(No Model.) 2 Sheets—Sheet 1.

V. POPP.

SYSTEM FOR PNEUMATIC CLOCKS.

No. 275,701. Patented Apr. 10, 1883.

Fig. 1

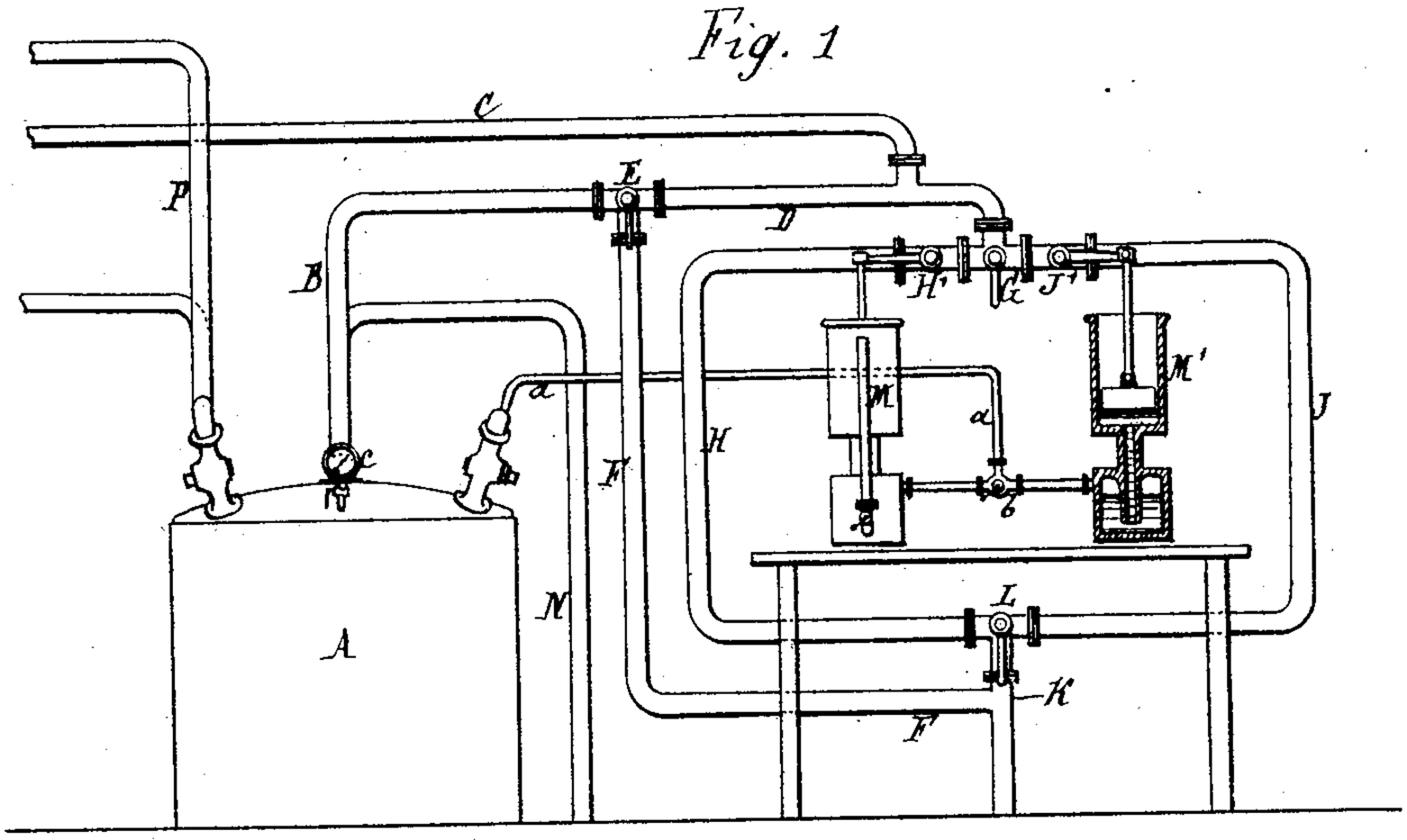


Fig. 2.

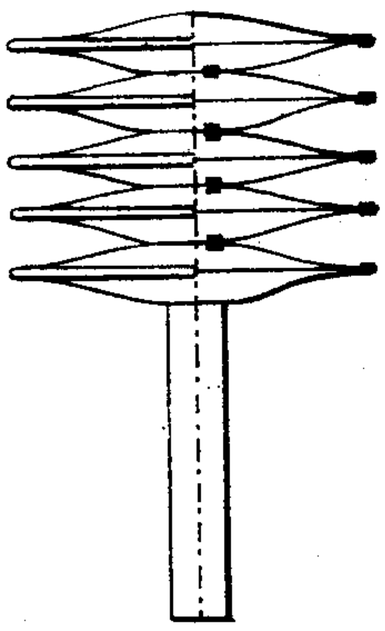


Fig. 3

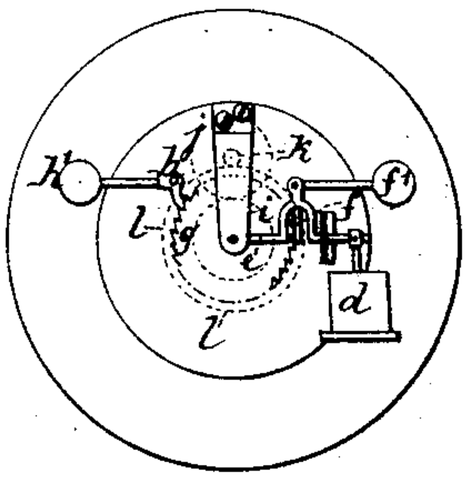


Fig. 4.

