(No Model.)

3 Sheets—Sheet 1.

J. A. STEININGER.

AUTOMATIC PUMP GOVERNOR.

No. 417,112. Patented Dec. 10, 1889.

Fig. 2.

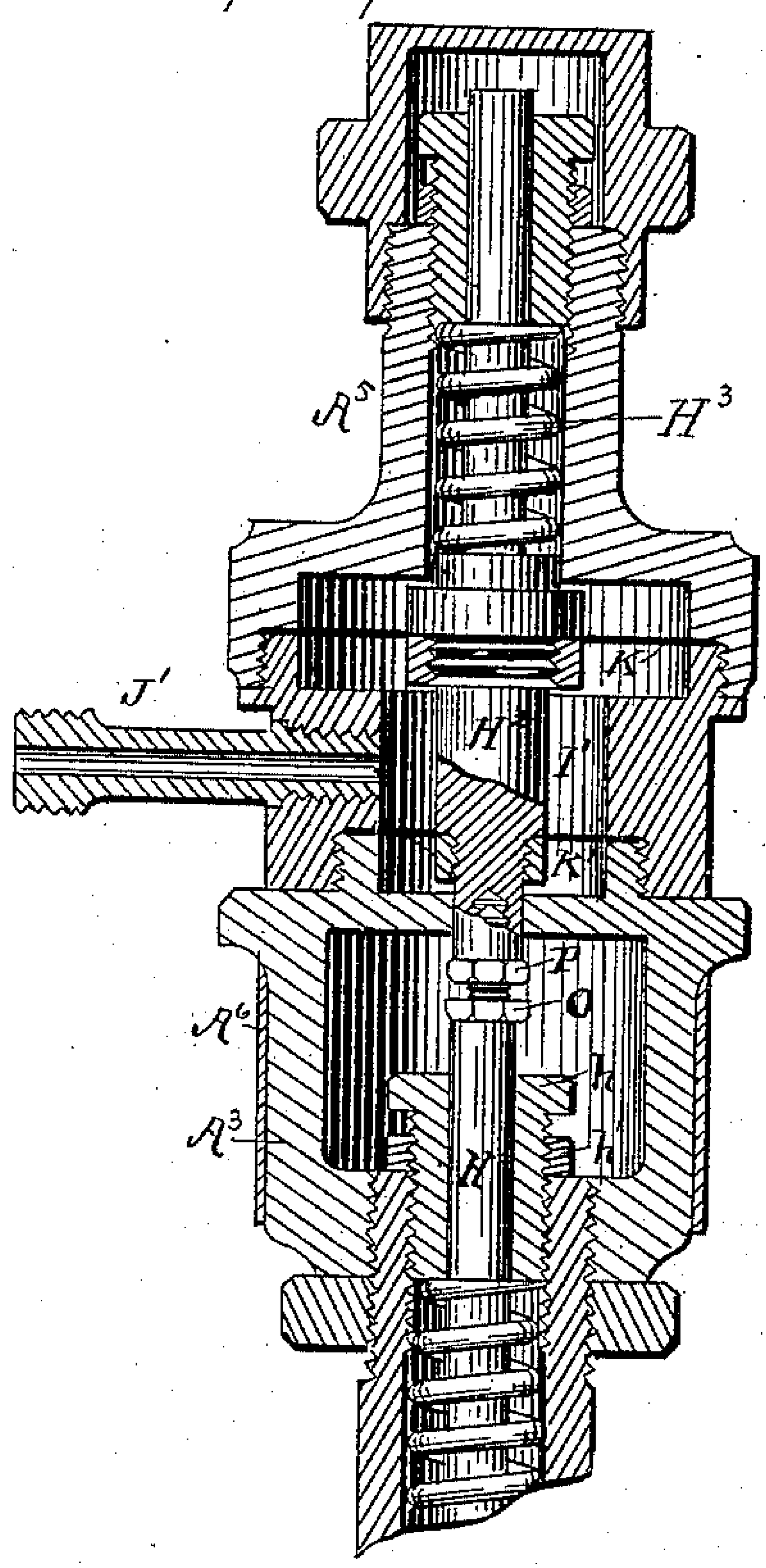


Fig. 1.

