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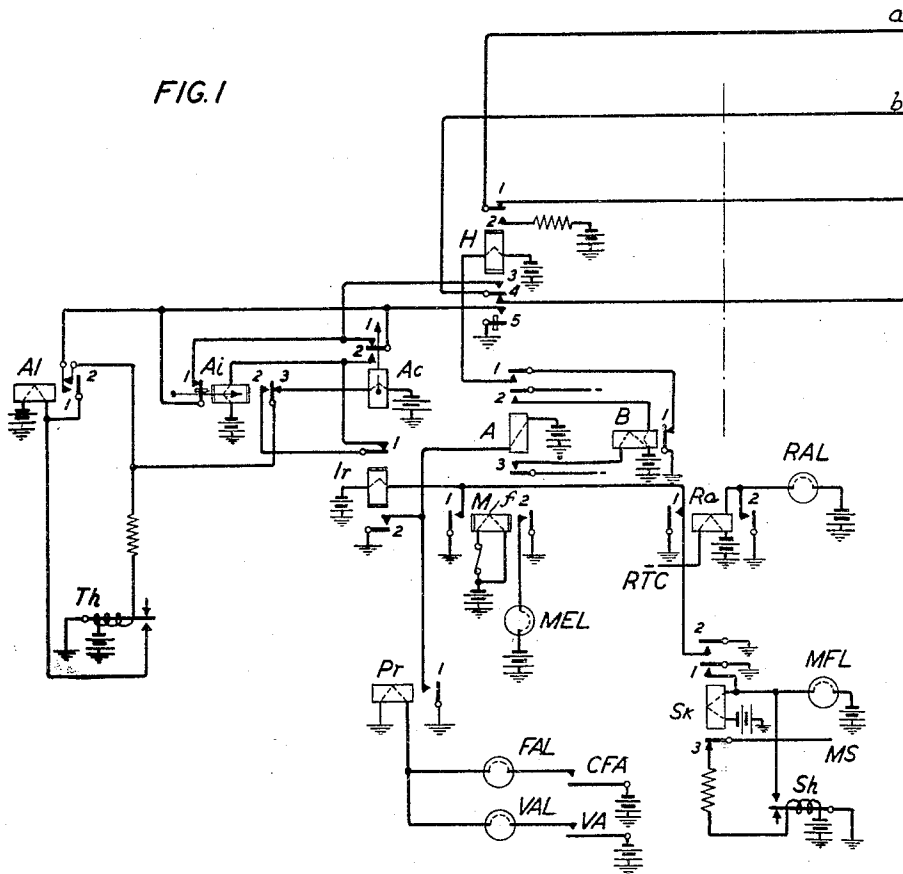
W. HATTON ET AL

