(No Model.)

2 Sheets—Sheet 1.

C. A. MAŸRHOFER.

HYDROPNEUMATIC CLOCK SYSTEM.

No. 271,888. Patented Feb. 6, 1883.

FIG. 3

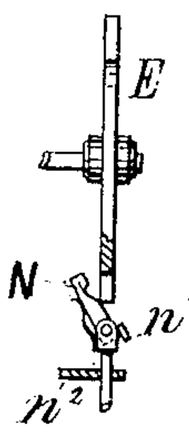
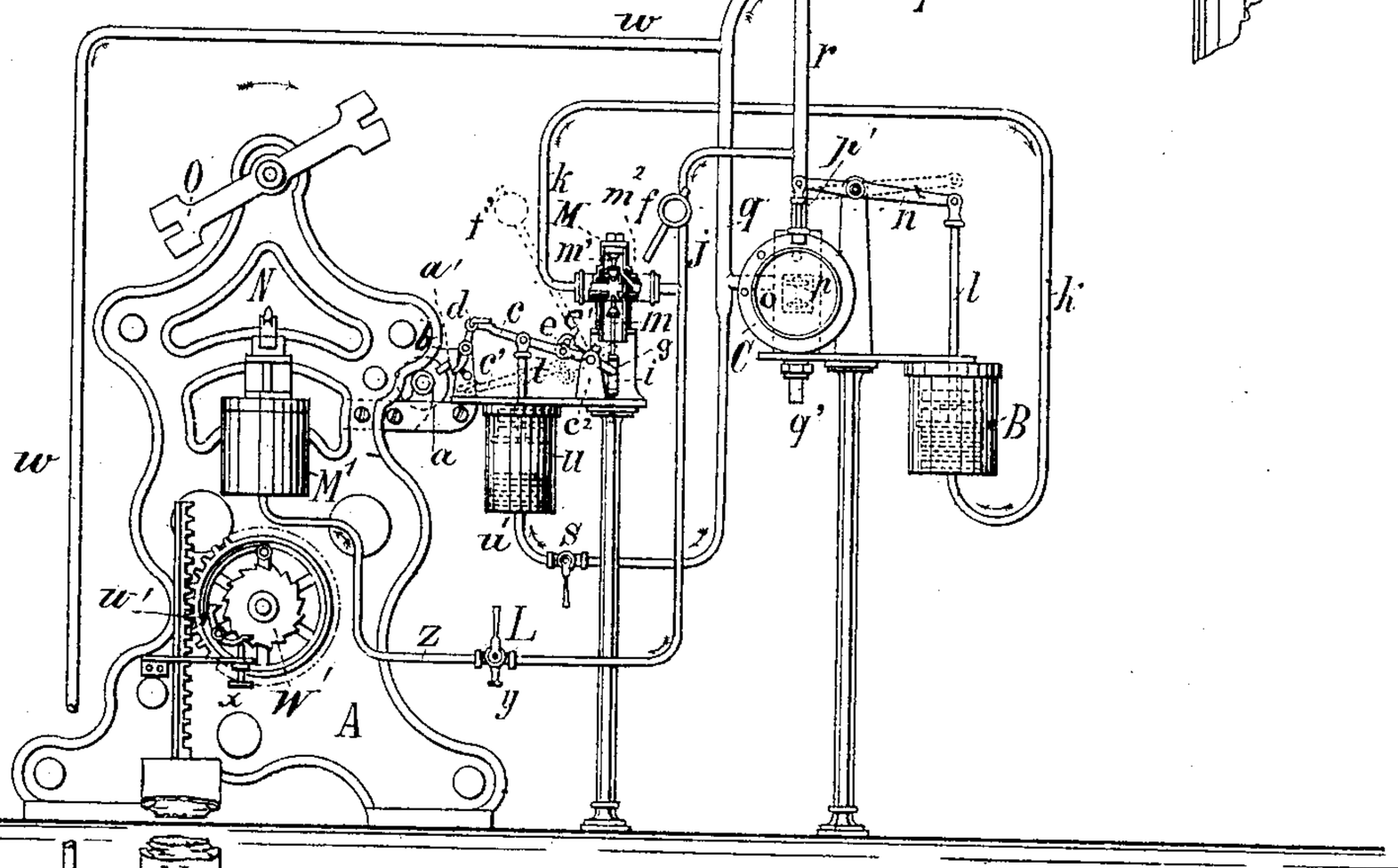


FIG. 2.

