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C. L. TETHEROW
FIRE ALARM SYSTEM

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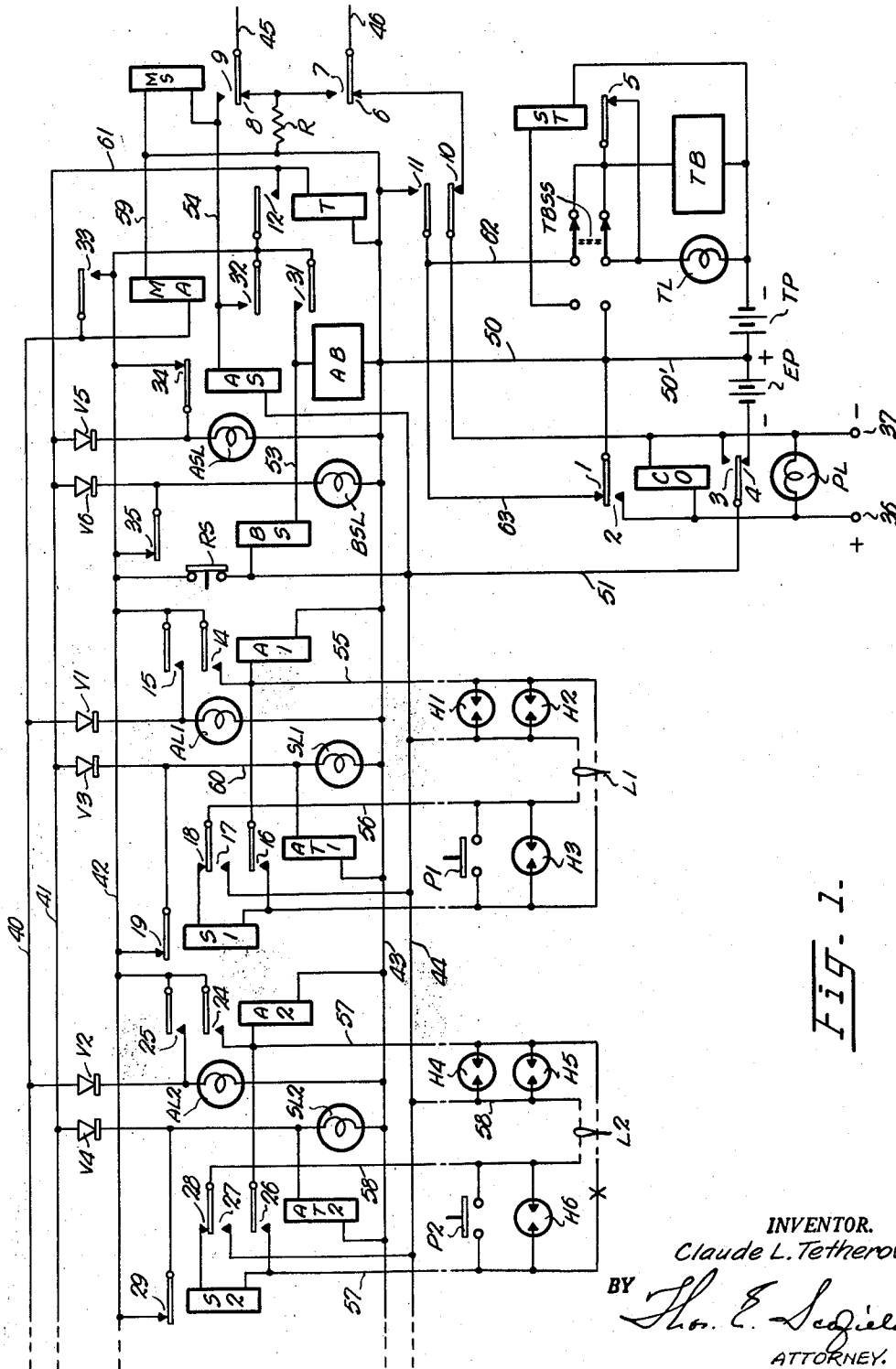


Fig. 1.

INVENTOR.
Claude L. Tetherow
BY *Thos. E. Seefeld*
ATTORNEY.

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FIRE ALARM SYSTEM

Claude L. Tetherow, Lincoln, Nebr., assignor to Notifier Corporation, Lincoln, Nebr., a corporation of Nebraska

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The present invention relates to fire alarm systems designed for the protection of specific premises, which premises in any given instance may comprise, for example, a single building (e.g., a hotel, hospital or business establishment) or a cluster of rather closely integrated buildings (e.g., a college, manufacturing plant or military post).

In such a system the primary objective quite naturally is to alert occupants of the protected premises in the event of fire and also to apprise the management or other appropriate personnel as to the portion of the premises in which the hazard exists, so that they may act speedily in combatting the fire and/or guiding any evacuation that may be necessary to protect life and property. Another object of my invention, however, is to provide facilities by means of which outside professional assistance will be summoned automatically and immediately as by signalling the fire station headquarters of the community in or near which the endangered premises is located.

To the latter end I provide at the headquarters station a compact alarm panel to which the alarm system of any private party desiring this additional protection can be connected by means of a simple two-conductor line which conveniently may be, for instance, a leased telephone line. An object of the invention, in other words, is to provide a single headquarters panel capable of serving any desired number of private subscribers, which panel will not only give the necessary alarm when the occasion arises but also will identify the subscriber whose premises is endangered.

Reverting to the installation at the protected premises, an object of the invention is to provide an alarm system for local personnel which is entirely self-sufficient in the sense that it is in no way dependent upon the headquarters station for any phase of its operation. According to the invention, the local installation comprises a small centrally located panel or cabinet containing all of the necessary components of the system except (1) the lines extending therefrom to different portions of the premises for detecting abnormal temperatures or rates of temperature rise, and (2) the bells, horns or other alarms which are to be operated for alerting personnel. This panel, like the panel at the headquarters station, can be assembled, wired and tested at the factory so that installation is reduced to a matter of completing the relatively simple external circuitry which will in any event be determined by the layout of the premises to be protected.

It is a feature of the invention to provide a local panel capable of serving any desired number of external detection circuits and which can at any time quite easily and simply be made to accommodate additional external circuits if the premises should be enlarged.

To the end that the local system be entirely self-sufficient, an object of the invention is to provide the panel

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with means for maintaining the external as well as the essential internal circuits under constant supervision so that any fault arising therein will immediately be called to the attention of local personnel for correction. Another object is to minimize the opportunities for faults to arise in the internal circuits of the panel; according to the invention, this is accomplished through the novel use of blocking valves (diodes or rectifiers) in certain alarm and supervisory circuits to eliminate relay contacts which otherwise would be required in these circuits.

Still another object of the invention is to supplement the supervisory functions of the local panel by providing for automatic over-all supervision at the remote headquarters panel; more particularly, it is one of my aims to provide the headquarters panel with means for maintaining constant automatic supervision over the various local panels connected thereto and in addition maintaining the various connecting lines between the headquarters panel and the local panels under constant supervision to the end that said lines may be kept clear of all faults which would impair the giving of an alarm at the headquarters station in the event of a fire at any one of the protected premises.

According to the invention, audible signals are utilized both at the protected premises and at the headquarters station for the purpose of alerting proper personnel whenever a fault of any kind arises in the circuitry of the system. A useful feature resides in the provision of means for silencing the audible signal at either location while a fault is being investigated and corrected. In this connection, an object of the invention is to safeguard against human error occurring through failure to recondition the signal for operation when the trouble is cleared; this is accomplished either by automatically reconditioning the signal at the proper time, or by providing an automatic reminder signal which will insure manual resetting.

With respect to the headquarters station, a collateral object of the invention is to provide an audible fire alarm signal which can be silenced when the fire fighting personnel are dispatched to the endangered premises; but which, despite having been silenced will automatically reoperate in the event that a fire breaks out at another premises before the original condition is cleared.

Yet another object is to provide a fire alarm system which will remain operative to give alarms if the occasion arises, even in the face of unremedied circuit faults that might be expected to make the system ineffectual.

Finally, an important aim of the invention is to provide a system having all of the foregoing features and advantages but which is relatively inexpensive to manufacture and install.

Other objects, together with the features and novelty whereby the objects are achieved, will appear in the course of the following description of the invention. In this description it will be assumed for the sake of simplicity that the audible fire alarm to be sounded at the protected premises and at the headquarters station is in each instance a single bell, and that a single buzzer is utilized at each location to give an audible indication of the existence of a circuit fault which requires attention. This, of course, should be understood merely to be exemplary of the audible signals which may be used. As those versed in the art will appreciate, the alarm signal may comprise a bell, a siren, a horn, or any desired combination of such sound emitters connected in parallel to operate simultaneously; on the other hand, the fault signal may comprise a buzzer, a bell, a horn or the like, so long as the sound emitted is easily distinguishable from that produced in the case of a fire alarm.

In the accompanying drawings which form a part of the specification and are to be read in conjunction therewith:

Fig. 1 is a schematic circuit diagram of a fire alarm system showing the portion thereof which is local to the premises to be protected; and

Fig. 2 is a schematic circuit diagram of a remote "headquarters" station which may be connected to one or more local stations of the kind illustrated in Fig. 1.

