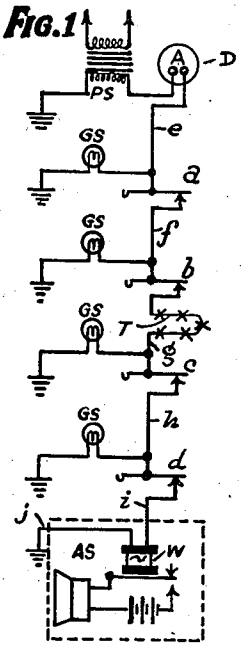
Nov. 3, 1942. C. E. BEACH 2,300,402

SIGNALING SYSTEM

Filed Aug. 3, 1940 4 Sheets-Sheet 1

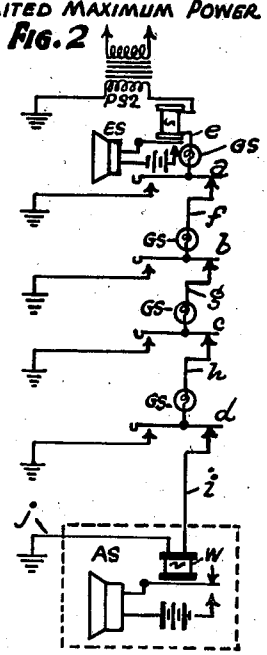
POWER SOURCE

FIG. 1



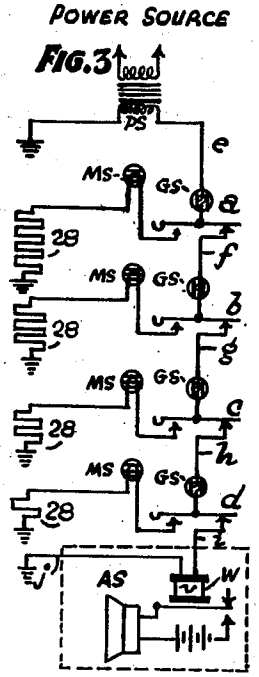
POWER SOURCE
LIMITED MAXIMUM POWER

FIG. 2



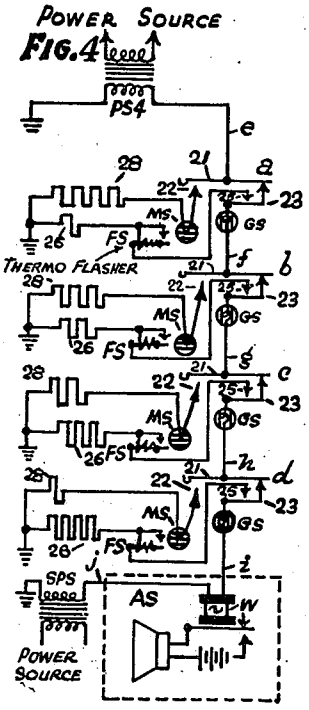
POWER SOURCE

FIG. 3



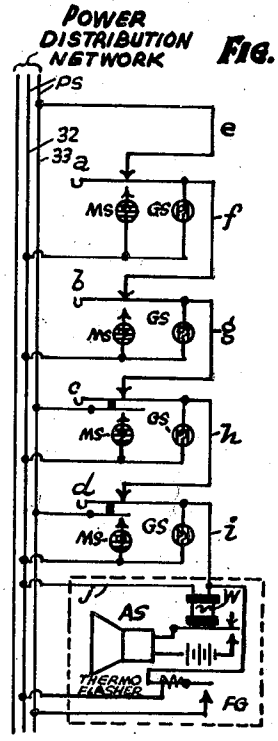
POWER SOURCE

FIG. 4



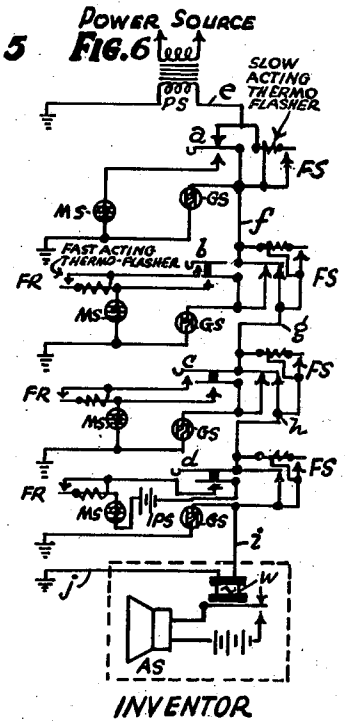
POWER DISTRIBUTION NETWORK

FIG. 5



POWER SOURCE

FIG. 6



INVENTOR

C. E. Beach

Nov. 3, 1942. C. E. BEACH 2,300,402

SIGNALING SYSTEM

Filed Aug. 3, 1940 4 Sheets-Sheet 2

FIG. 7

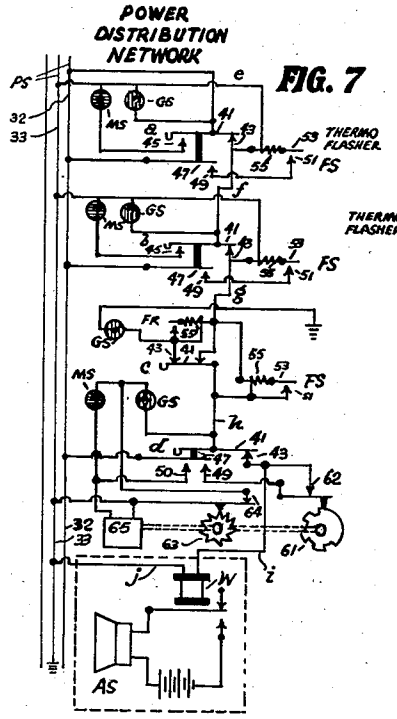


FIG. 8

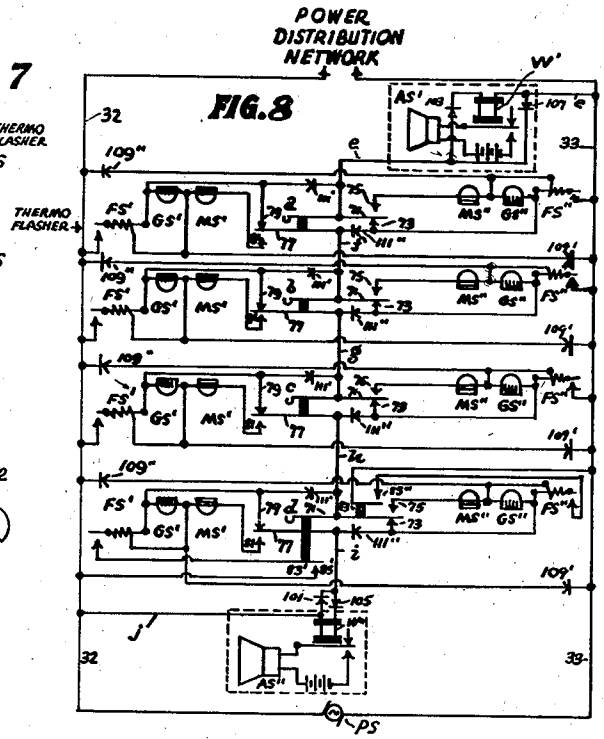
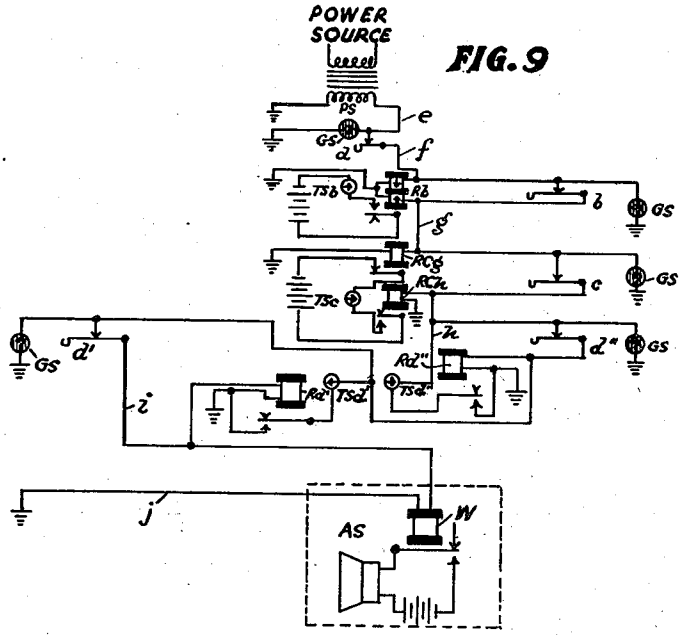


FIG. 9



INVENTOR

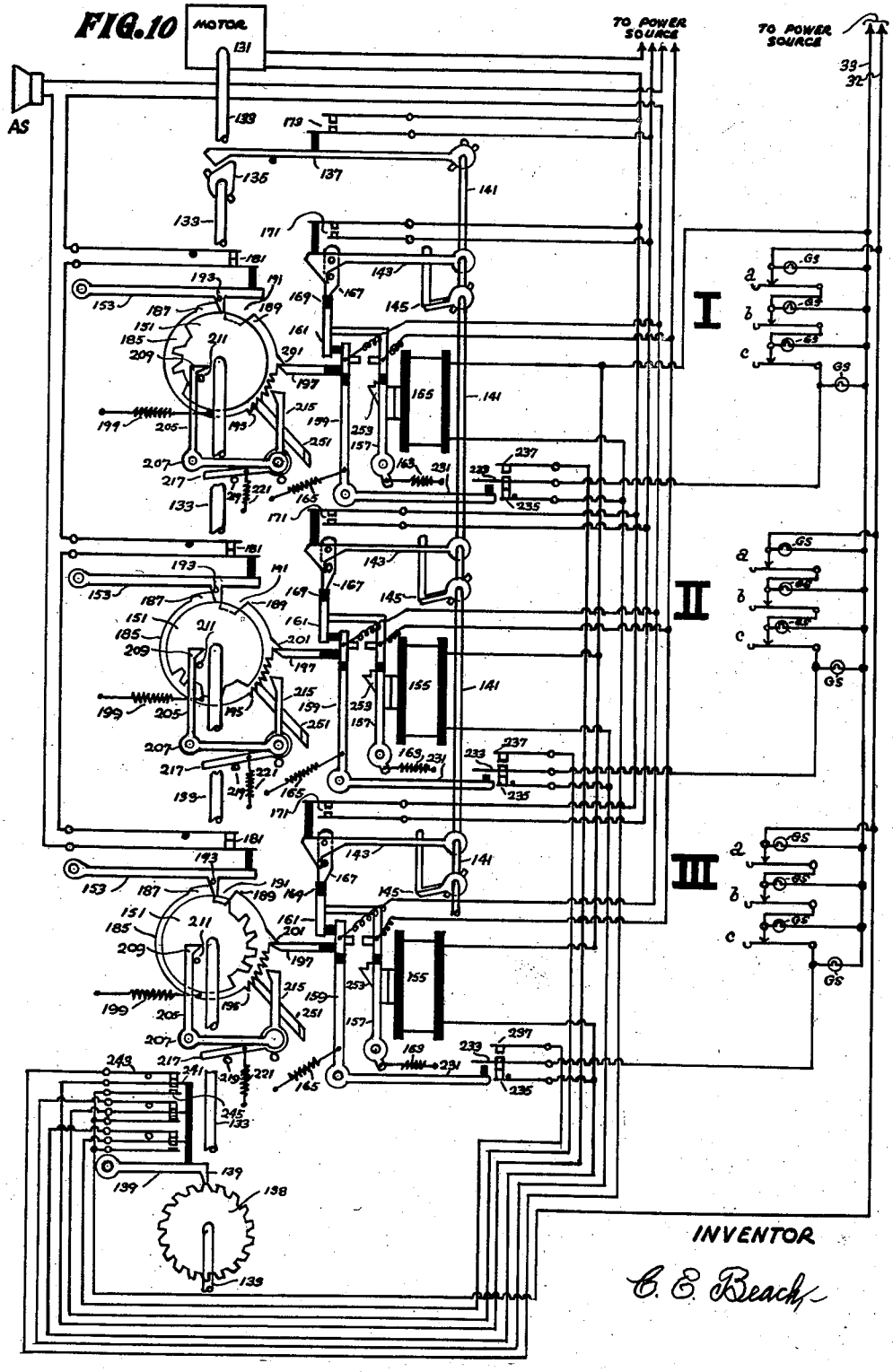
C. E. Beach

Nov. 3, 1942. C. E. BEACH 2,300,402

SIGNALING SYSTEM

Filed Aug. 3, 1940 4 Sheets-Sheet 3

FIG. 10



Nov. 3, 1942. C. E. BEACH 2,300,402

SIGNALING SYSTEM

Filed Aug. 3, 1940 4 Sheets-Sheet 4

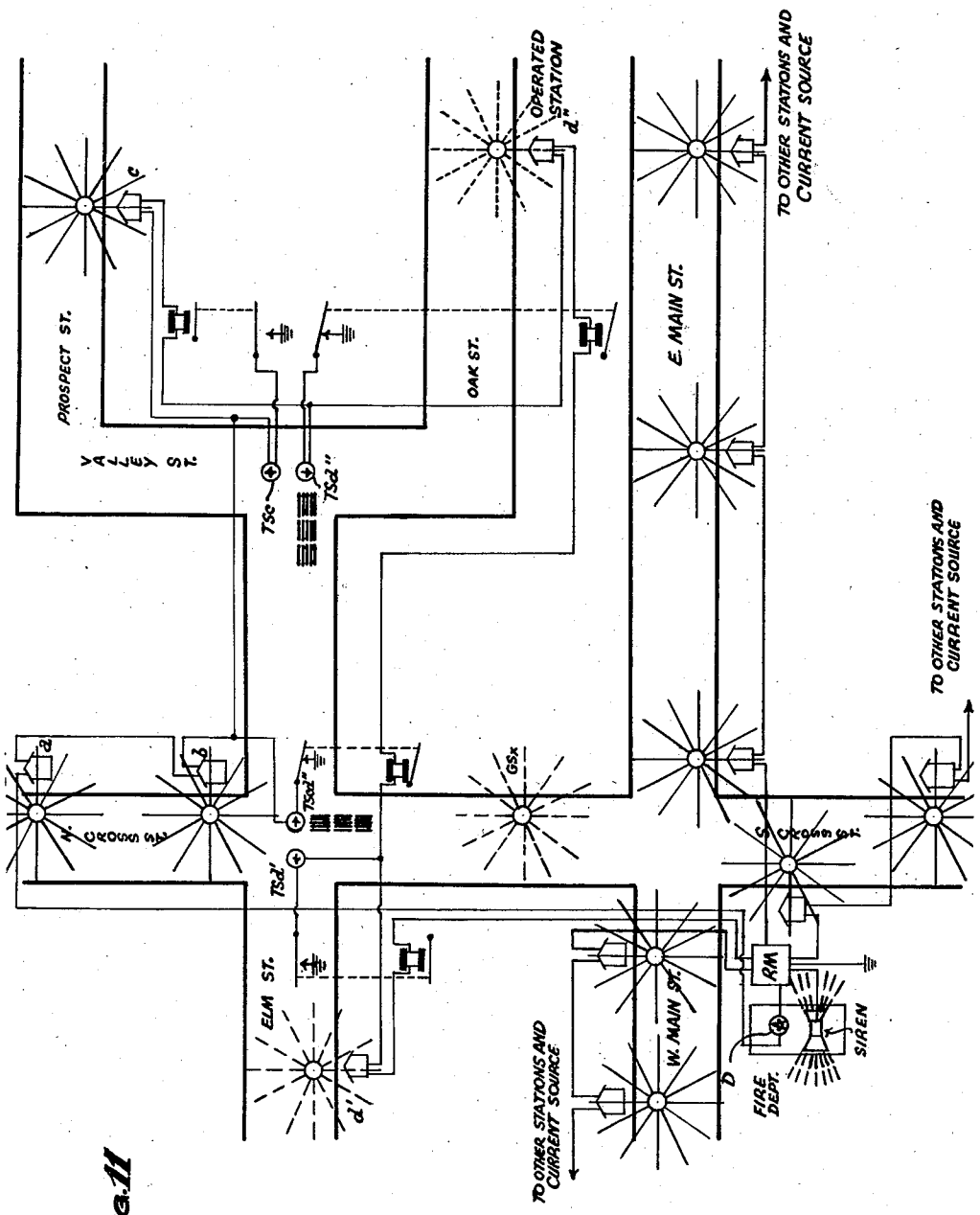


Fig. 11

INVENTOR.