FIG. 1



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(No Model.) 2 Sheets—Sheet 2.

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HYDROPNEUMATIC CLOCK SYSTEM.

No. 271,888. Patented Feb. 6, 1883.

Fig. 4.

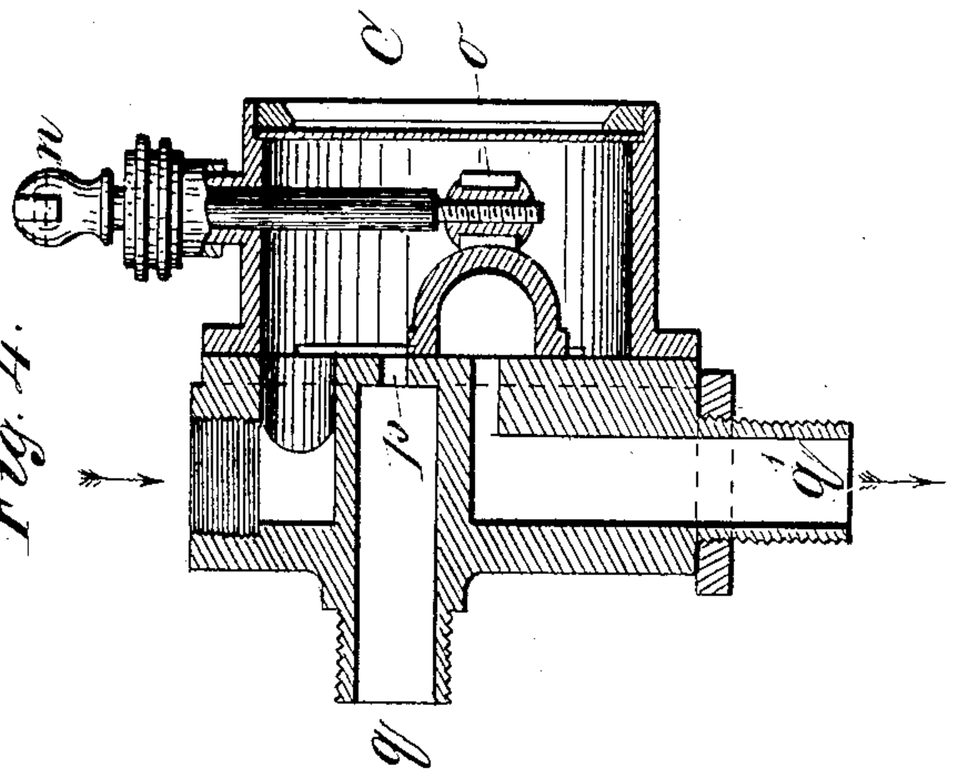
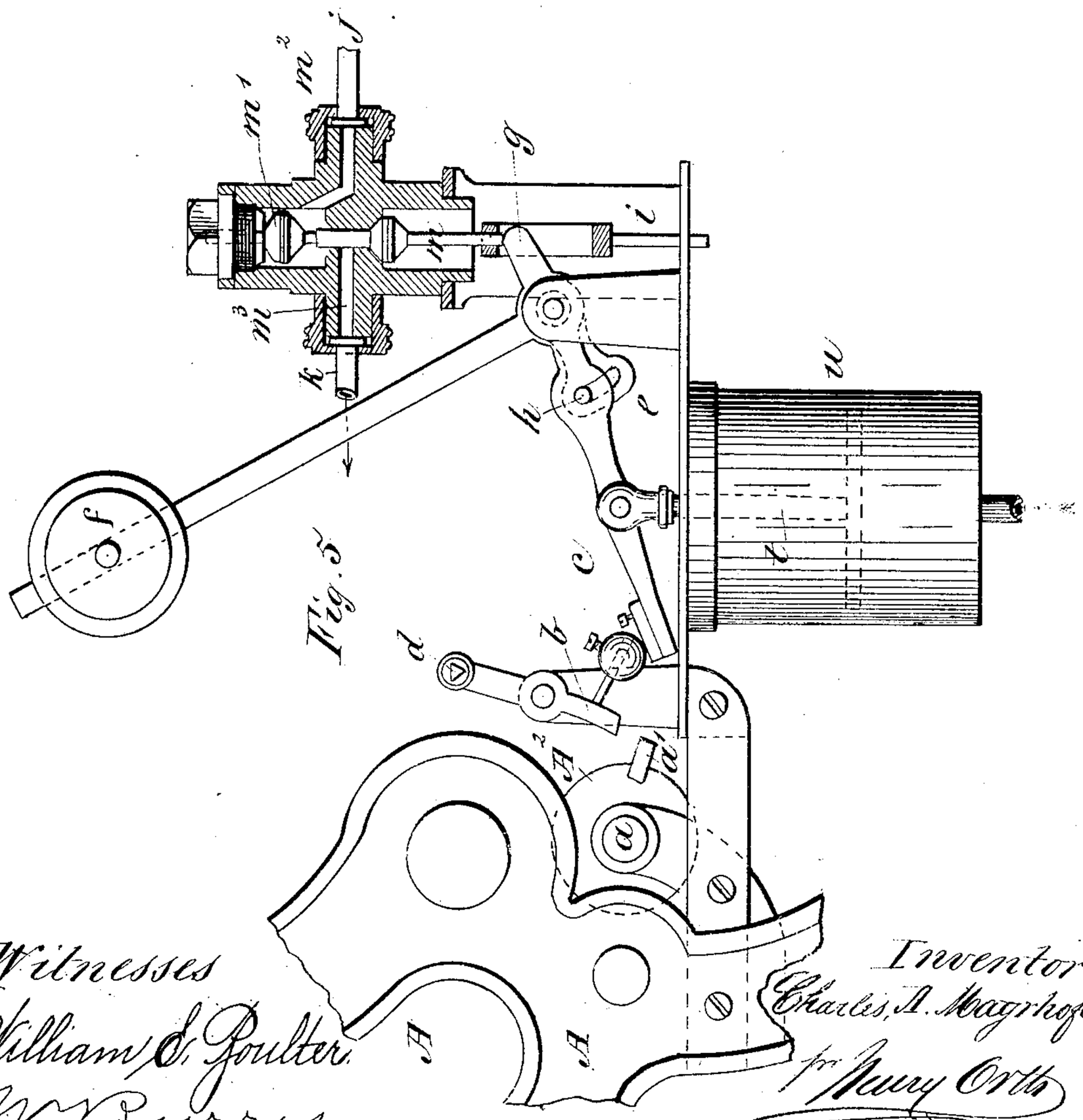