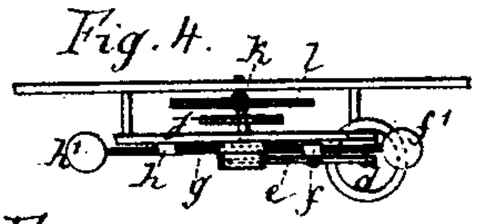


Fig. 5.

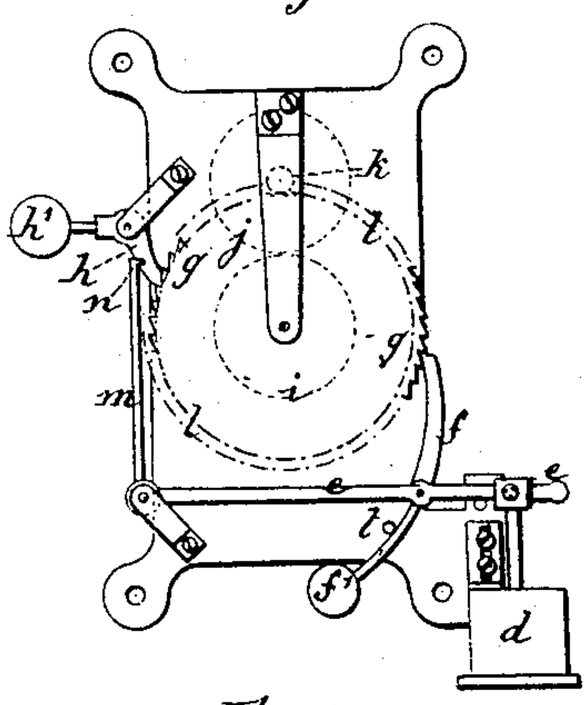


Fig. 6

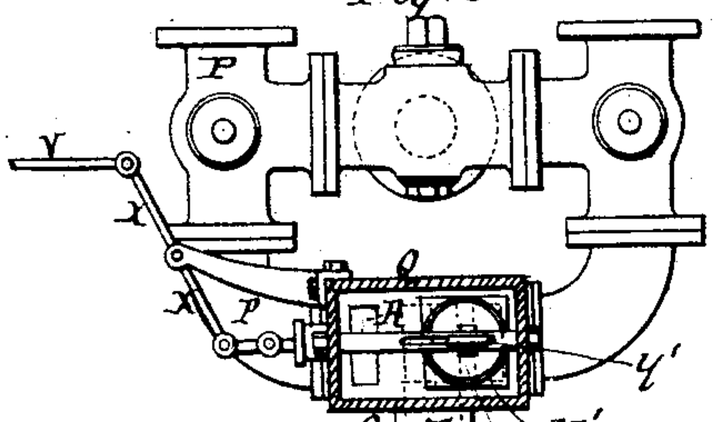
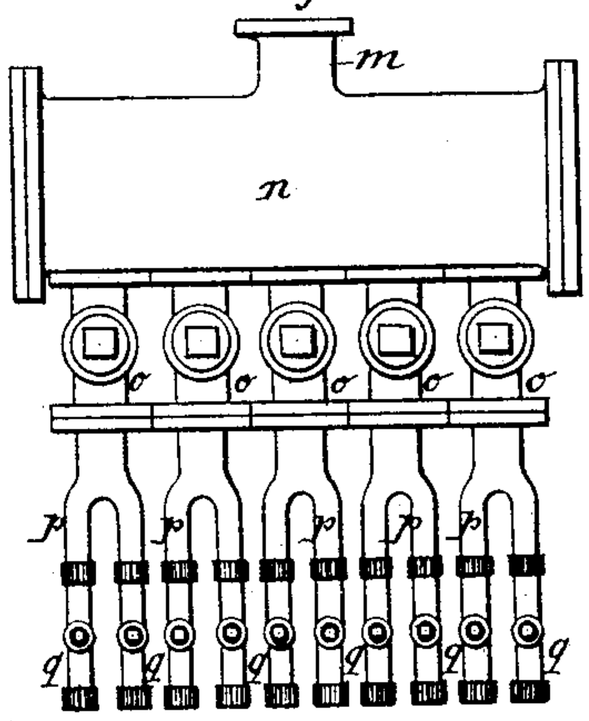


Fig. 7

Fig. 8



Witnesses:

E. E. Masson

Philip Pellaner

Inventor

Victor Popp

by A. Pollok

his Atty.