C. E. Beach

Patented Nov. 3, 1942 2,300,402

UNITED STATES PATENT OFFICE

2,300,402

SIGNALING SYSTEM

Clarence E. Beach, Brookline, Mass.

Application August 3, 1940, Serial No. 350,523

69 Claims. (Cl. 177—337)

This invention relates to signaling systems, and, more particularly, to signaling systems for guiding persons to—and away from, under certain circumstances — localities where signals originate; as, for example, conventional forms of so-called "fire alarm systems."

A type of fire alarm system which is commonly used in this country has facilities for manifesting code signals representative of various calling stations, or so-called "fire alarm boxes." Such manifestations are ordinarily made at fire department or brigade stations in order that firemen may interpret the signals pursuant to a prearranged code, which is there displayed, for the purpose of ascertaining localities where their services are required.

In factories and various other places where there is a recognized hazard to occupants, provision for manifestation of code signals is sometimes made in the hope that these signals will be so interpreted that at least some persons will proceed and guide others away from the danger zone.

As to such fire alarm systems, experience has demonstrated that response of the fire department thereto is frequently delayed to a serious extent because progress is obstructed by other vehicles. Even after it is realized that the fire department is moving in the vicinity, drivers of such other vehicles (as well as the police officers who attempt to direct such drivers) are uninformed as to the route which the fire department should follow, and therefore are unable to determine what action they should take in order to afford clear passage; including such matters as, for example, whether diversion of traffic into an adjacent side street will assist or will more seriously obstruct the fire department.

To decrease this serious traffic hazard, various expedients have been proposed which have been found to involve expense deemed prohibitive where anything approaching comprehensive application has been considered.

For example, some use has been made of systems for causing signal manifestations along certain highways and operable from fire department houses or fire alarm headquarters, but it has been found that, if any such system is to cover more than a very limited number of "specially congested traffic localities" in communities of medium or large size, they require a complexity of switches, conductors and signaling facilities which has been deemed both unworkable and prohibitively expensive.

In a few communities, supplemental appliances have been utilized for indicating when alarms have been sent from certain ones of their fire alarm boxes, but the benefits derived from such appliances have not been generally found to be sufficient to justify their cost.

Correspondingly, a few highway intersections which have been deemed of special importance have been equipped with code signal manifesters which have proved somewhat helpful, but it has been found that vehicle drivers and highway police are not likely to be able to so interpret code signals thus manifested as to ascertain what route will be taken by the fire department, thus greatly impairing the benefit from such signals other than in instances of some few so-called "bottle neck" intersections which are traversed during nearly all alarm responses.

It has been correspondingly demonstrated that, in times of emergency, occupants of factories and other premises are unlikely to recall code designations with sufficient assurance to be materially assisted thereby in selecting routes of exit which will avoid localities from which alarms have been sent.

In addition to all of the foregoing, it has been found, by a large number of the smaller communities, that the expense of procuring and maintaining dependable forms of code signaling systems is, for them, prohibitive; and such communities are therefore without fire alarm service, other than such as may be available through the use of verbal or telephone calls.

In view of the foregoing, it should be apparent that code signaling systems for fire alarm and various other classes of emergency calls may reasonably be termed informative; but do not justify designation by the term directive, in the sense of actually serving to guide persons to (or away from, as circumstances may require) localities from which calls have been sent.

It is, therefore, an important object of this invention to provide signaling systems which shall be directive, both in the sense of serving to guide, persons who should respond thereto, along paths leading to actuated calling stations, and in the sense of guiding, those who might be endangered thereat, along paths which avoid the localities of such stations.

It is a further important object to provide means whereby such guidance will be afforded in a manner which will be fully effective for those who are unacquainted with the localities from which calls may come or with the sequence in which guidance signals should be observed.

It is another object to provide means whereby

persons may be forewarned of approach of and of route to be traversed by emergency vehicles for which they should afford a clear right-of-way.

A further object is to provide types of signaling systems which are suited in functional characteristics and from considerations of economy, both in initial cost and in maintenance, to practical conditions usually prevailing in small communities; even in the smallest communities which have fire fighting equipment.

It is another object to provide types of such systems which are readily convertible for alternative uses, such as being employed supplemental to or in lieu of present conventional types of code signaling systems.

A further object is to utilize, as far as practicable, equipment usually in service in existing signaling systems, whereby to minimize the expense of supplementing, pursuant to this invention, the service afforded by such systems.

It is a still further object to provide directive emergency signaling systems of such character as to avoid the problems of so-called "non-interference and succession" which have been presented in code signaling systems, to the end that persons will not be falsely guided toward (or away from, as the case may be) stations from which no call has been sent, because of concurrent activity of two or more calling stations.

It is a further object to provide types of signaling systems such that they may be readily converted either to a form in which response will be led to that one of several concurrently operated stations as occupies a predetermined position in the group or series in which such stations are disposed (as, for example, the station nearest the center of a small community) or such, for example, as one in which those who respond will be consecutively led to each of concurrently operated stations in a similarly predetermined order.

Still other objects will be, in part, specifically pointed out in the ensuing description, and, in part, will be obvious to those skilled in this art.

In constructing this invention, instrumentalities are provided for independently manifesting normal conditioning as well as one or more forms of abnormal conditioning of respectively associated portions of a current path. For convenience, such a path will, at times, be hereinafter referred to as a "determining path."

Such association may be effected by serially including controlling mechanism for, and/or such manifesting instrumentalities themselves, in a determining path; or by connecting such mechanisms or instrumentalities between such a path and a conductor available for conductive association therewith generally along the length thereof, as, for example, with the earth or with a neutral or other conductor of an electrical distribution network; or by inductively or otherwise associating such mechanisms or instrumentalities so as to render them responsive to presence or absence, in various portions of respectively associated paths, of one or more types of excitation such, for example, as carrier currents.

Utilization of one of the broader aspects of this invention, as thus far described, will facilitate discovery of any rupture of a current path, whether through accident or intent. Such utilization may be particularly beneficial in subways, tunnels, mines, and the like, where conductors may be carried along walls to be ruptured by or in the event of wrecks, explosions or other emergencies.

For many uses, such as signaling systems whereby assistance may be manually summoned, instrumentalities should be distributed along the determining path, each involving means operable or conditionable for interrupting and/or otherwise suitably effecting diverse conditionings of the portions of such path at respective sides of an abnormally conditioned station. For convenience, such instrumentalities will be hereinafter referred to in some instances as "calling stations" and in other instances as "boxes."

Calling stations may consist of or include mechanism, operable manually or otherwise, for altering the electrical conditioning of portions of an associated determining path, or may consist of conductor sections of such a path which are readily frangible, or are fusible or otherwise thermostatically responsive, for effecting like results.

The manifestation of signals may be accomplished visually or audibly. For many classes of service, such, for example, as fire alarm service, signals are respectively associated with portions of a determining path, at least one of which signals is associated with such a path-portion as to be responsive to abnormal conditioning of any calling station or stations. For convenience, signals of the last named general type will be hereinafter referred to as "general alarm signals," and other such associated signals will be hereinafter referred to as "guidance signals." The incandescent lamps frequently provided for rendering conspicuous the locations of so-called "fire alarm boxes" may, under many circumstances, be advantageously utilized in accordance with this invention as "guidance signals."

Guidance signals should be provided in numbers and at locations such as to best assure adequate effectiveness particularly in situations where those whose movements should be governed thereby may be unacquainted with locations of calling stations or with the sequence in which signals should be observed because of the order in which their associated stations are connected in the determining path.

In some instances this will involve provision of guidance signals at locations other than in close proximity to calling stations; as, for example, provision of signals, say adjacent a main highway fork or intersection, such as will enable those responding to a call to readily discern whether the operated station is to be reached by continuing on that highway or by turning therefrom in one direction or the other.

Furthermore, signaling aspects should be so chosen, and signals should be so controlled that one abnormal signaling aspect will identify a lane or route leading to a station that has been operated, another aspect will signify that a calling station closely adjacent thereto has been operated, other aspects will indicate where turns should be made from previously followed routes (as by use of an arrow or index); and normally conditioned guidance signals will indicate paths leading to calling stations which have not been operated.

Abnormal conditioning of visual guidance signals may be accomplished by change of color, intensity, or continuity of display; comparatively slow and rapid rates of flashing being alternatively employed in certain cases where manifestation of two varieties of abnormality are desirable.

More specific aspects of this invention also include means for terminating the sounding of

audible general alarm signals after activity thereof for a predetermined time, while permitting guidance signals to remain active or abnormal until restoration of calling stations.

Still more specific forms of this invention provide means whereby a general alarm signal may be rendered responsive to a plurality of determining paths, as well as means whereby such response will be in accordance with codes distinctively identifying respective ones of determining paths from which calls are received and/or responsive to code signaling impulses automatically or manually formulated at calling stations.

In order that they may be more readily understood, various embodiments of the foregoing features of this invention, together with other specific features thereof, are indicated in the annexed drawings, in which:

Figures 1 to 9, inclusive, are diagrammatic representations of circuit arrangements disclosing certain of the more specific features of this invention and—collectively—are representative of the many embodiments of the elemental features thereof which may be alternatively utilized for meeting diverse service conditions.

Fig. 10 is a schematic representation of a system having several determining paths with associated mechanism rendering one general alarm signal (or group of such signals) responsive to all of such paths; and

Fig. 11 diagrammatically illustrates the application of features of this invention to and their operation in a public fire alarm system.

Embodiments of certain of the elemental features of this invention are schematically indicated in Figs. 1–9, in each of which the reference characters *a*, *b*, *c* and *d* designate switches of calling stations, and characters *e*, *f*, *g*, *h*, *i* and *j* respectively indicate portions of a determining path in which said stations are serially connected between a terminal of the winding W which governs a general alarm signal AS, and a terminal of a current supply source PS.

The remaining terminals of said source and winding are connected through paths including a conductor which is available adjacent various calling stations, and which conductor may be the earth (as indicated in Figs. 1, 2, 3, 4 and 6) and/or may form part of a power distribution network (as indicated in Figs. 5, 7 and 8). For convenience, any such generally available conductor will, at times, be hereinafter referred to as "a common return conductor."

Guidance signals GS are so located as to be visible along the path ordinarily followed in responding to a call, usually at least to the extent of providing one such signal in association with each calling station.

For many service conditions, it is desirable that, when a calling station has been operated, a signal or signals situated adjacent thereto will present an aspect which differs from the aspects presented by signals which are not associated with stations then in operated condition; hence, in Figs. 3, 4, 5, 6, 7 and 8, signals MS supplement the guidance signals GS for rendering conspicuous calling stations which have been operated. Such signals will, at times, be hereinafter referred to as "marker signals."

Where certain of the guidance signals are situated other than at calling stations, it may be found advantageous to have those signals which are associated with calling stations of a differing color or otherwise readily distinguishable from the others.

It should be understood that, under certain circumstances, as where marker signals are provided, it may be found more advantageous to connect the guidance signals to portions of the determining path between respectively associated calling stations and the alarm signal, as indicated, for example, in Figs. 4, 5, 6 and 8, instead of at the other side of such stations, as indicated in Figs. 1, 2, 3, 7 and 9.

Correspondingly, other features of this invention may be utilized without what are herein termed "alarm signals;" as, for example, where there are audible marker and/or guidance signals.

Where calling station switches are associated with some other signaling system, alarm signals responsive to determining paths may not be needed; as, for example, in a case where such switches are associated with so-called "boxes" of a fire alarm telegraph system in a manner such that an associated switch will be operated whenever the mechanism of a box is set in action. An arrangement whereby such switches may be so operated is disclosed in Patent No. 2,167,964, to Weld and Smith.

It should be further understood that wherever guidance, marker or other signals have been shown by the drawings and are herein described as deriving energy through the determining path—as for lighting lamps or for sounding audible signals—such energy may be otherwise obtained, without departing from the more general aspects of this invention, as from primary or secondary batteries, from public or private electric power supply networks or sources, from compressed air or other liquid, or from normally wound weight or spring operated mechanisms.

Inasmuch as energy so derived may be governed in accordance with various methods well understood by those skilled in this art (as by the use of interposed relays or the like) it is not deemed needful to describe any such methods in detail herein, other than to point out that signals should be so governed that they will be normally conditioned only while the determining path is uninterrupted between a predetermined end and respectively associated portions thereof.

For convenience in illustration, guidance and marker signals are indicated in the accompanying drawings as incandescent lamps and general alarm signals are indicated as of the horn or siren type. It should be understood, however, that audible signals and/or visual signals of other well-known types may be substituted for or used in addition to those so shown.

Where the accompanying drawings show systems having alternative arrangements of similar parts (as in the instances of Figs. 5, 6, 7, 8 and 9) it should be understood that this is done as a matter of convenience, and that, in utilizing this invention, adherence to one or another of such alternatives in a given system will usually afford best results.

Figure 1

With the arrangement indicated in Fig. 1, current flow from source PS normally supplies the lamps GS and energizes the alarm signal winding W through parallel paths, thus lighting these lamps and silencing the associated audible signal AS.

Opening of the determining path by a calling station switch, by a thermostat (as those indicated at loop T) or otherwise, will cause sound-

ing of the alarm AS as well as extinguishment of all guidance lamps in the determining path between the break and said alarm.

Thus, opening of the switch of station *b* will cause extinguishment of lamps GS of stations *c* and *d*, as well as deenergization of relay winding W, with resultant sounding of the alarm signal AS; but lamps GS of stations *a* and *b* will remain lighted by energy supplied from source PS through determining path conductors *e* and *f*.

Response to such call may then be made by proceeding to, or at least within sight of, various guidance signals in the order in which they are associated with the determining path, in the direction away from the general alarm signal AS; passing those guidance signal lamps which are extinguished, and recognizing station *b* as having been operated because its associated guidance signal GS is still lighted.

After acting in response to such a call, the system may be restored to normal condition by reclosing the open calling-station switch or switches.

Should two or more calling station switches be abnormally conditioned, those guidance signal lamps will be extinguished which are responsive to portions of the determining path situated between the alarm signal AS and such one of the abnormally conditioned stations as is associated with a portion of said path most distant from said alarm signal.

