No. 839,774. PATENTED DEC. 25, 1906.

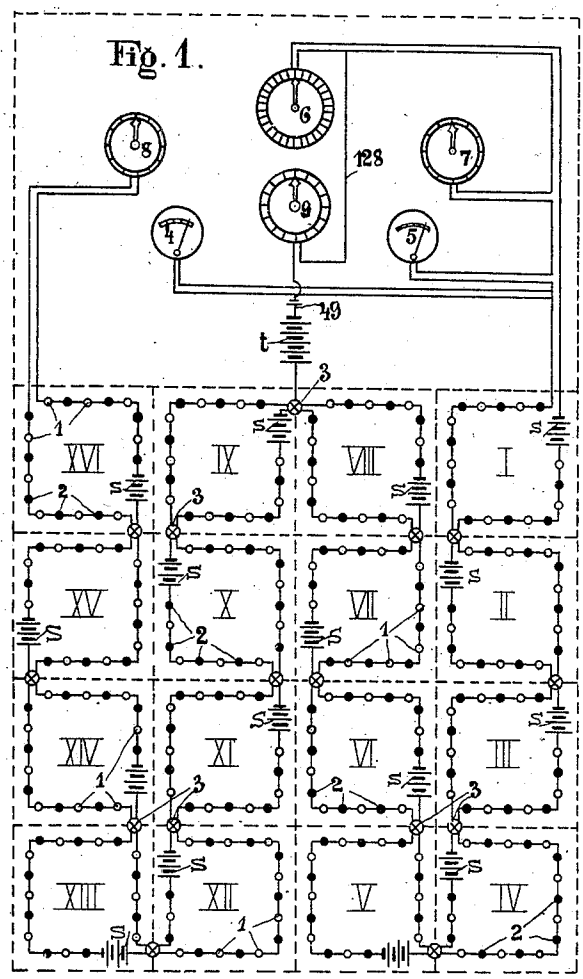
G. LENTSCHAT.

STREET LAMP LIGHTING AND EXTINGUISHING SYSTEM.

APPLICATION FILED OCT. 20, 1906.

8 SHEETS—SHEET 1.

Fig. 1.



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8 SHEETS—SHEET 2.

Fig. 2.

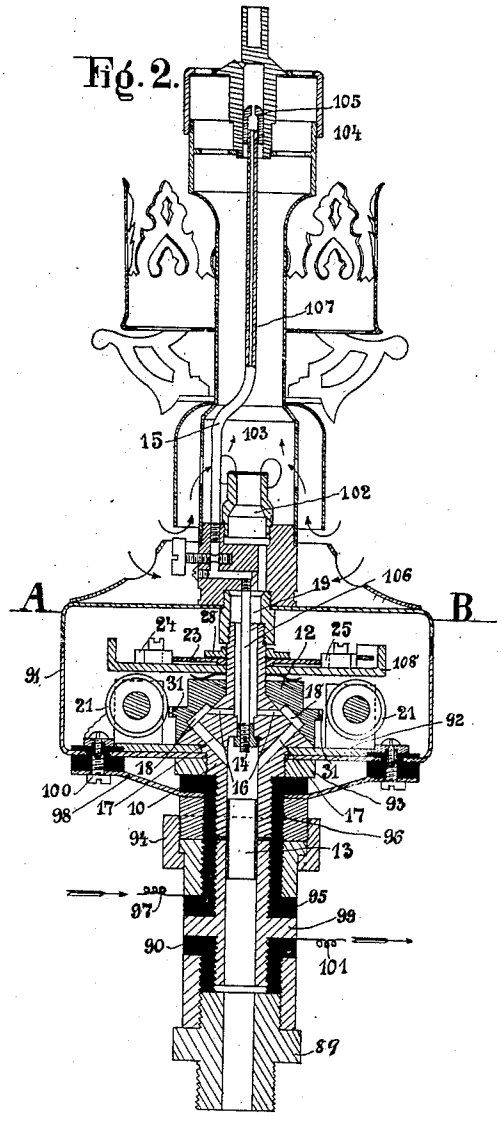

Fig. 3.

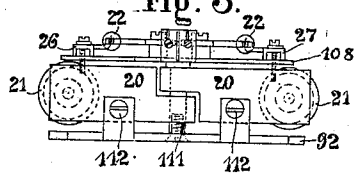

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Fig. 4.

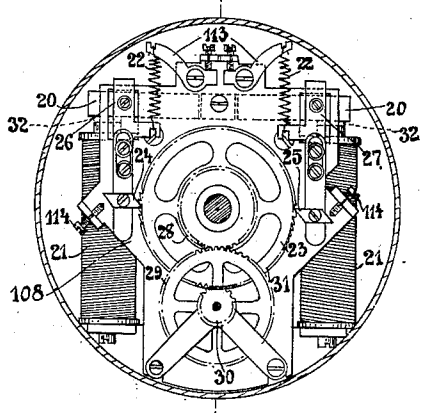


Fig. 6.

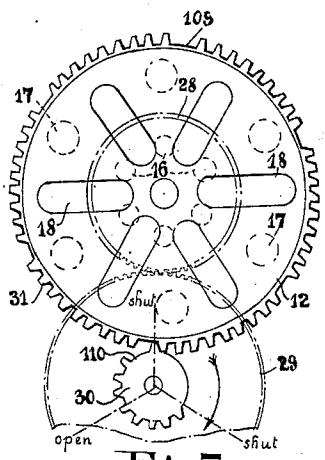


Fig. 5.

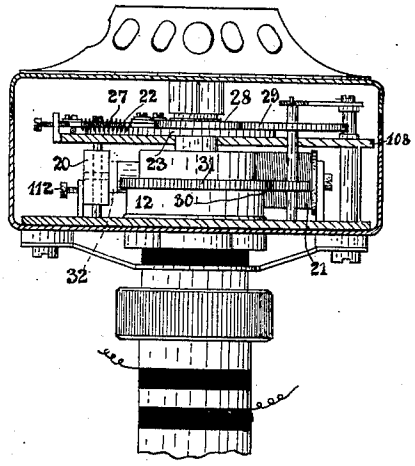
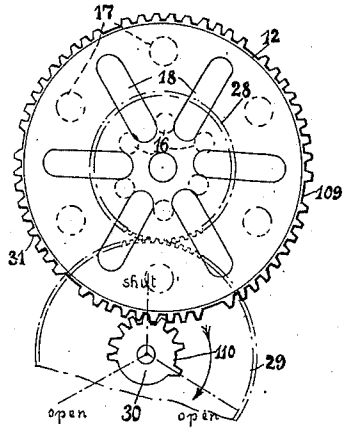


Fig. 7.



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8 SHEETS—SHEET 4.

Fig. 8.

