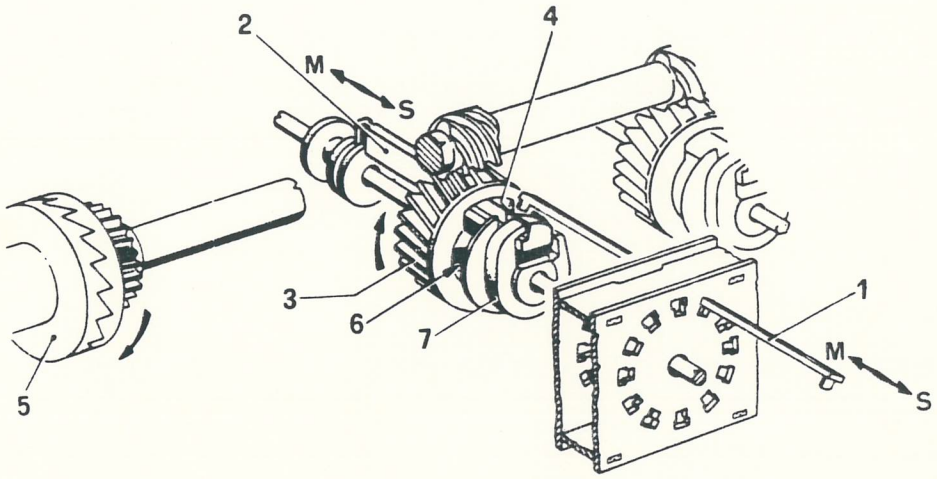
- with the rotation of the bail clutch by means of the rotation of the setting bail 1, there is positioning of the keyboard code bars 2 and consequently of the memory input couplings 3.

MEMORY INPUT



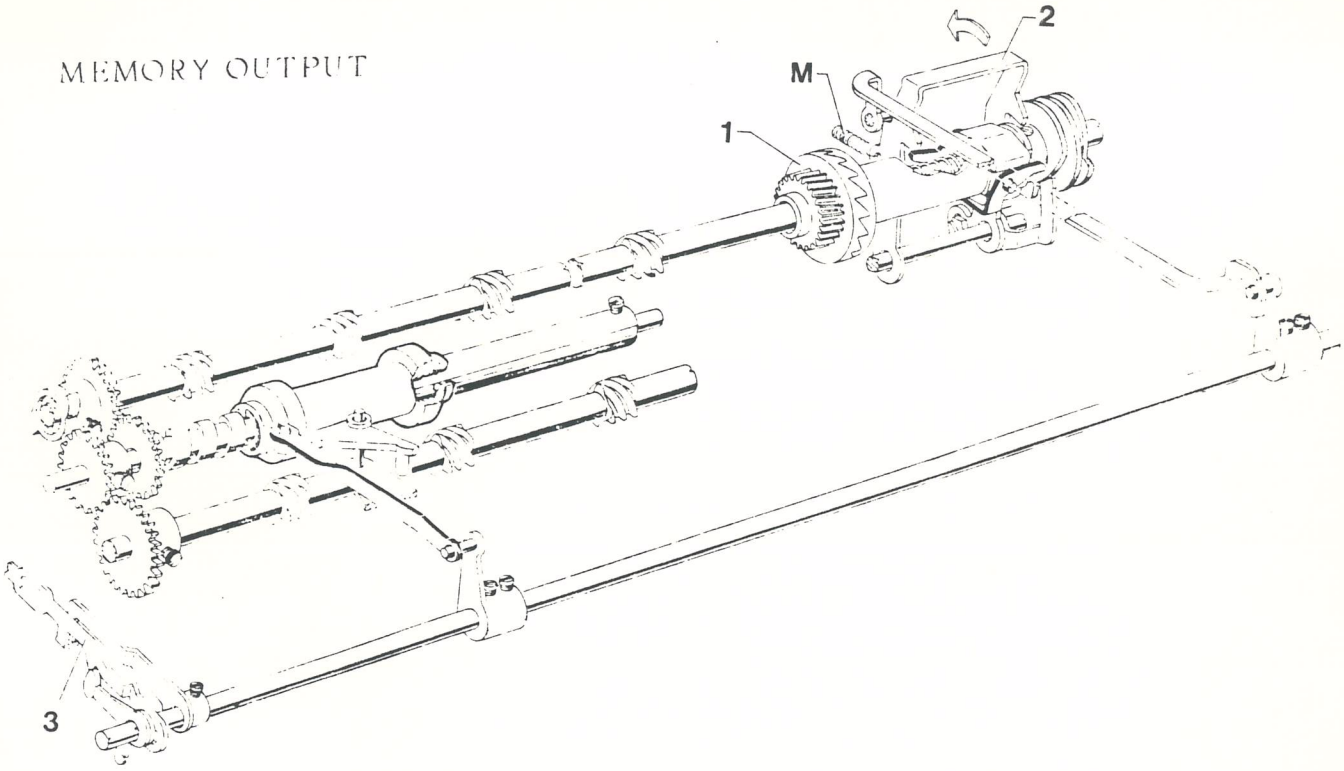
When the code is present on the memory input couplings it is necessary to close the memory input clutch by rotating bridge 1 through spring M; this is possible if there is conformity with:

a) cam D put into rotation by the bail clutch
b) slider 2, free to move to the right when the couplings are prope positioned.



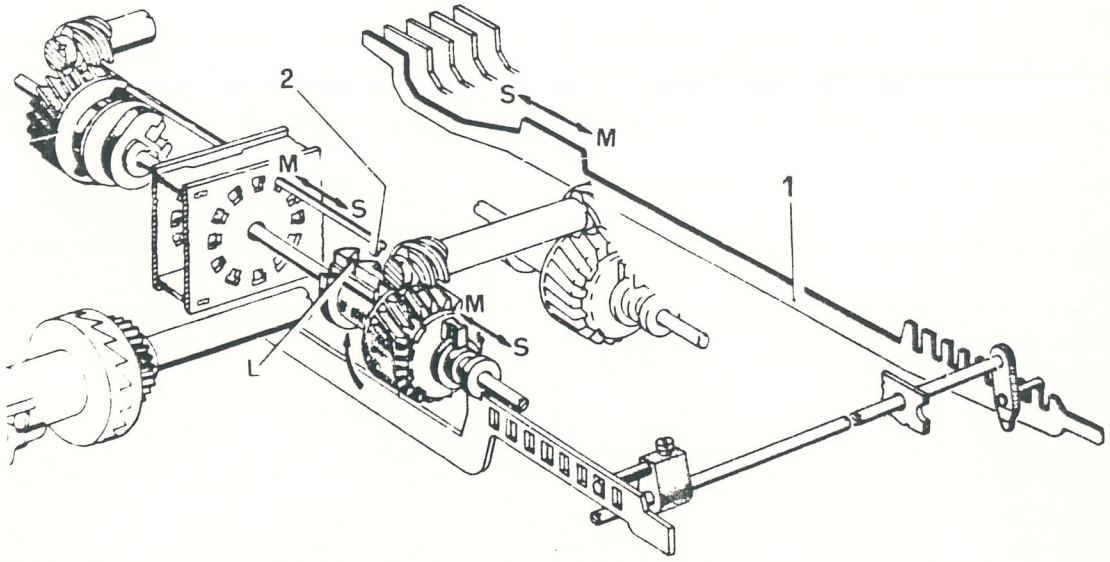
With the memory input cycle it is necessary to set the runner (1) in the MARK or SPACE position according to the position taken by the setter 2 by means of rotation, in the direction of the arrow, of gear wheel 3 and of setter 4; thus the runner is positioned by flanges 6 and 7.

MEMORY OUTPUT



After the memory input cycle it is necessary to close the memory output clutch (1) making bridge 2 rotate by means of spring M.
This is possible if there is conformity with:

a) the sleeve moved towards the right in the memory input cycle
b) lever 3 which is positioned forward when the serializer is free of codes.

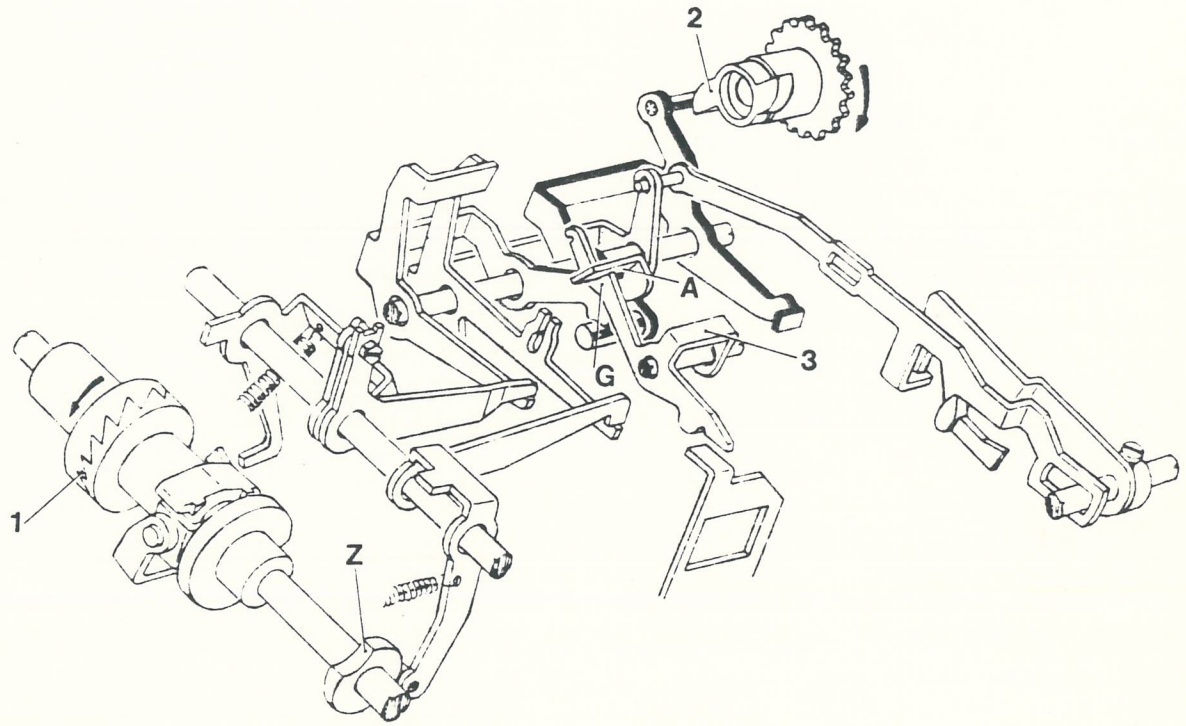


With the memory output cycle it is necessary to set the serializer code bar 1 in the MARK or SPACE position according to the position of the runner (2), by means of rotation of reader L.

N.B. with the memory output cycle there is recovery of one step of the sleeve.

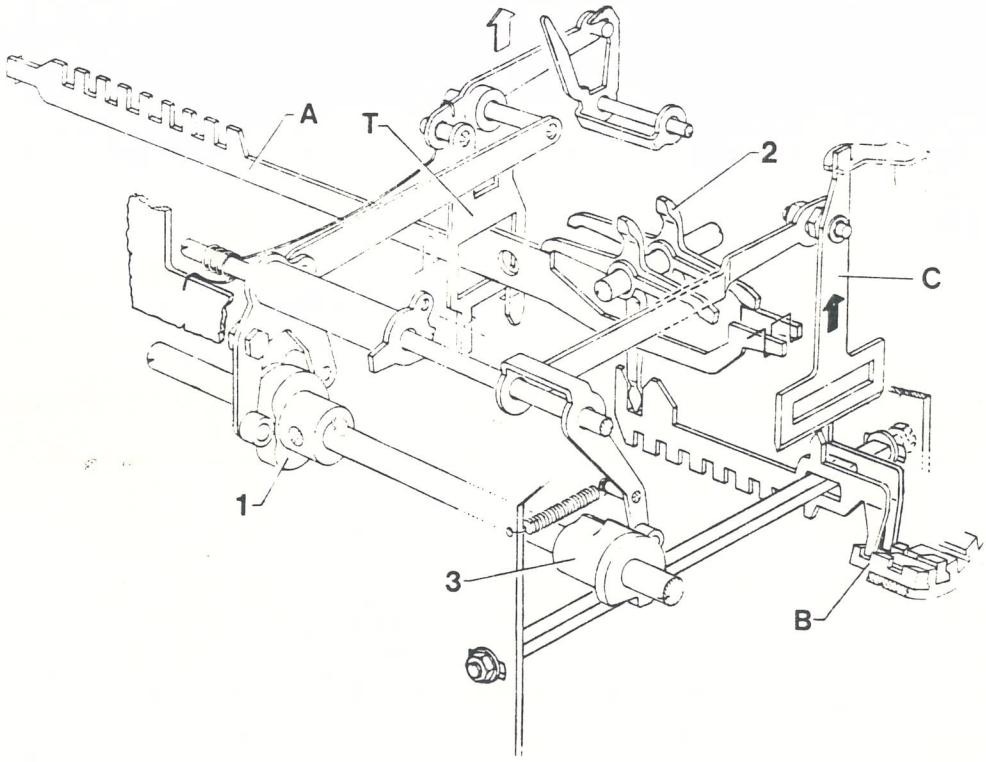
SERIALIZER

CLOSING OF SERIALIZER CLUTCH



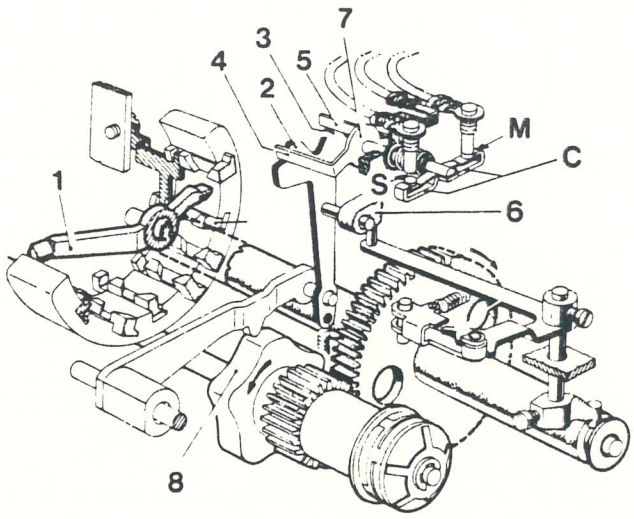
With the memory output cycle it is necessary to close the serializer clutch (1) by means of cam 2, and to prevent the output of other codes from the memory by means of the coupling of tab A onto step G of bridge 3. Moreover this block must be maintained beyond the clearance by means of cam 2.

COPYING MECHANISM



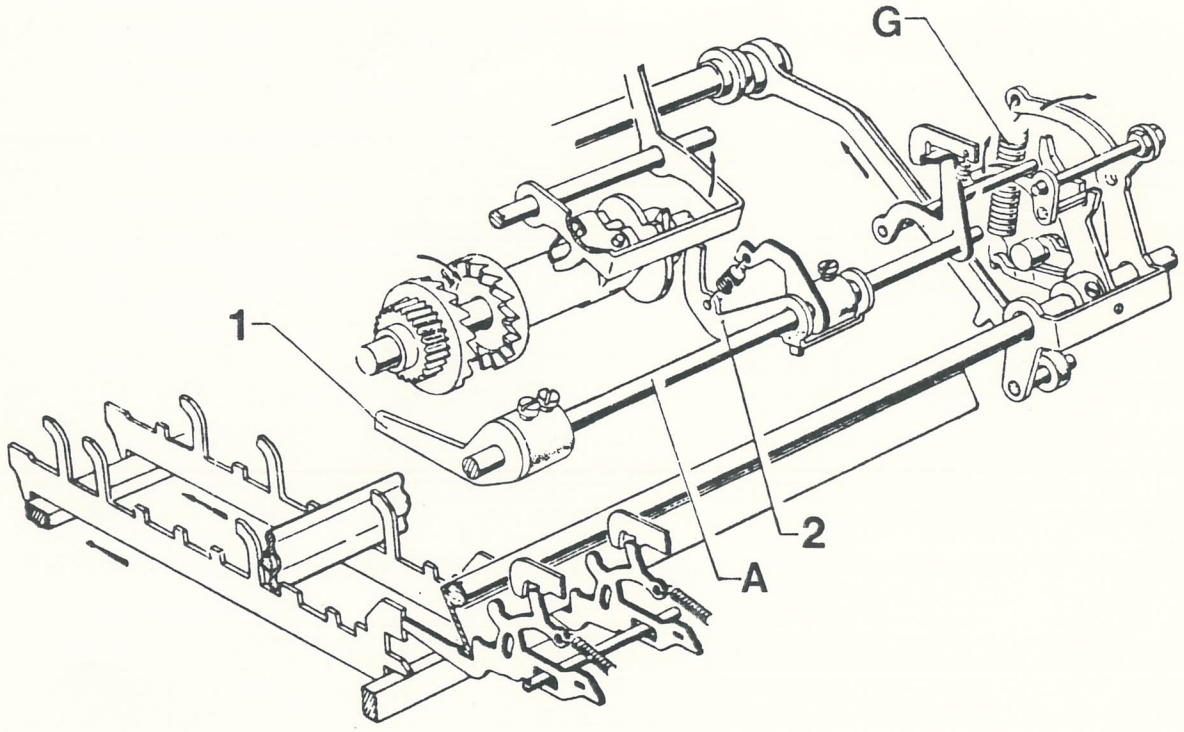
With the serializer cycle the code of the code bar must be transferred onto blocks B, raising frame 1 by means of cam 1 which causes rotation of the crosses 2, thus the blocks B must be kept positioned by means of the lowering of blade C commanded by cam 3.

SERIALIZER MECHANISM



After positioning of the blocks it is necessary to transform the mechanical code from parallel to series by means of rotation of blade 1, bringing profile 2 under tab 4 in the case of SPACE or profile 3 under tab 5 in the case of MARK; thus the codes are transformed into electrical impulses with the rotation and consequent closing of contacts S or M of rocker lever 7 commanded by cam 8.

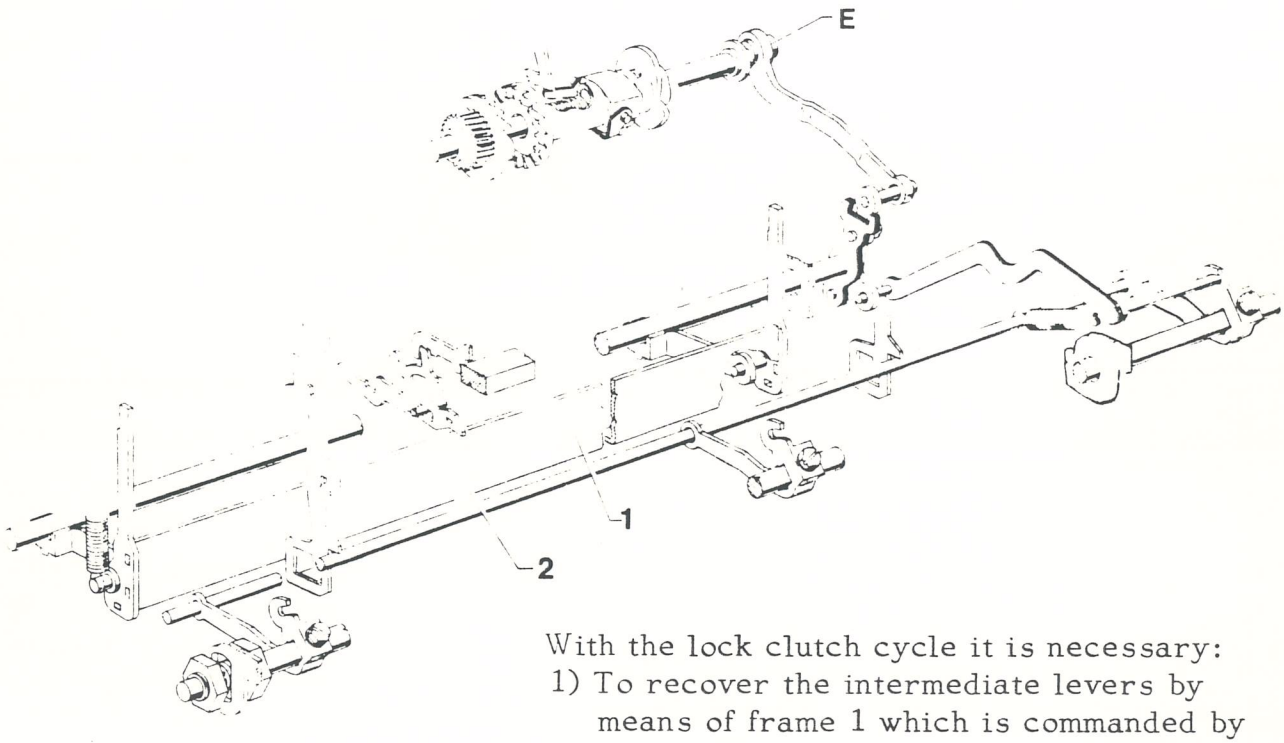
KEYBOARD LOCK FOR SIMULTANEOUS PRESSING OF TWO KEYS



Simultaneous pressing of two keys causes the stretching of coupling G of the setting bail and thus the rotation of shaft A of the lock; this rotation causes:

a) raising of the "keyboard lock" key
b) de-activation of the memory input clutch through handle 1
c) closing of the lock clutch by means of handle 2.

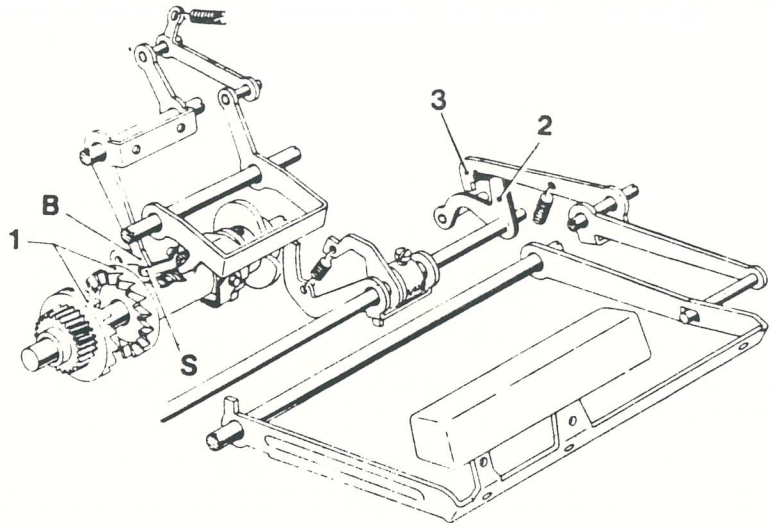
INTERMEDIATE LEVERS RECOVERY AND INCREASE OF TENSION OF KEYBOARD



With the lock clutch cycle it is necessary:

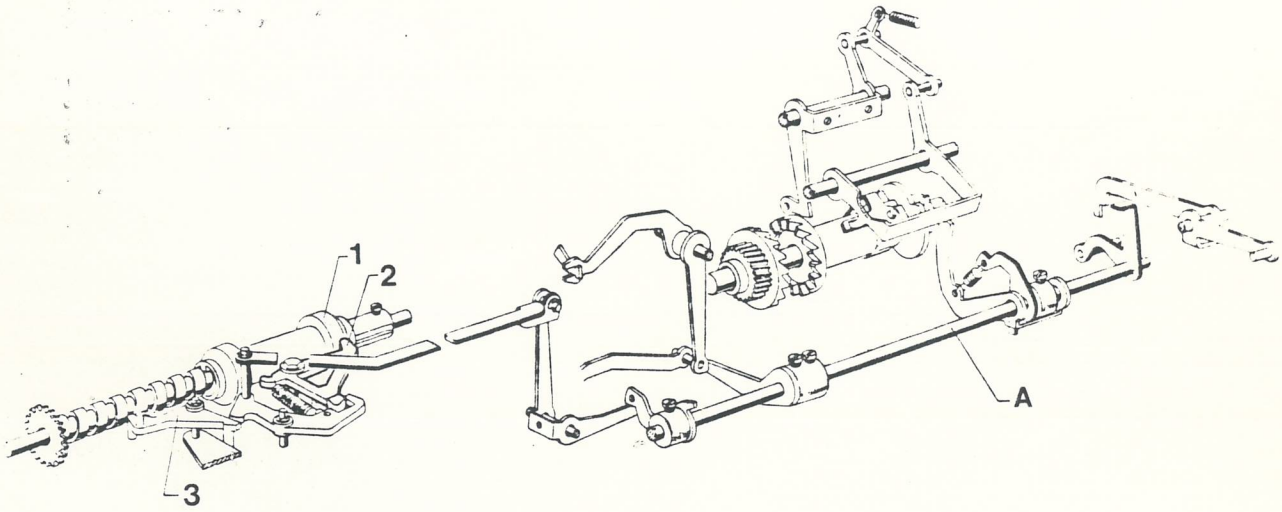
1) To recover the intermediate levers by means of frame 1 which is commanded by eccentric E.
2) To increase the tension of the keyboard by raising shaft 2 by means of eccentric E.

MAINTENANCE OF LOCK MECHANISM



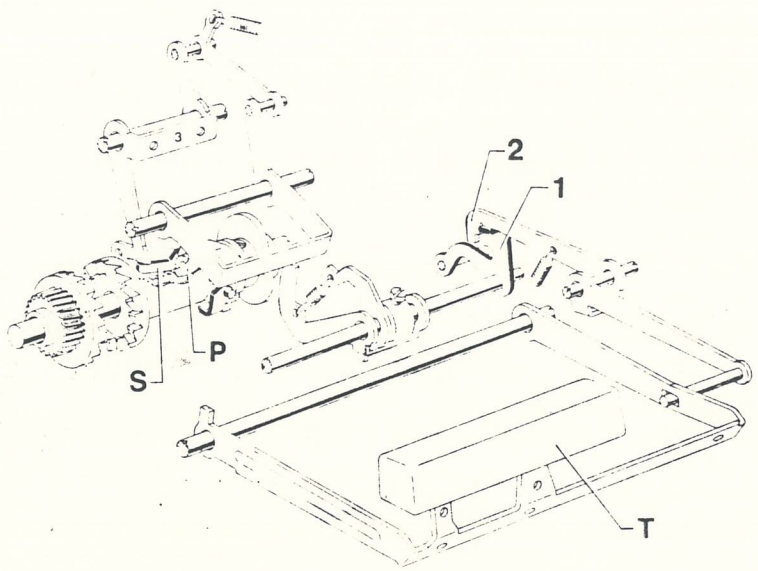
To maintain the mechanism in the lock position it is necessary to stop lock clutch 1 after 180° by placing tab B on the trajectory of S and by keeping it in this position with the coupling of bridge 3 onto lever 2.

KEYBOARD LOCKING WITH FULL MEMORY



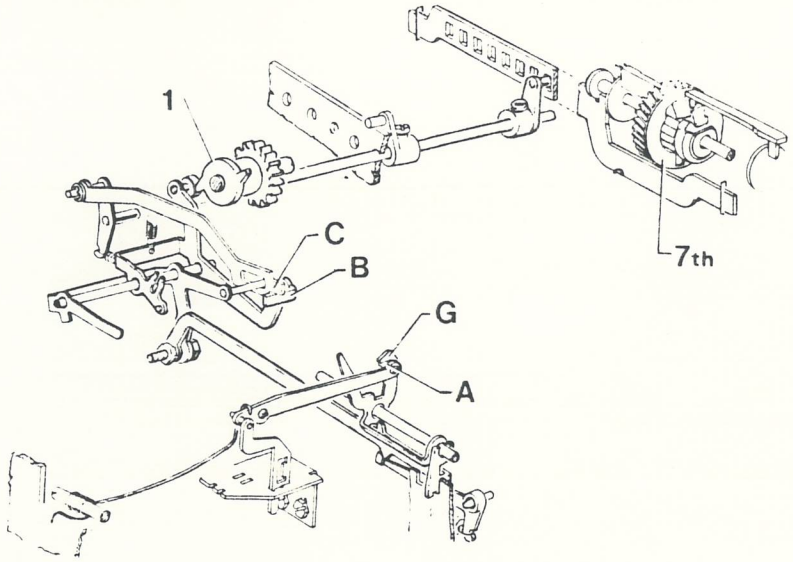
When 10 codes are accumulated in the memory sleeve 1, hitting bracket 2, causes the rotation of shaft A of the lock.
Lock may take place when the memory is unloaded, i.e. when sleeve 1 recovers the mechanism by rotating lever 3.