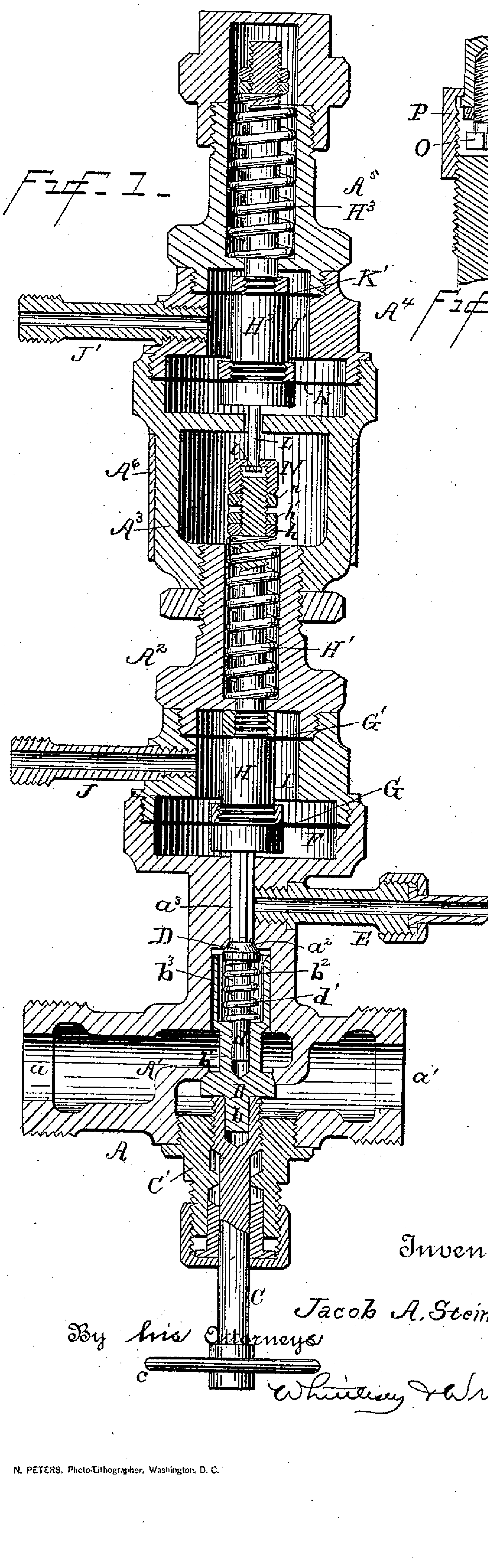


Fig. 4.

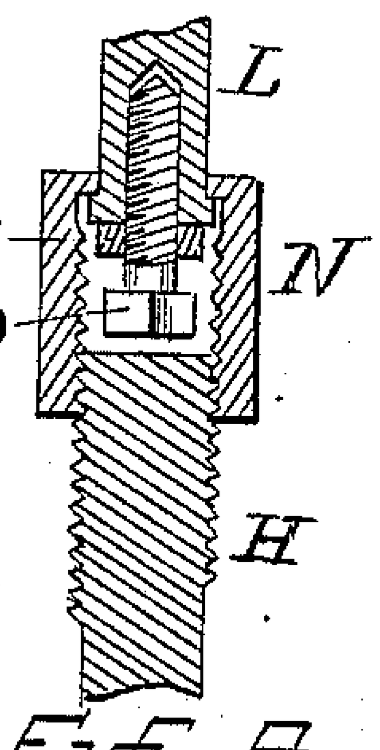
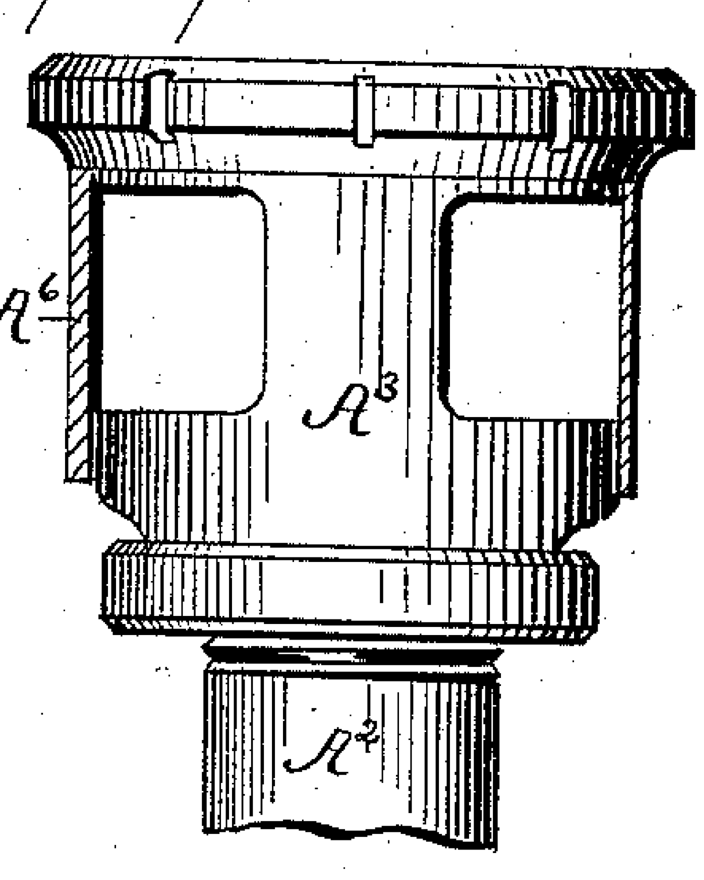