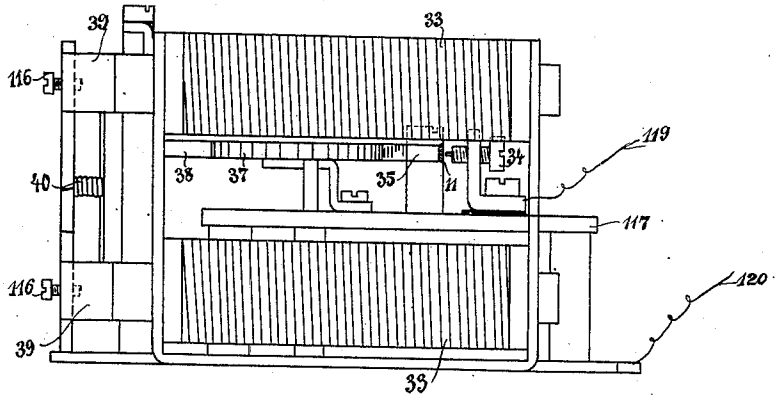
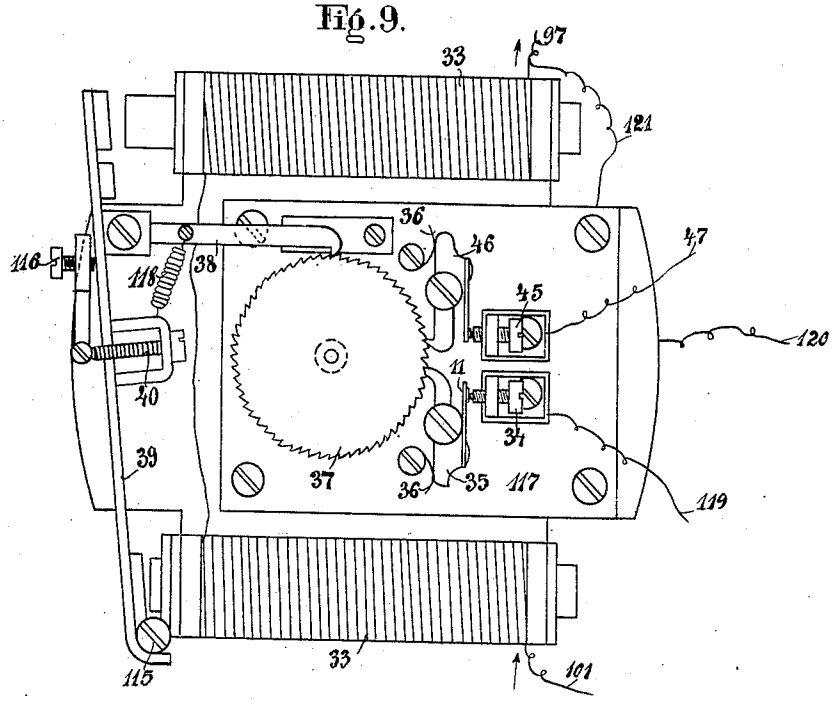


Fig. 9.



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8 SHEETS—SHEET 5.

Fig. 11.

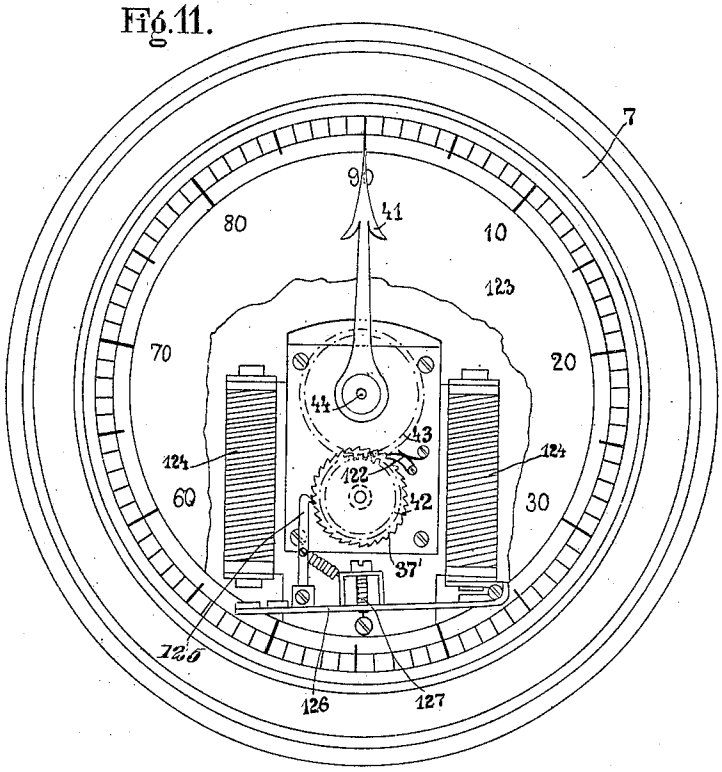

Fig. 10.

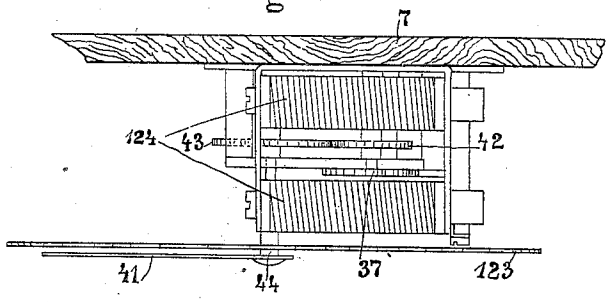

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Fig. 13.

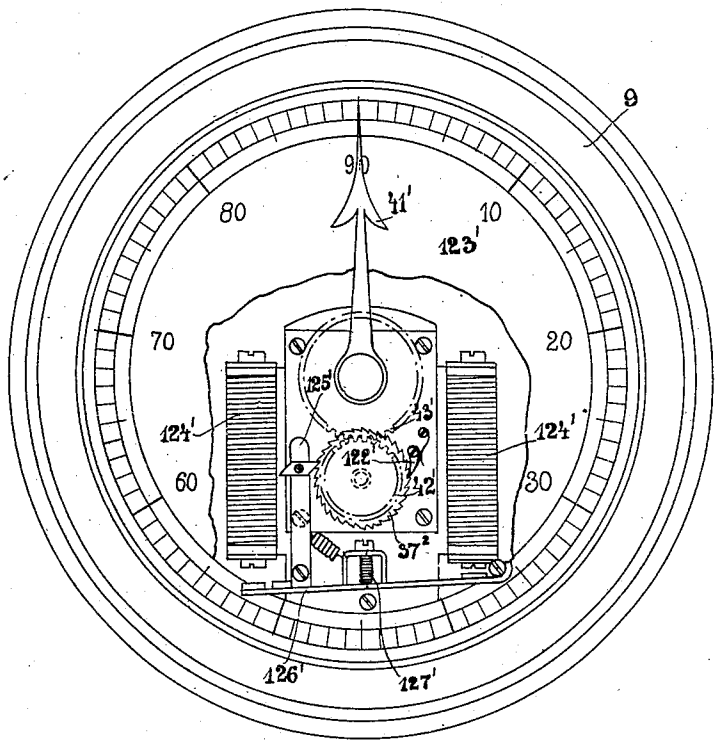
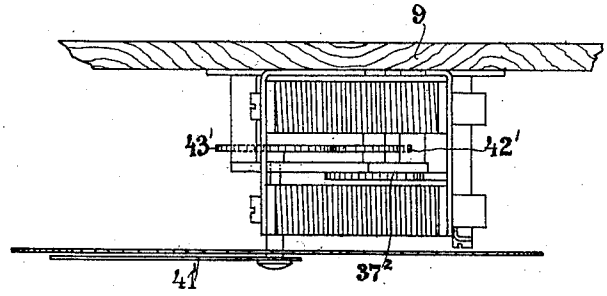


Fig. 12.