RELEASE



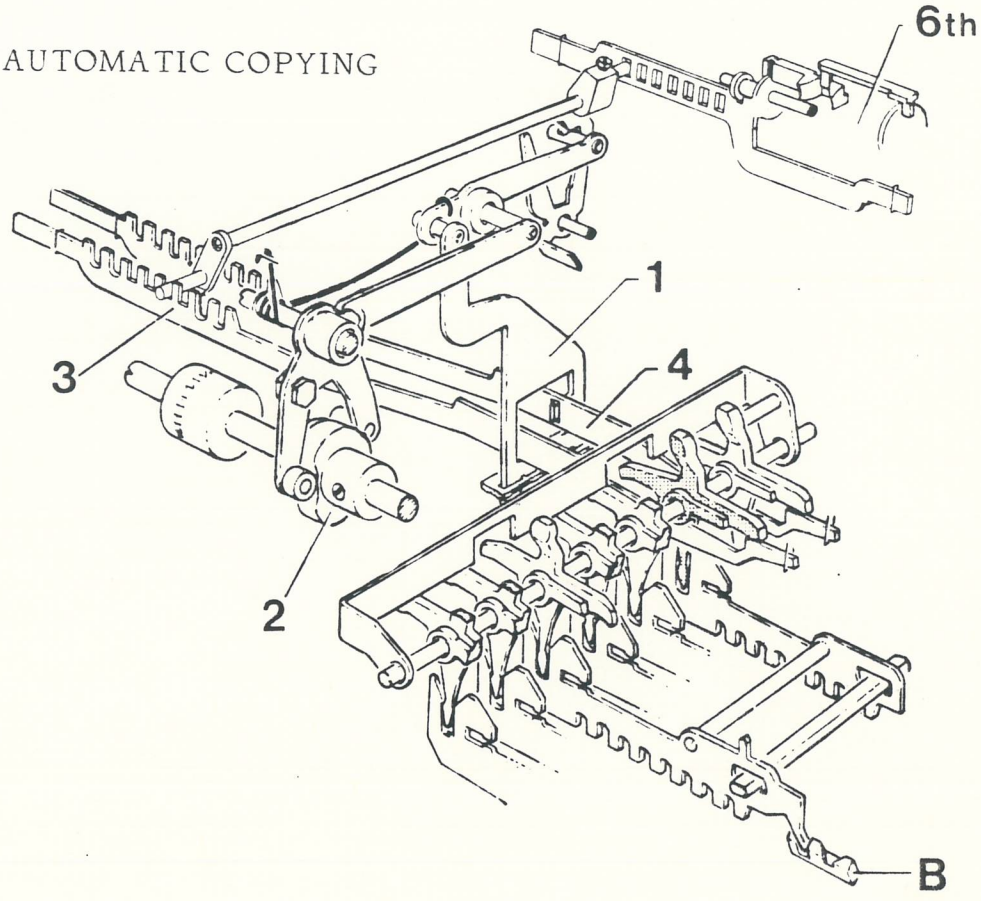
By pressing the "keyboard release" key, releasing lever 1 from bridge 2, the lock clutch can rotate by another 180° and thus return to the start conditions, i.e. P on S.

PRE-SETTING FOR AUTOMATIC COPYING



To send the automatic figures or letters code into the line, it is necessary to couple hook G to pin A, which is done by means of pre-setting of appendix C onto tab B caused by the memory output of the 7th cell and the command of the cam (1) mounted on the memory outout clutch.

AUTOMATIC COPYING



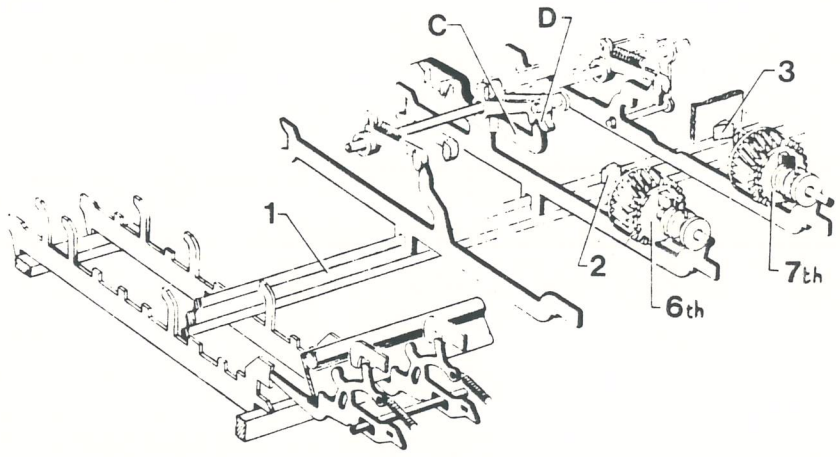
To set the automatic figures or letters code on blocks B it is necessary to command frame 1 by means of cam 2.

N.B. Slider 4 is fixed and carries the 1st - 2nd - 3rd - 4th - 5th bits to the MARK position.

Slider 3, controlled by the 6th cell, carries the 3rd bit to MARK for letters and to SPACE for figures.

AUTOMATIC CYCLE

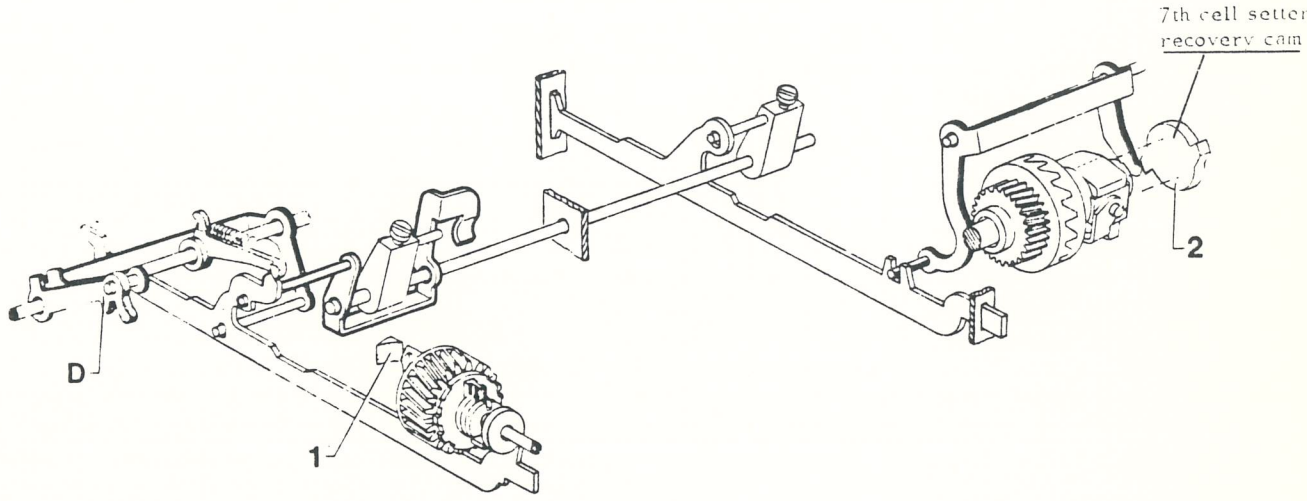
The letters/figures exchange codes must be automatically transmitted each time the operator moves from one key of the letters group to one of the figures group or vice-versa.
Each time an exchange is made, bar 1 is used.



Rotation of bar 1 causes:

a) the setting on the 6th cell of setter 2 in the letters or figures position according to the key which has been depressed.
b) the setting on the 7th cell of setter 3 in the direction of the arrow by means of teeth C and D and indicates memorization of the automatic cycle.

RECOVERY 7th CELL



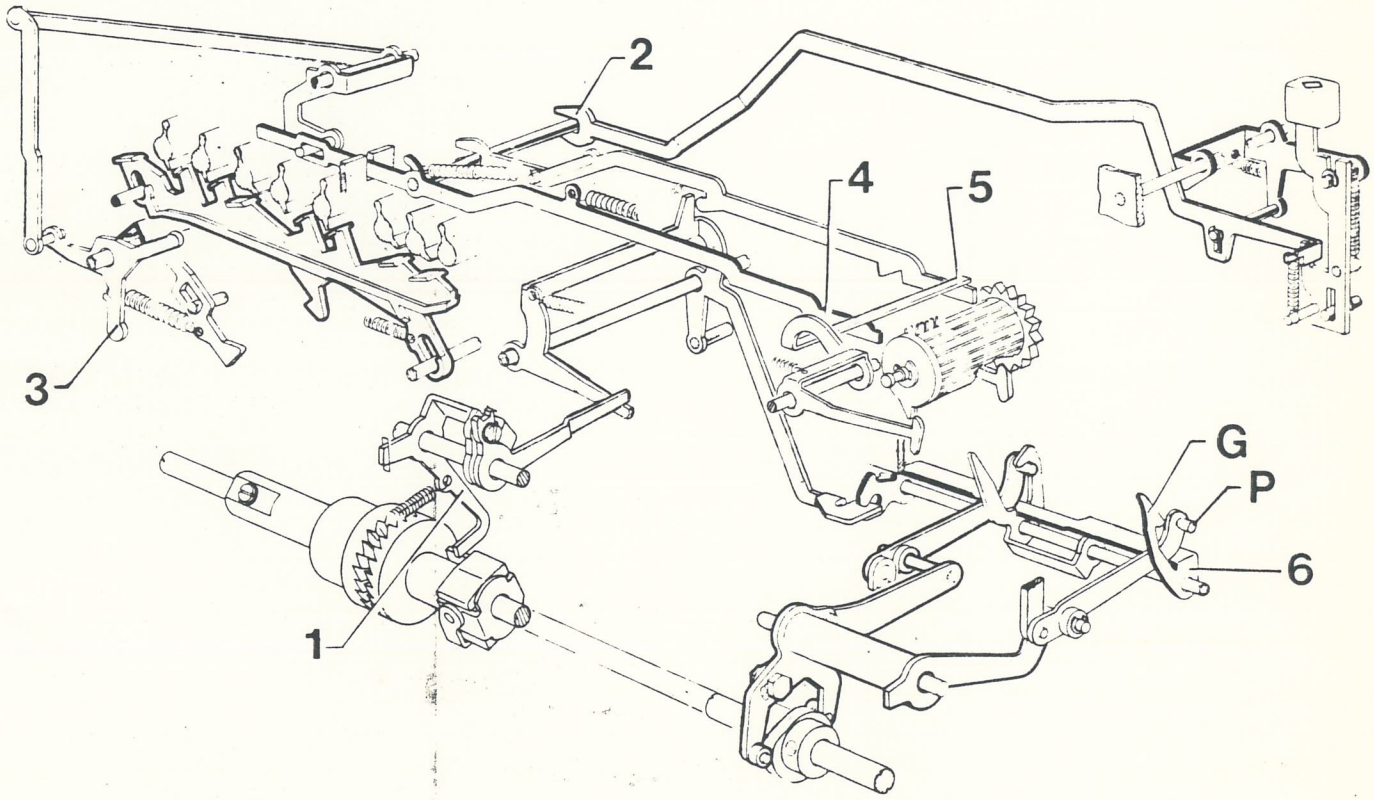
At the end of the memory input cycle, i.e., when the 7th cell has already memorized the presence of the automatic cycle, it is necessary to recuperate tooth D and setter 1 so that they may be pre-set for the subsequent cycle this is done by cam 2 on the memory input clutch.

AUTOMATIC ANSWER-BACK

The automatic answer-back device has the task of sending into the line, one by one, the 20 codes forming the name of the machine which is found on the Answer-Back drum..
If the name is made up of less than 20 codes, the remaining ones will also be sent into the line, but they will be letters. On the drum the wing plate indicates SPACE; the blank indicates MARK.

The automatic answer back may be started:

1) by the "Here is" key;
2) on reception of the "Who are you?" code.

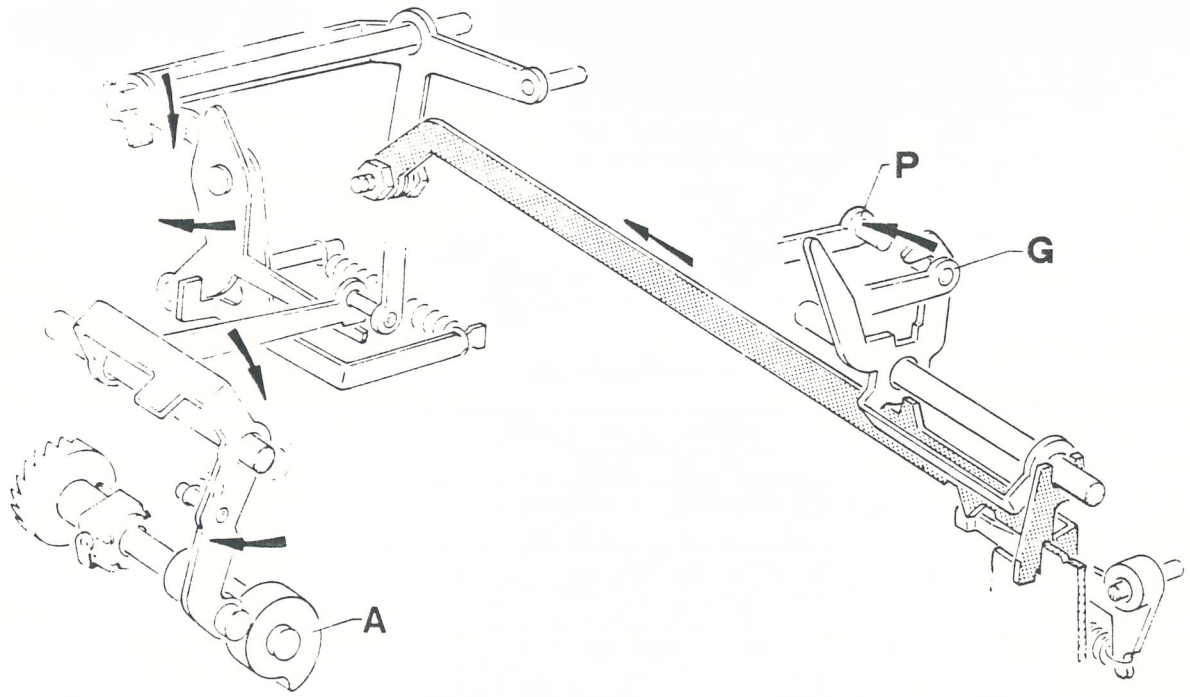


1) When the "Here is" key is depressed, it is necessary to close the serializer clutch by means of rotation of bridge 1 on the command of rod 2.

2) On reception of the "Who are you?" code it is necessary to close the serializer clutch by means of rotation of bridge 1 on the command of actuator 3.

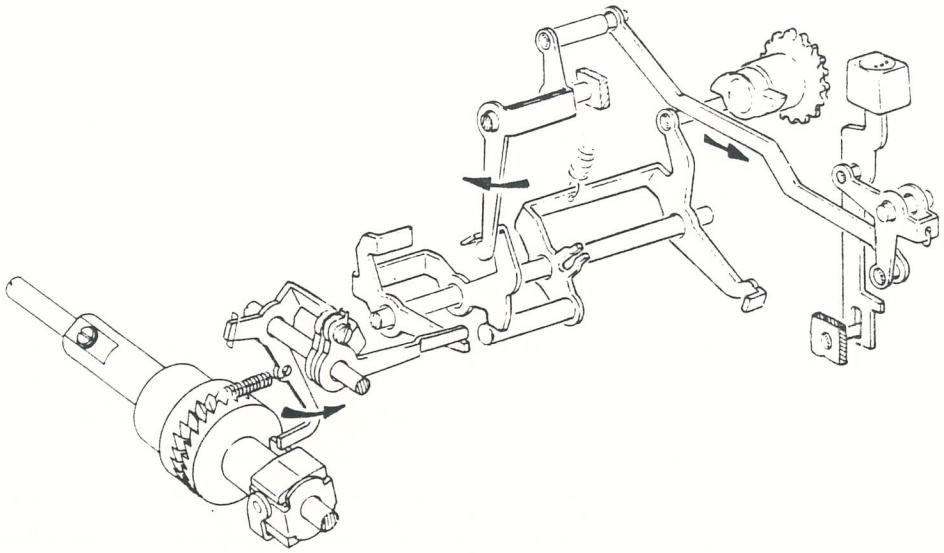
Moreover, to send the codes present on the drum into the line, it is necessary to couple hook G to pin P by means of rotation of bridge 6, and to maintain this condition as well as the closing of the serializer by coupling bridge 5 to tension bar 4.

COPYING HOOK RECOVERY



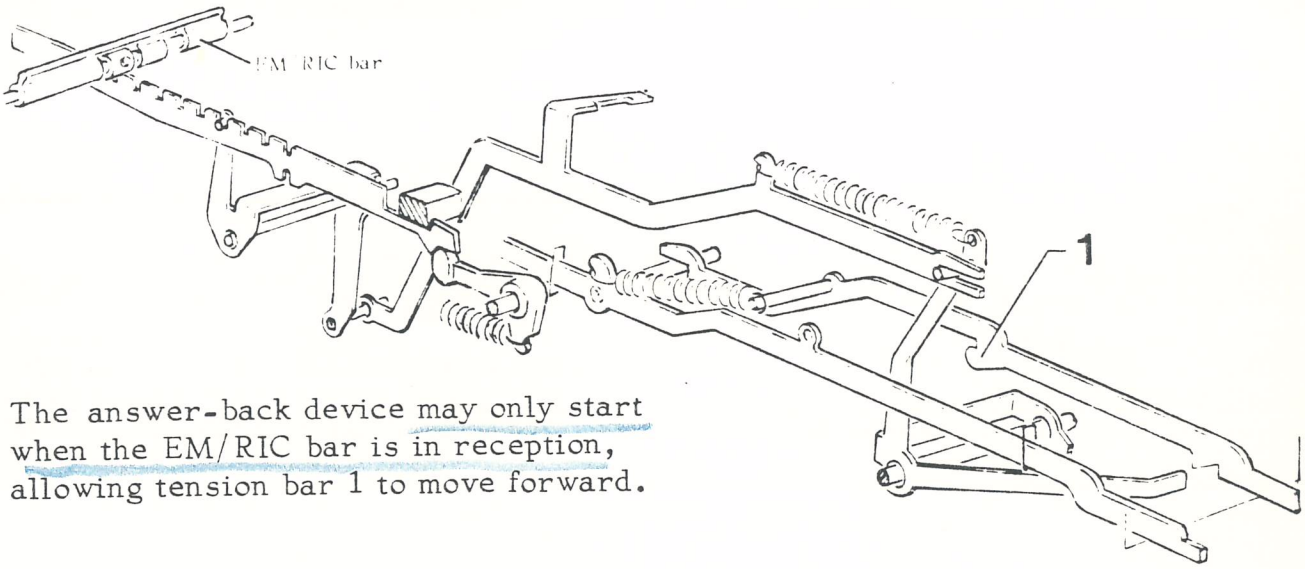
After the sending into the line of the figures or letters code, it is necessary to take hook G onto pivot P for sending of the code relative to the depressed key. This is done by means of cam A mounted on the serializer shaft.

REPEAT KEY



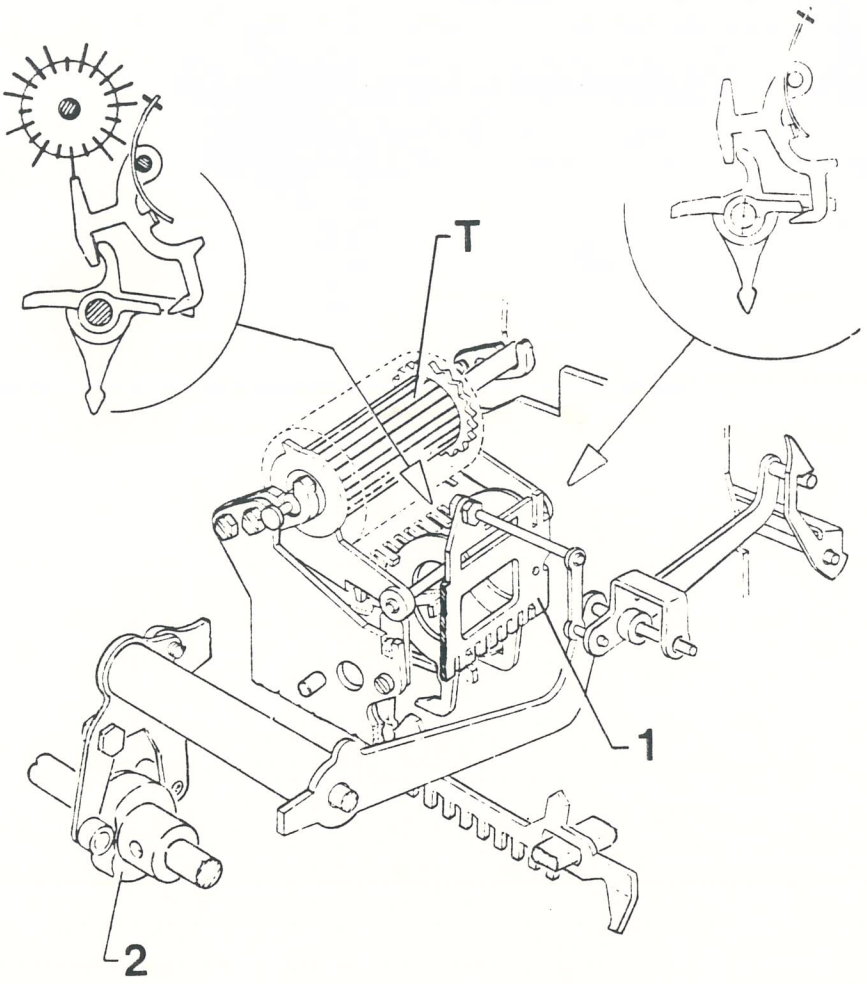
When this key is depressed, and whilst it is kept depressed, it is necessary to repeat the last combination present in the serializer by means of closing of the serializer clutch.

ANSWER-BACK DEVICE RELEASE CONTROL



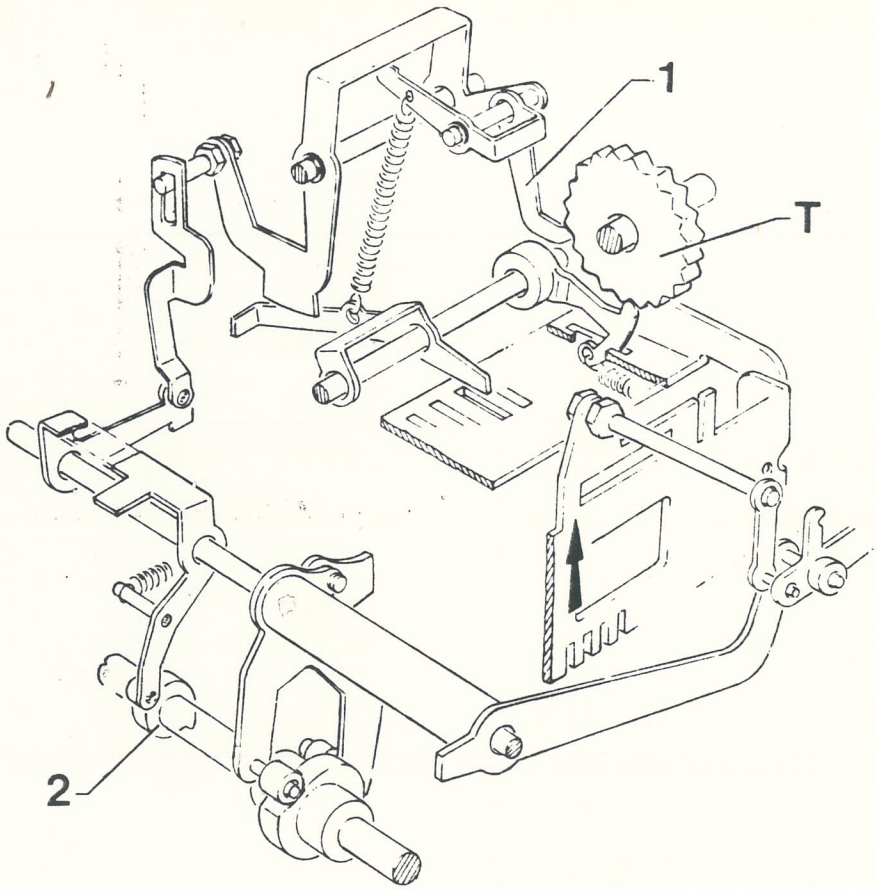
The answer-back device may only start when the EM/RIC bar is in reception, allowing tension bar 1 to move forward.

ANSWER-BACK COPYING



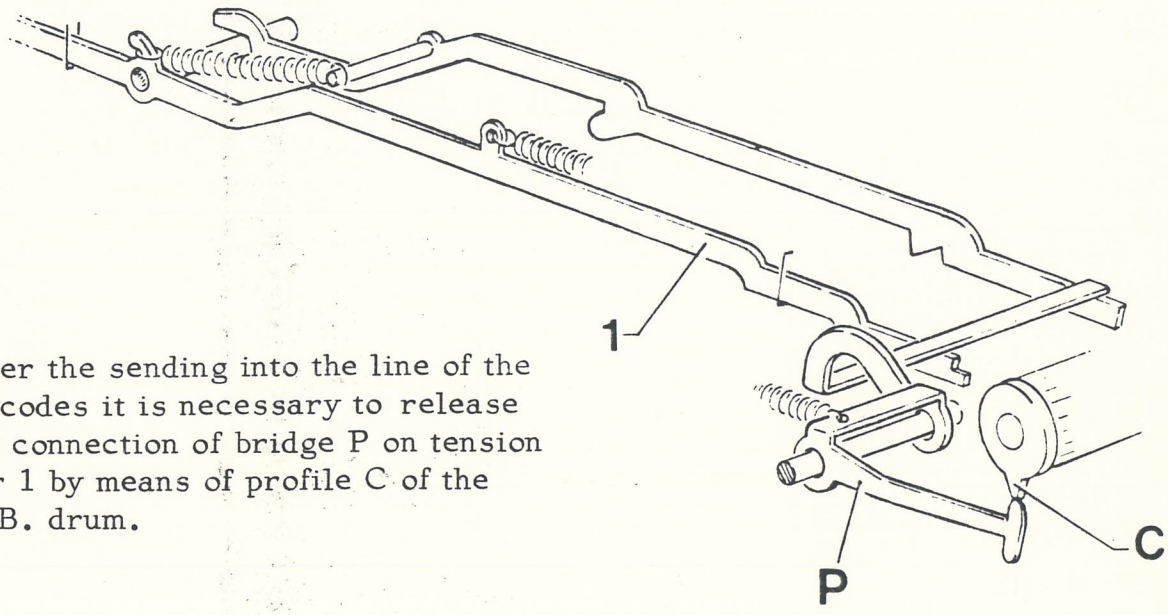
To transfer the codes of the answer-back drum onto the serializer blocks it is necessary to raise frame 1 by means of cam 2.

A.B. FORWARD MOVEMENT



After each copying it is necessary to make the A.B. drum move forward by one step by means of bridge 1 commanded by cam 2.

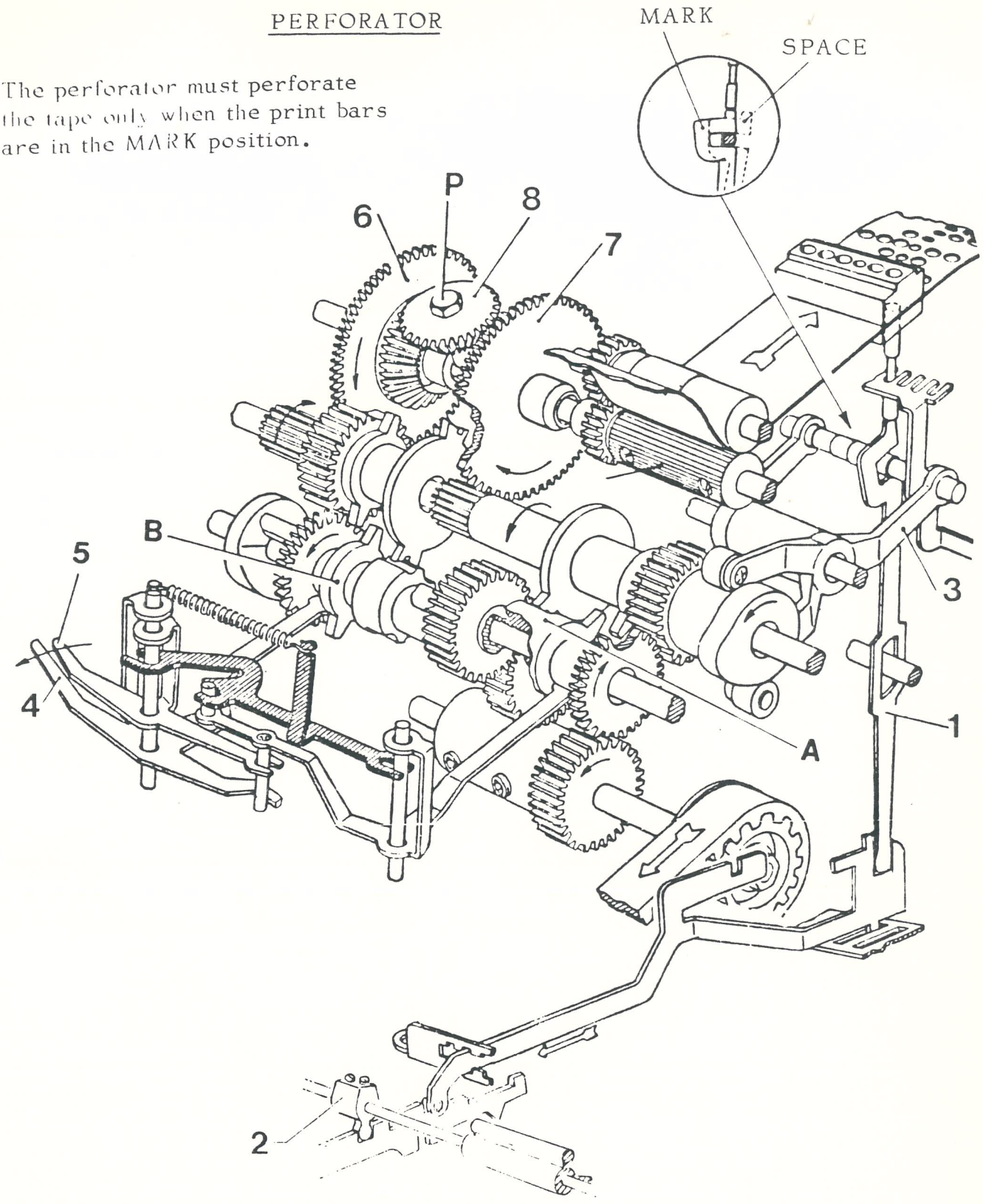
CLEARING OF THE MEMORY



After the sending into the line of the 20 codes it is necessary to release the connection of bridge P on tension bar 1 by means of profile C of the A.B. drum.

