4 Sheets—Sheet 1.

# W. COWAN.

## Gas-Regulator.

**No. 216,556.** **Patented June 17, 1879.**

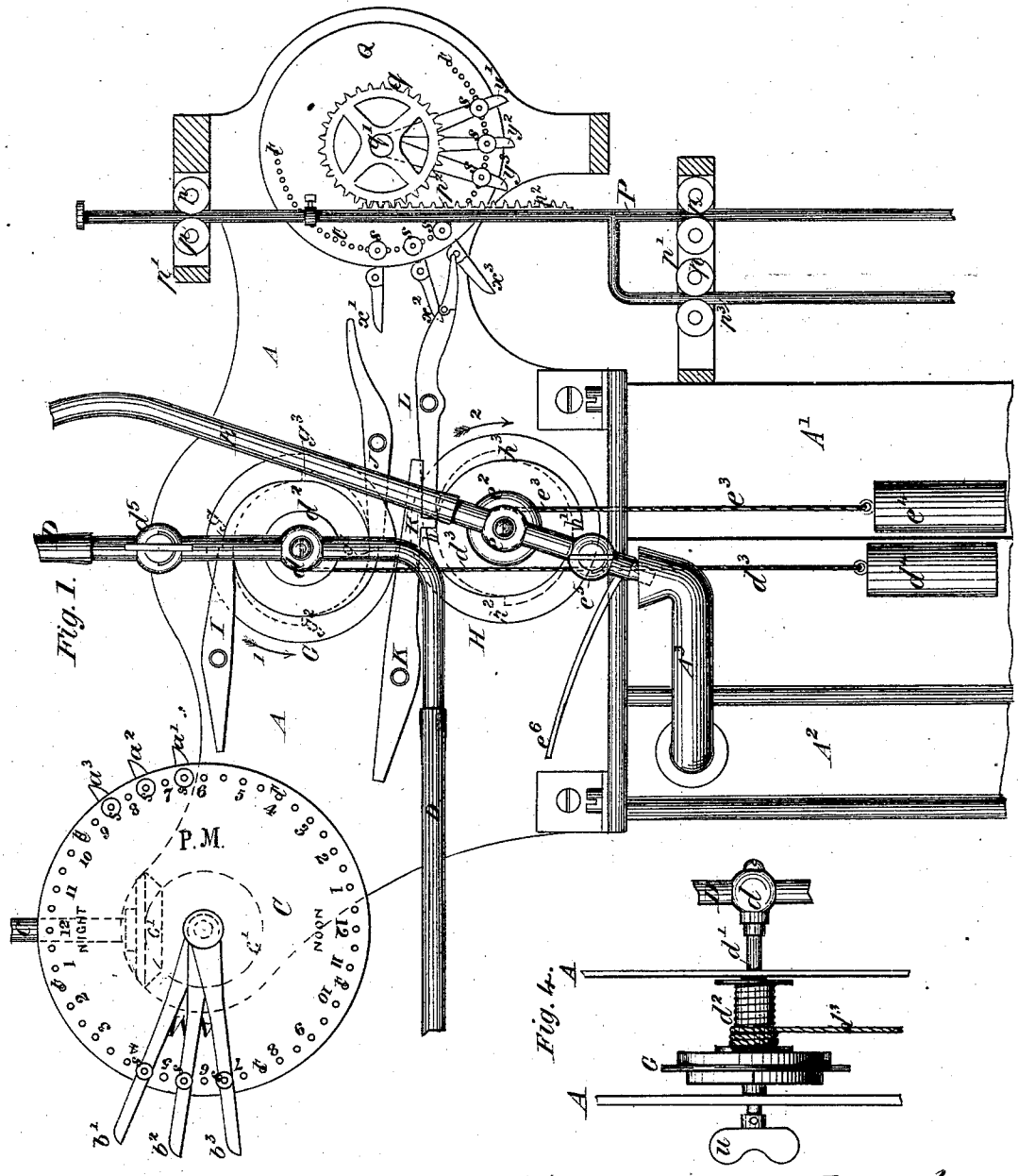



Fig. 1.



Fig. 4.

Attest:
Walter Allen
Geo. T. Smallwood Jr.

Inventor:
William Cowan.
By. Knight Bros
attys

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

4 Sheets—Sheet 2.

# W. COWAN.

## Gas-Regulator.

No. 216,556. Patented June 17, 1879.