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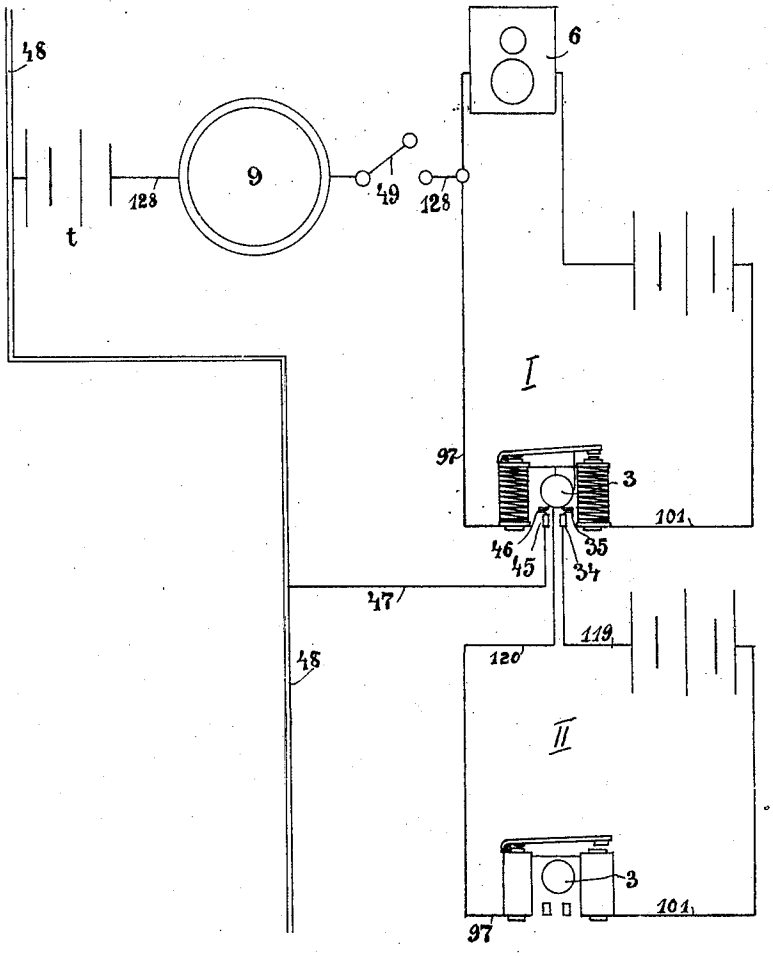
8 SHEETS—SHEET 7.

Fig. 14.



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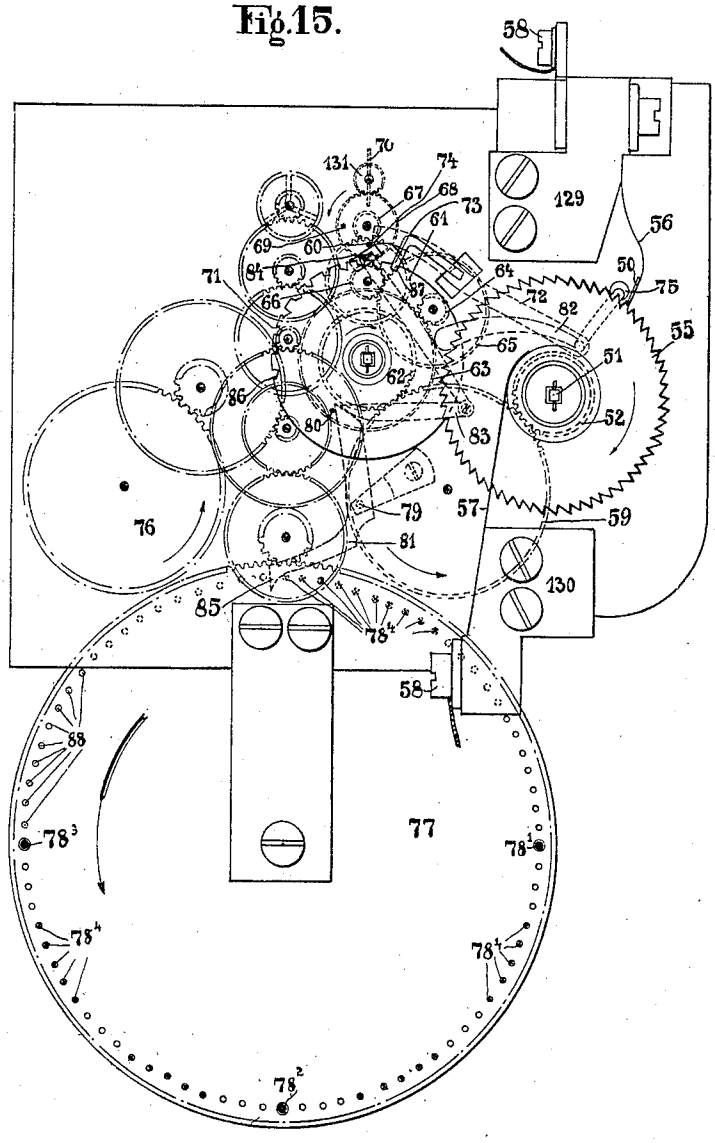
8 SHEETS—SHEET 8.

Fig. 15.



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UNITED STATES PATENT OFFICE.

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STREET-LAMP LIGHTING AND EXTINGUISHING SYSTEM.

No. 839,774. Specification of Letters Patent. Patented Dec. 25, 1906.

Application filed October 20, 1906. Serial No. 339,744.

To all whom it may concern:

Be it known that I, GEORG LENTSCHAT, a citizen of the Empire of Germany, residing at Hohenschönhausen, near Berlin, in the Empire of Germany, have invented a new and useful Street-Lamp Lighting and Extinguishing System, of which the following is a specification.

In my United States Patent No. 831,013, dated September 11, 1906, I have shown and described a gas-burner with an automatic lighter and extinguisher, which burner is specially suitable for a street-lamp or other gas-lamp and can be electrically lighted and extinguished over distance.

My invention relates to a system adapted to control the street-lamps of a town or other gas-lamps of a plant from a central station, the said street-lamps or other gas-lamps being preferably provided with automatic lighters and extinguishers according to my said invention mentioned above. Such gas-lamps are provided with pilot-burners and may be arranged to burn either up to midnight or for the whole night, so that for the following description they may be called "evening-lamps" and "night-lamps," respectively.

The system according to my invention comprises a plurality of circuits corresponding, say, to the plurality of the blocks of a town or to the plurality of sections of a plant, and the automatic lighters and extinguishers of the several street or other gas lamps are inserted in the said circuits, in each of which circuits they are connected in series. The several circuits are in turn connected one with another in series by means of suitable relays, so that the first circuit and the last circuit extend into the central station. The system is so arranged that on closing for a moment the first circuit from the central station by means of a specially-constructed clockwork or by hand the several circuits will be consecutively closed for a moment, so that all the automatic lighters and extinguishers will be operated. At the central station I provide two controlling apparatuses, which are inserted in the first and last circuits, respectively, so that after the several circuits have been consecutively closed for a moment the controlling devices will show any defect that may be somewhere in the system. I further provide at the central station a detecting apparatus by means of which the place of the said defect can be readily ascertained at the central station, so that the defect may be remedied quickly.

I will now proceed to describe my invention with reference to the accompanying drawings, in which—

Figure 1 is a diagram of the system, which is assumed to comprise, for example, sixteen circuits. Fig. 2 is a vertical section through a gas-burner and an automatic lighter and extinguisher. Fig. 3 is a front view of the mechanism contained in the casing of the automatic lighter and extinguisher. Fig. 4 is a horizontal section through the line A B in Fig. 2. Fig. 5 is an elevation of the automatic lighter and extinguisher, the casing and the frame-plates being shown in section. Fig. 6 is a view, on an enlarged scale, of the parts 12 30 in Fig. 5 seen from below, these parts being arranged for an evening-lamp. Fig. 7 is a similar view, the parts 12 and 30 being arranged for a night-lamp. Fig. 8 is an elevation of a relay adapted to connect any two of the circuits. Fig. 9 is a plan of the same. Fig. 10 is a vertical cross-section through a controlling apparatus. Fig. 11 is an elevation of the same. Fig. 12 is a vertical cross-section through a detecting apparatus. Fig. 13 is an elevation of the same. Fig. 14 is a diagram to show the manner in which the detecting apparatus shown in Figs. 12 and 13 is connected with the first circuit, and Fig. 15 is an elevation of a clockwork adapted to momentarily close the first circuit.

Similar characters of reference refer to similar parts throughout the several views.