Fig. 3.



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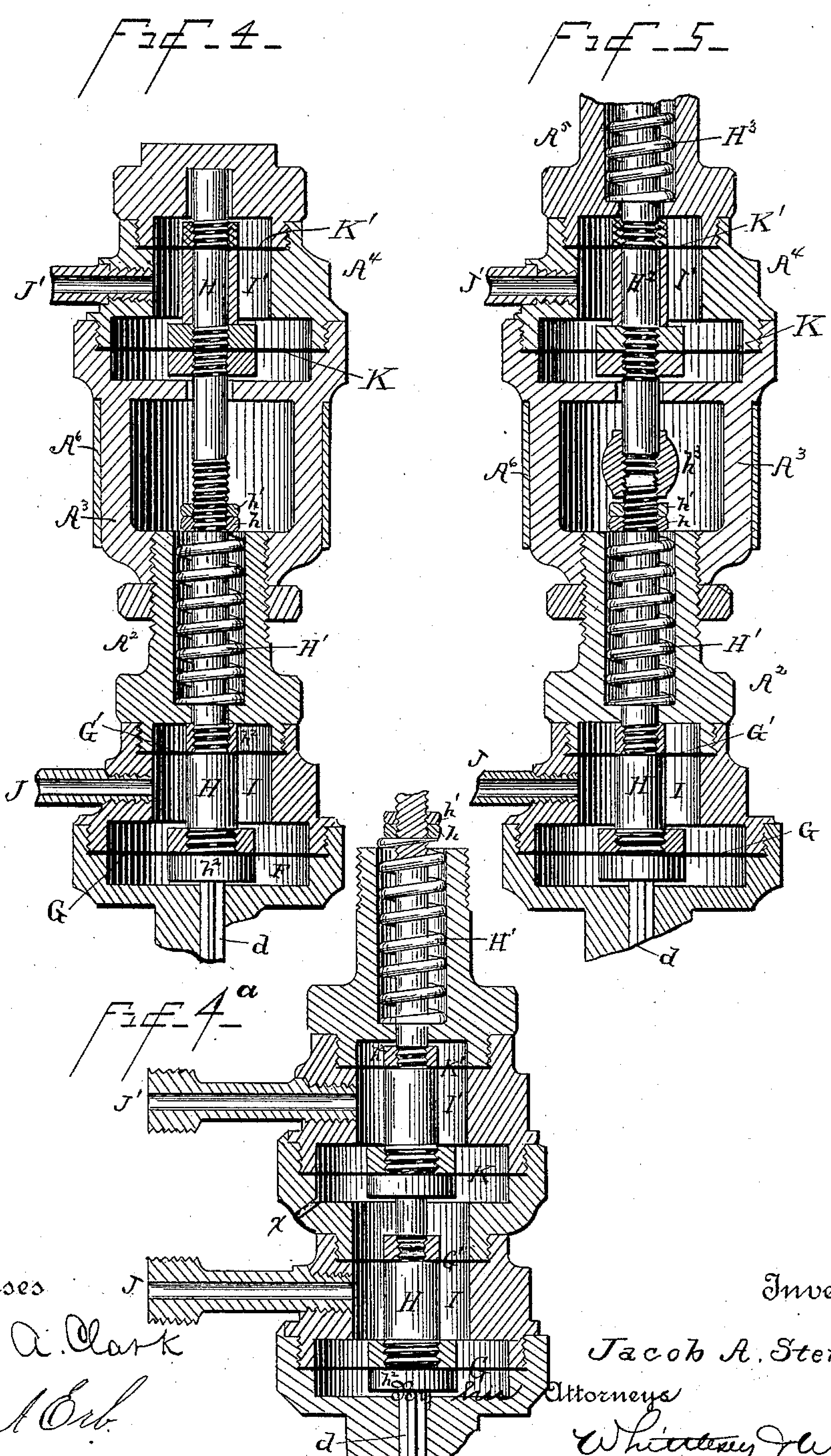