GENERAL DESCRIPTION

Referring first to Fig. 1, it will be convenient for purposes of explanation to assume that this represents an installation at a hospital or other institution which occupies a single building or a cluster or rather closely integrated buildings under a single management. In the main office or other selected location on the premises a small cabinet or central panel is provided which houses all of the equipment shown in Fig. 1 with the exception of the external fire detection loops such as L1 and L2. There can be as many external loops as needed, each serving a different section of the premises, but for simplicity only two have been illustrated. Thus, in the case of a multi-story building the first floor would be assigned one fire detection loop (L1), the second floor another loop (L2) and so on; or different loops can be assigned to different wings of the same building or to different outbuildings in a cluster comprising a single institution or plant.

Each external fire detection loop, then, comprises a pair of conductors which extends from the aforementioned cabinet or central panel and after passing through its assigned portion of the premises returns to the panel. At different points along its length (for example, in different rooms of the building) the fire detection devices H1, H2, H3, etc., are located, each of these comprising a pair of normally open contacts which close responsive to the temperature rising above a predetermined value and/or responsive to an abnormal rate of temperature rise even in the range below that value. Such thermally actuated devices are, of course, well known in the art. Any number of them can be connected to the same external loop in accordance with the requirements of a given installation, and the loop may also have connected thereto one or more manually operated pull boxes such as P1 and P2.

It will be noted that the external fire detection loop L1 has associated with it, in the central panel, certain equipment which is individual to that loop, namely:

Alarm relay	A1
Supervisory relay	S1
Alarm transfer relay	AT1
Alarm lamp	AL1
Supervisory lamp	SL1
Valves	V1, V3

As previously indicated, there is no practical limit to the number of fire detection loops that can be provided, but in the case of each loop there must be a similar set of relays, lamps, etc., individual thereto. Thus, external loop L2 is provided with:

Alarm relay	A2
Supervisory relay	S2
Alarm transfer relay	AT2
Alarm lamp	AL2
Supervisory lamp	SL2
Valves	V2, V4

all of which are connected to the conductors 40, 41, 42, 43 and 44 in precisely the same fashion as the corresponding equipment individual to loop L1. The same practice is, of course, followed in the case of each additional external fire detection loop with which the system is provided.

In addition to the equipment individual to specific ex-

ternal loops, as aforesaid, the central panel contains the following equipment common to all of the loops:

Alarm bell	AB
Trouble buzzer	TB
Auxiliary supervisory lamp	ASL
Bell supervisory lamp	BSL
Pilot lamp	PL
Trouble lamp	TL
Master alarm relay	MA
Auxiliary supervisory relay	AS
Bell supervisory relay	BS
Master signal relay	MS
Trouble relay	T
Changeover relay	CO
Signal transfer relay	ST
Reset switch	RS
Trouble buzzer silencing switch	TBSS
Valves	V5, V6
Emergency battery	EB
Trouble battery	TP

The local panel (Fig. 1) at the protected premises is connected by means of a two-conductor transmission line 45, 46 to a remote main panel (Fig. 2) that may be located, for example, at the fire headquarters station for the municipality in which, or near which, the protected premises is located. Another local panel like that of Fig. 1 but serving a different premises may be similarly connected to the main panel via transmission line 45', 46'.

Attention is directed to the fact that the incoming transmission line 45, 46 has associated with it certain equipment individual to that line, namely:

Central vigilance relay	CV1
Central alarm relay	CA1
Lock-in relay	LR1
Central alarm lamp	CAL1
Central supervisory lamp	CSL1
Valves	V7, V8, V11

The incoming transmission line 45', 46' has an identical set of relays (CV9, CA9, LR9), lamps (CAL9, CSL9) and valves (V9, V10, V12) individual to that line, all of these being connected to the common conductors 47, 48 and 49 in precisely the same fashion as the corresponding elements individual to incoming lines 45, 46. If there are other incoming transmission lines from additional local panels (and there is no limit to the number that can be accommodated by the central panel) it will be understood that each must be provided with similar individual equipment connected to the common conductors 47, 48 and 49 in the same manner; the back contacts (e.g., 82, 92) of the alarm relays associated with all of the various incoming lines are connected seriatim to the winding of the main alarm relay MAR as will be clear from the drawing. The main alarm relay is, of course, common to all of the incoming transmission lines and the same is true of the following components located at the main panel:

Main alarm bell	MAB
Main trouble buzzer	MTB
Main alarm lamp	MAL
Main trouble lamp	MTL
Main pilot lamp	MPL
Main lock-in relay	MLR
Main change-over relay	MCO
Trouble relay	TR
Trouble silencing relay	TS
Trouble silencing switch	TSW
Alarm silencing switch	ASW
Main reset switch	MRS

In both figures all manually operated switches are shown in their normal position, and the heat detecting devices (H1, H2, H3, etc.) of Fig. 1 also are shown in

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open or non-actuated condition, as is the case when they are not exposed to elevated temperature or to an abnormal rate of rise in temperature. The contacts of the various relays are shown in the position they occupy when no external source of power is connected to either panel; and under that condition all of the lamps are extinguished and all of the audible signals are silent. With this preliminary outline, let us consider the operation of my system, beginning first with the local panel shown in Fig. 1.

Stand-by operating condition

The local panel (Fig. 1) is designed in normal use to receive its power from an outside source connected to terminals 36, 37. This, of course, can be a battery or a D.C. generator; in most installations, however, it is more convenient to take advantage of the alternating current available at the protected premises via the commercial power mains, and supply same to a conventional full wave rectifier whose output is impressed upon terminals 36, 37 in the form of a D.C. potential of the polarity indicated. Pilot lamp PL and the winding of change-over relay CO are connected in parallel directly across these terminals so when the panel is thus energized, the pilot lamp is automatically lighted and relay CO is energized. Relay CO therefore operates closing its contacts 2 and 3.

Accordingly, conductor 43 now is energized positively over a circuit extending thereto from terminal 36 through contact 2 and conductor 50; conductors 42 and 44 (which normally are connected together by the reset switch RS) are energized negatively over a circuit extending thereto from terminal 37 through contact 3 and conductor 51. The ensuing operations can conveniently be described with reference to the positive potential now existing on conductor 43 and the negative potential existing on conductors 42 and 44.

From positive conductor 43 an obvious circuit extends through the alarm bell AB, conductor 53 and the winding of the bell supervisory relay BS to the negative conductor 44. The resistance of the supervisory relay coil is several times as great as the resistance of the alarm bell coil, so that 90 percent or more of the potential impressed on this series circuit appears across the relay coil and only a small portion appears across the bell—a situation which, as will be seen presently, is duplicated in the circuits for the other supervisory relays. While the resistance of relay BS is too high to permit the alarm bell AB to operate in series therewith, relay BS can and does operate in this circuit, opening its contact 35.

A second obvious circuit exists from positive conductor 43 through the winding of master signal relay MS, conductor 54 and winding of auxiliary supervisory relay AS to negative conductor 44. Accordingly, relay AS operates, opening its contact 34, but the resistance of its winding is too great to permit marginal relay MS to operate in series therewith so the contacts of the latter relay remain in the position shown.

A third obvious circuit exists from positive conductor 43 through the winding of alarm relay A1, conductor 55, winding of supervisory relay S1, contact 18 and conductor 56 to the negative conductor 44. Upon being energized over this circuit, supervisory relay S1 operates opening its contact 19, but the resistance of its winding is too great to permit the marginal alarm relay A1 to operate in series therewith, so its contacts remain in the position shown.

Relays S2 and A2 are energized in a similar series circuit extending over conductors 57 and 58 but, as has just been described, only the supervisory relay S2 will operate in this circuit, relay A2 remaining in non-operated condition as shown due to the higher resistance of the winding of relay S2. Any other supervisory relays

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individually associated with other external loops like L1 and L2 will be operated in similar fashion.

So long as the panel remains in stand-by operating condition as described, the only relays operated are CO and the various supervisory relays (AS, BS, S1, S2, etc.). The only lamp lighted is the pilot lamp PL. It should be noted, however, that the positive potential on conductor 43 is connected via a current limiting resistor R and contact 8 to conductor 45 of the outgoing transmission line, while the opposite conductor 46 of the transmission line is energized negatively via contacts 6 and 10 from the negative terminal 37 of the power supply. The purpose of this will be described presently.

Alarm conditions

Let it now be assumed that a fire begins in the section of the protected premises which is served by external loop L1, and more particularly in the region near the heat detector H2. By closing its contacts this detector places a short circuit condition on the winding of supervisory relay S1 thereby increasing the flow of current through the alarm relay A1. As a result, the supervisory relay releases and the alarm relay operates; the latter immediately closes a locking circuit for itself which extends from positive conductor 43 through the winding of relay A1 and contact 14 to the negative conductor 42. Accordingly, alarm relay A1 will remain operated even if the contacts of the heat detector H2 should subsequently reopen, or even if there should be some interruption in the continuity of one or both conductors of the external loop L1 as a result of the fire.