1,912,450

TELEPHONE SYSTEM

Filed Oct. 23, 1931

3 Sheets-Sheet 1



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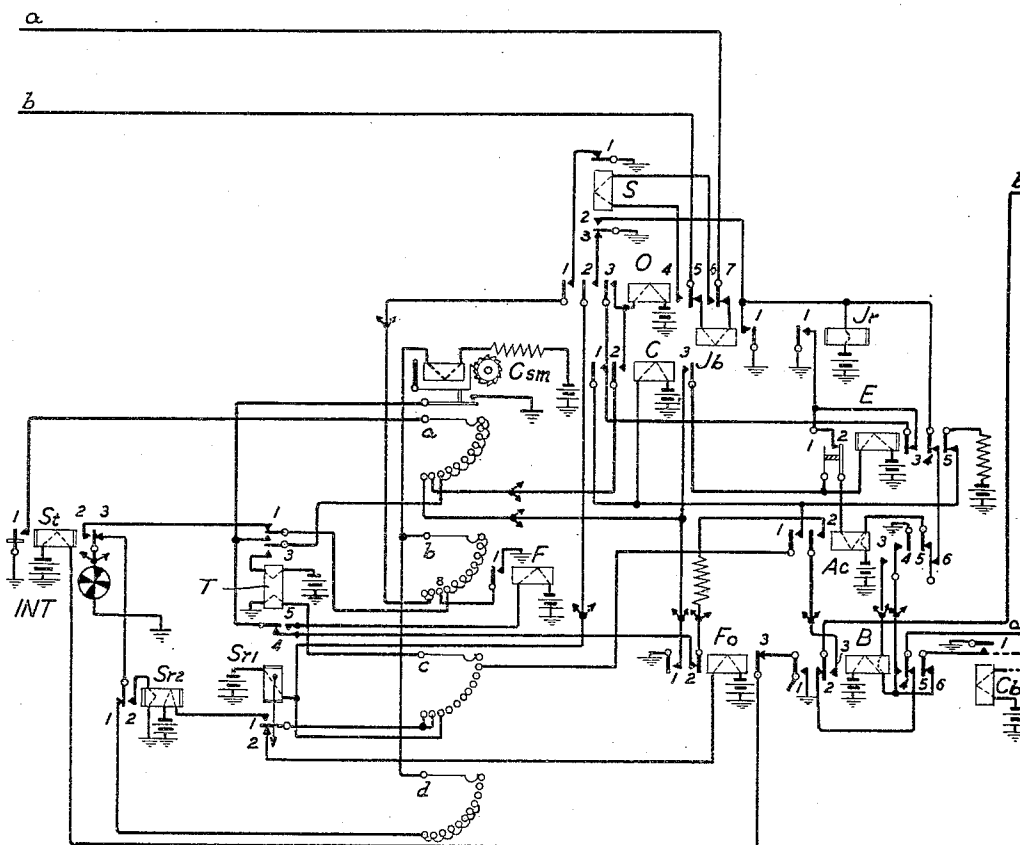
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FIG. 2



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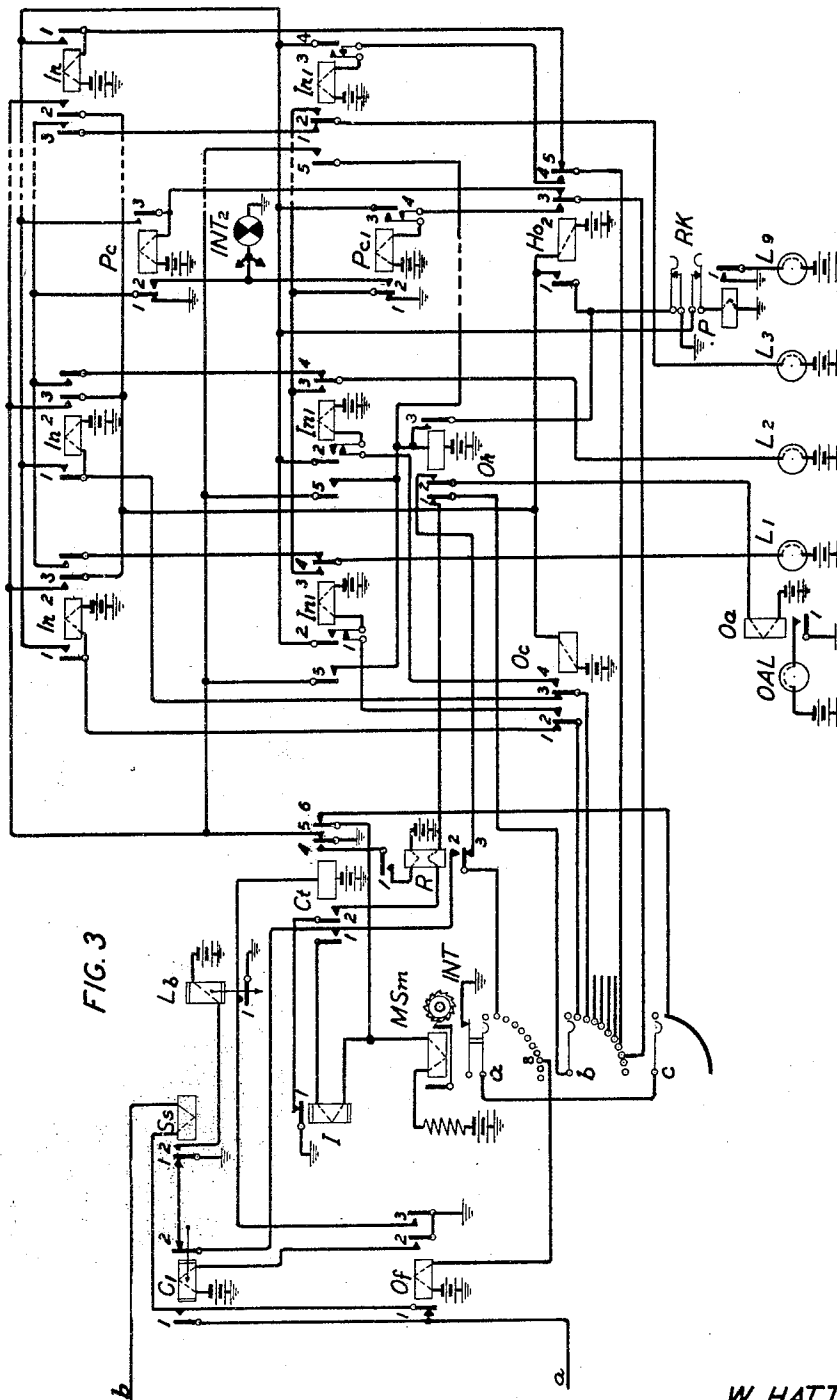
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TELEPHONE SYSTEM

