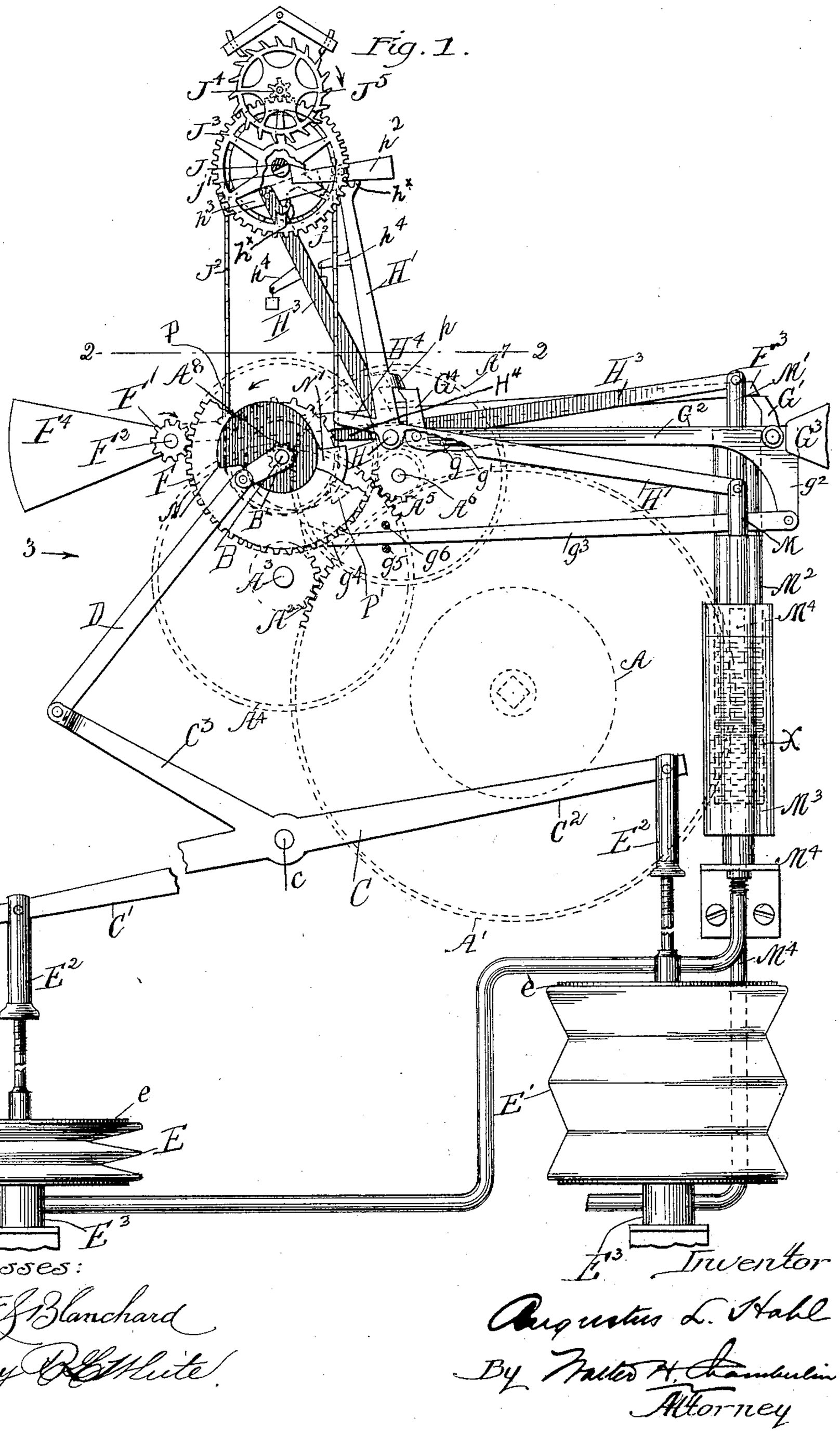
(No Model.) 2 Sheets—Sheet 1.