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AUTOMATIC PUMP GOVERNOR.

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Fig. 8

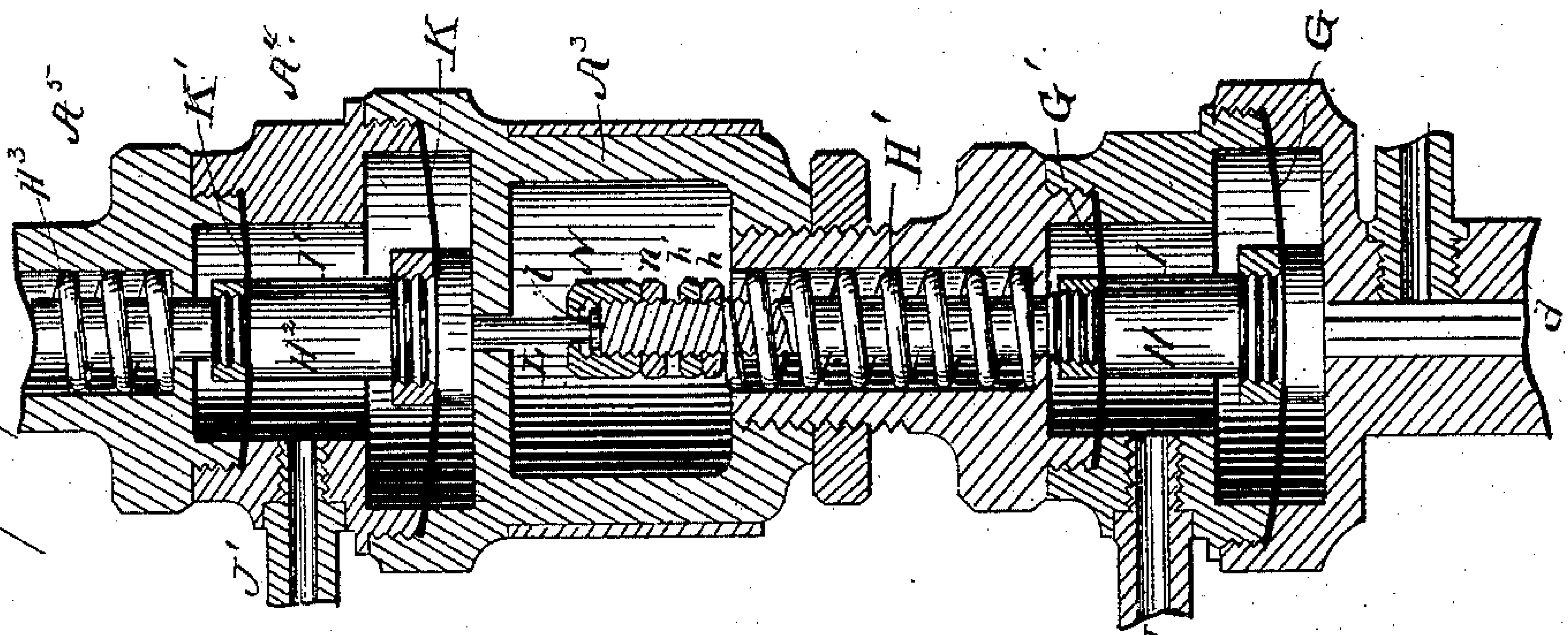