Upon operating, relay A1 completes an obvious circuit extending from positive conductor 43 through alarm lamp AL1 and contact 15 to negative conductor 42, whereby the lamp is lighted; the same contact completes the following circuit for energizing the master alarm relay MA: positive conductor 43, conductor 59, winding of relay MA, conductor 40, valve V1 and contact 15 to negative conductor 42.

(It should be noted perhaps at this point that the valve V1 and the corresponding valves V2, etc., have very low resistance to current flow in the direction just mentioned but very high resistance to current flow in the opposite direction. Accordingly, though a circuit exists from positive conductor 43 through alarm lamp AL2, valve V2, conductor 40, valve V1 and contact 15 to negative conductor 42, valve V2 blocks the flow of current in this circuit, preventing alarm lamp AL2 from lighting; the same is true of the alarm lamps individual to any additional external loops similar to L2.)

Upon operating, relay MA immediately completes a locking circuit for itself, which extends from positive conductor 43 via conductor 59, winding of relay MA and contact 33 to negative conductor 42. By closing contact 32, relay MA short-circuits the winding of relay AS (negative conductor 44, winding of relay AS, contact 32, conductor 42 and switch RS back to conductor 44) and at contact 31 a similar short circuit is completed for the winding of relay BS. Relays AS and BS therefore release; at contact 34 the former now completes an obvious circuit (positive conductor 43, lamp ASL and contact 34 to negative conductor 42) for lighting lamp ASL while at contact 35 a similar circuit is completed for lighting lamp BSL.

The short circuiting of relay BS increases the current flow through alarm bell AB, and same is now fully energized over a circuit extending from positive conductor 43 through the alarm bell and contact 31 to negative conductor 42. Similarly the short-circuiting of relay AS at contact 32 increases the current flow through master signal relay MS and same is fully energized, so that it opens contacts 6 and 8 and closes contacts 7 and 9. Accordingly, conductor 45 which previously had positive potential connected thereto now is energized negatively

over a circuit extending from negative conductor 42 through contact 32, conductor 54 and contact 9; and conductor 46 which previously was energized negatively now has positive potential connected thereto over a circuit extending from positive terminal 36 of the power supply through contact 2, conductors 50 and 43, current limiting resistor R and contact 7. In other words, the operation of relay MS results in a reversal of the polarity of outgoing conductors 45 and 46 of the transmission line extending to the central headquarters panel (Fig. 2).

As previously mentioned, supervisory relay S1 which is individual to the external loop L1 already has released due to the short circuit condition placed thereon by closing of the heat detector contacts H2. Consequently, relay contact 19 is closed, completing a circuit which extends from positive conductor 43 through the winding of relay AT1 and lamp SL1 in parallel, conductor 60 and contact 19 to negative conductor 42. Supervisory lamp SL1 therefore is lighted, and relay AT1 is energized but the latter serves no useful purpose at this point. The closing of contact 19 also completes the following circuit for energizing trouble relay T: positive conductor 43, winding of relay T, conductors 61 and 41, valve V3 and contact 19 to negative conductor 42. (Although a circuit exists from positive conductor 43 through supervisory lamp SL2, valve V4, conductor 41, valve V3 and contact 19 to negative conductor 42, it will be understood from the earlier description that valve V4 blocks the current flow in this circuit so prevents the supervisory lamp SL2 from lighting.)

Upon operating, relay T immediately completes a locking circuit for itself which extends from positive conductor 43 through the winding of the relay and contact 12 to negative conductor 42. It also opens contact 10 (which serves no useful purpose at this point) and closes contact 11; the latter completes a circuit which extends from the positive terminal of the trouble battery TP via conductors 50', 50 and 43 through contact 11, conductor 62, the upper blade of switch TBSS and trouble buzzer TB to the negative side of battery TP. The trouble bell is energized over this circuit, and inasmuch as the trouble lamp TL is in parallel therewith, it also is lighted.

Accordingly, it will be seen that as a result of the closing of heat detector contacts H2, the alarm bell AB and trouble buzzer TB are both placed in operation, and lamps ASL, BSL and TL are lighted, these being all of the lamps which are common to the various external fire detection loops L1, L2, etc. At the same time, for the purpose of identifying the portion of the protected premises in which the fire has started the lamps AL1 and SL1 individual to the fire detection loop L1 which serve that portion of the premises are also lighted. The lamps (such as AL2 and SL2) individual to other external fire detection loops of course remain unlighted. The operations which have been described as the result of the closing of heat detector contact H2 would of course be duplicated if any other heat detector in loop L1 were actuated, or if one of the manual pull boxes P1 associated with the same loop were operated.

If the foregoing alarm signal condition were initiated by a heat detector or pull box on another external loop, such as L2, the operations would be the same except that the lamps AL2 and SL2 individual to that loop would be lighted rather than the lamps AL1 and SL1. In the case of any alarm, the alarm relay (A1 in the case of external loop L1, and A2 in the case of external loop L2) remains operated over its own locking circuit, as do also the master alarm relay MA and trouble relay T, until such time as the panel is manually returned to normal condition as hereinafter described. Consequently, the audible signals will continue to sound and the lamps will remain lighted as outlined above until conditions warrant manual resetting of the panel.

Resetting the panel after a fire alarm

Let it be assumed that after a fire alarm has been initiated by the external detection loop L1 the fire has been extinguished and the heat detector (say, H2) which initiated the alarm has been replaced, or reset to open condition. To restore the panel to its normal stand-by condition so that it will be ready to reoperate in the event of another fire, it is only necessary to manually operate the self-restoring, normally closed reset switch RS which, upon opening, removes from conductor 42 the negative potential which was previously supplied thereto via conductor 51. It will be understood from the previous description that alarm bell AB, lamps ASL, BSL, AL1 and SL1 and relays MS, T, MA, A1 and AT1 all depend upon the negative potential on conductor 42 for their continued operation; accordingly, removal of potential from this conductor brings about the immediate release of these five relays, as well as extinguishing the four lamps and causing the alarm bell AB to cease operating.

Moreover, the opening of switch RS removes the short-circuit condition therefore existing on the windings of supervisory relays AS, BS and S1 so that these relays now reoperate over the same circuits as described earlier under the heading "Stand-by operating condition." Upon release of relay T, contact 11 opens to interrupt the previously described circuit for trouble buzzer TB and trouble lamp TL, so that this buzzer also ceases its operation and the associated lamp is extinguished.

The release of the master signal relay MS restores its contacts to the position shown, thereby restoring the outgoing conductors 45, 46 to the same polarity that existed thereon prior to initiation of the fire alarm. With reclosing of the manual switch RS, the panel is fully restored to stand-by operating condition and until such time as another fire hazard may arise, it will remain in this condition, unless in the meantime some circuit difficulty arises which should receive attention in order to insure continuity of protection. Let us now give attention to the matter of supervising the system to guard against the possibility of faulty operation.

Supervisory operation

Naturally, in installing a fire alarm system in a given premises, it is not to be anticipated that fires will occur with any frequency; on the contrary, a fire is an emergency which may occur only once in many months, or once in many years—or perhaps never. While awaiting that possible emergency, the system must maintain continuous vigilance, day in and day out, month after tedious month, during which time, if it is ready to give the proper alarm when and if the need arises, its condition can best be described as a state of suspended animation. It simply remains, in other words, in the stand-by operating condition described earlier.

Having in mind that except for infrequent and perhaps cursory inspections, the apparatus is likely to receive little attention during these long periods of inactivity, I make the system self-supervising to the end that it will give both audible and visual warnings in the event that it requires attention in order to insure its proper operation in the event of a fire. Such warnings are given to indicate the following abnormal fault conditions, any one of which may manifest itself as a source of potential trouble in the system during a period of stand-by operation:

(1) Main power supply failure.

(2) Open circuit in one of the external fire detection loops L1, L2, etc.

(3) Open circuit to alarm bell AB.

(4) Open circuit to coil of master signal relay MS.

Considering these faults in the order named, it will be evident that if there is a failure in the main power supply connected to terminals 36, 37, pilot lamp PL will be immediately extinguished and change-over relay CO will be de-energized opening contacts 2 and 3 and

closing contacts 1 and 4. With the closing of contact 1, a circuit is completed from the positive terminal of the trouble power supply battery TP through conductor 50', contact 1, conductors 63 and 62, the upper blade of switch TBSS and the trouble buzzer TB back to the negative terminal of the trouble battery; consequently, the buzzer TB sounds an audible alarm, and inasmuch as trouble lamp TL is in parallel with the bell, it also is lighted.

At the same time the panel's emergency battery EP is substituted as a source of temporary power for maintaining conductors 42, 43 and 44 energized at the same potential that existed thereon before the failure of the external power source; more specifically, the positive side of battery EP is connected via conductors 50' and 50 to the conductor 43 while the negative side of the battery now is connected via contact 4 and conductor 51 to supply negative potential to conductors 42 and 44. Accordingly, while the trouble buzzer is calling attention to the existence of a fault which requires correction, the system is otherwise maintained in stand-by operating condition ready to signal the existence of a fire hazard should one arise before the fault is corrected.