If it is desired that identification shall be made of an operated calling station in advance of response thereto, this can be accomplished by connecting a suitable instrument in the portion of the determining path situated between the power source and the calling station most directly connected therewith, as in the portion *e* of Fig. 1.

Such an instrument may be termed a "calling station designator," and should be of a type which will suitably manifest variations in electrical conditioning.

A designator D, of ammeter type, is indicated in Fig. 1; and corresponding instruments may be similarly associated with systems such, for example, as those of Figs. 5, 6, 7, 8 and 9.

It is evident that the current flow to which designator D is subjected will vary in differing degree responsive to operation of the various stations. Thus, if the current flow through winding W approximates that through each station signal, opening of station switch *d* will decrease the current flow one-fifth, that of station *c* two-fifths, and correspondingly for the other stations.

The station designations may therefore be consecutively marked upon the dial of the designator of such a system at intervals of one-fifth of the normal indication. Then, when a call is sent by interrupting the determining path, the designator will act in response to the reduction in current flow to designate the calling station.

Figure 2

The system of Fig. 2 differs from that of Fig. 1, principally, in that the guidance signals GS are serially connected in the determining path, the power source PS2 is of such character that the maximum current flow which will be delivered thereby will be insufficient to injure the guidance signals GS, and abnormal conditioning of calling station switches not only serves to interrupt the determining path (as in the case of Fig. 1) but also serves to connect to the earth (or other common return conductor) such portion of said path as leads therefrom through conductor *e* to source PS2. Furthermore, there is shown a disarrangement signal ES, which is associated with the power source PS2 in such manner as to give warning in the event of cessation of current flow therefrom into the determining path; the use of such an emergency signal may be omitted, however, under many operating conditions.

In operation, when, for example, the switch at station *c* is abnormally positioned, guidance signal GS at station *d* and alarm signal AS will be abnormally conditioned; that is, the lamp at *d* will be extinguished and an audible alarm signal will sound.

Because of the character of the source PS2, the current flow through the guidance signal lamps GS at stations *a*, *b* and *c* will not harmfully increase responsive to the decrease in the resistance of the current path due to shorting out the winding W and the lamp at *d*.

Accidental rupture of the determining path of Fig. 2 will cause a signal differing from that resultant from actuation of any calling station switch, in that all of the guidance signals will then be abnormally conditioned, and disarrangement signal ES will sound.

Figure 3

The system indicated in Fig. 3 differs from that of Fig. 2 in that its power source PS is of the ordinary constant potential type, and equalizing resistances 28 are included in the paths to the earth or other common return conductor which are closed incident to abnormal positioning of respectively associated calling station switches.

If any station switch of a system such as that of Fig. 3 is abnormally positioned, it interrupts current flow in the portion of the determining path extending therefrom toward and including alarm signal AS, and then establishes a path the resistance of which is substantially equivalent to that so interrupted, so that current flow therethrough may be maintained at substantially the same intensity as under normal conditioning.

Location marker lamps or other signals MS may form parts of respective equalizing resistances, thus rendering an operated station more conspicuous. Such marker signals may be made distinguishable from guidance signals by a difference in color, relative position or appearance.

Those responding to the alarm signal of a system having both guidance and marker signals, may first observe the guidance signal to which they have most ready access. If this is found to be normally conditioned, they should proceed in the direction toward the general alarm signal; if abnormal, they should proceed away from the general signal. In either event, the operated calling station will then be recognized by abnormal conditioning of its marker signal.

Marker signals, such as here contemplated, as well as those indicated by Figs. 4, 5, 6, 7 and 8 may, under many circumstances, be advantageously located in close proximity to respectively associated guidance signals; so that if, for example, the guidance signals are red and marker signals in close association therewith are blue, lighting of both such signals will cause a purple effect at a little distance, and thereby assist in ready identification of an abnormally conditioned station.

If desired, a disarrangement signal such as ES of Fig. 2 may be associated with the determining path of a system such as that of Fig. 3.

Figure 4

The embodiment indicated in Fig. 4 differs from that of Fig. 3 principally in that two current sources PS4 and SPS are provided at respective ends of the determining path, calling stations apply ground connections to both ends of the determining path when it is interrupted thereby, equalizing resistances 26, 28 are provided in such connections which are suitable for the respective paths to be established therethrough, a flasher interrupter FS is connected in one of these ground paths, (preferably that for the portion of the determining path extending toward alarm signal AS), and the guidance signals GS are connected in the portions of the determining path extending from the associated stations toward said alarm signal AS.

Each of the station switches comprises a member 21 which is normally spaced from but may be moved into engagement with a contact 22; also a movable member 23 which normally rests against said member 21 and moves into engagement with a contact 25 only while said member 21 is withdrawn therefrom incident to abnormal positioning thereof. The resistances 26 and the flasher interrupters FS are included in the connections between contacts 25 of the various stations and the earth or other common return conductor.

The resistances 26, 28 may be dispensed with if the sources PS4 and SPS are of limited maximum current type, as contemplated by Fig. 2. In any event, these sources should be of character such that all of such signals may be effectively supplied by either source independently of the other.

In operation, if, for example, the switch of station *b* is abnormally positioned, normal conditioning will be maintained of signal GS of station *a* and abnormal conditioning will be effected of marker signal MS of station *b* by current flow from one terminal of source PS4 through members 21 and 23 of switch of station *a* and through member 21 and contact 22 of switch of station *b*, through signal MS and resistance 28 of said station to the earth, and thence to the other terminal of source PS4; said resistance 28 being such as will compensate for that of the excluded portion of the determining path which is situated beyond station *b* in the direction of source SPS.

At the same time, there will be current flow in a path from one terminal of source SPS, through winding W, through guidance signals GS and switch members 23 and 21 of stations *d* and *c*, as well as signal GS, switch member 23 and contact 25 of station *b*, and thence through flasher FS and equalizing resistance 26 of station *b* to earth and to other terminal of source SPS; but resultant current flow will be insufficient to cause either effective energization of W or lighting of guidance signal lamps GS at stations *b*, *c* and *d*, until said flasher acts to close the contacts thereat.

The results of the establishment of these paths will be that signal GS of station *a* will remain normally conditioned (lamp continuously lighted) signal MS of station *b* will be abnormally conditioned (lamp of abnormal color continuously lighted) signals GS of stations *b*, *c* and *d* will be abnormally conditioned (intermittently lighted or flashed responsive to FS of station *b*) and alarm signal AS will be abnormally conditioned (sounding intermittently, if of audible type); which conditionings will continue until the switch of station *b* is restored to its normal position.

When switches of two or more stations are abnormally positioned, conditionings of signals associated with stations situated in the determining circuit between source PS4 and the abnormal station nearest thereto, and those between source SPS and the abnormal station farthest from source PS4, will be similar to conditionings of correspondingly situated signals as just described. Thus, assuming that stations *b* and *c* are concurrently abnormal, signal GS of station *a* will be normal (continuously lighted) and MS of station *b* will be abnormal (continuously lighted) and alarm signal AS, and signals GS of stations *d* and *c* will be intermittently energized (flashing and/or sounding); while signal GS of station *b* will be continuously deenergized (extinguished), and signal MS of station *c* will be normally conditioned (extinguished) notwithstanding that the switch of *c* is abnormal.

All signals of stations situated in the determining path between concurrently abnormal stations will be deenergized, thus without indication of either normal or abnormal conditioning thereof.

It will be evident that a disarrangement signal such as ES of Fig. 2 may be associated with embodiments of this invention such as that of Fig. 4. It will also be evident that response of the signals of Fig. 4 differentiates between an accidentally ruptured determining path and abnormal conditioning of a calling station switch, inasmuch as a merely ruptured determining path will cause continuous abnormal conditioning of such general alarm signal as is responsive to winding W, of all guidance signals GS associated with that path, as well as of a disarrangement signal ES (if one is provided); while abnormal positioning of a calling station switch will cause intermittent response of the signal AS and of the signal GS of the operated station as well as those associated with portions of the determining path situated between that station and the source SPS.

It will be understood by those skilled in this art that values for resistances corresponding to 26 and 28 may be so selected that the lamps situated in the determining path at one side of an operated station will be lighted far more brightly than those at the other side thereof. Such an arrangement might be found specially suited to uses in dark areas, as within buildings, tunnels, and the like.

It will also be evident that distinctive degrees of lamp brightness may be similarly attained for embodiments of this invention, other than that indicated in Fig. 4, and that need may thus be obviated for flashers at calling stations.

Figure 5

Fig. 5 indicates a system in which guidance and general alarm signals are connected in parallel with each other between the determining path and a common return conductor (which may be the earth) in a manner analogous to that indicated in Fig. 1, while providing operative results more nearly corresponding with those of systems such as that indicated in Fig. 4; calling station switching mechanisms indicated at stations *a*, *b* being of a type differing from that indicated at stations *c*, *d*.

Arrangements such as that of Fig. 5 are particularly suited to situations where an integral electrical power distribution network conductor system is available adjacent all calling stations and signals, as for example, conductors 32 and 33 of a three wire distribution system.

The guidance signals GS are associated with the determining path in portions thereof situated toward the general alarm AS from associated calling stations, while the corresponding signals of Fig. 1 are connected to the path at the opposite sides of the stations there shown. Otherwise, the arrangement of the guidance signals of Fig. 5 corresponds with that of like signals of Fig. 1, and requires no further explanation at this point.

The marker signals MS of stations *a* and *b* are energized from portions of the determining path situated between their respectively associated stations and the alarm AS, and their action will therefore be analogous to that of corresponding signals of Figs. 3 and 4, except as will be presently otherwise explained.

The marker signals MS associated with stations *c* and *d* are so energized and controlled that abnormal conditioning thereof will be effected when their respectively associated station switches have been operated, irrespective of the number of calling stations which are concurrently so operated and—in fact—independently of accidental rupture of any portion or portions of the determining path.

A system such as that of Fig. 5 also provides means (here exemplified by the conventional thermo-flashing interrupter FG) which is responsive to the portion of the determining path nearest the general alarm signal AS for causing intermittent application of a reenergizing electromotive force to such portion upon interruption or other abnormal conditioning thereof. It should be understood that various other well-known types of flashers (motor driven or otherwise) may be correspondingly used.

Operation of the switch of a calling station, such as *c*5 or *d*5, will cause abnormal conditioning (continuous lighting) of its associated marker signal MS; such operation will also cause intermittent abnormal conditionings (flashing) of its guidance signal GS as well as of guidance signals of other stations situated in portions of the determining path between any such operated station and the flasher FG, provided no intervening stations are then operated.

If two or more stations such as *a*5 or *b*5 are operated, marker and guidance signals will be caused to flash at such one thereof as is connected with the flasher FG by an unbroken portion of the determining path, together with the guidance signals of all other stations which are associated with such intervening unbroken portion. The guidance lamps which are associated with portions of such a path between operated stations will be extinguished, irrespective of whether they have been operated; however, marker lamps of operated stations such as *c*5 and *d*5 will be lighted even though situated in a portion of the determining path farther from flasher FG than some other operated station. Thus, an operated station such as *d*5 which is nearer flasher FG than all other operated stations, will continuously show a lighted marker signal MS and a flashing guidance signal GS, while only the associated marker signal will be lighted at operated stations of this type farther from flasher FG.

It will be noted that the general interrupter flasher FG is so associated with the determining path and with the conductors 32 and 33 of the current source that current normally flows through its heating coil. Hence, this flasher will become active very quickly, following interruption of the normal determining path by any calling station, notwithstanding low climatic temperature, so that formulation of flashing impulses will quickly occur for causing intermittent response of alarm signal AS and flashing of the guidance signal GS at such station, as well as like flashing of the guidance signals at intervening stations and of the marker signal of the operated station if it is of the type of *a*5 and *b*5.

Figure 6

The system of Fig. 6 resembles that of Fig. 5 in that the guidance signals GS and the marker signals MS are here connected in parallel between the ground and portions of the determining path between the associated stations and alarm AS, while resembling the system of Fig. 4 in having comparatively slow acting flashers FS, associated with various stations. These flashers are, however, here so associated as to intermittently interconnect portions of the determining path at respective sides of abnormally conditioned switches.

Three calling station arrangements are here indicated, of which those of stations *b*, *c* and *d* have flashers FR for causing, during abnormal switch positioning thereat, comparatively rapid flashing of respectively associated lamps MS, and, in the instances of stations *b* and *c*, flashing of lamps GS in unison therewith. The signals GS of stations *a* and *d* will, however, respond only to their slow flashers.

An independent power source IPS is associated with the marker signal MS and the flasher FR of station *d* in such manner that said signal will rapidly flash throughout abnormal positioning of its switch, irrespective of conditioning of any other calling station switches or of any portions of the determining path.

From the foregoing, it will be apparent that concurrent operation of several calling stations will result in lighting of the signals MS and GS of that station which is situated in the determining path nearest to source PS. If an operated station such as *a* is so situated, its signals MS and GS will be lighted intermittently responsive to its flasher FS; if such as *b* and *c*, its signals MS and GS will flash rapidly responsive to its flasher FR; and, if such as *d*, its signal MS will flash rapidly and its signal GS will flash slowly responsive to its flashers FR and FS, respectively.

Lamps MS of operated stations such as *a*, as well as lamps GS of unoperated calling stations toward alarm signal AS therefrom, will be lighted only during closures of flashers FS of all other stations then operated and situated in the determining path nearer source PS, and the lamps GS of operated stations such as *a* or *d* will be lighted only during closures of their own flashers FS which occur during closures at such other stations. At stations such as *b* and *c*, lamps MS and GS will be lighted only during closures of their own flashers FR which occur during closures of flashers FS of such other stations, and may therefore give a series of rapid flashes only during such other closures.

Thus, slowly flashing guidance signal lamps indicate a call from a station farther from the general alarm; guidance lamps continuously lighted, indicate that any operated station is nearer the general alarm; and a slowly flashing marker signal of a station such as *a* or a rapidly flashing marker signal of a station such as *b*, *c* or *d* will be found at an operated calling station.

It will be noted that, under normal conditions, there is no current flow through station flashers of systems such as that of Fig. 6, so that—still assuming that these flashers are of the thermal type—there will be some delay between the actuation of a calling station switch and the first closure of its associated flasher or flashers.

Resultant prolongation of first sounding of an audible alarm signal may prove to be distinctly advantageous in serving to render more noticeable the ensuing soundings of comparatively short duration.

If the general alarm signal is of the siren type, such a prolongation of the first blast may be particularly advantageous in that it will assure that the siren will attain a satisfactory velocity before its energization becomes intermittent.

Figure 7

Arrangements are indicated in Fig. 7 for obtaining various results supplemental to those described in connection with Figs. 1 to 6. Results thus obtainable include those of minimizing delay in bringing thermo-flashers into action, utilization of a single lamp or other signal for both guidance and marker purposes, and formulation of code signals in a determining path.

The determining path is here shown connected between conductors 32 and 33 of a power distribution network, and connections are indicated at stations *a*, *b*, and *d* with both of these conductors. It should be understood, however, that a common return conductor, such as the earth and/or several independent power sources, may be alternatively employed, as will be readily apparent to those skilled in this art.

Under normal conditions, there is current flow between the determining path and the conductor 33, through the heating coils 55 of the thermo-flashers FS of stations *a* and *b*. The tongues 53 of these flashers are therefore normally spaced from their contacts 51; and, upon operation of any such station, current flow ceases through the heating coil of its flasher. Resultant cooling then causes this tongue to move into engagement with its contact 51.

