C. E. BEACH.

SIGNAL SYSTEM.

APPLICATION FILED OCT. 1, 1915.

1,274,367.

Patented Aug. 6, 1918.

2 SHEETS—SHEET 1.

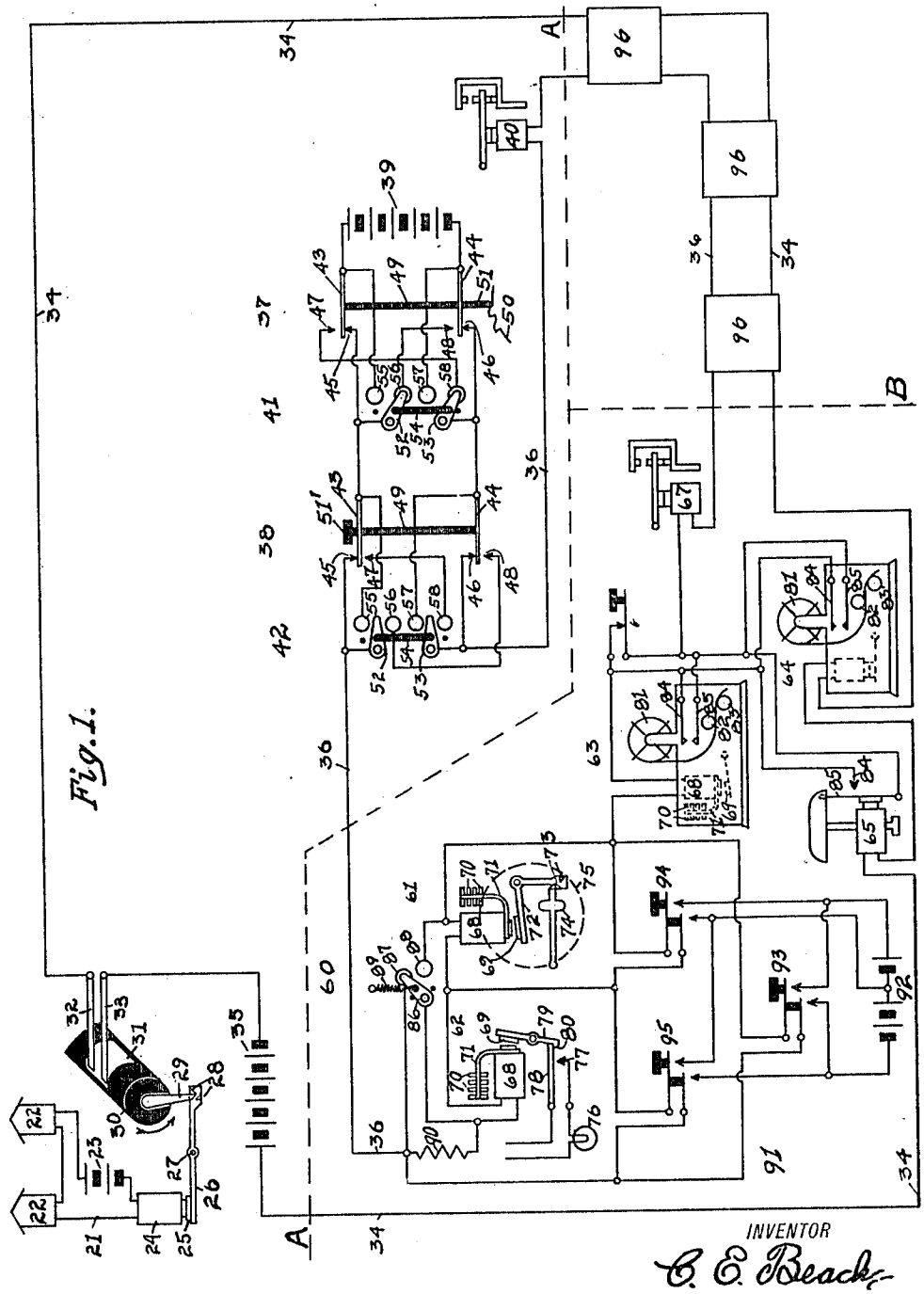

Fig. 1.

INVENTOR

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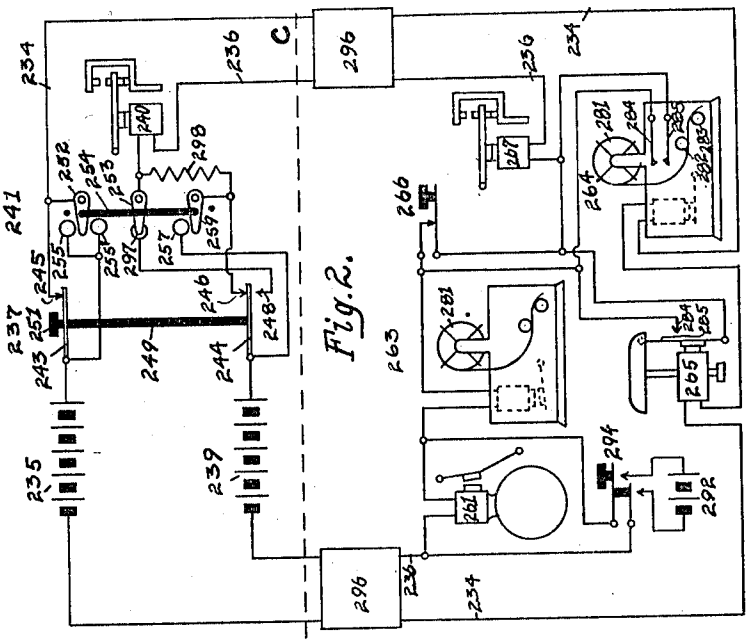

Fig. 2.

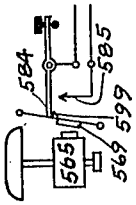

Fig. 5.

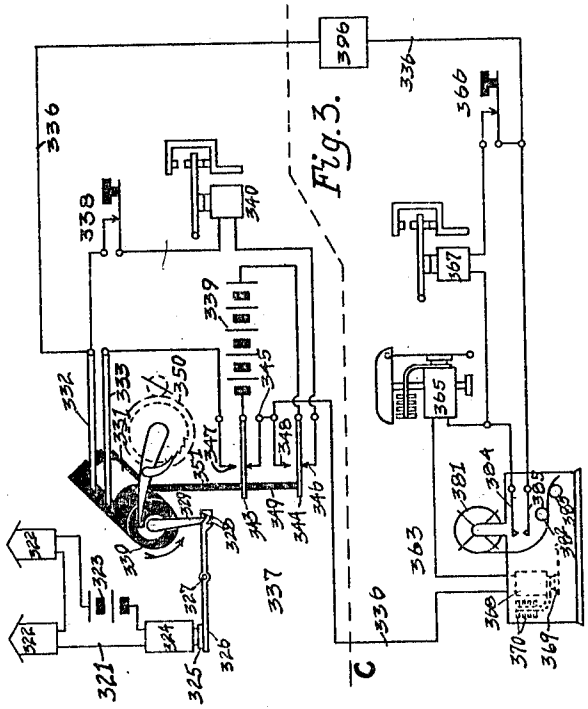

Fig. 3.

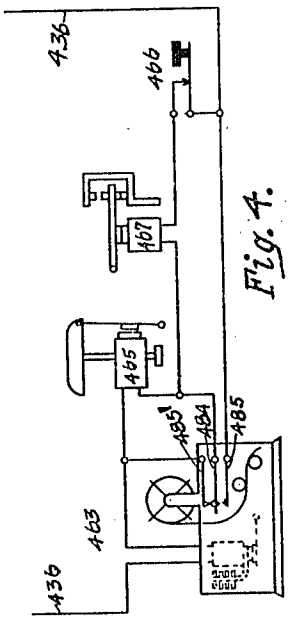

Fig. 4.

INVENTOR

C. E. Beach.

UNITED STATES PATENT OFFICE.

CLARENCE E. BEACH, OF BINGHAMTON, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE GAMEWELL FIRE ALARM TELEGRAPH COMPANY, OF NEWTON UPPER FALLS, MASSACHUSETTS, A CORPORATION OF NEW YORK.

SIGNAL SYSTEM.

1,274,367. Specification of Letters Patent. Patented Aug. 6, 1918.

Application filed October 1, 1915. Serial No. 53,563.

To all whom it may concern:

Be it known that I, CLARENCE E. BEACH, a citizen of the United States, residing at Binghamton, in the county of Broome and State of New York, have invented certain new and useful Improvements in Signal Systems, of which the following is a specification.

This invention relates to electrical signal systems and is particularly adapted for use in connection with receiving and recording devices having polarized magnetic mechanism embodying the inventions disclosed in Letters Patent 1,176,421, and 1,176,422, dated March 21, 1916, but various features of this invention are capable of use, either alone or in combination with each other, in connection with many other types of receiving and recording devices, and with various forms of signal systems.

Certain features of this invention are particularly adapted for use in systems having circuits which are depended upon for the transmission of signals of special importance, as for instance fire alarm signals, and which circuits are adapted for use for the transmission of comparatively unimportant signals, as for instance routine telegraphic signals, and which are so constructed that when these circuits are employed for telegraphic signals, such signals shall not interfere with fire alarm signals, circuits of this character being hereinafter referred to as "combination" circuits.

Combination circuit systems have been devised (such as that disclosed in Letters Patent No. 650,358, dated May 22, 1900, to Wm. H. Kirnan) having make and break telegraph keys, non-polarized and polarized relays, telegraph sounders and alarming devices such as tap bells or registers, or both tap bells and registers at fire apparatus houses, and having means at fire alarm headquarters for reversing the polarity of such combination circuits: all so arranged that at or about the commencement of the transmission of a fire alarm signal the polarity of such circuits will be reversed and the polarized relays at the fire apparatus houses will render the telegraph sounders unresponsive and the alarming devices responsive to the non-polarized relays, so that the alarm signals will be responded to by the alarming devices, and will close a shunt and thereby disable the telegraph keys; and so that at the conclusion of the transmission of a fire alarm signal the polarity of such circuits will be restored to normal, whereupon the polarized relays at the fire apparatus houses will remove the shunts from their associated telegraph keys, and remove the alarming devices from and restore the telegraph sounders to the control of said non-polarized relays.

In systems such as just described, local batteries are required at the fire apparatus houses for local circuits controlled by both the non-polarized and the polarized relays, so that the correct transmission of important alarm signals is dependent upon the effectiveness of numerous contact points which are normally open, and upon the effectiveness of local batteries which it has not been found practicable to keep under constant test, and it has been found that, through lack of the supervision and constant inspection which is available for the main batteries at fire alarm headquarters, such local batteries are liable to fail and cause alarms to be incorrectly interrupted by the alarming devices or entirely lost.