The second most likely source of trouble is in the external fire detection loops L1, L2 etc., themselves, since these extend considerable distances from the panel and may be exposed to physical injury in the course of the normal activities which take place on the protected premises. If, through loss of insulation or otherwise, a "cross" or short circuit should develop between the two conductors of any external loop, the result will be the same as if one of the heat detectors H1, H2, etc., had closed due to a fire hazard condition. The system will, in other words, operate to give a fire alarm as described hereinbefore and, while the alarm will be a false one, it naturally will lead to detection of the fault; in this connection, lighting of the alarm lamp and supervisory lamp associated with the faulty loop will identify the latter as the source of trouble and thus expedite discovery of the exact fault location.

Let us consider what occurs, on the other hand, if a break (i.e., an open circuit) develops in one or both conductors of an external loop. It should be noted at the outset that the occurrence of such a fault in one external loop does not in any way impair the operation of the remaining external loops. Thus, assuming such a fault to exist in loop L2, if a fire should break out in the region of the premises protected by loop L1 before the fault is corrected, one or more of the heat detectors H1, H2, etc., will be operated, causing supervisory relay S1 to release and alarm relay A1 to operate in normal fashion. As a result, lamps AL1, SL1, ASL and BSL will be lighted; the alarm bell AB will be placed in operation; relays MS and MA will be operated; and relays AS and BS will be released, all as described hereinbefore. In short, all of the normal fire alarm operations will take place except that the occurrence of a fire in the region of loop L1 will have no effect upon trouble relay T, trouble buzzer TB or trouble lamp TL inasmuch as these will already have been placed in operation by the occurrence of the fault on loop L2 as will be explained hereinafter.

As a matter of fact, even while one or both conductors of loop L2 are interrupted at some point remote from the local panel, this loop itself still will function to give fire protection in essentially normal fashion. To insure this, alarm transfer relay AT2 is operated as will also be described presently, and by closing contact 26 it connects the two ends of conductor 57 together within the panel while by closing contact 27 it connects the two ends of conductor 58 together within the panel. Consequently, in the event a fire breaks out anywhere in the region of the premises protected by loop L2, the heat detector operated thereby will—no matter where along the loop L2 it is located—complete a circuit for operating alarm relay A2 and causing alarm lamp AL2 to

be lighted. Lamps ASL and BSL also will be lighted and the alarm bell AB will be placed in operation, all as described above.

While, as will be seen from the foregoing, there is no lapse of fire protection in the event that the continuity of one of the external loops is interrupted, this condition naturally is not one which should be allowed to go unnoticed. It will now be convenient to consider the manner in which it is brought to the attention of the proper parties in order that the defective loop can be repaired. For his purpose, let us assume that conductor 57 of loop L2 has been severed at the point X. When this occurs, the circuit over which supervisory relay S2 is energized is, of course, immediately interrupted so that the relay releases, closing its contact 29. Closing of the latter contact completes a circuit which extends from positive conductor 43 through trouble relay T, conductors 61 and 41, valve V4 and contact 29 to negative conductor 42 whereby relay T energizes; at contact 12 this relay closes a locking circuit for itself and at contact 11 it completes a circuit for the trouble buzzer TB and the trouble lamp TL as has been explained hereinbefore.

The trouble buzzer and trouble lamp serve to call attention to the existence of a fault condition to be corrected and the closing of contact 29 on supervisory relay S2 also completes a circuit extending from positive conductor 43 through supervisory lamp SL2 and contact 29 to negative conductor 42 whereby the supervisory lamp is lighted to identify the external loop on which the fault exists. The winding of alarm transfer relay AT2 is in parallel with the supervisory lamp so also is energized; its function, as outlined earlier, is to insure that external loop L2 still can initiate a fire alarm if the need arises, despite the existence of the open circuit in conductor 57 at the point X.

While a fault of the foregoing kind (i.e., a break in one of the external detection loops) is perhaps the kind of fault which is encountered most frequently in practice, it should also be borne in mind that while the panel is in stand-by operating condition there is a continuous flow of current through the windings of all alarm relays (A1, A2, etc.) and their corresponding supervisory relays (S1, S2, etc.). Over long periods of time it may sometimes happen, particularly if ventilation is poor, that the winding of one of these alarm relays may become overheated and "burn out" or that for some other reason the continuity of the relay coil itself may be interrupted. Should this occur, for example in the case of alarm relay A2, it would, of course, immediately interrupt the circuit for the supervisory relay (S2) in series therewith causing the latter to release. The result will be the same as that occasioned by interruption of the external loop L2 at the point X—that is to say, trouble relay T is energized, causing trouble buzzer TB to sound an audible warning and causing trouble lamp TL to light simultaneously therewith, while supervisory lamp SL2 also is lighted to assist the repair personnel in locating the fault.

While the panel is in stand-by condition, there also is a continuous flow of current through two other series circuits whose continuity is essential to the proper operation of the panel in the event of a fire in the protected premises. The first of these circuits is the one extending from positive conductor 43 through the alarm bell coil AB, conductor 53 and the winding of bell supervisory relay BS back to negative conductor 44; the second extends from positive conductor 43 through the master signal relay MS, conductor 54 and the winding of auxiliary supervisory relay AS, back to negative conductor 44. In each of these circuits, only the supervisory relay normally is operated, and if either circuit should be interrupted for any reason (such as a burned out relay coil), the supervisory relay in that circuit will immediately release.

With the release of bell supervisory relay BS or auxiliary supervisory relay AS, a circuit will be completed from positive conductor 43 through the winding of trouble

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relay T, conductor 69, one of the valves V5 or V6 and through contact 34 or 35 (depending upon which relay has released) to negative conductor 42. Relay T operates over this circuit and by closing contact 11 causes the trouble buzzer TB to operate and the trouble lamp TL to light as described hereinbefore. If it is the bell supervisory relay which has released an obvious circuit over contact 35 also will exist for lighting bell supervisory lamp BSL; if, on the other hand, it is the auxiliary supervisory relay AS which has released, an obvious circuit will exist over contact 34 for lighting the auxiliary supervisory lamp ASL. The lighting of one or the other of these lamps naturally will identify the nature and location of the trouble so that it can be repaired.

Trouble buzzer silencing

Whenever the trouble relay T operates due to any of the fault conditions outlined above, a visual and audible trouble signal results due to the circuit extending from the positive terminal of trouble battery TP via conductors 50', 50 and 43, contact 11, conductor 52, the upper blade of switch TBSS and thence in parallel through trouble lamp TL and trouble buzzer TB back to the negative side of battery TP. Simultaneously therewith, one or more of the supervisory lamps ASL, BSL, S1, S2, etc., will be lighted to assist the service man in locating the source of the trouble. While he is doing this and making the necessary repair, the trouble buzzer TB can be silenced by manually reversing the double throw switch TBSS. When this is done, the lower blade of the switch connects the trouble lamp TL directly across the trouble battery TP so that it remains lighted. At the same time, the following circuit is completed over the upper blade of the switch: positive terminal of trouble battery TP, conductors 50', 50 and 43, contact 11, the upper blade of switch TBSS and the winding of signal transfer relay TS back to the negative side of the trouble battery. Relay ST operates over this circuit, opening its contact 5 so that the trouble buzzer TB now is silenced. Until the switch TBSS is restored to normal position, the lighted trouble lamp TL serves as a constant reminder that there is an abnormal condition requiring correction.

Should the faulty circuit conditions be corrected before the trouble buzzer silencing switch TBSS is restored to normal, the panel will be reset by momentarily opening reset switch RS and this will allow trouble relay T to release. Opening of contact 11 will interrupt the aforementioned circuit for signal transfer relay ST, so it also releases closing its contact 5. As a result, a circuit is completed from the positive terminal of trouble battery TP over conductor 50', the lower blade of switch TBSS, contact 5 and trouble buzzer TB back to the negative side of the trouble battery. Accordingly, the buzzer will now sound to signify correction of the difficulty and will continue to do so until the double throw switch TBSS is restored to normal position as shown, whereupon the circuit for trouble buzzer TB and trouble lamp TL will be opened, causing the former to be silenced and the latter to be extinguished.

Advantage of the same feature can be taken if the fault in question is the failure of the main power supply connected to terminals 36 and 37. As previously mentioned, when this occurs, the trouble buzzer and trouble lamp are energized by closing of contact 1 on relay CO. If during the interval that the trouble is being investigated and corrected, switch TBSS is reversed in position, it completes a circuit as before for maintaining trouble lamp TL lighted, and it also completes the following circuit for energizing relay ST: trouble battery TP, conductor 50, contact 1, conductors 63 and 62, the upper blade of switch TBSS and the winding of relay ST back to the negative side of the trouble battery. This again opens contact 5 and by so doing interrupts the circuit to the trouble buzzer. If power now is restored to the terminals 36, 37, change-over relay CO will reoperate, opening contact 1 and thus

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interrupting aforementioned circuit for the signal transfer relay SP. Closing of contact 5 therefore re-energizes the trouble buzzer as previously described and will cause it to continue to operate until the manual switch TBSS is restored to normal position.

