5 Sheets—Sheet 1.

S. D. CUSHMAN

SYSTEM OF FIRE ALARM AND POLICE TELEGRAPH.

No. 105,552. Patented July 19, 1870.

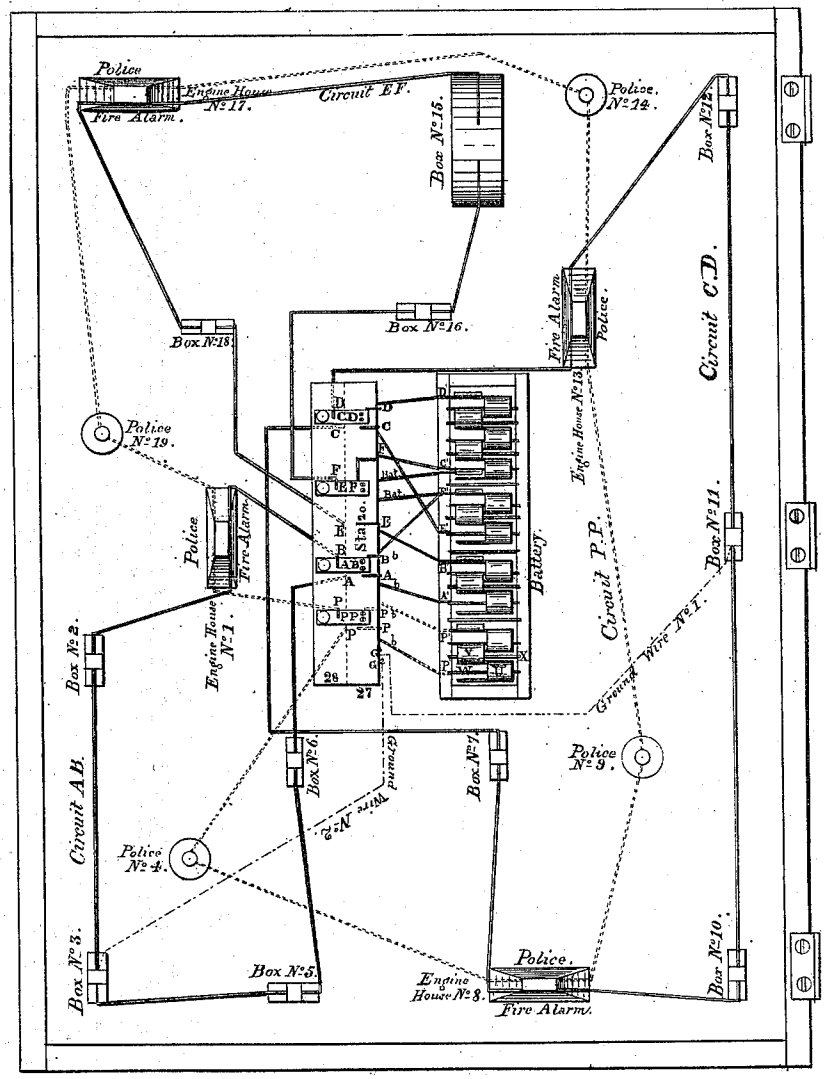

Fig. 1.

Witnesses.
Andrew Choffin
Ruth K. Abbott

Sylvanus D. Cushman Inventor.
by Jobabbott Attorney

5 Sheets—Sheet 2.

S. D. CUSHMAN.

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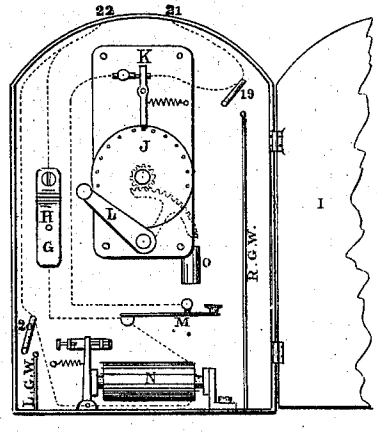

Fig.2

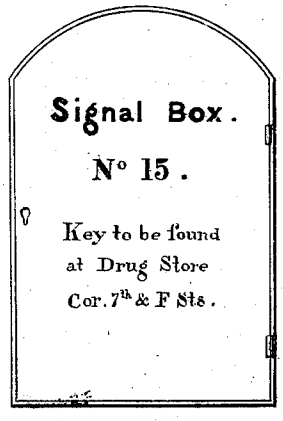

Fig.3.

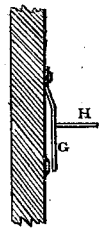

Fig.4.

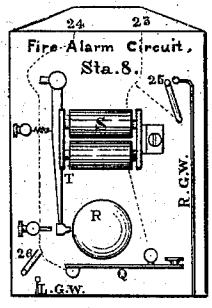

Fig.5.

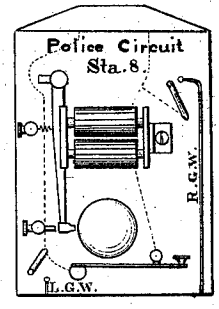

Fig.6.

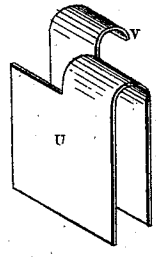

Fig.7.

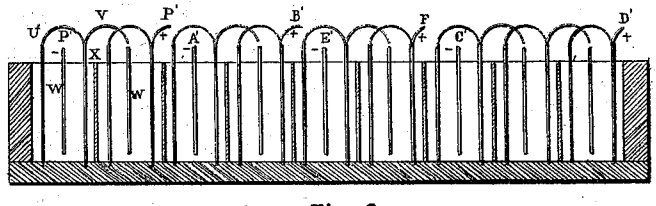

Fig.8.

Witnesses.
Andrew Chroffin
Rush R. Abbott

Sylvanus D. Cushman, Inventor
by Jos. Abbott Attorney

5 Sheets—Sheet 3.

S. D. CUSHMAN.

SYSTEM OF FIRE ALARM AND POLICE TELEGRAPH.

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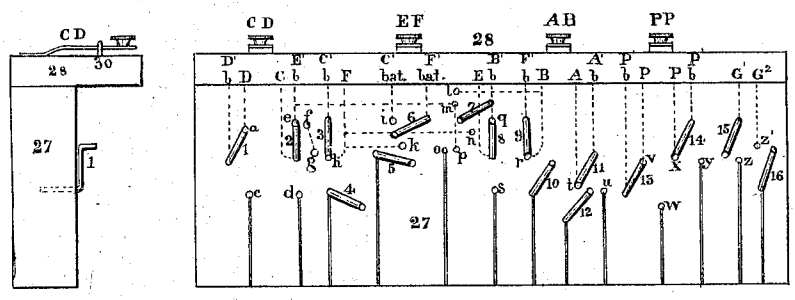


Figs. 9.