In such systems it has also been found that if the telegraph key at any fire apparatus house is held depressed through accident or design (as for instance, through accidentally laying a book on the desk so as to hold the key open) the associated combination circuit is not only rendered useless for telegraphic signals while such key is so held open but is also rendered useless for fire alarm signals, as the polarized relay controlling the shunt around such open key will not be energized to act to shunt said key until the circuit has been closed at the key. It has further been found that if such a circuit is standing open incident to the transmission of a telegraphic signal or if the attendant at some fire apparatus house unwittingly starts to transmit a telegraphic signal at or about the instant that a fire alarm signal starts, one or more strokes of the fire alarm signal may be lost before the reversal of polarity at fire alarm headquarters becomes effective at the polarized relay controlling the shunt around the key so operated.

Such earlier systems have been expensive to manufacture and have required skilled

supervision to keep them in operative condition, as it is not sufficient to keep the main current source at fire alarm headquarters in proper operating condition, but each of the local current sources must also be kept in correspondingly good condition, nor is it sufficient to keep all circuit making and breaking contacts at fire alarm headquarters in good order, as the condition of the relay contacts at the fire apparatus houses is of equal importance, as they are vital to the translation of the alarm thereat, and these contacts are more exposed to dirt and corrosion than those at headquarters, while usually being in charge of persons unskilled in the adjustment and care of electrical apparatus.

It has been deemed expedient to provide two classes of alarming devices at fire apparatus houses which are subject to frequent alarms, whereby alarm signals can be first transmitted to be received in a comparatively noiseless manner but so as to bring the alarm to the attention of a special attendant (usually termed "the house watch"), and then can be transmitted to cause responsive operation of comparatively loud sounding alarming devices, such as large gongs which will attract the attention and cause response of all the firemen in the house, so that a cutoff switch may be provided to silence the large gongs in the event of the house watch deciding that his company is not due to respond to that particular alarm, thus in the instance of night alarms all of the firemen may sleep through alarms except those in houses having apparatus due to respond to such alarm, and, for want of a better term, such firm alarm systems will be hereinafter referred to as "still alarm" systems.

It is evident that such still alarm systems should be so constructed that the loud sounding alarming devices may be alternately rendered unresponsive and responsive to their circuit without thereby causing them to sound, and on the other hand, it is well understood by those skilled in this art that ordinary alarming devices are arranged to sound when their controlling magnets are successively energized and deënergized. In view of these considerations it has been the practice to connect the comparatively loud sounding alarming devices in a normally open circuit, such normally open circuit being either controlled by a relay and supplied by a local battery at the fire apparatus house and having a silencing switch whereby the house watch could hold such local circuit open, or being a separate normally open circuit from fire alarm headquarters and having a silencing switch which was arranged to shunt the loud sounding alarming device and in some cases to substitute a corresponding resistance therefor. In either event the loud sounding alarming device was thus silenced during the time that the house watch held the switch in abnormal position.

One or more of the following disadvantages have been present in all of the still alarm systems employed prior to this present invention. 1. Normally open circuits have been employed, although it is well recognized in fire alarm practice that it is highly undesirable to employ normally open alarm circuits. 2. Local batteries have been employed at the various fire apparatus houses, thus incurring extra expense for the maintenance of batteries which are only occasionally used, requiring a large amount of work for the inspection and maintenance of such batteries at widely distributed points, and incurring a chance of alarm failures or lost alarms due to the inherent chance of failure without notice. 3. While the house watch has been warned when to commence silencing the loud sounding alarming devices, there has been nothing to indicate when such silencing could be discontinued.

It has been deemed highly desirable that duplicate alarm circuits be provided between fire alarm headquarters and the fire apparatus houses, and where such duplicate circuits are employed it has been usual to provide different kinds of alarming devices in such respective circuits, and if routine telegraphic devices are provided, to connect them in but one of these circuits, and for the want of a better term, systems employing such duplicate circuits will hereinafter be referred to as having "two classes of alarm circuits."

In the operation of systems having two classes of alarm circuits it is customary to first transmit alarm signals over circuits of one class and to then transmit them over circuits of the other class, and for want of better terms for indicating the order in which such classes of circuits are employed, circuits of the class over which alarm signals are first transmitted will be hereinafter referred to as "primary alarm circuits", and circuits of such other class will be referred to as "secondary alarm circuits."

As the secondary alarm circuits of still alarm systems heretofore used have been normally open, it has been impracticable to employ them for routine telegraphic signals, and the primary circuits of such systems have therefore been employed for the transmission of telegraphic signals.

Important objects of this invention are as follows:—

To provide a signal system comprising combination circuits so constructed and arranged that the receipt of alarm signals at the fire apparatus houses will not be dependent upon any normally open circuit, upon any local battery or battery not con-

stantly available for inspection and test by the attendants at fire alarm headquarters, the closing of normally open contacts of any relay at a fire apparatus house, or the maintenance of adjustments of relays at fire apparatus houses or other than at fire alarm headquarters.

To provide for the connection without the use of relays or local batteries, of alarming devices and telegraphic devices in combination circuits adapted for use with existing systems, so as to accomplish the useful functions of corresponding parts of said existing systems which are controlled by the use of relays and local batteries in such existing systems.

To provide a signal system having two classes of alarm circuits, *i. e.*, primary circuits and secondary circuits, the circuits of one of which classes being combination circuits, in which the telegraphic transmitting devices in such combination circuits are so controlled as to avoid mutilation of or loss of alarms either in the primary or secondary circuits because of the transmission of concurrent telegraphic signals or because of any telegraphic key or keys standing open.

To provide a signal system having two classes of alarm circuits, *i. e.*, primary and secondary alarm circuits, the circuits of one of which classes being combination circuits, in which the combination circuits are so arranged that they can be used for telegraphic signals only while the associated circuit of the other class stands closed, so that should one of the other class of alarm circuits be interrupted and thereafter stand open indefinitely, all of the telegraph keys in the associated combination circuit will be and remain disabled upon and during such interruption.

To provide simple and inexpensive means at each fire apparatus house whereby the telegraph key connected in the combination circuit at such house will be disabled or shunted out throughout the transmission of any alarm over such combination circuit and for a predetermined time thereafter.

To provide simple and inexpensive means at each fire apparatus house whereby the telegraph keys at such house will be disabled or shunted-out throughout the transmission of alarms over either of the classes of circuits connecting such fire apparatus house with fire alarm headquarters and for a predetermined time thereafter.

To provide simple and inexpensive means at each fire apparatus house whereby the telegraph key connected in the combination circuit at such house will be disabled or shunted-out throughout the transmission of any alarm over either of the two classes of circuits connecting such fire apparatus house with headquarters and for a predetermined time thereafter, and so that should one of the other class of alarm circuits be interrupted and thereafter stand open indefinitely, all of the telegraph keys in the associated combination circuit will be and remain disabled upon and during such interruption.

To provide a form of combination circuit adapted to include polarized alarming devices constructed and arranged to retain their armatures in attracted position during telegraphic signals but whose armatures retract during alarm signals and require an extraordinarily large current to move said armatures to attracted position.

To provide a form of combination circuit in which certain alarming devices and telegraphic devices will be automatically interchangeably connected without altering the resistance of the circuit.

To provide a form of normally closed secondary alarm circuits in which the normal current flow is of sufficient strength to be capable of causing the operation of the alarming devices therein and having effective silencing switches for alarming devices therein.

To provide a signal system comprising a normally closed alarm circuit including alarming devices which are unresponsive to ordinary breaks in said circuit and having means for causing the operation of one or more of said alarming devices without operatively altering the current flow throughout such circuit.

To provide a controlling switch adapted for use at fire alarm headquarters in connection with transmitting mechanism connected in a combination circuit whereby the operative relation of such transmitting mechanism with such combination circuit may be adjusted so that when said switch is in one position the operation of such transmitting mechanism will cause response of the telegraphic receiving devices only, and when said switch is in another position the operation of such transmitting mechanism will cause response of the alarming devices.

To render such signaling systems more simple and more economical to manufacture, install, and maintain, and adapted for accurate operation throughout long periods without requiring re-adjustment or the attention of a skilful person to keep them in working order.

Other objects of this invention are described in the following specification and more particularly pointed out in the claims.

In the interest of brevity, and for want of a better term, signal or alarm translating devices both of the type ordinarily characterized as "direct acting" and of the type ordinarily characterized as "electromechanical," will be hereinafter referred to as "alarming devices," and whenever "alarming devices" are hereinafter referred to as

being "included" in any circuit, it is intended to thereby indicate that the magnets which furnish the operating force for "direct acting" alarming devices or which by the movement imparted to their armatures mechanically and directly control the mechanism of "electromechanical" devices, are included in such circuit without the intervention of relays, local batteries or local circuits.

In applying this invention to a signal system comprising a combination circuit, the sounding and recording devices employed in such circuit are selected from the forms of such apparatus which are commercially so constructed as to retain their operative adjustment throughout long periods of use and which have main line magnets whose armatures mechanically control or drive the sounding or marking mechanism, said magnets being polarized in accordance with the inventions disclosed in my aforesaid copending applications, or otherwise so constructed and arranged as to be unresponsive to ordinary makes and breaks of the signal circuit such as are produced by the operation of ordinary telegraph keys, but are responsive to extraordinary current changes in the combination circuit, such as reversals of the current flow, and transmitting mechanism is provided at fire alarm headquarters for making such extraordinary current changes in the circuit, and there is also provided in the circuit suitable telegraphic mechanism consisting of the desired number of telegraph keys and suitable telegraphic receiving devices such as the usual telegraph sounders which are responsive to ordinary makes and breaks of the circuit. Each telegraphic transmitting device or key is provided with suitable disabling means, such as a shunt, suitably controlled by one or more of the alarming devices associated with or located adjacent to such telegraphic transmitting device, so as to cause the telegraphic transmitting device to be disabled whenever, under the conditions of the service for which such combination circuit is employed, it is desirable that said transmitting device should be disabled. For example, a system employing primary and secondary alarm circuits may be so arranged that whenever and so long as either the primary or the secondary circuit is in abnormal condition, the telegraphic transmitting device will be and remain disabled.

If such a combination circuit is a secondary alarm circuit associated with a primary alarm circuit, and it is desirable that no telegraphic signals may be transmitted between the initiation of an alarm signal on the primary circuit and the completion of that signal on the secondary circuit, alarming devices in the primary and secondary circuits, each having time measuring trains, such as the dial transfer train of a visual indicator or the paper feeding train of a register, which trains are arranged to be conditioned upon each stroke of an alarm to continue operating for a time longer than the longest interval between strokes of any alarm, should be equipped with circuit controlling contacts, controlled by said trains, and so connected with the telegraphic transmitting device shunt that said shunt will be closed throughout substantially all of the run of said trains. Thus, upon the initiation of an alarm in the primary circuit, a shunt for the telegraphic transmitting devices in the secondary circuit will be immediately closed and will remain closed until there has been no alarm impulse in the primary circuit for a time longer than the longest silent period between the initiation of such an alarm and the completion of its transmission over the primary circuit; and, upon the initiation of the transmission of such alarm upon the secondary alarm circuit, a similar shunt will be closed by the train associated with an alarming device responsive to the secondary alarm circuit and this second shunt will remain effective until there has been no alarm impulse in the secondary circuit for a time longer than the longest silent period between the initiation of such alarm and the completion of its transmission over the secondary circuit, and will then be automatically opened.