It will be evident from the foregoing that the local panel shown in Fig. 1 is a complete fire alarm system in and of itself. In the case of a fire the system will give appropriate audible and visual signals for alerting the local personnel so that they may take immediate action to deal with the situation; and in the meantime if any circuit difficulty should arise in the system itself it again will call attention thereto by appropriate audible and visual signals so that local personnel will be apprised of this difficulty. While the local panel is self-sufficient in these regards, it often is desirable to supplement the protection afforded thereby in the manner which now will be described with reference to Fig. 2.

CENTRAL HEADQUARTERS STATION

Stand-by operating condition

As was true in the case of the local panel (Fig. 1) the central panel (Fig. 2) is designed under normal conditions to receive its power from an external source connected to terminals 38 and 39. The main pilot lamp MPL and main change-over relay MCO are connected directly across these terminals and accordingly when the panel is thus energized the lamp immediately lights and relay MCO operates closing its contacts 87 and 88. Accordingly contact 87 causes conductors 64 and 48 to be energized negatively from the potential on terminal 39 while contact 88 causes conductors 65 and 47 to be energized positively. Therefore a circuit is completed from negative conductor 64 through the winding of main alarm relay MAR and the back contacts (e.g., 82 and 92) of all individual central alarm relays back to the positive conductor 47. Energized over this circuit, the master alarm relay MAR operates and opens its contact 99.

It will be recalled from the description previously given that when the local panel (Fig. 1) is in stand-by operating condition it applies positive potential to conductor 45 and negative potential to conductor 46. In the central station (Fig. 2) this causes current to flow through the central vigilance relay CV1 and valve V7; valve V8 under this condition prevents the flow of current through the central alarm relay CA1. Accordingly only relay CV1 is operated, opening its contact 81. The same will be true, of course, of the relays (such as CV9 and CA9) individual to transmission lines extending to other local stations similar to that shown in Fig. 1.

Accordingly under stand-by operating conditions at the central station all central vigilance relays CV1, CV9, etc., are operated and relays MAR and MCO also are operated; the only lamp lighted is the main pilot lamp MPL.

Alarm conditions

Should a fire alarm occur at the local panel (Fig. 1) the polarity of the potential connected to conductors 45 and 46 will be reversed as described hereinbefore. Upon such reversal valve V7 blocks the flow of current through relay CV1 while valve V8 now permits current to flow through the winding of the central alarm relay CA1. Relay CV1 immediately releases closing its contact 81 while relay CA1 operates opening contact 82 and closing contact 83. The opening of contact 82 interrupts the previously described circuit for relay MAR which therefore releases closing its contact 99. Therefore, a circuit now exists extending from positive conductor 65 through contact 99 and in parallel through the winding of relay MLR, the main alarm bell MAB and the main alarm lamp MAL to negative conductor 64. The main alarm bell MAB thus is placed in operation and the main alarm lamp MAL is lighted; the main locking relay

MLR also operates over this circuit to close its contact 98, but for the moment this serves no useful purpose.

Upon operation of the central alarm relay CA1 the closing of contact 83 completes a circuit which extends from negative conductor 48 through conductor 66, thence in parallel through lamp CAL1 and the winding of relay LR1, contact 83, conductor 67 and contact 92 back to the positive conductor 47. The central alarm lamp CAL1 individual to the transmission line 45, 46, therefore, is lighted and relay LR1 upon operating closes contact 84 to complete an obvious locking circuit for itself. At the same time contact 85 is opened interrupting the circuit for central alarm relay CA1 which immediately de-energizes and restores its contacts to the position shown. Despite the opening of contact 83 lamp CAL1 and relay LR1 remain energized over the locking circuit completed at contact 84. The closing of contact 82, however, causes relay MAR to re-energize, opening its contact 99; contact 98 now is effective to maintain relay MLR, the main alarm bell MAB and the main alarm lamp MAL energized despite the opening of contact 99.

All of the operations thus far described have taken place as a result of the momentary operation of central alarm relay CA1 which, it will be remembered, was initiated by the reversal of polarity on conductors 45 and 46. The release of central vigilance relay CV1 occasioned by such reversal closes contact 81 and thus completes an obvious circuit extending from positive conductor 47 through contact 81 and central supervisory lamp CSL1 back to negative conductor 48. This lamp, therefore, is also lighted. At the same time a circuit is completed from positive conductor 47 through contact 81, valve V11 and the winding of trouble relay TR back to negative conductor 48. Relay TR operates and by closing its contact 90, completes an obvious circuit connecting the main trouble battery MTP to the main trouble lamp MTL so that the latter is energized. The main trouble buzzer MTB is connected in parallel with this lamp by contact 97 so it also is placed in operation.

Although a circuit now exists which extends from positive conductor 47 through contact 81, valve V11, conductor 49, valve V12 and lamp CSL9 back to negative conductor 48, it will be understood from the earlier discussion that valve V12 blocks the flow of current over this circuit and, therefore, prevents lamp CSL9 from lighting. Accordingly only the lamps individual to the incoming line 45, 46 (i.e., CSL1 and CAL1) will be lighted to identify, so far as the central station is concerned, the premises which initiated the alarm. The main alarm lamp MAL and main trouble lamp MTL will, of course, also be lighted and the main alarm bell MAB and main trouble buzzer MTB will be energized to give audible signals for the purpose of alerting personnel at the central station.

If an alarm is initiated by the local station connected to the transmission line 45', 46' rather than by the one connected to transmission line 45, 46, the operations will be exactly as have been described except that lamps CSL9 and CAL9 will be lighted rather than lamps CSL1 and CAL1; lock-in relay LR9 will be operated rather than relay LR1; and central vigilance relay CV9 will be de-energized rather than relay CV1. Should alarms occur in quick succession on the transmission lines associated with two or more local panels, the pair of lamps individual to each of these lines will be lighted in the manner already described so that the central station personnel will be apprised of the simultaneous existence of fires at the different locations in question. It will be understood, however, that the lamps individual to any transmission line serving a premises at which there is no fire will remain dark.

Silencing the audible signals at central headquarters station

Let us assume once more than an alarm has come in on the transmission line 45, 46 and that as a result the main alarm bell MAB and main trouble buzzer MTB are in operation. The alarm bell may be silenced by momentary manual operation of the normally closed self-restoring switch ASW. When this is opened it interrupts the circuit for the main lock-in relay MLR which releases, opening its contact 98; the latter interrupts the circuit of the main alarm bell MAB and the main alarm lamp MAL so that both are de-energized. The switch ASW now may be permitted to return to closed position without producing any further effect.

To silence the main trouble buzzer the operator needs only to momentarily close the normally open self-restoring switch TSW. When this is done it completes a circuit extending from the positive terminal of the main trouble battery MTP through conductor 65, contact 90, switch TSW and the winding of the trouble silencing relay TS back to the negative side of the main trouble battery MTP. Relay TS energizes over this circuit and immediately completes a locking circuit for itself at contact 96 so that it will remain operated when switch TSW subsequently is permitted to open. At contact 97 the circuit for the main trouble buzzer MTB is opened so that it ceases operation; it should be noted, however, that the main trouble lamp MTL remains lighted by virtue of the circuit existing thereto at contact 90.

Should the fire alarm condition at the local panel (Fig. 1) now clear, the polarity of conductors 45, 46 will be restored to normal causing the central vigilance relay CV1 to reoperate. By opening contact 81 this relay will interrupt the circuit for the central supervisory lamp CSL1 and the trouble relay TR. Accordingly the lamp is extinguished while the relay releases. Contact 90, therefore, is now opened which will extinguish the main trouble lamp MTL and interrupt the circuit for the trouble silencing switch TS which also de-energizes.

When lamps MTL and CSL1 go out as just explained it is an indication to the operator at the central station that the alarm conditions have cleared and he can, therefore, reset the panel. To do this he momentarily opens the self-restoring main reset switch MRS which interrupts the circuit for lock-in relay LR1 and lamp CAL1; accordingly these are de-energized and, due to the opening of contact 84, will not reoperate when switch MRS is permitted to reclose. The central panel, thus, is fully restored to normal stand-by operating condition.

Let it now be assumed that a fire alarm condition has been initiated on transmission line 45, 46 and that by momentarily operating switches ASW and TSW the operator has silenced the main alarm bell MAB and the main trouble buzzer MTB. As previously noted, the main trouble lamp MTL still is lighted and so are the lamps CAL1 and CSL1 individual to the incoming transmission line 45, 46. Should an alarm condition now occur on another incoming transmission line (say 45', 46') the reversal of polarity on these conductors will cause relay CV9 to release and at contact 91 complete a circuit for lighting the associated supervisory lamp CSL9. At the same time relay CA9 will be momentarily energized and at contact 93 complete a circuit for lighting lamp CAL9 and energizing the lock-in relay LR9. Opening of contact 92 causes the master alarm relay to release, closing contact 99, so that the circuits once more are completed for energizing the master lock-in relay MLR, the main alarm bell MAB and the main alarm lamp MAL. It is to be noted, in other words, that even if these have been silenced by the opening of the switch ASW after an initial alarm, they will reoperate responsive to a second alarm condition on another incoming transmission line if such should occur before the alarm condition on the first incoming transmission line has been cleared. The

other operations which take place as a result of the second alarm will be clear from the description already given.