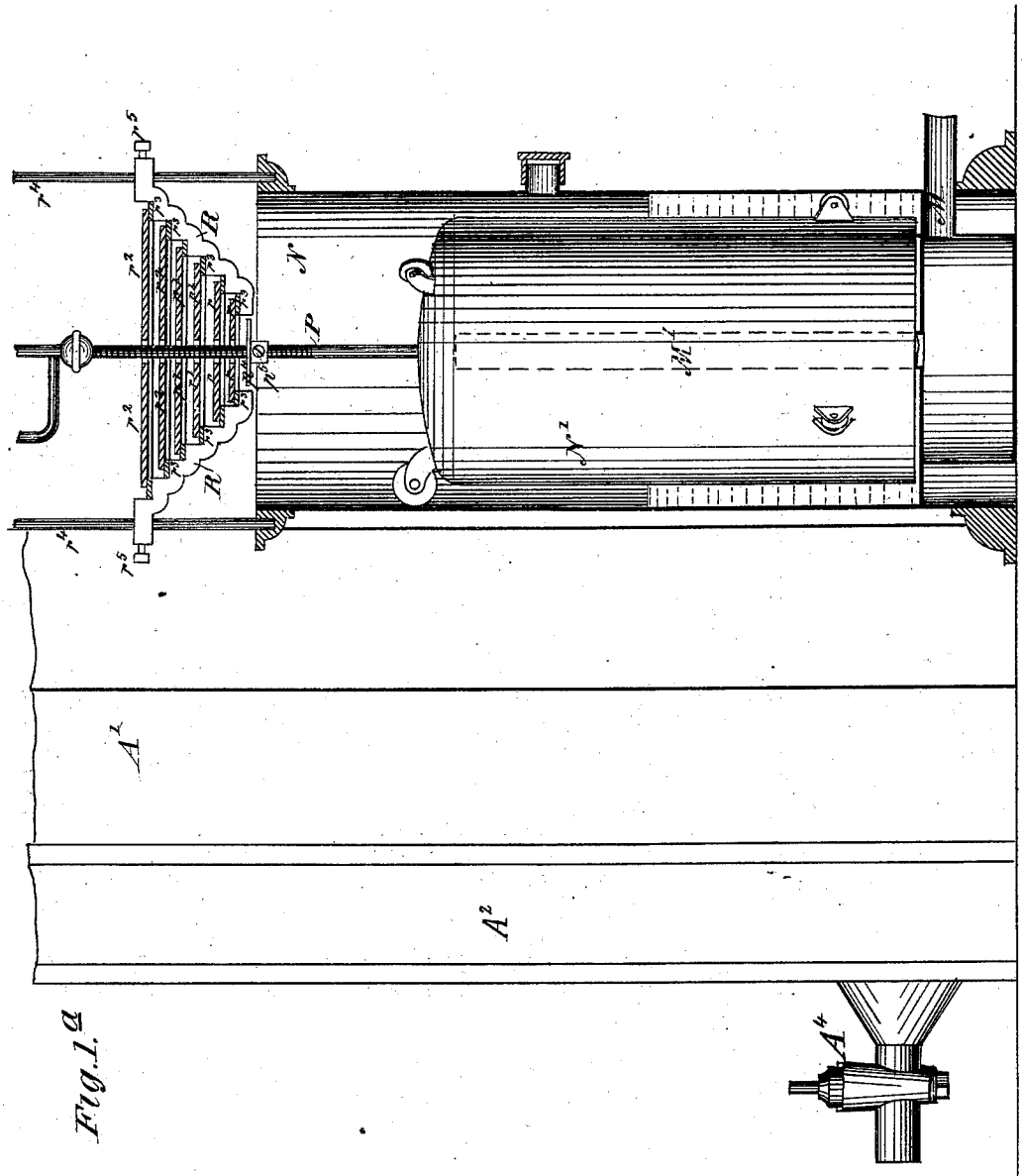



Fig. 1.a

Attest
Walter Allen
Geo. T. Smallwood Jr.