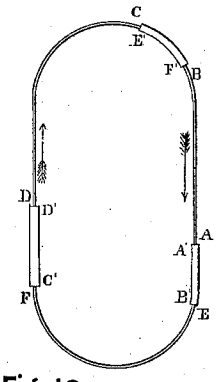
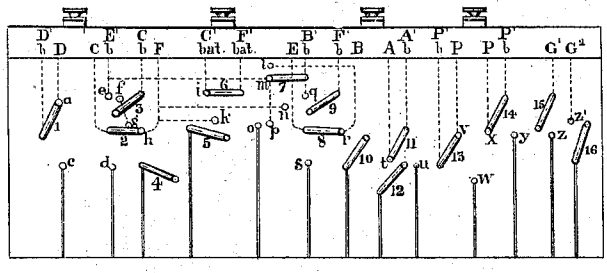
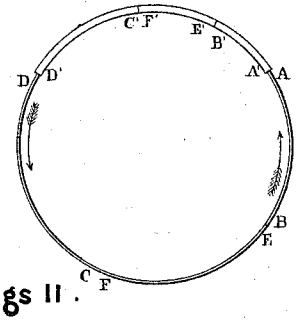
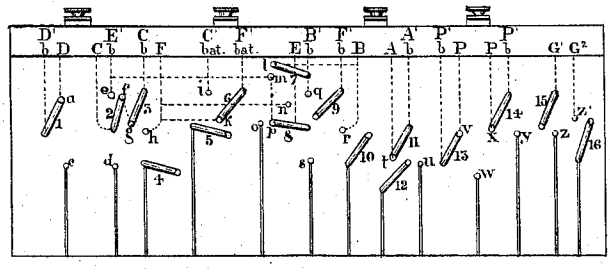


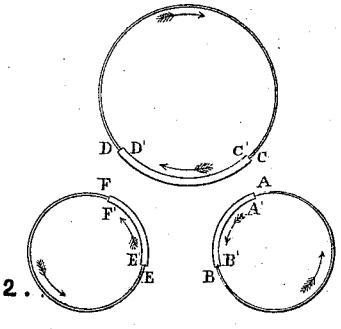
Fig. 10.





Figs 11.





Figs. 12.

Witnesses
Andrew C. Hoffin
Ruth K. Abbott

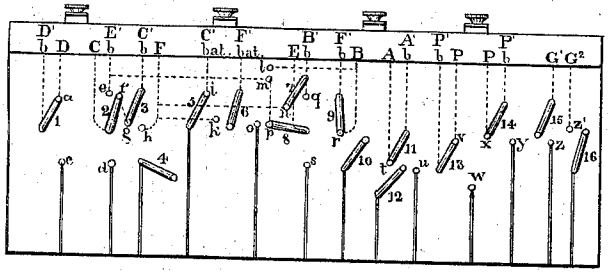
Sylvanus D. Cushman, Inventor.
by Jo. Abbott Attorney.

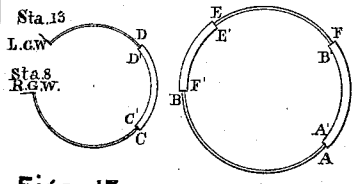
5 Sheets—Sheet 4.

S. D. CUSHMAN.

SYSTEM OF FIRE ALARM AND POLICE TELEGRAPH.

No. 105,552. Patented July 19, 1870.





Figs. 13.

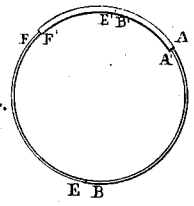
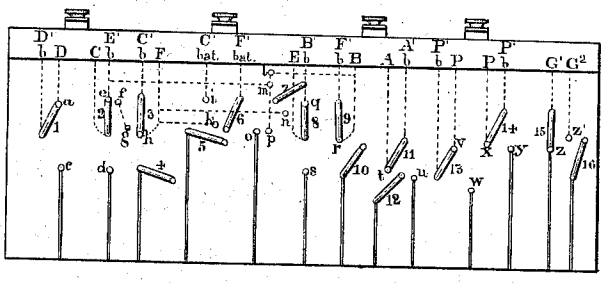
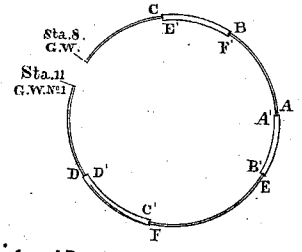
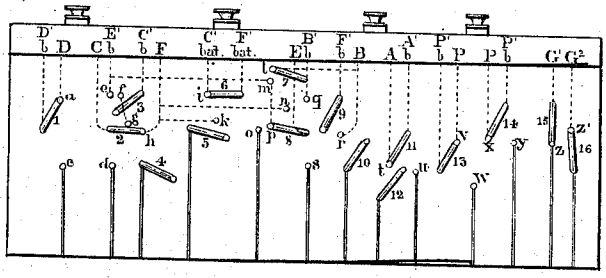


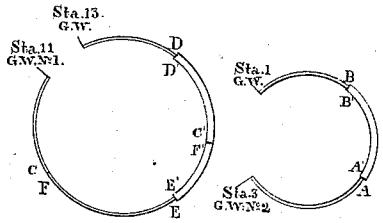
Fig. 14.





Figs. 15.





Figs. 16.

Witnesses.
Andrew Chaffin
Ruth K Abbott

Sylvanus D. Cushman Inventor
by Job Abbott Attorney.

5 Sheets—Sheet 5.

S. D. CUSHMAN.

SYSTEM OF FIRE ALARM AND POLICE TELEGRAPH.

No. 105,552. Patented July 19, 1870.

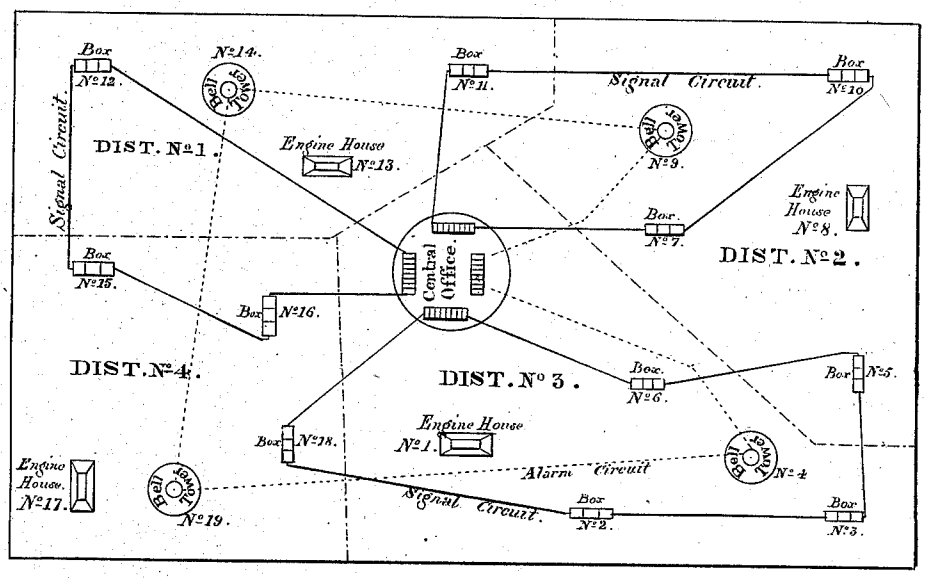


Fig. 17.