Fig. 5.



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UNITED STATES PATENT OFFICE.

CHARLES MAŸRHOFER, OF VIENNA, AUSTRIA-HUNGARY, ASSIGNOR TO LUDWIG MAUTNER, RITTER VON MARKHOF, OF SAME PLACE.

HYDROPNEUMATIC-CLOCK SYSTEM.

SPECIFICATION forming part of Letters Patent No. 271,888, dated February 6, 1883.

Application filed April 10, 1880. (No model.) Patented in Belgium February 16, 1880, No. 50,516; in Italy February 20, 1880, XIV, 11,588, and XXIII, 178; in England March 2, 1880, No. 920; in France April 1, 1880, No. 134,876; in Austria-Hungary May 18, 1880, No. 4,242, and No. 1,391; in Sweden July 19, 1880; in Denmark August 5, 1880, No. 754; in Spain October 19, 1880, No. 773, and in Germany March 16, 1881, No. 12,350.

To all whom it may concern:

Be it known that I, CHARLES ALBERT MAŸRHOFER, a citizen of Austria-Hungary, residing at Vienna, in the Austrian Empire, have invented new and useful improvements in means for synchronously working and automatically regulating and winding up clocks by means of compressed air, of which the following is a specification.

The object of my invention is to regulate and wind up a set of clocks, by a well-constructed standard clock, in an automatic manner, the air required for this purpose being compressed and automatically supplied thereto from any suitable compressing apparatus, said compressed air being also employed for winding up the standard clock.

In order that my invention may be fully understood, I will proceed to describe the same in detail, referring to the accompanying drawings, in which—

Figures 1 and 2 are elevations of so much of a standard-clock movement and a clock-movement regulated thereby as is necessary to illustrate the invention, and Figs. 3, 4, and 5 are detail views.