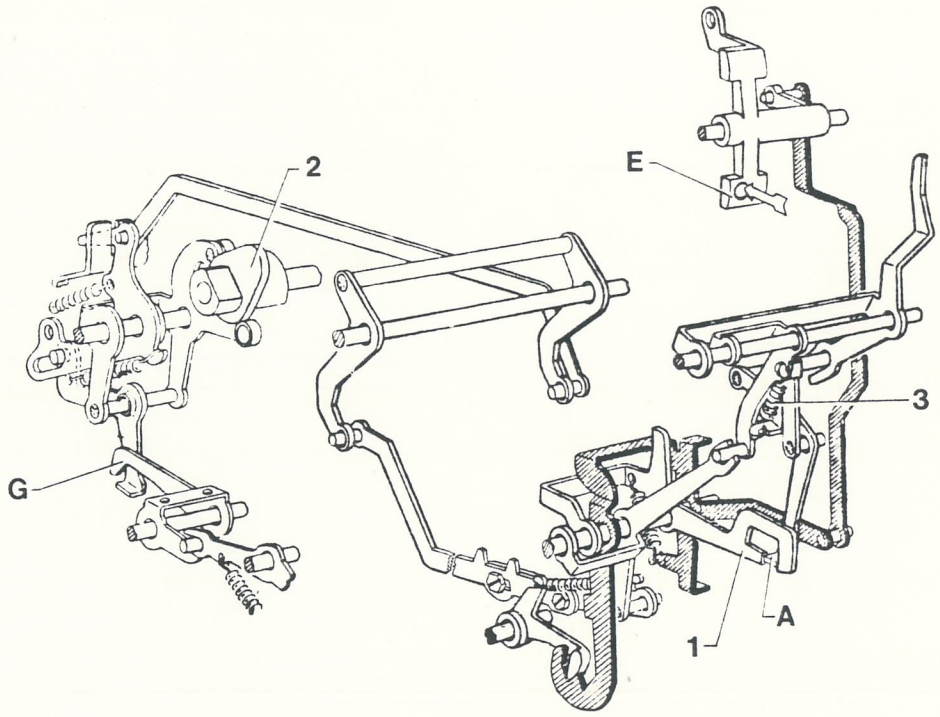
PERFORATOR

The perforator must perforate the tape only when the print bars are in the MARK position.



For perforation it is necessary to raise perforation rods 1 which are positioned by print bars 2, by means of frame 3 following the closing of clutches A and B which is due to movement of levers 4 and 5. During perforation the tape is still because clutches A and B, both being closed, transmit the motion to crown wheels 6 and 7 and planetary gear 8 rotates around its pivot P, but not angularly. When the perforation has been made (after 180°) clutch B is opened whilst clutch A stays closed, transmitting the motion to crown wheel 7, so that planetary gear 8 rotates angularly, feeding in the tape and moving it forward.

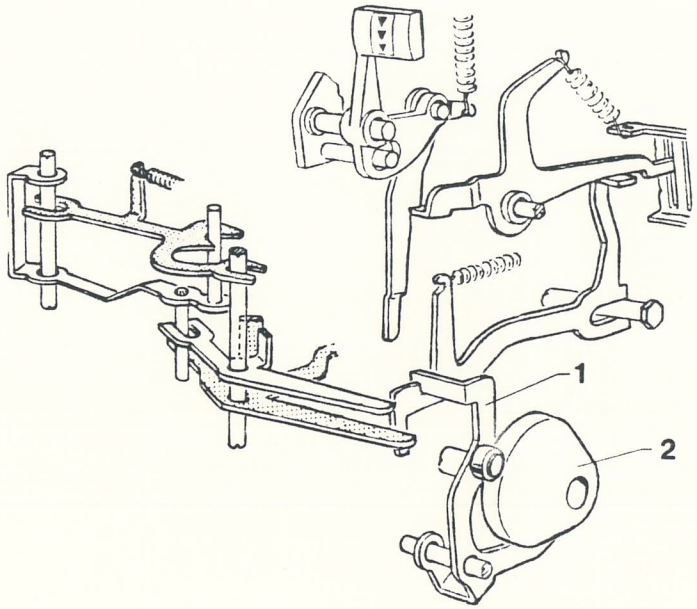
EXCLUSION OF THE PERFORATOR



By activating the exclusion key, bridge 1 is carried into the trajectory of tab A, so that the command of cam 2 will operate on coupling 3.

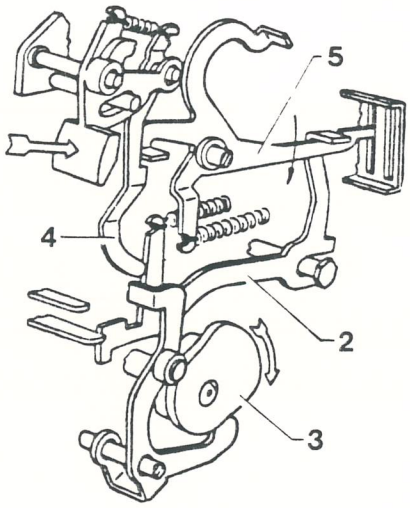
N.B. Hook G allows immediate suppression of perforation of the "Who are you?" code.

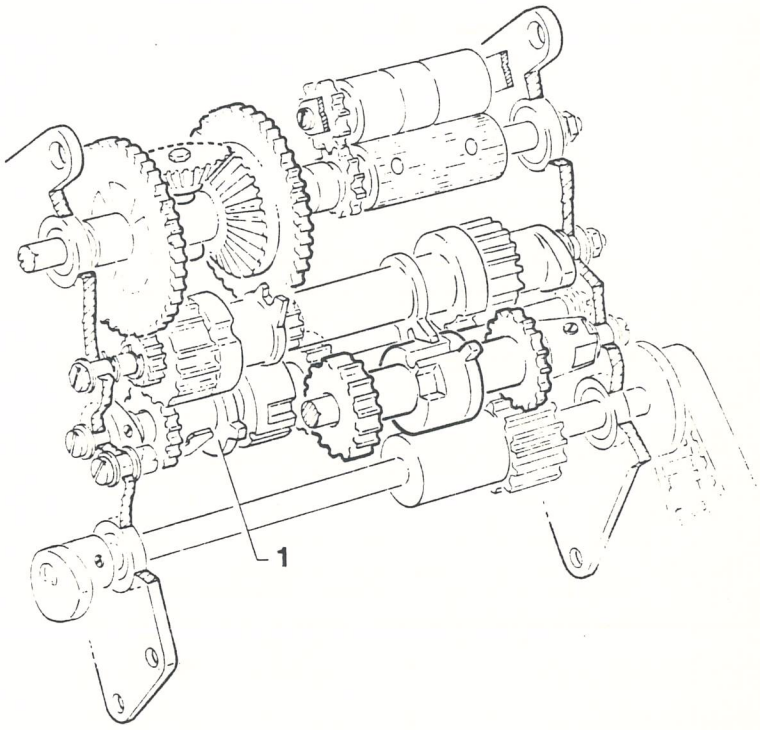
CONTINUOUS FORWARD MOVEMENT OF THE TAPE



When the continous forward movement key is activated the two perforator clutches must be closed by means of lever 1 commanded by cam 2.

SINGLE STEP RETURN





When the single step return key is activated the tape must move back by one step and this is done by means of intermediate gear 1 through lever 2 on command of cam 3.

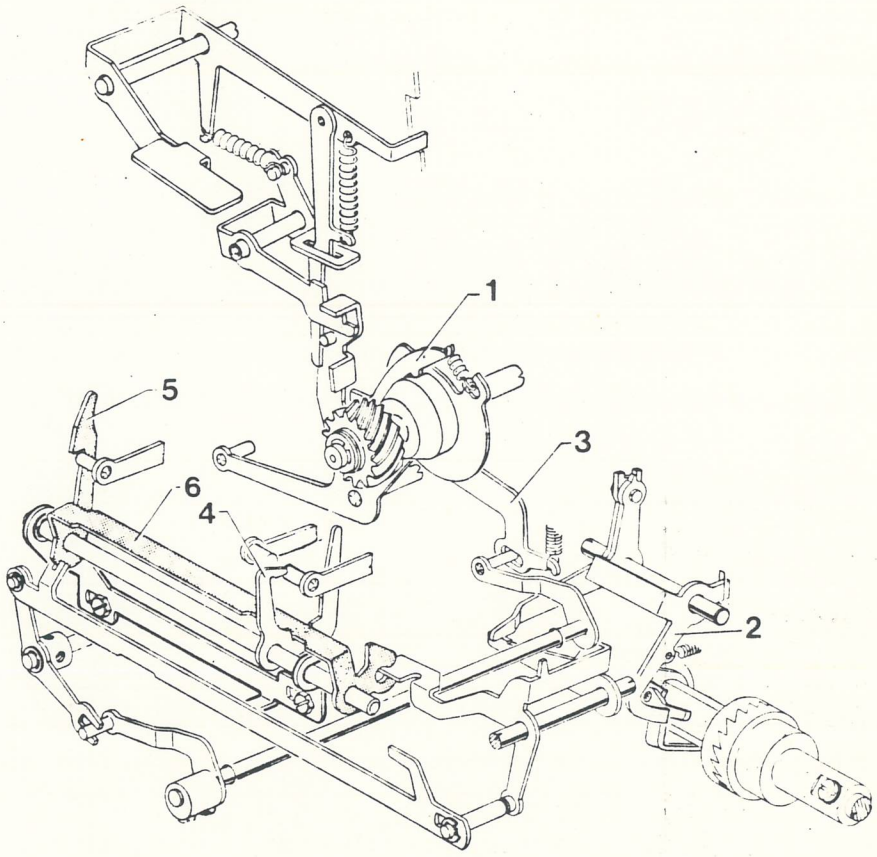
N.B. During the cycle tension bar 4, through lever 2, is released from the tab of lever 5, so that to have a subsequent return of one step it is necessary to release and repress the key.

READER

The reader must read the perforated tape and send the codes on it into the line.

When the start key is pressed it is necessary:

1) to close the reader clutch
2) to close the serializer clutch
3) to exclude manual - automatic - A.B. copying.

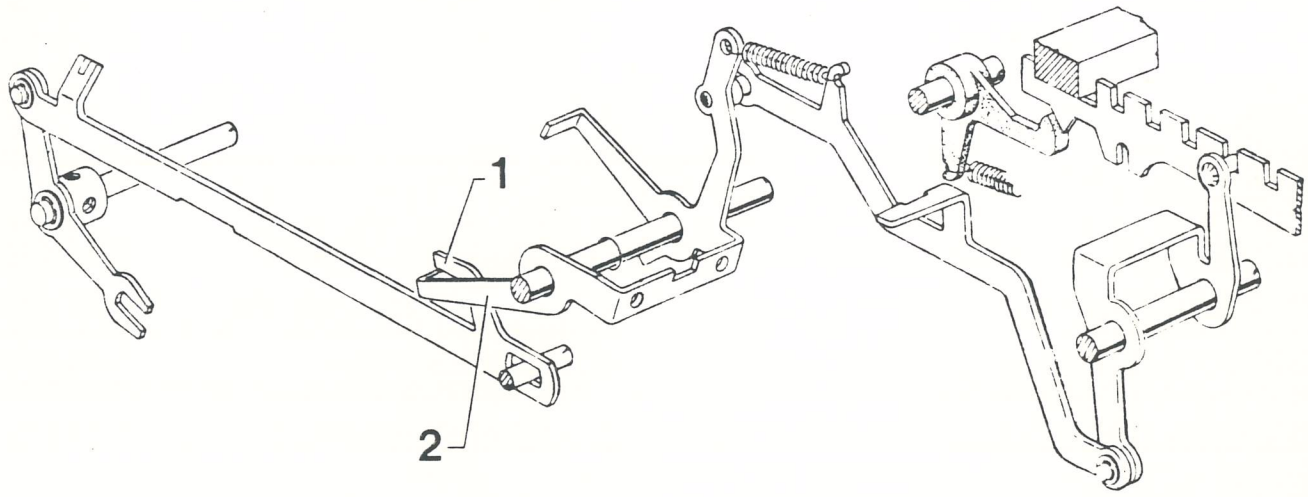


1) To close the reader clutch it is necessary to insert tooth 1 of the reader clutch spool cut-out by means of movement of lever 3.

2) To close the serializer clutch bridge 1 must be commanded by means of movement of lever 3.

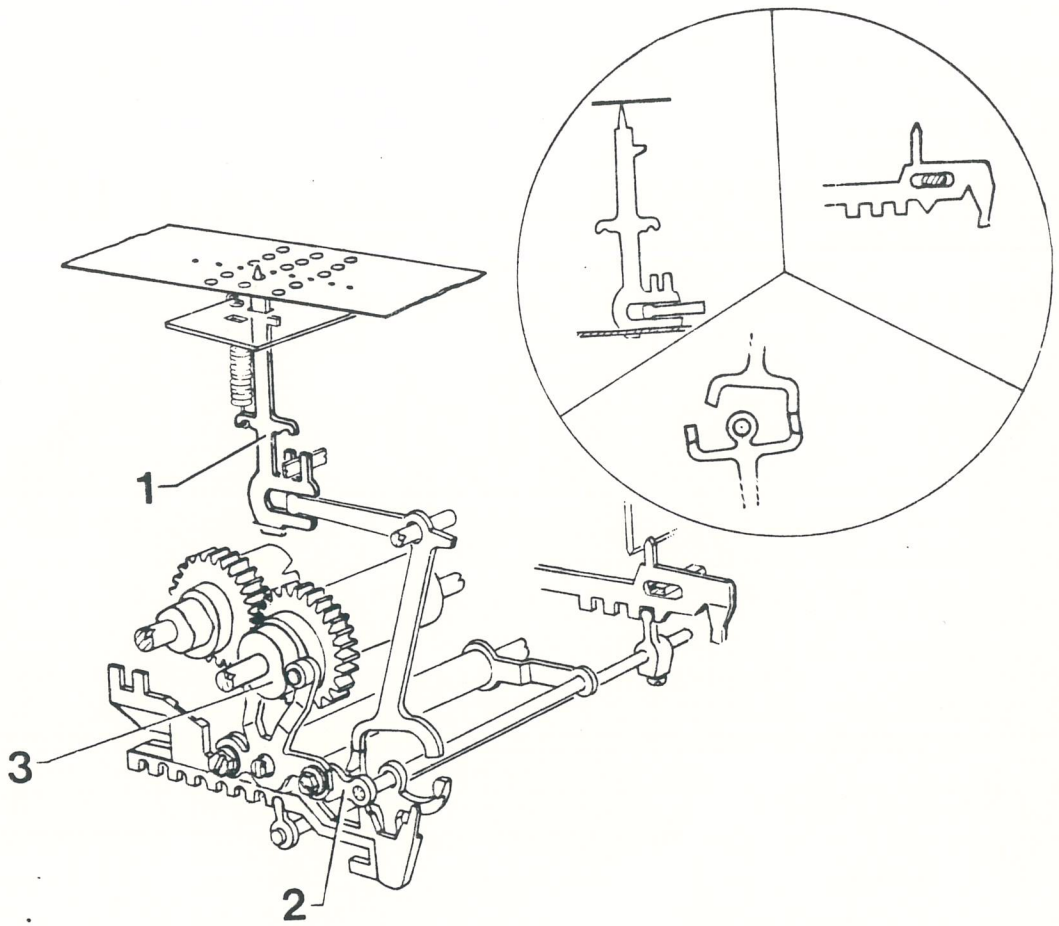
3) To exclude copying arms 4 and 5 must be released from the respective pins by means of movement of lever 3.

POSITIONING OF EM/RIC BAR FOR START OF READER



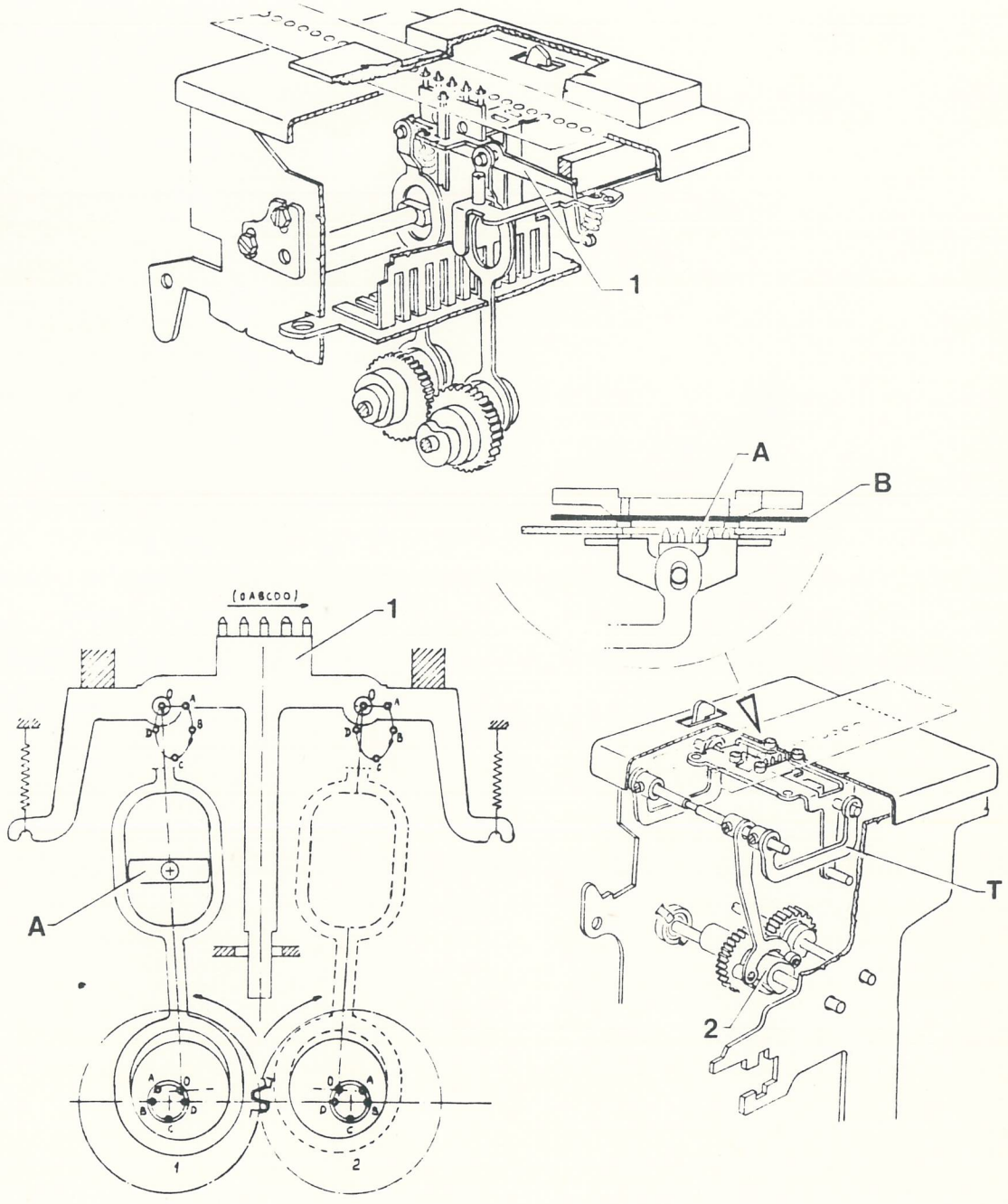
To start the reader the EM/RIC bar must be positioned in Reception so that the arm of bridge 2 is taken out of the trajectory of the appendix of tension bar 1.

COPYING



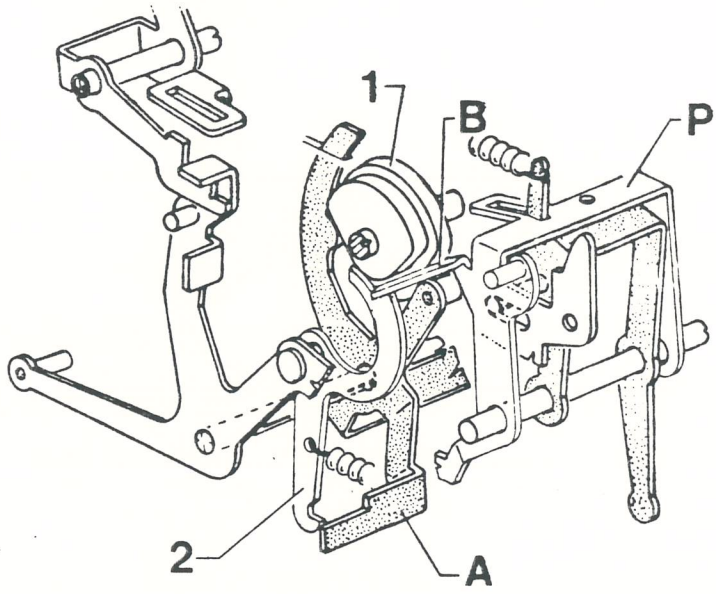
To transfer the code on the tape onto the serializer blocks, the tape must be checked by sensers 1 and thus, by means of frame 2 commanded by cam 3, the code is carried onto the serializer slides.

TAPE FORWARD MOVEMENT AND POSITIONING



To present the subsequent code to the one which has been read to the sensers the perforated tape must move forward. This is done by frame 1 which is controlled by the two tape forward movement eccentrics. The diagram shows the movement of forward movement frame 1. When the frame has completed the forward movement it abandons the tape to return to the start position and at this moment frame T, commanded by cam 2, intervenes to keep the tape positioned until the pins of frame 1 are re-inserted in the holes of the tape.

READER STOP

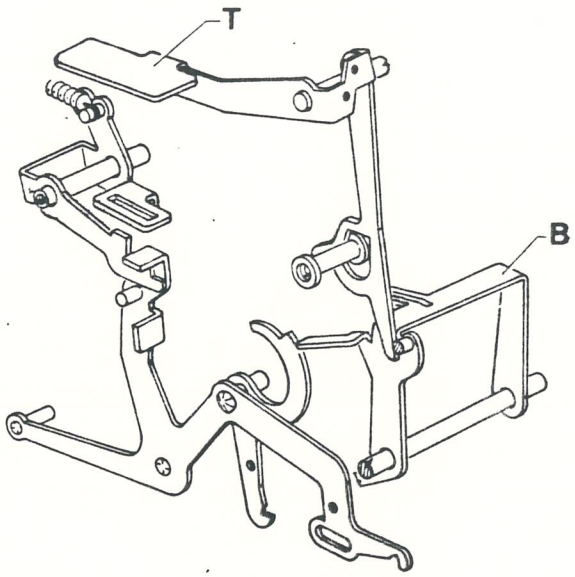


To stop the reader, appendix A of the bridge commanded by cam 1 must take lever 2 downwards. Lever 2 may be coupled to tab A and thus be commanded only when the universal bridge P is commanded in such a way as to take tab B out of the trajectory of lever 2.

The universal bridge can be commanded by:

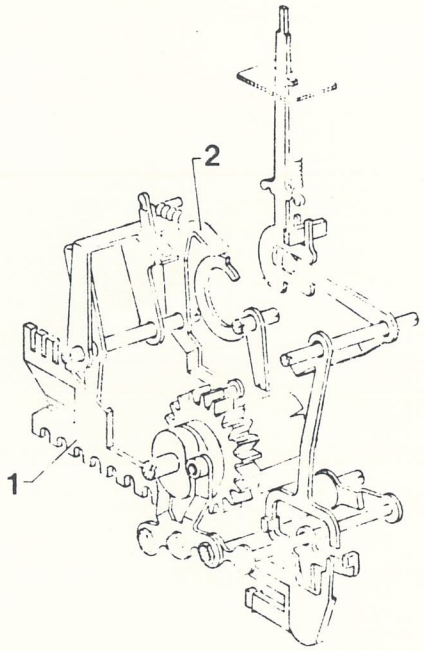
1) Stop key
2) senser which detects absence of tape
3) frame which detects stretched tape
4) code checking frame

STOP BY STOP KEY



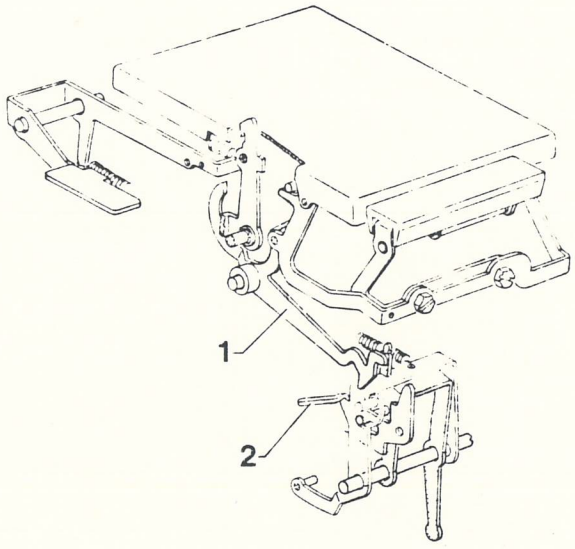
1) When the "Reader Stop" key is depressed, reader stop universal bridge B is commanded.

STOP BECAUSE OF ABSENCE OF TAPE

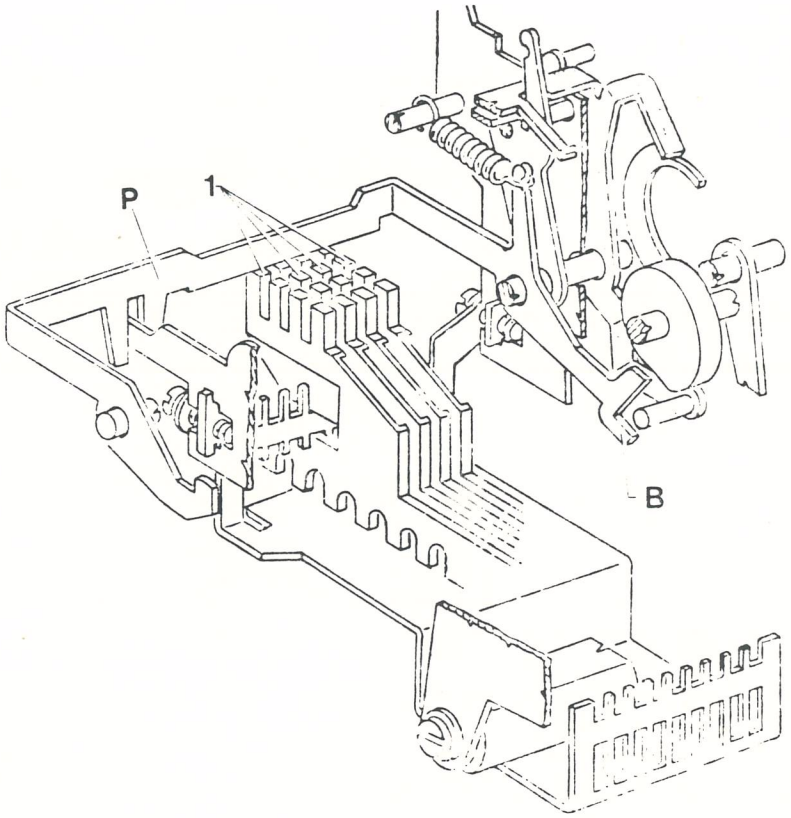


2) When there is no tape and copying is commanded by slide 1, universal bridge 2 will be commanded.

STOP BECAUSE OF STRETCHED TAPE

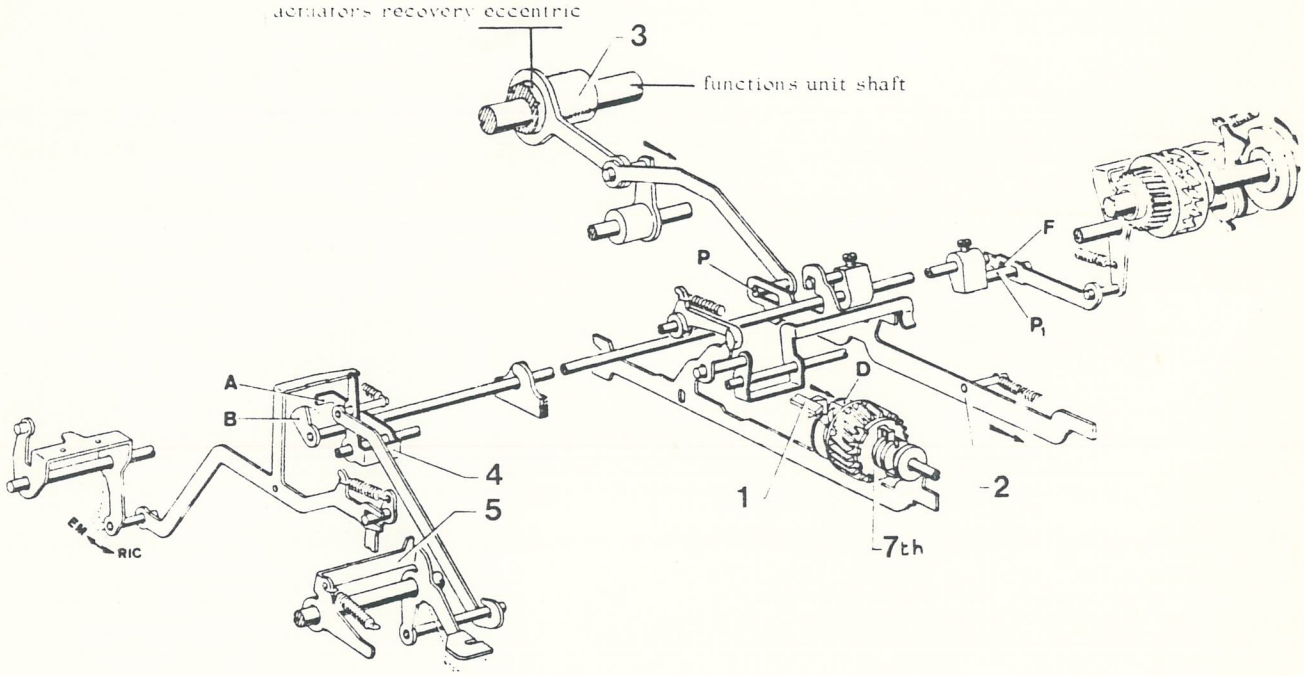


3) When the tape is stretched, universal bridge 2 is commanded by the end of lever 1.