Fig. 1 shows diagrammatically a system which is assumed to comprise, for example, sixteen sections I to XVI, that are indicated by dotted lines. The several sections may correspond to as many blocks of a town, which are each provided with a plurality of street-lamps, partly evening-lamps and partly night-lamps. The evening-lamps may be indicated by the white circles 1 1 and the night-lamps by the black circles 2 2. The automatic lighters and extinguishers of the several street or other gas lamps in each section are connected in series to form a circuit, in which a source of current *s* is in-

serted. The circuit of the first section I extends into the central station, which in Fig. 1 is indicated by the upper large rectangle in dotted lines. This first circuit includes a voltmeter 4, an amperemeter 5, a clockwork 6, and a controlling apparatus 7, all these apparatuses being disposed at the central station and being connected in series. The circuits in the several sections I to XVI are connected one with another by means of relays 3 3, the construction of which will be described later on. The last circuit extends from the section XVI into the central station and includes there a controlling apparatus 8 similar to that, 7, in the first circuit. The several relays 3 3 are in a manner to be described later on electrically connected with the gas-pipe system, which may be assumed to be indicated by the dotted lines. At the central station a detecting apparatus 9 is disposed, which is adapted to ascertain the place of any defect in the system. This apparatus 9 is shunted, on the one hand, to the first circuit and, on the other hand, to the gas-pipe system in a manner to be explained later on, and a source of current *t* is inserted in this shunt, as is clearly shown. Each time when the clockwork 6 closes for a moment the first circuit the first relay 3 is to be thereby energized for closing for a moment the second circuit in the section II. Thereby the second relay 3 is to be energized for closing for a moment the third circuit in the section III. The third relay 3 in turn will be thereby energized to close for a moment the fourth circuit in the section IV. In this manner the several circuits, from the first circuit to the last circuit, will be consecutively closed for a moment, so that the two controlling apparatuses 7 and 8 at the central station will be actuated and will show the state in the system.

Figs. 2 to 7 illustrate in several views a gas-burner with an automatic lighter and extinguisher which may be employed for each of the several street-lamps or other gas-lamps in the system. The construction is essentially the same as that described in my said application. The bottom piece 89 to be screwed into the gas-supply tube in the lamp-post or other support is in any known manner connected with a distributing-body 10 and is therefrom insulated by means of an annular screw-threaded piece 90 of insulating material. The distributing-body 10 is located mostly within the casing 91 and is fastened on a metallic base-plate 92 and the bottom of the metallic casing 91 by means of a nut 93. The tubular part of the body 10 beneath the casing 91 is surrounded with a metallic connection 94 and is therefrom insulated in any suitable manner—for example, by means of the two annular screw-threaded pieces 95 and 96, shown of insulating material. The connection 94 is shown as made in three parts, screwed one with another and arranged to clamp a line 97 below and a two-armed metallic support 98 above. Two electromagnets 21 21 are disposed on the metallic base-plate 92 within the casing 91, and their coils are connected in series. The free coil end of the left electromagnet 21 in Fig. 2 is electrically connected with the line 97 by means of the connection 94, the one arm of the support 98, and a suitable screw 100, which latter is insulated from the casing 91 in a manner clearly shown. The free coil end of the right electromagnet 21 in Fig. 2 is electrically connected with the distributing-body 10 by means of the metallic base-plate 92. A tubular screw-threaded piece 99 is electrically connected with the distributing-body 10 by means of a short tube 13 and is adapted to clamp with its collar a line 101 on the insulating annular piece 90. It will be seen that for energizing the two electromagnets 21 21 a current requires to be passed—say in the direction of the arrows—through the line 97, the parts 94, 98, and 100, the magnet-coils, the base-plate 92, the distributing-body 10, the parts 13 and 99, and the line 101. The distributing-body 10 is made conical in its middle and tubular above. In its conical part the distributing-body 10 is provided with six inclined channels 17 17 and six horizontal channnels 16 16, these channels being placed in the same radial planes, as is indicated by the dotted circles in Figs. 6 and 7. A distributer 12 is mounted to turn on the conical part of the distributing-body 10 and is provided with six recesses 18 18, (see Figs. 6 and 7,) which can register at a time with the inclined channels 17 17 and the horizontal channels 16 16. In this case the gas will be permitted to pass from the supply-gas tube upward through the connection 89, the tubular piece 99, the tube 13, the six inclined channels 17 17, the recesses 18 18, the horizontal channels 16 16, the upper central bore of the distributing-body 10, the two tubular connections 19 and 102 to the mixing-chamber 103, where it mixes with the air admitted through suitable holes in the direction of the arrows. The mixture of gas and air passes upward through the burner 104 and is burned above the latter in the known manner. A pilot-burner 105 is provided, which is constantly supplied with gas from the supply-gas tube through a central small tube 106, suitable channels in the connection 102, and a small upper tube 107. The construction of the burner itself and the manner of connecting it with the distributing-body 10 may be varied. A horizontal frame-plate 108 is secured above the base-plate 92 by means of suitable pillars and screws. An elastic disk with three or four radial arms is inserted between the frame-plate 108 and the distributer 12 and serves for pressing the latter on the distributing-body 10 to tighten the joint.

The distributer 12 is made in one piece with a gear-wheel 31 with sixty teeth, of which, however, six are cut off, (see Figs. 6 and 7,) so that six large spaces 109 109 are formed. This gear-wheel 31 meshes with a pinion 30 with fifteen teeth, of which, however, five consecutive and separate teeth are cut off, so that this pinion 30 has actually only nine teeth on two-thirds of its periphery and presents a large space 110. Fastened on the shaft of the pinion 30 is a gear-wheel 29, which meshes with another gear-wheel 28. The latter is rigidly connected with a ratchet-wheel 23, which is mounted to turn on the tubular part of the distributing-body 10. The two armatures 20 20 of the electromagnets 21 21 are mounted on a common stud 111 to rock in opposite directions. Their turns are limited by two adjusting-screws 112 112. Two slotted rods 26 and 27 are guided on the frame-plate 108 by means of suitable screws engaging in their slots. The two armatures 20 20 are pivotally connected with the two rods 26 and 27, respectively, by means of suitable screws passing through slots in the frame-plate 108. The two rods 26 and 27 are provided with arms, which are connected by helical springs 22 22 with the longer arms of two bell-crank levers 113 113, the shorter arms of which bear against two adjusting-screws, as is clearly shown in Fig. 4. The two helical springs 22 22 serve for detaching the two armatures 20 20 from their electromagnets 21 21 and for normally pressing them on the two adjusting-screws 112 112. The two rods 26 and 27 are provided with turnable pawls 24 and 25, respectively, which engage in the ratchet-wheel 23 and may be limited in their turns by adjusting-screws 114 114. It will be seen that on the two electromagnets 21 21 being energized they will simultaneously attract their armatures 20 20, so that the left armature 20 in Fig. 4 will by its rod 26 and pawl 24 feed the ratchet-wheel 23 through the distance of half a tooth-pitch, while the pawl 25, controlled by the right armature 20, will simply ride over the back of a tooth. On the two electromagnets 21 21 becoming without current the two helical springs 22 22 will return the two armatures 20 20 to their initial positions, so that during this motion the right helical spring 22 will by the pawl 25 feed the ratchet-wheel 23 through the distance of half a tooth-pitch, while the left pawl 24 will merely ride over the back of a tooth. Thus the ratchet-wheel 23 will be fed through one tooth-pitch in all each time when the two electromagnets 21 21 have been energized.

Of course where so preferred the mechanism described may be so modified that the ratchet-wheel 23 may be fed through the distance of one tooth-pitch during either the attraction or the return of the two armatures 20 20. In the former case it is only necessary to insert a filling-piece 32 between the right electromagnet 21 in Fig. 4 and its armature 20 to prevent the latter from moving and to so adjust the adjusting-screw 112 for the left armature 20 as to increase its turn, so that the pawl 24 may feed the ratchet-wheel 23 through the distance of one tooth-pitch. In the latter case—*i. e.*, to effect the feeding of the ratchet-wheel 23 during the return of either armature 20—it is necessary to insert the filling-piece between the left electromagnet 21 in Fig. 4 and its armature 20 and to double the turn of the right armature 20 by means of its adjusting-screw 112, or the construction of the mechanism may be modified in any suitable manner for attaining the same results.