The compressed air required to operate the secondary clocks through the medium of the standard clock to wind up said secondary clocks as well as the standard clock may be obtained from any well-constructed compressing apparatus. I prefer, however, to employ a compressing apparatus of my own invention, which I have fully described in the specification and illustrated in the drawings forming part of an application for Letters Patent of the United States filed on the 17th of November, 1880. I have therefore deemed it sufficient to partly indicate the air-receiver F, from which the compressed air is taken.

In operating clock mechanisms by means of compressed air it is of great importance that the said air should be delivered from the compressing apparatus in as dry a condition as it is possible to obtain it, and for this purpose I place in the primary circuit of pipes, or that circuit leading from the compressing devices to the clock-operating devices, a drying apparatus wherein the air is dried before reaching said operating devices.

In the above-described figures of drawings, F represents a portion of a compressed-air reservoir, within which the compressed air is stored for use, and from which it passes through a pipe, *s*, and its branches into the drying-vessels D and D′, wherein the air is deprived of its moisture by the usual means employed for this purpose. From the drying-vessels the air passes into the branch pipes *r*′, thence into pipe *r* to the valve-casing C, Fig. 1, and also shown in section on an enlarged scale in Fig. 4, from whence the air escapes into the atmosphere through port *q*′, the normal position of the valve *o* being such as to cover the port *p* and exclude the air from the clock mechanism except at stated periods, as hereinafter described. With the pipe *r* is also connected one end of a branch pipe, *j*, the other end of said branch pipe being connected with induction-port m^2, Figs. 1 and 5, of a valve-casing, M, to the eduction-port m^3 of which is connected a pipe, *k*, that has its other end connected with a piston-casing, B, the piston-rod *l* of which is connected by a lever, *n*, with the valve-rod *p*′ of the valve *o* in valve-casing C, for purposes that will be presently explained.

A represents the main frame of a standard clock, that supports its operating mechanism. A shaft, *a*, is geared with the clock-movement in such manner as to cause it to revolve once or any number of times up to twenty-four every twenty-four hours, according to the number of times it is desired to wind up the standard and the secondary clocks. This shaft *a* of said mechanism carries a cam-wheel, the cam *a*′ of which rotates in the path of the lower arm of a two-armed tripping-lever, *b*. The upper arm of the latter carries a prism-shaped stop, *d*, upon which rests the free end of a lever, *c*, pivoted upon a standard, c^2. To the lever *c* is pivoted the piston-rod *t* of the piston operating within the piston-cylinder *u*, that is connected by a branch pipe, *u*′, with the main supply-pipe *q*, said branch pipe being provided

with a stop-cock, S, that serves to regulate the amount of compressed air delivered to piston-casing *u*, the above devices being shown in Fig. 1, and on a larger scale in Fig. 5. The lever *c* is provided with an extension, *g*, that projects into the path of two abutments or stops formed on the lower end of the valve-rod *i*, to which are connected the valves *m* and *m'*, that operate in the valve-casing M. Instead of abutments on the lower end of the valve-rod, this rod may be provided with a slot, the extremities of which would serve as abutments for the extension of the lever *c*. It will be seen that when the cam-wheel rotates its cam *a'* depresses the lower arm of the tripping-lever *b* to liberate the free end of the lever *c*, which is depressed or moved downward into the position shown in dotted lines, Fig. 1, and full lines, Fig. 5, by the segment *e* and its weighted lever *f*, the pin *h* of which projects into the slot *e'* of said segments. This downward movement of the free end of the lever *c* produces a corresponding upward movement of the rear extension, *g*, of the lever, which being in contact with the upper abutment of the valve-rod *i* will lift said rod and its attached valves and admit compressed air through port m^2 into pipe *k*. This pipe *k* conducts the air coming from the drying-vessels through pipes *r j* and valve-casing M to the piston-casing B, raising its piston, and through the piston-rod *l*, lever *n*, and valve-rod *p* depressing the valve *o* to close the port *q'* and conduct the air through port *p* to the main distributing-pipe *q*. It will thus be seen that as long as the lever *c* is held upon the prism *d* the air that comes from the drying-vessels passes through the valve-casing into the atmosphere, as above set forth. The air admitted into the main line will also pass into the branch *w'* to the piston-casing *u*, raise its piston and rod *t*, which latter will bring the lever *c* back into engagement with the stop *d*, at the same time causing the valve-rod *i* to descend and the valve *m'* to close the port m^2, cutting off the air from casing B, the piston of which will descend and raise the valve *o* to close the port *p* and again open the port *q'* to allow the air to escape into the atmosphere. Another branch, *w*, leads from the main supply-pipe *q* to the bellows piston-casing W, the piston-rod of which terminates in a toothed rack that meshes with the winding-up wheel mounted loosely on its axle. This winding-up wheel carries a spring-pawl, *w'*, that engages with the teeth of a ratchet-wheel, W', (rigidly mounted upon the winding-wheel arbor,) when the toothed piston-rod moves upward, and which pawl is disengaged from the ratchet when the piston-rod descends, thereby turning the winding-up wheel backward, the rear arm of the pawl falling upon a small pin, *x*, attached to the clock-frame.