If it is deemed unnecessary to automatically prevent the transmission of telegraphic signals after warning has been given, by the transmission of an alarm over the primary circuit, that it is about to be transmitted over the secondary circuit, such a system may be arranged so that the telegraphic transmitting devices will be disabled from the action of the primary circuit only, in which case the attendants at the fire apparatus houses should be so trained that they will not break the secondary circuit after an alarm has started in the primary circuit, until the transmission of such alarm is completed on the secondary circuit.

If, owing to the conditions of service, it is desirable that the combination circuit shall not cause responsive action of the telegraphic receiving devices during the transmission of alarm signals, such telegraphic receiving devices should be controlled by the disabling means, as by inclusion in the shunt controlled as just described.

If it is desired that the current flow in a combination circuit shall not be materially altered when the telegraphic receiving devices are shunted out, the shunting switches controlled by the alarming devices should be arranged to substitute for the telegraph sounder an equivalent resistance, which may be the magnet windings of an alarming device such as, for example, a tap bell, so that during alarms the tap bell will sound, and

the telegraph sounder will only act in response to telegraphic signals.

If the conditions of service are such that it is desirable that the telegraph transmitting devices at each fire apparatus house or substation will be and remain disabled after the initiation of any alarm, until manually restored, each shunt switch should be so controlled by a suitable alarming device, such as, for example, a tap bell, that, upon the first alarm impulse in the circuit in which said device is included, such switch will be closed and will thereafter remain closed until manually restored.

If it is desired to prevent the transmission of telegraphic signals over a secondary combination circuit throughout any period during which its associated primary circuit may stand open, as the result, for example, of a broken line wire,—the shunts around the various telegraph keys should be so controlled by suitable alarming devices, as for instance by tap bells included in the primary alarm circuit, that, when the armatures of such bells stand in retracted position, such shunts will be closed.

In applying this invention to some signaling systems it may be found sufficient to provide such armature controlled shunts without also providing train controlled shunts, while in other systems, owing to different operating conditions, both armature controlled and train controlled shunts will be required. Whenever any such primary circuit armature controlled shunt is employed in a secondary combination circuit, it is evident that, if the primary circuit stands broken, the secondary circuit cannot be used for the transmission of telegraphic signals but will be reserved for the exclusive use of alarms,—thus removing all chance of its being open at a telegraphic transmitting device at the time an alarm should be transmitted thereon.

This invention may be applied to existing systems with a minimum of change by employing alarming devices having magnetic structure, such for example as shown in Letters Patent hereinbefore referred to, in which the electromagnet part and the permanent magnet part effectively attract the armature when acting in parallel, and are so proportioned that when the electromagnet part and the permanent magnet part are acting in series the armature is effectively attracted by the excess magnetism of the electromagnet part beyond that which may readily pass through the permanent magnet part. Such alarming devices should be so connected that the normal direction of current flow through the circuit is such that the electromagnet part and the permanent magnet part are acting in parallel, so that the armature will be attracted. If now a break occurs in the circuit, the armature will remain attracted. If the current is reversed the armature will still remain in attracted position, but upon a break in the circuit after the current has been reversed, the armature will be retracted and thus will cause the indication of a stroke of an alarm. During subsequent closures of the circuit the armature will be attracted, and retracted during breaks, thus indicating each break in the circuit while the current is reversed. At the completion of the transmission of the alarm, the current is restored to normal direction.

In order to provide for an increase in the flow of current when the direction of flow is reversed, the shunt for the telegraphic transmitting device should be made to include the telegraphic receiving device as well, so as to decrease the resistance in the circuit when the polarized alarming device is intended to be actuated.

If the conditions of service are such that it is desirable that alarming devices which are not responsive to ordinary makes and breaks of their circuit should be operable from emergency keys provided at the fire apparatus houses, so that for instance the house watch may call the firemen upon receiving a telephone call or a verbal alarm, a local current source should be supplied for each fire house having such alarming devices which are to be so operated, and one or more emergency keys should be provided for connecting such current source to the terminals of the device or devices in such manner that when so connected an operative current change will occur in the windings of said device or devices. In cases where fire apparatus houses are provided with alarming devices comprising alarm sounding instruments such as bells, alarm recording instruments such as registers, alarm indicating instruments such as lighting switches for controlling the electric lamps in the fire apparatus house, and mechanism for releasing horses, opening stable doors, or starting the engines of motor-driven fire apparatus, a plurality of keys may be provided, one of which keys should so connect the local current source to all of said alarming devices as to operatively alter the current flow therethrough, and other keys should correspondingly alter the current flow through individual devices, so that for instance the horses may be released, or the engines started, or the lights turned on, without sounding the alarm bell, etc.

In systems employing combination circuits it has been the practice to provide two sets of contacts at fire alarm headquarters, one set for the transmission of telegraphic impulses and another set for the transmission of alarm impulses, although both sets should never be simultaneously used. In arranging the transmitting mechanism at such a headquarters in accordance with this

invention, but one set of contacts need be provided, and controlling switch mechanism should be so connected with such contacts that when the switch mechanism is in one position, the contacts for effecting the abnormal current changes, such as reversals of polarity, will be effective, but when the switch mechanism is in another position such contacts will be rendered ineffective. Provision may also be made whereby the transmitting mechanism may be operated without formulating any signaling impulses in the circuit by providing a third position for the switch mechanism and so connecting the switch mechanism that when in this third position the transmitting mechanism cannot operatively alter the current flow in the circuit.

It is obvious that when operating conditions permit, it is desirable that but one set of contacts should be employed for the transmitting mechanism at headquarters, and in accordance with this invention such contacts may be actuated by a suitable manually or mechanically operated key, associated with switch mechanism such as just described, it being evident that if but one key is employed, a second operator cannot break in on the same set of circuits from headquarters for a telegraphic signal when such key is in use for alarms, no matter how confused he may become, although this could easily take place if separate keys or transmitting mechanism were provided.

In employing this invention where the conditions of service are such that it is desirable to provide a silencing switch for certain alarming devices at the fire apparatus houses, such as large bells, lighting switches, stable trips, engine starters, etc., so that such devices may be included in a normally closed circuit and still be rendered unresponsive to alarm impulses, such alarming devices should be so constructed and arranged as not to be responsive to ordinary makes and breaks of their circuit, and suitable switches and shunt circuits should be provided whereby said devices may be shunted out or switched out of the circuit.

Inasmuch as conditions may arise under which all of the silencing switches on one circuit will be operated at or about the same time (as for instance when none of the companies served by a given circuit are due to respond on a given alarm) it is desirable that a corresponding resistance be substituted for the alarming devices which are switched out by means of these silencing switches.

In order to guard against the silencing switch being left in its silencing position, each of such switches should be provided with a restoring spring so that it will automatically move to the position where it renders the various alarming devices effective except when manually held in its silencing position.

In order to indicate the completion of an alarm, so that the silencing switch need not be prematurely released, the combination circuit should include the loud sounding alarming devices, and the telegraphic receiving devices should not be controlled by the silencing switch, thus the attendant may determine when the transmission of an alarm on that circuit has been completed, so that the switch may be held in its silencing position until the completion of the alarm, and thereby save arousing the other occupants of that fire apparatus house through miscalculating the time required for transmitting such alarm.

In order that this invention may be better understood, the application thereof to a number of different types of signaling systems, is shown in the annexed drawings, but this invention is not limited to the applications shown, and it is evident that features of this invention are suitable to be applied to various types of signaling systems, either separately or in combination with each other, and this invention is not limited to the particular construction, arrangement or design of parts shown in said drawings and hereinafter described, as same are given merely for the clearer illustration of this invention, and many changes, and the inclusion or omission of parts, may be made without departing from the spirit of this invention.

Figure 1 diagrammatically indicates an application of features of this invention to a signal system having one or more box circuits controlling an automatic repeater, and primary and secondary alarm circuits.

Fig. 2 diagrammatically indicates another method of applying features of this invention to a signal system similar to that shown in Fig. 1.

Fig. 3 diagrammatically indicates an application of features of this invention to a signal system having one or more box circuits controlling an automatic repeater, and a combination alarm circuit controlled by the repeater.

Fig. 4 diagrammatically indicates another method of applying features of this invention to a signal system similar to that shown in Fig. 3.

Fig. 5 is a detail to be referred to.

Referring to Fig. 1, equipment adapted to be installed at fire alarm headquarters is shown above the dotted line A—A, and equipment adapted to be installed at a fire apparatus house is shown below dotted line A—A and to the left of dotted line B.

The box circuit 21 includes the alarm boxes 22, 22, the current source 23 and a repeater magnet 24.

In connection with the repeater magnet 24, transmitting mechanism, adapted to be

located at fire alarm headquarters, is conventionally indicated by the armature 25, the arm 26 pivoted at 27 and carrying said armature and the step by step detent ledges 28, the detent arm 29, which is arranged to so coöperate with said detent ledges that said arm will be released whenever the armature 25 moves to retracted position and having made a revolution will be stopped regardless of whether the armature stands in attracted or retracted position and will thereafter only be released when the armature moves from attracted to retracted position, the cylinder 30 moving with the detent arm 29, the contact plate 31 carried by said cylinder, and the contact fingers 32 and 33. Plate 31 normally connects said contact fingers but is withdrawn from connection therewith during the rotation of the cylinder 30.

The contact fingers 32 and 33 control a primary alarm circuit 34 in which a suitable current source 35 is provided.

Headquarters pole changing transmitting mechanism is generally indicated at 37 and 38, the transmitting mechanism 37 being conventionally shown as mechanically operable, and the transmitting mechanism 38 being conventionally shown as manually operable, the mechanism 37 and 38 being suitably connected to the secondary alarm combination circuit 36 and to the main current source 39 therefor.

The conventionally indicated telegraph sounder 40, for the fire alarm headquarters, is serially included in the secondary alarm combination circuit 36.

Controlling switch mechanism is generally indicated at 41 and 42, the switch mechanism 41 being associated with and adapted to control the operation of the transmitting mechanism 37, and the switch mechanism 42 being associated with and adapted to control the operation of the transmitting mechanism 38.