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3 Sheets-Sheet 3



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TELEPHONE SYSTEM

Application filed October 23, 1931, Serial No. 570,522, and in France December 19, 1930.

This invention relates to telephone systems and more particularly to a circuit arrangement for dealing with faults or alarms which may occur in such systems.

5 An object of the invention is to provide an improved arrangement for transmitting alarm signals and is to provide better facilities for indicating at one point in a telephone network the presence of a fault at a
10 distant point in such a network.

According to one feature of the invention a circuit arrangement is provided in which the presence of a fault is adapted to be signaled over an outgoing junction by means
15 of impulses, a different number of impulses being transmitted according to the particular type of fault which is present.

A circuit arrangement may also be provided for indicating at an attended exchange
20 a fault which is present at an unattended exchange, the receiving mechanism at the incoming exchange being so designed as to discriminate between different types of faults or between a fault and an ordinary
25 call. The receiving mechanism may be arranged to indicate a fault or to transmit a corresponding signal to a further exchange in the network.

The circuit arrangement may be so designed as to indicate at an attended exchange the presence of a fault at an unattended exchange, the recording mechanism at the attended exchange being so arranged
30 as to indicate the particular exchange in which such fault has occurred, provision also being made for indicating the type of fault which is present.

According to the preferred form of the invention, each exchange in which a fault
40 may occur is connected to a "center" exchange by a separate junction, and a single junction, over which alarm signals for all the exchanges are transmitted, connects the
45 "center" exchange to a main exchange. The identity of an exchange in which a fault occurs is recorded at the "center" exchange by a selector switch and a similar switch is provided at the "main" exchange which moves
50 in synchronism with the switch at the "cen-

ter" exchange to indicate the exchange having a fault at the "main" exchange.

The invention will be more completely understood from the following detailed description which is given in conjunction with
55 the accompanying drawings in which:

Fig. 1 shows a fault alarm circuit for indicating different types or classes of alarms by means of impulses.

Figs. 2 and 3 show a circuit arrangement
60 for use at a "center" and a "main" exchange respectively; which provide for receiving and extending the alarm signals transmitted from Fig. 1 and also for indicating at the
"main" exchange the particular exchange or
65 district in which the fault has occurred.

Referring first to Fig. 1, the operation of the circuit for giving an alarm, and indicating the class of fault will first be described.