(No Model.) 2 Sheets—Sheet 2.

V. POPP.

SYSTEM FOR PNEUMATIC CLOCKS.

No. 275,701. Patented Apr. 10, 1883.

Fig. 12

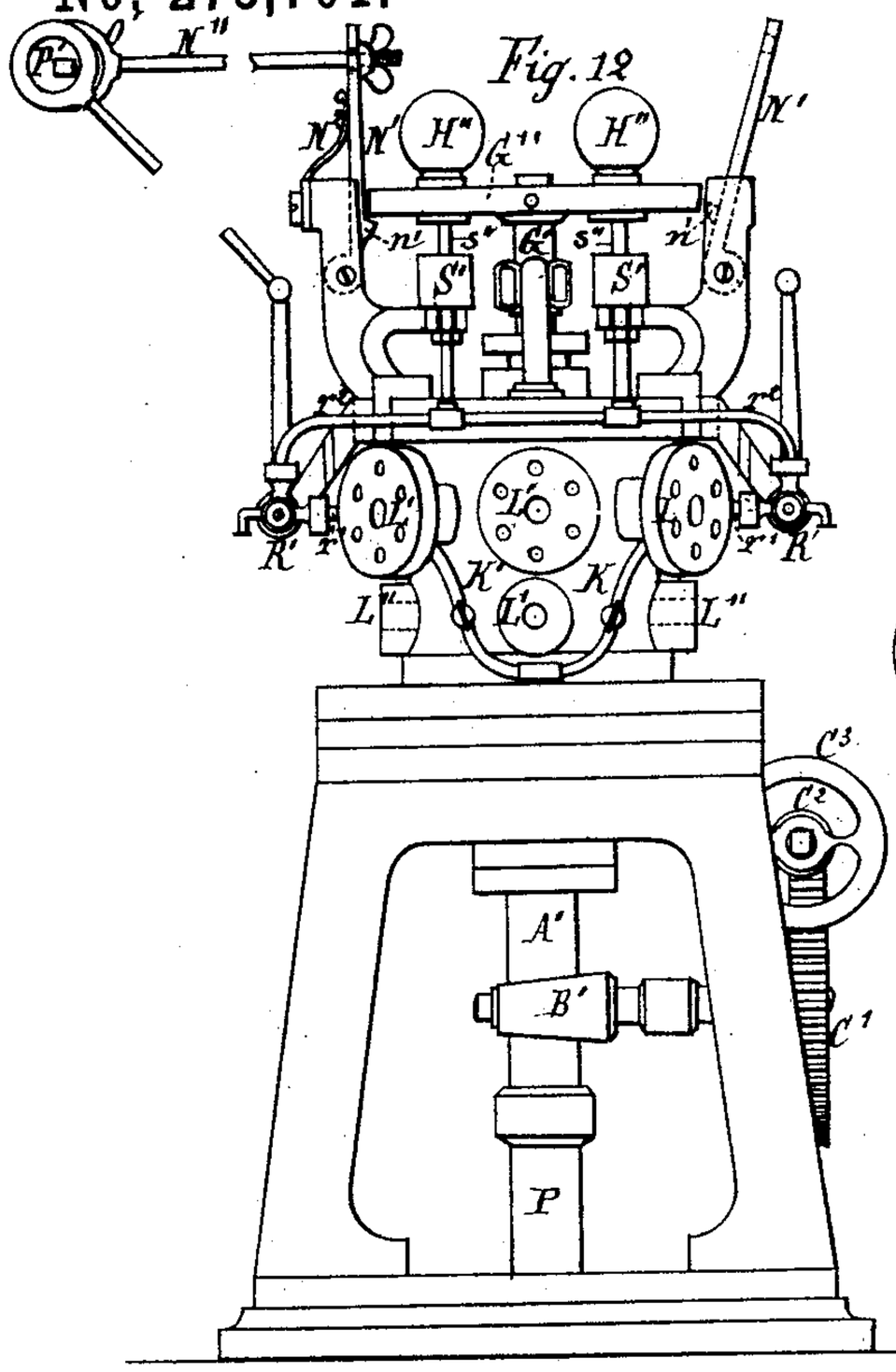


Fig. 14

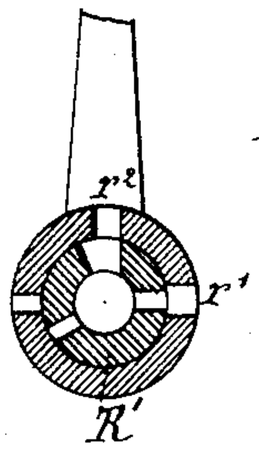


Fig. 13

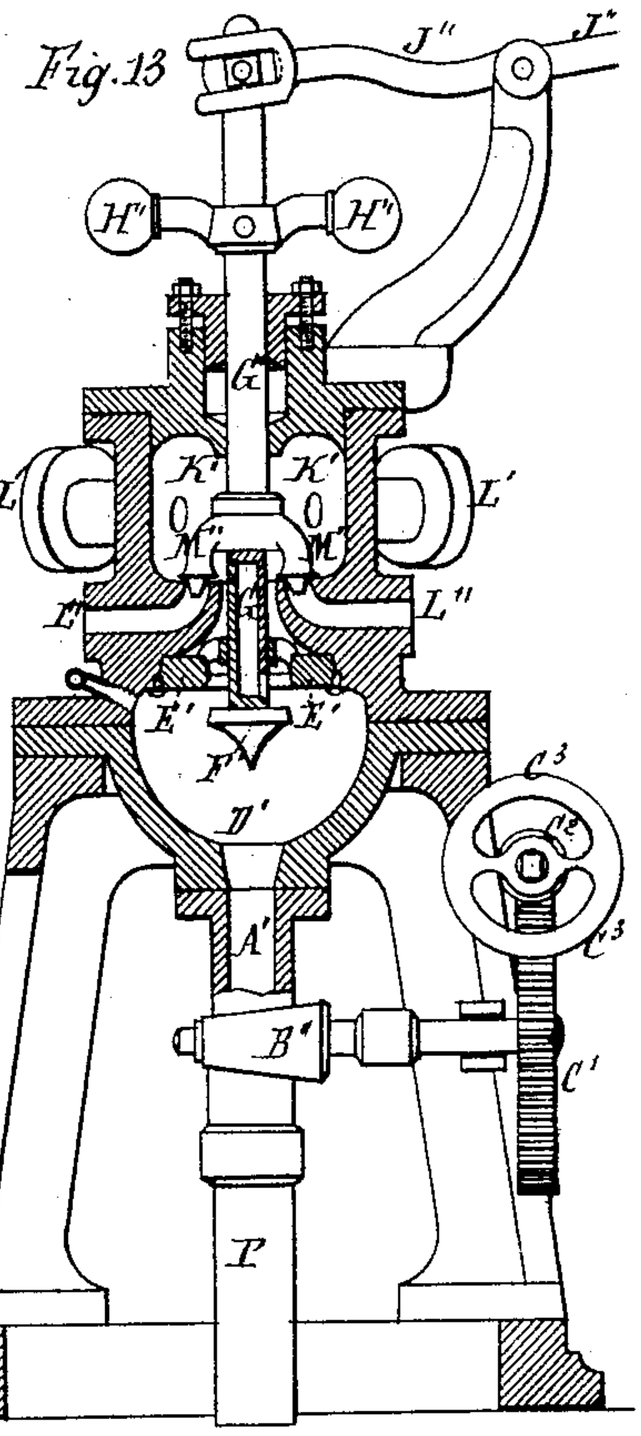


Fig. 9

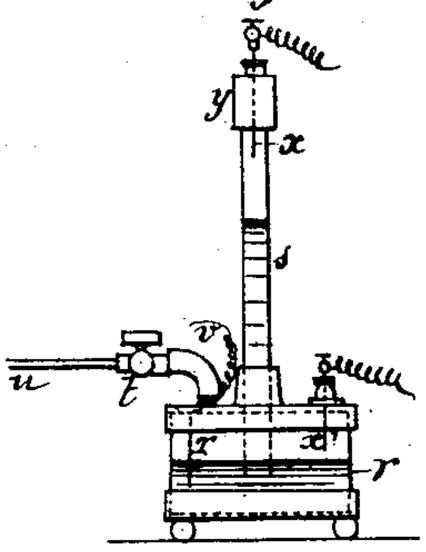


Fig. 10

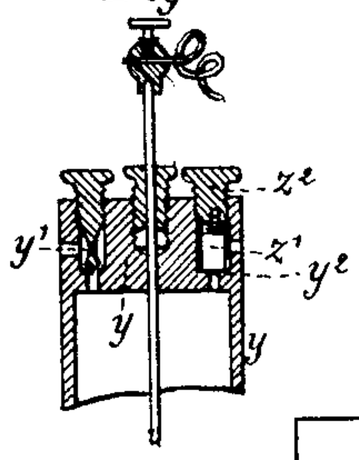


Fig. 11

Witnesses:
E. E. Masson
Philip Pollock

Inventor:
Victor Popp
by A. Pollok
his Atty.

UNITED STATES PATENT OFFICE.

VICTOR POPP, OF PARIS, FRANCE.

SYSTEM FOR PNEUMATIC CLOCKS.

SPECIFICATION forming part of Letters Patent No. 275,701, dated April 10, 1883.

Application filed August 24, 1880. (No model.) Patented in France February 10, 1877, No. 117,010; in Italy November 29, 1879; in Belgium April 29, 1880, No. 51,321; in England May 4, 1880, No. 1,828; in Germany May 5, 1880, No. 13,885; in Spain September 10, 1880, and in Russia February 16, 1882, No. 1,201.

To all whom it may concern:

Be it known that I, VICTOR POPP, of Paris, France, have invented certain Improvements in Pneumatic Clocks and Means for Operating the Same, of which improvements the following is a specification.

This invention relates to apparatus for distributing the compressed air to the clocks and for operating the latter, and also to certain improvements in the clocks themselves.