The transmitting mechanism 37 comprises,—the movable contacts 43 and 44 which are connected to the respective terminals of the main current source 39, the normally closed contacts 45 and 46 which cooperate with the movable contacts 43 and 44 respectively, the normally open contacts 47 and 48 which are adapted to coöperate with said movable contacts 43 and 44 respectively for effecting abnormal current changes in the secondary combination circuit 36, the insulating yoke 49 which connects the movable contacts 43 and 44 for simultaneous operation, and typical mechanical operating means 50 arranged to act through the extension 51 to operate the movable contacts 43 and 44.

The controlling switch mechanism 41 comprises,—the arms 52 and 53, the insulating yoke 54 which connects said arms for simultaneous movement, the contacts 55 and 56 for the arm 52, the contacts 57 and 58 for the arm 53, and suitable conductors connecting the arms 52 and 53 with the normally closed contacts 45 and 46 respectively, the contacts 55 and 57 with the movable contacts 43 and 44 respectively, and the contacts 56 and 58 with the contacts 48 and 47 respectively.

The relative construction and arrangement of the arms 52 and 53 and their cooperating contacts 55, 56, 57 and 58 is such that said arms may be moved to a position in which they will not connect with any of such contacts.

The connection and arrangement of the parts of the transmitting mechanism 38 and controlling switch mechanism 42 are the same as that of corresponding parts of the transmitting mechanism 37 and controlling switch mechanism 41, the manually operable extension or button 51′ being provided for the convenient actuation of the movable contacts 43 and 44 of said transmitting mechanism 38.

Fire apparatus house alarming devices are generally indicated by the group of polarized alarming devices 60, consisting of the loud sounding electromechanical gong 61 and the lighting switch 62; recording devices consisting of the polarized register 63 and the non-polarized register 64; and a comparatively noiseless alarming device consisting of a direct acting tap bell 65.

Fire apparatus house telegraphic devices are diagrammatically indicated by the make and break transmitting device 66, which is shown as a closed circuit telegraph key, and the make and break non-polarized receiving device 67 which is conventionally shown as a telegraph sounder.

Inasmuch as the electromechanical gong 61, the lighting switch 62, and the polarized register 63 have a similar form of magnet structure, corresponding parts thereof are represented by like reference characters.

The electromagnet section of each said magnet structure, diagrammatically indicated at 68, comprises two magnet cores and electromagnet windings therefor which are serially included in the secondary alarm combination circuit 36, an armature 69 being arranged to bridge one set of the adjacent ends of said cores, the other set of adjacent ends of said cores being magnetically disconnected.

The permanent magnet section of the said magnet structure comprises the permanent magnets 70 and the comparatively non-retentive extensions, diagrammatically indicated at 71, the permanent magnets being so connected by means of said extensions with the core ends of the electromagnet section which are adjacent to the armature that the like poles of all of said permanent mag-

nets are magnetically joined to the same electromagnet core.

The windings of the alarming devices 61, 62 and 63 are so proportioned to the permanent magnet sections thereof that when the current flow in the circuit 36 is in abnormal direction, as when it has been reversed by transmitting mechanisms 37 and 38, the associated armatures 69 will be moved to attracted position against the friction and retractile force to which their movement is subjected, the direction of the magnetization of the electromagnet cores being, in this event, such as to produce consequent poles in the vicinity of the armatures 69, and the cores employed in the electromagnet sections 68 should be comparatively retentive of magnetism so that during interruptions in the flow of current in said abnormal direction in said circuit 36 each armature 69 will be retained in attracted position. The number and size of the permanent magnets used should be such that a current flow through the electromagnet windings of the normal intensity and direction will produce such magnetization of the electromagnet cores in series with the magnetization of the permanent magnet section that the magnet structure will have but two free poles, which will be developed at the ends of the electromagnet cores which are not adjacent to the armature, and, as the poles adjacent to the armatures will be neutralized, said armatures 69 will be permitted to move to retracted position.

The mechanism controlled by the armature 69 of the electromechanical gong 61 is typically indicated by the bell crank lever 72 upon one end of which the armature 69 is mounted, the step by step escapement ledges 73 mounted upon the other end of said bell crank lever, the bell 75, and the typical hammer 74 which is suitably controlled by the movement of said ledges and which may be driven by any suitable mechanism, (not shown) to operate in a manner well understood by those skilled in the art, so that, whenever the armature 69 moves to retracted position, the hammer 74 will be permitted to move into contact with the bell 75 and thus sound said bell.

The lighting switch 62 may consist of any well known mechanism adapted to control suitable lighting devices as typically indicated by the lamp 76. Such mechanism being conventionally indicated by the stationary contact 77, the movable contact 78 adapted to coöperate therewith to establish current flow through the lamp 76, and the arm 79 having the hook 80 formed in one end thereof and carrying the armature 69 at the other end thereof, and so arranged that said hook may normally support the movable contact 78 out of engagement with the contact 77 and so that said hook will be withdrawn from the path of said contact 78 when the armature moves to attracted position.

The lighting switch 62 is illustrated for the purpose of typifying the various trips and other alarming devices utilized in various fire apparatus houses for lighting lamps, releasing stable doors, starting the engines of motor driven fire apparatus, etc., it being understood that the group of alarming devices indicated by the reference character 60 typifies those alarming devices which might be termed, for want of a better designation, "loud sounding alarming devices" because they are of such a character that their action will be manifested generally throughout the fire apparatus house in which they are installed, as distinguished from registers or recorders, small tap bells, telegraph sounders, indicators, etc., whose operation is only manifested to those in close proximity to them.

The register 63 is provided with suitable recording mechanism controlled or operated by its armature 69 and having paper feeding mechanism for the tape 81, comprising a suitable train which is typically indicated by the feed rollers 82 and 83, said paper feeding train being so controlled by said recording mechanism as to be conditioned, upon eaclf stroke of an alarm, to continue running for a time longer than the longest interval between strokes of any alarm, as is usual in registers employed for recording fire alarms. The register is provided with circuit closing means comprising the contacts 84 and 85 which are so arranged as to be closed throughout substantially all of the periods during which said train is conditioned for running, as is well known in the art.

Disabling means for the telegraphic transmitting device or key 66 is provided in the form of a shunt current path controlled by the contacts 84 and 85, and it is evident that such shunt current path will be closed during substantially all of the periods during which the feeding train of the register 63 is running.

The polarized magnetic structure of the alarming devices 61, 62 and 63 is employed for the purpose of rendering these devices unresponsive to ordinary makes and brakes of the combination circuit 36, such as those produced by the operation of the telegraph key 66, while rendering said alarming devices responsive to extraordinary current changes, such as those which may be produced by the operation of the pole changing transmitting mechanism 37 or 38.

The register 64 is equipped with non-polarized magnetic controlling structure arranged to suitably control or operate recording mechanism in any usual or well known manner, and comprising paper feeding mechanism and contacts controlled thereby

and responsive to the operation of the recording mechanism in a manner similar to that described in connection with the register 63, so as to similarly control a shunt current path around the telegraphic transmitting key 66. The electromagnet windings of the register 64 are serially included in the primary alarm circuit 34.

The comparatively noiseless tap bell 65 is provided with suitable electromagnet windings which are serially included in the primary alarm circuit 34 and are adapted to cause said bell to sound as a direct acting tap bell in a well known manner, circuit contacts being associated with the armature of said bell whereby a shunt around the telegraphic transmitting key 66 will be closed during all periods when the armature of said bell is in retracted position.

The shunt contacts of the register 64 are provided for the purpose of disabling the telegraph key 66 upon the first stroke of any alarm transmitted over the primary alarm circuit 34 and to thereafter maintain said key in disabled condition until after the elapse of a time, during which no alarm strokes have been transmitted over said circuit 34, which is longer than the longest interval between the strokes of any alarm.

The shunt contacts of the register 63 are provided for the purpose of disabling the telegraph key 66 upon the first stroke of any alarm which is transmitted over the secondary alarm combination circuit 36 and to thereafter maintain said key in disabled condition until after the elapse of a time, during which no alarm strokes have been transmitted over said circuit 36, which is longer than the longest interval between the strokes of any alarm.

The shunt contacts of the tap bell 65 are provided for the purpose of disabling the telegraph key 66 throughout all periods during which the primary alarm circuit 34 stands interrupted.

The resistance 90 is substantially equivalent to the combined resistance of the loud sounding alarming devices 61 and 62 and is serially included in the circuit 36 in such relation to said devices that the portion of said circuit including said resistance may be shunted without thereby shunting any other devices, and said alarming devices are so connected in said circuit that the portion of said circuit including said devices may be shunted without shunting said resistance.

The switch arm 86 and the contacts 87 and 88 are connected by suitable conductors with such points in the circuit 36 that, when said arm touches the contact 87 the resistance 90 will be shunted, and, when said arm touches the contact 88 the alarming devices 61 and 62 will be shunted.

A group of emergency keys is generally indicated by the reference character 91, said keys being so connected and arranged that, when operated, they will apply all or a suitable part of the local current source 92 to either one or both of the alarming devices 61 and 62 in such polarity as to reverse the direction of normal current flow therethrough, diverting the normal current flow of said circuit 36 through said local current source.

The emergency key 93 is so connected and arranged that, when operated, it will connect the entire local current source 92 around the portion of the circuit 36 which serially includes the electromagnet windings of the alarming devices 61 and 62 and the resistance 90.

The emergency key 94 is so connected and arranged that, when operated, it will connect a suitable part of the local current source 92 around the portion of the circuit 36 which includes the windings of the alarming device 61.

The emergency key 95 is so connected and arranged that, when operated, it will connect a suitable part of the local current source 92 around the portion of the circuit 36 which serially includes the windings of the alarming device 62 and the resistance 90.

Other fire apparatus houses 96, 96, 96 are diagrammatically indicated as being serially included in the duplicate alarm circuits 34 and 36, and are each assumed to be equipped with such alarming and telegraphic devices as the conditions of service thereat may require.

The operation of the fire alarm system shown in Fig. 1 is as follows:

Under normal conditions the box circuit 21, the primary alarm circuit 34, and the secondary alarm combination circuit 36 are closed; the direction of current flow in the circuit 36 being such as will magnetize the electromagnet sections 68 of alarming devices 61, 62 and 63 in series with their permanent magnet sections, so that their associated armatures 69 will stand in retracted position; the disabling shunt contacts of the alarming devices 63, 64 and 65 stand open; the mechanically movable parts shown are at rest; and the normal current path through the circuit 36 is as follows,—from the upper terminal of main current source 39, through movable contact 43, normally closed contact 45 of the transmitting mechanism 37, corresponding parts of transmitting mechanism 38, to upper terminal of resistance 90, from thence, owing to the comparatively low resistance of the current path through the contact 87 and arm 86 of the silencing switch, substantially all of the current will pass through said switch to and through the lighting switch 62, electromechanical gong 61, polarized register 63, telegraph key 66, telegraph sounder 67, the alarming and telegraphic devices included in circuit 36 at the fire apparatus houses 96, 96, 96, headquarters

sounder 40, normally closed contact 46 and movable contact 44 of transmitting mechanism 38, corresponding contacts of transmitting mechanism 37, to lower terminal of main current source 39.