A. L. HAHL.

PNEUMATIC CLOCK.

No. 598,066. Patented Jan. 25, 1898.

Fig. 1.



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(No Model.)

2 Sheets—Sheet 2.

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Fig. 2

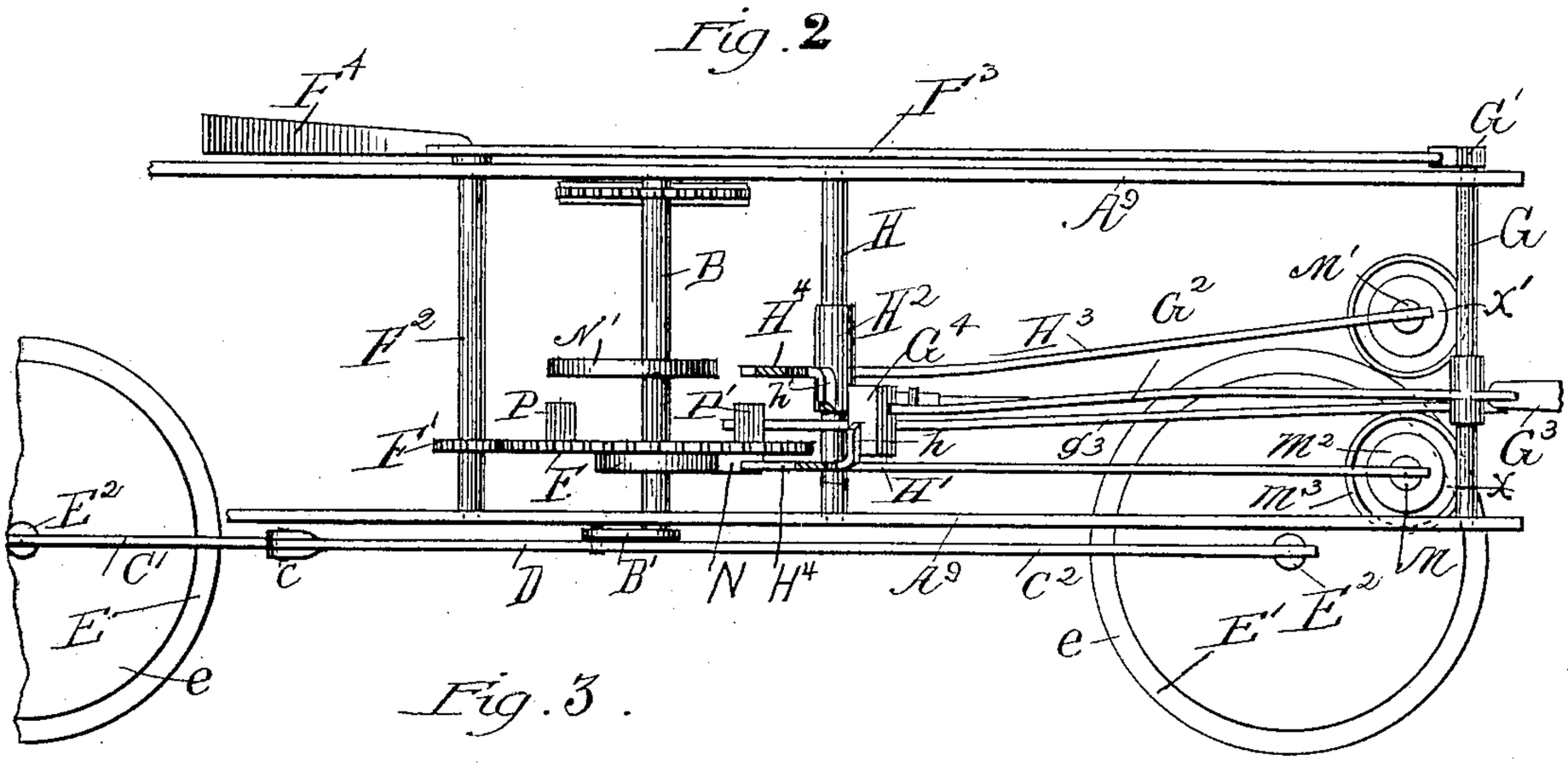
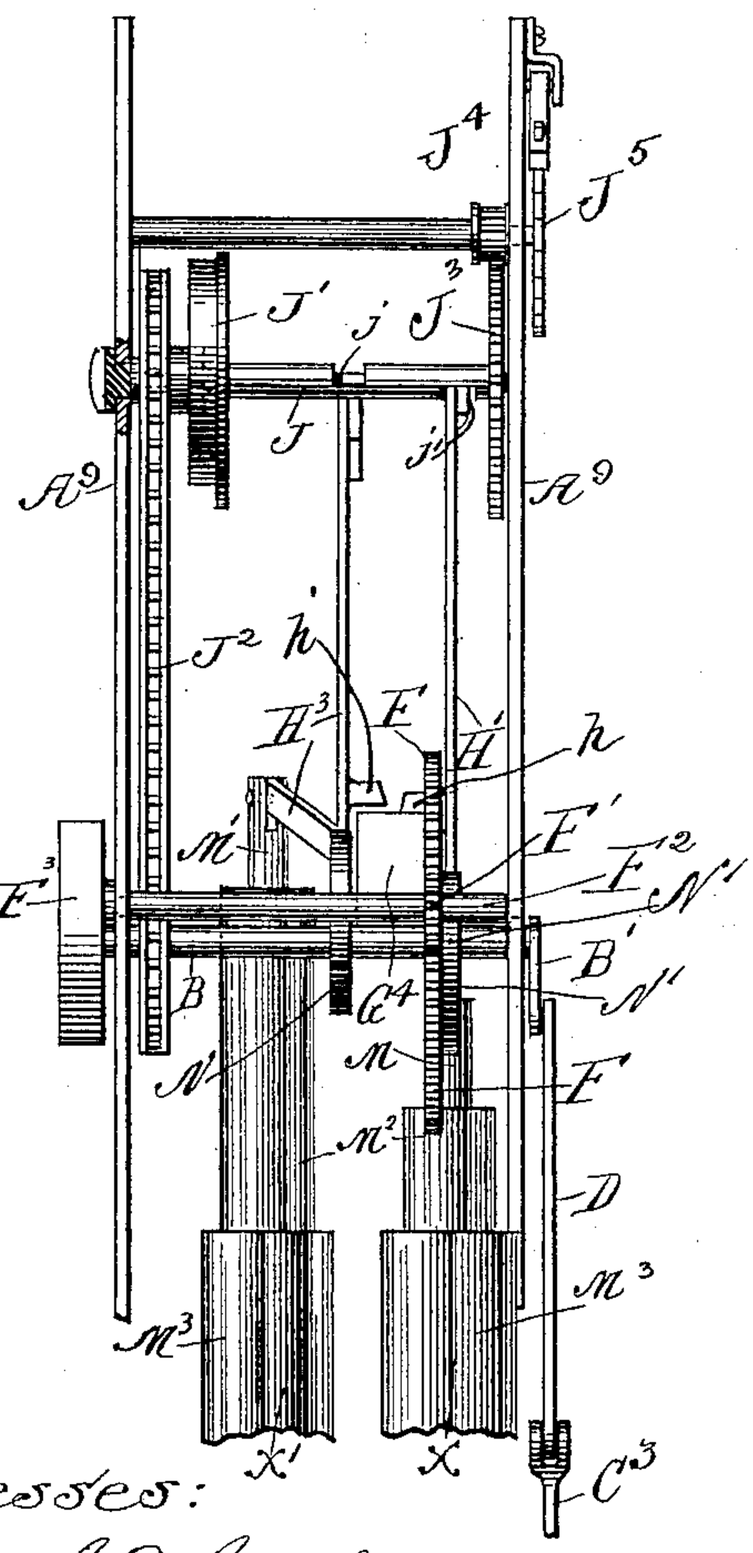


Fig. 3.