The ratio of the ratchet-wheel 23, the two gear-wheels 28 and 29, and the pinion 30 is made such that thirty closings of the respective circuit—in other words, the feed of the ratchet-wheel 23 through the distance of thirty tooth-pitches—are required for turning the pinion 30 through an angle of one hundred and twenty degrees. From an examination of Figs. 6 and 7 it will be clear that the distributer 12 will at the same time be turned through one-twelfth of its periphery, or through thirty degrees, provided that the teeth of the pinion 30 engage in those of the gear-wheel 31. It will also be seen that the turn of the distributer 12 through an angle of thirty degrees will suffice for establishing the communication between the gas-supply tube and the burner 104 or for interrupting this communication. Further, it will be obvious that sixty closings of the circuit are required for turning the pinion 30 through an angle of two hundred and forty degrees and for turning the distributer 12 through one-sixth of its periphery—that is, through sixty degrees—provided that the pinion 30 meshes with the gear-wheel 31. The said sixty closings of the circuit will therefore suffice for opening and for closing the communication between the gas-supply tube and the burner 104 in the case of Fig. 6 or for closing and for opening the said communication in the case of Fig. 7. If the pinion 30 does not mesh with the gear-wheel 31, it can be turned through an angle of one hundred and twenty degrees by means of thirty closings of the circuit without moving the distributer 12 at all, so that the latter will remain shut in the case of Fig. 6 and open in the case of Fig. 7. The two positions of the pinion 30 with regard to the distributer 12 (shown in Figs. 6 and 7) are different, in that in Fig. 6 the pinion 30 commences to mesh with the gear-wheel 31 on being turned in the direction of the arrow for opening the distributer 12, while in Fig. 7 the pinion 30 has already been turned through one hundred and twenty degrees before it commences to move the distributer 12 for opening it. Of course owing to the construction of the mech-

anism described the distributer 12 will always be opened and closed gradually and consecutively. I have marked in Figs. 6 and 7 the three principal positions of the pinion 30 by dotted radial lines and the words "Shut" and "Open" to illustrate the effects in both cases. The pinion 30 is to make one complete revolution during a day of twenty-four hours and requires in all ninety closings of the circuit. An examination of Figs. 6 and 7 will show that the effects of the different relative positions of the pinion 30 and the gear-wheel 31 will be different. When assuming their relative position to be that shown in Fig. 6 and the direction of the revolution of the pinion 30 to be that of the arrow, it will be evident that during the first thirty closings of the circuit the distributer 12 will be gradually opened, that during the following thirty closings of the circuit the distributer 12 will be gradually closed, and that during the last thirty closings of the circuit the distributer 12 will remain shut. On the contrary, when assuming the relative positions of the pinion 30 and the gear-wheel 31 to be that shown at Fig. 7, it will be evident that during the first thirty closings of the circuit the distributer 12 will be gradually opened, that during the following thirty closings of the circuit the distributer 12 will remain open, and that during the last thirty closings of the circuit the distributer 12 will be gradually closed. It will now be obvious that the relative position of the parts shown at Fig. 6 is suitable for the so-called "evening-lamps" and that the relative position of the parts shown at Fig. 7 is suitable for the so-called "night-lamps." Both the evening-lamps and the night-lamps in every circuit will therefore require the same number (viz., ninety) of closings of the circuit during twenty-four hours. The clockwork at the central station can be adapted in a manner to be described later on to close the first circuit at varying moments, so that it is easy to so operate the system that the evening-lamps burn from, say, six o'clock p. m. to midnight and the night-lamps burn from, say, six o'clock p. m. through the whole night till six o'clock a. m. At the latter moment the parts 30 and 31 of all street or other gas lamps will resume their initial positions shown. The spaces 109 109 of the gear-wheel 31 and the space 110 of the pinion 30 serve for facilitating the meshing together of the parts 31 and 30 should they have got a little displaced meanwhile by shocks or vibrations.

The construction of the relays 3 3 in the system illustrated in Fig. 1 is shown at Figs. 8 and 9 Each relay 3 may comprise two pairs of electromagnets 33 33, the coils of which are connected in series. The two armatures 39 39 are in any known manner mounted to rock at 115 and are normally detached from the electromagnets 33 33 and are pressed on adjusting-screws 116 116 by a helical spring 40. A ratchet-wheel 37 is mounted to turn with its shaft in a suitable frame 117 and works with two pawls 35 and 46, which are electrically connected with the frame 117 and are pressed by springs 36 36. A third pawl 38 is hinged to the two armatures 39 39 and is pressed on the ratchet-wheel 37 by a helical spring 118. The two pawls 35 and 46 are provided with contact-springs 11 11, which are adapted to come for a moment in contact with adjustable screws 34 and 35, respectively, each time when the ratchet-wheel 37 is fed through the distance of one tooth-pitch by the movable pawl 38, while causing the two pawls 35 and 46 to rock. The two adjustable screws 34 and 46 are mounted in angle-pieces, which are both insulated from the frame 117, and are connected with lines 119 and 47, respectively. The frame 117 is electrically connected, on the one hand, with a line 120 and, on the other hand, by a line 121 with that coil end through which the current leaves the coils of the electromagnets 33 33. It will be seen that on the electromagnets 33 33 being energized they will attract their armatures 39 39, and thereby cause the movable pawl 38 to ride over the back of the respective tooth of the ratchet-wheel. The moment the electromagnets 33 33 become without current the helical spring 40 will return the armatures 39 39 to their initial position and will cause the pawl 38 to feed the ratchet-wheel 37 through the distance of one tooth-pitch. Thereby, of course, the two pawls 35 and 46 will be rocked, so that their contact-springs 11 11 will for a moment come in contact with the adjustable screws 34 and 45 for purposes to be hereinafter described. It is to be noted that the two pawls 35 and 46 can be rocked only after the circuit of the electromagnets 33 33 has been reopened. The construction of this relay may be varied at pleasure, the only point being that the effects described be attained. In the first circuit in section I, Fig. 1, the coil end 101 is to be connected either with the line 101 of an automatic lighter and extinguisher according to Fig. 2 or with the source of current *s*, which may be a battery. The other coil end 97 is to be connected either with the line 97 in Fig. 2 or with the source of current *s*, as the case may be. In each following circuit in section II or III, and so on, this circuit is to be connected, on the one hand, with the line 119 and, on the other hand, with the line 120 of the relay in the preceding circuit, as is shown at Fig. 14.

The construction of either of the two controlling apparatuses 7 and 8 at the central station is shown at Figs. 10 and 11. It is essentially the same as that of the relay 3 just described, only that a single spring-pressed pawl 122 is employed for holding the ratchet-

wheel 37′ and that the latter is rigidly connected with a gear-wheel 42, which meshes with a gear-wheel 43. The latter is fastened on a shaft 44, which is mounted to turn in the frame and carries an indicator 41 for the scale 123. The coils of the four electromagnets 124 124 are connected in series and are inserted in the first circuit for the controlling apparatus 7 and in the last circuit for the controlling apparatus 8, as is shown in Fig. 1. The movable pawl 125, hinged to the armature 126, is adapted to feed the ratchet-wheel 37′ through the distance of one tooth-pitch during the return of the armature 37′ under the action of the helical spring 127—that is to say, after the first or last circuit, respectively, has been reopened. The ratio of the two gear-wheels 42 and 43 is so made that the indicator 41 is moved through the distance of one division of the scale 123 by each closing of the circuit. As explained above, in all ninety closings of the current in each circuit are to be effected in twenty-four hours for operating the several automatic lighters and extinguishers in the whole system. In accordance with this the scale 123 of the controlling apparatus 7 or 8 is provided with ninety divisions, as is fully shown in Fig. 11. Then the indicator 41 will make a complete revolution in twenty-four hours. It will be obvious that, provided everything in the system is in order, the indicators 41 of the two controlling apparatuses are required to move simultaneously and uniformly. In other words, the indicator 41 of the controlling apparatus 8 in the last circuit must keep pace with the indicator 41 of the controlling apparatus 7 in the first circuit. Should the former lag behind the latter, it would indicate that something in the system is wrong.