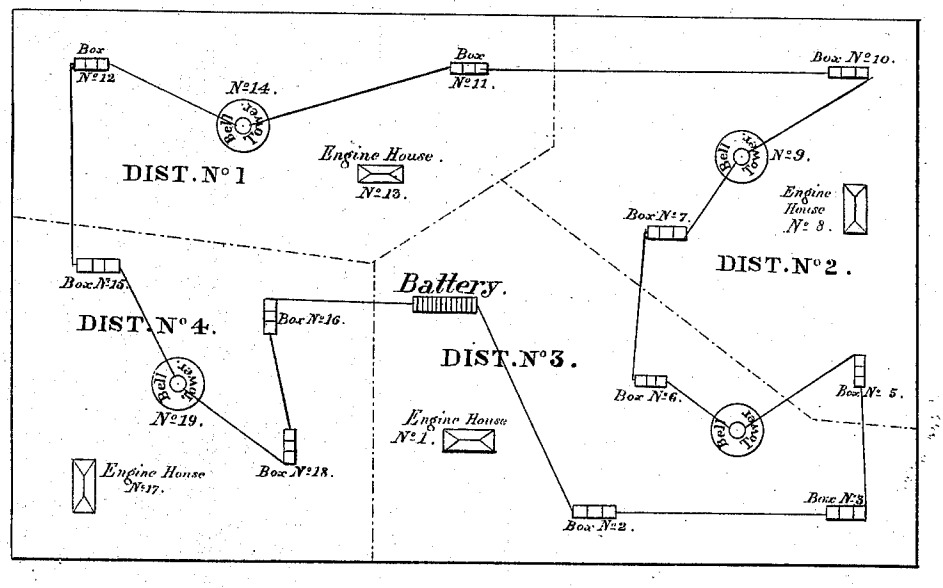


Fig. 18.

United States Patent Office.

SYLVANUS D. CUSHMAN, OF NEW LISBON, ASSIGNOR TO THE AUTOMATIC FIRE-ALARM COMPANY, OF LEETONA, OHIO.

Letters Patent No. 105,552, *dated July* 19, 1870.

IMPROVEMENT IN SYSTEM OF FIRE-ALARM AND POLICE-TELEGRAPHS.

The Schedule referred to in these Letters Patent and making part of the same

To all whom it may concern:

Be it known that I, SYLVANUS D. CUSHMAN, of New Lisbon, Columbiana county, Ohio, have invented a new and improved System of Fire-Alarm and Police-Telegraphs; and that the following is a full, clear, and exact specification thereof.

Nature and Objects of my Invention.

The first part of my invention relates to the combination of a series of signal-stations or boxes arranged at short distances from each other throughout a whole city, or a large portion thereof, with a series of electro-magnetic telegraph-sounders or gong instruments, located one at each of the principal offices of the fire department of the city, (such as the chief engineer's office, engine-houses, hose-houses, and hook-and-ladder houses,) and with a telegraph circuit, (termed a "fire-alarm circuit,") provided with suitable battery power, and having all the signal-boxes and fire-department instruments arranged in it, so that a signal of fire given at any one of the signal-boxes will be directly and telegraphically transmitted to each and all of the fire-department instruments in the city, thus providing any person with a suitable means of giving immediate notice of the outbreak of a fire in any locality to every branch of the fire department in the city, without giving a general public alarm, and thus calling out a large crowd, who only impede the operations of the fire department, and are of little or no service in extinguishing the fire.

The second part of my invention relates to arrangement of a continuous fire-alarm telegraph circuit, embracing all the signal-boxes and fire-department instruments in the city, or a large portion thereof, in two or more loops, which are so combined with the sections of the circuit battery as, in effect, to distribute the battery into the circuit without the necessity of locating the different sections of the battery in different localities in the city, whereby a more uniform electrical tension is maintained on all parts of the circuit, and the labor of keeping the various signal-box and fire-department instruments in electrical adjustment is materially diminished.

The third part of my invention relates to the combination and arrangement of a continuous fire-alarm telegraph-circuit, embracing all the signal-boxes and fire-department instruments in the city, or a large portion thereof, and arranged in two or more loops, with a suitable battery, and with a switch-board provided with suitable switches and ground-wires, the said signal-boxes and fire-department instruments being either or both of them provided with suitable switches and ground-wires, and the whole being so arranged as that the fire-alarm circuit can be worked as a continuous metallic circuit, with distributed battery, or as a continuous ground and metallic circuit with distributed battery; or as two or more metallic circuits, or as two or more ground and metallic circuits, each circuit having its own battery, formed by dividing the main-circuit battery, whereby the superintendent of telegraphs is enabled to electrically repair the telegraph circuit whenever the same is broken, either by accident or design, and can thus keep the city under the protection of the fire-alarm telegraph at all times, thus greatly increasing the utility of the telegraph for fire-alarm purposes.

The fourth part of my invention relates to the combination, with a fire-alarm telegraph circuit embracing all the signal-boxes and fire-department instruments in the city, or a large portion thereof, of a talking or police-telegraph circuit, provided with suitable battery, and working independent of the fire-alarm circuit, but having a suitable telegraph instrument at each of the fire-department offices in the fire-alarm circuit, and a telegraph instrument at each of the police stations in the city, or portion thereof, if found desirable, whereby the fire department, and, if desired, the police department, are provided with a separate telegraph circuit on which to transact their ordinary business, so that the fire-alarm circuit is reserved exclusively for fire-alarm purposes, while the two circuits act in combination, each with the other, for the purpose of locating breaks in either circuit, thus enabling the telegraph superintendent to locate and repair breaks in either circuit with great dispatch.

The fifth part of my invention relates to the combination, with the telegraph instruments in those fire-department offices which are provided with an instrument on both the fire-alarm and police circuits, of a telegraph-switch, with an accompanying ground-wire, or of two switches, located one at each side of the telegraphic mechanism, and provided each with a ground-wire, or with a branch of a common ground-wire, whereby the attendant at any of the fire-department offices can ground broken circuit at that office, when requested by the telegraph superintendent operating on the unbroken circuit, by which the superintendent is enabled to readily locate the break in the broken circuit, and can at once put the greater portion of the broken circuit into service, by directing the attendants at the offices at each side of the break to ground the broken circuit at those points, thus effecting the electrical repairing of the circuit in a few moments' time, and without leaving the office, or without leaving any considerable portion of the circuit out of service.

The sixth part of my invention relates to the combination with the electrical mechanism of the signal-boxes of a fire-alarm telegraph circuit, of two switches located at each side of said mechanism, and each provided with a ground wire, or with a branch of a common

ground wire, whereby the telegraph superintendent or his assistant can at any time electrically repair the broken circuit, so as to keep the whole line in service, by going to the section of the line in which he had located the break before leaving the office, and putting on the ground-wires at the signal-boxes at each side of the break, on the side of the boxes toward the break, thus bringing the circuit, with all the instruments, into service in a very quick and rapid manner, while if the break were in one of the signal-boxes in place of being in the line itself, he will at once detect it, thus affording a simple means of detecting any faults in the circuit through the instruments, which are very liable to be overlooked in the search for the break in the circuit.

The seventh part of my invention relates to the combination, with any of the loops in a fire-alarm telegraph circuit, of a wire termed a "cross-ground wire," which is attached to the distant central part of the loop, and extends to the switch-board in the telegraph superintendent's office, or to a fire department office, where it is provided with a suitable switch and ground-wire, whereby the superintendent is enabled to ground the loop at a point distant from his office without leaving the office, or without any loss of time, thus greatly facilitating the location of any break in the loop.

The eighth part of my invention relates to the construction of a continuous fire-alarm telegraph circuit, embracing a suitable battery and all the fire-department instruments and signal-boxes in the city, or a large portion thereof, the signal-boxes in the said circuit being provided with such automatic operating mechanism and switch mechanism as that the closing of the door of the said signal-box switches the electro-magnets out of the circuit without switching out the operating mechanism, whereby I obtain a combined working and reserve circuit, the working circuit consisting of the line proper and the wire on the electro-magnets in the fire-department instruments, and the reserve circuit consisting of the wire on the electro-magnets in the signal-boxes, which are put in combination with the working circuit whenever the box is opened and brought into service, but which are never in the circuit except when the box is in service, which, in the ordinary construction of fire-alarm telegraphs, makes about half of the total circuit a reserve circuit, (as the ordinary length of line between any two boxes is about half a mile, and the length of wires on the electro-magnets in each signal-box is about half a mile;) or, if the length of the circuit is measured by the amount of electrical resistance overcome in passing over such circuits, the reserve circuit is nearly six times as long as the working circuit, (as the half mile of wire on the electro-magnets has an electrical resistance equal to about three miles of common line,) thus obtaining a fire-alarm telegraph circuit which affords a more complete telegraphic system of communication between all parts of the city than any of the old systems of fire-alarm telegraphs, but which can be worked with from one-half to one-sixth the amount of battery required for the old systems, and which is much less liable to injury from atmospheric electricity than any of these old systems.