Any kind of alarm may be provided for,
70 and these may be divided into the urgent and the non-urgent variety as desired. The most common types of alarms are circuit fuse alarm, voltage alarm, motor failure alarm, main fuse alarm, and ringing alarm and of
75 these the first two are generally classed as being non-urgent and the last three as being urgent.

The apparatus for giving non-urgent alarms comprises relay *Pr* and contacts *CFA*
80 and *VA* controlled by the circuit fuse alarm and the voltage alarm respectively.

The apparatus for giving urgent alarms is connected to the winding of relay *Ir*.

If the motor should be out of order, ther-
85 mostatic relay *Sh* operates after a time interval, via lead *MS* thereby operating *Sh* which locks and connects ground to the winding of *Ir*. A similar operation takes place when a shaft failure alarm occurs. Relays *Mf* and *Ra* operate in case of main fuse and ringing failure respectively and in either case *Ir* operates.

In all cases of alarms a circuit will be completed for relay *A* either over *pr1* or *ir2*.
95 The windings of relay *B*, which controls the circuit for relay *H*, are connected via *a2*, *a3* the incoming the outgoing junction circuits respectively of the both way junction so that if the junction is busy in either di-
100

rection B will operate when A pulls up and prevent relay H energizing.

When the junction is free H will energize via *a1*, *b1*, A junction to "center" is now connected to the alarm circuit.

Relay H opens the outgoing junction; test battery is now connected to the "a" wire of the junction via *h2* and ground is connected to the "b" wire via *h5*, *ai1* and *ac1*, and *h3*, to operate the bridged line relay *Jb* in the fault circuit at the incoming end of the junction.

When the junction is taken into use for a normal call, the junction is looped and the fault line relay will not operate.

Relay *Ac* is operated over *ai3*, *al2*, and *h5*. A circuit is now closed for relay *Ai* over *ac2* and *h5*.

Relay *Ai* energizes slowly and when operated, opens the ground on the "b" wire at contact 1, thereby sending an impulse to the next exchange. Relay *Ai* at its contact 3 also opens the circuit for relay *Ac* which de-energizes slowly and after release connects again ground to the "b" wire.

If the alarm is non-urgent then relay *Ir* will not have been operated and relay *Ai* is therefore locked via *ir1*, *ai2*, *al2*, *h5*. A thermostat *Th* is operated via *al2*, *h5* after a time interval and energizes relay *Al*, thereby releasing *Ai* and opening the initial energizing circuit of *Ac*. Relay *Al* locks up until the fault is cleared preventing any further impulsing and disconnecting the thermostat.

If the alarm is urgent, relay *Ir* will be operated and relay *Ai* will release when its operating circuit is opened at *ac2*.

With *Ai* back, relay *Ac* will reoperate and the same cycle is repeated giving one impulse at each operation of *Al*.

The cycle is repeated until relay *Al* is operated by the thermostat and locks disconnecting *Al* and *Ac* at *al2*.

When the fault is cleared, the alarm apparatus returns to normal, releasing relays A and H and *Al*.

Referring now to Figs. 2 and 3, a circuit is shown for signaling urgent and non-urgent alarms from the circuit shown in Fig. 1 via a "center" exchange (Fig. 2) to a "main" exchange (Fig. 3) and for indicating in the "main" exchange the particular outgoing exchange in which the fault is present.

It is to be understood that in Fig. 2 the switch *Csm* together with relays *St*, *Sr1*, *Sr2*, *T*, *F*, *Fo* and *B* is common to all junctions incoming from the district exchanges, while relays *S*, *O*, *C*, *Jb*, *Jr*, *E* and *Ac* are individual to each incoming junction. One incoming junction is represented by the leads *a*, *b*.

When a fault occurs in a district exchange, an alarm impulse will be sent out from a circuit associated with the district exchange, such as that shown in Fig. 1 over the "a" and "b" wires thereby operating relay *Jb* *ac2*, *b3*.

which operates *Jr* over *jb1*. When the alarm impulse is completed relay *Jb* falls back and removes the short circuit from the left hand winding of relay *Ac* which thereupon operates from battery two windings of *Ac*, *c2*, *jr1*. The operation of *Ac* closes the circuit of *B*; battery, windings of *B*, *ac3*, *ac4*, ground. Relay *B* operates if the junction is free, the relay being short circuited to ground on *cb1* if the junction is busy, since under the latter condition *Cb* will be operated.