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UNITED STATES PATENT OFFICE.

AUGUSTUS L. HAHL, OF CHICAGO, ILLINOIS.

PNEUMATIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 598,066, dated January 25, 1898.

Application filed June 1, 1897. Serial No. 639,027. (No model.)

To all whom it may concern:

Be it known that I, AUGUSTUS L. HAHL, a citizen of the United States, residing at Chicago, county of Cook, State of Illinois, have invented a certain new and useful Improvement in Pneumatic Clocks; and I declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention has for its object the production of a pneumatic-clock system—that is to say, a system wherein a master clock or motor operates through a system of tubes or pipes to convey air impulses to subordinate clocks at any desired points, the air impulses acting to move the subordinate clocks in unison with the main clock or motor. Heretofore in the operation of systems of this general class it has been difficult and sometimes impossible to insure a uniform pressure for any considerable length of time in the system. This I accomplish by my present invention, which consists, essentially, in the provision of means for admitting air to and from the system independent of the air-impulsing mechanism.

The invention will be hereinafter more fully described and claimed.

In the drawings, Figure 1 is more or less of a diagrammatic view showing the mechanism in side elevations. Fig. 2 is a sectional view on the line 2 2 of Fig. 1. Fig. 3 is an elevation in the direction of arrow 3, Fig. 1.

Clock mechanisms are so well known at the present time that I will but briefly describe the parts of the old mechanism used in connection with my improvement.

A (shown in dotted lines, Fig. 1) represents any suitable drum driven from any suitable source of power—such, for instance, as a spring, a gravity-weight, or any other form of power that may be desired. This drum drives the pinion A', which, through the pinion A^2, revolves the shaft A^3, the latter revolving the gear A^4, which latter meshes with the pinion A^5. The pinion A^5 revolves the shaft A^6, which in turn revolves the gear A^7 thereon, and this gear A^7, meshing with the pinion A^8, revolves the shaft B. These parts which I have just described I will hereinafter term the "motor." It is by the revolution of this shaft B, driven as just explained, that the main impulsing mechanisms are operated. This shaft is journaled in the main frame-pieces A^9. (Shown in Fig. 2, but removed from Fig. 1.) On the end of the shaft B is a crank-arm B'. Pivoted from any suitable point of support, as at *c*, is a lever C, shaped with two arms C' C^2 and with another upwardly-extending arm C^3.

D is a pitman connecting the arm C^3 with the crank-arm B', so that a revolution of the crank-arm B' acts to tilt the lever C.

E E' are what constitute the main impulsing mechanisms. In my present application I have shown each one consisting of what is termed "bellows" mechanism, so well known in the art to which this invention pertains as a means for creating impulses that they need no further description. I would, however, have it understood at this point that my invention contemplates any other form of impulsing mechanism. I would also explain at this point that the main impulsing mechanisms E E' and the motors on the supplemental clocks (not shown) are of the well-known form, whereby a movement of the main bellows in either direction operates the supplemental motors—that is, a contracting movement of the bellows E operates the supplemental motors and also a distending movement operates the supplemental motors. The upper or movable end *e* of each of the bellows is connected by the rod or pitman E^2 with the respective arms C' C^2 of the lever C, the pitman E^2 being made adjustable, so that the length may be varied, and thus regulate the pressure exerted in the system. It will also be understood at this point that while I have in my present mechanism shown two main impulsing mechanisms and two sets of coöperative parts throughout, yet it is obvious that but a single set could be operated, although, of course, with more or less loss of the capacity of the mechanism. Located on the shaft B is a gear F and meshing therewith is a pinion F' on the shaft F^2. Carried by this shaft F^2 is a lever F^3, balanced at F^4 to compensate for the weight of the arm at the opposite side of the shaft. Journaled in the pieces A^9 is a shaft G, carrying on one end the upwardly-