At the operated station, this will establish a current path from supply conductor 32, through contacts 47, 49 which are associated with the switch member 41, through flasher contact 51 to the tongue 53; thus restoring current flow through the coil 55 and through the stations situated in portions of the determining path more distant from its normal connection with said conductor 32.

Repetition of this action will cause intermittent sounding of the alarm signal AS and flashing of the initially extinguished signals GS.

Operation of a station such as *a* and *b* causes its marker signal MS to be continuously lighted.

Although supply of needed energy at these stations is shown as from conductors 32, 33, it should be understood that such supply may be otherwise obtained, as from batteries or from other power sources.

The arrangement of station *c* illustrates the use of a ground return instead of a direct connection with the distribution network, where it is not needful that the coil of the flasher shall be normally heated.

The signal GS of station *c* is so controlled that while it serves as a guidance signal corresponding to the signals GS of stations *a*, *b* and *d*, it also serves as a marker signal in that, like the signals MS of stations *a* and *b*, the signaling aspect which it displays when its associated station has been operated is distinctively different from that displayed under any other circumstances. To this end, the rapid flasher FR is rendered effective by the operation of the switch of station *c*; said flasher being short-circuited at other times. The comparatively slow acting flasher FS then serves to cause flashing of the guidance lamps of stations in the path nearer to signal AS, as would be the case for stations such as *a* and *b*.

The arrangement of station *d* includes a driving motor 65 rendered active by operation of the switch member 41, and the rapid interrupter wheel 63 and the comparatively slow code signal formulator wheel 61 driven by said motor.

Operation of station *d* moves its switch member 41 away from contact 43, thus depriving the path portion between this station and the signal AS from the current normally reaching it from conductor 32 through the remainder of said path.

Such operation also carries the switch member 47 into engagement with the contacts 49 and 50, thus supplying energy from conductor 32 for causing operation of the motor 65 (as already referred to) and for lighting the associated signal lamp MS, as well as for re-energizing the path portion toward signal AS during closure of the contacts 62.

It should be understood that, although the motor 65 is indicated as electrically driven from the supply conductors 32, 33; this motor may be of spring driven type, normally pre-wound or wound incidental to operation of the switch member 41, and electrically or mechanically released, all in accordance with practices well known in the signaling station art.

Under normal conditions the alarm signal AS is silent, guidance lamps GS are steadily lighted, marker lamps MS are extinguished, flasher coils of stations such as *a* and *b* are heated, and motor 65 and the wheels 61 and 63 are at rest.

Operation of station *b* will deenergize its heater coil 55 and render abnormal its signal MS together with signal AS and the signals GS of stations *c* and *d*. Tongue 53 of the associated flasher FS will cool and therefore close with contact 51, re-energizing coil 55, relighting signals GS at *c* and *d* and silencing signal AS until reheating causes tongue 53 to again leave contact 51.

Signals GS at *c* and *d* will thereafter be intermittently lighted, signal AS will correspondingly sound, and signal MS at *b* will be constantly lighted until switch member 41 is restored.

Should switches be operated at both stations *a* and *b*, the lamp MS of station *a* will be lighted, the lamp GS of station *a* will remain lighted, the lamps MS and GS of station *b* will be lighted during closures of flasher FS of station *a*, and the lamps GS of other stations nearer signal AS will be lighted, and said signal silenced, during closures of the flasher FS at the station *b*. It will thus be indicated at station *b* that it has been operated and that another station more distant from signal AS has also been operated.

Operation of a station such as *c* will produce similar results, except that its signal GS will flash rapidly to show that it has been operated, and if a like station more distant from the signal AS has also been operated, such rapid flashings will occur only during closures of the contacts of the flasher of such other operated station.

Operation of a station such as *d*7 causes the alarm signal AS, and the guidance signals GS of stations between AS and the operated station

to respond in accordance with the code identifying the active station; here indicated as the code 4 for the station *d*.

In other words, the general alarm signal AS and the guidance lamps GS of stations between station *d*, and the alarm signal AS will have energizations in groups of 4, with intervening pauses, thus signifying that the station identified by this code is active. The guidance signal and the marker signal lamps of such active station will flash rapidly.

If two or more stations such as *d*7 are concurrently active, their marker signals will continuously and rapidly flash, just as if each were the only active station, as will the guidance signal of the active station farthest in the determining path from alarm signal AS. The alarm signal AS will respond to the code designating the station nearest in the determining path thereto, as will guidance signals of inactive stations therebetween. The guidance lamps of stations situated in the determining path between active stations will be lighted only during code signaling closures of such one of the active stations as is situated in the determining path nearest thereto in the direction away from the alarm signal AS; and should any such intervening station be active, its guidance signal will display a series of rapid flashes for each such code signaling closure.

Should the determining path be accidentally ruptured at any point, a continuous warning will be given by the alarm signal AS and by the extinguishment of all guidance and marker lamps.

While such path is so broken, should the switch be operated at any station such as *a*, *b* or *d*, if such station is situated in the determining path between the break and the winding W, the alarm signal AS, and the guidance lamps between said signal and the operated station will respond as if the determining path had not been ruptured. If the marker lamp of such operated station is controlled in a manner such as or analogous to that indicated at station *d*, the marker lamp of such station will indicate that it has been operated.

Figure 8

Under some conditions, it is desirable to provide signals for independently guiding responses from respective directions or along two routes—as along highways with lanes on opposite sides of a central barrier, or along adjacent so-called "one way streets," for vehicular movements in respective directions.

It is evident that, under such conditions, guidance signals may be of such form and so distributed as to serve to guide responses to various calling stations from localities in diverse or opposite directions therefrom by the use of two signaling systems each having a determining path and arranged in accordance with some embodiment of this invention such as those hereinbefore described.

In the embodiment of this invention which is indicated in Fig. 8, a single determining path serves such a dual-direction signaling system, the ends of such path being supplied from the respective conductors **32**, **33** of an alternating current supply, and paths are provided for governing the signals, which paths include uni-directional conductors or rectifiers **101**, **103**, **105**, **107**, **109**, **111**; so that the guidance signal lamps GS', the marker signal lamps MS' and the alarm signal AS' are governed by current flow in one direction and the lamps GS'' and MS'' with the alarm signal AS'' are governed by current flow in the opposite direction.

The alarm signals AS' and AS'' serve to summon responses from the localities of respective ends of the determining path, and the lamps GS' and MS' and the lamps GS'' and MS'' are rendered visible for guiding responses and facilitating movements from the localities of signals AS' and AS'', respectively.

At each calling station, a movable switch member **71** normally engages a contact **73** and is movable therefrom and into engagement with a contact **75**, and a supplementary switch member **77** normally engages contact **79**, being movable therefrom into engagement with contact **81** responsive to abnormal positioning of said member **71**.

For classes of service such that it is objectionable to have flashing of guidance signals and intermittent sounding of alarm signals result in response to breaking of the determining path when no stations have been operated, signaling stations should be provided with supplemental movable switch members such as those indicated at station *d*, at which members **83'** and **83''** are movable responsive to abnormal positioning of member **71** to close with contacts **85'** and **85''** respectively, and thereby complete a connection between the contacts of flashers FS' and FS'' with supply conductors **32** and **33** respectively, which connections are otherwise open at this station.

Under normal conditions, current flow in the direction toward supply conductor **33** proceeds through conductor *j*, rectifier **101**, conductor *i*, member **77** and contact **79** of station *d*, and there divides. One portion thence proceeds through associated guidance signal GS' and through coil of flasher FS' in parallel therewith, and thence through rectifier **109'** of said station to source conductor **33**. The other such portion proceeds through rectifier **111'** and conductor *h*, correspondingly through station *c*, through conductor *g* and correspondingly through station *b*, through conductor *f* and correspondingly through station *a*, through conductor *e*, rectifier **103** and winding W' to source conductor **33**.

Normal current flow in the direction toward supply conductor **32** proceeds through conductor *e* and rectifier **107**, through switch member **71** and contact **73** of station *a*, and there divides. One portion thence proceeding through associated guidance signal GS'' and through heating coil of flasher FS'' which is in parallel with said signal, thence through rectifier **109''** to supply conductor **32**. The other such portion proceeds through rectifier **111''** and conductor *f*, correspondingly through station *b*, through conductor *g* and correspondingly through station *c*, through conductor *h* and correspondingly through station *d*, through conductor *i*, rectifier **105**, winding W'' and conductor *j* to supply conductor **32**.

Operation of the switch of station *c* will interrupt current flow from supply conductor **32** to supply conductor **33** through a portion of the path just indicated, because of movement of member **77** away from contact **79**; and will interrupt current flow from supply conductor **33** to supply conductor **32** through a portion of the path just described because of movement of switch member **71** away from contact **73**.

Signal lamps GS'' of stations *a* and *b* and GS' of station *d* will remain lighted, being unaffected by such action; but signal lamps GS'' of stations *c* and *d* and GS' of stations *a*, *b* and *c* will be

extinguished, and alarm signals AS' and AS'' will sound.

Furthermore, signals MS' and MS'' of station *c* will be lighted through current paths established when members **77** and **71** engage contacts **81** and **75**, respectively, at said station.

When the alarm signals AS' and AS'' sound and certain of the signals GS' and GS'' are extinguished, as just described, the heating coils of flashers FS' and FS'' of station *c* will be deenergized and, resultant cooling will cause the tongues of these flashers to move into engagement with their associated contacts, and thus reestablish current paths for the alarm signals AS', AS'', and for the signals GS' and GS'' which were at first extinguished. Thereafter, such initially extinguished signals will be intermittently lighted, and sounding of said alarm signals will be intermittently continued, resultant from the alternate heating and cooling of said flashers.

From the foregoing, it will be evident that response from the locality of alarm signal AS'' will be guided to station *c* by the flashing of the guidance signal lamp GS'' at stations *d* and *c*, and by the continuous lighting of the signal MS'' at station *c*.

Response from the locality of alarm signal AS' will be correspondingly guided by flashing of the guidance signals GS' at stations *a*, *b* and *c* and by the continuous lighting of the signal MS' at station *c*.

Should several stations be concurrently operated, the response of the signals for respective directions of response will correspond with those of systems hereinbefore described.

For instance, if the switches of stations *b* and *c* are concurrently operated, alarm signals AS' and AS'' will sound, response from locality of alarm signal AS' will be guided to station *b*, where signal lamp MS' will be lighted intermittently (being dependent upon closures of flasher FS' of station *c*) thus indicating that it is one of several operated stations; while signal MS' of station *c* will be continuously lighted, thus indicating not only that it has been operated but also that there are no operated stations beyond it in the direction of travel away from signal AS'.

Response from locality of alarm signal AS'' will be correspondingly guided to stations *c* and *b*.

Should the determining path be accidentally broken, as by rupture of conductor *h* between stations *c* and *d*, the alarm signals would sound as in the case of the operation of a calling station, but none of the marker signals would be lighted.

Assuming that all of the stations are constructed as indicated at station *d*, such rupture of conductor *h* would result in continuous sounding of the general alarm signals AS' and AS'', and in extinguishment of guidance signals GS' of stations connected to the determining path between the break and the alarm signal AS', as well as signals GS'' of stations connected to said path between such break and the alarm signal AS''.

Were all of the stations constructed as indicated at stations *a*, *b* and *c*, the result would be the same as just described, except that closing of the contacts of the flashers, following deenergization of their heaters, would result in intermittency of the soundings of the alarm signals and of extinguishment of guidance lamps; so that closures of the flasher FS' of station *c* would cause intermittency in the sounding of alarm AS' and flashing of the signals GS' of stations *a*, *b* and *c*, and closures of the flasher FS'' of station *d* (were its construction such as that of stations *a*, *b* and *c*) would cause flashing of the signal GS'' thereat.

Figure 9

Arrangements indicated in Fig. 9 are specially suited to situations in which it is desirable to indicate which of several alternative courses should be followed in responding to a call.

For convenience in illustration, the general arrangement of the determining path and of the calling station switches here shown, corresponds with that indicated in Fig. 1; but it should be understood that the features of this invention which are indicated in Fig. 9 may be utilized in connection with embodiments other than such as that of Fig. 1.

Stations *b*, *c*, and *d''* are indicated as being at one side and station *d'* at the other side of the general course of the determining path. Thus, it might be that stations *b*, *c*, *d'* and *d''* are situated on streets at one side or the other of and are not visible from a main traffic artery; or such stations might be situated in rooms or sections of a building at some distance, and perhaps not visible from the main path of exit.

For the purpose of indicating at a distance when the switch of station *b* has been operated, signal lamp TS*b* is controlled by a relay R*b* which has a pair of windings which are so connected between the earth and conductors *f* and *g* that, so long as the current path through station *b* is closed, the current flow through one of these windings will neutralize that through the other.

Said lamp may display an arrow, as shown, for indicating the direction in which a turn should be made, and may well be located on the route ordinarily followed in responding to a call from station *a*, at a point adjacent the place where digression should be made from said route in responding to a call from station *b*.

Correspondingly, the connections from conductors *f* and *g* may be made where their courses leave the main route to provide a loop leading to station *b*.

From the foregoing, it will be evident that the current path through the signal TS*b* will be open other than when one of the conductors *f*, *g* is energized while the other deenergized. Thus, if the station is operated and the determining path is unbroken therefrom to source PS said signal will be lighted. If there is a general flasher arranged as indicated in Fig. 5, or if station *b* has a flasher arranged in accordance with disclosures of Figs. 4, 5, 6, 7 or 8, said lamp will be lighted intermittently. In fact, if station *b* has a flasher arrangement corresponding to those indicated at certain of the stations of Figs. 7 and 8, said lamp TS*b* may be caused to flash, while station *b* is in operated condition, even though the determining path is ruptured at one or both sides of said station.

Signal lamps TS*c*, TS*d'* and TS*d''* are associated with calling stations *c*, *d'* and *d''*, so as to operate in a manner corresponding to that of lamp TS*b* just described. For convenience, such signals will be at times hereinafter referred to as "turning signals."

Signal TS*c* is jointly controlled by relays R*cg* and R*ch* so that the current path through said lamp will be closed only when relay R*cg* is energized at a time when relay R*ch* is deenergized.

Said relays are connected between the earth

and conductors *g* and *h*, respectively. It will therefore be evident that deenergization of conductor *h* during energization of conductor *g* will result in lighting of signal TS*c*; but said lamp will not be lighted in the event of energization of conductor *h* during deenergization of conductor *g*, although signal TS*b* would be lighted under similar circumstances.

The turn signal lamps TS*d'* and TS*d''* associated with stations *d'* and *d''*, respectively, are arranged for lighting by current flow derived from portions of the determining path extending from their respectively associated stations toward source PS; the current paths through said signals being normally broken by the respectively associated relays R*d'* and R*d''* which are connected between the earth and portions of the determining path at the sides of their respectively associated stations farthest from source PS. If station *a* of Fig. 9 is operated, none of the turning signals will respond. If station *b* is operated, turning signal TS*b* will respond, but turning signals TS*c*, TS*d'* and TS*d''* will not respond. There will be corresponding responses to the other stations, and, assuming that stations *d'* and *d''* are at opposite sides of the same highway intersection, the arrows on their turning signals will indicate the direction in which turns should be made.