In the system on which the present invention is intended as an improvement the air under pressure is, by devices under the control of a regulator, allowed to flow into one or more pipes, by which it is conveyed to the clock or clocks. This inflow of compressed air being caused to take place at definite intervals, usually every minute, advances regularly the hands on the dials, and thus distributes the time. The regulator is reduced to the role of a distributer merely, and does not, as in some earlier systems, act itself to force the air through the pipes. There are therefore two distinct operations—namely, the preliminary compression of the air into a suitable reservoir, and the transmission of this air through the net-work of pipes by opening stop-cocks or valves at proper intervals through the medium of a regulator or governing clock. These general principles are retained in the improved system; but in the latter new or improved apparatus is employed in order that the operation may be more certain and efficient.

In order that the invention and the manner of carrying the same into effect may be fully understood, it will now be described in connection with the accompanying drawings, which form a part of this specification, and in which the same letters indicate like parts wherever they occur.

Figure 1 is a view in elevation, partly in section, of the distributing-reservoir and pressure-regulator therefor; Fig. 2, a similar view of motor-bellows for operating a clock pneumatically; Figs. 3 and 4, an elevation and plan, respectively, of a small pneumatic clock-movement; Fig. 5, an elevation of a larger movement adapted to prevent unauthorized advancing of the hands; Figs. 6 and 7, an elevation, partly in section, and a horizontal section, respectively, of balanced slide-valve and inclosing-box for admitting the compressed air into the distributing-pipes and releasing it after it has acted on the clocks; Fig. 8, a view in elevation of an apparatus for distributing the compressed air among a number of branches; Figs. 9 and 10, an elevation and section of an electric signaling apparatus to indicate excess or loss of pressure in the pipes, and Fig. 11 a diagram of the general arrangement of parts in a system. Figs. 12 and 13 illustrate, one in elevation and the other in section, two forms of apparatus for controlling the distribution of compressed air by lifting or puppet valves. Fig. 14 is a detail sectional view.

Distributing-reservoir and pressure-regulator, Fig. 1.—The reservoir A receives by the pipe B the compressed air from the high-pressure reservoirs. The air takes the following course: From the pipe C it passes into the pipe D to the three-way cock E, closed for the pipe D, but putting the pipes F and B in communication with each other. From pipe D the air passes through the three-way cock G, which is open, thence through pipes H and F by three-way cock L, and then descends the pipe K, which is closed at its opposite end, but with which is connected the pipe F. This is in communication by the cock E with pipe B. This last-named pipe conveys, as stated, the air into the reservoir A. Between pipes H and J and cock G are regulating-cocks H′ J′, which are closed when the reservoir A contains air at the normal pressure—1.7 atmospheres. The reservoir A is in communication, by the tube *a* and the three-way cock *b*, with two manometers, M M′. These are connected with each other and form a pressure-regulator. They are each composed of a lower chamber, with which is connected a monometric tube, and an upper chamber connected with the lower by a pipe, which extends nearly to the bottom of the latter. In the upper chamber is a float, which is connected by a jointed rod with an arm for operating one of the valves H′ J′. The manometers contain mercury, which, by the pressure of the air in the reservoir A, conveyed through the pipe *a*,

is forced upward from the lower into the upper chamber, and, when the pressure in said reservoir is at the normal point, lifts the float in said upper chamber, so as to close the regulating-cocks H′ J′. When, however, the pressure in the reservoir A decreases, the mercury returns to the lower chambers, the floats descend, and the regulating-cocks are open until the pressure is restored in the reservoir. Reservoir A is also provided with a manometer, *c*, a pipe, N, whereby it may be directly connected with the high-pressure reservoir when necessary, and two pipes, P, which conduct the air to the distributing-valves, whence it passes into the system of distributing-pipes.

Motor-bellows for clocks, Fig. 2.—This is formed, as will be readily seen from the drawings, of annular-shaped pieces of leather-like washers connected at their edges, which are inclosed by rings of copper or other suitable metal. At its lower end is a copper disk, through which the pipe for conveying the compressed air is in communication with the interior of the bellows. At the top is a disk, which pushes against the bar for operating the clock.

Clock-movements, Figs. 3, 4, and 5.—The compressed air, coming from the distributing-pipe, enters the cylinder *d*, in which works a piston, (or which serves as a guide to a bellows like that shown in Fig. 2.) The rod of this piston acts on lever *e*, which carries a pawl, *f*, engaging with the ratchet-disk, which has sixty teeth, and upon the axis of which is fixed the minute-hand. Every time the compressed air enters the cylinder *d*, or the bellows, the ratchet-disk is advanced one tooth and advances the minute-hand. Stop-pawl *h* maintains the rachet-disk in the position in which it has been placed. The pawls *f* and *h* are pressed against the ratchet by the counter-weights *f′* and *h′*. Moreover the axis of the ratchet carries a toothed wheel, which engages with another wheel, *j*, of the same diameter, on the axis of which is fixed a pinion, *k*, that commands the wheel *l*, carrying the hour-hand. In the case of large clocks an evil-disposed person will be tempted to put forward the minute-hand, and in order to avoid this difficulty the mechanism shown in Fig. 5 is adopted. The vertical arm *m*, attached to or made integral with the operating-lever *e*, carries at its upper part a projection, *n*, which, in the normal position—that is to say, when the piston or top of the bellows is in its lowest position—fits into a notch provided for the purpose in the stop-pawl *h*. In this position it is impossible to turn the wheel with sixty teeth, or, consequently, the minute-hand. When the bellows is filled or the piston raised the lever *e* is also lifted and withdraws the arm *m*, and consequently allows the pawl *h* to move and permit a tooth to pass. The stop *t*, fixed to the plate supporting the movement, and arranged so that the counter-weighted arm of the pawl *f* strikes against it, can also be used to prevent unauthorized advancement of the minute-hand.