4) On the copying of a code which anticipates the reader stop, frame P, as it does not meet the blocks of slides 1, commands the universal bridge with appendix B.

AUTOMATIC SAFETY CYCLE

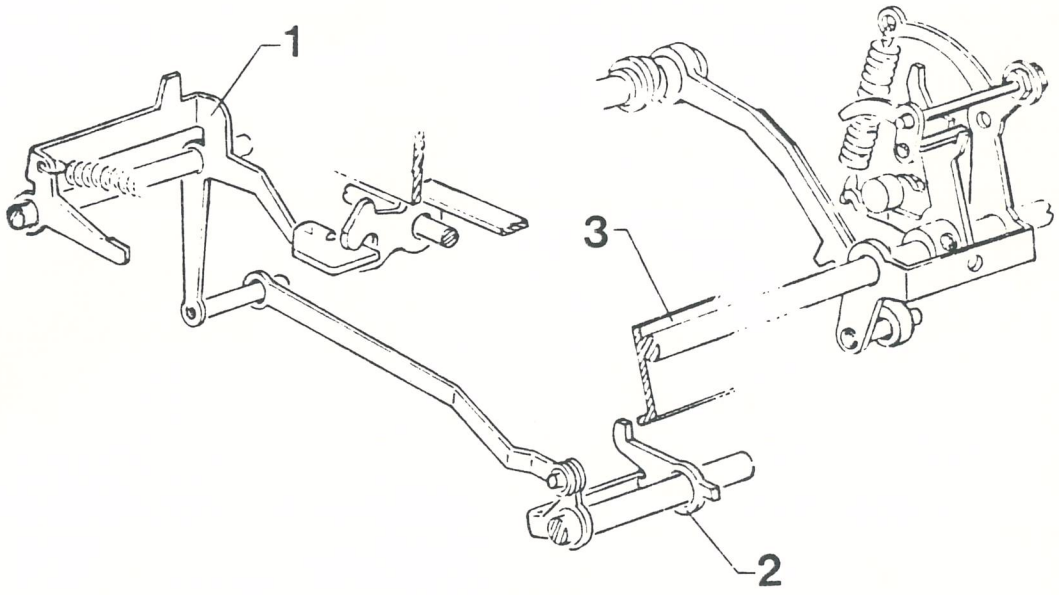


After receiving a message or sending a code by means of the reader or the automatic answer back, the keyboard may be pre-set for letters, and the printing unit pre-set for figures, or vice-versa; therefore, on the command of the functions unit, it is necessary to pre-set the emitting part of the machine to emit the letters or figures code combinations.

For an automatic cycle it is necessary to position runner 1 of the 7th cell forward, by means of slider 2 which is controlled by eccentric 3. Slider 2 can move forward only if handle B does not meet tab A or bridge 4.

Bridge 4 is controlled by the EM/RIC bar and by bridge 5 which is commanded when transmission is done by the reader or the automatic answer back.

INTERLOCK

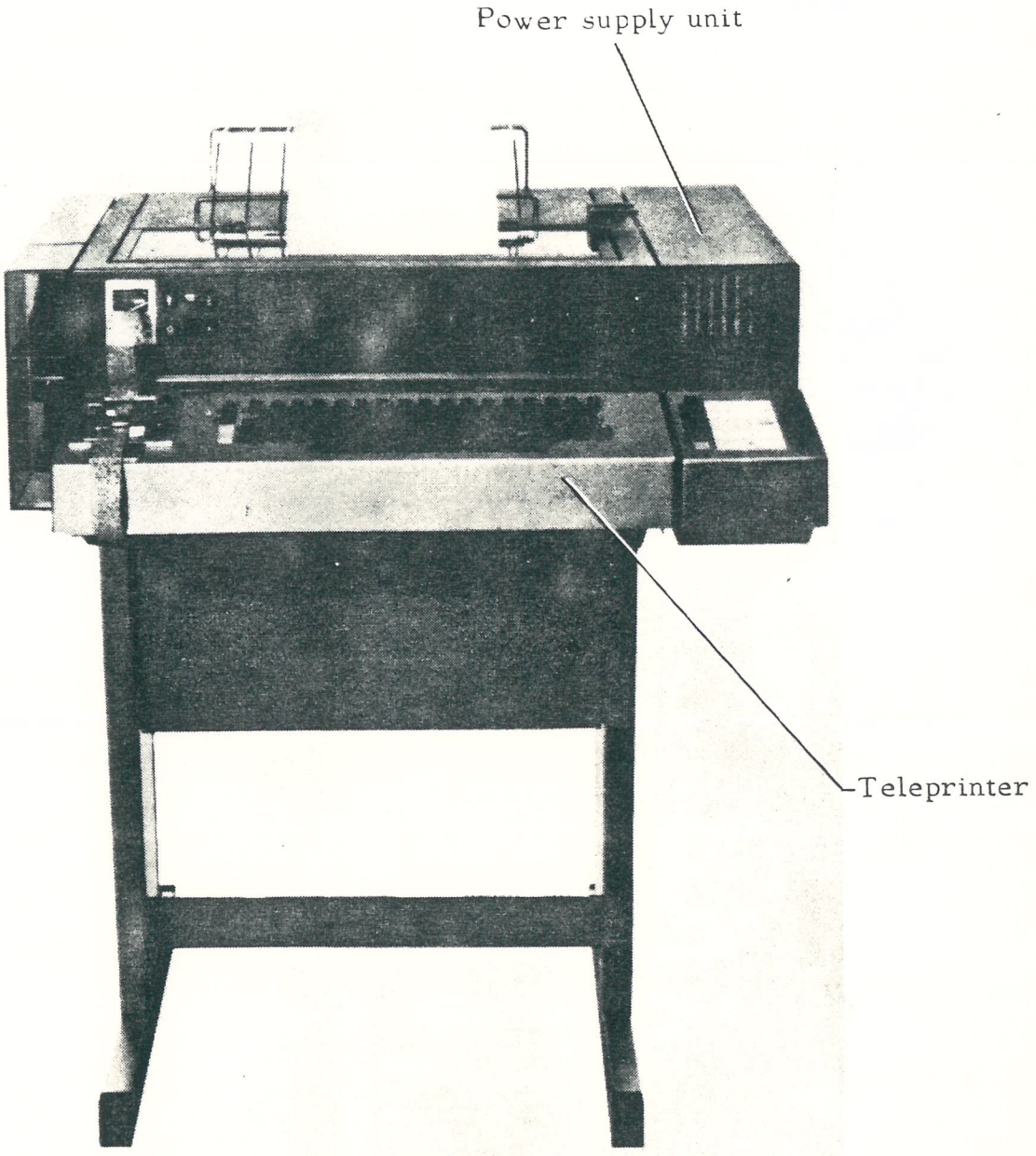


When the answer back device or the reader are in motion it is necessary to block the emission of codes from the keyboard by coupling the hook of bridge 2 to setting bail 3 by means of rotation of bridge 1.

TELEGRAPHIC POWER SUPPLY UNIT

INDEX

TE 300 TELEGRAPHIC SET WITH A063 POWER SUPPLY UNIT



4

5

DESCRIPTION OF CONNECTION DIAGRAM

Mains cable = Supplies socket 1.

A063 power supply cable = Supplies the A063 (transformer).

Motor sockets power supply cable = Supplies motor sockets 2 - 3 with the A063 switch in the ON position through socket 4.

Motor cable = Supplies the transformer and the teleprinter motor.

Telegraphic cable = Contains the connections to the transmission, reception electromagnet and deflector contacts.

TE services cable = Contains the connections of the alarm micro-switches (stretched tape - 'near end of tape' - 'near end of roll' - paper ripped) and signalling of motor in motion, keyboard locked and functions unit electrical outputs.

Interface cable = Contains the connections of the keys and of the console lamps, supplies the transmission contacts and connects them to the ML (line terminal board), collects the alarm signals present on the TE service cable and supplies the external transmitter telegraphic socket.

ML = Line terminal board = Connects the two teleprinters.

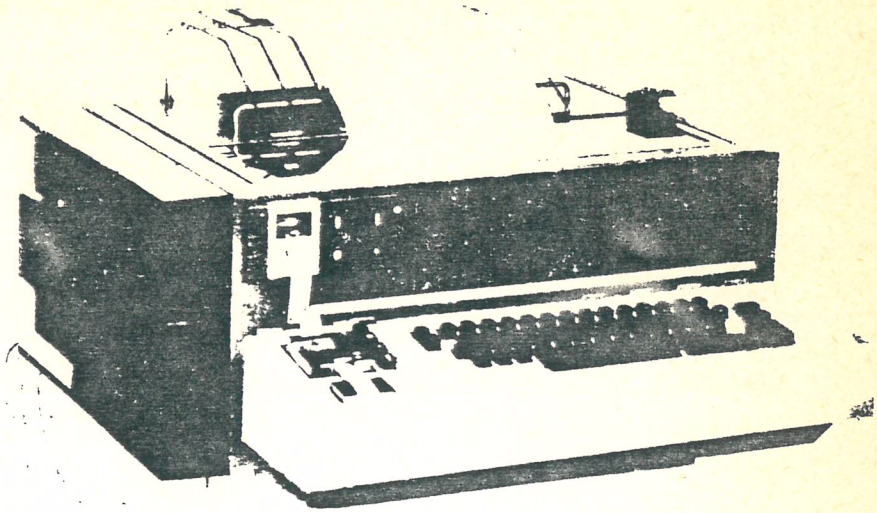
MS = Services terminal board = Used to carry an external alarm signal (e.g., to make a bell ring) and to pre-set external commands.

D1·D2 (Deflectors) = Used with the automatic transmitter.

D1 = Transmission contacts

D2 = Automatic transmitter deflector.

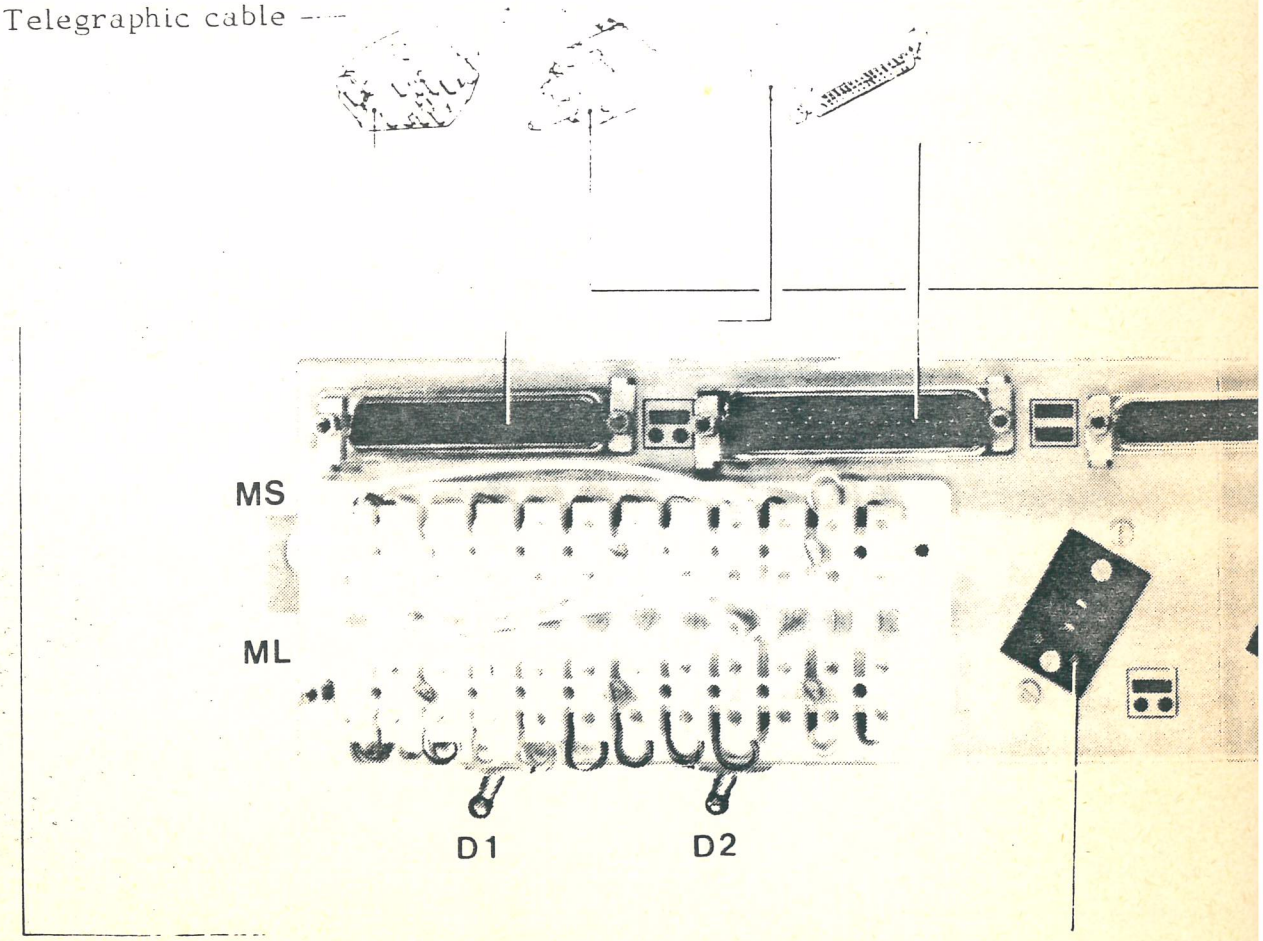
TE 315 TELEPRINTER



Motor cable

Services cable

Telegraphic cable

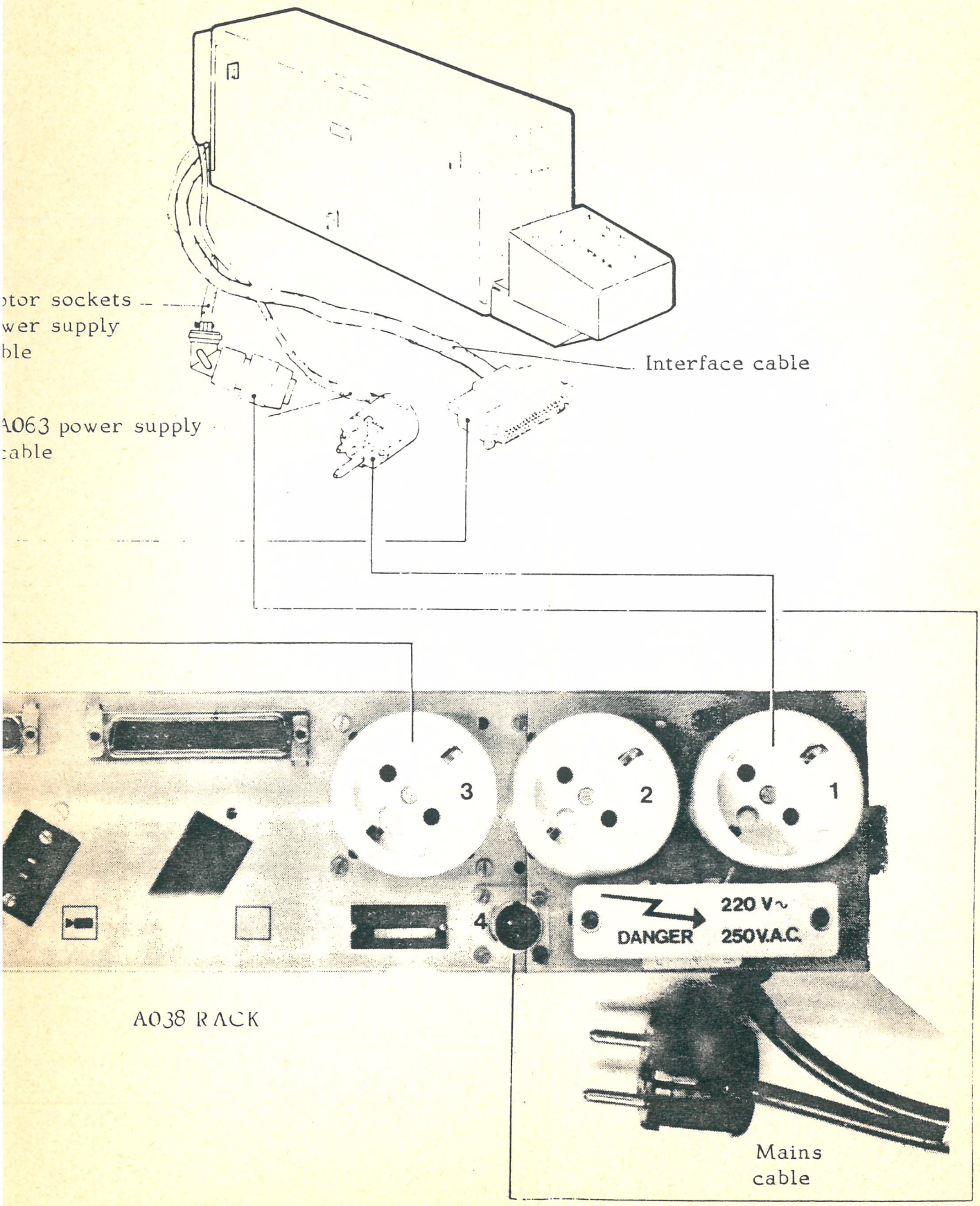


Teleprinter

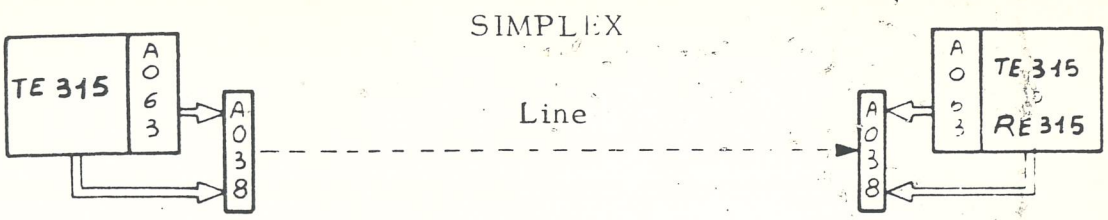
A063 Power supply unit

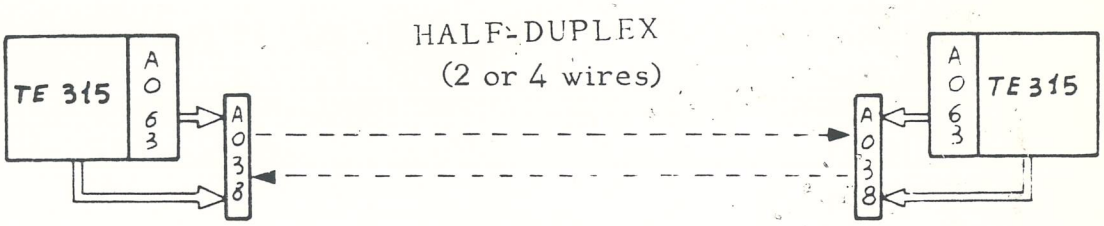
External automatic transmitter

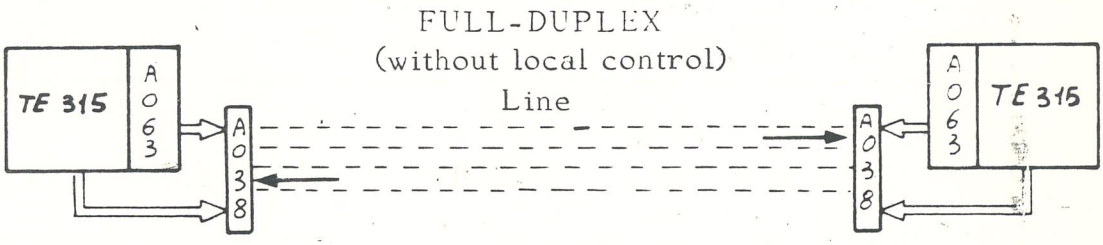
A063 POWER SUPPLY UNIT

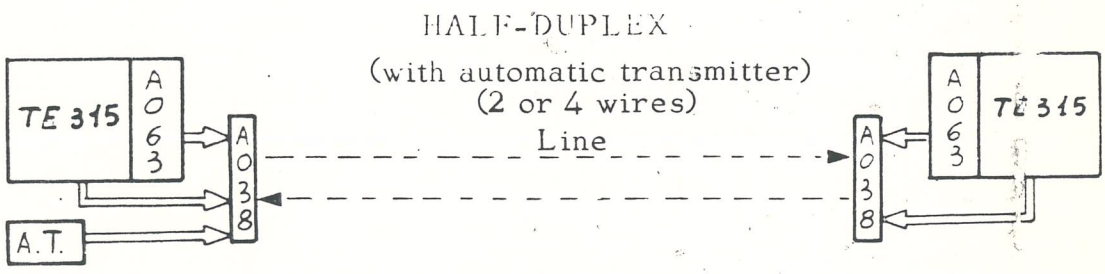


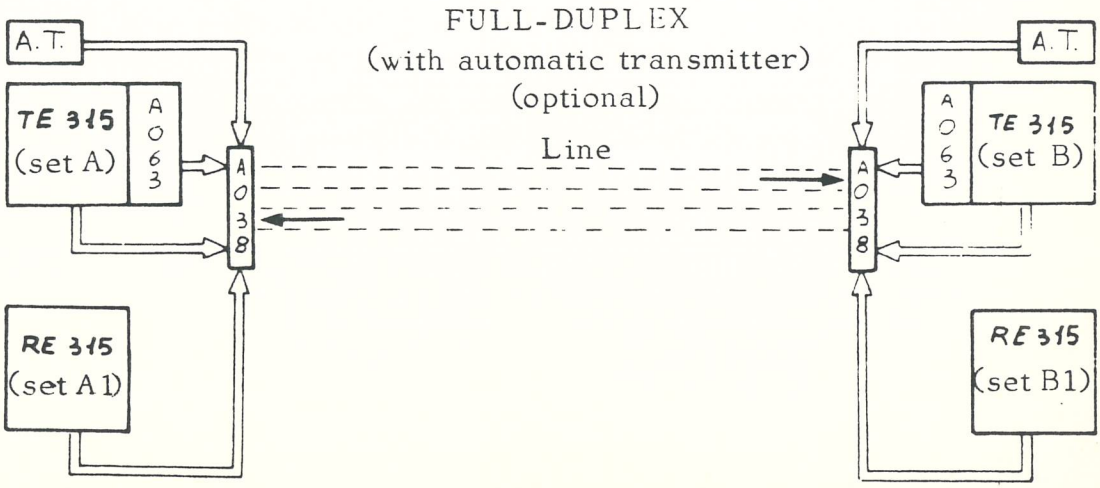
BLOCK DIAGRAMS OF THE A063 TELEGRAPHIC CONNECTIONS











A063 TELEGRAPHIC POWER SUPPLY UNIT

General description

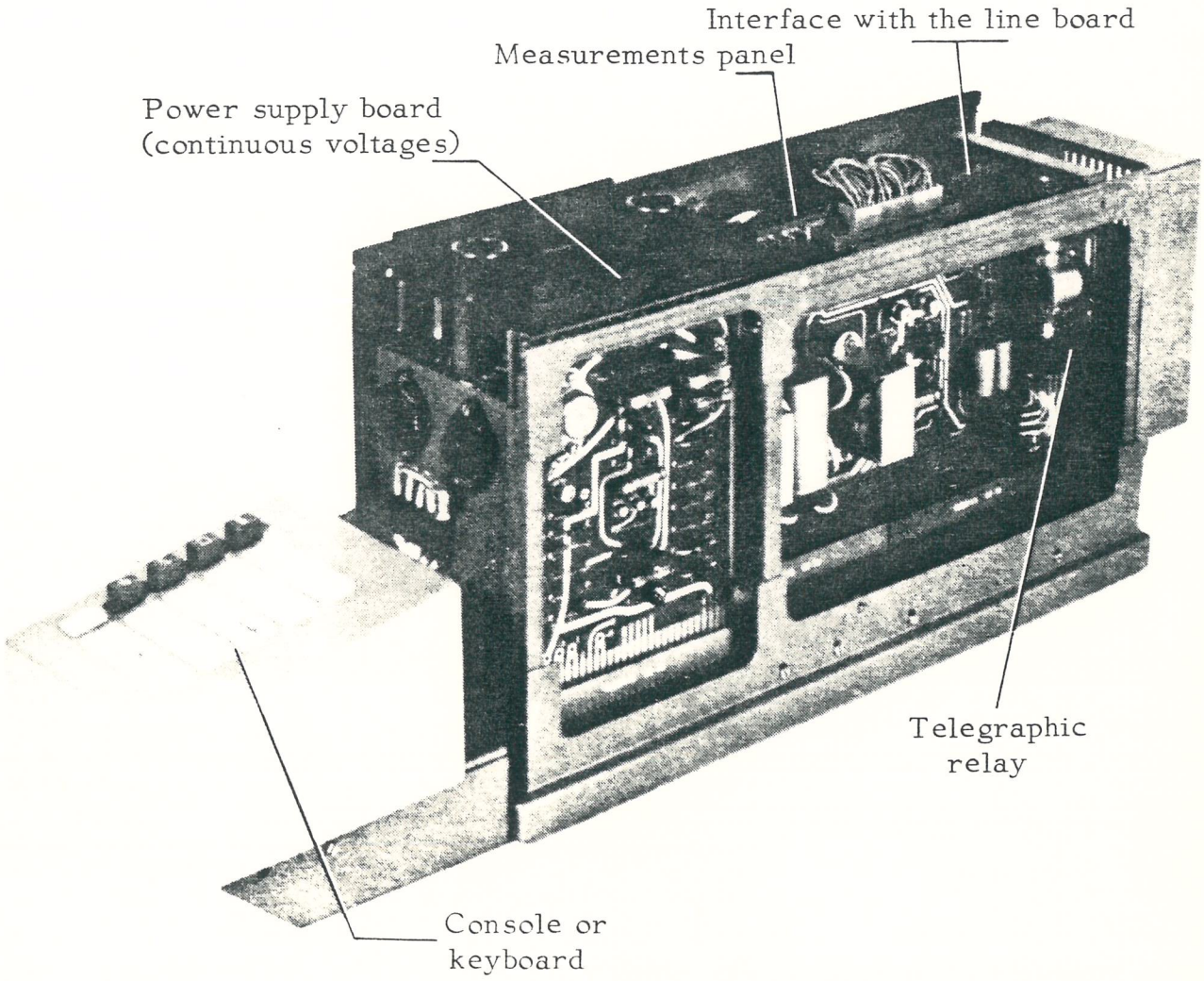
The power supply unit allows for telegraphic connections which use a TE 300 class teleprinter, which can use an external automatic transmitter or a card reader.

The power supply unit allows for "point-to-point" telegraphic connections operating according to the CCITT and US-UK systems. These connections are made on telegraphic lines with metallic continuity, or alternatively where devices which stop the flow of direct current are installed.

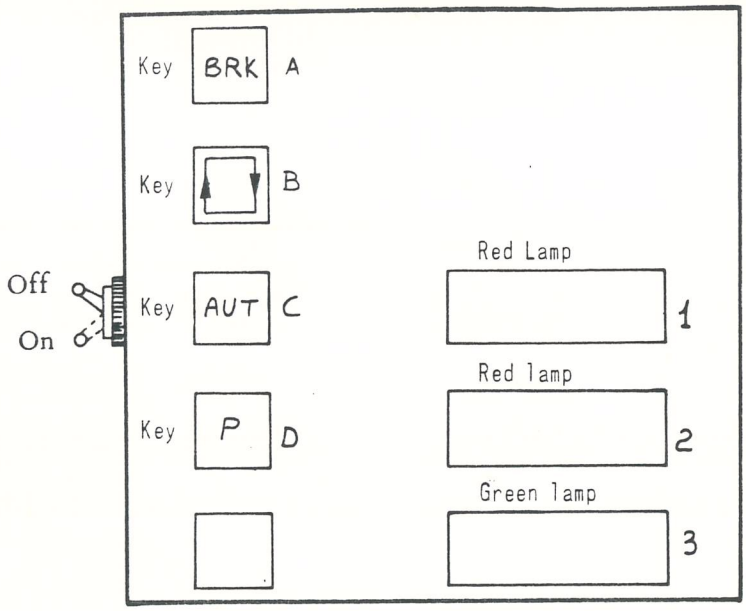
The unit supplies, through a rectifier circuit, continuous voltages of:

± 48V, ± 60V, ± 80V for connections in D.C.
48V, 60V, 80V, 96V, 108V, 120V for connections in S.C.

In the figure below the principal components of the A063 are shown.