When *B* operates, it closes a circuit for *St* over *b1* and *fo3*, connects the "a" wire of Fig. 3 to ground over *b4*, and *ac4* and connects the "b" wire over *b3*, *ac2*, *fo2*, *t4*, interrupter of the selector *Csm* to battery.

Relay *St* in operating, closes a circuit for the magnet *Csm*; ground INT, *st2*, *t1*, brush *b*, *Csm* to battery.

As soon as *Csm* arrives opposite the terminals corresponding to the district exchange in which the fault originated relays *C*, *T* operate; ground, winding of *T*, brush *G*, *ac1*, winding of *C*, battery. Relay *T* is arranged to be of a quicker operation than *C*. The two relays lock up, *T* over *t3*, wiper *a* and, *st1*, and *C* via *c1*, *c3*, *jr1*.

Relay *Ss*, which responds to the impulses created in the fundamental circuit by the stepping of *Csm* at its interrupter contacts, closes successively its back and front contacts.

The slow releasing relay *Lb* operates in response to the operation of relay *Ss* and this relay in turn operates relay *Ct*. Relay *Ct* closes the circuit of the selector *Msm*, battery, *Msm*, winding of *I*, *ct1*, *cf2*, *ss1*, ground.

Relay *Lb* holds *Ct* during the pulsing and the selector *Msm* completes its stepping when *ss1* opens at the end of the series.

Relay *I* is held operated during pulsing and releases at the end of the series of impulses, that is to say, when relay *T*, Fig. 2, operates.

The release of relay *I* indicates that *Csm* in Fig. 2 has found the exchange which has created the alarm and since *Msm* operates in synchronism with *Csm* it is found in the same position.

Relay *I* on releasing closes a circuit for relay *R* and the *In* relay corresponding to the district of the alarm, ground, *i1*, *ct2*, *R*, *oh1*, brush *b*, *Oc1*, *In*, battery, relay *R* locks over *r1*, *ct4*.

The particular *In* relay to be operated will depend upon the position to which the *Msm* switch is set which in turn will depend on the particular exchange having a fault.

The selector *Msm* now moves into position 8; battery, *Msm*, winding of *I*, *ct1*, *r2*, brush *a* INT, ground, relay *T*, Fig. 2, causes *Csm* to move to position 8, also under its own interrupter, and at the same time it connects relay *F* in the fundamental circuit, over *t5*, *fo2*, *b3*.

In position 8, *Csm* is operated over *f1* and brush *b*. When *Msm* reaches position 8 it operates *Of* over brush *a*. The fundamental circuit is opened at *of1*, thereby causing the release of *F*, Fig. 2, which opens the circuit of *Csm*, now steps to position 9 and in leaving 8 opens the circuit of slow releasing relay *Sr1* which was operated in position 8. The circuit of relay *T* is also broken when *Csm* leaves position 8 and at *t4* transfers the lead *b* of the fundamental circuit from relay *F* to the interrupter of *Csm*, as before.

As has been stated above, the relay *Of* opens the fundamental circuit in order to signal that *Msm* is ready to receive an alarm signal for urgent or non-urgent faults.

The momentary opening of the fundamental circuit by relays *Of* and *Cl* causes the relay *Ss* to fall back and operate *Msm*. After the closure of the fundamental circuit, relay *Ss* is again operated and *Msm* completes its ninth step. Both selectors are now in position 9.

Relay *O*, Fig. 2, now operates; battery, winding of *O*, *c2* brush *a*, *st1*, ground.

In position 8, relay *Sr1*, Fig. 2, operated via brush *c* in series with the lower winding of *T*.