Inventor:
William Cowan
By. Knight Bros
Attys

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

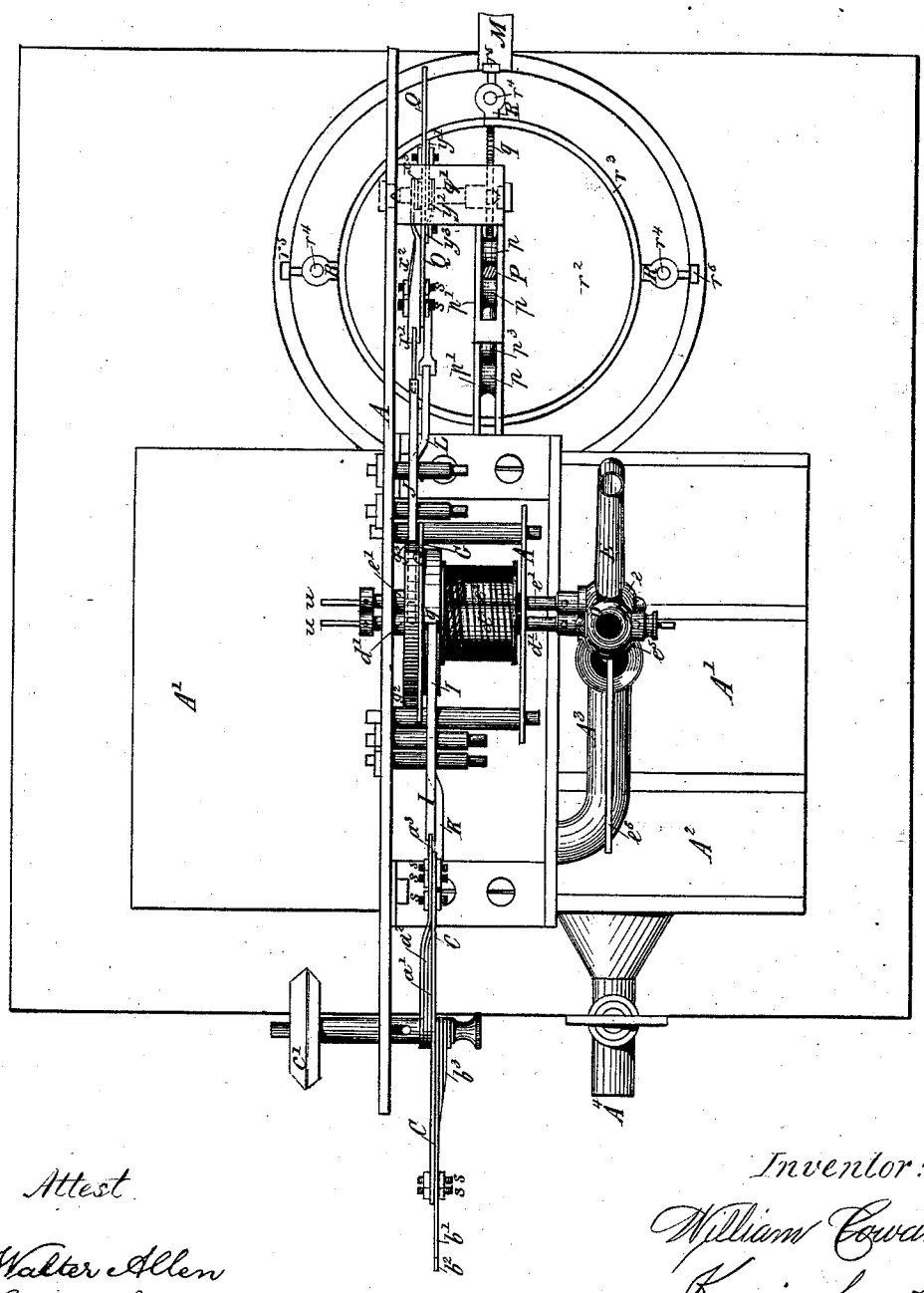
4 Sheets—Sheet 3.

# W. COWAN.

## Gas-Regulator.

No. 216,556. Patented June 17, 1879.

Fig 2.



Attest

Walter Allen

Geo. T. Smallwood Jr

Inventor:

William Cowan

By Knight Bros

Attys.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

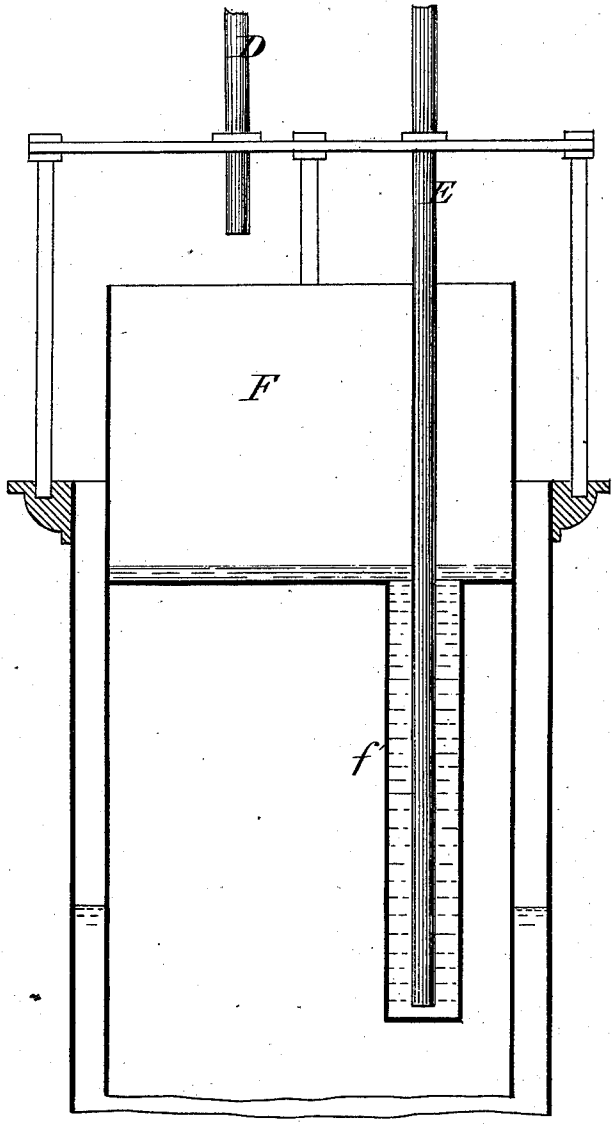
4 Sheets—Sheet 4.

# W. COWAN.

## Gas-Regulator.

**No. 216,556.** **Patented June 17, 1879.**

*Fig. 3.*




*Inventor:*

*William Cowan*

*By Knight Bros*

*Attys.*

*Attest:*

*Walter Allen*

*Geo. T. Smallwood Jr*

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

# UNITED STATES PATENT OFFICE.

WILLIAM COWAN, OF EDINBURGH, COUNTY OF MID-LOTHIAN, NORTH BRITAIN.

## IMPROVEMENT IN GAS-REGULATORS.

Specification forming part of Letters Patent No. **216,556**, dated June 17, 1879; application filed October 5, 1878; patented in England, July 5, 1878.

*To all whom it may concern:*

Be it known that I, WILLIAM COWAN, of Edinburgh, in the county of Mid-Lothian, North Britain, gas-meter manufacturer, have invented an Apparatus for Automatically Varying the Load and Pressure in Gas-Governors, of which the following is a specification.

My said invention relates to an apparatus for automatically varying the load and pressure in gas-governors; and has for its object to produce the increase of pressure required during the time when a large quantity of gas is being burned—as, for instance, during the night—and to reduce that pressure when a less quantity of gas is burned—for instance, during the day. The apparatus constituting this invention is not limited in its application to any special form of gas-governor, but is applicable to gas-governors generally.

The functions which the apparatus has to perform are, first, to supply water or other liquid—such as glycerine—so as to increase the load on the governor at the time when it is required to raise the pressure of gas; and, secondly, to draw off water or other liquid therefrom, so as to reduce the load on the governor when it is required to decrease the pressure. The automatic regulating of these operations is effected by means of a clock or other time-keeper giving motion to a disk provided with one or more tappets, which at stated periods operate mechanism to open a tap or cock on a pipe, through which liquid flows from a reservoir into a receptacle on the bell of the gas-governor, thus increasing the load and pressure, the said disk being also provided with one or more other tappets, which, at certain other stated periods, operate mechanism whereby a tap or cock upon a pipe is opened so as to withdraw the liquid from the bell of the governor, and thereby reduce the load and pressure thereon. Other mechanism is also provided for being operated by the pressure of the gas in the mains, which mechanism, in the case of the gas-pressure being increased, will, when the load has, on the governor, been raised to the desired extent, stop the supply of liquid to the governor, and which mechanism, in the case of the pressure of gas being reduced, will, when the load in the governor has been decreased to the required extent, stop the discharge of the liquid from the governor.

In the drawings, Figure 1 represents a front elevation of the upper part of apparatus for the aforesaid purpose constructed according to my invention, the lower part of the said apparatus being represented in Fig. 1ª. Fig. 2 is a plan of the same. Fig. 3 is a diagram illustrating, in section, the upper part of a governor the load and pressure of which are to be varied by my said apparatus. Fig. 4 is a detail, hereinafter referred to.

The same parts are marked with similar letters of reference in all the figures.