Supervisory operation at central headquarters station

One of the valuable features of the invention resides in the arrangement of the circuits at the central station to provide a visible and audible signal in the event of a trouble or fault condition developing at any of the local stations serviced thereby, or in the event of a break of short-circuit in the connecting lines from the local to the central station.

As has been explained in connection with the discussion of the supervisory operation of the local station illustrated in Fig. 1, any trouble or fault condition developing in the circuits therein immediately energizes trouble relay T thus initiating operation of trouble buzzer TB and trouble light TL to signal the existence of the unfavorable condition. Concurrently with the signal at the local panel, contact 10 is opened by relay T with the effect that the negative potential is removed from conductor 46 of the transmission line. As a result, current no longer flows through the winding of vigilance relay CV1 at the central headquarters (Fig. 2); the relay releases and contact 81 closes, thereby completing a circuit from positive conductor 65, through conductor 47, contact 81, and central supervisory lamp CSL1 to negative conductor 48. At the same time relay TR is energized, being in parallel with lamp CSL1 in a circuit including valve V11, and contact 90 therefore is closed. This completes an obvious circuit through main trouble lamp MTL and main trouble buzzer MTB to provide an immediate indication of difficulty somewhere in the over-all system. The illumination of lamp CSL1 localizes it to the station served by lines 45 and 46 and an investigation can be made and the fault or trouble corrected.

It should be evident that the occurrence of a fault or trouble condition as described above will have no effect on the alarm circuits of the central station and that neither the central alarm lamps CAL1, CAL9, etc., the main alarm lamp MAL nor the main alarm bell MAB will be energized. These elements remain in standby condition ready to receive a fire alarm. If while a fault exists at the station served by transmission line 45, 46, such an alarm should come in on line 45, 46, the resultant operation of alarm relay CA9 as heretofore described will light the associated central alarm lamp CAL9 and energize the main alarm bell MAB and main alarm lamp MAL, all in the manner set forth. As a matter of fact, the same will occur even if a fire should begin at the station where the fault exists. In other words, referring to Fig. 1 and assuming that trouble relay T is operated so that negative potential is removed from conductor 46, if master signal relay MS should now be energized due to the occurrence of a fire before the fault is cleared, it will cause conductor 45 to be energized negatively and conductor 46 to be energized positively as already explained, whereupon central alarm relay CA1 (Fig. 2) will be operated to bring in the alarm in normal fashion at the headquarters station.

It will be noted also that the arrangement at the central station is such that the trouble signal will be given at buzzer MTB and lamp MTL in the event of either a break of a "cross" in one of the transmission lines 45, 46, or 45', 46', etc. In either case, the vigilance relay CV1, CV9, etc., associated with the faulty transmission line will be de-energized, thus closing contact 81, 91, etc., and initiating operation of trouble relay TR and the trouble signals MTB and MTL as hereinbefore described, along with the supervisory lamp (CSL1, CSL9, etc.) individual to the faulty line. Where a "cross" or short circuit develops between the conductors of a given transmission line, the resistor R at the local station limits the amount of current to a safe value.

Main power failure at any of the local stations also

initiates activity of the trouble signals MTL and MTB at the central station. Immediately the potential is removed from terminals 36 and 37 (Fig. 1), the negative potential is removed from transmission line 46; this is not remedied by the bringing into play of the emergency power system. Vigilance relay CV1 (Fig. 2) is therefore de-energized and the closing of contact 81 sets in operation the trouble signals as hereinbefore explained. The central supervisory lamp CSL1 is also energized and provides a means of determining the particular station where the power failure has taken place.

The supervisory circuits at the central station also monitor the central station's own power supply, and provide an immediate signal should there be a failure. If there is a failure in the main power supply connected to terminals 38 and 39, main pilot lamp MPL will be immediately extinguished and change-over relay MCO will be de-energized opening contacts 87 and 88 and closing contacts 86 and 89. With the closing of contact 89, a circuit is completed from the positive terminal of the trouble power supply battery MTP through conductor 65', contact 89, contact 97 and the trouble buzzer MTB back to the negative terminal of the trouble battery; consequently, the buzzer MTB sounds an audible alarm, and inasmuch as main trouble lamp MTL is in parallel with the buzzer, it also is lighted.

At the same time the panel's emergency battery MEP is substituted as a source of temporary power for maintaining conductor 47, 48 and 49 energized at the same potential that existed thereon before the failure of the external power source. More specifically, the positive side of battery MEP is connected via conductors 65' and 65 to the conductor 47 while the negative side of the battery now is connected via contact 86 and switch MRS to supply negative potential to conductors 48 and 49. Accordingly, while the trouble buzzer is calling attention to the existence of a fault which requires correction, the central station is otherwise maintained in standby operating condition ready to signal the existence of a fire condition, should one arise before the fault is corrected.

While the failure of the regular power supply is being investigated and corrected the trouble buzzer MTB can be silenced by momentarily closing switch TSW; this completes a circuit from the positive terminal of battery MTP through contact 89, switch TSW and the winding of relay TS to the negative terminal of battery MTP whereupon relay TS operates to open the circuit of the buzzer at contact 79. At contact 96 relay TS completes a locking circuit for itself so will remain operated independently of switch TSW as previously described. Although the trouble buzzer now is silenced, the trouble lamp MTL remains lighted as a reminder of the existence of the fault. When the power supply is restored to terminals 38, 39, relay MCO will, of course, reoperate and the main pilot light MPL will again be lighted. By the opening of contact 89, the circuit for trouble lamp MTL is interrupted and the circuit for relay TS also is interrupted so that it will return to normal position.

Likewise, if the main trouble buzzer is placed in operation as a result of the energization of trouble relay TR (due to a fault existing in one of the local stations connected to the transmission lines 45, 46 or 45', 46', etc.) the trouble buzzer may be silenced by momentary operation of switch TSW. As previously described, this completes a circuit from the battery MTP over contact 90 and switch TSW for energizing relay TS which thereupon interrupts the circuit for the trouble buzzer while the trouble lamp MTL remains lighted. When the fault is cleared, relay TR will release and by opening contact 90 this interrupts the circuit for lamp MTL and relay TS so that the trouble signaling components are restored to normal condition.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects

hereinbefore set forth together with other advantages which are obvious and which are inherent to the apparatus.

Inasmuch as many possible embodiments of the invention may be made without departing from the scope thereof, it is to be understood that all matters herein set forth or shown in the accompanying drawings are to be interpreted as illustrative and not in a limiting sense.

For example, while I prefer to provide a central headquarters station such as shown in Fig. 2 in order to obtain dual alarms and dual supervision, such is not absolutely necessary because, as pointed out hereinbefore, each local station such as shown in Fig. 1 is self-sufficient. It will, in other words, give local personnel appropriate audible and visual signals in the event of a fire and in the event of any fault in the circuit; its operation will be the same regardless of whether or not a remote headquarters station is connected to the outgoing transmission line 45, 46. It will be understood that if there is no headquarters station in the system, the master signal relay MS serves no useful purpose and can be omitted, as can also its supervisory relay AS and the associated supervisory lamp ASL and valve V5. Likewise, contact 32 can be omitted from relay MA and contact 10 omitted from relay T. However, in the interest of standardizing the manufacture of local panels such as Fig. 1, it usually is desirable to provide these components against the possible future addition of a headquarters station (Fig. 2) to the system.

It will of course be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and its within the scope of the appended claims.

Having thus described my invention, I claim:

1. In a zoned alarm system, a source of D.C. potential, a conductor common to all of the zones, a different signal circuit for each zone, each said circuit comprising a lamp in series with a unidirectional current flow valve, the valves in all of said circuits being poled in the same sense with respect to the lamps in said circuits, the lamp end of each circuit being connected to one terminal of said source and the valve end of each circuit being connected to said common conductor whereby all of said circuits are in parallel, each said circuit having individual thereto a normally open contact for connecting the opposite terminal of said source to that circuit at a point intermediate the lamp and the valve in that circuit, zone controlled means for closing any one of said contacts, a device common to all of said zones, and a circuit for energizing said device from said source responsive to the closing of any of said contacts, said last circuit including the closed contact and said common conductor.

2. In a zoned alarm system having portions individual to the respective zones and other portions common to all of the zones, a source of D.C. potential, a conductor common to all of the zones, a signal circuit common to all of said zones, each zone also having an individual signal circuit, said common circuit and said individual circuits each comprising a lamp in series with a unidirectional current flow valve; the valves in all of said circuits being poled in the same sense with respect to the lamps in said circuits; the lamp end of each circuit being connected to one terminal of said source and the valve end of each circuit being connected to said common conductor whereby all of said circuits are in parallel, a normally open contact for connecting the opposite end of said source to said common circuit at a point intermediate the lamp and valve therein, means operative to close said contact responsive to a fault in a portion of the system which is common to all of said zones, each of the remaining ones of said circuits having individual thereto a normally open contact for connecting the opposite terminal of said source to that circuit at a point intermediate the lamp and valve in that circuit, means operative to close different ones of said last contacts responsive to

faults in portions of the system individual to different zones, a device common to all of said zones, and a circuit for energizing said device from said source responsive to the closing of any of said contacts, said last circuit including the closed contact and said common conductor.