A063 CONSOLE



OPERATING CONDITIONS

The power supply unit has the following operating conditions:

- on-line
- off-line
- transmission by external automatic transmitter
- set abandoned or made inactive
- preparation of perforated message.

In each of the stated conditions the telegraphic set may be equipped with an external automatic transmitter.

On-line

The condition is as follows:

- on-off switch is on
- green lamp no. 3 is lit
- no key has been pressed

The "on-line" condition has two aspects in relation to the TE 300 motor; i.e., if the latter is stopped or running. In both cases there will be:

- motor stopped, red lamp no. 1 lit;
- motor running, red lamp no. 1 off.

Monostable key A

This is used to generate BREAK; this condition is represented by a SPACE signal, which lasts for the whole of the period that the key is pressed.

Bistable key B

Released position: on-line condition.
Pressed: off-line condition, with activation of the call system.
Key B is interlocking with C, in that only one of the two keys may be in the pressed condition.

Bistable key C

Released position: normal on-line condition.
Pressed: transmission by external reader.

Bistable key D

Released position: normal on-line condition.
Pressed: the call device is activated and reception inhibited.

By pressing both keys C and D the perforated message preparation condition is brought about.

The conditions of the line, which is either transmitting or receiving, are those of Mark (+ in CCITT, - in US/UK), to keep the teleprinter electromagnet submitted to mark conditions.

This is valid for both point-to-point connections and manual exchange connections operating with the US/UK system.

In the two cases there will be:

- point-to-point connections (US/UK and CCITT)

The set is systematically on-line and communication can take place immediately without any operations, unless the correspondent, to which the set is connected, is in off-line condition.

In this case the correspondent must be advised by modulating any characters or by pressing the Break key;

- manual exchange connections (see section 5), US/UK system.

The set is in rest condition (negative mark polarity on the line) and the telegraphic set is disconnected from the exchange units.

The operator sends a Break signal of 500 ÷ 1,000 millisecs. duration, by pressing key A for the indicated time.

The Break signal, a positive space polarity signal, is interpreted by the exchange units in order to advise the operator that there is a call on the way.

The operator connects the calling user with the one required.

The end of connection is also a Break signal; this advises the exchange operator that the conversation is finished and the connection may be broken.

Off-line

The telegraphic set has the following conditions:

- key B pressed;
- all the other keys at rest;
- green lamp lit;
- red lamp no. 1 (the points made in the on-line section are valid here).

The telegraphic set, as far as the emitting part is concerned, is disconnected from the line, which is kept in the mark condition, and the emitted modulation reaches the teleprinter receiving unit, allowing typical off line operations.

The receiving line is excluded from the reception unit of the teleprinter and heads a signalling device.

In the case of a call from the correspondent, the operator, when the priority of the call has been recognised, can pass on-line by resetting key B in the rest condition.

With this operation, the signalling circuit is placed off the line and the machine's receiving units inserted in its place.

On the transmitting side the holding at rest condition is removed and the teleprinter modulator enabled in its place.

Transmission by external automatic transmitter

The telegraphic set has the following conditions:

- key C pressed;
- all the other keys at rest;
- green lamp no. 3 lit.

Assuming that the telegraphic set is programmed for half-duplex connections, despite this, it can take on the typical configuration of a full-duplex, in which the emitting part is represented by the external automatic transmitter and the receiving part by the TE 300 itself.

Therefore the set can emit messages from the external automatic transmitter and at the same time can accept them on its own teleprinter.

If the A063 is already programmed to operate in full-duplex, and if the set is equipped with both machine A (transmitting) and B (receiving), the active condition makes the telegraphic set assume the following configuration:

- machine A: is placed off the line; it can operate off-line;
- machine B: stays enabled on reception;
- external automatic transmitter: is enabled on transmission, replacing machine A.

However, in the case of connections using a single transmission channel (example with 2 wires, S.C.) the modulation sent by the correspondent is added to the one supplied by the external automatic transmitter thus generating confusion with the text.

Set abandoned or made inactive

The telegraphic set has the following conditions:

- key D pressed;
- all the other keys at rest;
- green lamp no. 3 lit.

The reception part of the telegraphic set is excluded from the line and the call device inserted in its place.

A possible modulation or Break coming from the correspondent is shown in the manner already described (red lamp no. 1 and buzzer).

Perforated message preparation

The telegraphic set has the following conditions:

- keys C and D pressed;
- all the other keys at rest;
- lamp no. 3 lit.

The telegraphic set takes on the following configuration:

- teleprinter, off-line;
- automatic transmitter, on-line (transmitting line);
- call device, on-line (receiving line).

The teleprinter operates in off-line conditions, and the use of the whole complex for preparing message tapes is permitted, check on the printing unit by the incorporated reader.

Meanwhile the external automatic transmitter remains connected on-line thus allowing normal messages to be sent.

The reception unit of the teleprinter, which is used for preparation of the messages, stays off the line and replaced by the call device; this is shown in the usual way, with any modulation or Break coming from the correspondent.

ALARMS

These give warning of anomalous conditions in the telegraphic set by use of acoustic or visual signalling, or by simultaneous use of two devices.

The following alarms give rise to both types of signalling (red lamp no. 1 and buzzer) and they last for as long as the conditions which have been generated by the following last:

- "near end of the printing paper roll";
- "printing paper broken";
- "end of the tape to be perforated".

The alarm for the tape stretched irregularly on the reader gives rise to an alarm which lasts about two seconds (no. 1 lamp and buzzer).

If the motor does not start, there is an alarm signalled by the lighting up of lamp no. 1.

In the full-duplex type telegraphic sets which thus use 2 teleprinters (A transmission, B reception), there is alarm signalling relative to machine B by means of lighting up of red lamp no. 2.

The alarm for machine B is signalled by the stated lamp, when suitable programming is established.

The alarm of machine A (red lamp no. 1 and buzzer) can be used, along with the methods previously shown, starting from external signalling, likewise for alarm lamp no. 2 (machine B).

Regulation of telegraphic currents

This is done by means of the two potentiometers 6-7 (one in reception, the other in transmission); the check of the currents is made with a milliammeter placed on the measurements panel, after having set commutators 1-2 in the following positions:

- receiving line current - 1 to the right, 2 to the left (R);
- emitting line current - 1 to the right, 2 to the right (S).

In connections in S.C. it is possible, by means of potentiometer 5, to vary the unbalance current and to check its value on the same milliammeter, after commuter 1 has been set to the left (ø).

Line tests

By means of commutator 4, placed on the measurements panel, it is possible to interrupt the line (deflector placed on BRK, break) or to place it in short-circuit (LOOP position).

The commutator placed in the middle position (LINE) assures the normal connection.

MEASUREMENTS PANEL

1 - Measurement commutator (unbalance current ø and R, S)

2 - Measurement commutator (R, S)

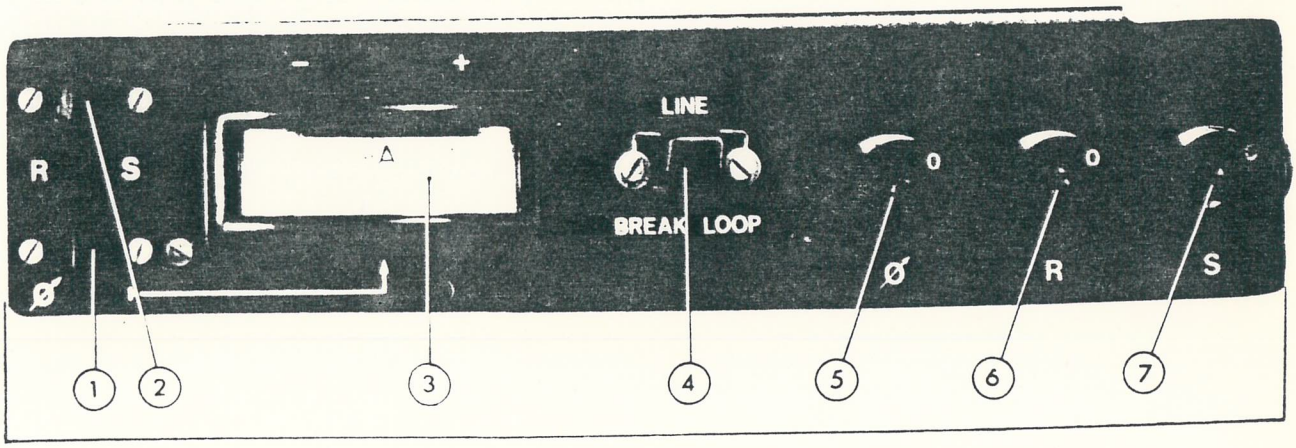
3 - Milliammeter with central zero and 75 mA at the bottor the scale

4 - Line check commutator (BRK = line open; LINE = normal, LOOP = short-circuit)

5 - Unbalance potentiometer

6 - Receiving line potentiometer

7 - Emitting line potentiometer.



TELEGRAPHIC EXCHANGES AND CONNECTION BOXES

INDEX

COMMUTATION NETWORK

General points

The commutation networks are those in which the communication between two users is made possible by connecting, between them, determined line sections which unite at a commutation centre, so as to created a connection between the two users, which lasts as long as the communication itself: when this stops, the connection is broken and the line sections are used to make other connections between other users.

The networks may be constructed as follows:

- either with a single commutation centre (star networks);
- or with several commutation centres (mesh networks).

Star networks

This is found in the systems which are simpler and less important, either because of the number of users, or because of the geographical distribution of the users: in this case each user is connected to the commutation centre (exchange) using a local line or a long distance line (according to the user's geographical position with respect to the centre) and connection between any two users is obtained by means of a single commutation operation (fig. 1).

STAR NETWORK

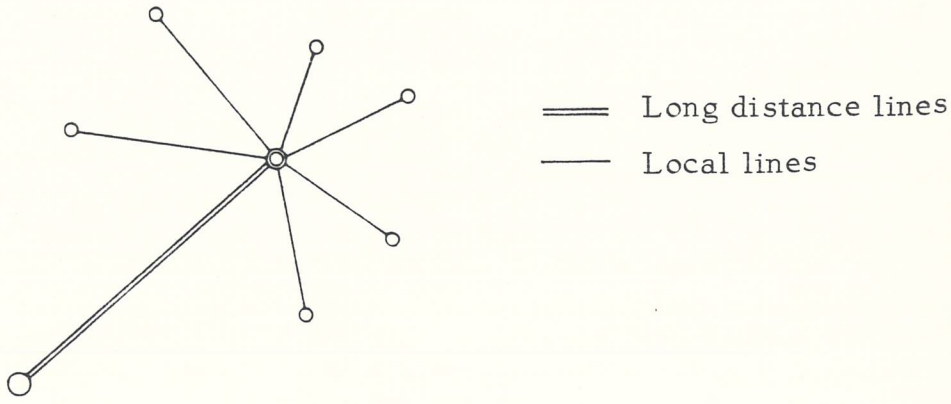


Fig. 1

Mesh networks

In the mesh networks there are different centres at which the nearer users are united, whilst the centres themselves are interconnected by junction lines.

It is clear that in order to limit to two the number of commutation operations necessary to interconnect any two users, each centre must be connected to all the others by means of suitable lines.

Thus the network has an aspect characteristic of a complete mesh network (fig. 2). If, because of economic convenience, this is not the case, there is an incomplete mesh network, and in this case the commutation operations necessary for each connection may be more than two (fig. 3).

MESH NETWORKS

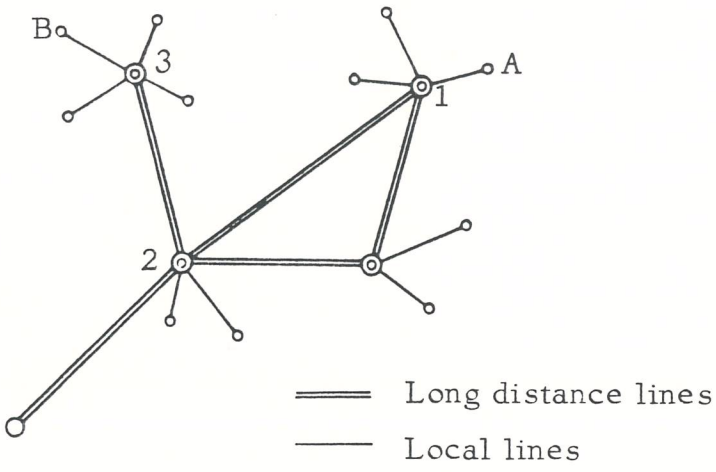


Fig. 3

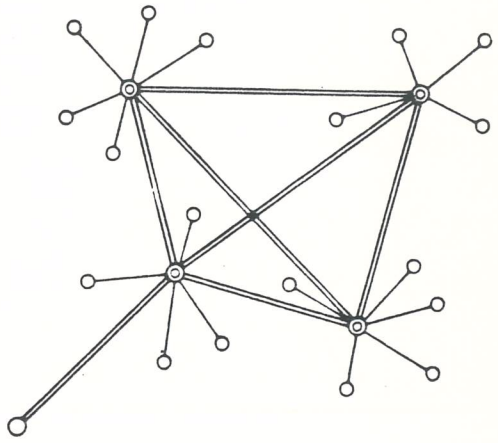


Fig. 2

Example: to connect user A with B, 3 commutations are necessary:

- to exchange 1 - to exchange 2 - to exchange 3 (fig. 3).

The operations of connecting lines which join at a centre may be manual or automatic, and the commutation apparatus (called exchanges) are likewise either manual or automatic.

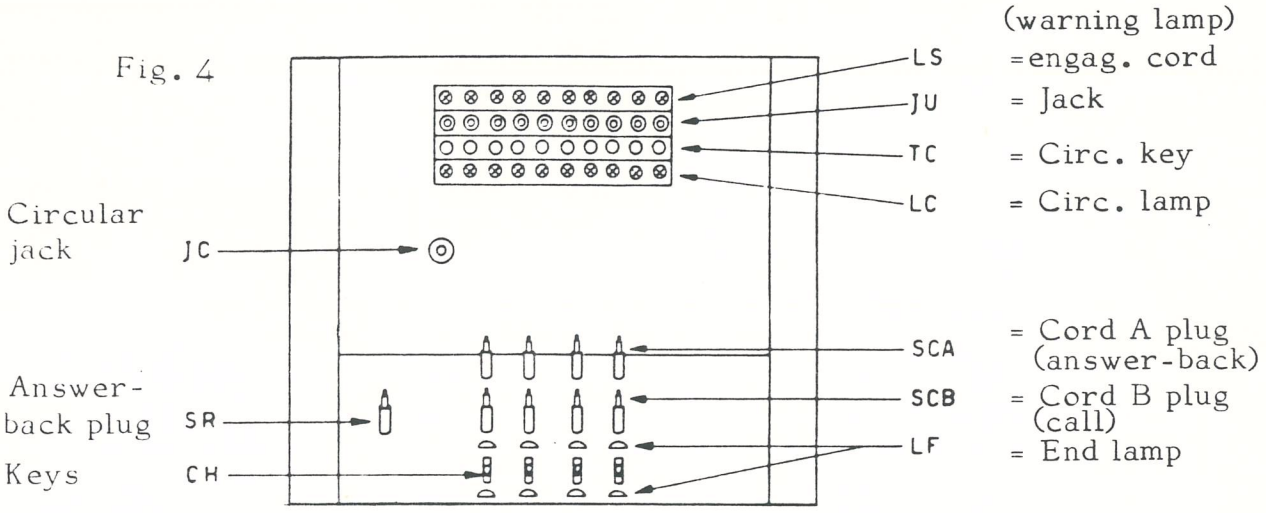
MANUAL EXCHANGES

At present the manual exchanges have lost a lot of their importance, since they are limited to networks with few users or with special destinations.

Therefore we will only describe the manual exchanges which make up the centre of a relatively simple star network with few users and with such reduced traffic that one or at the most two operators can carry out the service.

In this case the operation unit in the exchange is limited to a single switchboard, shown in diagram form in fig. 4.

Fig. 4



The switchboard has the following units:

- a number of JU jacks equal to that of the users connected to the exchange: each jack is equipped with one or two LS signalling lamps and possibly with a TC circular key;
- a number of double-plug cords (see ahead) equal to the number of simultaneous communications which can be made between pairs of users: obviously this number is to be proportioned to the anticipated traffic;
- one or two exchange machines (console teleprinter of the exchange).

Each cord is made up, from the operative point of view, of the following units:

- a pair of plugs connected to flexible cords, SCA - SCB, long enough to reach any jack;
- one or two CH keys;
- one or two LF signalling lamps.

The number or arrangement of the units vary according to the different systems: here we will describe one of the more simple layout: in this each cord is supplied with a pair of plugs, of which one is SCA answer-back and the other SCB call, with an operation key, CH, with three positions, and with two LF end lamps.

When a user connected to one of the jacks calls (and later we will see how this call is made), the LS lamp, situated in correspondence with the jack, is lit.

The operator then takes hold of the SCA answer-back plug of a free cord and inserts it into the jack which corresponds to the lamp which signalls the call: then he takes the CH operation key to the work position corresponding to plug SCA.

With this operation his machine is connected to the calling user's machine, and can receive details about the required user.

With a glance at the jacks panel the operator can immediately check if this user is free or engaged (in this case the plug of another cord would be fixed in) and, if the user is free, he takes the second SCB plug of the cord and inserts it into the jack which corresponds to the called user.

By moving the operation key into the second work position, he places his machine in communication with the called user; by sending the "WHO ARE YOU?" he makes sure that the user himself is able to receive the communication; after which, by moving the operation key into the rest position, he excludes his own machine and establishes connection between the users.

Generally, once the connection has been made, the operator can turn his attention to other callers.

When the two users have finished their conversation, by means of the 'end' signalling, one of them causes one of the end lamps linked to the cord to light: then the operator needs only to remove the plugs from the jacks and everything returns to rest.

One variation of this arrangement is the following: the operation key has only two positions: one WORK and one REST; in the first, the exchange machine can communicate simultaneously with the two users, the second is the position which corresponds to the connection made.

When the operator wishes to communicate with only one of the two users, he can do so by means of a special key, which is not part of the cord, but linked to the exchange machine.

Since generally the number of cords available is less than half of the users, it may happen that a user calls when all the cords are engaged: in this case the operator can still answer, since he has an SR answer-back plug, by means of which he can communicate with the calling user, and eventually take note of the connection request which may be made as soon as a cord is free.

One service which is used quite often in the manual exchanges is that of circular diffusion.
In this case a TC circular key to an LC lamp is linked to each jack. Moreover, there is a JC "circular jack" which is at the head of the input of a circuit for circular jacks.

The outputs of this circuit correspond to the different lines and are controlled by the TC circular keys linked to the single jacks.

When a user wishes to transmit a circular communication, he communicates this to the exchange operator who, after inserting the second cord plug into the circular jack, presses the keys corresponding to the jacks of the required users.

They all receive simultaneously the communication sent by the emitting user.

When the circular communication has finished, the operator removes the plug from the circular jack, but before taking the circular key back to the rest position, he waits until the circular lamps linked to the keys switch off; this indicates that the user's machine has received the circular communication regularly; if one of the lamps stays lit, the operator must intervene to check if possibly the circular communication itself might have to be repeated.

Many variations can be applied to the above arrangement to meet the clients's different requirements.

Often the operator is provided with, besides the machine to communicate with the users, a perforating-transmitting complex which allows him to record,on perforated tape, communications which, for various reasons, cannot be transmitted to the user immediately, and which must therefore be repeated later: thus, in the case of circular communications, if one of the users is engaged, the communication itself may be recorded to be subsequently re-transmitted as soon as the users concerned are free.

In the most modern form the manual exchanges may be built "without cords". In this operation a lamp and a key correspond to each user; the calling user, when the call has been made, is immediately connected with the exchange machine, and communicates to the latter its connection request; the operator, pressing the button of the called user, if the latter is free, immediately makes the communication, after which the exchange machine is free to receive other calls.

The lamp corresponding to each connected user lights up to indicate that the user is engaged; at the end of the communication, when the users send the end signal, the communication is automatically broken without intervention by the operator.

If, on the arrival of a call, the exchange machine is not free, the call is immediately connected to the machine as soon as it becomes free.

CRITERIA FOR MANUAL EXCHANGES SIGNALLING

The points which we will take into account now, relative to the manual exchanges, are important not only for themselves, but as an introduction to similar problems of automatic exchanges: in fact, whereas in manual exchanges, which as we have seen are limited to local networks, the signalling systems may be different and chosen according to circumstances, based on economic and practical criteria, for automatic exchanges, which are to be part of the international and world-wide telecommunication network, it is of major importance that they should be unified.
Therefore this material has been taken into consideration by the C.C.I.T.T. which has emitted recommendations for this purpose.

In order to face up to this question, we will begin to make some definitions.
A telegraphic user connected to an exchange can be found in two basically different conditions, corresponding to those in which a telephonic user is found according to whether or not he has the receiver down or raised.

If the user's teleprinter is not being used for a communication, and is not even operating to establish communication, we can say that it is at rest: if however, it is involved in requesting a connection, or if it is transmitting or receiving effectively, it is said to be in connection conditions.

Generally, the word criteria is used to describe those signals, or those significant states of the line, which have the purpose of making a connection, and have nothing to do with the exchange of information itself.

The criteria must, on a general basis, be made up of combinations, of different duration, of the two significant states of REST or of WORK, so as to be able to be transmitted onto the telegraphic communication channels without necessity of transformation; however, as we will see, this condition is not always respected.

We will now see this topic in the case of a manual exchange. The user must be able to transmit the following signals to the exchange operator:

a) a call signal with which he advises the operator of his wish to make communication;

b) details about the user with whom he wishes to be connected;

c) an end signal with which he advises the operator that the communication has finished and that the connection may be broken.

He must then receive other signals from the exchange, i.e.:

d) possibly, a signal confirming that his call has been received (i.e. that the call lamp is lit);

e) advice that the operator is included and waiting for details about the required user;

f) advice that the communication has been made, or;

g) advice that the communication cannot be made, and possibly the reason for this (called user engaged, not connected, breakdown, etc.);

h) indication that the connection is broken and the set has returned to rest conditions: this is, either as an answer to the end signal sent by the user, either as an effect of the end signal sent by another user, or as a result of the fact that the required connection could not be made.

Of these different signals, the one labelled "d" often is not used, and is substituted by the fact that the operator answers (signal "e").

Sometimes, as we will see, not even signal "h", which confirms the end, is used. All the other indications, except for that of call and that of end, are, in the case of the manual exchange, supplied by teleprinter signals: thus the two call and end criteria remain, as essential criteria to be established conventionally.

AUTOMATIC EXCHANGES

Automatic exchanges for teleprinters are divided into two major categories:

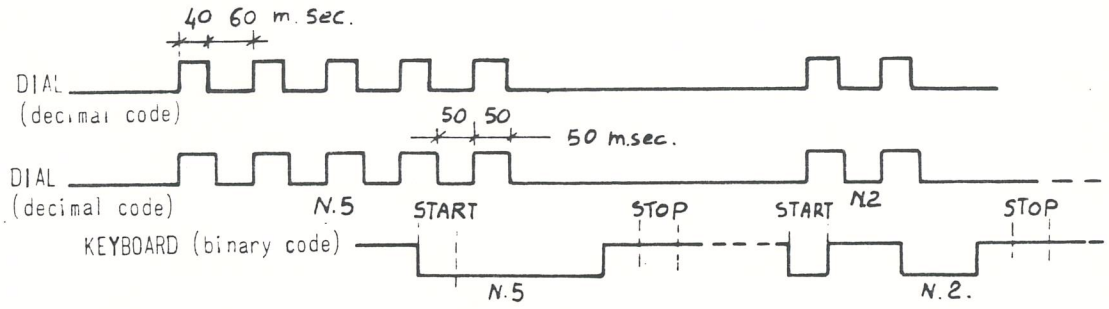
- exchanges with dial selection

- exchanges with selection by the keyboard.

The exchanges with dial selection were the first to be used; they are derived from the technique of telephonic commutation, since each user is represented by a number with different figures, and the required user is selected by operating a dial, identical to that found on a telephone.

Operation of this dial sends onto the line pulses which are a sequence of significant conditions of mark or space; with a decimal system, e.g. 52.

N.B. - There are two systems in the decimal code - 50 - 50 - 40 - 60 msecs.



In the large national networks the number of users is generally made up of two parts: the actual number of users, and a prefix which indicates the user's district: the prefix need not be dialled for communications made within one district.

As the Telex service became more widely known, and with the anticipated development, instead of the dial, the idea was to use the same teleprinter signals, (sent out by the keyboard), to control the selection: this required a certain number of units in the exchange (these units being similar in their conception to start-stop reception devices) capable of receiving and interpreting the telegraphic signals according to the C.C.I.T.T. code.

The anticipated advantages of the use of this technique were the following:

a) greater convenience in dialling the distinctive "number" of the caller, with the calling user having to operate the keyboard of the teleprinter, and not the dial;

b) identity of the selection signals with those of communication and thus the possibility of repetition and above all regeneration of one or the other with the same devices;

c) using, to form the "distinctive number", the 26 letters of the alphabet rather than the 10 figures, may mean shorter "distinctive numbers";

d) possibility, at least for the formation of the district prefix, of making the letters indicating the district coincide with the first letters of the chief city of the district itself, or at least with groups of letters which immediately identify the district: thus for example the prefix of the subscribers connected to the Torino (Turin) exchange could have been TO, that of Milano (Milan) MI and so on, which means a great advantage for memorizing the prefixes;

e) one advantage which is not necessarily connected with keyboard selection, but which nonetheless follows on rather naturally, is this: since units capable of receiving and interpreting the telegraphic signals must necessarily be used in the exchange, it becomes simple to supply the exchange with units capable of receiving and interpreting telegraphic signals, and units capable of emitting these signals: in this way different service indications may be given, instead of through conventional criteria, with the emission of groups of letters received by the subscriber's teleprinter: thus OCC to indicate that the called user is engaged (occupied); DER to give warning of a breakdown (Dèrangement) etc.
Even the time that the communication began and ended can be directly communicated to the subscriber's teleprinter: and this, as well as giving the subscriber every means of controlling the duration and period of each communication, facilitates the use of mechanical means for calculating the tariff and the debit of the cost of the different communications.

Of these advantages, those indicated under "c" and "d" can no longer be exploited in the national and international public networks.
In fact, it has become necessary to make possible interconnection between networks with dial selection and networks with keyboard selection, and, since the dial networks are incapable, apart from with considerable transformation, of accepting signals which do not have a decimal base, it was decided that even for keyboard selections, both the "distinctive numbers" of the users and the district prefixes would be made up of decimal figures, and similarly, even the prefixes indicating the country, in the case of international automatic selection, have been fixed in groups of two decimal figures.
Thus there remain, in favour of keyboard selection, the advantages shown under "a", "b", and "e", of which the most important is certainly "b", especially in view of world-wide interconnection of all the teleprinter networks and of the possibility of having automatic selection, by each single user, of any other user in any part of the world, a solution which obviously necessitates having selection pulses of the same nature as the telegraphic pulses so as to be able to exploit the same channels and the same transmission and regeneration systems.

CRITERIA FOR AUTOMATIC EXCHANGES SIGNALLING

We will now consider the criteria and the signals used in the two automatic telegraphy systems: dial system and keyboard system.
The necessary criteria for the service of an automatic keyboard are the following:

a) rest conditions;

b) call signal;

c) signal confirming call and invitation to transmit the required number. These two signals are generally made up of one signal: only when it is anticipated that the exchange might need considerable time before being ready to receive the numbering is it alright for the calling subscriber to receive a signal confirming that his call has been received; in practice this signal is anticipated, hypothetically, by the C.C.I.T.T. only in the case of international selection;

d) connection signal, indicating that the called subscriber is ready to receive: or no-connection signal, which means that the called subscriber cannot receive the communication. In the dial selection systems, generally the no-connection signal is unique for all the causes which impede connection. In the keyboard selection systems, when it is anticipated that service indications will be sent, by means of emission of teleprinter signals, there is indication of the cause of the lack of connection; and this is principally:

OCC = Engaged;

DER = Breakdown;

NA = Subscriber not admitted into communication with the caller;

NP = Subscriber not connected;

NC = Lack of junction circuits between exchanges;

e) end signal, sent by one of the connected subscribers;

f) return to rest, as an answer to the end signal.

Corresponding with the fact that the dial selection system does not require the use of the teleprinter for sending and reception of selection signals, (whilst in the keyboard system this use is indispensable), it is possible to have two fundamental signalling systems, both approved by the C.C.I.T.T., by whom they have been called "Type A" and "Type B" respectively.

In type A (BINARY code), more adapted to the keyboard selection system, the numbering invitation signal places the line in the connection condition and, simultaneously, starts the teleprinter motor, which is thus in the condition for transmitting, first the selection signals, then the actual conversation: moreover it is capable of receiving the service signals, as for example those already indicated in the case of no-connection, which specify the cause of this.

When it is indicated that connection has taken place, there may even be telegraphic signals, such as the reception of the name of the called subscriber, the reception of the hour and minute of the beginning of the connection etc.; or even simply conventional signals (150 ms. start polarity).

In type B however (DECIMAL code), which was the one applied in all the European dial selection network, and is still widely used, the teleprinter is set to receive and transmit only when connection has taken place: thus the numbering invitation signal is given by a conventional signal (25 mA stop signal), which causes, in the subscriber's connection box, the lighting of a lamp or the appearance of an optic signal (Malta cross): selection takes place by means of operation of the dial, without the teleprinter being involved: only when the connection is established is the line placed in communication conditions; the teleprinter motor starts and the machine can receive and transmit.