The mechanism is carried by side plates or framings A A, mounted upon a stand, $A^1$. A disk, C, has a motion of rotation imparted to it at any desired or convenient speed from a clock or other time-keeper, (not shown in the drawings,) the said motion being transmitted to the said disk through the shaft *c*, Fig. 1, and bevel-wheels *c'* *c'*. On this disk are fixed tappets $a^1$ $a^2$ $a^3$ and $b^1$ $b^2$ $b^3$, the office of the tappets $a^1$ $a^2$ $a^3$ being to operate the mechanism for increasing the load and pressure upon governor, and the office of the tappets $b^1$ $b^2$ $b^3$ being to operate the mechanism for decreasing the said load and pressure.

The pipe marked D leads from a reservoir to any position above the vessel F upon the bell of the governor for the weighting-liquid; (see Fig. 3;) and the pipe marked E is a siphon, the shorter end dipping into the liquid in the vessel F, Fig. 3, upon the bell of the governor to be loaded by my apparatus, a deep well, *f*, being, by preference, formed in the said bell, to insure that the end of the siphon constantly dips into liquid and does not become unsealed whatever may be the position of the bell of the governor.

The pipe D is provided with a tap or cock, *d*, and the siphon E is provided with a cock, *e*. The plugs of these cocks are formed on or carried by spindles $d^1$ $e^1$, (see Fig. 2,) supported and turning in the framing A. Each spindle carries a helically-grooved pulley (marked $d^2$ and $e^2$, respectively) and a cam or ratchet disk or wheel, which wheels are also keyed upon each spindle. The said wheels are marked G and H, respectively.

Cords or chains $d^3$ $e^3$ pass over and are wound upon the pulleys $d^2$ $e^2$, the said cords carrying weights $d^4$ $e^4$, having a tendency to turn the spindles $d^1$ $e^1$, respectively, in the direction of the arrows 1 2, Fig. 1. One of the spindles, $d^1$, (with its attachments,) is shown separately in side elevation in Fig. 4.

The wheel G upon the spindle $d^1$ is formed on one side with cam-like faces, terminating in ratchet-like stops $g$ $g^1$ diametrically opposite, and on the other side of the side wheel are formed similar cam-faces and stops $g^2$ $g^3$, also diametrically opposite, their position being midway between that of the stops $g$ $g^1$, so that there is one-fourth of the circumference of the wheel G between each two adjacent stops $g$ $g^1$ $g^2$ $g^3$. The tendency of the weight $d^4$ to turn the spindle $d^1$ in the direction of the arrow 1 is overcome either by one or other of the stops $g$ $g^1$ bearing against the end of the lever I, or by one or other of the stops $g^2$ $g^3$ bearing against the end of the lever J.

When either of the stops $g$ or $g^1$ bears upon the lever I the plug of the cock or tap $d$ will be in a position to close the passage for liquid through the pipe D; but the said plug will be in a position which opens the said passage when either of the stops $g^2$ or $g^3$ bears upon the lever J. The wheel H is similarly formed to the wheel G, it having upon one side stops $h$ $h^1$, and on the other side stops $h^2$ $h^3$, in a position midway between the stops $h$ $h^1$. The tendency of the weight $e^4$ is to turn the spindle $e^1$ in the direction of the arrow 2, and this tendency is overcome either by one or other of the stops $h$ $h^1$ bearing against the lever K, or by one or other of the stops $h^2$ $h^3$ bearing against the end of the lever L. In the former case the plug of the cock or tap upon the siphon E is in a position which closes the passage therethrough, and in the latter case the said plug opens the said passage.

The pipe M and its continuation M′, Fig. 1ª, lead from the gas-mains beyond the outlet of the governor to the interior of a bell, N′, dipping into liquid in a vessel, N. This bell and vessel somewhat resemble a small gas-holder; and the bell may be floated by air-vessels, counterbalance-weights, or otherwise, as may be desired, after the manner in which the bells or diaphragm of gas-governors are ordinarily floated or counterweighted.

The bell N′ carries at its top a long rod, P. This rod, as also the stand $A^1$, is shown partly broken away in Fig. 1. The said rod P is supported between roller-guides $p$ $p$ carried by brackets $p^1$ $p^1$, steadiness of movement being insured by a parallel guiding-rod, $p^3$, also running in roller-guides carried by the said brackets $p^1$. There may be any desired number of these guide-brackets. Upon the said rod P is formed a rack, $p^2$, which engages with a toothed wheel, $q$, fixed upon an axis, $q'$, upon which axis is also fixed a disk, Q, provided with a number of tappets, $x^1$ $x^2$ $x^3$, which project on one side of the said disk, and are in the same vertical plane as the tail of the lever J, so as to come into contact therewith, as hereinafter described; but the said tappets pass clear of the lever L. The said disk Q also carries tappets $y^1$ $y^2$ $y^3$, they projecting from the other side of the said disk, and being in the same vertical plane as the tail of the lever L, so as to act thereon as hereinafter described; but the said tappets pass clear of the lever J.

