700 TYPE TELEPHONES

1 GENERAL

The first of the current 700 series telephones were introduced in 1959 and for sales purposes were designated "Modern Telephones".

2 TELEPHONE TRANSMISSION CIRCUIT

2.1 The basic modern telephone instrument issued to new subscribers is the Telephone 746. A diagram of this instrument is given in ET 8386.

2.2 746 type circuit may be drawn as follows:-

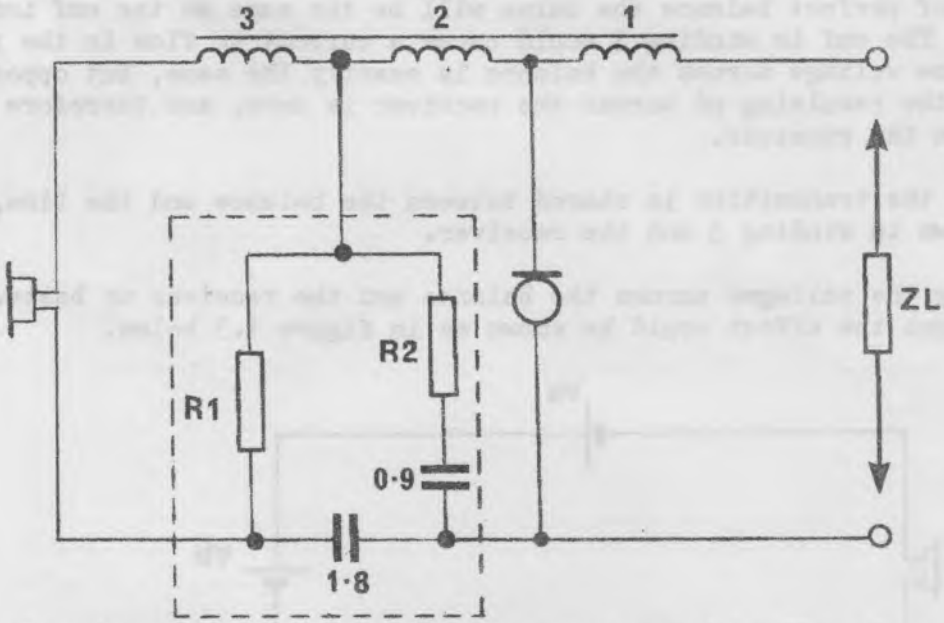


FIG 1.1

The subscribers line has an impedance represented by ZL. The resistors R1 & R2 in conjunction with 0.9 and 1.8 microfarad capacitors comprise a balance impedance (enclosed by the dotted line). The diagram may be further simplified by drawing this network as ZB in Fig 1.2.

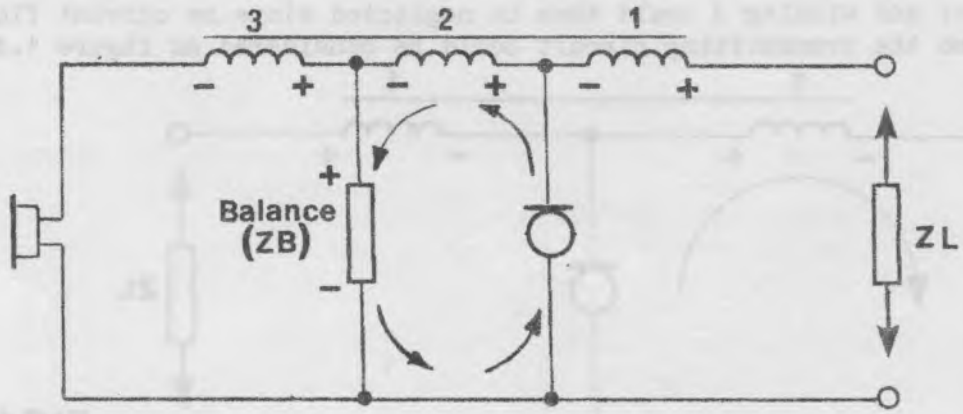


FIG1.2

NB: Although shown as a resistance ZB it is in fact an impedance and its value depends on the frequency of the ac signal.