Assuming that the fault which has created the alarm is of the non-urgent variety, no new impulse will be produced in the fundamental circuit leading from Fig. 1 to the "center" exchange and in consequence relay *Sr1*, in releasing slowly, closes *sr12* thereby energizing *Fo*. Contacts *fo2* open the *b* lead to the "main" exchange and *fo3* releases *St* while *fo1* operates relay *E* via *c3*. The opening of the "*b*" wire causes the release of relay *Ss* in Fig. 3 which in its turn releases relay *Lb*, so that *Msm* returns home via *ct6*, brush *c*, and *INT*.

With relay *Ct* released the circuit of relay *Pc* will be open at the moment when *Msm* passes to position 10. The relay *In* which was operated in series with relay *R* has locked up via *in1*, *RK*, *P* to earth, contacts *in3* are connected to the lamps *L1*, *L2*, *L3*, etc. Thus the particular *In* relay operated will operate one of the lamps which will indicate the exchange in which the fault is present, a separate lamp being provided for each exchange.

If the fault which has occurred is of the urgent variety a series of impulses are produced in the fundamental circuit between Fig. 1 and the "center" exchange Fig. 2 which continues after the switch *Csm* has reached position 9 in response to the first impulse.

Relay *S* responds to the first of these impulses after *Csm* is in position 9 and steps *Csm* via brush *b*, *o1*, and *st1*. *S* in deenergizing also closes a circuit for the slow relay *Sr1* via *S2* and *o2*.

Csm therefore advances to position 10 when *E* operates via *c3*, brush *a*, and *st1*.

In passing from position 9 to 10, *Csm* opens the fundamental circuit at its interrupter contacts thereby causing a momentary deenergization of relay *Ss*, Fig. 3, which drives *Msm* into position 10. In this position, the circuit of *Fo* in Fig. 2 will be completed to drive *Msm* home but in the meantime relay *Pc* will have operated; battery *Pc* *ho3* brush *b*, *R*, *ct2*, *it* to ground. By the time *Lb* falls back to release *Ct*, in response to the operation of *Fo*, relay *Pc* will have locked up over its contact 3 to ground on *RK*, in parallel with the particular *In* relay which has operated.

Owing to the fact that relay *Pc* is energized, the lamp which was connected up by the *In* relay is now connected to the interrupter *INT* 2 and the selected lamp instead of glowing continuously is caused to flash, thereby indicating that the fault is urgent. Relay *Ct* will have released when *Fo* operated, after the switches moved into position 10, and over *ct5* and *in2* a circuit is closed for relays *Oc* and *Ho* in parallel, and these relays lock up over *ho1* and the key *RK* to ground, and transfer the lead coming from the arc *b* of *Msm*, from relay *In* to the corresponding relay *Inl*. When a new alarm occurs everything takes place as described above except that the relay *Inl* is actuated in place of relay *In*.

The operation of any one of the *In1* relays will complete a circuit for relay *Oh*, from *ct5*, via *in15*.

If therefore an alarm should occur in a third district exchange, when the selector *Msm* arrives opposite the terminals corresponding to the district which creates this alarm relay *R* will find its circuit open at contact *oh1*. In this position relay *Oa* is energized from battery, winding of *Oa*, *oh2*, *r3*, brush *a* of *MSM* to ground. Relay *Oa* operates a special alarm *OAL* indicating that a third alarm is present, but cannot be recorded through lack of recording apparatus.

Due to the fact that relay *R* is not operated the restoring circuit of selector *Msm* remains open and in consequence there will be no momentary opening of the fundamental circuit indicating to the center in Fig. 2 that it can send the signal giving the source of an alarm. In order to record this third fault it is merely necessary to open the key *RK* momentarily thereby releasing the two fault indications already recorded.

The third fault can now be received in the same manner as previously described.

In the embodiment shown in the drawings the faults at the different district exchanges, which will be connected as Fig. 1 to the center at Fig. 2, are communicated to the "main" exchange Fig. 3 over a common junction.