Figure 10

As hereinbefore mentioned, a single general alarm signal, or a group of such signals, may be associated for control by any one of several determining paths through relays responsive to the respective paths and similar to those having winding W as indicated in Figs. 1–9; by connecting the contacts of such relays in parallel with each other; however, for many service conditions, it is desirable to provide facilities for accomplishing various results supplemental to those which would be obtained by the mere use of such relays.

Responsive and inter-relating mechanism such as indicated in Fig. 10 (and which, for convenience, will be at times hereinafter referred to as a "repeater") is specially suited for meeting many service conditions such as, for example: for silencing general alarm signals after a predetermined extent of activity; for causing general alarm signal response in accordance with a code identifying abnormally conditioned ones of the associated determining paths; for providing, in addition to such code formulating facilities, an arrangement for causing alarm signals to respond to special or station designating code signals which are formulated in an associated path; and for accomplishing other results supplemental to those hereinbefore referred to and which will be hereinafter more fully described.

Description of Figure 10

The repeater of Fig. 10 is shown in association with three circuits each comprising a determining path connecting calling stations and which will be referred to, for brevity, as "box circuits." These circuits are generally indicated at I, II and III.

For convenience, these circuits and their associated calling stations and guidance signals are arranged and represented in a manner substantially corresponding with Fig. 1. It should be understood, however, that provision for circuits arranged in accordance with other embodiments of this invention than that of Fig. 1, may be similarly made, also that larger or smaller numbers of circuits may be correspondingly associated.

General alarm mechanism is indicated at AS for response to calling stations of circuits I, II and III; and electrically driven or controlled motor mechanism is indicated at **131**.

It should be understood that the current source for the circuit of the alarm mechanism AS may be the same as that for the motor mechanism **131** and/or that for the box circuits, although here shown as if independent; also that separate current sources may be provided for the various box circuits, although they are here shown as supplied by a single source.

The drive shaft **133** is driven by the motor mechanism **131** and carries parts for general purposes including the restoring cam **135** and the toothed flasher wheel **138** which are fixed thereon, as well as parts associated with each of the box circuits, some of which are fixed upon said shaft and others of which rotate independently thereof, as will be hereinafter more fully explained.

The rock shaft **141** carries the fingers **143**, one for each box circuit, levers **145** for restoring each of said fingers, and a tracer **137** for the cam **135**.

The tracer **137** and the levers **145** are fixed upon said shaft, while the fingers **143** move independently thereof.

Associated with the mechanism representative of each box circuit, is a code wheel **151** which is fixed upon said drive shaft **133** and has a cooperating tracer **153**.

A portion of the periphery of each of said wheels is cut away, and within each such cutaway portion are teeth, which may be in one or more groups, for causing actuation of the associated tracer to effect formulation of a code signal indicative of the box circuit represented thereby.

The cutaway portions of these code wheels are angularly displaced, one from another, so that they will be presented to their tracers in the order of I, II, III; such cutaway portions of respective wheels being presented just before the withdrawal of the like portion presented immediately preceding it, except that uncut portions of the peripheries of all of said wheels, which portions are of substantial extent, will be so presented following that of the cutaway portion of the wheel representing the last circuit of the series (in the repeater shown, being circuit III) and before the next presentation of the cutaway portion of the wheel representing the first circuit of such series, the purposes for which will be hereinafter more fully explained.

There are spaces of like extent between the respective ends of each cutaway portion and the teeth therein nearest thereto, so that there will be substantially corresponding times between the withdrawal of the raised periphery preceding the presentation of the first tooth and between the withdrawal of the last tooth and the next presentation of the raised portion; furthermore, the height of the teeth is appreciably less than that of the uncut periphery portions; all for reasons which will be hereinafter more fully explained.

The flasher tracer **139** normally rests upon one of the teeth of the wheel **138** and, during rotation of said wheel, this tracer operates flasher contacts for the various box circuits. It should be understood that, if preferred, separate wheels **138** and tracers **139** may be provided for respective box circuits.

Other parts provided for respective ones of these circuits are alike; hence, the parts for but

one of said circuits will be here described in detail.

For each box circuit there is an electromagnet 155, having an armature lever 157 which cooperates with an independently movable contact lever 159 so that there will be an electrical connection between 157 and 159 whenever the magnet is deenergized.

An operating extension 161 carried by the armature lever 157 engages the lever 159 to move it away from its retracted position when the armature is in attracted position. The springs 163 and 165 urge retractive movement of the armature lever 157 and of the contact lever 159, respectively.

The finger 143 carries a latch piece 167, and the land 169 is carried into the path of the latch 167 during attracted positioning of the armature lever 157, so as to then prevent movement of the finger 143 from its elevated position.

Contacts 171 are held separated by the finger 143 while the latch piece 167 is above the land 169. The contacts 173 are normally open, and are closed when the tracer 137 is lifted by the cam 135; said contacts 173 and the contacts 171 of the various circuits being in parallel with each other and control the current path to the motor 131 so that, so long as any of these contacts are closed, the current path to said motor will be effective.

The levers 145 are so positioned on the shaft 141 with relation to their respectively associated fingers 143 that, when said tracer 137 is lifted, the contacts 173 will be closed before any lever 145 raises its associated finger 143 sufficiently to separate the contacts 171 controlled thereby.

The contacts 181 are held closed by the tracer 153 so long as it is supported either by raised portions or teeth of the code wheel 151.

The current path for the alarm signal AS is associated with the contacts 181, and those of 157 and 159 of the various circuits, in such manner that said signal will sound only when all of said contacts 181 are closed and the contact of the armature lever of 157 of some circuit touches that of its lever 159. The contacts 181 of the various circuits are shown in series with each other and with the alarm signal circuit, and the contacts of 157 and 159 for the various circuits are shown in parallel with each other and, as a group, in series with said circuit.

A shield 185 has raised portions 187 and 189 which are separated by the notch 191 and said portions are so formed that, when either is situated in the path of the projection 193 carried by the tracer 153, it will prevent said tracer from so moving as to permit separation of the contacts 181.

A ratchet-toothed portion 195 is in the periphery of said shield for cooperation with a retaining bar 197 which is carried by the contact member 159 and is of such length as to be withdrawn from the path of said teeth when said member 159 is in the position to which it is moved when the armature lever 157 is in its attracted position.

A spring 199 urges clockwise rotation of said shield 185, and a stop 201 projects from said shield, adjacent the end of its toothed portion 195 nearest said notch 191, for engagement with the bar 197 for arresting such rotation when the raised portion 187 of said shield is in the path of the projection 193.

Actuating mechanism is provided for rotating the shield 185 against the urge of said spring 199; said mechanism comprising an L-shaped lever 205, pivoted at 207, and having a vertical portion 209 disposed in the path of a pin 211 carried by the code wheel 151. The free end of the horizontal member of said L-shaped lever has pivotally attached thereto a dog 215 for engaging the toothed portion 195 of the shield 185.

A tail 217 is carried by the dog 215 and engages the stop 219 for at times moving said dog out of the path of said toothed portion.

A spring 221 is connected to the tail 217 between its pivotal attachment to the L-shaped lever 205 and the portion thereof which engages said stop, and thus serves to cause the dog 215 to swing toward the toothed portion 195 during counterclockwise rotation of said lever around its pivot 207 and, acting through said tail, also serves to urge clockwise rotation of said lever, and still further serves to cause said tail to rock around said stop during the final portion of such clockwise lever rotation and thereby swing said dog away from said toothed portion. The relative angular positionings of the cam 135 and the pins 211, is such that whenever the circuit for the motor mechanism 131 is interrupted resultant from withdrawal of the cam 135 from support of the tracer 137, and said motor mechanism thereafter comes to rest, the pins 211 of the various circuits will then be so positioned with relation to the cooperating ends of their L-shaped levers 205 as to functionally engage said ends soon after resumption of rotation of the shaft 133 and wheels 151.

An extension 231 moves with the contact member 159 for at times moving the contact 233 away from the contact 235 and against the contact 237.

The formation of the portion of the shield 185 which is in the path of retractile movement of the bar 197 while said shield is so positioned that the stop 201 rests against said bar, is such that the lever 159 and its extension 231 will then be prevented from moving to such position as will cause contact 233 to leave contact 235.

One end of the determining path of the associated box circuit is connected to power source conductor 32, and the other end of said path is connected to contact 233 which, in turn, normally rests against contact 235.

One end of the winding of magnet 155 is connected to contact 235 and the other end is connected to power source conductor 33; so that, so long as the power source is effective and the determining path is uninterrupted, the magnet 155 will be effectively energized.

Flasher contact 241 is normally held against contact 243 by tracer 139 which is supported by a tooth of flasher wheel 138. When tracer 139 drops between teeth of wheel 138, contact 241 moves away from contact 243 and into engagement with the contact 245.

Said contact 241 is connected with the contact 237 of its associated circuit. Said contact 243 is connected with the end of the winding of the magnet 155 which is also connected to the contact 235 of the circuit represented thereby; and the contacts 245 for the various circuits are connected in parallel with each other and with the power source conductor 32.

The arm 251 is carried by the shield 185 and the slanting abutment 253 is carried by the armature lever 157. The relative positionings of said arm and said abutment are such that, when the last step of counter-clockwise actuation is imparted to said shield incident to engagement of the dog 215 with the one of the teeth 195

farthest from the stop 201, said arm will act through said abutment to move said lever 157 toward attracted position, passing to the upper side of said abutment and being there retained, by a slight retraction of said lever, until the armature again moves to fully attracted position. While said arm 251 is so supported by said abutment 253, it serves to prevent the contact of armature lever 157 from touching the contact of lever 159.

Operation of Fig. 10

Normally, the current paths for the alarm signal AS and for the motor mechanism 131 are open, the determining paths are closed, and the magnets 155 and guidance signals GS associated with said paths are energized.

First considering operation of some one calling station or box. Assuming that the switch of station *b* opens the determining path of circuit I. The guidance signal lamps at respective sides of station *c* will be extinguished, the magnet 155 of this circuit will be deenergized, its armature lever 157 will retract and thereby establish a connection with the contact of its lever 159, the land 169 will be withdrawn from support of the latch piece 167, and the finger 143 will drop with resultant closure of the contacts 171.

Such closure between the contacts of 157 and 159 completes a current path for the alarm signal AS which will thereupon start to sound, and closure of said contacts 171 completes a path causing the motor mechanism 131 to rotate the drive shaft 133 and parts fixed thereon.

Resultant rotation of the code wheels 151 will cause their pins 211 to act through the L-shaped levers 205 and dogs 215 to advance their respective shields sufficiently to bring the first notches of their toothed portions into the paths of their respectively associated bars 197.

The contact lever 159 of circuit I will thereupon further retract (accompanied by its armature lever 157) and thereby carry its bar 197 into the notch presented thereto, so as to retain its shield 185 from return movement.

Inasmuch, however, as the levers 159 of circuits II and III remain in attracted position, their associated shields will be restored to normal positioning when the pins 211 have moved past the cooperating portions of their levers 205.

Such further retraction of the lever 159 of circuit I causes the associated contact 233 to move from its contact 235 to its contact 237 and thereby render effective the flasher contacts 241, 243, 245.

Thereafter, the rotation of wheel 138 will cause power source conductor 32 to be connected, through contacts 241, 245, to the end of the determining path of circuit I which is normally connected to the magnet 155, whenever the tracer 139 drops incidental to withdrawal of support of a tooth of wheel 138 therefrom; with resultant flashing of the guidance signal lamps GS which were at first extinguished; which flashing will continue so long as said member 159 is so positioned as to hold contact 233 against contact 237.

Inasmuch as contact 241 always leaves contact 243 before touching contact 245, the magnet 155 is always disconnected from said determining path whenever such flashing connections are effected.

The described advancement of the shield 185 of circuit I, carried its raised portion 187 out of the path of the projection 193; so that the tracer 153 would be thereafter supported solely by the code wheel 151, and would drop upon presentation thereto of the cutaway portion of said wheel, thereby permitting the contacts 181 to separate and thereby break the current path for the alarm signal AS.

Said alarm signal will herefore be then silenced, until the code teeth of the wheel 151 successively raise said tracer and thus cause two short blasts of said signal, followed by another silent interval which ends when the cutaway portion of said code wheel is withdrawn from the path of said tracer.

It will be understood that two short blasts, preceded and followed by silent intervals, is the code signal indicated for designating circuit I. Had the call been from circuit II, the code wheel indicated therefor would have caused three short blasts and had it been from circuit III there would have been four such blasts.

It is obvious that other code designations for the various circuits could be provided by suitably altering the number and arrangement of teeth within cutaway portions of the code wheels.

After the first revolution of the wheel 151, the pins 211 will again act through the levers 205 and the dogs 215 to advance the shields 185; so that the shield of circuit I will thereby attain another step of advancement, which step will be retained by its bar 197, because of continued retraction of levers 157 and 159, while the shields of the other circuits will move back to their normal positions when disengaged by their dogs 215, because their levers 159 still hold their bars 197 out of the paths of their teeth.

Ensuing revolutions of the drive shaft 133 will thereafter result in signal AS sounding further repetitions of the code signal representative of circuit I, and, after each such repetition, the shield 185 of said circuit will be advanced another step; so that, finally, the raised portion 189 thereof will be carried into the path of the projection 193, and thereby render the tracer 153 unresponsive to its code wheel 151.

Such final one of the actuated steps of the shield 185 of circuit I will also cause its arm 251 to act through its abutment 253 to move the associated armature lever 157 away from the contact of its lever 159, and thereby silence the signal AS.

Thereafter, the flasher mechanism 138, 139, 241, 243, 245 will, so long as the determining path of circuit I remains broken, continue to connect said determining path alternately to the winding of its magnet 155 and to the supply conductor 32, so that the guidance signal lamps at respective sides of station *c* will continue to flash.

If, now, said determining path is restored, as by reclosing switch *b*, its magnet 155 will be reenergized if flasher contact 241 is then touching contact 243; otherwise, when these contacts next close.

Such reenergization of said magnet will cause its armature lever 157 to move to attracted position, thereby withdrawing the abutment 253 from the path of the arm 251, besides moving aside the free end of the latch piece 167 by bringing the land 169 into the normal path thereof, and acting through the extension 161 and the lever 159, will cause withdrawal of the bar 197 from the path of the toothed portion of the shield 185; whereupon said shield will be turned by its spring 199 until it has reached its normal position, when its rotation will be arrested by the stop 201 striking against said bar 197.

The current path for the motor mechanism 131 will thereafter be interrupted when the support of the cam 135 is next withdrawn from its tracer 137, following such lifting of said tracer as caused the finger 143 to carry the latch piece 167 above the land 169 and thereby serve to break and prevent reclosing of the contacts 171.

Following such interruption of the motor mechanism circuit, the repeater will come to rest with all parts in their normal positions.

Should station switches of two or more circuits be operated at or about the same time, the results would be similar to those just described; the principal differences being in concurrent sounding of the two codes and in final restoration of the repeater when both box circuits finally become reclosed.

In such concurrent activity of two or more box circuits, their codes will be sounded without an intervening long blast if the cutaway portions of their code wheels overlap; otherwise, they will be separated by a long blast.

Thus if, on the one hand, the circuits I and II shown are concurrently active, there will be a silent interval after the initial long first blast, then two short blasts, another similar silent interval, then three short blasts, then another such silent interval followed by a long blast continuing until the silent interval preceding the next repetition of the code number. On the other hand, if circuit II is inactive when circuits I and III are active, after the two short blasts representative of circuit I have been preceded and followed by silent intervals, there will be a long blast (while the cutaway portion of wheel 151 of circuit II passes its tracer) then four short blasts, preceded and followed by similar silent intervals.