Fig. 7

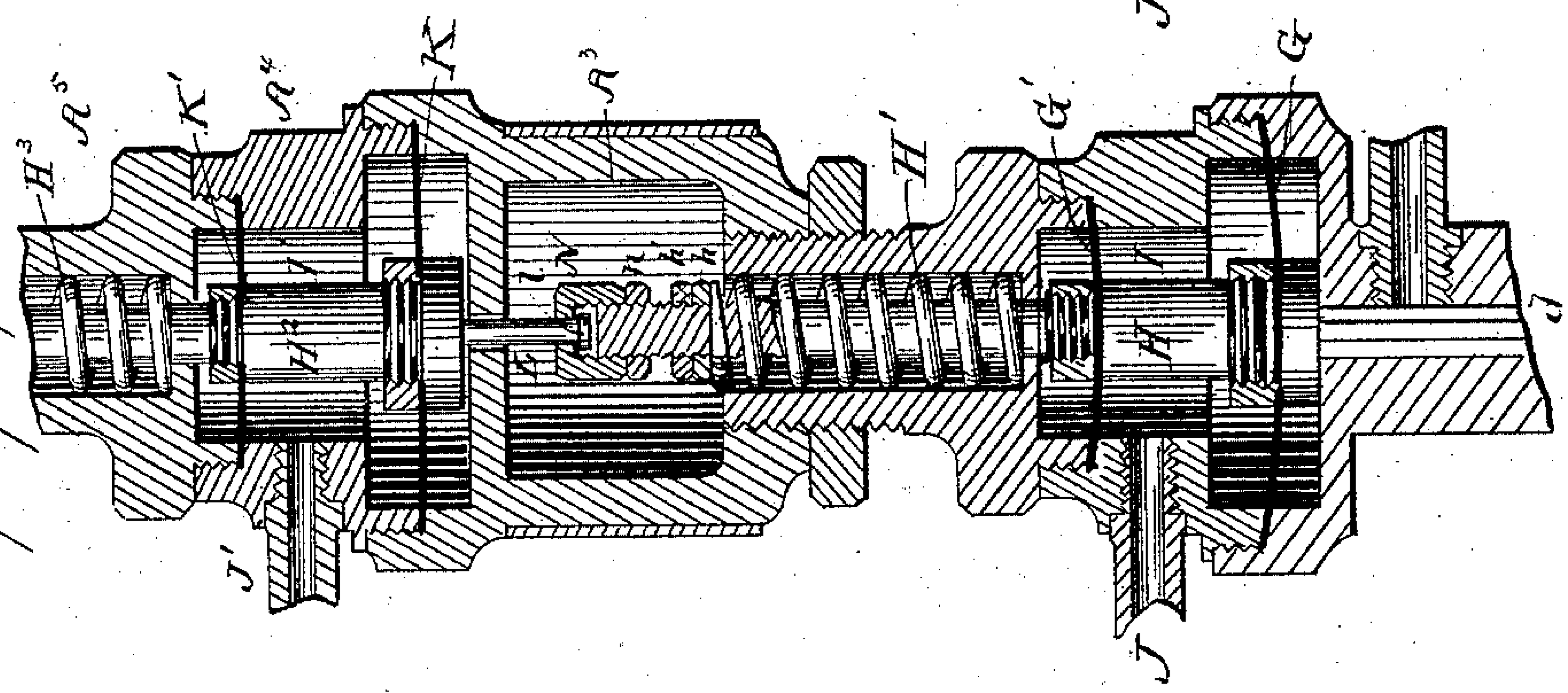
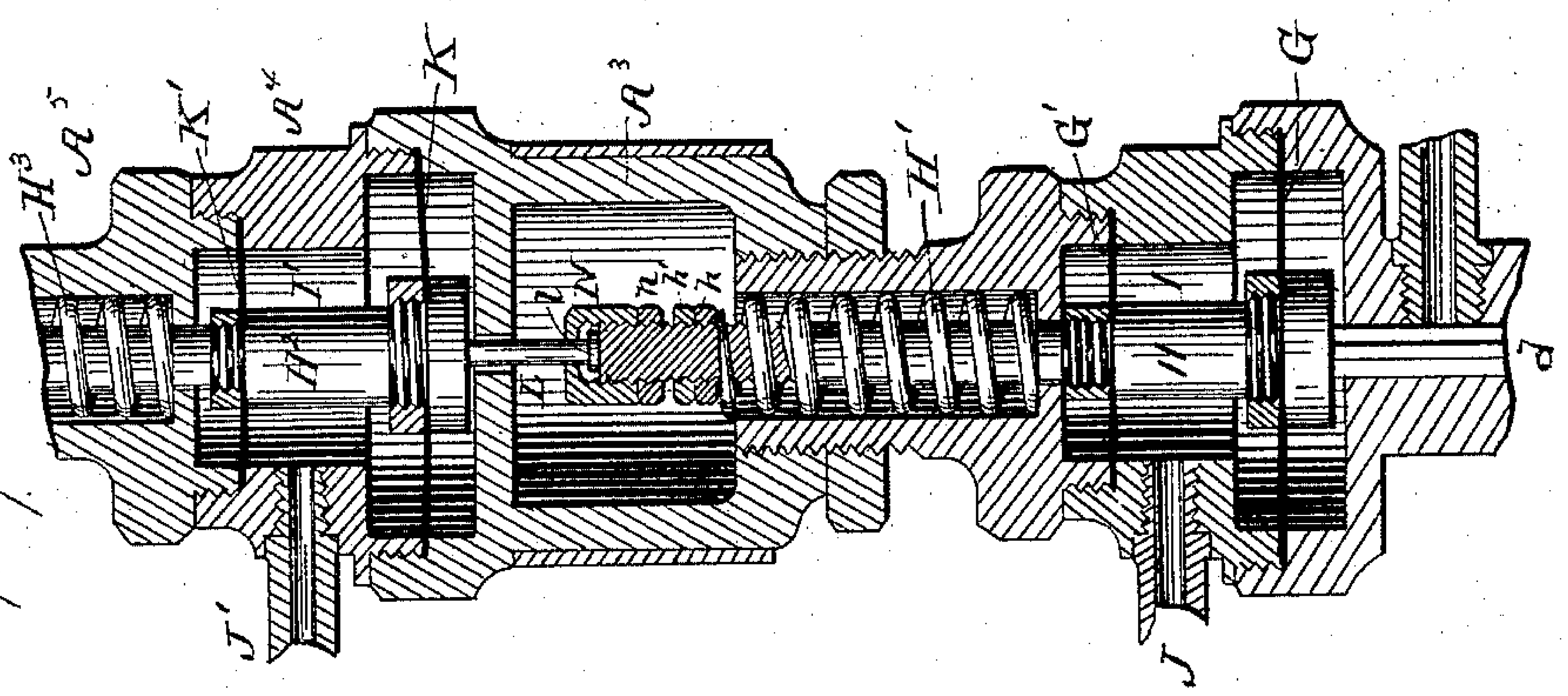