Balanced slide-valve, Figs. 6 and 7.—The compressed air, coming from the distributing-reservoir by the pipe P, enters the box Q by the orifice R. This box is provided with an orifice, S, through which air passes into the distributing-pipes, and an escape-opening, T. When the valve U is in the normal position which is represented in the drawing, the distributing-orifice S and the escape-opening T are in communication with each other, and the air in the distributing-pipes is at the same pressure as the surrounding atmosphere. At the proper time the regulating-clock acts upon the valve-rod by means of the jointed rod V and lever X, and places the valve in such position that communication between the orifices S and T is cut off and the inlet-opening R is in communication with the distributing-orifice S. The compressed air then passes through the distributing-pipes and acts to advance the minute-hands of the various clocks. The slide-valve is then restored to its first position, the orifices S and T are put in commuication with each other, and the compressed air escapes from the distributing-pipes. In order to diminish the pressure of the valve on its face, it is constructed in the following manner: On the outer side of the valve is a cylinder, U′, in which works the piston U^2. The rod Y of this piston carries the roller Y′, which travels on the bar Z, solidly fastened in the interior of the valve-box. The pressure tending to force the valve against its face-bearing is transferred in great part into the pressure of the roller Y′ on the bar Z. In fact, the pressure of the valve on its face is no more than that which results from the pressure of the air on its own surface diminished by that of the piston—that is to say, it is reduced to about one-fifth of what it would be if the valve were not balanced by the means indicated.

Apparatus for controlling the distribution of compressed air by lifting or puppet valves, Figs. 12, 13, and 14.—Instead of the slide-valve just described, distributing apparatus with lifting or puppet valves can be employed. This is made at the same time to serve as a starting-point for a number of branch distributing-pipes, which are at definite intervals put in communication with a common compressed-air receiver. In the drawings two dispositions of realizing this system are represented. These are alike so far as the construction of the valve mechanism and distributing apparatus is concerned. They differ in the mechanism for conveying the action of the regulating-clock. An essential feature of both apparatus is a bar carrying at the lower part a valve for putting the distributing-chamber in communication with the compressed-air receiver, and at its upper part a number of valves whose function is to open or close the discharge-pipes. In Fig. 12 the operation of the valves is effected by means of compressed air acting upon an

arrangement of bellows and controlled by the regulating-clock. In Fig. 13 the operation of the valve is effected directly by the clock itself. Referring more particularly to this last-named figure, the compressed air enters the apparatus by the pipe A′, put in communication with the distributing-reservoir A by the cock B′ and pipe P. This cock is operated by worm-gearing C′ C², turned by a hand-wheel, C³, for putting the system in operation or stopping it. From the pipe P the air enters the receiver D′, having at its upper part the seat E′ of the valve F′. At every minute the valve is moved by the bar or rod G′, to which are fixed the counter-weights H″. The fall of these weights produces a sudden opening of the valve F′. The valve-rod G′ is jointed at its upper part to a lever, J″, controlled by the clock. Normally the lever J″ is engaged. At the proper moment—that is to say, at every minute—it is tripped by the clock, the valve F′ is suddenly opened, and the compressed-air receiver D′ is put in communication with the distributing-chamber K′. This chamber is provided with passages L′, connected with different distributing-pipes. The air then enters the distributing-pipes and acts upon the various clocks, and a few seconds afterward a discharge takes place. For this purpose the chamber K′ is provided with discharge-passages L″. These are in number equal to those marked L′, and are closed by means of valves M″. These valves are fixed to the bar G′ and disposed in such manner that the discharge-passages are closed at the same moment that the valve F′ is opened. When the clock acts upon the bar G′ by means of lever J″ to close the valve F′ the valves M″ are removed from their seats and the distributing-pipes in communication with the passages L′ are put in communication with the outer air through the distributing-chamber and discharge-passages L″.