When the repeater is operating responsive to any box circuit or circuits, if the determining path of some other circuit is broken, formulation of the code signal representative of such other circuit will commence following the next ensuing advancement of its shield 185 responsive to its dog 215, and the sounding of its code signal will not be terminated, resultant from later advancement of its shield, until it has been repeated the usual number of times.

When the repeater is formulating code signals representative of two or more circuits, reclosure of one of such circuits during the formulation of its code signal will not result in interruption thereof, as its tracer 153 will not be raised high enough by any code tooth to permit the raised shield portion 187 to pass below its projection 193, and the alarm circuit will be reclosed around the opened armature contacts of the box circuit so restored by closed like contacts of some other circuit which has remained open.

However, the ensuing withdrawal of the cutaway portion of its code wheel will cause said tracer to be so raised that said projection 193 will permit said raised portion 187 to pass thereunder and thereby prevent further repetitions of its code number.

In a repeater having various parts so proportioned that the armature never moves out of the effective range of its magnet, should no other circuit be open when a box circuit is restored during the formulation of its code signal, resultant separation of the armature controlled contacts will cause immediate cancellation of any then remaining portion of such signal. It is believed that, for many uses, such action would not be objectionable.

If it is desired to prevent such premature termination of a code signal, this can be accomplished by so proportioning the parts that the armature will be out of the effective range of the magnet except when its retraction is no greater than when it is supported either by the arm 251 or by the member 159 while the bar 197 rests against the raised portion of the shield 185 adjacent the projection 201.

Sounding of special signals such as the various familiar forms of so-called "all out" and "general alarm" and the like, may be effected from various calling stations by alternately breaking and closing the determining path thereat. This may be accomplished by special actuation of the calling station switch, by the use of some well known type of telegraph key, or otherwise, as desired.

When such special signals are so formulated each break of the box circuit will result in a closure of the alarm circuit at the associated armature controlled contacts, causing the signal AS to sound; and each closure of the box circuit will terminate such sounding and will also prevent retention of accumulations of actuations of the associated shield, to thereby prevent release of the tracer 153 for effecting code signal formulation.

It will be apparent that most satisfactory results will be obtained in the use of the particular form of repeating mechanism here shown, if, in the formulation of such special signals, short blasts are sounded, keeping the box circuit closed between blasts.

If it is desired to adapt the repeater shown to a system having, at calling stations, code signaling formulators such as indicated at station *d* of Fig. 7, this may be accomplished by changes such as the following:

Omit the flasher means comprising the wheel 138, tracer 139, contacts 241, 243, 245, extensions 231 and the associated contacts 233, 235, 237.

Omission may also be made of the code wheels 151, the tracers 153 and the associated contacts 181; leaving the alarm circuit responsive to the armature controlled contacts on levers 157 and 159.

The contacts of levers 159 may be made stationary, and the bars 197 omitted therefrom, coresponding means to be provided in place thereof so that similar parts carried by or responsive to fingers such as 143 will coöperate with ratchet teeth of the shields 185, and the form of the portions 209 of the L-shaped levers 205 so altered that they will cause their dogs 215 to engage the teeth of the shields 185 somewhat before the cam 135 has lifted its tracer 137 enough to free the shield 185, and will continue such engagement until the shaft 133 has thereafter rotated, following withdrawal of the cam 135 from the tracer 137, for a time longer than the longest interval between the breaks incident to any signal.

With parts so revised, the signal AS will sound throughout each break of an active box circuit, so long as the shield has not been advanced far enough to cause the arm 251 to act through the abutment 253 to move the armature lever 157 away from the contact 159. After such movement, the circuit of the alarm signal AS will be rendered unresponsive to such circuit until its shield has been restored.

If alterations such as just indicated are made in the L-shaped lever portion 209, accumulations of shield movement will not be cancelled until the armature has remained in attracted position

from an occasion when the cam 135 has raised and then released its tracer 137, until the dog 215 has thereafter withdrawn from the path of the teeth of the shield 185, incident to movement of its pin 211 beyond said lever portion 209.

Similar changes will adapt the repeater shown to systems having flashers at calling stations, such, for example, as those indicated in Figs. 4, 6, 7 and 8, or to any service conditions such that it is desired that response of general alarm signals of limited duration will result from each occasion when a given box circuit is continuously or intermittently interrupted.

It should be understood that certain of the results attained by the use of repeaters similar to that just described may also be obtained by governing the relationships between box circuit relays (such, for example, as those indicated in Figs. 1 to 9) and an alarm circuit, by the use of timing mechanisms of well known types such, for example, as those commonly used in railway and highway traffic signaling.

Figure 11

In order to more graphically show the manner in which responses to calls may be guided and those along highways may ascertain where right-of-way should be made available for emergency vehicles, Fig. 11 indicates signal manifestations incident to operation of the switch of one of the calling stations of a system having representations of many of the features of this invention which have been hereinbefore more fully described.

For convenience in reference, an arterial highway is designated as "East Main Street" and "West Main Street" at respective sides of a minor highway which is, in turn, designated as "North Cross Street" and "South Cross Street" at respective sides of Main Street.

Intersecting said North Cross Street is another minor highway designated as "Elm Street" across the right hand end of which a highway designated as "Valley Street" extends parallel to Cross Street. Other highways designated as "Prospect Street" and "Oak Street" extend from the respective ends of Valley Street parallel to Elm Street and in the direction away from Cross Street.

Determining paths are indicated as radiating from the intersection of Main and Cross Streets, each path having calling stations and guidance signals indicated in association therewith.

The determining path for the locality around North Cross Street supplies a guidance signal GS*x* visible from the intersection with Main Street, and a calling station *d'* and its signal on Elm Street to the left of Cross Street; like stations *d''* and *c* and their lamps on Oak Street and Prospect Street, respectively, at the other side of Cross Street; as well as other stations *b* and *a*, and their lamps, along Cross Street beyond Elm Street.

From station *a*, the determining path doubles back to the fire department station on West Main Street, where it includes a designator D, such as indicated in and described in connection with Fig. 1.

A siren type general alarm signal is indicated at the fire station, in association with repeating mechanism RM, which may be such as that of Fig. 10.

The turning signal lamps TS*d'* and TS*cd''* at the intersection of Elm and North Cross Streets are associated with station *d'*, and with stations *d''* and *c* collectively; and the turning signal lamps TS*c* and TS*d''* are correspondingly associated with stations *c* and *d''*, all in a manner corresponding to that of the turning signal lamps indicated in Fig. 9 in association with stations *d'* and *d''*.

As shown, it is assumed that station *d''* has been operated, and that this station is of a type having a fast acting flasher for its guidance signal such, for example, as that indicated at stations *b*, *c* or *d* of Fig. 6, or such as station *c* of Fig. 7.

The guidance signal lamps on Main Street, on South Cross Street, and beyond Elm Street on North Cross Street are shown as burning continuously. Lamp GS*x* is flashing slowly, as is lamp at signal *d'*.

Turning signals TS*d'* and TS*c* are not lighted, but like signals TS*cd''* and TS*d''* are intermittently lighted, flashing slowly. The guidance signal lamp at station *d''* is flashing rapidly. Designator D at the fire department identifies the operated station.

Those hearing the siren alarm may ascertain the route to the operated station in that the continuously burning lamps along Main Street and South Cross Street, and those beyond Elm Street on North Cross Street indicate that the operated station is situated therefrom toward the Main and Cross Street intersection. At this intersection it will be indicated, by the flashing signal GS*x*, that North Cross Street leads therefrom toward the operated station; and at the intersection of Elm and North Cross Streets it will be indicated by the steadily burning signal of station *b* that the operated station is not farther away from Main Street along Cross Street. However, the flashing pointer signals TS*cd''* and TS*d''* indicate that turns to the right should be made on Elm Street and again on Valley Street; after which the origination of the call is clearly identified by the rapidly flashing signal at station *d''*.

Indoor service

Various ones of the embodiments of this invention which have been herein described may be advantageously utilized for giving warning of danger and for guiding exposed persons along paths which avoid dangerous localities.

For example, if an embodiment such as that indicated by Fig. 5 is so employed, calling station *a* might be situated on the ground floor, and stations *b*, *c*, *d*, and the like, on the various floors above. A suitable number of audible warning signals distributed around the premises could be controlled from a relay having a winding W, such as that indicated for governing alarm signal AS.

If installed in a building having stairways at each end thereof, calling stations could be distributed on the various floors adjacent the respective stairways, separate determining paths being provided for those adjacent each stairway.

Audible warning signals could be made responsive to such determining paths, and visual and/or audible outdoor signals could be provided at doorways through which the respective stairways discharge.

With such arrangements, operation of any calling station would cause signals for warning occupants that they should leave the building, and would result in lighting of the marker lamp of the operated station, as well as in causing flashing of guidance lamps for floors above it. These guidance lamps could be situated adjacent to or utilized for illumination of so-called "exit" signs.

Assuming that the operated station is at an end or corner of the third floor, those on first and second floors would find all exit or guidance lamps burning steadily, thus indicating that all stairways were available for their use. Those on the third floor would find a lighted marker lamp adjacent the operated calling station and those on the fourth floor would observe that the guidance or exit lamp at the entrance to the stairway above the operated station was flashing; thus warning occupants of the third and fourth floors to use exit ways other than that adjacent the operated calling station.

It will be evident that embodiments of this invention indicated in the other figures of the drawings may be correspondingly utilized.

It will also be evident that occupants may be correspondingly guided when signals result from action of thermostats or other circuit controllers such, for example, as are diagrammatically indicated in Fig. 1 in the loop T for supplementing calling station switch *b*.

Outdoor lamps adjacent doorways would also serve to guide members of a local brigade or a municipal fire department, as the doorway over which an outdoor guidance lamp is found flashing will be recognized as that leading to the portion of the building from which the alarm originated. Then, on entering, if the first floor guidance lamp is not flashing, it will be evident that the call originated from one of the upper floors and such floor will be identified, upon reaching it, because the marker lamp on such floor will be lighted and/or the guidance lamp will there be flashing.

Supplementing other signaling systems

In utilizing this invention in connection with other forms of signaling systems, such, for example, as conventional fire alarm telegraph systems, the calling station switches of this invention may be associated with the starting handles of the telegraph formulating mechanism at various stations, and the guidance lamps distributed along the route ordinarily taken by fire department vehicles in responding to calls in that locality so that, in the instance of an arterial highway, the starting of any code formulator or fire alarm box mechanism will cause flashing of guidance signals along the portion of such highway which should be traversed in responding to a call from the operated box, and guidance lamps beyond the locality of such box will be continuously lighted.

Such conditionings will enable traffic officers and drivers of vehicles to determine what portions of the highway should need to be cleared. In portions of the highway where the guidance lights (which may also serve as fire alarm box location markers) are burning continuously, it may be assumed that traffic may proceed as usual, but where such lamps are flashing, right-of-way should be cleared for the fire department vehicles, and cross town traffic into or across the main highway should be suspended.

It will be understood by those skilled in this art that this invention is susceptible of various embodiments which differ in certain details from those illustratively indicated in the accompanying drawings and herein described in detail; as, for example, by having calling stations act to substantially block comparatively high frequency carrier current in determining paths, while not preventing flow of direct current or of low frequency alternating current, instead of having them act to interrupt such paths; and as by inductively coupling guidance and other signals, or controllers therefor, with determining path conductors in various well known ways, instead of providing conductive association therebetween.

It should also be understood that this invention is not limited to the particular arrangements shown in the accompanying drawings and hereinbefore described, except insofar as specified in the appended claims, as many changes may be made in construction and arrangement, and parts may be added or omitted without departing from the spirit of this invention or from the broader aspects thereof.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention, which, as a matter of language, might be said to fall between said claims.

I claim:

1. A signaling system having a circuit comprising a path subject to alteration, at each of various places along its length, such as will render abnormal the electrical conditioning of such path part as is situated between any altered one of said places and a predetermined end thereof without correspondingly affecting the conditioning of the part situated between such place and the other end of said path, and signals respectively associated with and for diversely manifesting normal and abnormal conditionings of portions of said path interspersed between said places.

2. A signaling system having a circuit comprising a path subject to alteration, at each of various places along its length, such as will render abnormal the electrical conditioning of such path part as is situated between any altered one of said places and a predetermined end thereof without correspondingly affecting the conditioning of the part situated between such place and the other end of said path, signals respectively associated with and for diversely manifesting normal and abnormal conditionings of portions of said path interspersed between said places, and means for rendering intermittent such manifestations of abnormal conditionings.

3. A signaling system having a normally energized circuit comprising a current path subject to blocking of current flow from one side to the other of each of various places along the length thereof, and signals associated with portions of said path interspersed between said blocking places for effecting abnormal conditioning of respective signals only responsive to such path blocking as occurs between its associated portion and a predetermined end of said path.

4. A signaling system having a normally energized circuit comprising a current path subject to blocking of current flow from one side to the other of each of various places along the length thereof, signals associated with portions of said path interspersed between said blocking places for effecting abnormal conditioning of respective signals only responsive to such path blocking as occurs between its associated portion and a predetermined end of said path, and means for rendering intermittent such abnormal signal conditioning.

5. A signaling system having signal causing stations, signals, a circuit comprising a path with which said stations and signals are associated in interspersed relationship at various places along the length thereof, and means including

said stations, portions of said circuit and connections of said stations and signals thereto for effecting, incident to operation of any of said stations, abnormal conditioning of only those of said signals which are associated with portions of said path which are situated at a predetermined side of an active station.

6. A signaling system having a plurality of signal manifesters, a normally energized circuit comprising a path with respective portions of which said manifesters are associated for functional response thereto, signal causing stations associated with said path intermediate such manifester-associated portions thereof, and means involving and for effectuation by respective ones of said stations for altering the conditioning of those of said portions which are situated between respective stations and a predetermined end of said path in a manner which will cause functional response of the associated manifesters without correspondingly altering the conditioning of other portions of said path.

7. A signaling system having a plurality of signal manifesters, a normally energized circuit comprising a path with respective portions of which said manifesters are associated for functional response thereto, signal causing stations associated with said path intermediate such manifester-associated portions thereof, and means involving and for effectuation by respective ones of said stations for altering the conditioning of those of said portions which are situated between respective stations and a predetermined end of said path in a manner which will cause functional response of the associated manifesters without correspondingly altering the conditioning of other portions of said path, and means associated with said circuit for rendering intermittent any such abnormal path conditioning.

8. A signaling system having a plurality of signal manifesters, a circuit comprising a path with respective portions of which said manifesters are associated for functional response to abnormal conditioning thereof, signal causing stations associated with said path intermediate said portions and each operable for effecting abnormal conditioning of only those of such portions as are situated in said path at a predetermined side thereof, and means for causing a signaling manifestation adjacent an operated station which distinctively differs in character from any signal manifestation elsewhere which is resultant from operation of such station.

9. A signaling system having a plurality of signal manifesters, a circuit comprising a path with respective portions of which said manifesters are associated for functional response to abnormal conditioning thereof, signal causing stations associated with said path intermediate said portions and each operable for effecting abnormal conditioning of only those of such portions as are situated in said path at a predetermined side thereof, means for rendering such abnormal conditionings intermittent at a frequency within a predetermined range, and means rendered effective incident to such operation for intermittently causing signaling manifestations adjacent an operated station at a frequency distinctively differing from those within the aforesaid range.