projecting arm G′ and carrying also the lever G^2. The latter carries a weight G^3 for a purpose hereinafter explained. Normally the lever F^3 rests upon and is prevented from revolution by the arm G′. Carried by the outer end of the lever G^2 is a spring-pawl G^4, the pawl being held from too much movement by the pin *g*, but adapted to yield against the pressure of the spring *g′*.

H is a shaft pivoted in the side pieces A^9, carrying a lever H′. Surrounding the shaft H is a sleeve H^2, carrying a lever H^3. The pivotal points of the levers H′ H^3 are thus substantially concentric with each other, and yet the levers have a movement independent of each other. Extending from each lever H′ H^3 and toward the other is an arm shown at *h* on the lever H′ and at *h′* on the lever H^3. These arms *h h′* are alternately above and engage the pawl G^4 on the lever G^2 to normally prevent the upward tilting of the lever G^2. On the upper end of each lever H′ H^3 is a pawl, that on the lever H′ being lettered h^2 and that on the lever H^3 being lettered h^3. These pawls may of course be weighted at one end, so as to normally keep them in the desired position, or they may be spring-pawls formed in the usual well-known manner. A stop $h^\times$ is provided to limit the tilting movement of each.

J is a shaft carrying and being revolved by any of the well-known forms of spring driving-drums J′, Fig. 3, the spring being wound in any suitable manner—as, for instance, by the sprocket-chain J^2, extending up from the shaft B—so that each revolution or partial revolution of the shaft B operates through the sprocket-chain J^2 to wind up the spring which revolves the shaft J. The revolution of this shaft J is governed by any suitable form of escapement mechanism, and in this instance I have shown on the shaft the gear J^3, meshing with the pinion J^4 and the usual escapement-wheel J^5. This mechanism which I have just described constitutes what I will term the "time" mechanism and is the well-known form.

I would at this point state that I prefer to so construct the spring for revolving the shaft J that it is never completely unwound in giving the shaft a single revolution, so that even if the main motor stops the shaft J will continue to be revolved until the load on the motor is relieved, as hereinafter explained, and the spring for revolving the shaft J will again be wound up.

It will be observed by reference to Fig. 3 that the shaft J is provided with two notches *j j′*, disposed on opposite sides of the shaft and also disposed so that the pawl h^2 will register opposite one notch, while the pawl h^3 will register opposite the other notch. It will thus be seen that as the shaft J revolves the pawl h^2 or h^3, as the case may be, will prevent its respective lever H′ or H^3 from tilting until the shaft revolves to bring the notch opposite the pawl, when the weight h^4 will tilt the lever. It will be observed that each lever H′ H^3 is of substantially bell-crank form, with an additional arm H^4 on each lever. Pivoted to the lever H′ at *m* is a rod M, a similar rod M′ being pivoted to the lever H^3. On the end of each rod M M′ is a cylinder M^2, having an open end downward. Suitably sustained from any convenient point is a larger cylinder M^3, having an open upper end, the cylinder M^2 loosely fitting within the cylinder M^3 and capable of movement up and down therein. Extending up from the bottom of the cylinder M^3 is a pipe M^4, having its end terminating within the cylinder M^2. The cylinder M^3 is filled with any suitable fluid, preferably mercury, so that when the cylinder M^2 is in its lower position its mouth is sealed; but when in its upper position the outer air has free access to the cylinder M^2, and consequently to the pipe M^4. This pipe M^4 extends to and taps the main service-pipe E^3, extending from the impulsing mechanism. Of course the lever H^3 is provided with a valve mechanism similar to that which I have just described, and the main service-pipe connected with one main impulsing mechanism E is tapped by the pipe M^4 from one valve mechanism, which we will letter X, while the main service-pipe from the other impulsing mechanism E′ is tapped by the other valve mechanism, which we will letter X′.