3. In a zoned alarm system, a source of D.C. potential, a pair of conductors each common to all of the zones, a different alarm circuit for each zone, a different supervisory circuit for each zone, each of said circuits comprising a lamp in series with a unidirectional current flow valve, the valves in all of said circuits being poled in the same sense with respect to the lamps in said circuits, the lamp end of each of said circuits being connected to one terminal of said source of potential, the opposite end of each alarm circuit being connected to one of said common conductors whereby all of said alarm circuits are in parallel, the opposite end of each supervisory circuit being connected to the other common conductor whereby all of said supervisory circuits are in parallel, each alarm circuit having a normally open contact for connecting the opposite terminal of said source to that circuit at a point intermediate the lamp and valve in that circuit, zone controlled means for closing any one of said contacts, a master alarm device connected to said one conductor and energized thereover from said source responsive to the closing of any one of said contacts, each supervisory circuit also having a normally open contact for connecting said opposite terminal of said source to that circuit at a point intermediate the lamp and valve in that circuit, zone controlled means for closing any one of said last contacts, and a master trouble device connected to said one conductor and energized thereover from said source responsive to the closing of any one of said last contacts.

4. In an alarm system of the character described, a source of D.C. potential, a plurality of detection circuits, a master alarm device common to said detection circuits, a plurality of individual alarm circuits corresponding respectively to said detection circuits, each alarm circuit comprising an individual alarm device in series with a unidirectional current flow valve, the valve end of each alarm circuit being connected to one terminal of said master alarm device, the opposite end of each alarm circuit and the opposite terminal of said master alarm device being connected to one terminal of said source of potential, each alarm circuit having a normally open contact for connecting the opposite terminal of said source to that circuit at a point intermediate the alarm device and valve in that circuit, means for closing the contact individual to any particular alarm circuit responsive to an abnormal condition in the detection circuit corresponding to that alarm circuit, and the valve in each alarm circuit being so poled as to permit current to flow through same and said master alarm device in series responsive to the closing of the contact associated with that circuit.

5. In an alarm system of the character described, a plurality of detection circuits, a pair of conductors common to said circuits, a plurality of identical alarm circuits connected in bridge between said conductors whereby said alarm circuits are in parallel with one another, said alarm circuits corresponding respectively to said detection circuits, a master alarm device, a source of D.C. potential having one terminal connected to one of said conductors and also connected through said master alarm device to the other conductor, means operated responsive to an abnormal condition in one of said detection circuits to connect the other terminal of said source to the alarm circuit corresponding to that detection circuit, each alarm circuit containing, between the point at which said other terminal is connected thereto and said one conductor, an alarm device individual to the detection circuit corresponding to that alarm circuit, and each alarm circuit also containing between said point

and said other conductor a unidirectional current flow valve poled to prevent current from flowing through that circuit's individual alarm device when said other terminal of said source is connected to another alarm circuit.

6. In a self-supervising alarm system of the type described, a central panel containing a source of potential, an alarm relay and a supervisory relay; an external loop comprising a two-conductor detection line extending from said panel so that it passes through a portion of the protected premises outside the panel and then returns to the panel, the portion of said line outside said panel being bridged by one or more normally open contacts capable of being closed to initiate an alarm, the coil of said supervisory relay normally being connected in bridge to said line at one end thereof, the other end of said line having one conductor thereof connected to one terminal of said source of potential and the other conductor connected through the winding of said alarm relay to the opposite terminal of said source, said supervisory relay normally being energized over said line from said source and said alarm relay being marginal whereby it cannot operate in series with said supervisory relay, a device in said panel controlled by said supervisory relay so as to operate responsive to the release of said supervisory relay for any reason, and means controlled by said device upon operation to disconnect said supervisory relay from said one end of said line and to connect together within the panel the opposite ends of each conductor of said line.

7. In a zoned alarm system of the type wherein an alarm condition in any zone causes the selective actuation of zone-identifying means in such manner as to register the identity of the zone in which said condition exists; the improvement which comprises, a first station having a trouble relay and an alarm relay common to all zones, means for operating said trouble relay responsive to a fault condition in any zone, means for operating said alarm relay responsive to an alarm condition in any zone, a second station remote from said first station but connected thereto by a two-conductor transmission line, a pair of oppositely polarized relays at said second station connected in bridge to said line, a source of D.C. potential at said first station normally connected in bridge to said line to energize a particular one of said polarized relays, means at said first station for interrupting said last connection responsive to operation of said trouble relay, and other means at said first station for reversing the connection of said source to said line responsive to the operation of said alarm relay thereby to energize the other polarized relay.

8. A system as in claim 7 wherein each polarized relay comprises a relay having its winding in series with a unidirectional current flow valve.

9. A system as in claim 7 having a pair of alarms at said second station, a circuit for operating one of said alarms responsive to release of said particular one of said polarized relays, and a circuit for operating the other alarm responsive to energization of the other polarized relay.

10. In an alarm system as in claim 7, a contact so controlled by said particular polarized relay that said contact is open whenever the relay is energized and closed whenever the relay is released; a series circuit comprising a source of potential, a lamp and said contact; a circuit in parallel with said lamp including an audible signal in series with a normally closed contact; a transfer relay adapted to open said last contact; a second circuit in parallel with said lamp including in series the winding of said transfer relay and a normally open manual switch of the self-restoring type, said switch being momentarily closable to energize said transfer relay in parallel with said lamp; and a normally open contact on said transfer relay connected in parallel with said manual switch to complete a locking circuit for said transfer relay upon momentary closing of said switch.

11. In an alarm system as in claim 7, a series circuit

at said second station comprising a source of potential, the winding of a master relay and a normally open contact, means for momentarily closing said contact to energize said master relay responsive to energization of said other polarized relay, a locking circuit in parallel with said contact comprising a normally open contact on said master relay in series with a normally closed manual switch of the self-restoring type, and a circuit in parallel with said master relay winding including said switch in series with a signal device.

12. In an alarm system, a series circuit comprising a source of potential, a lamp and a normally open contact, means for at times closing said contact and on each instance maintaining same closed for a variable interval of time, a circuit in parallel with said lamp including an audible signal in series with a normally closed contact, a relay operable to open said last contact, a second circuit in parallel with said lamp including in series the winding of said relay and a normally open switch of the self-restoring type, and a normally open contact on said relay connected in parallel with said switch to complete a locking circuit for said relay upon momentary closing of said switch.

13. In an alarm system, a normally open contact, means for at times closing said contact and in each instance maintaining same closed for a variable interval of time, a relay having a normally closed contact, an alarm, a source of potential, a reversible two-position switch, a circuit completed by said switch in one position thereof, said circuit including in series said source, said switch, said alarm and said first contact; said switch effective in the other position to substitute the winding of said relay for said alarm in said circuit, and an alternate circuit for said alarm completed by said switch in said last position thereof, said alternate circuit including in series said source, said alarm and said relay contact.

14. In an alarm system as in claim 13, a second alarm device, a circuit completed by said switch when in said one position thereof to connect said second alarm device in parallel with said first alarm, and a circuit completed by said switch when in said other position thereof for connecting said second alarm device directly in bridge to said source of potential.

15. In a fire alarm system, a central station, a plurality of local stations each having a two-conductor transmission line extending to said central station, each local station having thereat a source of D.C. potential normally connected in bridge to that station's transmission line, means at each local station for disconnecting said source from the line in the event of a local circuit fault condition, other means at each local station for reversing the polarity of the D.C. potential connected to that station's transmission line in the event of a local alarm condition, said central station having, for each transmission line, a polarized supervisory relay connected to that line and normally energized by said D.C. potential connected thereto at the associated local station, said central station also having, for each transmission line, an oppositely polarized alarm relay connected to that line and energized only upon said reversal of polarity of the D.C. source at the associated local station, a master alarm signal and a master trouble signal at said central station, means controlled jointly by all of said alarm relays and effective to operate said alarm signal responsive to the energization of any of said alarm relays, and means controlled jointly by all of said supervisory relays and effective to operate said trouble signal responsive to the release of any of said supervisory relays.

16. In a fire alarm system, a central station, a plurality of local stations each having a two conductor transmission line extending to said central station, each local station having thereat a source of D.C. potential normally connected in bridge to that station's transmission line, means at each local station for disconnecting said source from the line in the event of a local circuit fault condition,

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other means at each local station for reversing the polarity of the D.C. potential connected to that station's transmission line in the event of a local alarm condition, said central station having, for each transmission line, a polarized supervisory relay connected to that line and normally energized by said D.C. potential connected thereto at the associated local station, said central station also having, for each transmission line, an oppositely polarized alarm relay connected to that line and energized only upon said reversal of polarity of the D.C. source at the associated local station, a master alarm signal at said central station, means controlled jointly by all of said alarm relays and effective to operate said alarm signal responsive to energization of any of said alarm relays, a master trouble lamp at said central station, means controlled jointly by all of said supervisory relays and effective, responsive to the release of any one thereof, to connect a source of potential to said lamp to light same, a circuit in parallel with said lamp including an audible signal in series with a normally closed contact, a transfer relay adapted to open said last contact, a second circuit in parallel with said lamp including in series the winding of said transfer relay and a normally open manual switch of the self-restoring type, said switch being momentarily closeable to energize said transfer relay in parallel with said lamp, and a normally open contact on said transfer relay connected in parallel with said manual switch to complete a locking circuit for said transfer relay upon momentary closing of said switch.