In the apparatus just described the closing of valve F′ is effected by the clock itself through the medium of the lever J″, on which it acts directly; but in order to avoid the inconvenience which arises from this disposition—an inconvenience which consists principally in that the clock must be made to support the shock resulting from the sudden fall of the counter-weights H″ and transmitted to it by lever J″—the disposition represented in Fig. 12 is employed. In this the valve-rod G′ is jointed to the cross-piece G″, carrying two counter-weights H″ and sustained at a suitable height by shoulders *n′* of two levers, N′, pressed outward by springs N², of which one only is shown. At the proper moment the levers N′ are moved outward by the clock through the medium of rods N″ and eccentrics O′. The shoulders *n′* no longer sustain the cross-piece G″, and the counter-weights H″ fall, carrying with them the valve F′ and valves M″, thus putting in communication the compressed-air receiver and distributing-chamber and closing the discharge-passages. Other eccentrics, P′, operating the three-way cocks R′ through an eccentric-rod and lever-arm, put in communication, by the passages *r′ r²*, the chamber K′ with two bellows, S′, of which the rods S″ lift the cross-piece G″, so as to close the valve F′ and open the discharge-passages. The cross-piece G″ is then engaged by the levers N′, the cocks R′ (see the horizontal section, Fig. 14) put in communication the passages *r²* with the atmosphere, and the bellows then collapse, in order to act anew on the cross-piece G″ the next minute.

Apparatus for distributing the compressed air between a number of branches, Fig. 8.—The compressed air from the slide-valve or puppet-valve distributer arrives by the passage *m* in box *n*, which may be of cast-iron or other suitable material. With this box are connected a number of pipes provided with cocks *o* and branched beyond said cocks, as shown at *p*, each of the branches being provided with a separate cock or valve, *q*. These pipes *p* serve to convey the compressed air to the various clocks.

Electric signaling apparatus, Figs. 9 and 10.—This is composed of a glass vessel, *r*, in which descends a tube of the same material, *s*. The vessel *r* contains mercury, and is in communication with a distributing-pipe by the cock *t* and tube *u*. One of the poles of the electric battery is in communication with the vessel by means of wire *v*, which plunges into the mercury therein contained. In the upper part of the tube *s* is the platinum point *x*, connected through the coils of the electric bell with the other pole of the battery. In the vessel *r* is another platinum point, *x′*, also connected with the bell and same pole of battery as *x*. When the distributing-pipe is in communication with the compressed-air receiver the pressure in this receiver is transmitted to the mercury of the signaling apparatus and causes it to ascend the tube *s*. When, on the contrary, the distributing-pipe is in communication with the external air, the mercury in the tube *s* descends into the vessel *r*. In the normal operation the mercury does not ascend in the tube *s* far enough to make contact with *x*, nor does it descend into the vessel *r* sufficiently to make contact with the point *x′*. If, however, the pressure in the distributing-pipe becomes too great, the mercury mounts higher in the tube *s*, and, by making contact with the platinum point *x*, causes the bell to ring and announce that the operation is not proceeding properly. If, on the other hand, the distributing-pipe should become broken from any cause, the mercury in the column *s* would descend continuously and fill the vessel *r*, so as to make contact with the point *x′*, and thus ring the bell. At the upper part of the tube *s* is a cap, *y*. (See Fig. 10.) The platinum point *x* passes through a stuffing-box. Besides the opening for the rod *x*, there are in the cap *y* two openings, *y′ y²*. In the first is a screw forming an obstruction and arranged to close more or less completely the opening *y′*,

so as to allow to the external air a passage more or less free, and thus regulate the descent of the mercury in the tube *s*. The screw should be so adjusted that the mercury ascends and descends once a minute, the ascent corresponding to the pressure in the distributing-pipes and the descent to its escapement. In the second opening, y^2, is a spring-valve, z', which allows the air contained in the tube *s* to escape readily when the mercury ascends—that is to say, during the time of the pressure in the distributing-pipes. The raising of this valve is regulated by the screw z^2. It will be seen, therefore, that if the distributing-pipes should be broken the mercury would continue to descend the tube *s*, because the external air could always enter the tube by the opening y', and the mercury would seek the same level as in the vessel *r*, whereas while the distributing-pipe remains whole sufficient time would not be allowed for the mercury to descend entirely into the vessel *r* or sufficiently to make contact with the platinum point x'.

General arrangement of the system, Fig. 11.—The air from the pumps 1 passes into the high-pressure reservoirs 2 3. Each of the pipes from the pumps is in communication with both reservoirs by means of pipes 5, provided with three-way cocks 4. A pipe, 6, provided with cocks 34 39, also connects the two reservoirs. With a second pipe, 7, is connected a pipe, 8, which itself may be put in communication with the interior of reservoir A by means of cross-pipe and cocks 9, 10, and 11, 9 being a three-way cock. With the cross-pipe are connected pipes 12 13, which lead to slide-valves 14 15. From these valves pipes 16 17 extend to the distributing apparatus 18, by which the air is divided among a number of branches. With one of these branches the signaling apparatus is shown connected. The slide-valves are controlled by regulating-clocks placed at 19. The air from the two reservoirs 2 3 can be and is usually carried by pipes 20 21, three-way cocks 22, regulating-cocks 29 30, controlled by the two manometers forming the pressure-regulator, and thence by pipes 45 46, three-way cock 28, pipe 44, cock 31, and pipe 23 into reservoir A. Two other pipes, 24 25, can be made to put the reservoirs 2 3 into direct communication with reservoir A, the first directly by pipe 26, the second through pipe 27 and pressure-regulating apparatus.