As already mentioned above, a detecting apparatus 9 is disposed at the central station for ascertaining the place of any defect in the system. This apparatus 9 is shown at Figs. 12 and 13 and may be constructed exactly the same as the two controlling apparatuses 7 and 8. The several parts are denoted by the same characters of reference, only that the index (′) has been added and that the reference character 37′ in Fig. 11 is replaced by 37^2 in Fig. 13. The only difference between Figs. 11 and 13 is that the movable pawl 125′ is adapted to feed the ratchet-wheel 37^2 through the distance of one tooth-pitch during the attraction of the armatures 126′. However, this difference is immaterial, the essential point being that the indicator 41′ be moved through the distance of one division of the scale 123′ by each closing of the respective circuit.

For operating the detecting apparatus 9 the coils of its electromagnets 124′ are inserted in a shunt 128 between the first circuit and the gas-pipe system 48, as is shown in Figs. 1 and 14. In this shunt 128 a suitable source of current *t*—say a battery—is inserted, as has already been mentioned above, and also a switch 49, Fig. 14, is preferably inserted in this shunt. The line 47 of every relay 3 (see Figs. 9 and 14) is also connected with the gas-pipe system 48, which in Fig. 1 may be assumed to be indicated by the dotted lines. It will be now evident that the switch 49 being switched on each time when the first circuit in section I is for a moment closed to energize the electromagnets 33 33 of the first relay 3, afterward during the return of the armatures 39 39, not only the second circuit in section II, but also the circuit including the lines 97 and 121, Fig. 9, and the frame 117 of the first relay 3, the spring-pressed pawl 46, with its contact-spring 11, the adjustable screw 45, the line 47, the gas-pipe system 48, the battery *t*, the detecting apparatus 9, and its shunt 128 will be for a moment closed. The consequence of this will be that in the second circuit in section II the electromagnets 21 21 in all the automatic lighters and extinguishers and the electromagnets 33 33 of the second relay 3 will be energized. At the same time in the other circuit the electromagnets 124′ 124′ of the detecting apparatus 9 will be energized for moving the indicator 41′ through the distance of one division of the scale 123′. During the return of the armatures 39 39 of the second relay 3 in a similar manner as before not only the third circuit in section III, but also the circuit comprising the detecting apparatus 9, the lines 97 and 121, and the frames 117 of the first and second relays 3 3, the second line 47, and the gas-pipe system 48 will be for a moment closed. In consequence of this the electromagnets 21 21 in all the automatic lighters and extinguishers in the section III and the electromagnets 33 33 of the third relay 3 will be energized, and at the same time the electromagnets 124′ 124′ of the detecting apparatus 9 will be energized. All these occurrences will repeat in the circuits in the following sections IV, V, and in the increasing circuits of the detecting apparatus, so that the indicator 41′ of the latter must necessarily move through the distance of as many divisions of the scale 123′ as there are sections in the system. Either of the circuits in the several sections can be closed only if everything is all right; but if there should be any defect somewhere in the relay 3 or in the automatic lighters and extinguishers or in the lines of course the circuit cannot be closed at all. If something in the first circuit in section I should be wrong, of course the clockwork may perform its work of closing the first circuit without producing this effect, so that the indicators 41 in the two controlling apparatuses 7 and 8 will not be shifted. This being the fact, the superintendent would know that it is the first circuit where the defect lies. When the switch 49

is switched on, and thereby the detecting apparatus 9 is engaged, then if in the first circuit and in the first relay 3 everything is right the closing of the first circuit will cause the indicators 41 and 41′ of the first controlling and the detecting apparatuses to move each through the distance of one division. If in the first relay 3 there should be some defect as regards its parts 39 39 or 38 37 or 35 and 34 or 46 and 45, this relay may not be able to close the second circuit in section II or the circuit including the detecting apparatus 9, so that the indicator 41′ of the latter will remain in its initial position. The superintendent will then know that in the first circuit everything is all right, but that either in the second circuit in section II or in the circuit including the detecting apparatus there is something wrong.

If the second circuit and the increased circuit of the detecting apparatus 9 have been closed, of course the indicator 41′ of the latter will be shifted through the distance of two divisions, while the indicator 41 of the first controlling apparatus will continue pointing at the first division of its scale 123. The indicator 41′ of the detecting apparatus 9 will be in this manner consecutively shifted as long as the following circuits have been actually closed one after the other. If, for instance, in the sixth circuit in section VI or in the sixth relay 3 there should be something wrong, the indicator 41′ of the detecting apparatus 9 will not be shifted to the sixth division, but will remain in its previous position, in which it points at the fifth-division line. The superintendent will then know where the defect may lie.

As mentioned above, thirty closings of either circuit are required for opening or closing each distributer 12—in other words, for turning it through an angle of thirty degrees. From an inspection of Figs. 6 or 7 it will be clear that the distributer 12 will remain open, either partly or wholly, only during its motion through a part of thirty degrees—say through twenty degrees—so that of the thirty closings of the circuit only twenty closings may be effective. The remaining ten closings of the circuit are therefore utilized for shifting the indicators 41 of the two controlling apparatuses 7 and 8 and also the indicator 41′ of the detecting apparatus if the latter is switched on previous to the lighting or extinction, respectively, of the street or other gas lamps. Thereby the superintendent is enabled to examine the state of the system, so as to be able to remedy in time any defect in the system before the street or other gas lamps are lighted or extinguished, respectively.

The clockwork 6, to be presently described, is so arranged that the ten closings of the current in each circuit previous to the lighting or extinction of the street or other gas lamps can be effected at certain moments which may be selected. This clockwork 6 is shown at Fig. 15 and comprises a going-train, a controlling-disk 77, and a train adapted to momentarily close the first circuit. The controlling-disk 77 is a large gear-wheel, which is adapted to be rotated once in twenty-four hours by the going-train. The latter may comprise a gear-wheel 76 with a spring-barrel, (not shown,) various gear-wheels and pinions, and a balance-wheel, indicated by dotted circles. The controlling-disk 77 is provided along its periphery with a plurality of holes 88 88, the number shown of which being eighty. Three principal pins 78′, 78^2, and 78^3 can be introduced into convenient holes 88 88 and may be secured therein by means of screw-threads or otherwise, and, if desired, they may be withdrawn and introduced into other holes 88 88 in accordance with the varying times of sunset and sunrise. The first pin 78′, according to its position shown on the controlling-disk 77, serves for opening both the evening-lamps and the night-lamps at six o'clock p. m., the second pin 78^2 serves for closing only the evening-lamps at midnight, and the third pin 78^3 serves for closing the night-lamps at six o'clock a. m. Thirty further pins 78^4 78^4 are at disposal for operating the controlling and detecting apparatuses and may be introduced into convenient holes 88 88; but there must be ten of them between any two of the three principal pins 78′, 78^2, and 78^3, so that they may effect the ten closings of the first circuit at the selected moments previous to the operation of either of the three pins 78′, 78^2, and 78^3.