Therefore, even the no-connection signal, because the calling subscriber is engaged or for other reasons, is given by a conventional signal, so that the line passes briefly from the rest condition to that of connection, to then return immediately to rest conditions: the machine's motor starts for an instant, but then stops immediately after.
Thus it is not possible to know what is the cause of the lack of connection.

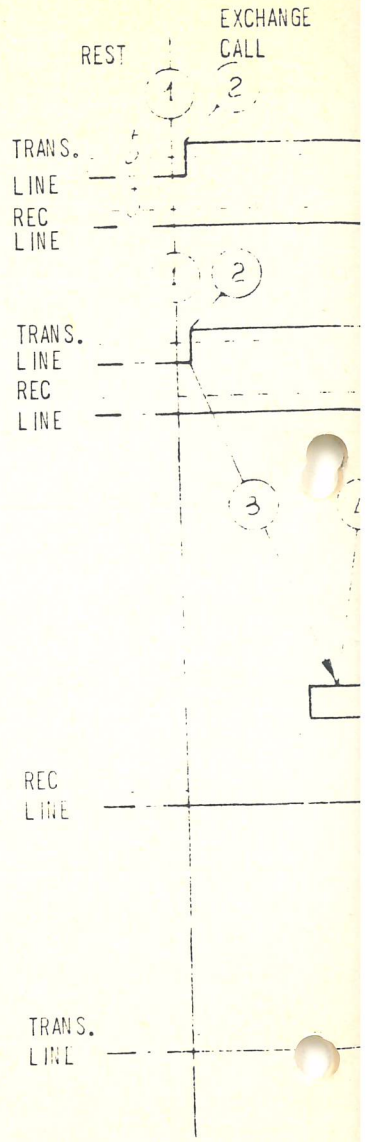
N.B. - It is possible to connect the connection box with keyboard selection to exchanges of type B, if the EXCHANGE and the CONNECTION BOX are suitably pre-set.

It is not possible to connect the connection box with dial selection to type A exchanges.

LINE POWER SUPPLY

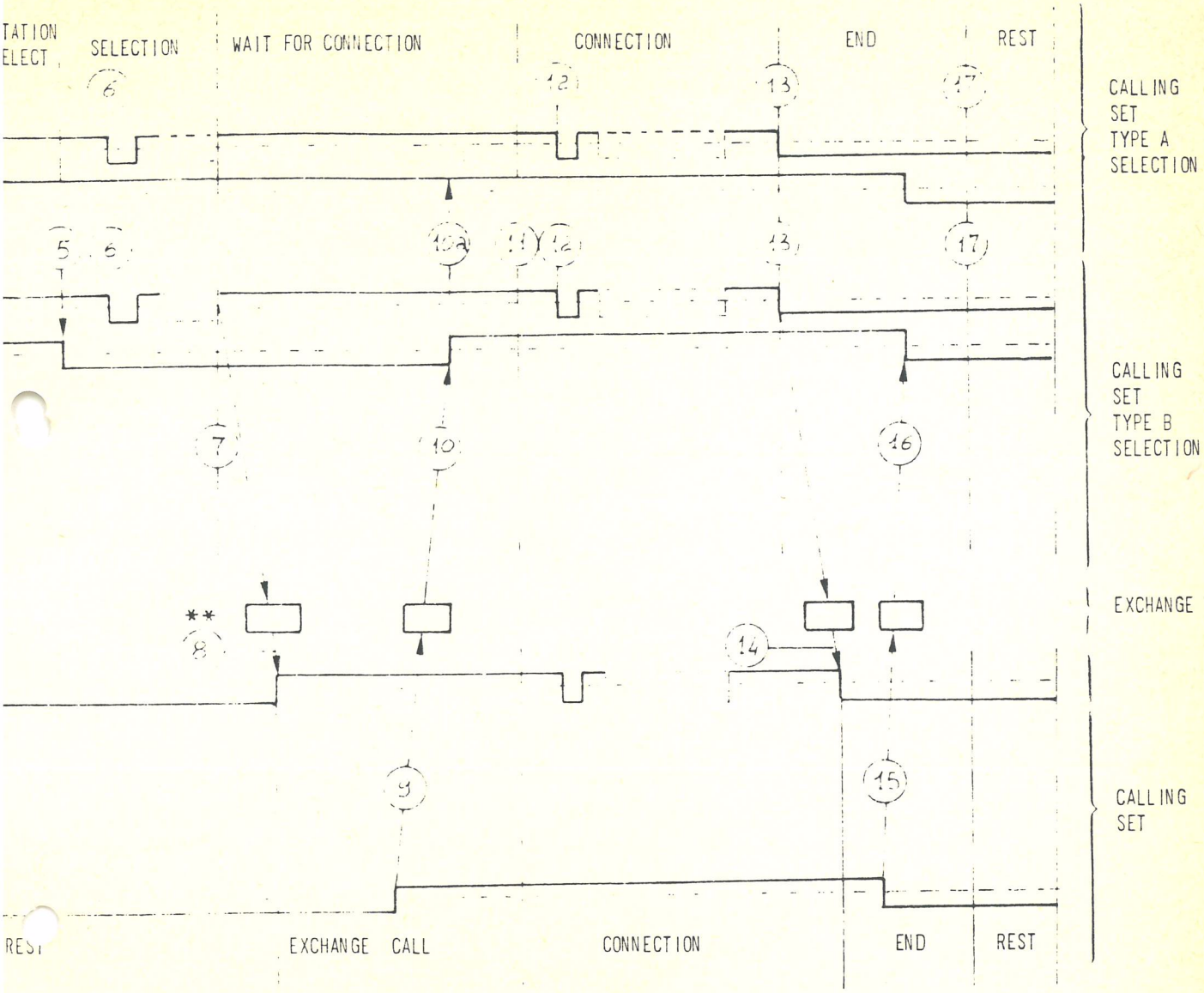
Transmission: is supplied by the teleprinter
Reception: is supplied by the exchange

1 - Operator's call to the exchange (call key)
2 - Reversal of polarity on transmission line (from - to +)
3 - Call signalling in exchange
4 - Answer from exchange (polarity reversal on recep. line)
- Invitation to select (reception from - to +)
- Dial selection = dial release
- KEYBOARD selection = start of motor
5 - End of invitation
* 6 - Selection (composition of correspondent's number)
7 - End of selection
8 - Signalling of call from the exchange to called set (polarity reversal from - to + on the latter's recep. line)
9 - Acceptance of the call with polarity reversal from - to + on the transmission wire of the called set
10 - The exchange answers that the called set is free with polarity reversal from - to + on the reception line of the calling set (DIAL selection)
10a - KEYBOARD selection: the user, since he has not received "engaged" or "out of service" from the exchange, sends the "WHO ARE YOU?" to the other user, who, being connected, will reply
11 - Visual signalling (on the caller's console) that the connection has taken place (DIAL selection)
* 12 - Conversation in half-duplex
13 - End of connection (end key on console) polarity reversal on the transmitter's transmission line (from + to -)
14 - The exchange signals "end" to the called set by reversing polarity on the reception line (from + to -)
15 - Answer that end has taken place on the called set with polarity reversal on the transmission line (from + to -)
16 - The exchange signals "end" to the calling set with polarity reversal on the reception line (from + to -)
17 - Reset rest conditions for both sets



* The intercharacter time depends on the exchange (i.e. time between two characters) - after this time everything returns to rest.

PERATIVE DIAGRAM - DOUBLE CURRENT - HALF-DUPLEX
ONNECTION WITH AUTOMATIC EXCHANGE - CCITT SIGNALLING



** Signallings of calling user engaged or out of service.

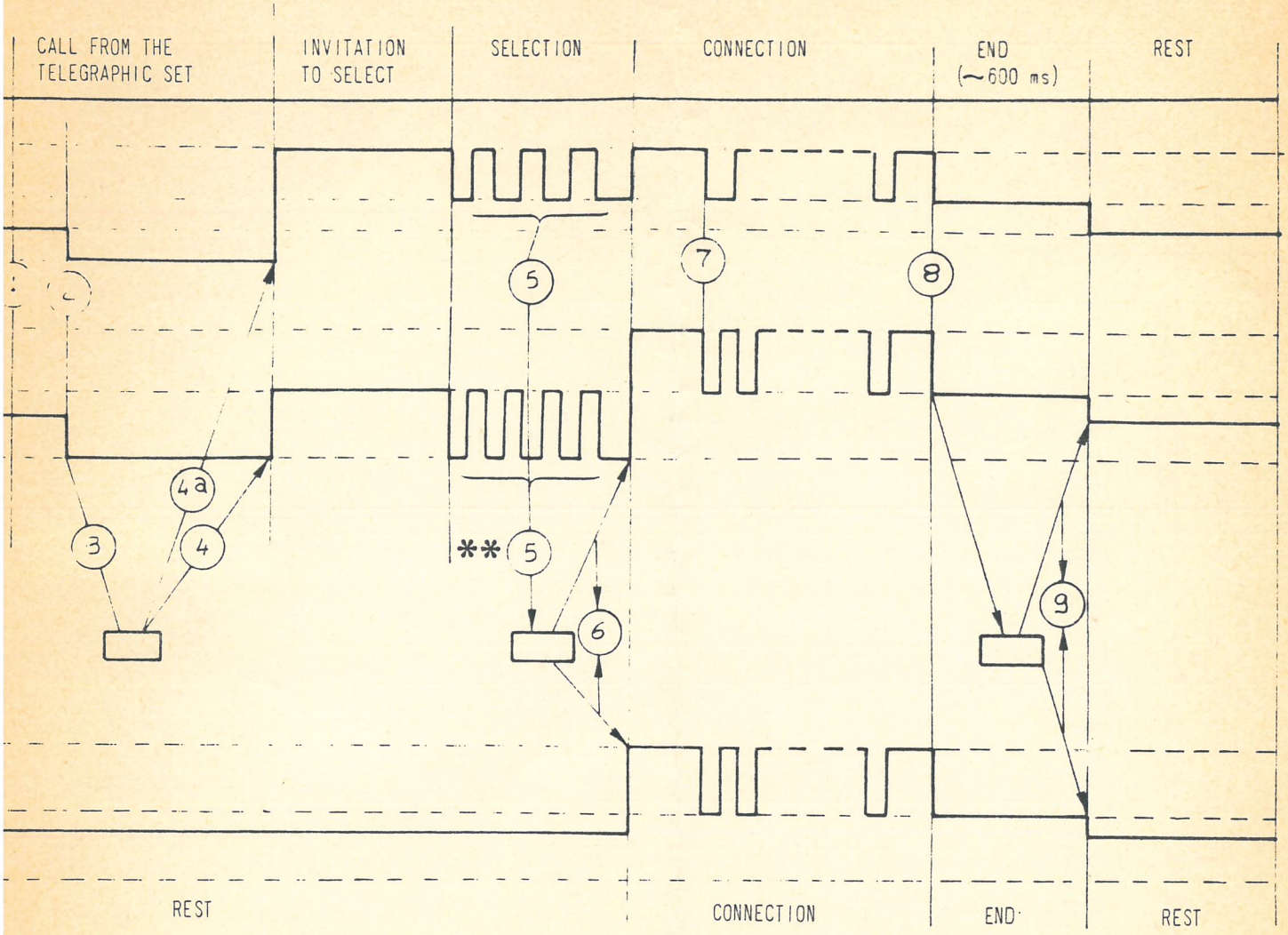
Connection boxes with keyboard signalling: in this case the exchange sends to the calling set the written signallings DER (out of service) or OCC (engaged) ; the exchange subsequently resets the rest condition of the calling set.

Connection boxes with dial signalling: the exchange does not reverse the polarity of the calling set's reception line (10) ; therefore the set returns to rest.

OPERATIVE DIAGRAM

CONNECTION WITH AUTOMATIC EXCHANGE - CCITT SIGNALLING

SINGLE CURRENT, HALF-DUPLEX



** Signallings of calling user engaged or out of service.

Connection boxes with keyboard signalling: in this case the exchange sends the written signallings to the calling set - DER (out of service) or OCC (engaged); the exchange subsequently resets the rest condition of the calling set.

Connection boxes with dial selection: the called set stays at rest and the calling set is taken to rest.

LINE POWER SUPPLY :

is always supplied by the exchange

1 - Operator's call to the exchange (call key)

2 - Variation of the line current (from -5 to -40 mA) caused by the call

3 - Call signalling in the exchange (due to current variation)

4 - Answer from exchange (interruption of line current) invitation to select
Dial selection = dial release
Keyboard selection = motor start

4a - Answer from exchange (reversal of line current) (invitation to select)
Keyboard selection = motor start

5 - Selection (composition of the correspondent's number)

6 - DIAL selection - signalling of start of connection with line polarity reversal (from -40 to +40 for the calling set)
KEYBOARD selection: the user, since he has not received "engaged" or "out of service" from the exchange, sends the "WHO ARE YOU?" to the other user, who, being connected, will answer.

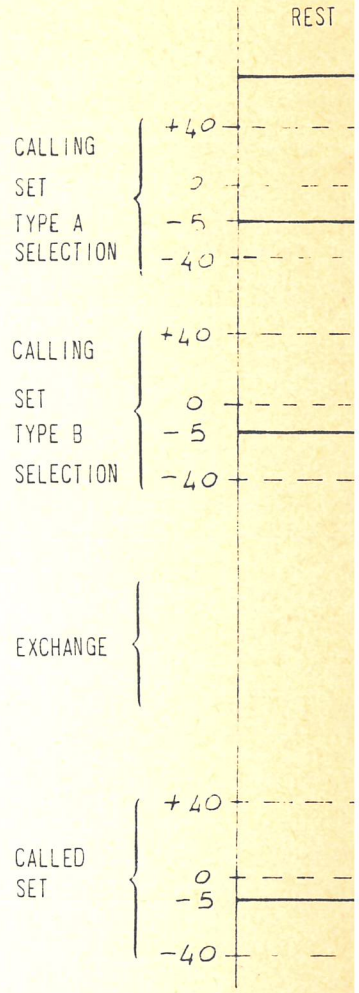
In both cases the motor of the called set starts

7 - Conversation in half-duplex

8 - End of connection (end key) interruption of the line current for a period > of 600 msecs.

9 - Resetting of rest condition for both the sets (line current - 5mA)

The intercharacter time (time between two characters) depends on the exchange - after this time everything returns to rest.



ITALIAN TELEX SERVICE

This is based on the following principles:

- keyboard selection;
- single or double current connection, according to the users;
- type B signalling.

The Italian telex network , according to the project being undertaken, will include:

1) 2 National Telegraphic Centres (Rome and Milan) where international connections will meet;

2) 2 Principal Departmental Telegraphic Centres (Bologna and Naples) which have equal importance to the National Centres, but have no international connections.

A mesh network is scheduled between these four centres, which is now incomplete only because of the lack of connection between Bologna and Naples.

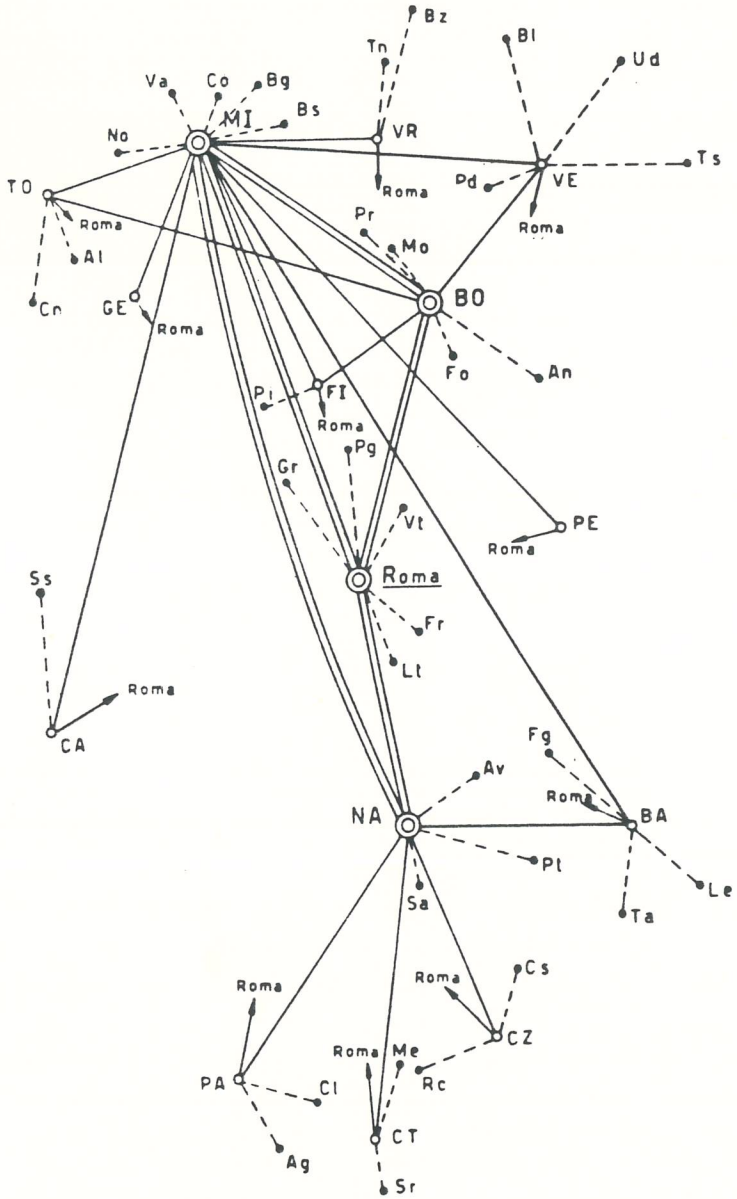
3) Departmental Centres (Turin, Verona, Venice, Genoa, Florence, Pescara, Cagliari, Bari, Catanzaro, Palermo, Catania) each of which has a connection with Rome and at least one other connection with one of the other principal Departmental Centres.

The network which connects these centres is called a primary network, and, as has been seen, is a mesh network which is widely incomplete. At each centre of this network a star network meets, which connects to this a certain number of district centres, (thirty-six altogether), each of which has an automatic exchange to which the individual users are connected.

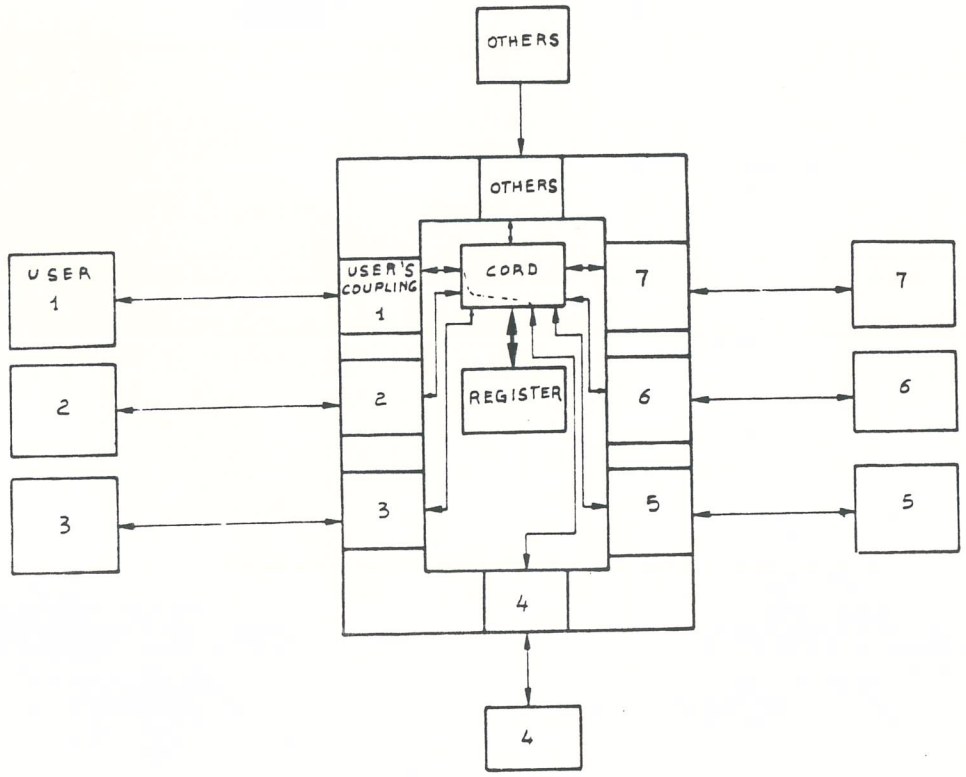
Therefore a connection between two users each connected to a District centre will be made up of two sections of line connection between user and district centre, and of four sections of long distance line, and that is:

- one between the district centre and the departmental centre;
- two at the most for the connection between departmental centres;
- one between the departmental centre and the district centre.

The diagram shows the main network and the district network; the connections of each Departmental TC with Rome have been omitted.



AUTOMATIC EXCHANGE BLOCK DIAGRAM



Procedures:

1st - Call; the user's coupling receives the call and signals it to the cord

2nd - Invitation to select: takes place if the cord is free.

3rd - Selection: is received by the register through the cord.

4th - Connection: if the called user is free he is put into connection by means of the cord.

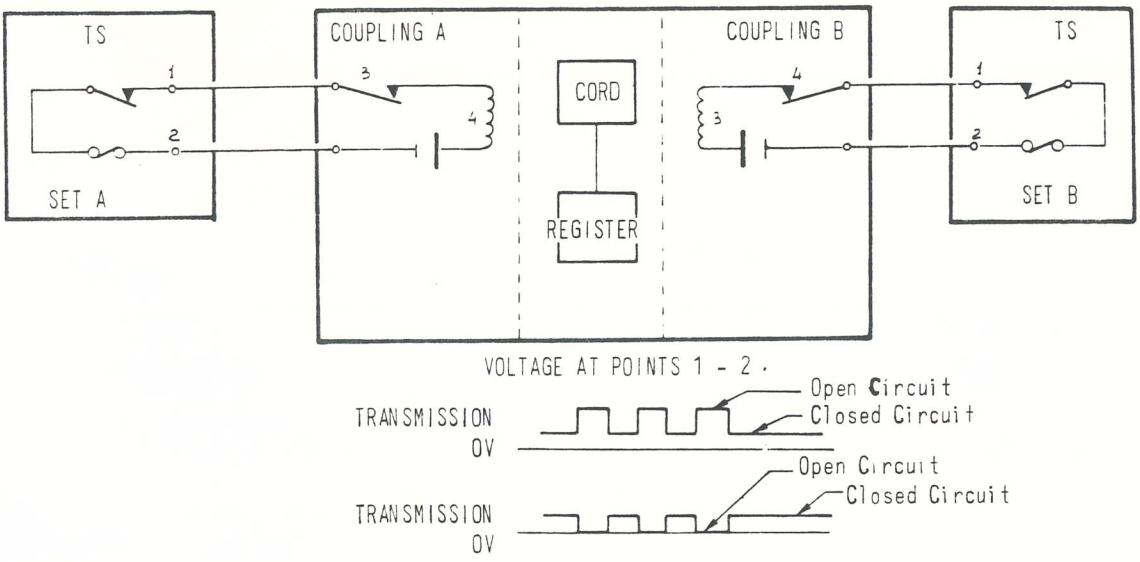
5th - End of connection: two users disconnected on the cord.

N.B. - In the diagram users 1 - 4 are connected.

Operating principles of the user's couplings to an s.c. connection

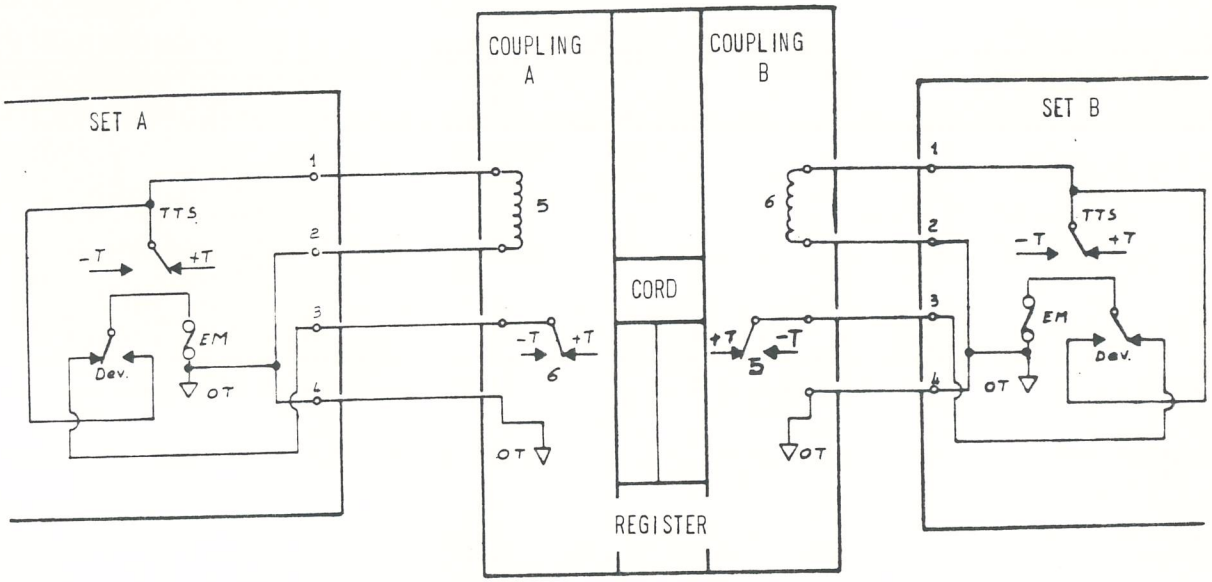
When set A modulates it activates electromagnet 4 which controls contact 4 of coupling B.

Contact 4 repeats the same modulation at set B.

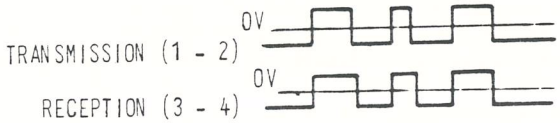


Operating principle of the user's coupling to a d.c. connection.

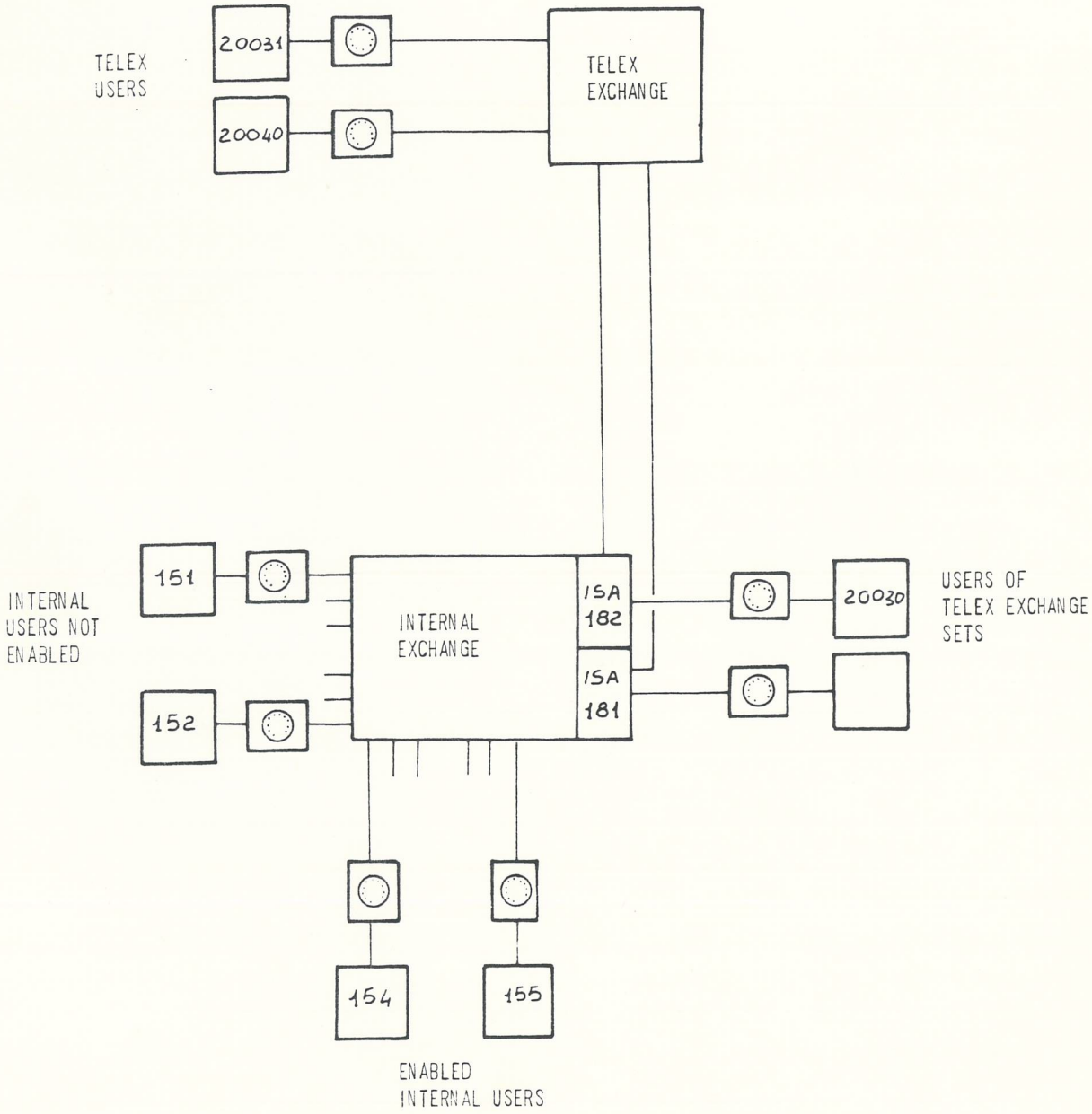
When set A modulates it activates electromagnet 5 which controls contact 5.
Contact 5 modulates on the EM of set B.
Electromagnet 6 controlls contact 6.