The operation is as follows, the reservoir A serving as the distributer, and reservoirs 2 3 receiving the air from pumps 1: Cocks 34 and 39 of pipe 6 are open, putting the reservoirs 2 3 in communication with each other. Cock 9 at reservoir A is then shut. Cocks 37 and 42 of pipe 21 are open, and the compressed air passes into reservoir A by cocks 37 42, pipes 21 20, cock 22, regulating-cocks 29 30, pipes 45 46, cock 28, pipe 44, (cocks 38 and 43 being closed,) cock 31, and pipe 23. Cocks 35, 40, 36, 41, and 9 are shut, and reservoir A is now in communication with reservoirs 2 3 through the pressure-regulator. From reservoir A the compressed air passes, through the cocks 10 11, pipes 12 13, into the boxes of slide-valves 14 15. If it should be desired to make one of the reservoirs 2 or 3 serve as a distributer, (suppose 3, for example,) it would be necessary to put this reservoir in communication with pipes 12 and 13, which extend to the slide-valves. This would be accomplished by closing the cock 35 and opening cock 40 of pipe 7, closing cocks 10 and 11, and opening cock 9. It would also be necessary to put the reservoir 3 in communication with the pressure-regulator, which would be accomplished by closing cock 42 of pipe 21, opening cock 37, closing cocks 31 38, and opening 43 of pipe 25. It is evident that it would be necessary, by means of cock 4, to break the communication of the pumps with reservoir 3 and to close cocks 34 and 39 of pipe 6. The air would then take the following course: reservoir 2, cock 37, pipe 21, pipe 20, cocks 22 30 29, pipes 45 46, cock 28, pipes 27 25, and cock 43 to reservoir 3, thence by cock 40, pipe 7, (cock 35 being closed,) pipe 8, cock 9, pipes 12 13, and slide-valves 14 15, (cocks 10 and 11 being closed.)

Moreover, by opening and closing the proper cocks the reservoir A might be made to serve as a high-pressure reservoir, and might be put in communication with one or the other of reservoirs 2 3, the second of said reservoirs serving as a distributer.

It is obvious that various modifications may be made in the construction and disposition of the several parts in their forms, materials, and dimensions without departing from the spirit of this invention. In place of an electric bell, other signaling indicator or signaling devices could be used.

Having thus explained the said invention, and the manner of carrying the same into effect, what I claim is—

1. A pneumatic-clock system comprising, in combination with the clocks and the air-distributing pipes, the following elements, to wit: the high-pressure reservoir, the distributing-reservoir, the automatic pressure-regulator for controlling the flow of air from the high-pressure to the distributing reservoir, so as to maintain constant the pressure in the latter, and the valve apparatus controlled by a master clock or regulator for opening and closing at regular intervals the communication between the distributing-reservoir and the distributing-pipes, substantially as described.

2. In combination with the clocks and distributing-pipes of a pneumatic-clock system, the high-pressure reservoir, the distributing-reservoir, and the pressure-regulator, comprising the two manometers communicating with the distributing-reservoir, and provided with separate floats controlling each a valve in a pipe connecting the high-pressure with the distributing reservoir, substantially as described.

3. The combination, in a pneumatic clock, of the ratchet-disk, the impulse-pawl, the stop-pawl, and the automatic locking device for engaging and holding the stop-pawl during the retreat of the impulse-pawl and for releasing it as the latter advances, substantially as described.

4. A balanced slide-valve operated or controlled by a master clock or regulator, in combination with a reservoir of compressed air, distributing pipes and cocks for supplying air to the pneumatic clocks, said valve being arranged to open and close at intervals the communication through said pipes between said reservoirs and the said clocks, substantially as described.

5. In a pneumatic-clock system, the combination, with a reservoir of compressed air, of a distributing-chamber connected with said reservoir, a series of distributing-pipes provided with regulating-cocks and communicating with said chamber, and valves controlled by a regulator-clock, for admitting the flow of compressed air into said pipes at definite intervals, substantially as described.

6. An electric indicator comprising a pressure-chamber and tube for containing mercury, an inlet for admitting air into said chamber, a conductor for establishing normally an electrical connection with the mercury in said chamber and tube, a contact for completing the circuit through the mercury when the latter rises in the tube, and a second contact for completing a circuit when the mercury falls in the tube and rises in the chamber, substantially as described.

7. The combination, with the distributing-pipes of a pneumatic-clock system and the mechanism for forcing or admitting at intervals air under pressure into said pipes, of electrical signaling apparatus operated by an abnormal increase or decrease of pressure in said pipes, substantially as described.

8. The combination, with two or more reservoirs and the air compressors or pumps, of a pressure-regulator and system of pipes whereby either of said reservoirs may receive the air directly from the compressors or indirectly through the other reservoir and the pressure-regulator, substantially as described.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

VICTOR POPP.

Witnesses:
GEO. H. SCIDMORE,
CH. MARDELET.