If now it is desired to transmit a telegraphic signal from any fire apparatus house, the key 66 of such house may be suitably manipulated whereupon the sounders 40 and 67 included in circuit with the key 66 so operated will act in response thereto.

If it is desired to manually transmit a telegraphic signal from headquarters, the controlling switch mechanism 42 should be positioned as shown, so that the switch arms 52 and 53 of said mechanism will not connect with either of their contacts, and the transmitting mechanism 38 should be suitably operated. The operation of said transmitting mechanism will cause the circuit 36 to be broken each time its movable contacts 43 and 44 are depressed and to be closed whenever said contacts are raised so as to connect with the normally closed contacts 45 and 46.

As the polarized alarming devices 61, 62 and 63 are unresponsive to ordinary makes and breaks of the circuit 36, such as are produced by the operation of the key 66 or by the operation of the transmitting mechanism 38 when its controlling switch 42 is in the position shown, none of said alarming devices will respond to such telegraphic signals.

If it is desired to transmit a telegraphic signal by the use of the mechanical operating means 50, the controlling switch mechanism 41 should be so adjusted that its arms 52 and 53 will not connect with either of their contacts, whereupon the mechanical operating means 50 may act through the extension 51 to swing the movable contacts 43 and 44 so as to alternately open and close the circuit 36 and thus cause response of the telegraph sounders 40 and 67 without causing response of any of the alarming devices, such as 61, 62 or 63.

When either controlling switch mechanism 41 or 42 is so positioned that its arms 52 and 53 do not connect with either of their associated contacts, no operative current change in the circuit 36 will result from the movable contacts 43 and 44 of the associated transmitting mechanism touching their respective contacts 47 and 48, as the conductors leading from said contacts 47 and 48 stand open at their controlling switch contacts 58 and 56 respectively.

If an alarm is transmitted from one of the boxes 22, the operation of said box will cause the usual current changes in box circuit 21, so as to cause the primary circuit 34 to be alternately interrupted and closed at the contact fingers 32 and 33 in accordance with practice well known to those skilled in this art. Such alarm will thereupon be sounded in a comparatively noiseless manner by the tap bell 65 and recorded by the register 64, which are responsive to said primary circuit 34, and will be suitably manifested at the other fire apparatus houses 96, 96, 96.

Upon the first stroke of an alarm so transmitted, the paper feeding train associated with the register 64 will be conditioned to run, thereby causing the circuit closing contacts 84 and 85 of said register to close a shunt path around the telegraph key 66, and upon each stroke of said alarm said train will be conditioned to hold said contacts closed for a time, measured by the running of said train, longer than the longest interval between strokes of any alarm, so that throughout the transmission of such alarm over the circuit 34, and for a time thereafter longer than the longest interval between strokes of any alarm, the telegraph key 66 will be shunted by the closure of the contacts 84 and 85 of the register 64.

During the transmission of such alarm over circuit 34, or immediately after the completion thereof, such alarm should be repeated over the secondary alarm circuit 36, in accordance with practice which is well understood by those skilled in this art, and to that end controlling switch mechanism 41 may be set to the position shown, so that its arms 52 and 53 will connect with its contacts 56 and 58 respectively, and its mechanical operating means 50 may thereupon act in any suitable and well known manner, through the extension 51, to swing the movable contacts 43 and 44 between their associated contacts 45, 46, 47 and 48.

When the controlling switch mechanism 41 is thus positioned, the normally open contact 47, which is associated with movable contact 43, is connected through its contact 58 and arm 53 with the normally closed contact 46 associated with movable contact 44, and the normally open contact 48, which is associated with said movable contact 44, is connected through its contact 56 and arm 52 with the normally closed contact 45 associated with movable contact 43, thereby rendering said contacts 47 and 48 effective for reversing the polarity of the current flow in the circuit 36 upon each operation of the movable contacts 43 and 44 of the transmitting mechanism 37.

Assuming adherence to the custom of awaiting the transmission over a primary circuit of at least one or two rounds of such an alarm before initiating the transmission thereof over a secondary circuit, it is evident that an attendant whose attention is attracted by the operation of the comparatively noiseless tap bell 65, would be enabled to determine, from the alarm sounded

by said bell and recorded by the register 64, whether or not his company should respond thereto, and would have ample time to move the arm 86 of the silencing switch from contact 87 to contact 88 before the initiation of the transmission of such alarm over circuit 36.

If the switch arm 86 is so moved from its contact 87 to its contact 88, and is thereafter held in such position throughout the transmission of such alarm over the circuit 36, the loud sounding alarming devices 61 and 62 will not respond to such alarm but the sounder 67 and register 63 will respond thereto, although neither of which would by its action manifest said alarm generally throughout the fire apparatus house in which they are installed.

After the alarm has been thus manifested for the required or usual number of rounds, the attendant will know that the transmission thereof on the circuit 36 has been completed, and that he can therefore release the arm 86 of his silencing switch without risk of releasing it before the completion of the transmission of such alarm.

If the silencing switch is not operated during the transmission of such alarm, upon the first reversal of the current flow in circuit 36 incident to the transmission of such alarm, the hook 80 of lighting switch 62 will be withdrawn from the path of the movable contact 78, which will thereupon act to cause the lamps (diagrammatically indicated by lamp 76) to be lighted and remain burning until such movable contact is manually restored, thus visibly manifesting throughout the fire apparatus house in which said lamps are installed that an alarm is being received, and upon reversal from abnormal to normal direction of the current flow in said circuit 36, incident to the transmission of such alarm therein, the hammer 74 of the electromechanical gong 61 will be released and will strike the gong 75, thus audibly manifesting such alarm throughout its fire apparatus house.

Upon the first stroke of an alarm so transmitted over the circuit 36, the paper feeding train associated with the register 63 will be conditioned to run, thereby causing the circuit closing contacts 84 and 85 of said register to close a shunt path around the telegraph key 66, and upon each stroke of said alarm said train will be conditioned to hold said contacts closed for a time, measured by the running of said train, longer than the longest interval between strokes of any alarm, so that throughout the transmission of such alarm over the circuit 36, the telegraph key 66 will be shunted by the closure of the contacts 84 and 85 of the register 63.

If the current flow in the primary alarm circuit 34 should be indefinitely interrupted, as by a broken wire, the contacts of tap bell 65 will close the shunt around the telegraph key 66 throughout the time that said circuit 34 stands open, and will thus prevent the secondary circuit 36 from being interrupted or disabled through the opening of said key, so that alarms sent out, either through the mechanically operable pole changing transmitting mechanism 37 or the manually operable pole changing transmitting mechanism 38, will be received without interruption or mutilation on account of any attempt to utilize the key 66 at or about the time of the transmission of such alarm.

From the foregoing it is evident that the shunt current paths provided around the telegraph key 36, and forming a disabling means therefor, will be closed throughout and for a predetermined time following the transmission of alarms, and throughout periods when the primary circuit 34 stands open.

Should a telephone or verbal alarm be received at the fire apparatus house where the group 91 of emergency keys is located, the firemen at such house may be notified of such alarm by pressing the emergency key 93 one or more times, thereby causing the lighting switch 62 to act to light the lamps controlled thereby, and causing the electromechanical gong 61 to sound.

In the event of such a telephone or verbal alarm being received during the daytime, the emergency key 94 may be employed to cause the electromechanical gong 61 to sound without operating the lighting switch 62, and the emergency key 95 may be similarly employed for causing the operation of the lighting switch 62 without causing the operation of the electromechanical gong 61.

When any of the emergency keys are thus operated, the current flow in the secondary alarm combination circuit 36 will only be operatively altered through the portion of such circuit to which the terminals of the keys so operated are connected, although the current flow through the rest of the circuit will be somewhat increased because of the connection of the local current source 92 to said circuit in parallel with one or more alarming devices in such polarity as to coöperate with the main current source 39 and thereby, in effect, more than cancel from said circuit the resistance of the devices so shunted.

In Figs. 2 and 3 equipment adapted to be installed at fire alarm headquarters is shown above the dotted line C—C, and equipment adapted to be installed at fire apparatus houses is shown below said line.

Fig. 2 illustrates how features of this invention may be advantageously employed in a system having a combination circuit employing marginal current alarming devices instead of polarized alarming devices,

and employing transmitting mechanism arranged to cause simultaneous response of the alarming devices on each of two classes of duplicate alarm circuits, but otherwise similar to the alarm system shown in Fig. 1.

The combination circuit 236 includes main current source 239, suitable contacts of transmitting mechanism 237 and controlling switch 241, and telegraph sounder 240 which are adapted to be located at fire alarm headquarters.

The alarm circuit 234 of the other class, includes current source 235 and is suitably connected to contacts of transmitting mechanism 237 and controlling switch 241.

The mechanism generally indicated at 237 is intended to typify any suitably operated transmitting mechanism, whether adapted for manual or mechanical operation and comprising, for example, a double pole telegraph key, or forming part of a mechanism such as a manual transmitter or automatic repeater.

The transmitting mechanism 237 comprises the movable contact 243 and its coöperating normally closed contact 245 which are serially included in the circuit 234, the movable contact 244 and its coöperating normally closed contact 246 which are serially included in the combination circuit 236, the normally open contact 248 adapted to cooperate with the movable contact 244 for effecting abnormal current changes in the combination circuit 236, the insulating yoke 249 which connects the movable contacts 243 and 244 for simultaneous operation, and a typical operating extension or button 251.

The controlling switch mechanism 241 comprises the arms 252, 253 and 259, the insulating yoke 254 which connects said arms for simultaneous movement, the contacts 255 and 255′ for the arm 252, the contact 297 for the arm 253, the contact 257 for the arm 259, and suitably conductors connecting the arm 252 with the normally closed contact 245, the arm 259 with the normally closed contact 246, the contacts 255 and 255′ with the movable contact 243, the contact 297 with the normally open contact 248, and the contact 257 with the movable contact 244.

The relative construction and arrangement of the arms 252, 253, and 259 and their coöperating contacts 255 and 255′, 297, and 257 is such that said arms may be moved to a position in which the arms 252 will not connect with either of its coöperating contacts 255 or 255′, the arm 253 will connect with its coöperating contact 297, and the arm 259 will not connect with its coöperating contact 257; and that said arms may be moved to another position in which the arm 252 will connect with its coöperating contact 255′, but the arms 253 and 259 will not connect with their coöperating contacts; and that said arms may be moved to a third position in which the arm 252 will connect with its contact 255 and the arm 259 will connect with its contact 257, but the arm 253 will not connect with its contact 297.

