the subscriber responds, when it darkens, in which condition it remains until the subscriber restores the receiver to the hook and causes the lamp to light up again. The other supervisory lamp on the cord circuit is controlled in a similar manner by the sub­scriber who originated the call, and as that subscriber’s telephone is off the hook when the peg is inserted, the lamp is not lighted at all until the subscriber replaces the receiver. When both lamps glow, the operator, who thereby knows that both subscribers have restored their instruments, discontinues the connexion.

A cord circuit, similar in many respects, including the method of operation, but equipped with condensers and impedance coils, in place of the repeating coil, is shown in fig. 13.

In fig. 11 a meter or counter is shown associated with the sub­scriber’s line, and in both figs. 12 and 13 position meters are shown connected to the cord circuits. The operation of these meters is controlled by the operators. The subscriber's meter is joined in multiple with the cut-off relay, and whenever a peg is connected to the circuit a current flows through the meter. This current is small, however, and the meter is not operated until a much larger current is passed through it. Calls are registered by pressing a key, which connects a battery through a position meter of very low resistance to the socket of the line jack, thereby furnishing the necessary energy to the meter. The position meter just mentioned is common to all the cords on one position and records all com­pleted calls handled at the position. Some administrations, in addition to employing the ordinary position meter, use a second one for registering ineffective calls.

In large towns served by a number of exchanges the junction equipment is an important feature. In many cases from 60 to 80 per cent. of the calls originated at an exchange arc for subscribers con­nected to other exchanges, and in these cases the junction plant forms a considerable fraction of the whole equipment. Moreover each call junctioned is dealt with by at least two operators. The junction circuits connecting two exchanges are invariably divided into two groups, one for traffic from exchange A to exchange B, the other for traffic from B to A. At the outgoing end the circuits are multipled on the subscribers’ switch­board, while at the incoming end they terminate in plugs on a special incoming junction switchboard upon which the subscribers' lines are multipled in the usual way.

When a subscriber at exchange A asks for a connexion to a subscriber at B, the operator at A, to whom the request is made, passes the particulars over an order wire to an operator at B. The latter names a disengaged junction circuit, then “ tests ” the line of the wanted subscriber, and if she finds it free, finally completes the con­nexion and rings the subscriber. During the progress of these operations the A operator connects the originating subscriber to the junction circuit named by the B operator. There is only one signal on the cord circuit at B, and that signal is controlled by exchange A. Each of the subscribers controls a signal at A, and when either or both of the telephones are replaced, the action is indicated by the lamps there. Control of the call is thus vested in the operator at the originating exchange, at which point the connexion must be severed before a clearing signal can appear at B.

*Party Lines.—*A circuit which serves more than one subscriber is termed a "party line." It was originally the practice to place the calling apparatus in series in the line circuit, but the effect of the large impedance introduced by the electromagnets of the call­bells was such that not more than two or three persons could be connected without seriously impairing the efficiency of the circuit for speech transmission. An improvement was effected in this respect by the introduction of the “ bridging" system, in which the bells possessing high inductance are placed in parallel between the two wires of the circuit. Although the bells are constantly in circuit their high impedance prevents any appreciable interference with the telephonic currents. In America, on farmers' circuits, ten or more stations arc frequently connected to one line; but in England ten is practically the maximum. In city districts the modern practice is to restrict the number to four stations per line, and to equip the exchanges and stations for selective ringing. In one arrangement, now in extensive use, each telephone set is fitted with a relay of high inductance which is bridged across the circuit in series with a condenser. When the relay is operated it connects a bell between one of the wires of the circuit and earth, while the bell itself is arranged to respond to current pulsations in one direction only. The four tele­phones on a circuit are so wired that the relays connect two of the bells between each wire and earth, and further that one of each pair of bells responds to positive and the other to negative pulsations. This system of course requires that the exchange equipment shall include machines capable of delivering a positive pulsating current and a negative pulsating current, besides the usual alternations required for the ringing of ordinary subscribers.

In another party line system a harmonic prin­ciple is employed: the ringing machines deliver alternating currents of four frequencies, while each bell is constructed to operate at a particular frequency only. Of the four bells connected to a circuit each responds to a different frequency.

*Trunk Line Working.*—Trunk or long-distance working is com­plicated by the necessity for recording all calls. The system of the British Post Office is worked as follows : A subscriber desiring a long-distance connexion calls up his local exchange in the ordinary way, and the operator there, being informed that a trunk connexion is desired, extends the subscriber's line to the Post Office by means of a record circuit. At the Post Office a record operator replies and takes particulars of the connexion, and these are entered upon a ticket. The record operator then removes her speaking apparatus from the circuit, and the local operator, receiving a disconnect signal, severs the connexion at the local exchange. Meanwhile the ticket is conveyed to the position where the lines to the town wanted are terminated. If there be a line free, or when the turn of the call is reached, particulars of the connexion wanted are passed to the distant end, and the trunk operators request the local exchanges to connect the subscribers by means of junction circuits to the trunk exchanges where the necessary connexions are made between the trunk line and the junctions. The call is controlled by the trunk operators, the junction circuits being equipped in such a manner that the subscribers’ signals appear at the trunk exchanges, from which point disconnecting signals are sent automatically to the local exchanges, when the connexions between the trunk and the junction circuits are removed.

The large modern trunk exchanges are equipped with relays and lamps for signalling purposes. “ Calculographs " are employed for stamping the time upon the tickets, and there is associated with each trunk circuit a device which lights a lamp as soon as the scheduled limit of the period of conversation is reached.

Particulars of calls are now passed between trunk centres to a great extent over telegraph circuits superposed upon the trunk