It is obvious however that if desired a plurality of junctions might be provided between the "center" and the "main" exchange and

a separate junction might be allotted to each district for the transmission of alarm signals to the main. In this case the particular junction over which the alarm signal is transmitted will give an indication at the main as to the particular district exchange in which the fault has occurred.

In the case of faults at the "center" exchange, relays in a fault circuit individual to center and corresponding to that shown for an incoming junction, are directly operated for urgent and non-urgent alarms, and the fault indication is repeated in a similar manner to that already described.

It is obvious that means could be provided at the "center" exchange if desired to respond to the impulse or impulses from the district exchange and to indicate the exchange at which the fault has occurred and/or the type of fault, without repeating the indication to the "main" exchange.

What is claimed is:

1. In a signaling system, fault indicating means, a line, and means for transmitting a different number of impulses over said line responsive to the particular type of fault indication present.

2. In a signaling system, a first and a second exchange, a line connecting said exchanges, fault indicating means at said first exchange, means for transmitting different types of signals from said first exchange in accordance with the type of fault present and means at the second exchange for discriminating between different types of signals to indicate the type of fault present at the first exchange.

3. In a signaling system, two exchanges, fault indicating means at one exchange, a line between said exchanges, means for transmitting a different number of impulses over the line from said one exchange in accordance with the particular type of fault present, and means at the other exchange responsive to said impulses for indicating said different types of faults.

4. In a signaling system, a first, a second and a third exchange, a line connecting said first and second exchanges, a line connecting said second and third exchanges, fault indicating means at said first exchange, means for signaling from said first exchange in accordance with the type of fault present, means at said second exchange for discriminating between different types of signals, means at said second exchange responsive to different types of signals for transmitting corresponding signals over the line to the third exchange, and means at the third exchange for discriminating between different types of signals received to indicate the type of fault present at said first exchange.

5. In a signaling system, a first, a second and a third exchange, a line connecting said first and second exchanges, a line connecting

said second and third exchanges, means for signaling from said first exchange over the line to the second exchange in accordance with the type of fault present at said first exchange, means at said second exchange responsive to the signals incoming from said first exchange for transmitting corresponding signals over the line to the third exchange, and means at said third exchange for detecting said different types of signals and means for visually indicating said different types of signals received at said third exchange.

6. In a signaling system, a plurality of unattended exchanges, an attended exchange, lines between said unattended exchanges and the attended exchange, fault indicating means at said unattended exchanges, means for transmitting different types of signals from said unattended exchanges over the corresponding lines to said attended exchange in accordance with the type of fault present, and means at the attended exchange for indicating the particular unattended exchange in which the fault has occurred, and means for indicating the type of fault present.

7. In a signaling system, a plurality of first exchanges, a second exchange and a third exchange, lines between said first exchanges and the second exchange, a line between the second exchange and the third exchange, fault indicating means at said first exchanges, means for signaling from any of said first exchanges over the corresponding lines to the second exchange in accordance with the type of fault present at said first exchanges, and means responsive to the signals incoming to the second exchange for transmitting corresponding signals to the third exchange and means at said third exchange responsive to the signals incoming to said exchange for identifying any of the first mentioned exchanges signaling to the second exchange and for discriminating between the different types of signals to indicate the type of the fault present at any of said first exchanges.

8. In a signaling system, a plurality of first exchanges, a second exchange and a third exchange, lines connecting said first exchanges to said second exchange, a line connecting said second exchange to said third exchange, fault indicating means at said first exchanges and means for signaling from said first exchanges in accordance with the type of faults present, a step-by-step switch in the second exchange, a step-by-step switch in the third exchange, means for operating said switches in synchronism in response to signals incoming from any of said first exchanges, means at said third exchange operative in response to the setting of the switches for identifying any of said first exchanges having transmitted signals to the second exchange, and means for discriminating between different types of signals at said third

exchange to indicate the type of the fault present at the first exchanges having transmitted signals to said second exchange.

In witness whereof, we hereunto subscribe
5 our names this 8th day of October 1931.

WILLIAM HATTON.
ERNEST J. ROUSSEAU.
GUSTAVE T. WARMOES.

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