The resistance 298 is serially included in the combination circuit 236, one terminal of said resistance being connected to the switch arm 253 and the other terminal of said resistance being connected to the switch arm 259.

The resistance 298 is such that, when effectively included in the combination circuit 236, it will so reduce the current flow in said circuit as to enable telegraphic signals to be transmitted over said circuit without causing the operation of marginal current alarming devices which may be included therein and which would be responsive to the current which would flow through said circuit were such resistance not so included therein.

Fire apparatus house alarming devices are generally indicated by the marginal current loud sounding gong 261, the marginal current register 263, the register 264, and the direct acting tap bell 265.

Fire apparatus house telegraphic devices are diagrammatically indicated by the make and break transmitting device 266, which is shown as a closed circuit telegraph key, and the make and break non-marginal receiving device 267, which is conventionally shown at a telegraph sounder.

The marginal current alarming devices 261 and 263 are so constructed and arranged that they will act in response to makes and breaks of the circuit 236 when the resistance 298 is shunted out of said circuit and so that they will be unresponsive to makes and breaks in said circuit when the current path through said circuit includes said resistance.

The telegraph key 266 and the electromagnet windings of the gong 261, register 263 and sounder 267 are serially connected in the combination circuit 236, and the windings of the register 264 and tap bell 265 are serially included in the circuit 234.

The register 264 is equipped with magnetic controlling structure which is arranged to suitably control or operate recording mechanism in any usual or well known manner, and comprises paper feeding mechanism and contacts 284 and 285 controlled thereby and responsive to the operation of such recording mechanism in a manner similar to that described in connection with the register 63 shown in Fig. 1, so as to similarly control a shunt current path around the telegraphic transmitting key 266.

The tap bell 265 is provided with suitable electromagnet structure which is adapted to cause said bell to sound as a direct acting tap bell in a well known manner, circuit contacts being associated with the armature of said bell whereby a shunt around the tele-

graphic transmitting key 266 will be closed during all periods when the armature of said bell is in retracted position.

The shunt contacts of the register 264 are provided for the purpose of disabling the telegraph key 266 upon the first stroke of any alarm transmitted over circuit 234 and to thereafter maintain said key in disabled condition until after the elapse of a time, during which no alarm strokes have been transmitted over said circuit 234, which is longer than the longest interval between the strokes of any alarm.

The shunt contacts of the tap bell 265 are provided for the purpose of disabling the telegraph key 266 throughout all periods during which the circuit 234 stands interrupted.

The emergency key 294 is so connected and arranged that, when operated, it will connect the local current source 292 around the portion of the circuit 236 which includes the winding of the alarming device 261, said key being so connected and arranged that, when said local current source is so connected to said circuit, the current flow through the windings of the gong 261 will be operatively increased substantially as when the circuit 236 is closed while the resistance 298 is shunted.

Other fire apparatus houses 296, 296 are diagrammatically indicated as being serially included in the duplicate alarm circuits 234 and 236, and each is assumed to be equipped with such alarming and telegraphic devices as the conditions of service thereat may require.

The operation of the fire alarm system shown in Fig. 2 is as follows:

Under normal conditions the alarm circuits 234 and 236 are closed, the strength of the current flow in combination circuit 236 being such that the magnetic structures of the marginal current alarming devices 261 and 263 are insufficiently magnetized to cause said devices to respond to makes or breaks in the current flow in said circuit, the disabling shunt contacts of the alarming devices 264 and 265 stand open, the mechanically movable parts shown are at rest, and the normal current path through the combination circuit 236 is as follows,—from the right hand terminal of current source 239, through movable contact 244, normally closed contact 246, resistance 298, headquarters sounder 240, alarming and telegraphic devices included in circuit 236 at one of the fire apparatus houses 296, sounder 267, key 266, register 263, gong 261, the alarming and telegraphic devices included in circuit 236 at the other of the fire apparatus houses 296, to the left hand terminal of current source 239.

If now the key 266 is operated for the transmission of a telegraphic signal, the sounders 240 and 267 will act in response thereto, but the alarming devices 261 and 263 will not act in response thereto as the current flow through the circuit 236 is insufficient to cause responsive action of said alarming devices on account of the presence of resistance 298 therein.

If it is desired to transmit a telegraphic signal from headquarters, the controlling switch mechanism 241 should be so positioned that the arm 252 will connect with its contact 255′ but the arms 253 and 259 will not connect with their coöperating contacts, whereupon the movement of the contact 243 incident to the operation of the transmitting mechanism 237 will not operatively alter the current flow in circuit 234 as the contacts 243 and 245 of said transmitting mechanism will be shunted through arm 252 and contact 255′, but the movement of the contact 244 will cause alternate makes and breaks in the circuit 236, said circuit being broken whenever said contact 244 is moved away from normally closed contact 246 and closed whenever said contacts come together, but the engagement of contact 244 with the normally open contact 248 will not operatively affect the circuit 236 as the conductor connecting contact 248 will be dead ended at contact 297 of the controlling switch 241.

It will thus be seen that when the controlling switch 241 is in the position where its arm 252 rests upon its contact 255′, the operation of transmitting mechanism 237 will not cause responsive action of the alarming devices in circuits 234 and 236 but will cause responsive action of the telegraph sounders in circuit 236.

If the controlling switch 241 is so positioned that its arm 252 rests upon its coöperating contact 255, the circuits 234 and 236 will not be operatively affected by the actuation of the transmitting mechanism 237 as the contacts 243 and 245 and the contacts 244 and 246 of said transmitting mechanism will be shunted through contact 255 and arm 252 and through contact 257 and arm 259 respectively of said controlling switch, and the conductor connecting contact 248 will be dead ended at contact 297.

Under normal conditions the controlling switch 241 may be positioned as shown in the drawing, so that the arms 252 and 259 do not touch their coöperating contacts when the arm 253 is resting upon its contact 297.

If the transmitting mechanism 237 is actuated while the controlling switch 241 is positioned as just described, upon each depression of the movable contacts 243 and 244, the circuit 234 will be interrupted and the current path of circuit 236 will be shunted around resistance 298 through switch arm

253, contact 297 and normally open contact 248.

Upon each such extraordinary energization of circuit 236, the marginal current alarming devices 261 and 263 will be effectively energized and a stroke of the alarm will be sounded by the gong 261 and recorded by the register 263. Upon each break in the circuit 234 the alarming devices 264 and 265 will act, the former to record and the latter to sound a stroke of said alarm.

Upon the first stroke of an alarm so transmitted, the paper feeding train associated with the register 264 will be conditioned to run, thereby causing the circuit closing contacts 284 and 285 of said register to close a shunt path around the telegraph key 266, and upon each stroke of said alarm, said train will be conditioned to hold said contacts closed for a time, measured by the running of said train, longer than the longest interval between strokes of any alarm, so that, throughout the transmission of such alarm over circuits 234 and 236, the telegraph key 266 will be shunted by the closure of the contacts 284 and 285 of said register 264.

If the current flow in the alarm circuit 234 should be indefinitely interrupted, as by a broken wire, the contacts of tap bell 265 will close the shunt around the telegraph key 266 throughout the time that said circuit 234 stands open, and will thus prevent the combination circuit 236 from being interrupted or disabled through the opening of said key while the circuit 234 stands open.

In the event of a telephone or verbal alarm being received, the emergency key 294 may be employed, to cause the gong 261 to sound, by so connecting the local current source 292 to the terminals of said gong as to cause an extraordinary current flow therethrough.

Whenever the emergency key 294 is thus depressed it will cause the current flow through the combination circuit 236 to be slightly decreased on account of the increased fall of potential across the terminals of the gong 261 due to the added current flow therethrough but such decrease in the current flow in the circuit 236 will be insufficient to cause operative response of any of the alarming or telegraphic devices included therein.

Fig. 3 shows an application of certain features of this invention to a combination circuit like that shown in the Kirnan patent hereinbefore referred to.

The box circuit 321 includes alarm boxes 322, 322, current source 323, and repeater magnet 324.

In connection with the repeater magnet 324, pole changing transmitting mechanism, adapted to be located at fire alarm headquarters, is conventionally indicated by the armature 325, the arm 326 pivoted at 327 and carrying said armature and the step by step detent ledges 328, the detent arm 329 which is arranged to so coöperate with said detent ledges that said arm will be released whenever the armature 325 moves to retracted position and having made a revolution will be stopped regardless of whether said armature stands in attracted or retracted position and will thereafter only be released when the armature moves from attracted to retracted position, the cylinder 330 moving with the detent arm 329, the contact fingers 332 and 333, the contact plate 331 so carried by said cylinder as to normally stand out of contact with said contact fingers but to connect said fingers during a suitable part of the rotation of the cylinder 330, the pole changing mechanism 337, and mechanical operating means such as is usual in fire alarm repeaters and well understood by those skilled in this art, typically indicated by the time train 350, and comprising means adapted to cause or permit the movement of the pole changing mechanism 337 to abnormal position upon the first stroke of an alarm responded to by the cylinder 330 and only restoring said mechanism 337 to normal position after a time longer than the longest interval between strokes of any alarm.

The circuit 336 includes current source 339 and has connected therein the contact fingers 332 and 333 so that said circuit may be made and broken by the coöperation of the plate 331 with said fingers, the pole changing mechanism 337 being so connected in said circuit that, when operated, it will reverse the direction of current flow therethrough.

The conventionally indicated telegraph sounder 340 and key 338 are connected by suitable conductors in series with each other and between the normally closed contact 346 and the contact finger 332, and the contact finger 333 is connected to the normally open contact 347, so that, when the pole changing mechanism 337 is in normal condition, said sounder and key are included in the current path of circuit 336, and so that, when said pole changing mechanism is in abnormal condition, the contact fingers 332 and 333 will be substituted in said current path for said sounder and key.

Fire apparatus house alarming devices are indicated by the polarized register 363 and the polarized tap bell 365, fire apparatus house telegraphic devices being indicated by the non-polarized make and break telegraphic receiving device diagrammatically represented by the sounder 367 and a make and break telegraphic transmitting device diagrammatically indicated by the key 366.

Inasmuch as the register 363 and the tap bell 365 have similarly formed magnet struc-

ture, corresponding parts thereof are represented by like reference characters.

The magnet structures embodied in the register 363 and tap bell 365 are similar to those provided in the gong 61, lighting switch 62, and register 63, as described in connection with Fig. 1, except that the number and size of the permanent magnets used should be such that, when the intended strength of current is flowing through the electromagnet windings in abnormal direction (as when it has been reversed by the mechanism 337), the magnetism of the electromagnet structure will exceed that which may readily pass through the permanent magnets 370 to an extent sufficient to develop consequent poles adjacent to the armature 369, so that said armature may thereby be moved to or retained in attracted position, so that upon interruption of the current flow through such windings the residual or permanent magnetism in the cores of the electromagnet sections 368 will act in series with the magnetization of the permanent magnets 370 so that the magnet structure will have but two free poles, which will be developed at the ends of the electromagnet cores which are not adjacent to the armature, and as the poles adjacent to the armatures will then be neutralized, said armature 369 will be permitted to move to retracted position.