2.3 TRANSMITTING

Referring to figure 1.2

The transmitter is energised from the Exchange Battery and when speaking into the transmitter, varying dc is produced. Considering only the alternating component of this current, the transmitter can then be treated as an alternating voltage generator, which at any one instance could cause a current to flow in the direction shown by the arrows.

When transmitting therefore winding 2 has the greater ampere turns product and will control the flux in the core and the direction of the induced emfs will be as shown.

The current due to the transmitter will flow through the balance impedance ZB and a potential difference will be developed across this as shown. Under conditions of perfect balance the value will be the same as the emf induced in winding 3. The emf in winding 3 would cause a current to flow in the receiver but since the voltage across the balance is exactly the same, but opposite in direction, the resulting pd across the receiver is zero, and therefore no current will flow in the receiver.

Output from the transmitter is shared between the balance and the line, no current flows in winding 3 and the receiver.

Representing the voltages across the balance and the receiver as batteries of equal voltages the effect could be shown as in figure 1.3 below.

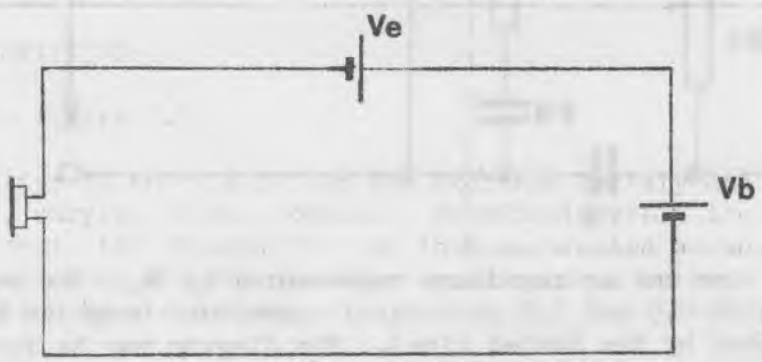


FIG 1.3

The receiver and winding 3 could then be neglected since no current flows in this circuit, and the transmitting circuit could be considered as figure 1.4 below.

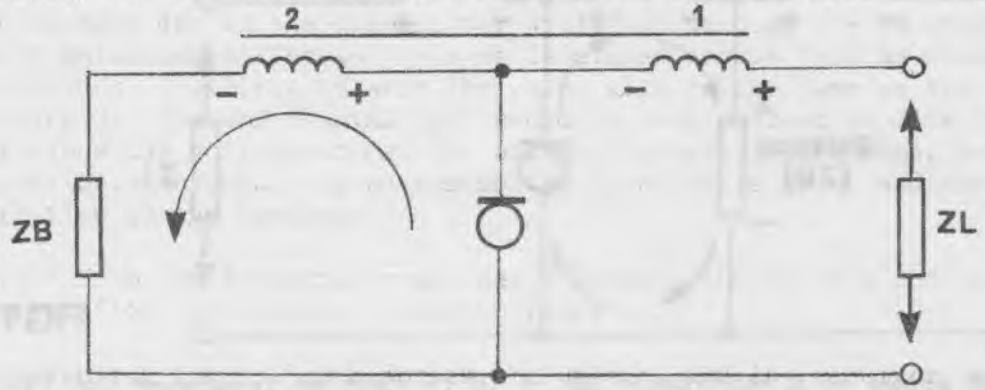


FIG 1.4

The voltages across windings 1 and 2 are in series aiding and are applied to the line with the balance impedance in series. The induction coil therefore acts as an auto transformer with 402 turns on the primary and 402 + 670 turns on the secondary.

Turns ratio = $\frac{1072}{402} = \frac{2.67}{1}$ approx.

Impedance ratio = $\frac{(2.67)^2}{1} = \frac{7.1}{1}$ approx

The impedance ratio matches the transmitter to the line for maximum power transfer.

2.4 RECEIVING

Under receive conditions the transmitter behaves as a resistance of low value. The current path, shown in figure 1.5, is via winding 1 and the transmitter. Winding 1 has the greater ampere turns product in this case and controls the flux in the core and hence the induced emfs.