Description of Accompanying Drawing.

Figure 1 is a plan of drawing showing the application of my system to a city.

Figure 2 is an elevation of the interior of a signal-box of a construction adapted to my system.

Figure 3 is an elevation of the same, with door closed.

Figure 4 is a side view of switch in signal-box.

Figures 5 and 6 are elevations of the office instruments in the fire-alarm and police circuits.

Figure 7 is a perspective view of copper plate in battery.

Figure 8 is a longitudinal section of battery.

Figures 9 are front and end elevations of switch-board.

Figure 10 is a diagram of fire-alarm circuit with distributed battery.

Figures 11 are diagrams of fire-alarm circuit with concentrated battery, with corresponding arrangement of switch-board.

Figures 12 are diagrams of fire-alarm circuit working in three separate metallic loops, with corresponding arrangement of switch-board.

Figures 13 are diagrams of fire-alarm circuit, working one ground-loop and one metallic loop, with distributed battery, with corresponding arrangement of switch-board.

Figure 14 is a diagram showing another mode of working large loop shown in figs. 13, by uniting the circuit-loops and concentrating the battery.

Figures 15 are diagrams showing a mode of electrically repairing break in line between stations 10 and 11, by working with one ground circuit with distributed battery, with corresponding arrangement of switch-board.

Figures 16 are diagrams showing mode of electrically repairing fire-alarm circuit, in case line is broken between stations 11 and 12, and between stations 2 and 3, by working in two ground-loops, with corresponding arrangement of switch-board.

Figures 17 and 18 are diagrams showing the application of two of the old systems of fire-alarm telegraphs to the drawing of city shown in fig. 1.

General Description.

The space inclosed by double lines or frame, in fig. 1, is supposed to represent a city, in which my improved system is to be introduced.

The switch-board 27, and key-board 28, together with the battery, constitute station 20, which is the office of the superintendent of telegraph, and which, from the nature of the telegraphic operations there performed, may be termed the "repair office."

This "repair office" is most conveniently located in the central part of the city, in any suitable room or building which may be provided for the purpose.

Stations 1, 8, 13, and 17, represent the engine-houses, hose-houses, hook-and-ladder houses, chief engineer's office, or any other branches or offices of the fire department in various localities in the city, which should be informed of the existence and location of a fire in the city.

Stations 2, 3, 5, 6, 7, 10, 11, 12, 15, 16, and 18, represent the signal-stations or boxes, which are placed in various localities in the city, at such distances from each other as to bring every point in the city within a reasonable distance of a signal-station.

Stations 4, 9, 14, and 19, represent police stations, in different parts of the city, which are conveniently brought into the talking-circuit of the fire department, both to afford a telegraph-circuit for the police department, and to enable the police to co-operate with the fire department in the care and protection of property in case of fire.

In order to render more clear the construction and operation of my system, I will first describe the character of the different mechanisms used in connection therewith; then explain the arrangement of the different circuits; then illustrate the practical working of the system; and then show wherein it differs from previous systems.

The first, and motor mechanism of the system, is the battery, which may be of any of the well-known forms, (Grove's sectional battery being a convenient one for the purpose,) but, for purpose of simple illustration, I have shown a modified form of Wollaston's battery, which consists of a plain baked wood box, divided, by partitions X, into several cells, in each of

which is arranged a zinc plate, W, and a double copper plate, U.

The copper plate is of a ∩-form, as shown in fig. 7, and sits astride of the zinc plate, as shown in fig. 8, so as to bring a surface of copper opposite each surface of the zinc plates, and an arm, V, on each copper plate U, is connected with the zinc plate W, in the next cell, as shown in figs. 1 and 8.

The battery is represented as being in four sections, the poles of which are indicated by plus and minus signs, the section P′ P′ being for the police-circuit, and the sections A′, B′, E′, F′, and C′ D′, being the sections of the fire-alarm circuit battery, which circuit is arranged to work in one, two, or three loops, as will be hereafter shown.

The signal-boxes consist of a box of iron, or other suitable material, provided with a door, I, which is kept locked, to prevent persons from giving false alarms.

These signal-boxes are usually secured to the outside of buildings located at street-corners, or to telegraph-poles at such corners, and at such distances from each other as the city authorities may deem necessary for the protection of property.

Each box is designated by a particular number or letter, and has written on it, or near it, directions as to where a key may be found, and, usually, directions are affixed on the inside of the door, to direct persons how to give an alarm.

The operating mechanism in the signal-box may be the ordinary key mechanism, or an automatic mechanism, or both classes of mechanism may be combined in the box, which will usually be found to be the better plan, as will be hereafter shown.

In the signal-box represented in figs. 2 and 3, the automatic mechanism consists of the pivoted key K, which is operated by the circuit-wheel J, which is, in turn, operated, through a vibrating gear-sector and pinion, by means of a winding lever, L, and weight O, or its equivalent, the general construction being the same as that represented in reissued Letters Patent No. 4,013, granted to Alexander Allen, June 7, 1870, for fire-alarm apparatus, to which reference is made for a more complete description.

The key mechanism consists of a simple spring-key, M, of an ordinary form, and the electro-magnets N, with a pivoted armature, (arranged as a simple sounder, or having a hammer and gong arranged in connection therewith,) are arranged on the bottom of the box, as shown.

On the back of the box is secured the spring switch G, on which is the rod H, which is struck by the door I, when closed, thus pressing the spring switch G onto its anvil, and closing the switch.

The circuit through the box is from the point 21, through the automatic key K, spring key M, and electro-magnets N, to the point 22, as indicated by dotted lines, and the switch-circuit is from the spring key M, through the switch G, to the point 22, as is also indicated by dotted lines, from which it is seen that, when the door I, and, consequently, the switch G, are closed, the electro-magnets N will be switched out of the main circuit, all of which is more fully explained in Letters Patent No. 103,150, granted to Sylvanus D. Cushman, May 17, 1870, for fire-alarm-telegraph signal-box.

The pivot-switches, 19 and 20, are arranged on the box-circuit, one at each side of the electrical mechanism, and are arranged to connect with ground-wires, marked R G W and L G W, which may be separate wires, or branches of a common wire, extending from the signal-box down into the ground.

The fire-alarm instruments, represented in fig. 5, consist of a spring key, Q, electro-magnets S, pivoted armature lever T, and gong R, with the suitable spring and tension devices common to such parts.

The circuit through these instruments is from the point 23, through the magnets S and key Q, to the point 24, as indicated by dotted lines, and the pivot-switches 25 and 26 are arranged on the box-circuit, one at each side of the electrical mechanism, and are arranged to connect with the ground-wires R G W and L G W, which extend, either separately or as branches of the same ground-wire, from the instrument into the ground.

The talking-circuit, or police-circuit instruments, represented in fig. 6, are of the same general construction as the fire-alarm instruments represented in fig. 5, and it is desirable to have them provided with switches and right and left-hand ground-wires, as is shown in drawing.