The polarized register 363 is equipped with magnetic controlled structure, which is arranged to suitably control or operate recording mechanism in any usual or well known manner, and comprises paper feeding mechanism and contacts 384 and 385 controlled thereby and responsive to the operation of such recording mechanism in a manner similar to that described in connection with the register 63 shown in Fig. 1, so as to similarly control a shunt current path around telegraph key 366 and telegraph sounder 367.

As the tap bell 365 is responsive to all alarms transmitted over circuit 336, no useful purpose would be served by having the sounder 367 also responsive to such alarms, and inasmuch as the entire intensity of the current flow employed for magnetizing the magnet structures of the alarming devices 363 and 365 as already described, need not be employed for telegraphic signals, it is advantageous to somewhat increase the intensity of the line current flow during alarms and to decrease it at other times, and the telegraph sounder 367 is therefore included in the shunt controlled by the contacts 384 and 385, and the sounder 340 is included in the current path which is normally closed through contact 346 but is shunted by contact 347 during alarms, so that said sounders are included in the circuit 336 when the pole changing mechanism 337 is in normal position and the shunt controlled by the contacts 384 and 385 is open, but the resistance of said sounders is excluded from the circuit 336 during the transmission of alarms.

The operation of the devices shown in Fig. 3 is as follows:

Under normal conditions the box circuit 321 and the combination circuit 336 are closed, the direction of current flow in the circuit 336 being such as will magnetize the electromagnet sections 368 of the alarming devices 363 and 365 in parallel with their permanent magnet sections, so that their associated armatures 369 will stand in attracted position, and in the event of the interruption of such current flow will be retained in attracted position as already described; the disabling shunt contacts of the alarming device 363 stand open; and the mechanically movable parts shown are at rest.

The transmission of telegraphic signals may be accomplished as already described in connection with Figs. 1 and 2, and the polarized alarming devices 363 and 365 will not respond to the breaks in the circuit 336 incident to the transmission of such telegraphic messages for the reasons hereinbefore explained.

If an alarm is transmitted from one of the boxes 322, the operation of said box will cause the usual current changes in box circuit 321, so as to cause the cylinder 330 to be alternately released and stopped in accordance with practice well understood by those skilled in this art. Upon the first release of the cylinder 330, the plate 331 will connect the fingers 332 333 and the mechanically operating means 350 will act through the pole changing mechanism 337 to reverse the direction of the current flow in the combination circuit 336 and said circuit 336 will thereafter be interrupted by the withdrawal of the plate 331 from fingers 332 and 333.

Upon the reversal of the current flow through the circuit 336, the electromagnet sections of the magnet structures of the polarized alarming devices 363 and 365 will be magnetized in series with the permanent magnet sections of said structures, the intensity of such magnetization so exceeding that which may readily pass through said permanent magnets that the armatures 369 will be retained in attracted position, but as soon as the circuit 336 is broken, by the withdrawal of the plate 331 from engagement with the fingers 332 and 333, the magnetization of said electromagnet sections will be decreased to the intensity maintained by the residual magnetism of the comparatively retentive cores thereof, which intensity will not exceed that which may readily pass through said permanent magnets, and there-

fore the consequent poles adjacent to the armatures 369 will be neutralized and said armatures will move to retracted position, thereby causing the bell 365 to sound and the recording mechanism of the register 363 to act, to record the first stroke of the alarm and to start the paper feeding train running and thereby close the shunt around the key 366 and sounder 367 at the contacts 384 and 385.

It will be noted that, upon the initial action of the pole changing mechanism 337, the current path established thereby for the circuit 336 excludes the sounder 340, and as the sounder 367 is shunted by the action of the contacts 384 and 385, the intensity of the current flow in said circuit 336 will be materially increased during succeeding closures of such alarm, so that the excess magnetization of the electromagnet sections of the anomalous magnet structures of the alarming devices 363 and 365 will be amply sufficient to move the armatures 369 against the friction and retractile force to which their movement is subjected.

After the elapse of a time, following the last stroke of an alarm, which is longer than the longest interval between strokes of any alarm, the contacts 384 and 385 will be separated, thereby breaking the shunt around the key 366 and the sounder 367, and the mechanical operating means 350 will act to close the circuit 336 and to restore the current flow therethrough to normal direction and through its normal path including the key 338 and the sounder 340, and the armatures 369 of the alarming devices 363 and 365 will thereupon be moved to attracted position.

Fig. 4 shows an application of certain features of this invention to the substation or fire house equipment whereby an alarming device and a telegraph sounder may be so connected and arranged that an ordinary alarming device, without either marginal current or polarized magnetic structure, may be employed and said alarming device will respond only to alarms and the telegraph sounder will respond only to telegraphic signals.

The register 463 may be provided with magnet structure similar to that described in connection with polarized register 63 shown in Fig. 1 or polarized register 363 shown in Fig. 3.

In addition to shunt controlling contacts 484 and 485 coöperating with the paper feeding train of the register 463 there is provided a contact 485′ with which the contact 484 is adapted to normally connect, the control of said contacts being such that, when the paper feeding train is at rest, the contacts 484 and 485′ will be connected but the contact 485 will be separated therefrom, and, while the paper feeding train of said register is conditioned for running, the contacts 484 and 485 will be connected and the contact 485′ will be disconnected therefrom.

A terminal of the telegraph sounder 467 and a terminal of the direct acting non-polarized tap bell 465 are connected to each other and to contact 484, the remaining terminal of said sounder being connected through its associated telegraph key 466 to the contact 485 and to the combination circuit 436, and the remainging terminal of the alarming device 465 being connected to the contact 485′ and through the windings of the register 463 with a terminal of the combination circuit 436.

The tap bell 465 typically indicates an alarming device which can either be comparatively noiseless like the tap bell 65 shown in Fig. 1, a loud sounding gong similar to the electromechanical gong 61 shown in Fig. 1, or the loud sounding gong 261 shown in Fig. 2, except that the alarming device 465 does not require either polarized or marginal current magnetic structure.

Ordinary makes and breaks in the circuit 436 may be produced by means of the key 466 when the contact 484 is in normal position and such makes and breaks will cause responsive action of the telegraph sounder 467.

Abnormal current changes in the circuit 436 will cause responsive action of the register 463 whereby the contact 484 will be moved away from the contact 485′ and against the contact 485, thereby rendering the alarming device 465 responsive to such abnormal current changes and the sounder 467 unresponsive thereto, and as said sounder and bell may be of approximately the same resistance, it is evident that the substitution of one for the other may be made without materially altering the resistance of the circuit 436.

Fig. 5 shows means for controlling the shunt around telegraphic devices such as that described in connection with contacts 84 and 85 shown in Fig. 1, whereby said contacts will be automatically closed at the commencement of an alarm but will not be automatically opened, thus disabling the telegraphic transmitting devices from the commencement of an alarm until such contacts are manually restored to normal condition.

The arrangement typically indicated by Fig. 5 will be found useful in applying this invention to alarming devices which lack a time train suitable for operating contacts such as the contacts 84 and 85 described in connection with Fig. 1.

The tap bell 565 is shown in Fig. 5 as having an armature 569 which typifies the controlling armature of all of the alarming devices hereinbefore described, and is intended to show such armature in its normal

position whether such position be its attracted position or its retracted position, said armature 569 being provided with a ledge 599 which is adapted to support an end of the movable contact 584 and hold same out of engagement with the stationary contact 585 so that whenever the armature 569 moves to abnormal position or to the position which it assumes only when subjected to extraordinary current flow in its circuit (if it is included in the combination circuit) or to a break in its circuit (if it is included in a circuit of a class other than a combination circuit), contact 584 is permitted to engage contact 585. Said contacts 584 and 585 are suitably connected with a shunt around a telegraphic device or devices so that whenever said armature moves to its abnormal position said devices will be shunted and said shunt will continue regardless of the subsequent movement of the armature 569 until the contact 584 is manually restored to its normal position.

The novel polarized magnet structure shown in the accompanying drawings and hereinbefore described does not form part of this invention but forms the subject matter of Letters Patent 1,176,421 and 1,176,422, dated March 21, 1916, and is therefore not herein claimed, but what I claim and desire to secure by Letters Patent of the United States is:

1. In a signal system:—make and break telegraphic transmitting and receiving devices, alarming devices so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks, one of said alarming devices comprising recording mechanism having a paper feeding train adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm, transmitting mechanism adapted to cause responsive operation of said alarming devices, and disabling mechanism for one of said telegraphic transmitting devices suitably controlled by the running of said train.

2. In a signal system:—make and break telegraphic transmitting devices, non-polarized telegraphic receiving devices, pole-changing transmitting mechanism, polarized alarming devices responsive to the operation of said pole-changing mechanism, one of said alarming devices comprising recording mechanism having a paper feeding train adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm, and disabling mechanism for one of said telegraphic transmitting devices suitably controlled by the running of said train.

3. In a signal system:—make and break telegraphic transmitting and receiving devices, alarming devices so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks, one of said alarming devices comprising recording mechanism having a paper feeding train adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm, transmitting mechanism adapted to cause responsive operation of said alarming devices, and a shunt for one of said telegraphic transmitting devices so controlled by said train as to be closed during the running of said train.

4. In a signal system:—make and break telegraphic transmitting devices, non-polarized telegraphic receiving devices, pole-changing transmitting mechanism, polarized alarming devices responsive to the operation of said pole-changing mechanism, one of said alarming devices comprising recording mechanism having a paper feeding train adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm, and a shunt for one of said telegraphic transmitting devices so controlled by said train as to be closed during the running of said train.

5. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and receiving devices at substations; alarming devices at said substations some of which are so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks; two classes of alarm circuits each including certain of said alarming devices at the substations and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and alarming devices so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks, and the other class of alarm circuits including alarming devices each comprising means adapted to close a circuit during the operation of said devices; and shunts at one or more substations, for the telegraphic transmitting devices thereat, suitably controlled by said circuit closing means.

6. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and non-polarized telegraphic receiving devices at substations; alarming devices at said substations some of which are polarized; two classes of alarm circuits each including certain of said alarming devices at the substations and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits

including telegraphic devices and polarized alarming devices, and the other class of alarm circuits including alarming devices each comprising means adapted to close a circuit during the operation of said devices; and shunts at one or more substations, for the telegraphic transmitting devices thereat, suitably controlled by said circuit closing means.

7. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and receiving devices at substations; alarming devices at said substations some of which are so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks; two classes of alarm circuits each including certain of said alarming devices at the substations comprising means adapted to close a circuit during the operation of said devices, and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and alarming devices so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks; and shunts at one or more substations, for the telegraphic transmitting devices thereat, suitably controlled by said circuit closing means.

8. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and non-polarized telegraphic receiving devices at substations; alarming devices at said substations some of which are polarized; two classes of alarm circuits each including certain of said alarming devices at the substations comprising means adapted to close a circuit during the operation of said devices, and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and polarized alarming devices; and shunts at one or more substations, for the telegraphic transmitting devices thereat, suitably controlled by said circuit closing means.

9. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and receiving devices at substations; alarming devices at said substations some of which are so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks; two classes of alarm circuits each including certain of said alarming devices at the substations and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and alarming devices so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks, and the other class of alarm circuits including alarming devices comprising recording mechanism having paper feeding trains adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm; and disabling mechanism at one or more substations for the telegraphic transmitting devices thereat suitably controlled by the running of said trains.

10. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and non-polarized telegraphic receiving devices at substations; alarming devices at said substations some of which are polarized; two classes of alarm circuits each including certain of said alarming devices at the substations and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and polarized alarming devices, and the other class of alarm circuits including alarming devices comprising recording mechanism having paper feeding trains adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm; and disabling mechanism at one or more substations for the telegraphic transmitting devices thereat suitably controlled by the running of said trains.

11. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and receiving devices at substations; alarming devices at said substations some of which are so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks; two classes of alarm circuits each including certain of said alarming devices at the substations and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and alarming devices so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks, and the other class of alarm circuits including alarming devices comprising recording mechanism having paper feeding trains adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm; and shunts at one or more substations for the telegraphic transmitting devices thereat so connected and controlled by said trains as to be closed during the running of said trains.

12. In a signal system:—a central station

and one or more substations; make and break telegraphic transmitting and non-polarized telegraphic receiving devices at substations; alarming devices at said substations some of which are polarized; two classes of alarm circuits each including certain of said alarming devices at the substations and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and polarized alarming devices, and the other class of alarm circuits including alarming devices comprising recording mechanism having paper feeding trains adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm; and shunts at one or more substations for the telegraphic transmitting devices thereat so connected and controlled by said trains as to be closed during the running of said trains.

13. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and receiving devices at substations; alarming devices at said substations some of which are so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks; two classes of alarm circuits each including certain of said alarming devices at the substations and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and alarming devices so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks, and the other class of alarm circuits including alarming devices comprising recording mechanism having paper feeding trains adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm; and shunts at one or more substations for the telegraphic transmitting devices thereat so connected and controlled by alarming devices included in the alarm circuit of said other class as to be closed during the running of said trains and to be closed whenever said other class circuit is open.

14. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and non-polarized telegraphic receiving devices at substations; alarming devices at said substations some of which are polarized; two classes of alarm circuits each including certain of said alarming devices at the substations and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and polarized alarming devices, and the other class of alarm circuits including alarming devices comprising recording mechanism having paper feeding trains adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm; and shunts at one or more substations for the telegraphic transmitting devices thereat so connected and controlled by alarming devices included in the alarm circuit of said other class as to be closed during the running of said trains and to be closed whenever said other class circuit is open.

15. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and receiving devices at substations; alarming devices at said substations some of which are so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks; two classes of alarm circuits each including certain of said alarming devices at the substations comprising recording mechanism having paper feeding trains adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm, and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and alarming devices so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks; and shunts at one or more substations for the telegraphic transmitting devices thereat so connected and controlled by said trains as to be closed during the running of said trains.

16. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and non-polarized telegraphic receiving devices at substations; alarming devices at said substations some of which are polarized; two classes of alarm circuits each including certain of said alarming devices at the substations comprising recording mechanism having paper feeding trains adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm, and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and polarized alarming devices; and shunts at one or more substations for the telegraphic transmitting devices thereat so connected and controlled by said trains as to be closed during the running of said trains.

17. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and receiving devices at substations; alarming devices at said substations some of which are so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks; two classes of alarm circuits each including certain of said alarming devices at the substations and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and alarming devices so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks comprising recording mechanism having paper feeding trains adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm, and the other class of alarm circuits including alarming devices comprising means adapted to close a circuit during the operation of said devices; and shunts at one or more substations for the telegraphic transmitting devices thereat so connected and controlled as to be closed during the running of said trains and to be closed whenever said other class circuit is open.

18. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and non-polarized telegraphing receiving devices at substations; alarming devices at said substations some of which are polarized; two classes of alarm circuits each including certain of said alarming devices at the substations and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and polarized alarming devices comprising recording mechanism having paper feeding trains adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm, and the other class of alarm circuits including alarm devices comprising means adapted to close a circuit during the operation of said devices; and shunts at one or more substations for the telegraphic transmitting devices thereat so connected and controlled as to be closed during the running of said trains and to be closed whenever said other class circuit is open.

19. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and receiving devices at substations; alarming devices at said substations some of which are so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks; two classes of alarm circuits each including certain of said alarming devices at the substations comprising recording mechanism having paper feeding trains adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm, and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and alarming devices so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks; and the other class of alarm circuits including alarming devices comprising means adapted to close a circuit during the operation of said devices; and shunts at one or more substations for the telegraphic transmitting devices thereat so connected and controlled as to be closed during the running of said trains and to be closed whenever said other class circuit is open.

20. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and non-polarized telegraphic receiving devices at substations; alarming devices at said substations some of which are polarized; two classes of alarm circuits each including certain of said alarming devices at the substations comprising recording mechanism having paper feeding trains adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm, and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, one class of alarm circuits including telegraphic devices and polarized alarming devices, and the other class of alarm circuits including alarming devices comprising means adapted to close a circuit during the operation of said devices; and shunts at one or more substations for the telegraphic transmitting devices thereat so connected and controlled as to be closed during the running of said trains and to be closed whenever said other class circuit is open.

21. In a signal system comprising a circuit including make and break telegraphic transmitting devices, non-polarized telegraphic receiving devices, a main current source, pole-changing transmitting mechanism associated with said main current source, and polarized alarming devices responsive to the operation of said pole-changing transmitting mechanism;—one or more emergency keys each associated with one or more of said polarized alarming devices, and current sources associated with each of said keys, the capacity of the current sources being such and the emergency keys

being so connected that they will be adapted to operatively reverse the current flow through the associated alarming devices without operatively altering the current flow throughout the remainder of the circuit.

22. In a signal system comprising a circuit including make and break telegraphic transmitting and receiving devices, a main current source, alarming devices not responsive to ordinary makes and breaks but responsive to extraordinary current changes, and transmitting mechanism adapted to produce said extraordinary current changes;—one or more emergency keys each associated with one or more of said alarming devices, and current sources associated with each of said keys, the capacity of the current sources being such and the emergency keys being so connected that they will be adapted to operatively alter the current flow through the associated alarming devices without operatively altering the current flow throughout the remainder of the circuit.

23. In a signal system comprising a circuit including make and break telegraphic transmitting devices, non-polarized telegraphic receiving devices, a main current source, pole-changing transmitting mechanism associated with said main current source, and one or more groups of polarized alarming devices responsive to the operation of said pole-changing transmitting mechanism;—one or more groups of emergency keys, each group of keys having associated therewith a group of alarming devices, and independent current sources associated with said groups of emergency keys, the capacity of each current source being such and the emergency keys associated therewith being so connected that they will be adapted to operatively reverse the current flow through all of the associated group of alarming devices without operatively altering the current flow through the remainder of the circuit and to operatively reverse the current flow through different ones of said associated group of alarming devices without operatively altering the current flow through the remainder of the circuit.

24. In a signal system comprising a circuit including make and break telegraphic transmitting and receiving devices, a main current source, one or more groups of alarming devices not responsive to ordinary makes and breaks but responsive to extraordinary current changes, and transmitting mechanism adapted to produce said extraordinary current changes;—one or more groups of emergency keys, each group of keys having associated therewith a group of alarming devices, and independent current sources associated with said groups of emergency keys, the capacity of each current source being such and the emergency keys associated therewith being so connected that they will be adapted to operatively alter the current flow through all of the associated group of alarming devices without operatively altering the current flow through the remainder of the circuit and to operatively alter the current flow through different ones of said associated group of alarming devices without operatively altering the current flow through the remainder of the circuit.

25. In a signal circuit including non-polarized telegraphic receiving devices, polarized alarming devices, and transmitting mechanism; switching mechanism adapted to control the relation of said transmitting mechanism to said circuit, whereby, when said switching mechanism is in one position, the operation of said transmitting mechanism will cause breaks in said circuit, and, when said switching mechanism is in a second position, the operation of said transmitting mechanism will cause reversals of the current flow in said circuit.

26. In a signal circuit including non-polarized telegraphic receiving devices, polarized alarming devices, and transmitting mechanism; switching mechanism adapted to control the relation of said transmitting mechanism to said circuit, whereby, when said switching mechanism is in one position, the operation of said transmitting mechanism will cause breaks in said circuit, and, when said switching mechanism is in a second position, the operation of said transmitting mechanism will cause reversals of the current flow in said circuit, and, when said switching mechanism is in a third position, the operation of said transmitting mechanism will not operatively affect the current flow in said circuit.

27. In a signal system:—a central station and one or more substations; make and break telegraphic transmitting and non-polarized telegraphic receiving devices at substations; alarming devices at said substations some of which are polarized; primary and secondary alarm circuits each including certain of said alarming devices at the substations and transmitting mechanism at the central station adapted to cause responsive operation of said alarming devices, said primary circuit including telegraphic devices and a polarized alarming device; a shunt for said polarized alarming device; and a spring restored manually operable switch for said shunt.

28. In a signal system:—make and break telegraphic transmitting and receiving devices, alarming devices so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks, one of said alarming devices comprising a time train adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm, transmit-

ting mechanism adapted to cause responsive operation of said alarming devices, and disabling mechanism for one of said telegraphic transmitting devices suitably controlled by the running of said train.

29. In a signaling system:—make and break telegraphic transmitting and receiving devices, alarming devices so constructed as to be responsive to extraordinary current changes but not to be responsive to ordinary makes and breaks, one of said alarming devices comprising a time train adapted to be conditioned upon each stroke of an alarm to run for a time longer than the longest interval between strokes of any alarm, transmitting mechanism adapted to cause responsive operation of said alarming devices, and a shunt for one of said telegraphic transmitting devices so controlled by said train as to be closed during the running of said train.

In witness whereof, I hereunto subscribe my name, this 30th day of September, A. D., 1915.

C. E. BEACH.

Witness:
M. L. THOMAS.