Fig. 6



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UNITED STATES PATENT OFFICE.

JACOB A. STEININGER, OF CRESTON, IOWA.

AUTOMATIC PUMP-GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 417,112, dated December 10, 1889.

Application filed August 1, 1889. Serial No. 319,385. (No model.)

To all whom it may concern:

Be it known that I, JACOB A. STEININGER, a citizen of the United States, residing at Creston, in the county of Union and State of Iowa, have invented certain new and useful Improvements in Automatic Pump-Governors for Brake Mechanism; and I do 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 appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to devices by which the supply of steam to the power-generating mechanism of a fluid-pressure brake apparatus is automatically cut off when the pressure in the train-pipe or main reservoir reaches certain limits and is restored when the pressure in either falls below a determined limit.

The object of the device is to prevent such an excess of pressure as would tend to cause the sliding of the wheels, and to obviate the unnecessary operation of the pump, as well as to provide for the accumulation of such surplus of pressure in the main reservoir when the brakes are applied as will insure their prompt release when required.

A further object is to insure that the surplus pressure thus accumulated in the main reservoir shall bear a certain ratio to the reduction of pressure in the train-pipe, whereby if the train-pipe pressure is excessively reduced the surplus pressure pumped up shall be greater than when the train-pipe pressure is but slightly reduced, so that in any event the train-pipe pressure may be quickly restored with no more than the necessary expenditure of steam.

Certain other advantages and capabilities of my invention will appear in connection with the detailed explanation hereinafter given, and it will be apparent that my invention is applicable, broadly, to the controlling of a valve by two independent pressure-chambers.

The improvement consists, essentially, in two movable abutments, each located in a pressure-chamber of its own and connected with a valve in such a manner that each has an independent control of the valve, whereby any reduction of the pressure below the normal in either chamber will cause the valve to open.

My improvements are shown as applied to the air-pump governor of an air-brake system, though they are not necessarily confined to that specific kind of brake.

In the drawings, Figure 1 is a full-length vertical section of the preferred form of governor, the pressure-chambers being relieved from pressure, and the throttle-valve being about to open to start the pump. Fig. 2 is a modification designed to be used when the reduction of pressure is to move the stem downward to positively operate a throttle-valve. Fig. 3 is an elevation of the casing inclosing the adjustable joint uniting the stems, the slip-cover being in section. Figs. 4 and 4ᵃ are modifications in which the stem is in one piece. Fig. 5 shows a rigid stem composed of two parts adjustably united. Figs. 6, 7, and 8 illustrate the successive operations of the parts under different conditions; and Fig. 9 is a detail showing a modification of the joint uniting the stems.

The same letters refer to corresponding parts in the same figures.

Steam is applied to the steam-cylinder of the air-pump through a valve-casing A, entering the casing from the boiler at *a* and passing to the steam-chest of the pump at *a'*. A septum A' extends across the valve-casing, having in it an opening. A throttle-valve B seats against a face around the delivery side of the opening and is supported in place by a threaded spindle C, a cavity in which receives the stem *b* of the valve. The spindle projects through a stuffing-box to the outside of the casing and is provided with a suitable handle *c*, by means of which it can be run in and out through the threaded sleeve C'. From the upper side of the valve rises a neck *b'*, the upper part of which is enlarged, forming a cylindrical head b^2, which slides easily in a recess in the valve-casing. Along one side of the head is formed a groove or port b^3. The neck *b'* is hollow to receive the stem *d* of an exhaust-valve D, which is held up to its seat a^2 by a helical spring *d'*, surrounding the stem *d* inside of the head b^2, which is counterbored to receive it. The valve-stem *d* is extended above the valve and is provided with wings to guide it centrally in the passage-way a^3, which communicates with the exhaust-pipe E. These parts are all old and are found in the automatic air-pump governor in common use. The operation of them is as follows: The spindle C is screwed down so as to permit the throttle-valve B to be unseated by the excess of steam-pressure on the upper side of the valve, permitting steam to pass through the valve-casing to the pump. When the pump is to be stopped, the valve D is unseated, allowing the steam on the upper side of the valve B to escape through the exhaust E, which causes an excess of steam-pressure on the lower side of the valve B, forcing the valve to its seat in the septum A′ and cutting off the supply of steam to the pump.

My improvements relate to those parts of the governor by which the valve D is automatically seated and the pump started when the pressure in the train-pipe or the main reservoir falls below a given point, and, on the other hand, the valve is unseated and the pump stopped when the train-pipe or main-reservoir pressures reach said given point, as will now be described.

In its simplest form my governor consists of two pressure-chambers, arranged one above the other and containing movable abutments carried on a rigid stem that passes through both chambers, and is provided with a spring or springs adapted to resist the fluid-pressure on the abutments. Such an arrangement is shown in Fig. 4, in which the valve-stem d projects into the lower chamber F, in which works a movable abutment G, such as a piston, or, preferably, a diaphragm of flexible material held securely around its periphery. The abutment is carried on a stem H, projecting into the upper part of the chamber F, which is of lesser diameter than the lower part, and in which is a movable abutment G′—preferably a diaphragm—fastened to the stem H. The space I between the two diaphragms constitutes what I term the "train-pipe pressure-chamber," being in communication with the train-pipe of the brake system through the pipe J. The stem H extends up through a counterbored casing A^2, in which is a helical spring H′, surrounding the stem and seated on the bottom of the counter-bore. At the top of the casing the stem is screw-threaded to receive the nut h and the jam-nut h', by means of which the tension of the spring can be adjusted, the upper end of the spring bearing against the under side of the nut h. The spring thus tends to resist any downward pull on the stem H.