If preferred, both the fire-alarm and police-instruments could be made as common sounders, without the hammer and gong, or the fire-alarm instrument could be a gong-sounder, and the police instrument a common sounder; but, in practice, I prefer to make both instruments gong-sounders, especially where they are located at the engine-houses, where there is liable to be considerable noise.

The fire-alarm and police instruments at the engine-houses, which are on both the fire-alarm and police-circuits, are placed close to each other, or at such distances from each other as to enable persons at one instrument to hear the blows or taps on the other instrument, for purposes which will be hereafter shown.

The switch-board 27 is of an ordinary form, and is provided with suitable switches and ground-wires, to enable the telegraph-superintendent to manipulate the circuits and battery, as will be presently shown; and on it, or near it, is arranged the key-board 28, on which are conveniently arranged the keys P P A B, and so on, one for each loop or circuit, together with one or more sounders for each loop, a paper register for recording the alarm given on the fire-alarm telegraph, and a galvanometer for showing the degree of intensity of the electric current, the two instruments last named being simply for convenience, and not forming essential features of the mechanism for my system.

The portions of the telegraph-circuits between the various signal-boxes and fire-department instruments in my system (except where the ground forms a part of the circuit) consist of common telegraph-wire, which is carried, on suitable insulators, on the tops of buildings, or on poles, in an ordinary manner.

The battery, switch-board, key-board, fire-alarm instruments, police instruments, and signal-boxes, having been located in various parts of the city, in the general manner described, the construction of the circuit or series of circuits, uniting such instruments in one complete system, is a matter which will depend very much on the skill and judgment of the telegraph engineer having charge of the construction; but the following description will serve to give an illustration of one mode of arranging the circuit in the city represented in fig. 1:

Commencing at the repair-office, station 20, on the switch-board 27, at A, I run the circuit or loop A B through the signal-boxes, Nos. 6, 5 and 3, 2, and through the fire-alarm instrument at engine-house No. 1, back to the switch-board at B. Then, commencing on the switch-board at E, I run the circuit or loop E F, through signal-box No. 18, fire-alarm instrument at engine-house No. 17, and signal-boxes Nos. 15 and 16, back to the switch-board at F. Then, commencing on the switch-board, at C, I run the circuit or loop C D through signal-box No. 7, fire-alarm instrument at engine-house No. 8, signal-boxes Nos. 10, 11, and 12, and fire-alarm instrument at engine-house No. 13, back to the switch-board at D.

These three circuits or loops, A B, E F, and C D, form the fire-alarm circuit, and, when the whole system is in order, they are all united together in one continuous circuit.

The talking or police-circuit, which is marked circuit P P in fig. 1, and is represented by double-dotted lines, is run from the switch-board at P, through the police-circuit instruments at police-station No. 4, engine-house No. 8, police-station No. 9, engine-house No. 13, police station No. 14, engine-house No. 17, police station No. 19, and engine-house No. 1, back to the switch-board at P.

Assuming, for convenience, that the ends of these several circuits are at the top of the switch-board, (as would be the case were the several loops or circuits brought into the upper part of the building containing the repair office,) and that the keys P P, A B, E F, and C D, are in the different loops P P, A B, E F, and C D, the ends of the different circuits will be represented by the dotted lines P P, A B, E F, C, and D, on the switch-board 27, as shown in figs. 9 to 16.

The poles of the different battery sections being designated by the letters P' P', A' B', and so on, and wires being attached to said poles, I bring the ends of the battery wires P' P' to the switch-board 27 at *b b*, as indicated by dotted lines at each side of the circuit-wires P P.

The battery-wire A' is brought to the switch-board at the right-hand side of the circuit-wire A, and the battery-wire B' is brought to the right-hand side of the circuit-wire E.

The battery-wire E' is brought to the right-hand side of the circuit-wire C, and the battery-wire F' is brought to the left-hand side of the circuit-wire B.

The battery-wire C' is brought to the left-hand side of the circuit-wire F, and the battery-wire D' is brought to the left-hand side of the circuit-wire D, and battery-wires marked "bat" are brought from the poles C' and F' to the switch-board, as shown by wires, indicated by dotted lines C' and F', having "bat" marked over them.

The switch 1 is pivoted on the end of the battery-wire D'. Switch 2 is pivoted on the end of the circuit-wire C; switch 3 on the end of the battery-wire C'; switch 6 on the end of the battery-wire F', bat; switch 7 on the battery-wire B'; switch 8 on the end of the circuit-wire E; switch 9 on the end of battery-wire F'; switch 11 on the end of the battery-wire A'; and switches 13 and 14 on the ends of the battery-wires P' P'.

The switches 4, 5, 10, and 12 are pivoted at the ends of wires extending into the ground, and are used to ground the ends of the wires F, C', B, and A, respectively, and the wires *c d o s u w y* are ground-wires, which are used in connection with the switches 1, 2, 6, 8, 11, 13, and 14, for grounding the ends of the wires on which said switches are placed.

If, now, the switches 11, 9, 8, 3, 2, and 1, be turned onto the anvils *t*, *r*, *q*, *h*, *e*, and *a*, which are on the ends of the wires A, B, B', F, E', and D, respectively, as shown in fig, 9, we shall have the continuous circuit with distributed battery, represented in fig. 10, in which A' B', C' D', and E' F', represent the sections of the fire-alarm circuit-battery, and A B, C D, and E F, the three loops of the fire-alarm circuit.

As the electric current is evolved by the decomposition of the negative metal, (zinc,) and passes through the acid fluid in the battery to the positive metal, (copper,) the course of the current through the battery-sections is from the negative to the positive pole, and over the circuits connecting the poles of the battery-sections the course is from the positive to the negative pole, from which it is evident that the current on the circuit in fig. 10 has the direction indicated by arrows, so that the large battery-section C' D', which contains three cells, works over the large loop D C, and the smaller battery-sections, E' F' and A' B', each of which contain two cells, work over the small loops B A and E F, thus distributing the battery into the circuit in a very perfect manner.

The advantages resulting from distributing the battery into the circuit will be readily seen, by converting the circuit represented in fig. 10 into a continuous circuit, with concentrated battery, as represented in fig. 11, which is done by turning the switch 9 off from the anvil *r*, turning the switch 8 onto said anvil, turning the switch 7 onto the anvil *m*, on a wire connected with the wire E', as indicated by dotted lines, turning the switch 6 onto the anvil *i*, on the end of the wire C', bat., turning the switch 3 off from the anvil *h*, and turning the switch 2 onto said anvil, thus obtaining the arrangement of switch-board, shown in fig. 11, by which the adjacent poles, E' B' and F' C', of the battery-sections are connected, so as to make the battery one complete section, and the ends B E and C F of the loops are also connected, so as to form one loop, which is united, at its ends A and D, to the ends A' and D' of the complete battery.

In this arrangement of the battery and circuit it is evident that, while there may be a very strong current on the wire near the positive battery-pole D', the intensity of such current will be more or less diminished by imperfect insulations of the line, so that, if the line be of a very extended character, the intensity on the portion B A will be materially less than that on the portion D C, and an instrument adjusted to work in the portion D C would not work in the portion B A, nor would a battery-power, sufficient to operate the instruments on the portion D C, be sufficient to operate the instruments on the portion B A.

But, in the arrangement shown in fig. 10, the loop D C is of a moderate length, and, consequently, there is but little difference in the intensity of the current at its ends, and, if the battery-power of the section C' D' is sufficient to work the loop D C, it is all that is necessary, as the other portions, B A and E F, are worked by their own battery sections, E' F' and A' B'.