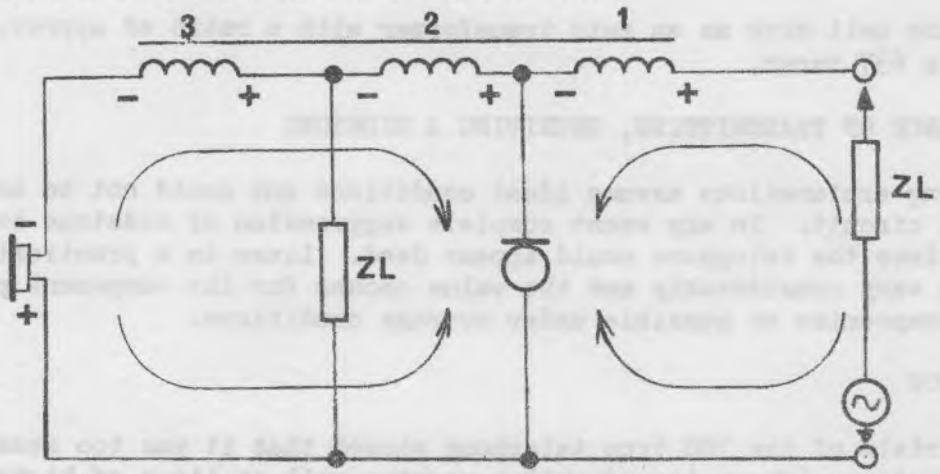


FIG 1.5

The emfs induced in windings 2 and 3 cause a current to flow via the receiver. The potential difference developed across the receiver is the same as the emf induced in winding 3. The resulting potential difference across the balance ZB will be zero and no current will flow in the balance.

The input power from the line is shared between receiver and transmitter.

Receive circuit can be shown as in figure 1.6 where ZB has been neglected since no current flows in that circuit.

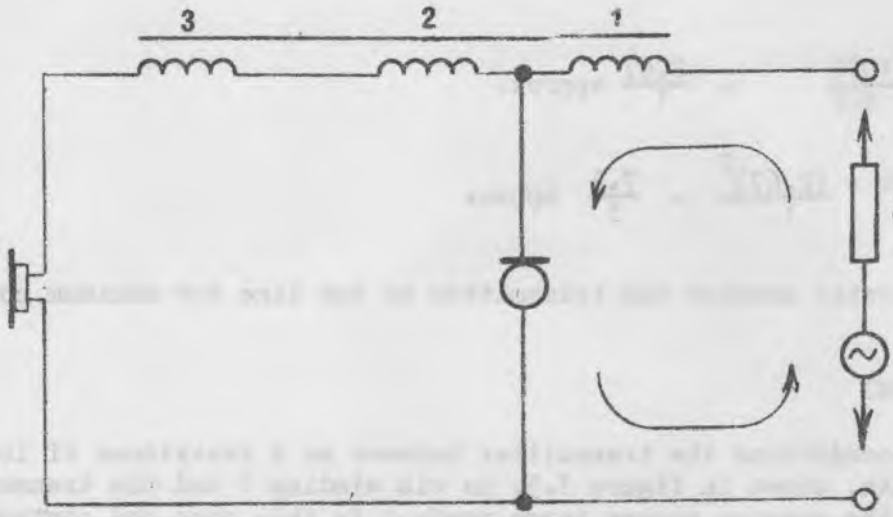


FIG 1.6

The induction coil acts as an auto transformer with a ratio of approx. 1.1 eg 670 turns to 637 turns.

2.5 BALANCE OF TRANSMITTING, RECEIVING & SIDETONE

The foregoing explanations assume ideal conditions and could not be achieved in a practical circuit. In any event complete suppression of sidetone is not desirable since the telephone would appear dead. Lines in a practical telephone system also vary considerably and the value chosen for the component parts give as good a compromise as possible under average conditions.

3 THE REGULATOR

Original field trials of the 700 type telephone showed that it was too sensitive on lines of low resistance (short lines) whilst working well on lines of higher resistance.