SET A VOLTAGES AT POINTS 1 - 2 3 - 4



CONNECTION BETWEEN TELEX EXCHANGE AND INTERNAL EXCHANGE



The internal exchange, through device ISA (automatic selection), is connected to the Telex exchange.
(N.B. - There may be more than one ISA device).

To the ISA is connected the Telex set of the internal exchange to which the external user is always connected and from which it automatically receives the automatic answer back.

With a suitable procedure it can also be connected to a non-enabled internal user; this is described in detail in point b.

CONNECTION PROCEDURES

Internal connections

Internal users 151 - 152 - 154 - 155 can be interconnected by dialling the number of the required user.

Telex connection

a) From enabled internal user to external user.
. E.g. 154 calls 20031

1 - Call

2 - Invitation to select

3 - Selection (number ISA - 182)

4 - Connection to Telex exchange

5 - External user selection (20031)

6 - Reception of date and time by Telex exchange and reception of called user's automatic answer-back
(N.B. - the automatic answer-back has been released by the Telex exchange)

7 - Sending of the text (in this case XXXXXX)

8 - End of connection key pressed

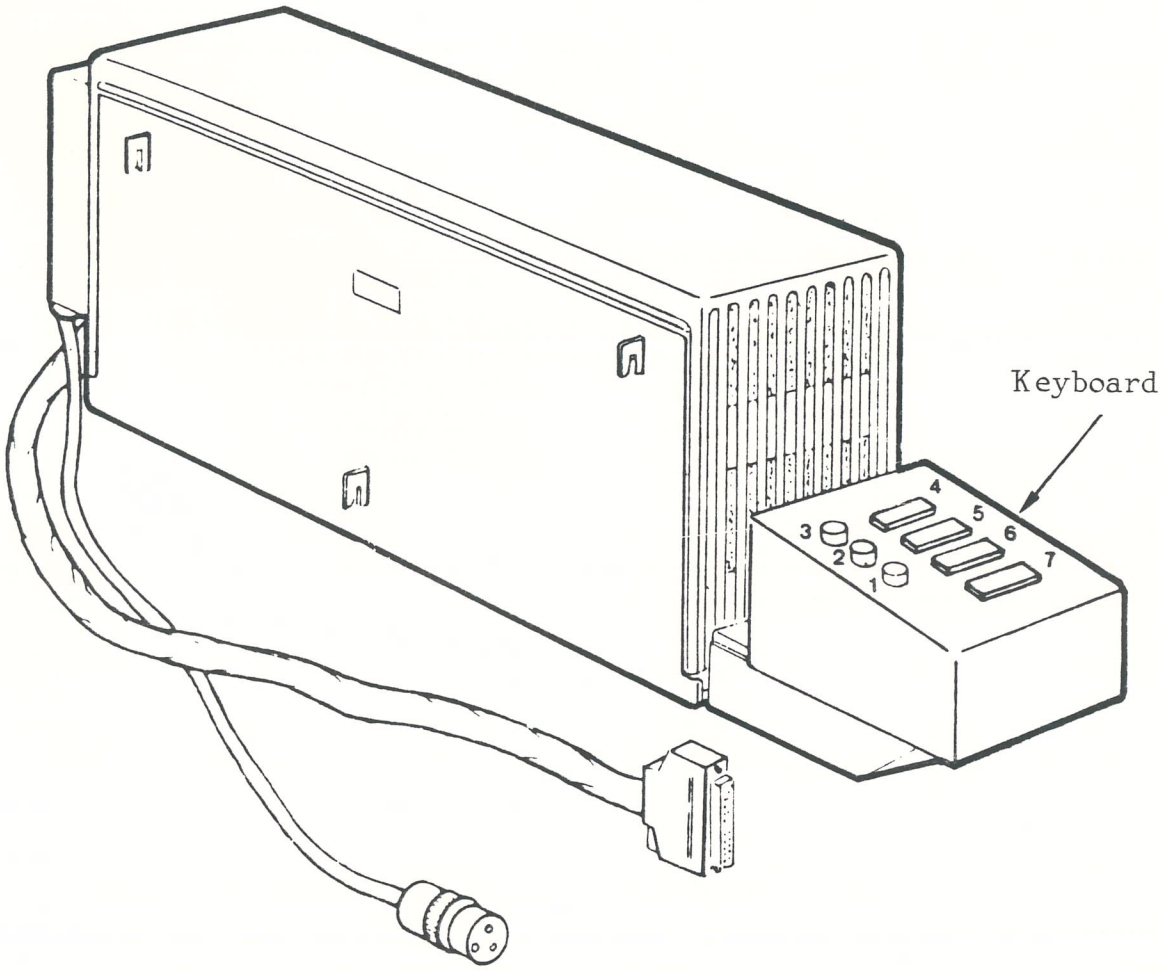
9 - Reception by the Telex exchange of the tariff (in this case 0003).

PRINTING ON SET 154

1822ºº31
15/º5 14.1º
A 2ºº31 MONTE
XXXXXX
ººº3

b) From the external user to the enabled internal user. E.g. from 20031 to 155, 156, 154

	PRINTING ON SET 20031
1 - Call	2ºº3º
2 - Invitation	15/º5 14.14
3 - Selection internal exchange Telex set (20030)	2ºº3º COIVRE
	XVXV
4 - Reception of date - time by the exchange and automatic answer-back of the called set	OK
	155
	OCC
N.B. At this point the connection between the external Telex user and the internal Telex set is made and, if a further insertion towards another internal user was not requested, the message could start on its way. To reach the internal user, the external Telex user types prefix XVXV on the keyboard.	XVXV
	OK
	156
	DER
	XVXV
	OK
	154
	154 COSTA
5 - Prefix XVXV	THANKS END
6 - Reception of OK by internal exchange (= invitation to select required internal user)	XVXV
	XVXV
	OK
7 - Selection of user (155)	155
8 - Reception of OCC (selected user is engaged)	OCC
9 - Prefix XVXV	ºº13
10 - Reception of OK	
11 - Selection of user (156)	
12 - Reception of DER (out of service)	
13 - Prefix XVXV	
14 - Reception of OK	
15 - Selection of user (154)	
16 - Reception of selected user's automatic answer-back	
17 - Transmission of text	
18 - Prefix XVXV (the Telex exchange sends the end to the 154 user)	
19 - Prefix XVXV (to select another user)	
20 - Reception of OK	
21 - Selection of user 155	
22 - Reception of OCC (it is still engaged)	
24 - End of text	
25 - Reception of tariff	



A011 CONNECTION BOX

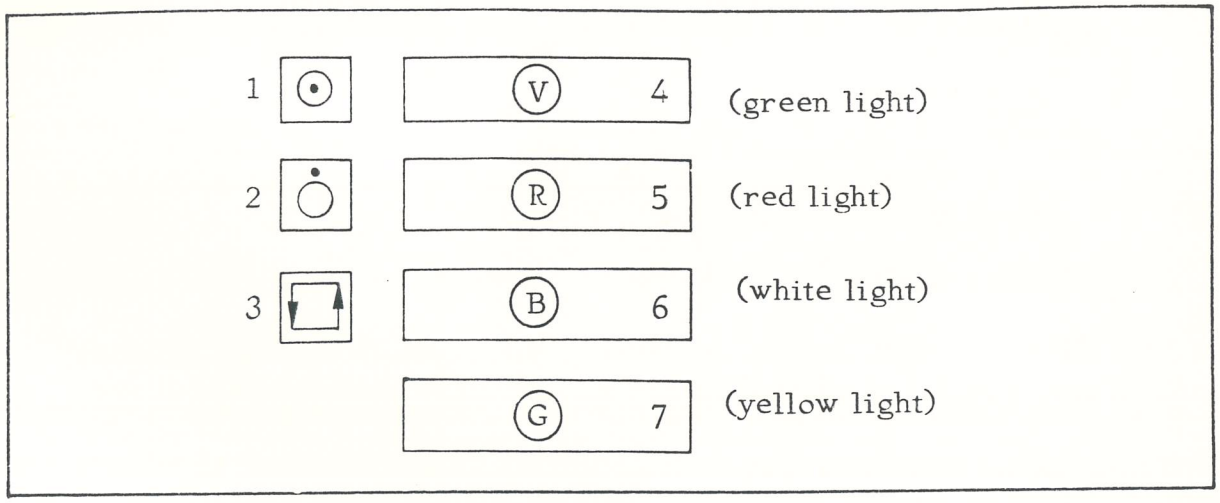
- Connects a Te315 teleprinter to a commutation exchange (manual or automatic).

- Transmits and receives in single current, traffic in half-duplex.

- Selects the called set through the teleprinter keyboard.

- Operates in off-line for perforation or duplication of the perforated tapes. Can pass automatically from the off-line position to on-line after a call from the exchange.

CONTROL KEYBOARD



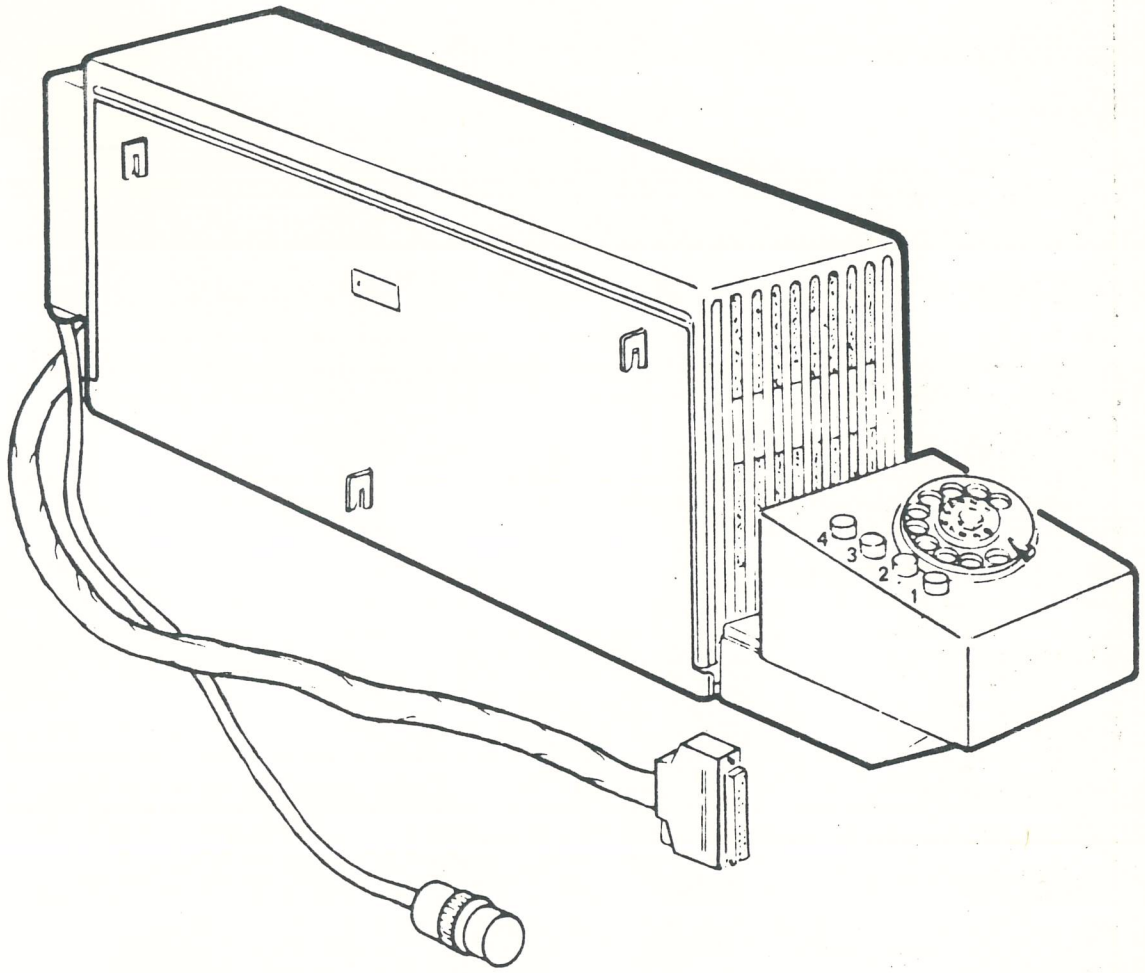
KEYS	LAMPS
Monostable  This is the call key for the connection	Green *
Monostable  This is the end of connection key	Red. It lights when: - the teleprinter motor stops - a call is entering with set in off-line N.B. - an acoustic alarm is coupled to the lamp.
Monostable  Key for off-line connection	White *
	Yellow. It lights when there is an alarm condition, (e.g. end of roll, end of tape etc.) during the rest or connection condition.

* Red - green lit = call
White-green lit = connection
White lit = off-line

Type A C.C.I.T.T.

Red - green lit = call
White - red lit = exchange's answer
White-green lit = connection
White lit = off-line

Type B C.C.I.T.T.



A012 CONNECTION BOX

- Connects a Te315 teleprinter to a commutation exchange (manual or automatic).
- Transmits and receives in single current, traffic in half-duplex.
- Selects the called set through a dial.
- Operates in off-line for perforation or duplication of perforated tapes. Can pass automatically from off-line to on-line after call from exchange.

CONTROL KEYBOARD

KEYS	LAMPS
 1 Monostable The call key for connection to the line	V 1 Green - incorporated in the call key
 2 Monostable End of connection key	R 2 Red - incorporated in the End key
 3 Monostable Key for off-line connection	B 3 White - incorporated in the off-line key
	G 4 Yellow

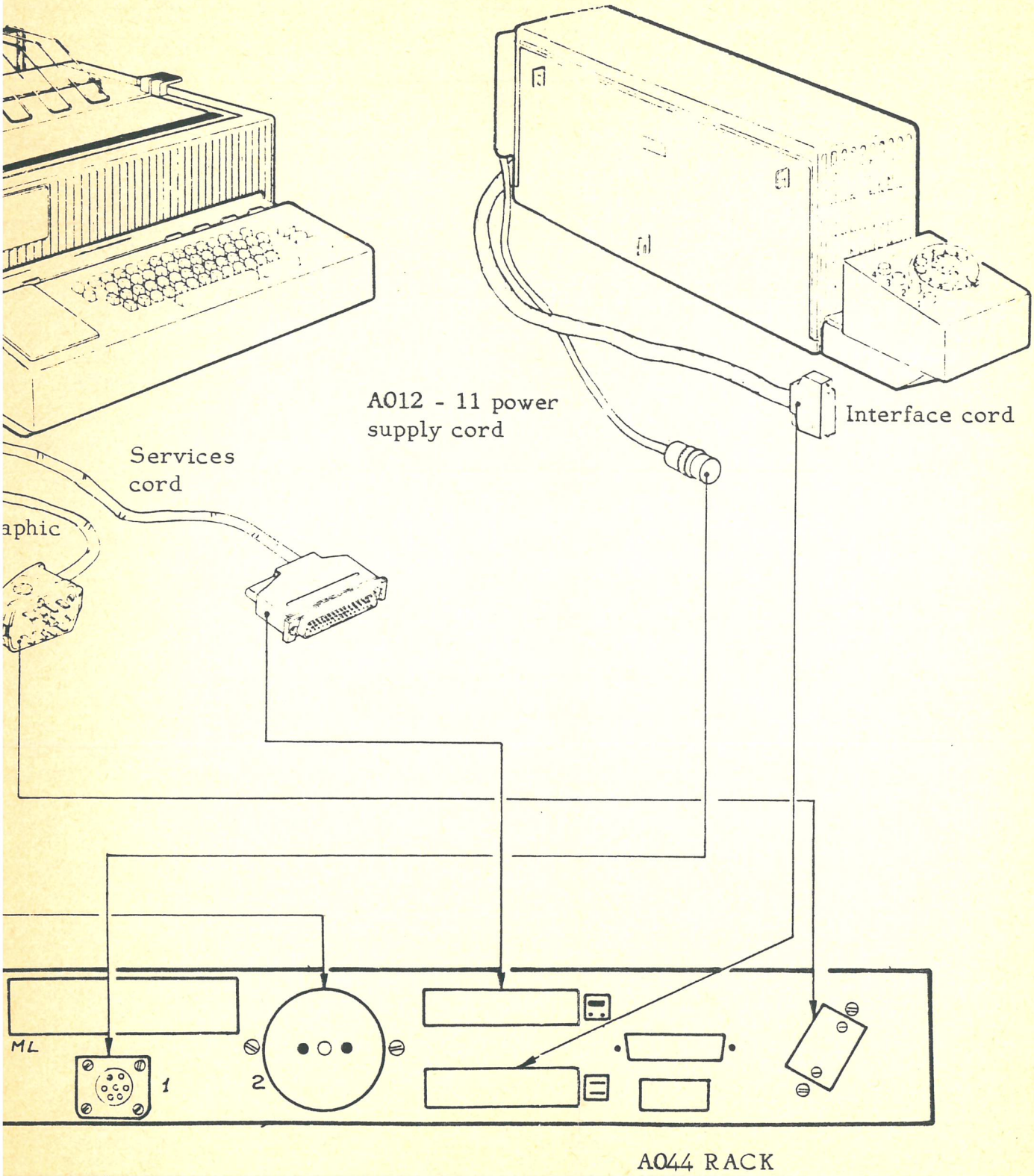
Signalling lamps:

Yellow lit = signals alarm conditions during connection and rest
Red lit = signals alarm conditions for stopped Te315 motor
} For manual and automatic exchanges

Green lit = call
White and red lit = answer from exchange (invit. to select)
White and green lit = connection
White lit = operation in off-line
} For automatic exchanges

Red and green lit = call
White and green lit = connection
} For manual exchanges

Note: alarm conditions are caused by:
- Te315 motor stopped or not at running speed
- paper broken
- almost end of tape
- almost end of roll


A012 - 11 power supply cord
Interface cord
Services cord
aphic
ML
1
2
A044 RACK
ains cord

DESCRIPTION OF CONNECTION DIAGRAM

Mains cord = supplies sockets 1 and 2.

A012-11 power supply cord = Supplies the connection box transformer.

Motor cord = supplies the transformer and the motor of the teleprinter.

Telegraphic cord = contains the connections to the contacts of transmission, of the reception electromagnet and of the deflector.

Te 315 services cord = contains the connections of the alarm microswitches (paper broken, near end of tape and near end of roll); signalling of motor running, the controls of the keyboard block and exclusion of the perforator; the electrical outputs of the functions unit.

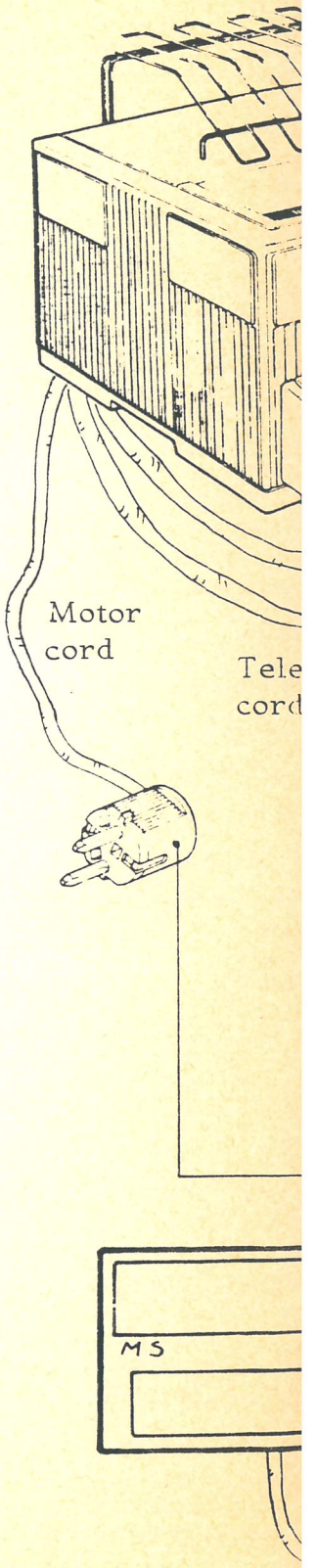
Interface cord = contains the connections of the keys and of the console lamps; supplies the Te transmission contacts and connects them to the ML terminal board; it collects the alarm signallings present on the Te services cable.

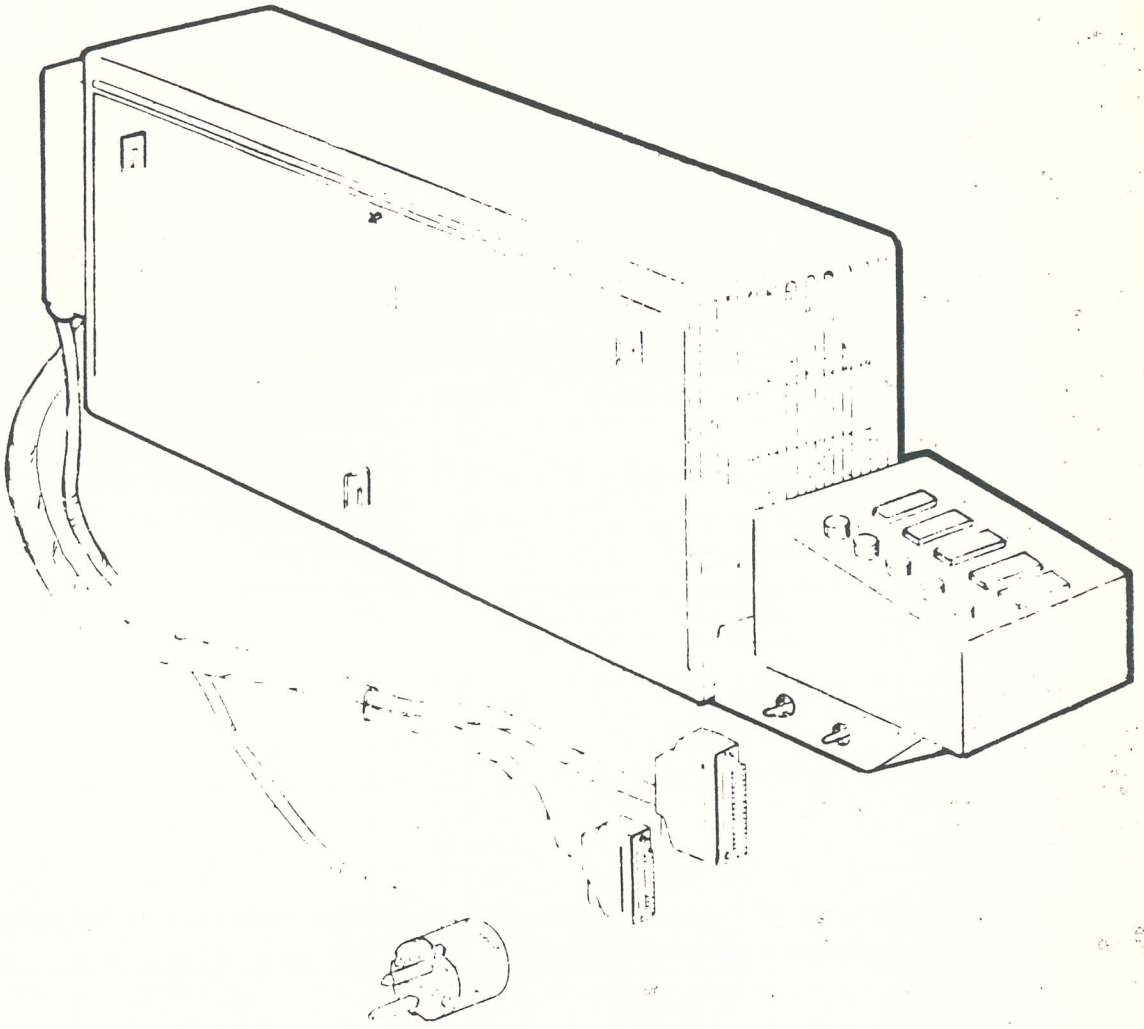
ML Terminal board = Connects the two teleprinters through the line.

MS Terminal board = is used to carry an alarm signalling (e.g. makes a bell ring) and to preset controls outside the teleprinter.

= Teleprinter

= Connection box

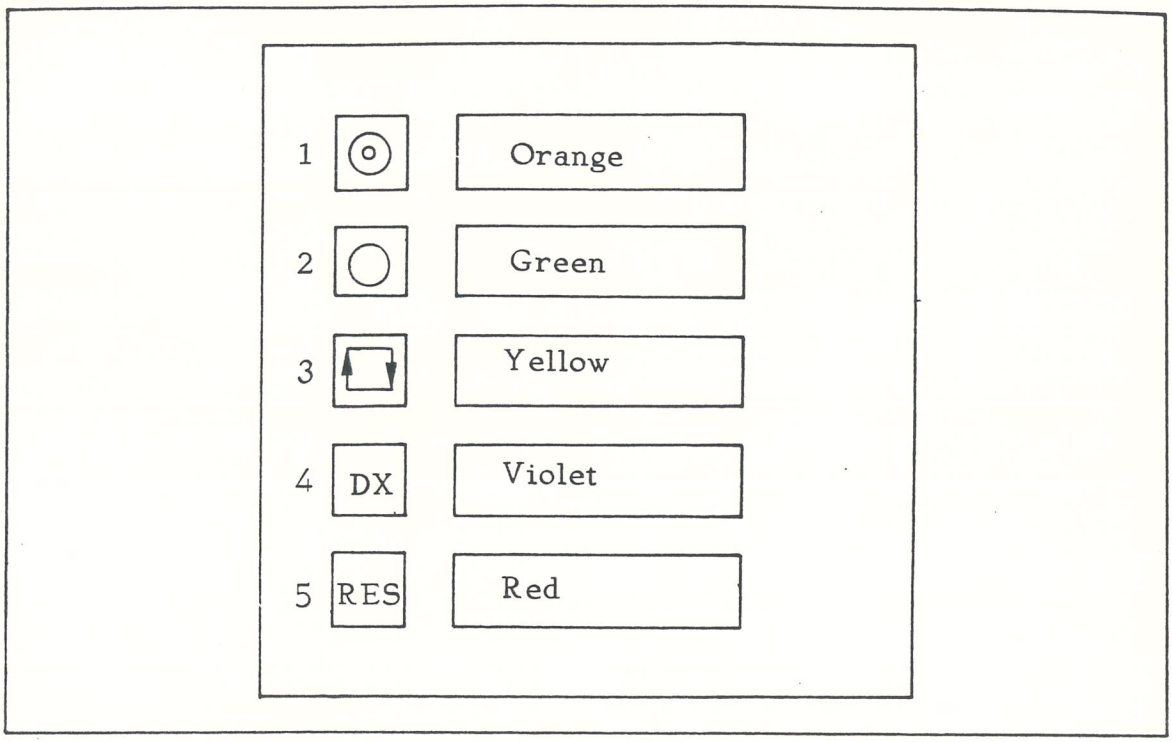




A013 CONNECTION BOX

- Connects one or two teleprinters to a commutation exchange (manual or automatic).
- Transmits and receives in double current.
- Traffic in half-duplex with a single Te315; possibility of duplex traffic with the addition of a second Te315.
- Selects the called set through the teleprinter keyboard.
- Operates in off-line for perforation or duplication of perforated tapes. Can pass automatically from off-line to on-line after a call from the exchange.

CONSOLE



KEYS	LAMPS
Monostable 1. Call key for connection to the line	Orange. Means call on the way or reader in motion.
Monostable 2. End of connection key.	Green. Means invitation to select or connection under way.
Monostable 3. Off-line connection key.	Yellow. Means machine in off-line.
Monostable 4. Full-duplex connection key.	Violet. Means connection in DX.
Monostable 5. Reset key for alarms and for return to Half-duplex from Full-duplex.	Red. Means alarm condition.

ALARM SIGNALLING AND SERVICES CONDITIONS

These are shown by the sound of the buzzer or even by the lighting of a red lamp placed in correspondence with key 5.

The key itself is used to silence certain types of alarms: certain alarms are permanent and not silencable until the causes of the alarm have been eliminated.

The alarm condition (buzzer and red lamp) takes place when there is:

1) Near end of paper
2) Broken paper
3) End of tape to be perforated
4) Motor not running

In cases 1, 2, and 4 connection cannot take place.

If conditions 1, 2 and 4 occur whilst connection is taking place, the system immediately passes to the end.

5) Keyboard locking

Takes place with the entering call when the latter finds the set in off-line condition.
It lasts for 3 seconds and during this time there is acoustic and luminous signalling.
By means of jumpering, a permanent alarm can be generated, which is resettable by key 5.

6) Exclusion of the perforator

This occurs in the case of an entering call on the set in off-line, simultaneously with the locking of the keyboard.

7) Starting of the incorporated reader

Apart from manually, the reader can be started by recognition, carried out by the Te315 teleprinter, of a KLKL sequence of characters.

8) Stopping of the incorporated reader

No alarm condition is determined by:

a) manual action on reset button 5 or on the set stop control on the reader;
b) end of connection (end key).

The following cases determine an alarm condition (permanent, according to the programming done previously):

c) end of message tape;
d) tape stretched;
e) stop by correspondent.

The two cases of stop c), e) give rise to a permanent alarm, which can be silenced by use of the Reset key with US/UK type programming.

If it is not programmed the alarm does not take place.
Case d) is always active until the cause of the alarm is removed.