It will be evident to the electrician that the particular manner of combining the circuit-loops and the battery-sections may be somewhat varied, to suit circumstances, care being taken to have each loop connect the positive pole of one section with the negative pole of the other section, to which it is attached.

As either of the arrangements of the fire-alarm circuit, shown in figs. 10 or 11, are continuous circuits, embracing all the signal-boxes and fire-alarm instruments in the city, as specified in the first clause of my statement of invention, I will explain the working of such circuit in its complete form, before explaining the mode of locating breaks, and of electrically repairing and working the line when broken.

In place of dividing the city into fire-districts, for the purpose of assigning certain territory to the care of the different companies in the fire department, as has been the practice under previous systems of fire-alarm telegraphs, I effect the same result by assigning to each company or companies the care of fires or alarms occurring near certain signal-boxes, as, for example, in the city, represented in fig. 1, I would issue the following directions to the companies.

Engine No. 1 will attend fires at signal-boxes Nos. 2, 3, 6, and 18, and station 20.

Engine No. 8 will attend fires at signal-boxes Nos. 5, 6, 7, and 10.

Engine No. 13 will attend fires at signal-boxes Nos. 11, 12, and 16, and station 20.

Engine No. 17 will attend fires at signal-boxes Nos. 15, 16, and 18.

It will be observed that two engines have orders to attend fires at boxes 6, 16, and 18, and at station 20, as I have assumed that these boxes are located in the central part of the city, where property is very valuable and buildings are close together, so that a fire

should be brought immediately under control, if possible.

Suppose that a fire breaks out in the vicinity of box No. 15. The person seeing the fire will run to box No. 15, get the key at the place indicated on the box, open the door of the box and draw down the winding lever L, by means of the knob at its end, by which the weight O will be drawn up, when, on releasing the lever L, the circuit-wheel J will revolve from right to left, and the pins or notches on it will vibrate the key K, and thus open the circuit, in such a manner as to cause the blows |–| | | |—|–| | | |—|–| | | | to be struck on the sounder N, (which is brought into the circuit by the opening of the box-door,) or, if the circuit-wheel be constructed to give the alarm with the improved fire-alarm signal, shown in reissued Letters Patent No. 4,012, granted to Alexander Allen, June 7, 1870, the alarm will consist of these blows | | | | | | . –|–| | | |—| | | | | | | | | |–|–| | | |—| | | | | | | | |–|–| | | |, as is more fully set forth in the patent referred to.

But, as all the engine-houses and signal-boxes are in the same continuous circuit, it is seen that the alarm will be also struck at every fire-alarm instrument in the city, so that engine-houses 1, 13, 8, and 17, will all receive instant notice of the fire, and engine No. 17 will immediately run to box No. 15, while the other engines will put themselves in readiness to run out.

If the fire at box No. 15 should prove to be too large to be managed by engine No. 17, whose duty it was to attend such fire, the chief engineer, or other officer having charge of the fire department forces at the fire, will go to box 15 and call engine No. 13, by means of the key M, and order them to come to the fire, or to send a hose-carriage, or a wagon with fuel, or whatever may be needed, and in the same manner he can call on the other engines, Nos. 1 and 8, for any assistance, thus bringing the whole fire-department out to subdue the fire, if found necessary.

When the fire has been brought under control, the chief engineer can go to box 15 and inform the department that the fire is out, so that the teams on the engines which were put in readiness to start to the fire, on the giving of the first alarm, can be unhitched.

The various orders for the direction of the department are conveniently arranged in codes, in which a certain number is used to denote a particular order, as for example, |–| | |, or 13, may mean "come to fire with steamer and hose-carriage;" |–| | |, or 14, "come to fire with hose-carriage;" | |–|, or 21, "come to fire with ladders and men;" | |–| | | | |, or 26, "come to fire with wagon;" | | |–|, or 31, "come to fire with fuel;" | | |–| |, or 32, "fire is out, you may unhitch;" |–| |, or 22, "I understand, will come;" | |–| | | |, or 25, "horse sick, out of service;" and so on, for every order which is necessary, thus greatly facilitating the transmission of orders, and saving valuable time in managing the fire.

As occasion might occur for sending an order or asking a question which was not laid down in a system of codes, it is desirable to have an alphabet which can be readily used by the firemen, with a moderate amount of practice, and without the long study required to become an expert operator with the Morse alphabet, and for this purpose a numerical alphabet of the following form will be found desirable:

A is |–| |, or 13, that is, one blow followed by three blows; B is | | | |–| | |, or 44; C is | | | |–| |, or 42; D is | | |–| | |, or 33; E is |–| |, or 12; F is 43; G is 25; H, 32; I, 31; J, 36; K, 35; L, 15; M, 51; N, 14; O, 22; P, 52; Q, 26; R, 41; S, 23; T, 21; U, 24; V, 53; W, 16; X, 45; Y, 34; and Z is 46; in which alphabet the number of blows constituting a letter are arranged to correspond with the frequency of the use of such letter in practice, the letters most frequently used, E and T, having the least number of blows, and so on.

If the fire near box 15 should be noticed by a person near box 16, he could go to box 16, and, by means of the key M in said box, could give the alarm for box 15, thus avoiding any delay in giving notice of the fire to the fire department.

It is also seen that the fire-alarm circuit can be used by any of the fire-department officers away from the location of the fire, for inquiring of the officer at the box near the fire about the progress of the fire, as, upon opening any box in the whole circuit, the person opening the box is at once enabled to communicate with persons at any other open boxes, or at any of the fire-department offices.

In all these telegraphic manipulations on the fire-alarm circuit during the announcement, management, and closing of a fire, it is seen that the repair office, with the exception of the battery, forms no essential feature of the system, so that if the line was never broken, there would be no need of such office, and the circuit-ends A B E F C D could be attached directly to the battery-poles A′ F′ B′ C′ E′ D′, when any signal-box or fire-alarm instrument would be a suitable station from which to direct the operations of the fire department.

But as the circuit-wires are liable to be broken, either by accident or design, which would break the circuit, it is necessary to have some means of repairing the circuit, with the least possible delay, and I will now explain how such repairs are made by the telegraph superintendent at the repair office.

It will be noticed that the continuous fire-alarm circuit just described, is wholly a metallic circuit, of which the ground forms no part; and that it is worked as a closed circuit, so that the electro-magnets in the fire-department instruments keep the armature levers drawn up to them at all times, unless the circuit is broken, so that, if the firemen or superintendent see an armature lever standing drawn back from the magnets by the tension-spring, they know that the circuit has been broken.

The superintendent, on learning of the break, goes to the switch-board 27 at the repair office, station 20, and turns switches 2 and 3 onto the anvils *f* and *g* at the ends of a short wire, indicated by dotted lines.

Then he turns switch 6 onto anvil *k* at the end of wire connected to circuit-wire F, and switch 7 onto anvil *l* at the end of wire connected to circuit-wire B, and switch 8 onto the anvil *p* at the end of wire connected to battery-wire E′, and arranges the other switches as shown in fig. 12, by which he connects each separate loop with the poles of its battery-section, thus making the fire-alarm circuit into three distinct circuits, each with its own battery, as indicated by diagrams in fig. 12.

We will suppose the break to have been made between boxes 10 and 11 in the C D circuit.

The superintendent, having arranged the circuits A B, E F, and C D, as shown in fig. 12, tries the A B circuit by means of the key A B, and finds that the sounder on that circuit works correctly, showing that the A B circuit is unbroken.