It is obvious that instead of the particular form of liquid-valve mechanism which I have herein described I might use any other form of valve, but I prefer the form shown.

Located on the shaft B are two cams N N′, disposed on opposite sides of the shaft and also disposed to register with the respective arms H^4 on the levers H′ H^3, so that a revolution of the shaft B will cause the cams N N′, as the case may be, to strike the arm H^4 on its respective lever H′ H^3 and tilt the latter, so as to throw the cylinder M^2 to its lower or sealed position. Pivoted to an arm g^2 on the lever G^2 is an arm g^3, having on its end a projection g^4. The outer end of the arm g^3 is sustained and guided by the pins g^5 g^6. On the face of the gear F are two projections P P′, disposed at opposite points with respect to the shaft and adapted successively to come into contact with the projection g^4 on the arm g^3 and move the latter longitudinally, and thus tilt the lever G^2 for the purpose hereinafter explained.

I will now describe the operations of the mechanisms. The parts are so arranged that the shaft J will revolve a half-revolution every minute, although, of course, it is obvious that the action of the parts might be arranged to take place at other predetermined intervals. In my present mechanism, however, we will assume that an impulse takes place every minute. It should be remembered that in the present mechanism there are two sets of impulsing mechanisms and two sets of valves, and that when the air in the service-pipe connected with the mechanism E is be-

ing compressed and an impulse created thereby the air in the mechanism E′ is being relieved of pressure by the upward movement of the bellows and an impulse created by such action. Normally the lever H′ is held in the position shown in Fig. 1 by the pawl h^2 coming into contact with the shaft J, but as the notch j' turns around until it registers with the pawl h^2 the latter is relieved and the weight h^4 tilts the lever H′ and pulls up the cylinder M^2, thus opening the service-pipe to the outer air. This tilting movement of the lever H′ has carried the arm h away from the pawl G^4 on the lever G^2 and allowed the weight G^3 to tilt the lever G^2, and thus carry the arm G′ away from the end of the lever F^3. As before explained, this lever F^3 is connected up with the shaft B, so that when the arm G′ clears the lever F^3 the shaft B is permitted to rotate, being driven by the motor, as before explained. As soon as the shaft B commences to rotate it carries the cam N′ against the arm H^4 on the lever H^3, and as the shaft B continues to rotate the cam quickly tilts the lever, so that its cylinder M^2 is carried down into the cylinder M^3 and the service-pipe thus closed to the external air, the pawl h^3 engaging the shaft J and holding the lever in its tilted position. The same revolution of the shaft B has revolved the crank-arm B′ and through the pitman D has tilted the lever C, and thus caused a movement of the main impulsing mechanism and sent an impulse through the service-pipe. In my present mechanism it is designed that the lever F^3 should revolve four times before it is again stopped. After, say, the third revolution one of the projections P or P′ has reached the end of the lever g^3 and pressing against it moves it from the position shown by dotted lines to its full position. This movement tilts the arm G′ back to the position shown in Fig. 1, so that at the next revolution of the lever F^3 it will engage and stop the lever, and consequently the revolution of the shaft B, the lever G^2 being prevented from tilting back after the projection P passes the arm g^3 by the pawl G^4 engaging the arm h' on the lever H^3. It should be further explained that the shaft B in the present mechanism makes only a half-revolution for each minute or for each impulse, and it should also be explained that when the shaft B is at rest the crank-arm B′ and the pitman D have not quite reached the dead-center, so that for the first part of the revolution of the shaft B there will be no perceptible movement of the lever C, and consequently of the impulsing mechanism, this giving the cam time to tilt the lever to close the valve before the impulsing mechanism operates.