The tappets $a^1$ $a^2$ $a^3$ on the disk C are fixed on one side of the said disk, so as to be in the same plane and come into contact with the tail of the lever I, as hereinafter described, but to pass clear of the lever K.

The tappets $b^1$ $b^2$ $b^3$ are fixed on the other side of the said disk C, and are in the path of the tail of the lever K, so as to come into contact therewith, as hereinafter described; but they pass clear of the lever I at one side thereof.

Upon the rod P is carried a disk or table, $p^4$, adjustable upon a screw formed on the said rod, and the said disk is fixed in any position to which it may be brought by a set-screw, $p^5$. This disk, when the bell N′ rises or falls, as hereinafter described, takes up or deposits weights $r$ $r^1$ $r^2$, which weights are for the purpose of controlling the effect of the pressure of the gas upon the interior of the said bell. The said weights have central holes, through which the rod P passes, and they are supported (when the bell N is depressed) upon rings $r^3$, carried by stepped supports R, adjustable upon guide-rods $r^4$, and fixed in position by set-screws $r^5$.

The tappets of the disk C, and also those of the disk Q, are attached thereto in any convenient way, so that they may be brought into any position upon the said disk.

In the drawings I have represented the said tappets as being formed of strips of metal having an eye at one end, which passes over the spindles upon which the said disks turn, they being secured to the disk at their outer ends by screw-pins and nuts at $s$ $s$, the pins passing through holes $t$ in the said disks, so that by removing the said pins the tappets may be moved to and fixed at any desired distance apart upon the said disks.

The disk C is, as aforesaid, shown as arranged to revolve once in every twenty-four hours, and consequently the dial, divided as shown in the drawings, will pass a space between two adjacent holes during every half-hour; and the holes are marked with figures or indications, which will denote the place at which tappets should be fixed in order to operate at any particular time.

The figures or indications marked upon the disk C in the drawings, it will be evident will indicate the position for fixing but the one set of tappets for acting on the lever I, and allowance must be made in fixing the other set of tappets for the distance which the disk has to travel between the tails of the levers I and K; or in place of marking the dial as shown, separate markings may be made for each set of tappets; or the set of tappets $b^1$ $b^2$ $b^3$ may

be formed with the acting ends bent or brought forward (in advance of the hole by which they are fixed to the disk C) a distance equal to the space between the tails of the levers I K. In this case one set of markings will answer for both sets of tappets.

The tappets $x^1$ $x^2$ $x^3$ are jointed so that they act upon the lever J only during their ascent when the disk Q is rotated in one direction, and yield without acting thereon during their descent—that is to say, when the disk Q is rotated in the opposite direction. The tail of the lever L is similarly jointed, so that the tappets $y^1$ $y^2$ $y^3$ act thereon only during their descent, the said tail of the lever yielding against the said tappets during their ascent. The levers I, J, K, and L are also so weighted, or otherwise arranged, (by the pressure of springs, for instance,) that in their normal position their inner ends incline to rest upon the cam-faces or against the stops of the wheels G and H.

I will now describe the action of the apparatus, premising that the apparatus is shown in the drawings as being arranged to raise the pressure of the gas gradually by three increments of weight, each successively applied to the governor, and after a lapse of time to decrease the pressure gradually by three separate decrements. The disk C being slowly rotated from the clock or other time-piece, as aforesaid, at a certain time, for which the tappets have been adjusted, the tappet $a^1$ will come into contact with the tail of the lever I, and by depressing it will raise its other end from the stop $g$ on the wheel G. The weight $d^4$ being thus free to fall will then descend and cause the spindle $d^1$ to rotate through a quarter of a revolution—that is to say, until the stop $g^2$ comes against the lever J. The quarter-revolution of the spindle $d^1$ turns the plug of the cock or tap $d$ of the pipe D so as to open the passage therethrough, and liquid will flow through the said pipe into the vessel F, Fig. 3, at the top of the bell of the governor to be weighted.