10. A signaling system having a plurality of signal manifesters; a circuit comprising a path with respective portions of which said manifesters are associated for functional response to abnormal conditioning thereof; signal causing stations associated with said path intermediate said portions, severally associated with said manifesters and each operable for effecting abnormal conditioning of only those of such portions as are situated in said path at a predetermined side thereof; and means for causing, incident to operation of any station, abnormal conditioning of the manifester associated with that station, which conditioning is of a character which distinctively differs from conditionings of any manifester associated with a non-operated station.

11. A signaling system having a plurality of signal manifesters; a circuit comprising a path with respective portions of which said manifesters are associated for functional response to abnormal conditioning thereof; signal causing stations associated with said path intermediate said portions, severally associated with said manifesters and each operable for effecting abnormal conditioning of only those of such portions as are situated in said path at a predetermined side thereof; and means for rendering intermittent such abnormal conditionings of said signals and for rendering the intermittency of such station-associated signals at a frequency distinctively differing from that of such other signals.

12. A signaling system having a plurality of signal manifesters; a circuit comprising a path with respective portions of which said manifesters are associated for functional response to abnormal conditioning thereof; signal causing stations associated with said path intermediate said portions, severally associated with said manifesters and each operable for effecting abnormal conditioning of only those of such portions as are situated in said path at a predetermined side thereof; and means for rendering intermittent such abnormal conditionings of said manifesters and for rendering the intermittency of such station-associated manifester at a frequency distinctively faster than that of such other manifesters.

13. A signaling system having a plurality of signals, signal causing stations each involving means responsive to operation thereof for causing abnormal conditioning of an associated one of said signals, signal manifesters distinctively differing from said signals, a circuit comprising a path with respective portions of which said manifesters are associated for functional response to abnormal conditioning thereof, each of said stations also comprising means rendered effective incident to operation of such station for effecting abnormal conditioning of only those of such portions as are situated in said path at a predetermined side of such station.

14. A signaling system having a plurality of signals, signal causing stations each involving means responsive to operation thereof for causing intermittent abnormal conditioning of an associated one of said signals, signal manifesters distinctively differing from said signals, a circuit comprising a path with respective portions of which said manifesters are associated for functional response to abnormal conditioning thereof, each of said stations also comprising means rendered effective incident to operation of such station for effecting abnormal conditioning of only those of such portions as are situated in said path at a predetermined side of such station.

15. A signaling system having a plurality of signal manifesters, a circuit comprising a path with respective portions of which said manifesters are associated for functional response to abnormal conditioning thereof, signal causing stations associated with said path intermediate said por-

tions and each operable for effecting abnormal conditioning of only those of such portions as are situated in said path at a predetermined side thereof, a signal for distinctively designating a particular response routing, and means for rendering said signal effective only during operated conditioning of a calling station or stations for response to which such routing should be followed.

16. A signaling system having a plurality of signal manifesters, a circuit comprising a path with respective portions of which said manifesters are associated for functional response to abnormal conditioning thereof, signal causing stations associated with said path intermediate said portions and each operable for effecting abnormal conditioning of only those of such portions as are situated in said path at a predetermined side thereof, a signal for distinctively designating a particular response routing, and means governed by said path for rendering said signal effective only during operated conditioning of a calling station or stations for response to which such routing should be followed.

17. A signaling system having a plurality of signal manifesters, a circuit comprising a path with respective portions of which said manifesters are associated for functional response to abnormal conditioning thereof, signal causing stations associated with said path intermediate said portions and each operable for effecting abnormal conditioning of only those of such portions as are situated in said path at a predetermined side thereof, a signal, and means for causing a predetermined aspect of said signal responsive only to diversity of conditioning of certain of said portions.

18. A signaling system having a plurality of signal manifesters, a circuit comprising a path with respective portions of which said manifesters are associated for functional response to abnormal conditioning thereof, signal causing stations associated with said path intermediate said portions and each operable for effecting abnormal conditioning of only those of such portions as are situated in said path at a predetermined side thereof, a signal, and means for causing a predetermined aspect of said signal responsive only to normal conditioning of a certain one of said portions while a certain other is abnormally conditioned.

19. A signaling system having a plurality of signal manifesters, a circuit comprising a path with respective portions of which said manifesters are associated for functional response to abnormal conditioning thereof, signal causing stations associated with said path intermediate said portions and each operable for effecting abnormal conditioning of only those of such portions as are situated in said path at a predetermined side thereof, a signal, and means for governing said signal, said means associated with said path for causing a predetermined aspect of said signal responsive only to diversity of conditioning of a certain two of said portions in which the one thereof is abnormal which is situated in said path at said predetermined side of the other.

20. A signaling system having a plurality of signal manifesters, a circuit comprising a path with respective portions of which said manifesters are associated for functional response to abnormal conditioning thereof, signal causing stations associated with said path intermediate said portions and each operable for effecting abnormal conditioning of only those of such portions as are situated in said path at a predetermined side thereof, a signal associated for energization from a certain one of said portions, and means for rendering effective such energization only during abnormal conditioning of another of said portions, which other portion is situated in said path at said predetermined side of said certain portion.

21. A signaling system having a circuit comprising a path subject to alteration, at each of various places along its length, such as will render abnormal the electrical conditioning of such path part as is situated between any altered one of said places and a predetermined end thereof without correspondingly affecting the conditioning of the part situated between such place and the other end of said path, stations severally associated with said path places and each comprising means operable for effecting abnormal conditioning of a path portion as aforesaid which conditioning is distinctively different from that resultant from accidental rupture of said path, and signals respectively associated with and for diversely manifesting conditionings of path portions intermediate such places, inclusive of manifestations clearly distinguishable both from those resultant from normal conditionings and those from accidental rupture of said path.

22. A signaling system having a circuit comprising a path subject to alteration, at each of various places along its length, such as will render abnormal the electrical conditioning of such path part as is situated between any altered one of said places and a predetermined end thereof without correspondingly affecting the conditioning of the part situated between such place and the other end of said path, stations severally associated with said path places and each comprising means operable for intermittently effecting alterations of a path portion conditioning as aforesaid, and signals respectively associated with and for diversely manifesting normal and abnormal conditionings of portions of said path interspersed between said places.

23. A signaling system having a circuit comprising a path subject to alteration, at each of various places along its length, such as will render abnormal the electrical conditioning of such path part as is situated between any altered one of said places and a predetermined end thereof without correspondingly affecting the conditioning of the part situated between such place and the other end of said path, stations severally associated with said path places and each comprising means operable for causing formulation of code signaling impulses in a path portion as aforesaid, and signals respectively associated with and for diversely manifesting normal and abnormal conditionings of path portions intermediate such places.

24. A signaling system having signal causing stations, a circuit comprising a path with which said stations are associated at various places along the length thereof, signals serially connected for energization from portions of said path interspersed among said places, and means including and rendered effective incident to operation of said stations for limiting energization of said path to portions situated between a predetermined end thereof and an operated station.

25. A signaling system having signal causing stations, a circuit comprising a path with which said stations are associated at various places along the length thereof, signals connected in parallel with each other for energization from

said circuit through portions of said path interspersed among said places, and means including and rendered effective incident to operation of said stations for limiting energization of said path to portions situated between a predetermined end thereof and an operated station.

26. A signaling system having a current path, signal lamps normally lighted by energy supplied from said path at various places along the length thereof, and signal causing stations associated with said path between various ones of such places and each involving means for causing extinguishment of only such of said lamps as are associated with portions of said path situated at a predetermined side of the station.

27. A signaling system having signal causing stations, a circuit comprising a path with which said stations are associated at various places along the length thereof, signal lamps associated with portions of said path interspersed among said places and connected for lighting by energy derived from said circuit, and means including and rendered effective incident to operation of respective ones of said stations for causing extinguishment of only those lamps which are associated with portions of said path situated between a predetermined end thereof and an operated station.

28. A signaling system having a plurality of signal causing stations, a normally energized circuit comprising a path with which said stations are associated at various places along the length thereof, signal lamps normally lighted from said circuit through connections with respective portions of said path between said stations, means including said stations and rendered effective incident to abnormal conditioning of respective ones thereof for causing extinguishment of only such of said lamps as are connected with portions of said path which are situated at a predetermined side of an operated station, other signal lamps associated with respective ones of said stations, and means including said stations for applying energy from said circuit for lighting of said other lamps during abnormal conditioning of their respectively associated stations.

29. A signaling system having a circuit comprising two conductors one of which provides a current path energized from one end thereof, signal lamps connected between said conductors at various places along the length of said path, and signal causing stations connected intermediate such connections to said path and each comprising means for severing said path thereat.

30. A signaling system having a plurality of signal lamps, a circuit including a normal current path in respective portions of which said lamps are serially connected, signal causing stations connected in said path between such portions thereof, and means including said stations for establishing respectively associated abnormal paths, each abnormal path excluding the signal lamps connected in the portion of said normal path situated between a predetermined end thereof and the associated station, while including the lamps situated in the remainder of said normal path.

31. A signaling system having a plurality of signal lamps, a circuit including a normal current path in respective portions of which certain of said lamps are serially connected, signal causing stations connected in said path between such portions thereof, and means including said stations for establishing respectively associated abnormal paths each including a respective supplemental one of said lamps and such of said certain lamps as are included in said normal path between a predetermined end thereof and the associated station while excluding the remainder of said certain lamps.

32. A signaling system having a plurality of signal lamps, a circuit including a normal current path in respective portions of which said lamps are serially connected, signal causing stations connected in said path between such portions thereof, means including said stations for establishing respectively associated abnormal paths, each abnormal path excluding the signal lamps connected in the portion of said normal path situated between a predetermined end thereof and the associated station, while including the lamps situated in the remainder of said normal path, and equalizing resistances connected in respective abnormal paths.

33. A signaling system having a plurality of signal lamps, a circuit including a normal current path in respective portions of which certain of said lamps are serially connected, signal causing stations connected in said path between such portions thereof, and means including said stations for establishing respectively associated pairs of abnormal paths, one of each of such pairs of abnormal paths including a respective supplemental one of said lamps, an equalizing resistance and such of said certain lamps as are included in said first named path between a predetermined end thereof and the associated station, and the other path of each of such abnormal pairs including a second equalizing resistance and the remainder of said certain lamps.

34. A signaling system having a first and a second current path, a limited-maximum-current source interconnecting said paths, normally lighted signal lamps serially connected in respective portions of said first path, signal causing stations connected intermediate such path portions, means including respective stations for thereat severing said first path and establishing a connection with said second path for maintaining current flow in portions of said first path situated between said source and such connection, and normally extinguished lamps associated with respective ones of said stations and included in respective connections.

35. A signaling system having a first and a second current path, a limited-maximum-current source interconnecting said paths, normally lighted signal lamps serially connected in respective portions of said first path, signal causing stations connected intermediate such path portions, and means including respective stations for thereat severing said first path and establishing a connection with said second path for maintaining current flow in portions of said first path situated between said source and such connection.

36. A signaling system having a first and a second current path, current sources interconnecting the respective ends of said first path with said second path, signal causing stations associated with said paths at various places along the length of said first path, and signal lamps serially connected in said first path and in interspersed relationship with said stations, each of said stations having means operable for establishing connections one of which includes one of said sources and such of said lamps as are situated in said first path between a predetermined end thereof and the associated station and the other

of which connections includes the other of said sources and such of said lamps as are situated in said first path between the other end thereof and the associated station.

37. A signaling system having a first and a second current path, current sources interconnecting the respective ends of said first path with said second path, signal causing stations associated with said paths at various places along the length of said first path, signal lamps serially connected in said first path and in interspersed relationship with said stations, each of said stations having means operable for establishing connections one of which includes one of said sources and such of said lamps as are situated in said first path between a predetermined end thereof and the associated station and the other of which connections includes the other of said sources and such of said lamps as are situated in said first path between the other end thereof and the associated station, and means for rendering current flow in said second connection significantly different in character from that in said first connection.

38. A signaling system having a first and a second current path, current sources interconnecting the respective ends of said first path with said second path, signal causing stations associated with said paths at various places along the length of said first path, and signal lamps certain of which are serially connected in said first path and in interspersed relationship with said stations and others of which are individually associated with respective stations, each of said stations having means operable for establishing connections one of which includes one of said sources and such of said lamps as are situated in said first path between a predetermined end thereof and the associated station together with the appropriate one of said other lamps, and the other of which connections includes the other of said sources and such of said lamps as are situated in said first path between the other end thereof and the associated station.

39. A signaling system having signal causing stations, signals, a normally energized circuit comprising a path with which said stations and signals are associated in interspersed relationship, means, including said stations and portions of said circuit, for effecting, incident to station operation, abnormal conditioning of various groups of said signals, and thermo-means associated with said circuit for normal continuous heating therefrom and for rendering intermittent such abnormal conditionings.

40. A signaling system having signal causing stations, signals, a normally energized circuit comprising a path with which said stations and signals are associated in interspersed relationship, means, including said stations and portions of said circuit, for effecting, incident to station operation, abnormal conditioning of various groups of said signals, and thermo-means, at respective stations and for normal continuous heating from said circuit, for rendering intermittent such abnormal conditionings.

41. A signaling system having signal causing stations, a circuit comprising a path with which said stations are associated at various places along its length for governing the continuity thereof, two groups of signals for guiding responses from diverse directions, and means, including connections associating said signals with said circuit, in interspersed relationship with said stations, for rendering the signals of said groups responsive to current flow in said path having respectively diverse characteristics.

42. A signaling system having signal causing stations, an alternating current circuit comprising a path with which said stations are associated at various places along its length for governing the continuity thereof, two groups of signals for guiding responses from diverse directions, and means, including connections associating said signals with said circuit, in interspersed relationship with said stations, for rendering the signals of said groups responsive to current flow in said path in one direction and the other, respectively.

43. A signaling system having signal causing stations, a circuit comprising a path with which said stations are associated at various places along its length for governing the continuity thereof, two groups of signals for guiding responses from diverse directions, connections associating said signals with said path for effecting normal conditioning of all of said signals during continuity of said path, and means for rendering abnormal only those signals of said groups which are associated with portions of said path which are situated on predetermined respective sides of any station-caused path interruption.

44. A signaling system having signal causing stations, an alternating current circuit comprising a path with which said stations are associated at various places along its length for governing the continuity thereof, two groups of signals for guiding responses from diverse directions, and connections including asymmetric conductors associating said signals with said path for effecting normal conditioning of all of said signals during continuity of said path and for rendering abnormal only those signals of said groups which are associated with portions of said path which are situated on predetermined respective sides of any station-caused path interruption.

45. A signaling system having signal causing stations, signals, a normally energized alternating current circuit comprising a path with which said stations and signals are associated in interspersed relationship, means rendered effective by abnormal conditioning of any station for opposing current flow in one direction and the other between any such station and the respective ends of said path, and means for rendering abnormal certain of said signals during such opposition to current flow in one direction in the path portions with which they are respectively associated and for so rendering other of said signals during opposition to current flow in the other direction in the respectively associated path portions.

46. A signaling system having signal causing stations, signals, a normally energized alternating current circuit comprising a path with which said stations and signals are associated in interspersed relationship, means rendered effective by abnormal conditioning of any station for opposing current flow in one direction and the other between any such station and the respective ends of said path, and means comprising asymmetric conductors for rendering abnormal certain of said signals during such opposition to current flow in one direction in the path portions with which they are respectively associated and for so rendering other of said signals during opposition to current flow in the other direction in their respectively associated path portions.