It will thus be seen from the above description that the following action takes place: Starting with the mechanism in the position shown in Fig. 1, the relief and tilting of the lever H′ will act to open the valve X and, as above explained, will release the stop-arm, so that the motor starts to revolve the shaft B. Immediately the cam N′ tilts the lever H^3 and closes the valve X′, and this is immediately succeeded by the compressing action of the impulsing mechanism E′. Of course the movement of the parts to compress the bellows E′ has also distended the bellows E, and thereby created an impulse by the release of pressure in the service-pipe and secondary clocks connected therewith, as previously explained. The parts now remain in this position until the end of the minute, when the lever H^3 is released from the shaft J, and the valve X′ thus opened the cam N tilts the lever H′ and closes the valve X. Then the bellows E is compressed and the bellows E′ distended. Thus I have provided, in addition to each impulsing mechanism, a valve by means of which the service-pipe is opened to the external air after each impulse by compression and just before or coincident with the return of the impulsing mechanism to make the next impulse by the release of said pressure, the valve of course closing before the next compressing movement. The result is that the impulsing mechanism on its downward or compressing movement always has substantially the same pressure to act against at the beginning of its stroke—that is to say, atmospheric pressure—and thus the full stroke is utilized, while the opening of the service-pipe just before or coincident with the impulse created by the upward or releasing movement of the impulsing mechanism acts, if necessary, to aid this impulsing mechanism in its return movement by relieving the pressure in the service-pipe, or if there should be a vacuum due to leaky pipes by relieving said vacuum. This prevents the stoppage of the motor, which might otherwise occur from overpressure in the system or the diminishing of the motive power from the drying of the oil or the thickening of the oil when exposed to severe cold, for the reason that even if the motor has not sufficient power to make the impulsing mechanism complete its compressing stroke, yet there will be sufficient to move the supplemental clocks, and at the end of the minute the valve opens. The pressure is thereby relieved, and the motor is strong enough to make the impulsing mechanism complete its downward stroke and then start on its upward stroke. On the other hand, if after the compressing stroke some of the air leaks out, thus creating a vacuum, the opening of the valve will destroy the vacuum and the impulsing mechanism be permitted to complete its upward stroke.

Among other advantages of this construction are that it reduces the size of the motor and amount to power to run it by a large percentage and that it removes the necessity of having especially-trained experts to handle the system successfully.

While I have shown each valve connected with its respective service-pipe, yet it is obvious that each might be connected with its

system at other points and still come within the scope of my invention.

It is also obvious that numerous other details of the construction might be altered without departing from the spirit of the invention, which consists, essentially, in the production of means independent of the impulsing mechanism for governing the admission of air to and from the system.

What I claim is—

1. In a pneumatic-clock system the combination with the air-impulsing mechanism and mechanism for operating the same of mechanism for governing the admission of air to and from the system independent of the air-impulsing mechanism, substantially as described.

2. In a pneumatic-clock system the combination of an impulsing mechanism, mechanism for operating the same a service-pipe, and means independent of the impulsing mechanism for governing the admission of air to and from the service-pipe, substantially as described.

3. In a pneumatic-clock system the combination of an impulsing mechanism, mechanism for operating the same a service-pipe, and means independent of the impulsing mechanism for opening the service-pipe to the external air, substantially as described.

4. In a pneumatic-clock system the combination of an impulsing mechanism, mechanism for operating the same a service-pipe, and a valve independent of the impulsing mechanism for governing the admission of air to and from the service-pipe, substantially as described.

5. In a pneumatic-clock system the combination of an impulsing mechanism, mechanism for operating the same a service-pipe and a valve independent of the impulsing mechanism for opening the service-pipe to the external air, substantially as described.

6. In a pneumatic-clock system the combination of a motor an impulsing mechanism operated thereby, a service-pipe connected with the impulsing mechanism, a lever adapted to open and close communication between the service-pipe and the external air, means whereby said motor may move the lever in one direction and a time mechanism working independent of the motor controlling the movement of the lever in the opposite direction, substantially as described.