The increase of pressure in the mains is communicated through the pipes M M′ to the under side of the bell N′, which will therefore rise, and when the desired pressure has been attained the rod P will have risen sufficiently to cause the disk $p^4$ to take up weights $r$ sufficient to control the effect of this particular pressure. The rising of the rod P will also, through the rack $p^2$ and toothed wheel $q$, give a motion of partial rotation to the disk Q, the tappets whereon, having been so arranged as to act at the desired point of time upon the tail of the lever J, will, by raising it, disengage the other end of the lever from the stop $g^2$, and the weight $d^4$, being thus freed, will, by falling, cause the spindle $d^1$ to revolve through a quarter of a revolution—that is to say, until it is stopped by the lever I coming against the stop $g^1$—in which position the plug of the cock $d$ closes the passage through the pipe D, and consequently the flow of the weighting-liquor will cease, so that the pressure is maintained constant until after another fixed interval the revolution of the disk C causes the tappet $a^2$ to act upon the lever I and again open the tap or cock $d$, when a further increase of pressure is obtained by the liquid again flowing through the pipe D. When this second degree of pressure has been attained the bell N′ will rise to a greater elevation, taking up additional weights $r^1$ $r^1$, which will control the effects of this pressure. The tappet $x^2$ will next act upon the lever J, and again cause the closing of the tap or cock $d$ in the manner hereinbefore described. After another fixed interval of time the further revolution of the disk C causes the tappet $a^3$ to effect the opening of the tap or cock $d$ and add additional weighting-liquid to the governor, and when the desired pressure has thereby been attained the bell N′ will rise to a still greater elevation, and additional weights $r^2$ will therefore be taken up to control the effect of the augmented pressure. The tappet $x^3$ will next act upon the lever J to cause the shutting of the cock $d$, and the pressure now attained will be maintained until the time or times at which the tappets $b^1$ $b^2$ $b^3$ have been arranged to act upon the lever K to operate the plug of the cock $e$ of the siphon E. At such time or times the revolution of the disk C causes the tappet $b^1$ to depress the tail of the lever K, whereby the projection at its other end is raised from the stop $h$, and the weight $e^4$ causes the spindle $e^1$ to receive a quarter of a revolution, when it will be stopped by the stop $h^2$ coming against the end of the lever L. The cock $e$ of the siphon E is thus opened, and the liquid flows therethrough from the loading-vessel F, Fig. 3, of the governor, whereby the pressure is decreased. This decrease of pressure is communicated from the mains through the pipes M and M′ to the under side of the bell N′, which consequently falls a certain distance until the tappet $y^1$ acts upon the tail of the lever L, and, by raising the other end, releases the wheel H. The weight $e^4$, being thus free to fall, gives another quarter of a revolution to the spindle $e^1$, it being stopped by the stop $h^1$ coming against the projection on the lever K. The cock $e$ is thus closed, and the siphon consequently discontinues to withdraw water from the loading-vessel upon the bell of the governor. As the bell N′ descends the weights $r^2$ are successively deposited upon their rests, and the decreased pressure of gas thus obtained will be maintained until the tappet $b^2$ acts upon the lever K to again open the cock $e$, when more liquid will be withdrawn from the loading-vessel F on the bell of the governor until the further descent of the bell N′, owing to the decrease of pressure in the mains, causes the next tappet, $y^2$, to act upon the tail of the lever L and shut the cock $e$. The weights $r^1$ $r^1$ will also now be deposited. The pressure of gas thus decreased is maintained until the tappet $b^3$ again causes the opening of the cock $e$, when more liquid is withdrawn from the vessel F,

and the decrease of pressure thus produced causes the bell N′ to descend. The tappet $y^3$ now acts upon the lever L and causes the closing of the cock, and the remaining weights upon the bell N′ will be deposited upon their rests $r^3$. The low pressure thus attained is maintained until the revolution of the disk C again causes the tappet $a^1$ to act on the lever I, when the motions and successive series of actions already described are repeated, and so on continuously until the weights $d^4$ and $e^4$ are fully run out. When this occurs the said weights are wound up again by means of handles $u$ at their backs, and the apparatus again operates as before described.

The tappets of the disks C and Q may be arranged in any desired manner to increase or decrease the pressure, as may be required, according to the seasons of the year or other circumstances; and the increasing and diminishing of the pressure may be effected at one action of the tappets, in which case but one tappet $a^1$ and one tappet $b^1$ will be required upon the disk C; or two or a greater number than three such tappets may be employed to increase or decrease the pressure in any manner, as may be desired. In all cases the tappets upon the disk Q are of a number and disposed in a manner corresponding with the number and arrangement of the tappets of the disk C, so that after a tappet of the said disk C has opened the cock $d$ or the cock $e$ to increase or to diminish the pressure, as soon as the requisite degree of increased or diminished pressure is attained a tappet upon the disk Q will cause the closing of the tap $d$ or the tap $e$ which has been so opened by the tappet of the disk C.