He then tries the E F circuit by means of the key E F, and finds that circuit complete, showing that the break is on the C D circuit.

He can then unite the A B and E F circuits into a continuous circuit, with distributed battery, as shown in right-hand diagram in fig. 13, by turning switch 9 onto anvil *r*, turning switch 7 onto anvil *n* at end of wire connected with circuit-wire F, and turning switch 6 off from anvil *k*, as shown by switch-board in fig. 13, thus putting the A B and E F loops into service, or, if preferred, these loops might be united and worked with concentrated battery, as shown in fig. 14,

by an arrangement of switches, readily seen by any electrician, from an examination of that diagram, and the arrangement of switch-boards shown in figs. 11 and 12.

Now, to locate the break in circuit C D, he grounds the pole C′ of the battery-section C′ D′, by turning switch 5 onto the anvil *i*, and turns the switches 13 and 14 onto the anvils *v* and *x*, thus connecting the battery-section P′ P′ with the circuit P P, and putting the police circuit into service.

Then, by means of the key P P, he calls engine-house No. 13 on the police circuit, and on the police instrument at that engine-house, and directs the attendant to put on the left ground-wire on the fire-alarm instrument, which the attendant does by turning swith 26 onto anvil on wire marked L G W, (see fig. 5.)

He now tries the key C D, and finds he has a complete ground-circuit, having one end grounded at the battery-pole C′, and the other end at engine-house No. 13, showing that the loop C D is not broken between station 20 and engine-house No. 13.

He now directs engine-house No. 13 to take off ground-wire, and directs engine-house No. 8 to put on left ground-wire, using the police circuit for this purpose, as before.

He now tries the key C D, as before, and finds he has no circuit, showing that the break in the line is between engine-houses Nos. 8 and 13.

He can now direct engine-house No. 13 to put on left ground-wire, and engine-house No. 8 to take off left and put on right ground-wire, thus obtaining a ground-circuit embracing both the engine-houses Nos. 8 and 13, as shown in center diagram in fig. 13, as is readily seen, so that he has a circuit to all the engine-houses, and can repeat orders from the broken C D circuit to the continuous A B, E F circuit, and *vice versa*, as is readily seen; but a more complete repair of the continuous circuit will be presently shown.

The portion of the C D circuit between engine-houses Nos. 8 and 11 being of considerable length, and embracing several boxes, it is desirable to locate the break within shorter limits before leaving the repair office station 20; and for this purpose, the wire marked "ground-wire No. 1" is attached to the circuit C D at signal-box No. 11, which is near the center of this loop, and is brought across to the switch-board 27, as indicated by single dotted line, where it is marked G′, and is provided with the switch 15.

This wire is termed a "cross ground-wire," and a similar ground-wire, marked "ground-wire No. 2," is attached to the circuit A B at box No. 3, and is brought across to the switch-board, where it is marked G^2.

Now, if the superintendent, after putting on the left ground-wire at engine-house No. 8, and finding that the break was between engine-houses Nos. 8 and 13, should put on his "cross ground-wire No. 1," by turning switch 15 onto ground-wire *z*, he would obtain a complete ground-circuit, having one end grounded at the battery-pole C′, and extending through station 13, 12, and 11, over cross ground-wire No. 1 to switch-board, where it is grounded at *z*, showing that break is between box No. 11 and engine-house No. 8.

The line is now put in electrical repair by connecting the circuits A B, E F, and C D, with the battery-sections A′ B′, E′ F′, and C′ D′, as described in figs. 9 and 10, putting on the right ground-wire at engine-house No. 8, and leaving on the "cross ground-wire No. 1," thus obtaining a continuous ground-circuit, distributed battery, as shown in fig. 15, and leaving but one signal-box out of the circuit.

If the superintendent wishes to find between which two boxes or stations the break is located, so as to repair the broken wire, or to electrically repair the circuit without repairing the wire, which it may be desirable to do in the night, when the wire cannot be seen, and when it is desirable to have every box in service, he can arrange his circuits as shown in fig. 13, and then direct engine-house No. 8 to take off ground-wire.

Then, leaving an attendant to repeat orders from one circuit to the other, he goes to the first box, No. 10, on the other side of engine-house No. 8, and puts on the right-hand ground-wire (supposing him to be facing the circuit C D) by means of the switch 19, (see fig. 2.)

Then he tries the circuit by means of the key M, and finds he has a circuit toward engine-house No. 8, showing that the break is between stations 10 and 11, as he had located it between stations 8 and 11 before leaving the repair office.

Leaving the right ground-wire on box No. 10, he goes to box No. 11, and puts on the left ground-wire (unless the cross ground-wire No. 1 is on the left-hand side of the box mechanism, in which case he would ground by that wire at the repair office,) then returns to the repair office and connects the circuit and battery-sections, as shown in figs. 15, thus obtaining a continuous circuit, with distributed battery, embracing all the signal-boxes and fire-alarm instruments in the city.

From this description it is seen that the object of using a right and left hand ground-wire on each instrument is to keep the instrument in the circuit at all times; and it is evident that, where there are both fire-alarm and police instruments in the same office, one ground-wire would answer for each instrument; but it is desirable to have the two ground-wires whenever it is convenient.

It is also seen that the "cross ground-wire No. 1" might be brought to engine-house No. 13, instead of to the repair office, station 20, in which case it would be grounded by the attendant at the engine-house, under the direction of the superintendent.

If we suppose the break in the circuit to be in the mechanism of box No. 10, the superintendent would not have had a circuit by putting on the right ground-wire, as was before explained in locating the breaks between boxes 10 and 11.

Should he find this to be the case, he could try the left ground-wire by bringing the switch 26 up to the anvil on said wire, and noticing whether any spark passes from one to the other, or he could put on the left ground-wire and walk back to engine-house No. 8 and try the circuit.

In either case, if he found he had a circuit, he would know that the break was between the switches 20 and 19 in box No. 10, showing that the circuit through the box was broken and needed attention.

Suppose, for a second example, that the line is broken between stations 11 and 12 and stations 2 and 3. The superintendent switches the circuit into three loops, as shown in figs. 12, and, by means of the keys A B, E F, and C D, tries the three circuits, and finds that the E F circuit is complete, and that the A B and C D circuits are broken.

Leaving the E F circuit as a separate metallic loop, he grounds the battery-pole C′, and, by means of the P P circuit, he orders engine-house No. 13 to put on left ground-wire, by which he gets a ground circuit, showing that there is no break between stations 20 and 13.

Then he orders No 13 to take off ground-wire, and puts on the "cross ground-wire No. 1," and tries the key C D, but gets no circuit, showing that the break on the C D circuit is between stations 11 and 13.

He now orders engine-house No. 13 to put on left ground-wire, unites the battery-poles C′ F′, unites the circuit ends C and F, and unites the circuit end E to

battery-pole E', thus uniting the E F and C D circuits and putting them in service, as shown in center figure in figs. 16.

To find the break in the A B circuit, he grounds the battery-pole A', and orders engine-house No. 1 to put on left ground-wire, by which he gets a ground circuit.

He then orders No. 1 to take off ground wire, and puts on his "cross ground-wire No. 2," but gets no circuit, showing that the break is between stations 1 and 3.

He now orders engine-house No. 1 to put on left-ground wire, and connects the battery-pole A' to the circuit end A, thus obtaining the ground circuit, shown in right-hand figure, in fig. 16, by which he completes the fire-alarm circuit in two ground loops, on which orders may be repeated from one to the other, as before explained.

In this description I have assumed that the fire-alarm instruments are all in the main circuit, and are worked directly by the main battery, without the aid of a local circuit battery and relay.