9) Signalling of incorporated reader in motion

When the programming of this type has been established, each time the incorporated reader is started, there is separation of the telegraphic circuits in its two communication channels; the system takes on the configuration of a type of full-duplex, whose receiving head ends at an alarm system, and the transmitting one, as well as at the line, at the local control.

The correspondent, if he should wish to call the attention of the other attached operator, can do so by typing characters at random on his own Te315.

The sent characters are not printed by the set, which is emitting through the incorporated reader, but detected by an alarm device (lamp and buzzer).

Further programming could give rise, apart from by the alarm, to the stopping of the reader (see previous point).

10) External signallings

The alarm signalling can be taken out by means of two electrical outputs (48 Vcc.); of the two, one is excludible, as the operator wishes, through switch IE.2 placed under the box of the A013.
Moreover, any signalling taken out can be silenced by the Reset key.

11) Alarm for entering call

If suitably programmed, an entering call with the set at rest, could give rise to a permanent type of alarm condition, silencable with the Reset key.

The same alarm can be excluded at the discretion of the operator by use of switch IE.1 placed under the box of the A013.

12) Alarm for reception of the "Bell" character

Reception of the bell character can give rise, if programmed, to alarm conditions.

These may be:

a) permanent (buzzer and red lamp) silencable with the Reset key;

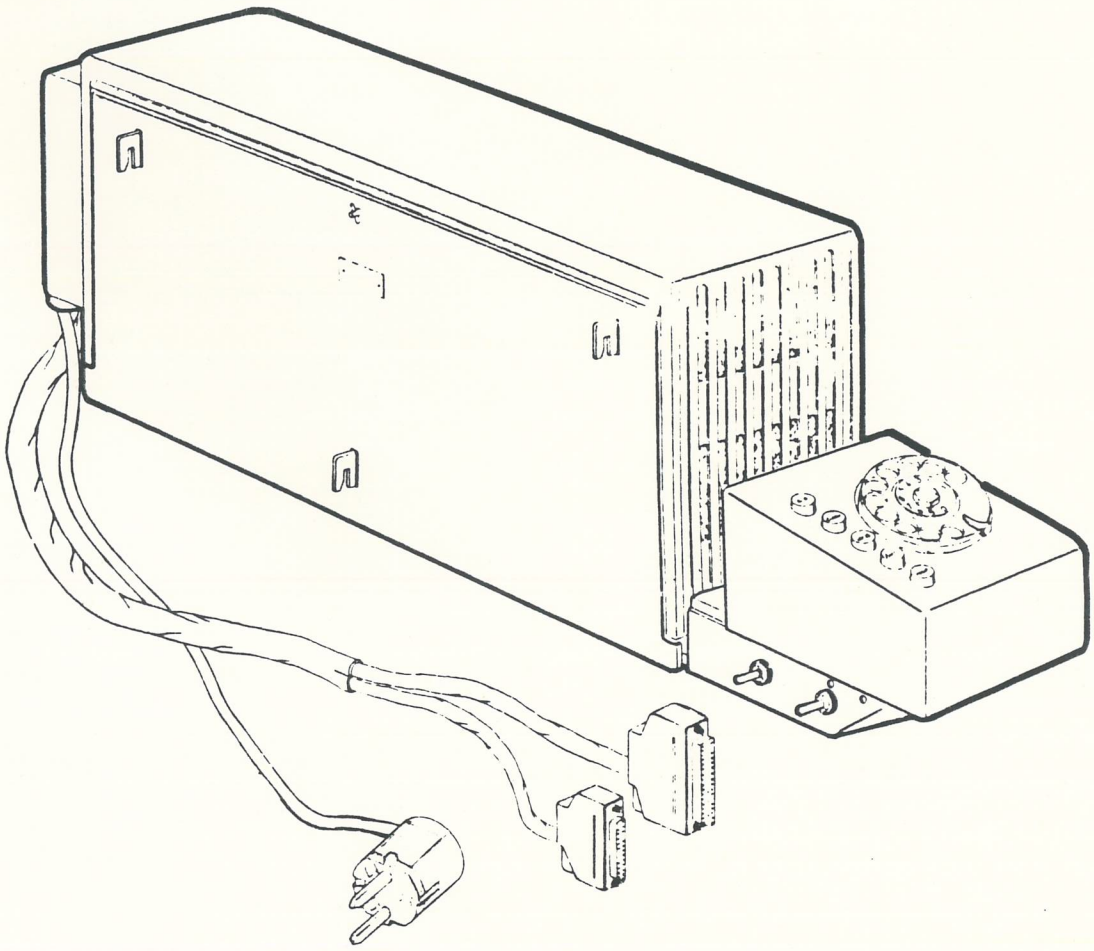
b) temporary (buzzer and red lamp) according to the sequence of the bell characters.

The a) and b) types of alarm are chosen during programming.

13) Monitor on the communication channels

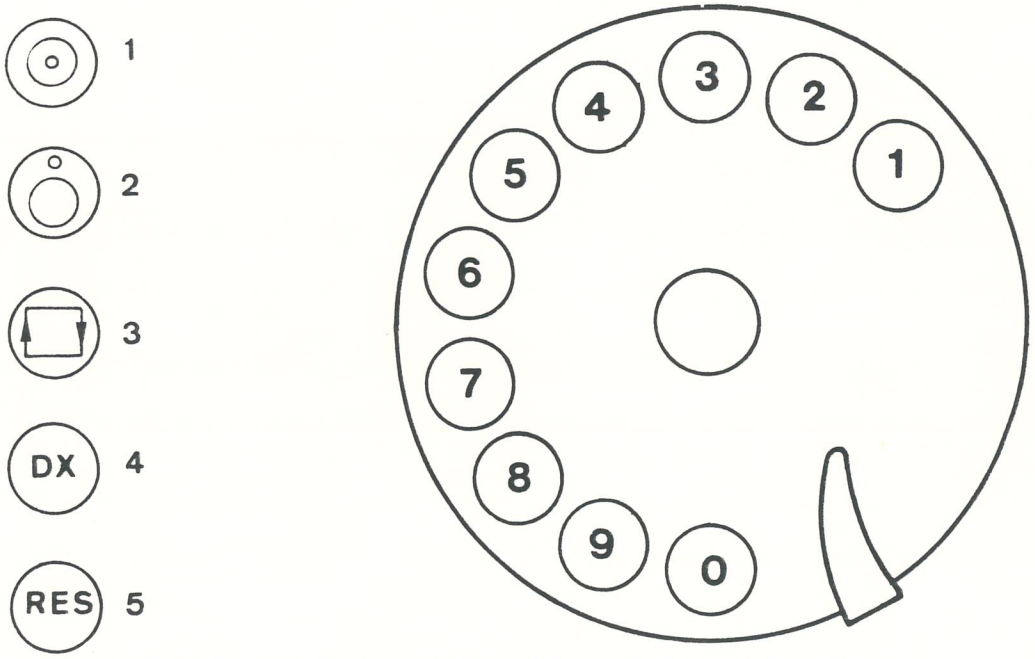
The communication channels (both or one of the two) can be equpped with a monitor at the end of the recording of the traffic.

The A013 is equipped with extended terminals at the heads of the communication channels, to which teleprinters, reception only, can be connected.



A014 CONNECTION BOX

- Connects one or two teleprinters to a commutation exchange (manual or automatic).
- Transmits and receives in double current.
- Traffic in half-duplex with a single Te315; possibility of traffic in duplex with the addition of a second Te315.
- Selects the called set through a dial.
- Operates in off-line for perforation or duplication of perforated tapes.
  Can pass automatically from off-line to on-line after a call from the exchange.



KEYS	LAMPS
Monostable 1. Call key for connection to the line.	Orange. Incorporated in Call key. Means call on the way or reader in motion.
Monostable 2. End of connection key.	Green. Incorporated in End key. Means invitation to select or connection under way.
Monostable 3. Off-line connection key.	Yellow. Incorporated in the Off-line key. Means machine in off-line.
Monostable 4. Full-duplex connection key	Violet. Incorporated in the DX key. Means connection in DX.
Monostable 5. Reset key for alarms and for return to Half-duplex from Full-duplex.	Red. Incorporated in Reset key. Means alarm condition.

ALARM SIGNALLING AND SERVICES CONDITIONS

These are shown by the sound of the buzzer or even by the lighting of the Red lamp placed inside key D.

The key itself is used to silence certain types of alarms: certain other alarms are permanent and not silencable until the causes of the alarm have been eliminated.

In detail there will be:

1) Near end of paper
2) Broken paper
3) End of tape to be perforated
4) Motor not running

The alarm (buzzer and red lamp) takes place; in cases 1), 2) and 4) moreover, connection cannot take place.

If conditions 1), 2) and 4) occur during connection, the system immediately passes to the end.

5) Keyboard locking

Takes place with the entering call when the latter finds the set in off-line condition.
It lasts 3 seconds and during this time there is acoustic and luminous signalling.
By means of jumpering, a permanent alarm can be generated, which is resettable by key 5.

6) Exclusion of the perforator

In the case of an entering call on the set in off-line, this occurs simultaneously with the locking of the keyboard.

7) Starting of the incorporated reader

Apart from manually, the reader can be started by recognition, carried out by the Te315 teleprinter, of a KLKL sequence of characters.

8) Stopping of the incorporated reader

No alarm condition is determined by:

a) manual action on reset button or on the set stop control on the reader;
b) end of connection (end key).

The following cases determine an alarm condition (permanent, according to the programming done previously):

c) end of message tape;
d) tape stretched;
e) stop by correspondent.

9) External signallings

The alarm signal can be taken out by means of two electrical outputs (48 Vcc.); of the two, one is excludible, as the operator wishes, through switch IE.2 placed under the box of the A014.

Moreover, any signalling taken out can be silenced by the Reset key.

10) Alarm for entering call

If suitably programmed, an entering call, with the set at rest, can give rise to a permanent type of alarm condition, silencable with the Reset key.

The same alarm can be excluded at the discretion of the operator by use of switch IE.1 placed under the box of the A014.

11) Alarm for reception of the "Bell" character

Reception of the bell character can give rise, if programmed, to alarm conditions.

These may be:

a) permanent (buzzer and red lamp) silencable with the Reset key;

b) temporary (buzzer and red lamp) according to the sequence of the bell characters.

The a) and b) types of alarm are chosen during programming.

12) Monitor on the two communication channels

The communication channels (both or oné of the two) can be equipped with a monitor at the end of the recording of the traffic.

The A014 is equipped with extended terminals at the heads of the communication channels, by which the teleprinters, reception only, can be extended.

DESCRIPTION OF CONNECTION DIAGRAM

Mains cord = supplies sockets 1, 2 and 3.

A013-A014 power supply cord = supplies the connection box transformer.

Motor cord = supplies the transformer and the motor of the teleprinter.

Telegraphic cord = contains the connections to the contacts of transmission, of the reception electromagnet and of the deflector.

Te315 services cord = contains the connections of the alarm micro-switches (tape stretched - near end of tape - near end of roll - paper broken) and signalling of motor running, locking of the keyboard and electrical outputs of the functions unit.

Interface cord = contains the connection of the keys and of the console lamps; supplies the transmission contacts and connects them to the line, it collects the alarm signallings present on the Te services cable, supplies the telegraphic socket of the external transmitter with power.

ML Line terminal board = connects the two teleprinters.

MS Services terminal board = is used to carry an external alarm signalling (e.g., makes a bell ring) and to preset external controls.

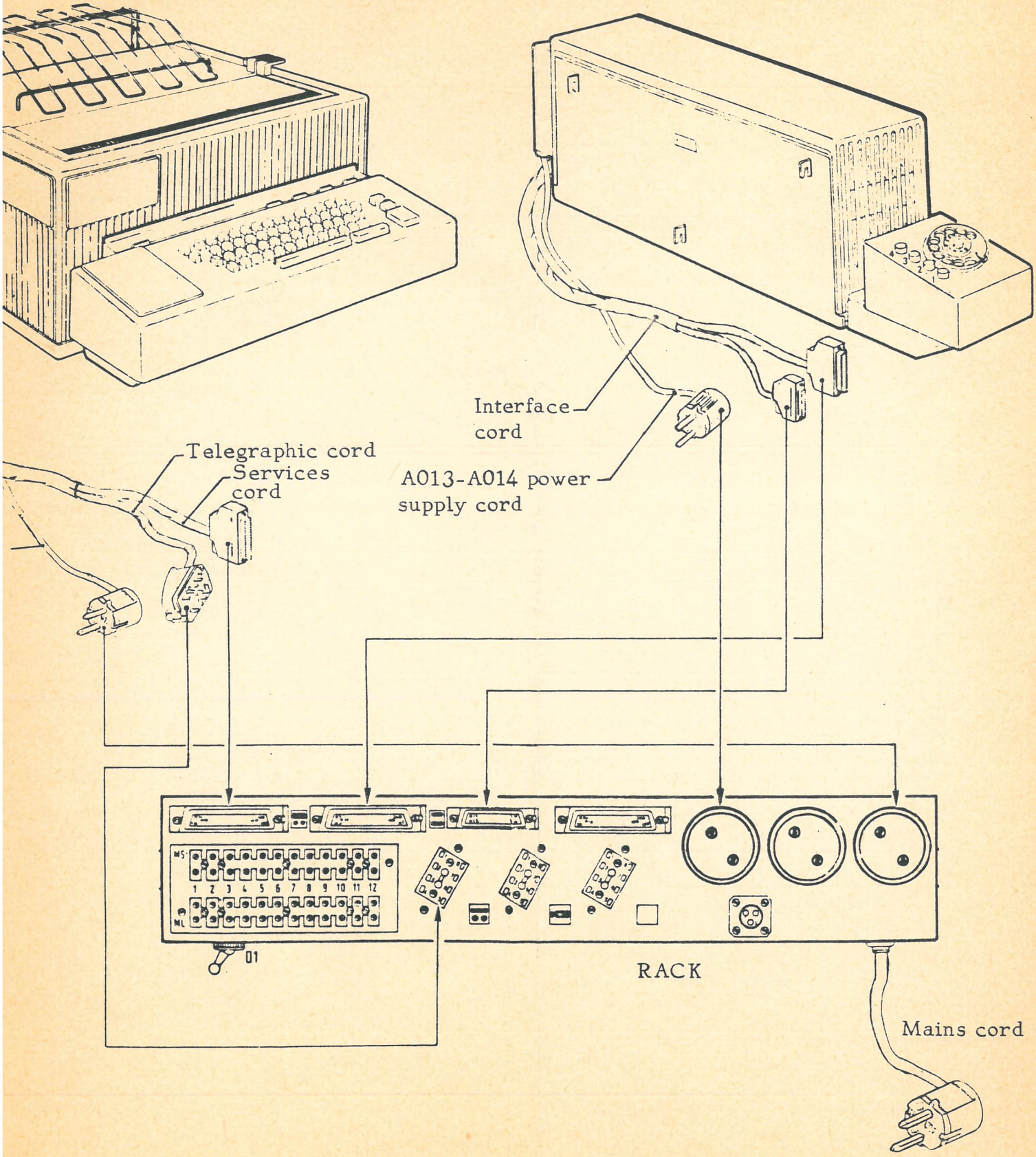
D1, deflector = used with the automatic transmitter.

Mo
cor

 = Teleprinter

 = A013-14 power supply unit

 = External automatic trasmitter


Interface cord
Telegraphic cord
Services cord
A013-A014 power supply cord
MS
ML
1 2 3 4 5 6 7 8 9 10 11 12
01
RACK
Mains cord

A

Acoustic telegraphy = Harmonic telegraphy

Active user

Station with mains power supply.

Aid relay = Telegraphic relay

Amplifying station

Station which systemizes the electronic devices set out along the telephonic connections in harmonic telegraphy, to restore the original intensity to the attenuated signals.

Answer-back device

Device in the emission unit on which, by means of code wards, the user's name is set out. When the "Who are you?" code is sent, the operator releases the correspondent's name.

Arithmetic apparatus

Telegraphic apparatus which works with pulses combined, for each signal, into groups of characters preceeded by a start pulse and followed by a stop pulse.
The group of characters can follow one another without any restraint of rhythm.

Attenuation

Decrease in value undergone by power, voltage or current when crossing a line or even an apparatus.
The measure unit is the Bel; the Decibel is used more - this is the tenth part of the Bel (see also Neper).

Automatic transmitter

Emitting apparatus controlled by the perforated zone, which works with the maximum permitted speed, and contains 5 keyboard probes which test for the presence or absence of punch-holes on the tape.

B

Baud = Telegraphic velocity

Velocity in Baud expresses the number of pulses sent per second.

Bel

Measure of attenuation expressed by the relationship between the quantity entered and that extracted. This relationship is expressed by the logarithm of the ratio of the two values.
The measure unit is the Bel; the Decibel is the tenth part.
-Neper is also used; this corresponds to 0.86 Bel.

C

Cable terminal

Piece of metal sheet suitably shaped, (forked, eyelet etc), soldered to the ends of the conductors to make clamping under the terminal screw more secure and easier.

Carrier currents = Harmonic telegraphy

Characteristic instant

Instant in which a pulse starts.

Circular communication

Simultaneous transmission to several sets.

Clutch

Device which, at the suitable moment, transmits the movement of the driving shaft, controlled by the motor, to the driven shaft.

Code with 5 units

Code obtained by different arrangement, in groups of 5, of two different elements. The code 'voices' are 2^5, i.e. 32.
It is the code used by the teleprinter when (according to the circumstances) positive and negative pulses, or even pulses of circuit presence and absence are used for the two different code elements. (See also: Telegraphic Alphabet).

Concentrator

Commutation unit, which connects a certain number of users to one or more service sets.
It is distinguished from the 'exchange' because it does not provide for communication between users. It can be manual or automatic.

Connection

The total of the circuits or transmission channels which combine two or more stations.

Connection with 2 wires

The telegraphic circuit has two outputs, which can be connected with 2 conductors or even with a conductor and ground.
A connection with 2 wires corresponds to one channel.

Connection with 4 wires

The telegraphic circuit has four outputs, two for the emitting circuit and two for the reception electromagnet circuit.
These four outputs can be connected with four or even three conductors; in the second case one conductor is used in both circuits and can be substituted by ground.
A connection with 4 wires corresponds to two channels.

Control

Text sent out is recorded by the emitting machine itself.

Corresponding machine

Machine installed at the head of the communication channel opposite the line to which the local machine is connected.
Also called "distant machine".

Counter voltage, operation in

Connection in which the value and direction of the current depend on the sum and difference of the voltages applied to the line by both stations. The voltages are in conformity for the mark pulses and in opposition for the space pulses. There is always a holding current on the line.

D

Decibel

Tenth part of a Bel (see : Bel).

Deflector

Commutation unit mounted on the teleprinter and automatic transmitter. In the teleprinter it is used to connect the line to the emission contacts during emission and to the electromagnet during reception.
In the automatic transmission the deflector excludes the apparatus from the line during the rest period.

Direct current telegraphy

System in which telegraphic signals are obtained by modulation of a direct current with single or double polarity.

Distant machine = Corresponding machine

Double current, operation in

Connection in which modulation is obtained by polarity reversal; the mark pulses are distinguished from the space pulses by the current sign.

Duplex = Duplicated or half -duplicated connection

Duplex, operation in

Exists when two separate communication channels are used simultaneously for the traffic, one for emission and one for reception.
To be able to control the emission it is therefore necessary to use two machines per set.

E

Electrical diagram

Drawing of an electrical circuit in which the various components are indicated by symbols which are connected to each other by lines representing the conductors.

Electrically controlled automatic transmitter

Automatic transmitter in which the emission is started by use of an electromagnet rather than by hand.

Emission

Electro-mechanical operation by which pulses are generated and sent into the line.

Emission or serializing unit

Total of the units which read the positions of the keyboard code bars when a key is pressed, translating them into subsequent positions of the emission contact, corresponding to the code elements of the key pressed. It also contains the Answer-Back device.

F

Filter

Electrical device, made up of inductors and capacity, suitably connected, which allows determined frequencies to pass and blocks the others.

Frequency

Is a characteristic parameter of alternate quantities which indicates the "frequency" with which the quantity completes an entire cycle or period and then assumes the same values. It is measured in Hertz (Hz) which indicated the number of periods per second.

Fuse

Has the form of a conductor, with materials and dimensions adapted, and is inserted into a circuit to protect the connected units; it melts when the current which runs through it exceeds a pre-established value, and thus interrupts the circuit to be protected.

G

Ground connector

Protection device which discharges to ground possible excess voltages produced by atmospheric disturbance, inductions, accidental contacts etc.

Group connection

Connection of several telegraphic sets in the same network which can inter-communicate, as in the case of conversation between several people.

H

Half-duplex, operation in

Connection in which emission and reception alternate on the same connection, which can be of 2 or 4 wires.

Harmonic telegraphy

Telegraphic system which has several communication channels simultaneously on a single connection. The various channels are made up of alternating currents with frequencies, called "vector frequencies", spaced oned from the other by 120 Hz. The frequencies used are found in the following ranges - under 300 Hz (infracoustic), 300 - 3000 Hz (acoustic), over 3000 Hz (superacoustic).

Hertz (C.P.S.)

Measure unit of a frequency.
1 Hz equals one period per second, for example a 45 Hz frequency = 45 periods per second (see : frequency).

Holding current

Current which circulates in the telegraphic line and in the apparatus attached to this during the mark period, or during absence of emission.

I

Impartially adjusted relay

Relay in which the armature is free of external mechanical or electrical influences.

Infracoustic telegraphy = Harmonic telegraphy

J

Jack

Socket for insertion plug.

L

Letters-figures exchange

The two services which select the print-wheels unit.

Local machine

Machine installed at the head, near the communication channel.
Also called "near".

Local or off-line connection

Teleprinter is excluded from the line and records its own emission.

M

Machine release

Action which commands the beginning of an operative cycle.
The pressing of the key enters the code and simultaneously releases the emission unit.

Margin

Measure of the teleprinter's aptitude to correctly receive distorted signals; it corresponds to the maximum distortion at which the teleprinter still receives correctly.

Mark = Mark contact, mark pulse

Mark contact

Emitter's fixed contact which supplies positive current in double current operation.

Mark pulse

Presence of current pulse in the "single current" operation or positive current pulse in the "double current" operation. Stop is always a mark pulse.

Metallic continuity, connection to ...

Connection without transformers or repeaters, therefore it can be crossed by direct current.

Multiple communication = Circular communication

N

Near machine = Local machine

Neper = Bel

Non-polarized relay

Relay (or electromagnet) without a permanent magnet. Its working depends solely upon the intensity of the current; without this the armature stays in the position to which it is carried by the unbalance spring.

P

Panel

Complex of electrical units mounted on metallic boards, which in turn are set out on the front part of a cubicle. The units are found inside and the adjustment and handling devices outside.

Passive user

Station without mains power supply.

Perforator

Apparatus for preparation of the perforated zone; it is made up of 5 code punches controlled by the teleprinter code bars and of one punch of smaller diameter which produces the line of feed-holes.

Phaser

Device which, by changing the position of the entry wedge in relation to the wedges entered, changes the timing of the moments of code pulses selection relative to the moment of the Start.

Polarized relay

Relay (or electromagnet) which has fixed polarities obtained by a permanent magnet. The armature positions are determined by the direction of the current; without this the armature stays in the position in which it was left by the last received pulse.

Potentiometer

Variable resistance.

Power supply unit

Apparatus which converts mains supply alternating current into direct current which will then be modulated by the teleprinter transmission. It is made up generally of dry rectifiers and includes levelling filters and adjustment and measuring instruments.

Print unit

Total of the reception bars, of the print mechanism and of the paper-carrying units.

Pulse or bit

Element which makes up the telegraphic signal consisting of a constant quantity of current with finite duration. In the teleprinter the signal is made up of 7 pulses; start, 5 of code, and stop.

Pushbutton system

Transit operation with the perforated zone in which messages are started off by means of operation of the pushbutton panel.

R

Radio bridge

Connection made with very short waves between two or more stations.

Real line

Communication channel made up of metallic circuits.

Reception electromagnet

Also incorrectly called relay.
Electromagnetic device which transforms mark and space pulses coming from the line into as many character positions of its mobile armature. These positions are read mechanically and used, in groups of 7, to select the character to be printed or the task to be carried out.

Reception or parallelizing unit

Total of the selection levers which transform the positions assumed by the electromagnet armature, under the action of the pulses arriving, into mechanical positions, which, in their turn, control the printing units.

Repeater relay = telegraphic relay

Restitution

Characteristic (of distortion, attenuation etc.) with which a signal sent down a line appears at the other end of the line.

Rhythmic apparatus

Telegraphic apparatus which works with pulses following one another without interruption (e.g. Baudot and Hughes apparatus).

Rigid, connection = set to set

S

Selection instant

Instant in which the entry wedge checks the position of the electromagnet armature by detecting the nature of the pulse which runs down the line.

Send to ground

Connect to a ground socket.

Service communication

Telegraphic (or telephonic) communication which does not take part in the

normal traffic, but which relates to the management of the line or to administrative or technical information.

Set = user's set

Set to set, connection

Connection which directly links the two machines placed at opposite ends of the same connection.

Signal

Combination of pulses corresponding to an alphabetic sign, to a figure, to a punctuation sign or even to a service (see: telegraphic alphabet).

Signal element = pulse or bit

Signal with 7 pulses

Signal made up of 7 equal pulses (5 of code, 1 of start and 1 of stop).

Signal with 7·5 pulses

Signal made up of 6 equal pulses and a final one (stop) prolonged by half a pulse.

Single current, operation in

Connection in which modulation is obtained by interruption of current.

Space = space contact = space impulse

Space contact

Emitter's fixed contact which supplies negative current in double current operation.

Space pulse

Absence of current pulse in the "single current" operation or negative current in the "double current" operation. Start is always a space pulse.

Start and stop

Two pulses which, respectively, precede and follow the five code pulses, and have the function of starting the reception shaft rotating at the beginning of each signal, and stopping it at the end.

Superacoustic telegraphy - harmonic telegraphy

T

Tag

Metallic part, to which, by using solder, the end of a conductor is connected.

Telegraphic alphabet

Correspondence table between the printing signs (and teleprinter services) and the code combinations which represent them.

Telegraphic center

Telegraphic station supplied with several teleprinters and which is the center for several lines.

Telegraphic channel

Telegraphic communication channel obtained by the modulation of an alternating current carried by the same connection used for other alternating currents of different frequencies.

Telegraphic distortion

Alternation in length of the theoretical signal, caused by imperfections of the connected machine and by electric characteristics of the communication channel. It is measured by referring to the theoretical length of the pulse (considered to be equal to 100), the maximum clearance between the theoretical character instants (see Character instant) and the corresponding causes of distortion.

Telegraphic filter and teleprinter motor

Electrical device (see filter) which discharges to ground the high frequencies generated by sparking at the emission contacts, at the deflector contacts and at the speed regulator, to avoid disturbance of radio sets which are installed in the same area as the teleprinters.

Telegraphic modulation

Action by which the teleprinter connects, without a fixed time, the power source to the communication channel, so that current pulses with signs, intensity and pre-established duration run down the line.

Telegraphic performance

Number of effective signals emitted during a given period of time; it depends on the efficiency of the connection and above all, on the operator's training.

Telegraphic relay

Electromagnetic device controlled by the telegraphic currents which determine the oscillation of a mobile armature between two contacts, of which one or both are connected to the power source polarities. The armature and power source are part of an electric circuit, in which the pulses generated by the armature oscillation correspond in their order - but not always in their nature - to the first telegraphic pulses.

Telegraphic terminal

Apparatus which, at the end of a communication channel, connects this to the teleprinter.

Telegraphic velocity

This is given by the inverse of the duration, expressed in seconds, of an elementary pulse. The measure unit is the Baud, which indicates the maximum number of elementary pulses which can be transmitted in one second. When the duration of the elementary pulse is 1/50 of a second (which is usually the case because of international conventions), there is a telegraphic velocity of 50 Baud.

Telephonic relay

Multiple switch activated by an electromagnet, by means of a command from a distance.

Teleprinter services

Auxiliary service keys, which generally do not print, and which are each assigned a code. The services are: letter-figure exchange, carriage return, interliner, space, "who are you?", bell.

Terminal

Metallic part to which, by means of a screw, the end of the conductor is secured.

Timing switch

Teleprinter unit, which interrupts the motor's power supply circuit about 50 seconds after the reception, or after the recording in control of the last signal.

Transmit

Service for retransmission of received traffic.

Transmit, time of

Time which the mobile armature of a relay electromagnet or of a contact takes to move from one position to another.

Transmission

This is the emission of a message and its correct reception by the correspondent machine; when this reception does not occur, for any reason, the message, even if correctly emitted, is not transmitted.

Transmission velocity

Maximum number of signals that a telegraphic apparatus can emit and receive in the first minute; it depends on the telegraphic velocity and the number of pulses which form the signal.
In Europe, as in nearly all the countries outside Europe, a 50 Baud telegraphic velocity is used, which is an emission of 428 signals per minute with a 7 pulse signal and an emission of 400 signals per minute with a 7·5 pulse signal.
In the United States however, a 45·5 Baud velocity is used which is an emission of 390 and 364 signals per minute respectively.

U

Unbalanced relay

Relay in which the armature is subject to the unilateral action of a spring or a current, called unbalance.

User's set

Telegraphic station supplied with a teleprinter or another apparatus connected to a circuit or communication network.

V

Vector current = Harmonic telegraphy

Vector frequency = Harmonic telegraphy

Virtual line

Independent communication channel made by use of repeaters on two metallic circuits which already exist; from this results a third communication channel which does not interfere with those separately established on each of the two real circuits.

W

Wiring

Total of the electrical conductors of an apparatus.