The pipe D and siphon E are each provided with additional taps (marked $d^5$ and $e^5$, respectively,) by which the rate of the liquid passing into or being withdrawn from the vessel F on the bell of the governor may be regulated; and the siphon E is provided with a mouth-tube, $e^6$, by which the siphon may be filled should it accidentally become emptied. The liquid from the siphon E may be discharged into a tank, $A^2$, through a pipe, $A^3$, and it may be discharged from the said tank by opening the stop-cock $A^4$.

The gas-pipe M is provided with a cock, by which the entry of gas to the interior of the bell N′ may be regulated.

It will be evident that many modifications and variations of the mechanism constituting my apparatus may be adopted. For example, the tappets $x$ and $y$ may be upon the rod P itself instead of upon a disk, Q, actuated by the said rod, in which case the said tappets will be made capable of adjustment at various distances apart upon the said rod. The weights taken up by the disk $p^4$ may be arranged so as to be taken up either the whole of each weight (which is to regulate a certain pressure) at one time, or each weight may be subdivided into two or more portions, so that its separate portions may be taken up successively at two, as shown and described, or at more than two, periods of the ascent of the bell N′ between any two given points of pressure. By thus subdividing the weights the pressure upon the bell N′ may be gradually accumulated or gradually decreased during the ascent or during the descent of the bell between any two points of pressure. The weights $r$ may also be supported in various ways other than that shown. They may, for instance, be supported at various distances apart in a cylinder provided with slots of various depths, in which cylinder the weights will be held at different heights by pins upon the said weights resting in the said slots. This will allow of the weights being all of the same diameter.

The plugs of the cocks $d$ and $e$ may also be upon the other end of the spindles $d^1$ $e^1$, the pipe D and the siphon E being in this case at the back instead of at the front of the apparatus.

In place of using a siphon E for drawing off the liquid, as hereinbefore described, a pipe partly flexible or mechanically jointed, communicating with the loading-vessel by a tap, may be substituted, so that the liquid which loads the governor is drawn off therethrough as the pressure is by the reduction of the load being decreased. This pipe and tap or cock are, however, equivalents of the siphon E and cock $e$.

Having now described and particularly ascertained the nature of my said invention, and the system, mode, or manner in or under which the same is or may be used or practically carried into effect, I would observe, in conclusion, that I wish it to be understood that I do not limit myself to the precise details hereinbefore described, and illustrated in the accompanying drawings, as the same may be varied without departing from the nature of my invention; but—

What I consider to be novel and original, and therefore claim, is—

1. In a gas-regulator, the clock-work-actuated disk C, having adjustable tappets on each side, lever I, cam-wheel G, having ratchet-stops on each face, disk Q, having adjustable tappets on each side, weights $r$ $r^1$ $r^2$, levers J, K, and L, and cam-wheel H, having ratchet-stops on each face, substantially as and for the purposes described.

2. In a gas-regulator, the pipe D, cock $d$, spindle $d^1$, turning in the framing A and carrying said cock, weighted helically-grooved pulley $d^2$, and cam-wheel G, arranged and operated substantially as and for the purpose set forth.

3. In a gas-regulator, the siphon E, cock $e$, spindle $e^1$, turning in the framing A and carrying said cock, weighted helically-grooved pulley $e^2$, and cam-wheel H, arranged and operated substantially as and for the purpose set forth.

4. In a gas-regulator, the bell N′, sliding vertically within the vessel N, and operating a rod, P, adapted to actuate the disk Q, hav-

ing adjustable tappets, substantially as set forth.

5. In a gas-regulator, the rod P, supported in roller-guides $p$ and guided by the rod $p^3$, and having rack $p^2$, for engagement with a toothed wheel, $q$, on the disk Q, substantially as and for the purpose set forth.

6. In a gas-regulator, the rod P, adjustable disk $p^4$, weights $r$ $r^1$ $r^2$, rings $r^3$, and supports R, for controlling the effect of the pressure upon the interior of the bell, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM COWAN. [L. S.]

Witnesses:

JAMES ALEXANDER STRACHAN,
85 *Constitution Street, Leith.*

WILLIAM HENRY COWAN,
5 *Colinton Road, Edinburgh.*