If it were found desirable to indicate the occurrence of a break in the circuit by a blow on the fire-alarm gongs instead of indicating such break simply by the position of the armature lever, as was before explained, I place a relay in the main circuit and arrange the sounder on a local circuit with local battery, and arrange the relay so as to close the local circuit on the back stroke, from which it is evident that the local circuit will be closed by the breaking of the main circuit, thus causing a blow to be struck on the local sounder, by which the attention of the attendant is called to the break in the main circuit.

Where a city is very large, or is very elongated in form, or is scattered over a large extent of territory, so that the engines in one portion of the city would seldom, if ever, attend fires occurring in another portion, it may be desirable to introduce a separate system of fire-alarm telegraphs into each portion of the city; but as each system would be substantially like that herein described, no further description seems to be required.

The police circuit P P, which was not described as being in service until the occurrence of a break, is really kept in service at all times, and serves as the ordinary talking circuit, the fire-alarm circuit being ordinarily used only in case of fire.

Should a break occur in the P P circuit, it can readily be located and electrically repaired by the aid of the fire-alarm circuit, in a manner readily seen from the foregoing description of the mode of locating and repairing breaks in the fire-alarm circuit.

The peculiar advantages of my improved system of fire-alarm telegraphs over previous systems, and the difference between it and previous systems will be best seen by applying those systems to the city, as shown in fig. 1, and examining their operations.

Descriptions of the old systems of fire-alarm telegraphs are found in Letters Patent No. 17,355, dated May 19, 1857, granted to W. F. Channing, as assignee of Channing and Farmer, (a more complete description of which is found in Silliman's Journal, 2d series, vol. 13, in an article entitled "On the municipal electric telegraph, especially in its application to fire-alarms,") and in Letters Patent No. 23,060, dated February 22, 1859, granted to W. F. Channing, assignee of M. G. Farmer.

The first-mentioned system is known as "The American Fire-Alarm Telegragh," and may be termed the city system, and its essential circuit features are—

First, the signal circuits, which consist of several loops, running out from the central office, and each embracing certain of the signal boxes in the city.

Second, the alarm circuits, which consist of one or more loops running out from the central office, and embracing certain bell-towers or other buildings, containing large bells, which are struck by machinery in the manner described in Letters Patent No. 8,920, dated May 4, 1852, granted to Moses G. Farmer, or embracing other suitable mechanism for sounding a public alarm.

The other essential feature of this system is, the central office, at which all the signal-circuits and alarm-circuits terminate, and where all communications are received from the signal-circuits by an operator, and transmitted over the alarm-circuits.

Figure 17 represents an application of this city system to the city, shown in fig. 1, in which we have the city divided into four districts, and the signal-boxes arranged in three loops or "signal-circuits," and the bell towers arranged on one alarm-circuit.

Suppose now that a fire breaks out at box No. 5. The person discovering the fire goes to box No. 5 and turns in the alarm, as in my system, but this alarm is transmitted, not to the engine-houses, but to the central office, as the engine-houses are not on the signal-circuit, with the box No. 5, nor are they described as being on any circuit.

The operator at the central office gets the alarm signal from box No. 5, and thus becomes aware of a fire in District No. 2, but the firemen at engine-house No. 8, whose duty it is to attend this fire, have not yet heard of it.

Central office operator then puts a battery on the alarm-circuit, which is without a battery, except when an alarm is to be sounded, and, by means of a key or other mechanism, strikes on the bells in the towers of the alarm-circuit the number of the district in which the alarm of fire is given, which, in this case, is No. 2, and not the number of the box giving the alarm of fire.

By this means the firemen learn that there is a fire in District No. 2, and start out to find it.

To give them the location of the fire, the central-office operator, after giving the district number on the alarm-circuit turns to the signal-circuits, and repeats on them the number of the box giving the alarm, and as the magnets in the signal-boxes in this city system are left in the circuit at all times, if the firemen will run to the nearest box, they will hear the number of the box giving the alarm, and can thus learn where to go to the fire.

The second-mentioned system is termed the "town system," as it is designed for smaller cities or towns, and dispenses with a central office.

It consists of one circuit, embracing the several signal-boxes in the city, and also the several bell-towers, or other public alarm sounding mechanisms, and its application to the city, shown in fig. 1, is fully shown in fig. 18.

If an alarm of fire be turned in at box No. 5 on this system, the bells on the bell-towers will at once strike |–|, or 2, the number of the district, or | | | | |, or 5, the number of the box, depending on the arrangement of the circuit-wheel in the signal-box.

It is almost needless to say that neither of these systems present any such facilities for managing the fire department, or for locating breaks, or for electrically repairing the circuit, or for an economical use of the battery-power, as are found in my improved system, as it will be evident to any electrician, from an examination of figs. 17 and 18, that nearly all of the manipulations shown on my system could not be performed on either of these systems.

I lay no claim to a signal-box or battery, or switch-board, key-board, or circuit, taken separately, as the first of these features is simply an ordinary telegraph apparatus placed in a box out of doors, it may be, instead of being placed in an office, which is simply

a change in location with no invention, while all of the features are well known to every electrician.

Claims.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The continuous fire-alarm telegraph-circuit herein described, the same consisting of a continuous metallic circuit, or a continuous ground and metallic circuit, provided with suitable battery-power, and embracing all the signal-boxes at various points in the city, or a large portion thereof, and electro-magnetic sounders at each of the fire-department offices, so that an alarm given at any signal-box will be at once announced to every fire-department office without giving a public alarm, substantially as specified.

2. The arrangement of a continuous fire-alarm circuit, embracing all the signal-boxes and fire-department instruments, in two or more loops, and the combination of the said loops with the sections of the circuit-battery, so as to distribute the battery into the circuit, substantially as is herein specified.

3. The combination of a continuous fire-alarm circuit, embracing all the signal-boxes and fire-department instruments, and arranged in two or more loops; a circuit-battery, divided into two or more sections, and a switch-board provided with suitable switches, and so combined with the circuit and battery as that said circuit can be worked as a continuous metallic circuit, with distributed battery, or as a continuous ground and metallic circuit with distributed battery, or as two or more ground loops or metallic loops, each with its own battery-section, substantially as is herein specified.

4. The combination with a fire-alarm circuit, embracing all the signal-boxes and fire-alarm instruments, of a talking or police-circuit, working independent of the fire-alarm circuit, but having an electro-magnetic sounder at each of the fire-department offices in the fire-alarm circuit, substantially as and for the purpose specified.

5. The combination with the telegraph instruments in those fire-department offices, having an instrument on both the fire-alarm and police-circuits of one or two ground-wires with accompanying switches, the several parts being arranged substantially as and for the purpose specified.

6. The combination with a fire-alarm signal-box, of two ground-switches, located on the main fire-alarm circuit, one at each side of the operating mechanism, and arranged to connect with suitable ground-wire or wires, substantially as is herein specified.

7. The combination of a cross ground-wire with the loop of a fire-alarm circuit, substantially as and for the purpose specified.

8. A continuous fire-alarm circuit, provided with suitable battery, and embracing all the signal-boxes and fire-department instruments, said signal-boxes being provided with such operating mechanism as that the closing of the signal-box door, switches the electro-magnets out of the main circuit, thus obtaining a combined working and reserve circuit, substantially as specified.

As evidence of the foregoing, I have hereunto set my hand, this 11th day of June, A. D. 1870.

SYLVANUS D. CUSHMAN.

Witnesses:

IRA A. CHASE,

JOB ABBOTT.