47. A signaling system having a circuit comprising a current path and a conductor available for association with portions of said path distributed along the length thereof, a current source connected between an end of said path and said conductor, signals connected between said respective portions of said path and said conductor, signal causing stations severally comprising means for interrupting said path at places interspersed between said portions thereof, and means associated with and for giving warning of impairment of current flow in a portion of said path adjacent said end thereof.

48. A signaling system having signal causing stations, signals, a normally energized circuit comprising a path with which said stations and signals are associated in interspersed relationship, means including said stations and portions of said circuit for effecting, incident to operation of respective stations, current supply to only those signals situated between an operated station and a predetermined end of said path, and means responsive to resultant variations in electrical conditioning of said path end for identifying an operated station.

49. A signaling system having a circuit comprising a current path and a conductor available for association with portions of said path distributed along the length thereof, a current source connected between an end of said path and said conductor, signals connected in parallel with each other between said conductor and said path portions, means for interrupting said path intermediate various of said portions and thereby preventing current flow to signals more distant from said source with resultant alteration in the extent of current flow through said path from said end thereof, and means responsive to variations in current flow between said path end and said signals for identifying the locality of any such interruption.

50. A signaling system having a plurality of circuits each comprising a current path and a conductor available for association with portions of said path along the length thereof, signals and signal causing stations associated with said circuit in interspersed relationship along said path, means including said stations and rendered effective incident to abnormal conditioning of respective ones thereof for causing abnormal conditioning of only such of said signals as are associated with portions of said path which are situated at a predetermined side of an abnormally conditioned station, a general signal, and means responsive to abnormal conditioning of any of said paths for causing response to said general signal.

51. A signaling system having a plurality of circuits each comprising a current path and a conductor available for association with portions of said path along the length thereof, signals and signal causing stations associated with said circuit in interspersed relationship along said path, means including said stations and rendered effective incident to abnormal conditioning of respective ones thereof for causing abnormal conditioning of only such of said signals as are associated with portions of said path which are situated at a predetermined side of an abnormally conditioned station, and means responsive to abnormal conditioning of any of said paths for acting to intermittently restore normal conditioning to otherwise abnormally conditioned paths.

52. A signaling system having a plurality of circuits each comprising a current path and a conductor available for association with portions of said path along the length thereof, signals and signal causing stations associated with said circuit in interspersed relationship along said path, means including said stations and rendered effective incident to abnormal conditioning of respective ones thereof for causing abnormal conditioning of only such of said signals as are associated with portions of said path which are situated at a predetermined side of an abnormally conditioned station, a general signal, and means responsive to abnormal conditioning of any of said paths for causing response of said signal and for acting to intermittently restore normal conditioning to otherwise abnormally conditioned paths.

53. A signaling system having a plurality of circuits each comprising a current path and a conductor available for association with portions of said path along the length thereof, signals and signal causing stations associated with said circuit in interspersed relationship along said path, means including said stations and rendered effective incident to abnormal conditioning of respective ones thereof for causing abnormal conditioning of only such of said signals as are associated with portions of said path which are situated at a predetermined side of an abnormally conditioned station, and mechanism responsive to circuits of such plurality for acting, during aforesaid abnormal path conditionings, for causing signaling manifestations distinctively representative of abnormally conditioned ones of said paths.

54. A signaling system having a plurality of circuits each comprising a current path and a conductor available for association with portions of said path along the length thereof, signals and signal causing stations associated with said circuit in interspersed relationship along said path, means including said stations and rendered effective incident to abnormal conditioning of respective ones thereof for causing abnormal conditioning of only such of said signals as are associated with portions of said path which are situated at a predetermined side of an abnormally conditioned station, mechanism normally responsive to circuits of such plurality for acting, during aforesaid abnormal path conditionings, for causing intermittent normal conditionings of otherwise abnormally conditioned path portions, and means including said mechanism for causing predetermined signal manifestations distinctively representative of abnormally conditioned ones of said paths.

55. A signaling system having a plurality of circuits each comprising a current path and a conductor available for association with portions of said path along the length thereof, signals and signal causing stations associated with said circuit in interspersed relationship along said path, means including said stations and rendered effective incident to abnormal conditioning of respective ones thereof for causing abnormal conditioning of only such of said signals as are associated with portions of said path which are situated at a predetermined side of an abnormally conditioned station, a circuit for response to signals from said plurality of circuits, and mechanism responsive to circuits of such plurality for acting, during aforesaid abnormal path conditionings, for effective formulation of code signaling impulses in said responsive circuit distinctively

representative of abnormally conditioned ones of said paths.

56. A signaling system having a plurality of circuits each comprising a current path and a conductor available for association with portions of said path along the length thereof, signals and signal causing stations associated with said circuit in interspersed relationship along said path, means including said stations and rendered effective incident to abnormal conditioning of respective ones thereof for causing abnormal conditioning of only such of said signals as are associated with portions of said path which are situated at a predetermined side of an abnormally conditioned station, a circuit for response to signals from said plurality of circuits, and mechanism responsive to circuits of such plurality during aforesaid abnormal path conditionings, for acting effectively only during a time measured by operation of said mechanism, for causing formulation of code signaling impulses in said responsive circuit distinctively representative of abnormally conditioned ones of said paths.

57. A signaling system having a plurality of circuits each comprising a current path and a conductor available for association with portions of said path along the length thereof, signals and signal causing stations associated with said circuit in interspersed relationship along said path, means including said stations and rendered effective incident to abnormal conditioning of respective ones thereof for causing abnormal conditioning of only such of said signals as are associated with portions of said path which are situated at a predetermined side of an abnormally conditioned station, a circuit for response to signals from said plurality of circuits, mechanism normally responsive to circuits of such plurality for acting, during aforesaid abnormal path conditionings, for causing intermittent normal conditionings of otherwise abnormally conditioned path portions, and means including and acting effectively only during a time measured by operation of said mechanism, for causing formulation of code signaling impulses in said responsive circuit distinctively representative of abnormally conditioned ones of said paths.

58. A signaling system having a plurality of circuits each comprising a current path and a conductor available for association with portions of said path along the length thereof, signals and signal causing stations associated with said circuit in interspersed relationship along said path, means including said stations and rendered effective incident to abnormal conditioning of respective ones thereof for causing abnormal conditioning of only such of said signals as are associated with portions of said path which are situated at a predetermined side of an abnormally conditioned station, a circuit for response to signals from said plurality of circuits, mechanism normally responsive to circuits of such plurality for acting, during aforesaid abnormal path conditionings, for causing intermittent normal conditionings of otherwise abnormally conditioned path portions, and means including said mechanism for causing formulation of code signaling impulses in said responsive circuit distinctively representative of abnormally conditioned ones of said paths.

59. A signaling system having a plurality of circuits each comprising a current path and a conductor available for association with portions of said path along the length thereof, signals and signal causing stations associated with said circuit in interspersed relationship along said path, means including said stations and rendered effective incident to abnormal conditioning of respective ones thereof for causing abnormal conditioning of only such of said signals as are associated with portions of said path which are situated at a predetermined side of an abnormally conditioned station, mechanism normally responsive to circuits of such plurality for acting, during aforesaid abnormal path conditionings, for causing intermittent normal conditionings of otherwise abnormally conditioned path portions, and means operable by and for rendering said mechanism unresponsive to such circuits during each of said intermittent normal conditionings thereof.

60. A signaling system having a plurality of circuits each comprising a current path and a conductor available for association with portions of said path along the length thereof, signals and signal causing stations associated with said circuit in interspersed relationship along said path, means including said stations and rendered effective incident to abnormal conditioning of respective ones thereof for causing abnormal conditioning of only such of said signals as are associated with portions of said path which are situated at a predetermined side of an abnormally conditioned station, a circuit for response to signals from said plurality of circuits, mechanism normally responsive to circuits of such plurality for acting, during aforesaid abnormal path conditionings, for causing intermittent normal conditionings of otherwise abnormally conditioned path portions, means operable by and for rendering said mechanism unresponsive to such circuits during each of said intermittent normal conditionings thereof, and means including said mechanism for causing formulation of code signaling impulses in said responsive circuit distinctively representative of abnormally conditioned ones of said paths.

61. A signaling system having a plurality of circuits each comprising a current path and a conductor available for association with portions of said path along the length thereof, signals and signal causing stations associated with said circuit in interspersed relationship along said path, means including said stations and rendered effective incident to abnormal conditioning of respective ones thereof for causing abnormal conditioning of only such of said signals as are associated with portions of said path which are situated at a predetermined side of an abnormally conditioned station, a circuit for response to signals from said plurality of circuits, mechanism normally responsive to circuits of such plurality for acting, during aforesaid abnormal path conditionings, for causing intermittent normal conditionings of otherwise abnormally conditioned path portions, means operable by and for rendering said mechanism unresponsive to such circuits during each of said intermittent normal conditionings thereof, and means including and acting effectively only during a time measured by operation of said mechanism, for causing formulation of code signaling impulses in said responsive circuit distinctively representative of abnormally conditioned ones of said paths.

62. A signaling system having a plurality of normally energized circuits each comprising a path subject to blocking of current flow therein at various places along the length thereof, signals respectively associated with portions of said

path between said blocking places in a manner such that abnormal conditioning of respective signals will result from such blocking only when it occurs between the associated portion and a predetermined end of said path, and mechanism having electromagnets for respective energization from the other ends of said paths, contacts severally governed by said magnets for abnormal conditioning only during deenergization thereof, a drive shaft, means for rotating said shaft, means responsive to said magnets for governing such rotation, means including respectively associated ones of said contacts for intermittently acting to isolate deenergized magnets from their respectively associated paths and for establishing connections for effecting reenergizations of such paths during isolations of their magnets therefrom.

63. A signaling system having a plurality of normally energized circuits each comprising a path subject to blocking of current flow therein at various places along the length thereof, signals respectively associated with portions of said path between said blocking places in a manner such that abnormal conditioning of respective signals will result from such blocking only when it occurs between the associated portion and a predetermined end of said path, and mechanism having electromagnets for respective energization from the other ends of said paths, contacts severally governed by said magnets for abnormal conditioning only during deenergization thereof, a drive shaft, means for rotating said shaft, means for initiating such rotation responsive to deenergization of any of said magnets and for terminating such rotation only following energization of all of said magnets continued for a predetermined time measured by the rotation of said shaft, and means including respectively associated ones of said contacts for intermittently acting to isolate deenergized magnets from their respectively associated paths and for establishing connections for effecting reenergizations of such paths during isolations of their magnets therefrom.

64. A signaling system having a plurality of normally energized circuits each comprising a path subject to blocking of current flow therein at various places along the length thereof, signals respectively associated with portions of said path between said blocking places in a manner such that abnormal conditioning of respective signals will result from such blocking only when it occurs between the associated portion and a predetermined end of said path, a circuit for response to signals from said plurality of circuits, and mechanism having electromagnets for respective energization from the other ends of said paths, contacts severally governed by said magnets for abnormal conditioning only during deenergization thereof, a drive shaft, means for rotating said shaft, means for initiating such rotation responsive to deenergization of any of said magnets and for terminating such rotation only following energization of all of said magnets continued for a predetermined time measured by the rotation of said shaft, and means jointly governed by said contacts and by rotation of said shaft for effecting formulation of code signaling impulses in said responsive circuit distinctively representative of circuits of deenergized magnets.

65. A signaling system having a plurality of normally energized circuits each comprising a path subject to blocking of current flow therein at various places along the length thereof, signals respectively associated with portions of said path between said blocking places in a manner such that abnormal conditioning of respective signals will result from such blocking only when it occurs between the associated portion and a predetermined end of said path, a circuit for response to signals from said plurality of circuits, and mechanism having electromagnets for respective energization from the other ends of said paths, contacts severally governed by said magnets for abnormal conditioning only during deenergization thereof, a drive shaft, means for rotating said shaft, means for initiating such rotation responsive to deenergization of any of said magnets and for terminating such rotation only following energization of all of said magnets continued for a predetermined time measured by the rotation of said shaft, means including respectively associated ones of said contacts for intermittently acting to establish connections for effecting reenergizations of paths associated with deenergized magnets, means jointly governed by said contacts and by rotation of said shaft for effecting formulation of code signaling impulses in said responsive circuit distinctively representative of circuits of deenergized magnets, and means operable by said shaft for limiting the extent of such formulations.

66. A signaling system having a plurality of normally energized circuits each comprising a path subject to blocking of current flow therein at various places along the length thereof, signals respectively associated with portions of said path between said blocking places in a manner such that abnormal conditioning of respective signals will result from such blocking only when it occurs between the associated portion and a predetermined end of said path, a circuit for response to signals from said plurality of circuits, and mechanism having electromagnets for respective energization from the other ends of said paths, contacts severally governed by said magnets for abnormal conditioning only during deenergization thereof, a drive shaft, means for rotating said shaft, means for initiating such rotation responsive to deenergization of any of said magnets and for terminating such rotation only following energization of all of said magnets continued for a predetermined time measured by the rotation of said shaft, means including certain respectively associated ones of said contacts for intermittently acting to isolate deenergized magnets from their respectively associated paths and for establishing connections for effecting reenergizations of such paths during isolations of their magnets therefrom, and means jointly governed by other of said contacts and by rotation of said shaft for effecting formulation of code signaling impulses in said responsive circuit distinctively representative of circuits of deenergized magnets, and means operable by said shaft for limiting the extent of such formulations.

67. Signaling mechanism having a plurality of current paths for association with signal initiating circuits, electromagnets normally associated with said paths for several response thereto, and means for intermittently acting to isolate abnormally conditioned magnets from their respectively associated current paths and for establishing abnormal connections with such paths during isolations of their magnets therefrom.

68. Signaling mechanism having a plurality of current paths for association with signal initiat-

ing circuits, electromagnets associated with said paths for several response thereto, contacts associated for abnormal conditioning concurrently with respective magnets, means for rendering said mechanism active responsive to abnormal conditioning of any of said magnets, a current path for a signal responsive circuit, means jointly governed by said contacts and by said mechanism incident to aforesaid activity thereof for effecting formulation of code signals in said last named path distinctively representative of the circuits of abnormally conditioned magnets, and means for limiting the time during which such impulses will be formulated resultant from a series of abnormal conditionings of any of said magnets uninterrupted by normal conditioning continued for a predetermined time measured by operation of said mechanism.

69. Signaling mechanism having a plurality of current paths for association with signal initiating circuits, electromagnets normally associated with said paths for several response thereto, contacts associated for abnormal conditioning concurrently with respective magnets, a drive shaft, means for rotating said shaft, means for initiating such rotation responsive to abnormal conditioning of any of said magnets and for terminating such rotation only following normal conditioning of all of said magnets continued a predetermined time measured by operation of said mechanism, means including certain respectively associated ones of said contacts for intermittently acting to isolate abnormally conditioned magnets from their respectively associated current paths and for establishing abnormal connections with such paths during isolations of their magnets therefrom, a current path for a signal responsive circuit, means jointly governed by other of said contacts and by rotation of said shaft for effecting formulation of code signals in said last named path distinctively representative of the circuits of abnormally conditioned magnets, and means for limiting the time during which such impulses will be formulated resultant from a series of abnormal conditionings of any of said magnets uninterrupted by normal conditioning continued for a predetermined time measured by operation of said mechanism.

C. E. BEACH.