The closing of the first circuit is effected by means of a ratchet-wheel 55 and a contact-spring 56. The ratchet-wheel 55 is fastened on a shaft 51 and is insulated therefrom, and a contact-spring 57 is kept in constant contact with its nave. The two contact-springs 56 and 57 are secured on suitable supports 129 and 130, respectively, which are insulated from the frame of the clockwork 6 and are provided with binding-posts 58 58 for the first circuit. The contact-spring 56 is provided with an insulation 50, which normally rests on the respective tooth of the ratchet-wheel 55, whereby the circuit is broken. When, however, in a manner to be presently described the ratchet-wheel 55 is fed through the distance of one tooth-pitch, the point of the contact-spring 56 is adapted to come for a moment in contact with the tooth, whereby of course the first circuit will be closed. The shaft 51 of the ratchet-wheel 55 is mounted in the frame to turn and carries a gear-wheel 52, which meshes with a gear-wheel 59, provided with a spring-barrel. (Not shown.) It is this spring-barrel which drives the ratchet-wheel 55 and a train comprising the gear-wheels 59, 62, 63, 64, 65, 66, 61, 67, 68, and 131 and the fly 70. The ratchet-

wheel 55 has sixty teeth, and the gearing is so proportioned that the gear-wheel 62, and consequently also a notched disk 71, fastened on its shaft, makes two revolutions for every revolution of the ratchet-wheel 55. The notched disk 71 is on one-third of its periphery provided with ten notches 86 86, which correspond to the ten closings of the first circuit previous to the lighting or extinction of the street or other gas lamps. The distance between two notches 86 86 of the disk 71 corresponds to that between two teeth of the ratchet-wheel 55—that is to say, the latter will be turned through the distance of one tooth-pitch if the notched disk 71 is turned through one notch-pitch. A locking-lever 72 is mounted in the frame to rock and is provided with a hooked projection 74 at its free end and with a pawl 73, which passes through an aperture of the frame and can engage in either of the notches 86 86 87 of the disk 71. In this position of the locking-lever 72 its projection 74 is adapted to bear against a pin 60 on the gear-wheel 61, whereby the train is stopped. The locking-lever 72 is, moreover, provided with a bent arm 75, which passes through an aperture of the frame to without and can be seized with one's finger for withdrawing the pawl 73 from the respective notch 87 or 86 of the disk 71. Thereby the projection 74 of the locking-lever 72 will be moved out of the path of the pin 60, so that the train will be released and will commence to move until the pawl 73 engages in the next following notch 86, when the train will be stopped. Evidently during this motion of the train the ratchet-wheel 55 will have once closed the first circuit for a moment. If the pawl 73 engages in the first notch 87, it is obvious that the pawl 73 may be withdrawn ten times from the notched disk 71 by seizing the bent arm 75 with one's finger until the pawl 73 engages in the last notch 86, the disk 71 being turned in the direction of the arrow. Then the ratchet-wheel 55 will have been turned through the distance of ten tooth-pitches, so that it will have closed for a moment the first circuit ten times. If now the pawl 73 be withdrawn from the last notch 86 by means of the bent arm 75, of course the ratchet-wheel 55 will be turned through the distance of twenty tooth-pitches before the pawl 73 engages in the first notch 87, so that twenty consecutive closings of the first circuit are thereby effected. As a rule, however, the pawl 73 is not to be withdrawn by hand in the manner just described; but it is to be actuated by the clockwork as follows: A bell-crank lever 81 is mounted in the frame to rock at 79, and its upper arm is made to normally bear against a pin 80. In this position of the lever 81 the nose 85 of its lower arm will engage in the path of the several pins $78'$ 78^2 78^3 78^4. The said nose 85 is adapted to slide with its inclined face over either of the said pins, so that during the slow rotation of the controlling-disk 77 in the direction of the arrow the lower arm of the lever 81 will be raised. The upper arm of the lever 81 works with the lower arm of a second bell-crank lever 83, the upper arm of which works with an arm 82 on the locking-lever 72 and is at its free end 84 adapted to work with a pin 69 on the gear-wheel 68 in the following manner: If either of the pins $78'$ 78^2 78^3 78^4 on the controlling-disk 77 meet the nose 85, and thereby slowly turn the bell-crank lever 81, also the second bell-crank lever 83 and the locking-lever 72, until the pawl 73 gets out of the notch 87 or 86, as the case may be, and the projection 74 releases the pin 60, then the train will commence to move, but only for a short time until the pin 69 on the gear-wheel 68 meets the upper end 84 of the lever 83 and is thereby checked, so that the train is again stopped. The moment, however, the respective pin 78 has left the nose 85 and the latter drops the parts 81 and 83 will return to their initial positions, so that the upper end 84 will release the pin 69, and the train will commence to move for effecting the single or the twenty consecutive closings of the first circuit, as the case may be.

The system is operated as follows: The thirty-three pins $78'$ 78^2 78^3 78^4 are in the manner described adjusted on the controlling-disk 77 for effecting the lighting and the extinction of the street or other gas lamps at the desired moments and also for effecting the ten closings of the first circuit preparatory to each of the three said moments. Normally the detecting apparatus 9 is withdrawn by switching off its switch 49. During day-time all the street or other gas lamps will be closed and their parts 30 and 31 will occupy the positions shown in Figs. 6 and 7 for the evening-lamps and the night-lamps, respectively. At the determined ten points of time before six o'clock p. m. the clockwork 6 will effect ten single closings of the first circuit in section I, so that the remaining fifteen circuits in sections II to XVI will also be closed for a moment one after the other by the respective relays 3 3. If everything in the system is in order, the indicators 41 of the two controlling apparatuses 7 and 8 will be each time shifted through one division of their scales 123. The distributers 12 of the several street or other gas lamps will be fed each time through the distance of $\frac{5}{30}=\frac{1}{6}$th of a tooth-pitch of the gear-wheels 31. Should the indicator 41 of the second controlling apparatus 8 not keep pace with that of the first controlling apparatus 7, the superintendent will know that there is some defect in the system. He may then switch on the switch 49 to engage the detecting apparatus 9 and wait for the next following closing of the first circuit or he may withdraw the pawl

73 from the respective notch 86 of the disk 71 by means of the bent arm, in which case, of course, the respective pin 78^4 will require to be taken off the controlling-disk 77, so as to make everything square. The closing of the first circuit will cause the consecutive closings of the following circuits as far as everything in the latter is all right, and the indicator 41′ of the detecting apparatus 9 will be shifted through as many divisions of the scale 123′ until it stops. Then the superintendent will know the circuit or the relay where the defect must lie, and he may send his assistant to seek and to remedy the defect. After the defect has been remedied the assistant moves by hand the armatures 39 39 of the respective relay 3 to close for a moment the following circuit, and thereby the remaining circuits, so that the indicator 41 of the second controlling apparatus 8 will point at the same division-line of the scale 128 as the indicator 41 of the first controlling apparatus 7, and the indicator 41′ of the detecting apparatus 9 will point at the sixteenth division-line of the scale 123′ and will show that everything is in order. If, however, a second defect should be in either of the following circuits, the superintendent will know this by looking at the two controlling apparatuses 7 and 8 and by watching the detecting apparatus 9, so that he can send word to his assistant. On the first principal pin 78′ lifting and leaving the nose 85 of the bell-crank lever 81 at six o'clock p. m. the pawl 73 will have been withdrawn from the last notch 86 of the disk 71 and will henceforward ride over the smooth part of the periphery of the disk 71, while the ratchet-wheel 55 will be turned through the distance of twenty tooth-pitches, so that it will momentarily close the first circuit twenty times consecutively until the pawl 73 engages in the first notch 87, when the train will stop. The consequence of this will be that the distributers 12 of all the street or other gas lamps will open the communication for the gas, so that all the lamps will be lighted. In the course of time between six o'clock p. m. and midnight the ten intermediate pins 78^4 will in the manner described momentarily close the first circuit ten times for actuating the indicators of the two controlling apparatuses 7 and 8. The superintendent will thus be kept carefully informed of the state of the system. At midnight after the second principal pin 78^2 has lifted and left the nose 85 of the bell-crank lever 81 the train will be started and the ratchet-wheel 55 will momentarily close the first circuit twenty times consecutively until the train stops, so that in the automatic lighters and extinguishers of all the evening-lamps the distributers 12 will have shut off the gas-supply, and thus extinguished these lamps, while the distributers 12 of all the night-lamps remain in their open state. In the course of the night before six o'clock a. m. the first circuit will be closed ten times for actuating the indicators of the controlling apparatuses in the manner described. At six o'clock a. m. the third principal pin 78^3 will start the train, and the ratchet-wheel 55 will close the first circuit twenty times consecutively, so that the distributers of all the night-lamps will be closed to extinguish the latter.