17. In a fire alarm system, a central station, a plurality of local stations each having a two-conductor transmission line extending to said central station, each local station having thereat a source of D.C. potential normally connected in bridge to that station's transmission line, means at each local station for disconnecting said source from the line in the event of a local circuit fault condition, other means at each local station for reversing the polarity of the D.C. potential connected to that station's transmission line in the event of a local alarm condition, said central station having, for each transmission line, a polarized supervisory relay connected to that line and normally energized by said D.C. potential connected thereto at the associated local station, said central station also having, for each transmission line, an oppositely polarized alarm relay connected to that line and energized only upon said reversal of polarity of the D.C. source at the associated local station, a series circuit at said central station comprising a source of potential the winding of a master relay and a normally open contact, means controlled jointly by all of said alarm relays and effective to momentarily close said contact responsive to the energization of any of said alarm relays, a locking circuit in parallel with said contact comprising a normally open contact on said master relay in series with a normally closed manual switch of the self-restoring type, a circuit in parallel with said master relay including a switch in series with a master alarm signal device, a master trouble signal device at said central station, and means controlled jointly by all of said supervisory relays and effective to operate said trouble signal device responsive to the release of any of said supervisory relays.

18. In a fire alarm system, an originating station having local circuits for detecting alarm conditions, a remote receiving station, a two-conductor transmission line extending from said originating station to said receiving station, said originating station having thereat a source of D.C. potential normally connected in bridge to said transmission line, means at said originating station for disconnecting said source from the line in the event of a local circuit fault condition, other means at said originating station for reversing the polarity of the D.C. potential connected to said transmission line in the event of an alarm condition, said remote receiving station having thereat a polarized supervisory relay connected to the line and normally energized by the D.C. potential con-

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nected thereto at said originating station, said receiving station also having thereat an oppositely polarized alarm relay connected to the line and energized only upon said reversal of polarity of the D.C. source at said originating station, a master alarm signal and a master trouble signal at said receiving station, means controlled by said alarm relay to operate said master alarm signal responsive to energization of said alarm relay, and means controlled by said supervisory relay to operate said master trouble signal responsive to release of said supervisory relay.

19. In a fire alarm system, an originating station having local circuits for detecting alarm conditions, a remote receiving station, a two-conductor transmission line extending from said originating station to said receiving station, said originating station having thereat a source of D.C. potential normally connected in bridge to said transmission line, means at said originating station for disconnecting said source from the line in the event of a local circuit fault condition, other means at said originating station for reversing the polarity of the D.C. potential connected to said transmission line in the event of an alarm condition, said remote receiving station having thereat a polarized supervisory relay connected to the line and normally energized by the D.C. potential connected thereto at said originating station, said receiving station also having thereat an oppositely polarized alarm relay connected to the line and energized only upon said reversal of polarity of the D.C. source at said originating station, a master alarm signal at said receiving station, means controlled by said alarm relay to operate said master alarm signal responsive to energization of said alarm relay, a master trouble lamp at said receiving station, means controlled by said supervisory relay responsive to release thereof to connect a source of potential to said lamp to light same, a circuit in parallel with said lamp including an audible signal in series with a normally closed contact, a transfer relay adapted to open said last contact, a second circuit in parallel with said lamp including in series the winding of said transfer relay and a normally open manual switch of the self-restoring type, said switch being momentarily closeable to energize said transfer relay in parallel with said lamp, and a normally open contact on said transfer relay connected in parallel with said manual switch to complete a locking circuit for said transfer relay upon momentary closing of said switch.

20. In a fire alarm system, an originating station having local circuits for detecting alarm conditions, a remote receiving station, a two-conductor transmission line extending from said originating station to said receiving station, said originating station having thereat a source of D.C. potential normally connected in bridge to said transmission line, means at said originating station for disconnecting said source from the line in the event of a local circuit fault condition, other means at said originating station for reversing the polarity of the D.C. potential connected to said transmission line in the event of an alarm condition, said remote receiving station having thereat a polarized supervisory relay connected to the line and normally energized by the D.C. potential connected thereto at said originating station, said receiving station also having thereat an oppositely polarized alarm relay connected to the line and energized only upon said reversal of polarity of the D.C. source at said originating station, a series circuit at said receiving station comprising a source of potential the winding of a master relay and a normally open contact, means controlled by said alarm relay to momentarily close said contact responsive to energization of said alarm relay, a locking circuit in parallel with said contact comprising a normally open contact on said master relay in series with a normally closed manual switch of the self-restoring type, a circuit in parallel with said master relay including a switch in series with a master alarm

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signal device, a master trouble signal device at said receiving station, and means controlled by said supervisory relay to operate said master trouble signal device responsive to release of said supervisory relay.

21. In a self-supervising alarm system of the type described, a central panel, a plurality of external loops each comprising a two-conductor detection line extending from said panel so that it passes through a portion of the protected premises and then returns to the panel, each of said two-conductor lines having an individual supervisory relay normally connected in bridge to that line at one end thereof, each of said two-conductor lines having at the other end thereof a circuit connected in bridge to the line, said circuit comprising a source of potential in series with an alarm relay individual to the line, the supervisory relay for each line normally being energized over the line from said source and the alarm relay for each line being marginal whereby it cannot operate in series with that line's supervisory relay, the portion of each two-conductor line outside said panel being bridged by one or more normally open contacts capable of being closed thereby to simultaneously operate the alarm relay and release the supervisory relay for that line, each line having an alarm signal individual to that line, means controlled by each line's alarm relay for operating that line's alarm signal responsive to operation of said relay, and means controlled by each line's supervisory relay for operating that line's supervisory signal responsive to release of said supervisory relay.

22. An alarm system as in claim 21 wherein said panel has a master alarm signal and a master trouble signal common to said lines, means controlled jointly by all of said alarm relays and effective to operate said master alarm signal responsive to operation of any of said alarm relays, and means controlled jointly by all of said supervisory relays and effective to operate said master trouble signal responsive to the release of any of said supervisory relays.

23. In a self-supervising alarm system of the type described, a central panel, a plurality of external loops each comprising a two-conductor detection line extending from said panel so that it passes through a portion of the protected premises and then returns to the panel, each of said two-conductor lines having an individual supervisory relay normally connected in bridge to that line at one end thereof, each of said two-conductor lines having at the other end thereof a circuit connected in bridge to the line, said circuit comprising a source of potential in series with an alarm relay individual to the line, the supervisory relay for each line normally being energized over the line from said source and the alarm relay for each line being marginal whereby it cannot operate in series with that line's supervisory relay, the portion of each two-conductor line outside said panel being bridged by one or more normally open contacts capable of being closed thereby to simultaneously operate the alarm relay and release the supervisory relay for that line, said panel having a master alarm signal and a master trouble signal common to said lines, means controlled jointly by all of said alarm relays and effective to operate said master alarm signal responsive to operation of any of said alarm

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relays, and means controlled jointly by all of said supervisory relays and effective to operate said master trouble signal responsive to the release of any of said supervisory relays.

24. An alarm system as in claim 23 wherein said means controlled jointly by said alarm relays comprises a master alarm relay and wherein said means controlled jointly by said supervisory relays comprises a master trouble relay, said master alarm relay having means effective upon operation thereof to connect said source of potential to said master trouble relay thereby to operate the latter, and said trouble relay effective when operated either by said master alarm relay or by said supervisory relays to connect said source to said master trouble signal to operate said signal.

25. In a zoned alarm system of the type wherein each zone has an individual alarm relay arranged to operate whenever there is an alarm condition on the detection circuit for that particular zone, and wherein each zone also has an individual normally operated supervisory relay arranged to release whenever there is a fault condition on that particular zone's detection circuit; the improvement which comprises a master alarm relay and a master trouble relay common to all of said zones, a source of potential, each of said individual alarm relays having means effective upon operation of that relay to connect said source to said master alarm relay, whereby the latter is operated by one of said individual alarm relays whenever there is an alarm condition on any of said detection circuits, each supervisory relay having means effective upon operation of that relay to connect said source to said master trouble relay, whereby the latter is operated by one of said supervisory relays whenever there is a fault condition on any of said detection circuits, means controlled by said master alarm relay upon operation to connect said sources to said trouble relay whereby said trouble relay also is operated whenever there is an alarm condition on any of said detection circuits, an alarm signal and a trouble signal also common to all of said zones, means controlled by said master alarm relay upon operation to connect said source to said alarm signal whereby the latter is operated whenever there is an alarm condition on any of said detection circuits, and means controlled by said master trouble relay upon operation to connect said source to said trouble signal whereby said trouble signal is operated whenever there is either an alarm condition or a fault condition on any of said detection circuits.

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