By means of the above-described mechanism the winding-up wheel is locked to its arbor through the medium of the ratchet and pawl, when the toothed piston-rod is caused to ascend by the influx of compressed air into piston-casing W, and is disengaged therefrom when said piston-rod descends. Hence the winding-up wheel need only be partially toothed, as it has a reciprocating rotary motion upon its arbor only, and not a continuous rotary motion, as is the case in all ordinary clocks.

In Fig. 2, which represents a secondary clock or series of such, I have shown a differently-constructed winding-up mechanism that may be employed, if desired, with a standard clock, and which mechanism is also operated automatically from the standard clock in the following manner: When the tripping-lever *c* is released to admit compressed air to the line-pipe *q*, branch *w*, and piston-casing W, to wind up the standard clock, the air passes also from the line or circuit pipe *q* to the branches Q Q' Q^2, provided with valves a^2 b^2 c^2, respectively, the valve-rods R^3 of which have their outer ends forked, and through the fork of said rods passes the cord of the operating-weights R R' R^2. These valves being kept open by the weight of the valve-rods, the air therefore passes from the branches Q Q' Q^2 to vessels A' B' C', filled with mercury, and containing each a paddle-wheel, e^2, mounted upon a shaft, X, that also carries a pinion, (shown in dotted lines,) which gears with a winding-up wheel, G' G^2 G^3. Thus at every revolution of the cam-wheel A^2 of the standard clock the tripping-lever opens the valve *m'* to admit air to the line-pipe *q*, and the respective branches to wind up the standard as well as the secondary clocks simultaneously, and as the weight or weights R R' R^2 are elevated by the winding-up pinion they carry with them the end of the valve-rods which rotate the valves a^2 b^2 c^2, and upon reaching a given point said valves close and stop the further winding up.

A branch pipe, G, connected with the line-pipe *q*, admits compressed air to the piston-casing D^2, the piston-rod of which carries a regulating-pin, N, so that when these clocks are wound up the piston is also raised, and the pin enters the recess of a regulating-fork, E, mounted on and revolving with the minute-hand when said fork is in or nearly in a vertical position, so that when the winding up is effected hourly or half hourly, the secondary clocks are at the same time regulated.

From what has been said, it will be seen that the winding up and regulating of a series of pneumatically-connected clocks may be effected automatically at any desired time by gearing the cam-arbor *a* in such manner with the movement of the standard clock as to revolve once in twenty-four hours, or to revolve once at intervals of one or any number of hours during that period.

The regulating of the standard clock and the secondary clocks simultaneously is effected at stated times, preferably at noon, in the following manner: The branch pipe *j*, that admits compressed air to the valve-casing M, is also connected with a piston-casing, M', the

piston-rod of which carries at its upper end a regulating-pin, N. When at noon the three-way cock L is turned by hand to admit compressed air to the casing M′, the piston is raised and the regulating-pin N enters into a recess in one of the wings of the regulating-fork O, that is mounted on the minute-hand arbor and rotates therewith to regulate the clock, as described above, so that when the cam-shaft *a* is geared to the clock-movement of the standard clock in such manner as to operate the admission-valve precisely at noon, and the attendant at the same time turns the three-way cock L, the standard as well as the secondary clocks are regulated simultaneously.

It will be readily understood that the pipe G may be connected with the pipe *l*, between the three-way cock L and the piston-casing M′, to regulate the secondary clocks only at that time when the standard clock is regulated. This, however, would necessitate the use of an additional line-pipe, G, which would consid rably increase the expense of constructing the circuit, and as the cam-shaft *a* is always geared to open the valve *m′*, either at the hour or half-hour, when the regulating-fork is in a vertical position, this secondary or additional line-pipe can be dispensed with, and the secondary clocks wound up and regulated simultaneously.