The system and its several apparatuses described may be varied in many respects without departing from the spirit of my invention.

I claim—

1. In a system for lighting and extinguishing street or other gas lamps from a central station, the combination with a plurality of circuits, the first and the last of which extend into the central station and each circuit comprising a source of current, of a plurality of automatic lighters and extinguishers in said plurality of circuits and adapted to be operated by electrical impulses for lighting or extinguishing street or other gas lamps, relays connecting the several circuits in series and each adapted on being energized by the momentary closing of the preceding circuit to afterward momentarily close the following circuit, means at the central station for momentarily closing the first circuit, and two controlling apparatuses at the central station and adapted to be operated by electrical impulses in the first and last circuits respectively.

2. In a system for lighting and extinguishing street or other gas lamps from a central station, the combination with a plurality of circuits, the first and the last of which extend into the central station and each circuit comprising a source of current, of a plurality of automatic lighters and extinguishers in said plurality of circuits and adapted to be operated by electrical impulses for lighting or extinguishing street or other gas lamps, relays connecting the several circuits in series and each adapted on being energized by the momentary closing of the preceding circuit to afterward momentarily close the following circuit, a clockwork at the central station and adapted to momentarily close the first circuit at determined points of time, and two controlling apparatuses at the central station and adapted to be operated by electrical impulses in the first and last circuits respectively.

3. In a system for lighting and extinguishing street or other gas lamps from a central station, the combination with a plurality of circuits, the first and the last of which extend into the central station and each circuit comprising a source of current, of a plurality of automatic lighters and extinguishers in said plurality of circuits and adapted to be oper-

ated by electrical impulses for lighting or extinguishing street or other gas lamps, relays connecting the several circuits in series and each adapted on being energized by the momentary closing of the preceding circuit to afterward momentarily close the following circuit, means at the central station for momentarily closing the first circuit, two controlling apparatuses at the central station and adapted to be operated by electrical impulses in the first and last circuits respectively, a gas-pipe system shunted to the first circuit at the central station and to the several relays, a source of current and a detecting apparatus inserted in the shunt at the central station, the detecting apparatus being adapted to be operated by electrical impulses.

4. In a system for lighting and extinguishing street or other gas lamps from a central station, the combination with a plurality of circuits, the first and the last of which extend into the central station and each circuit comprising a source of current, of a plurality of automatic lighters and extinguishers in said plurality of circuits and adapted to be operated by electrical impulses for lighting or extinguishing street or other gas lamps, relays connecting the several circuits in series and each adapted on being energized by the momentary closing of the preceding circuit to afterward momentarily close the following circuit, a clockwork at the central station and adapted to momentarily close the first circuit at determined points of time, two controlling apparatuses at the central station and adapted to be operated by electrical impulses in the first and last circuits respectively, a gas-pipe system shunted to the first circuit at the central station and to the several relays, a source of current and a detecting apparatus inserted in the shunt at the central station, the detecting apparatus being adapted to be operated by electrical impulses.

5. In a system for lighting and extinguishing street or other gas lamps from a central station, the combination with a plurality of circuits, the first and the last of which extend into the central station, of a plurality of sources of current in said plurality of circuits, a plurality of automatic lighters and extinguishers in said plurality of circuits and comprising electromagnetic devices adapted to be energized by electrical impulses and also mechanisms controlled by the electromagnetic devices for gradually opening and closing the gas-supply tubes of street or other gas lamps, relays connecting the several circuits in series and each adapted on being energized by the momentary closing of the preceding circuit to afterward momentarily close the following circuit, a clockwork at the central station and adapted to momentarily and consecutively close the first circuit at determined points of time, and two controlling apparatuses at the central station and comprising dial-works and electromagnetic devices which latter are adapted to be energized by electrical impulses in the first and last circuits respectively for shifting the indicators.

6. In a system for lighting and extinguishing street or other gas lamps from a central station, the combination with a plurality of circuits, the first and the last of which extend into the central station, of a plurality of sources of current in said plurality of circuits, a plurality of automatic lighters and extinguishers in said plurality of circuits and comprising electromagnetic devices adapted to be energized by electrical impulses and also mechanisms controlled by the electromagnetic devices for gradually opening and closing the gas-supply tubes of street or other gas lamps, relays connecting the several circuits in series and each adapted on being energized by the momentary closing of the preceding circuit to afterward momentarily close the following circuit, a clockwork at the central station and adapted to momentarily and consecutively close the first circuit at determined points of time, two controlling apparatuses at the central station and comprising dial-works and electromagnetic devices which latter are adapted to be energized by electrical impulses in the first and last circuits respectively for shifting the indicators, a gas-pipe system shunted to the first circuit at the central station and to the several relays, a source of current and a detecting apparatus inserted in the shunt at the central station, the detecting apparatus comprising a dial-work and an electromagnetic device which latter is adapted to be energized by electrical impulses in the shunt-circuits for shifting the indicator.

7. In a system for lighting and extinguishing street or other gas lamps from a central station, the combination with a plurality of circuits, of a plurality of relay sconnecting the several circuits in series and each adapted on being energized by the momentary closing of the preceding circuit to afterward momentarily close the following circuit, it comprising an electromagnetic device inserted in the preceding circuit, a ratchet-wheel, a movable pawl hinged to the armature and adapted to feed said ratchet-wheel through the distance of one tooth-pitch during the return of the armature, a spring-pressed pawl for holding said ratchet-wheel and adapted to be rocked thereby, a contact-spring on said spring-pressed pawl, and an adjusting-screw adapted to momentarily come in contact with said contact-spring, said ratchet-wheel and said adjusting-screw being inserted in the following circuit.

8. In a system for lighting and extinguishing street or other gas lamps from a central

station, the combination with a plurality of circuits, of a gas-pipe system shunted to the first and the last of said plurality of circuits, and a plurality of relays connecting the several circuits in series and each adapted on being energized by the momentary closing of the preceding circuit to afterward momentarily close the following circuit and to short-circuit the shunt-circuit of the gas-pipe system, it comprising an electromagnetic device inserted in the preceding circuit, a metallic frame, a ratchet-wheel mounted thereon to turn, a movable pawl hinged to the armature and adapted to feed said ratchet-wheel through the distance of one tooth-pitch during the return of the armature, two spring-pressed pawls for holding said ratchet-wheel and adapted to be rocked thereby, two contact-springs on said spring-pressed pawls, two adjusting-screws insulated from the frame and adapted to momentarily come in contact with said two contact-springs, and a shunt between the frame and the preceding circuit, said frame and one of said two adjusting-screws being inserted in the following circuit and the other adjusting-screw being shunted to the gas-pipe system.

9. In a clockwork for a street or other gas lamp lighting and extinguishing system, the combination with a frame, of a going-train therein, a second train in said frame and comprising a series of gear-wheels and pinions with a fly, also a ratchet-wheel and a notched disk which on a smaller part of its periphery is provided with a plurality of notches, a controlling-pawl mounted in said frame to rock and adapted to engage in either notch of said notched disk and at the same time to stop one of the gear-wheels by means of a pin, two binding-posts, a stationary contact-spring on one of said two binding-posts and adapted to slide on the nave of said ratchet-wheel, a movable contact-spring on the other of said two binding-posts and adapted to come for a moment in contact with either tooth of said ratchet-wheel during its feed, a circuit including said two binding-posts, said ratchet-wheel being adapted to momentarily close said circuit once for every shift of said controlling-pawl from one notch to the next one and several times during the motion of said controlling-pawl over the smooth part of the periphery of said notched disk, a controlling-disk mounted in said frame to turn and provided on the periphery with gear-teeth in which said going-train engages for rotating it once during twenty-four hours, and also provided along the periphery with a plurality of holes, a plurality of controlling-pins removably adjusted in convenient holes of said controlling-disk, and means controlled by said plurality of controlling-pins for withdrawing said controlling-pawl from said notched disk.

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Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.