An automatic regulator was introduced to reduce the sensitivity on short lines, whilst allowing full efficiency on longer lines.

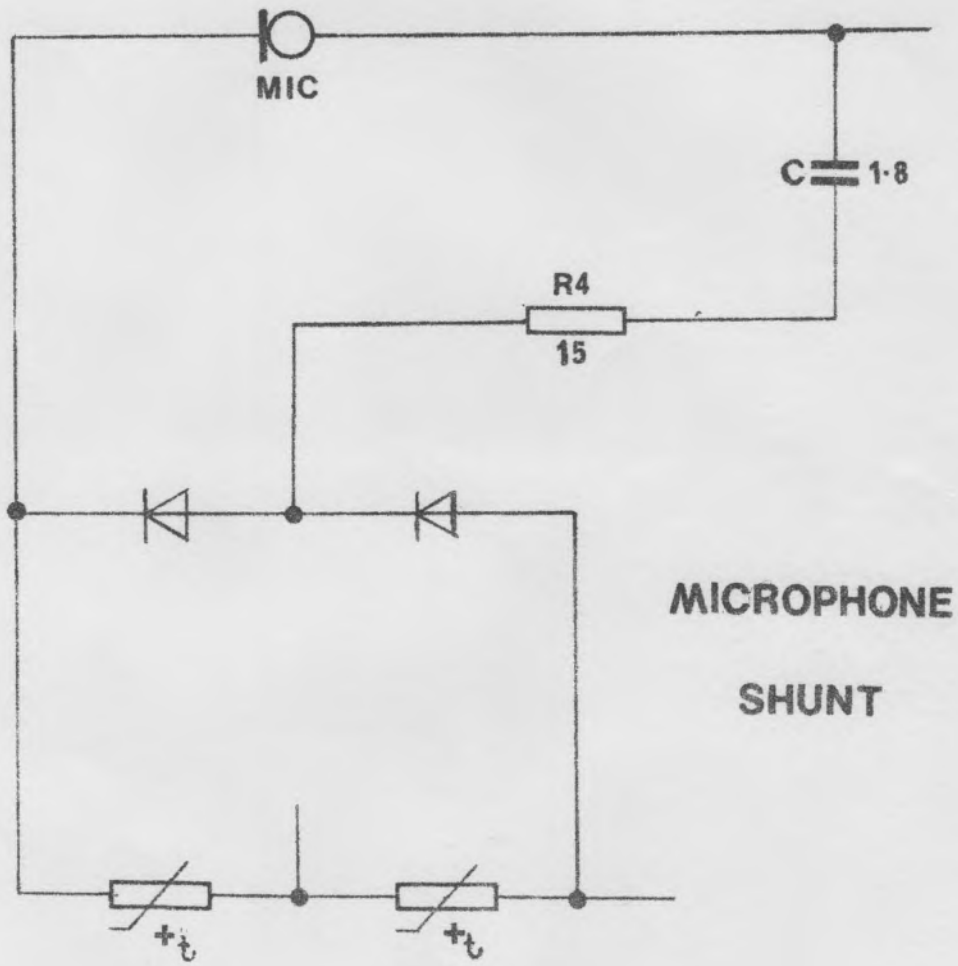
The regulator consists of a network of rectifiers and a resistor bulb.

3.1 OPERATION

The purpose of the regulator is to vary the amount of ac speech current flowing through the microphone and receiver. This is achieved by shunting the two components with a rectifier. If the rectifier is forward biased it will permit current to pass through it freely. However, if the rectifier is reverse biased current will not flow. Different degrees of forward bias will cause different values of speech current to flow through it.

The resistor bulb (which is a non-linear resistor having a positive temperature coefficient of resistance) is effectively in parallel with the rectifier. As varying amounts of dc line current flow through the resistor bulb this applies a varying amount of forward bias to the rectifier.

The more the rectifier is forward biased, the more current will flow through it. As the rectifier shunts the component (say microphone) this causes lower amounts of current to flow through the component. The converse is also true.



- END -

M J DEVONPORT

TELEPHONE No. 746