In order to prevent the motion of the clock being impeded by the pressure, which continues for some time during the winding up of the secondary clocks, the regulating-pin N is hinged to the upper end of the piston-rod, as shown in Fig. 3, so that when said rod reaches the limit of its upward throw the pin is thrown backward out of the path of the regulating-fork, to allow the latter to continue its motion with the minute-hand, and when the piston again descends the stop *n′* comes in contact with the guide-plate n^2 of the frame, causing the spring to throw the pin forward again.

Having now described my invention, what I claim is—

1. The combination of a series of secondary clocks arranged in a pneumatic circuit, each provided with a winding-up pinion actuated pneumatically, with a standard clock, and a tripping mechanism geared with the movement thereof to periodically trip a valve and admit compressed air into the main circuit, whereby the standard clock, as well as the secondary clocks, is periodically and automatically wound up.

2. The combination of a series of secondary clocks arranged in a pneumatic circuit, each provided with a regulating-pin actuated pneumatically, and arranged to engage a regulating-fork mounted on and moving with the minute-hand arbor, with a standard clock and a tripping mechanism geared with and timed by the movement thereof to trip a valve and admit compressed air into the main circuit to throw the regulating-pin into engagement with the regulating-fork to regulate the secondary clocks simultaneously and automatically.

3. The combination, with the winding-up mechanism of a clock actuated pneumatically, the weight that operates the clock-movement, and the compressed-air-supply pipe, of a valve operated by said weight, when the clock is wound up, to cut off the supply of compressed air to the winding-up mechanism.

4. The combination, with the regulating-fork of a clock mounted on and moving with the minute-hand arbor, of a regulating-pin actuated pneumatically to engage said fork and regulate the clock, and devices to throw the regulating-pin out of the path of the fork when said pin has reached the limit of its upward movement, for the purpose specified.

5. The combination, with the regulating-fork of a clock mounted on and moving with the minute-hand arbor, of a regulating-pin actuated pneumatically for the purpose set forth, and devices to throw the pin out of the path of the regulating-fork when said pin has reached the limit of its upward movement, and into the path of the said fork when the pin has reached the limit of its downward movement, for the purpose specified.

6. The combination, with a standard clock and a series of secondary clocks provided with winding-up and regulating devices arranged to be operated pneumatically, a tripping mechanism connected with the movement of the standard clock, and an auxiliary three-way valve actuated by said tripping mechanism, of a three-way main valve interposed in the primary circuit, and the supply-pipe and devices for operating said valve periodically controlled by the standard-clock movement through the medium of said tripping mechanism and auxiliary valve, substantially as described, for the purpose specified.

7. The combination, with a standard clock and a series of secondary clocks and their winding-up and regulating mechanisms described, and a primary pneumatic circuit composed of a compressed-air reservoir, devices to deprive the air of its moisture, a line-pipe, and suitable connections with said regulating and winding-up mechanisms, of a primary and a secondary valve controlled and timed by the movement of the standard clock to periodically, automatically, and synchronously wind up said standard and secondary clocks and simultaneously regulate the latter, substantially as described.

8. The combination, with a standard clock and one or more secondary clocks, their winding-up and regulating mechanisms, a primary pneumatic circuit and connections with said winding-up and regulating mechanisms, and a primary and secondary valve controlled by the standard clock, all as set forth, of an auxiliary valve for each secondary clock, operated and controlled by the power that actuates the latter to cut off the supply of air to the regu-

lating and winding-up mechanism independently of the cut-off mechanism of the standard clock, substantially as and for the purposes specified.

9. The combination, with the regulating devices of a standard clock and the regulating and winding-up devices of a series of secondary clocks arranged in the same pneumatic circuit and operated pneumatically, a primary valve interposed in the main and supply lines, and a secondary valve controlled and timed by the standard-clock movement to actuate said primary valve, for the purpose specified, of an auxiliary valve, L, interposed in the main line, and the connection with the regulating devices of the standard clock, as and for the purpose specified.

In witness that I claim the foregoing I have hereunto set my hand this 28th day of February, 1880.

C. A. MAŸRHOFER.

Witnesses:

HENRY PALM,

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