7. In a pneumatic-clock system the combination of a motor, an impulsing mechanism operated thereby, a service-pipe connected with the impulsing mechanism, means for governing admission of air to and from the service-pipe independent of the impulsing mechanism and means between the motor and said governing means for closing the admission of air to the service-pipe before the movement of the impulsing mechanism to create an impulse, substantially as described.

8. In a pneumatic-clock system the combination of a motor, an impulsing mechanism operated thereby, a service-pipe connected with the impulsing mechanism, a valve for governing admission of air to and from the service-pipe independent of the impulsing mechanism and means between the motor and valve for closing the valve before the impulse is started by the impulsing mechanism, substantially as described.

9. In a pneumatic-clock system the combination of a motor, an impulsing mechanism operated thereby, a service-pipe connected with the impulsing mechanism, means for governing admission of air to and from the service-pipe independent of the impulsing mechanism and a time mechanism adapted to release said governing mechanism and allow it to open the service-pipe, substantially as described.

10. In a pneumatic-clock system the combination of a motor, an impulsing mechanism operated thereby, a service-pipe connected with the impulsing mechanism, a valve for governing the admission of air to and from the service-pipe independent of the impulsing mechanism and a time mechanism adapted to release said valve and allow it to open the service-pipe, substantially as described.

11. In a pneumatic-clock system the combination of a motor, an impulsing mechanism operated thereby, a service-pipe connected with the impulsing mechanism, a valve for governing the admission of air to and from the service-pipe independent of the impulsing mechanism, time mechanism for controlling the movement of the valve in one direction, stop mechanism connected with the impulsing mechanism and intermediate mechanism between said stop mechanism and the valve whereby a movement of the valve releases a stop mechanism, and allows the impulsing mechanism to operate, substantially as described.

12. In a pneumatic-clock system the combination of a motor, an impulsing mechanism operated thereby, a service-pipe connected with the impulsing mechanism, a valve for governing the admission of air to and from the service-pipe independent of the impulsing mechanism, time mechanism for controlling the movement of the valve in one direction, stop mechanism connected with the impulsing mechanism, intermediate mechanism between said stop mechanism and the valve whereby a movement of the valve releases the stop mechanism and allows the impulsing mechanism to operate, and means connected with the motor for returning the parts to their normal position, substantially as described.

13. In a pneumatic-clock system the combination of a motor, two sets of impulsing mechanisms operated thereby, a service-pipe for each impulsing mechanism, a valve for governing the admission of air to and from each service-pipe independent of the impulsing mechanism, a single set of time mechanism for controlling the movement of each valve in one direction, a single set of stop mechanism con-

nected with the impulsing mechanisms, and a single set of intermediate mechanism between said stop mechanism and the valves whereby a movement of the valves on being released by the time mechanism releases the stop mechanism and allows the impulsing mechanisms to operate, substantially as described.

14. In a pneumatic-clock system the combination of a motor, two sets of impulsing mechanisms operated thereby, a service-pipe for each impulsing mechanism, a valve for governing the admission of air to and from each service-pipe independent of the impulsing mechanism, a single set of time mechanism for controlling the movement of each valve in one direction, a single set of stop mechanism connected with the impulsing mechanisms, a single set of intermediate mechanism between said stop mechanism and the valves whereby a movement of the valves on being released by the time mechanism releases the stop mechanism and allows the impulsing mechanisms to operate, and means connected with the motor for returning the parts to their normal position, means for each valve connected with the motor for returning the valves to their closed position and means connected with the motor for returning the stop mechanism to its normal position, substantially as described.

In testimony whereof I sign this specification in the presence of two witnesses.

AUGUSTUS L. HAHL.

Witnesses:
W. H. CHAMBERLIN,
DE WITT W. CHAMBERLIN.