Upon the upper end of the casing A^2 is secured an open frame A^3, preferably composed of two arms, as shown, rising from a threaded sleeve screwed upon the end of the casing A^2 and locked by a suitable jam-nut.

The nuts $h\,h'$ are easily accessible through the open sides of the frame A^3, which is provided with a removable slip-cover A^6 to protect the nuts from dirt and from accidental displacement. The frame supports a chambered block A^4, in which is a movable abutment K. A smaller abutment K′ is located in the smaller upper portion of the chamber A^4, and both abutments are carried by the stem H, which projects up into the casing A^2. The space I′ between the two abutments K K′ constitutes what I call the "main-reservoir-pressure chamber," being connected with the main reservoir by means of the pipe J′.

Since the abutments G and K are of greater area than the abutments G′ K′, any increase of the fluid-pressure in either of the pressure-chambers I I′ will exert a downward pull on the stem. The tension of the spring can be adjusted to resist this tendency until the unbalanced pressure on the abutments G K exceeds a determined limit, when the stem will descend and open the exhaust-valve D.

In the compressed-air system the normal pressure in the main reservoir is about ninety pounds to the square inch, which by means of a loaded valve (the feed-valve) in the engineer's valve is reduced to seventy pounds in the train-pipe, the excess of twenty pounds being retained in the main reservoir to insure a speedy release of the brakes. The total normal unbalanced pressure on the abutments G and K is therefore one hundred and sixty pounds, and the spring H′ must be strong enough to yield only when these normal pressures have been reached.

The stem H is provided with suitable collars h^2, which limit the amount of its vertical play in the chambers. It is preferably about one thirty-second of an inch in practice.

In the modification shown in Fig. 4^a the two pressure-chambers are brought close together, and the spring is arranged above them. The space between the two pressure-chambers is vented by an opening x to prevent the accumulation of pressure between the abutments G′ and K, which would interfere with the free action of the abutments. It is obvious that the stem may, if desired, be made in two parts united by an adjustable joint, as shown in Fig. 5, where the stems H H^2 are united by a right and left hand nut h^3. It is also obvious that instead of one spring two may be used, as shown in Fig. 5, the stem H or H^2 being extended up into a counter-bored casing A^5, where it is furnished with a pair of nuts to adjust the tension of the upper spring H^3.

It is preferable to use two springs instead of one, since one can be set to balance the normal train-pipe pressure and the other the normal main-reservoir pressure, and each can be independently regulated.

The operation of my device is as follows: Suppose the parts to be as shown in Figs. 4, 4^a, and 5, the exhaust-valve D being closed and the pump at work. The pressure in the train-pipe and chamber I and in the main reservoir and chamber I′ will rise until it reaches the limits at which the springs H and H^3 have been set to yield. The stems H and H^2 will then move down, unseating the valve D and stopping the pump; but this will not happen so long as the pressure in either chamber fails to reach its limit, since the resistance of both the springs H′ H^3 must be overcome. The exhaust-valve D being open and the pump stopped, the train-pipe and main-reservoir pressures being at their normal point—say seventy and ninety pounds, respectively—let a reduction take place in the main-reservoir pressure from leakage or from using the air for some purpose. This will destroy the balance between the tension of the spring H^3 and the pressure on the abutment K, allowing the unbalanced strength of the spring to lift the stem, the downward pressure in the train-pipe chamber I being so little in excess of the strength of the spring H′ that these two forces are almost balanced, and so offer but very little resistance to the pull on the stem. Any reduction in the main-reservoir pressure will therefore start the pump, even though the pressure in the train-pipe chamber is at its normal, and the pump will continue to operate until the normal pressure has been restored in the main reservoir. Again, the exhaust-valve D being open and the pump stopped, let the train-pipe pressure be reduced, as by applying the brakes, or by a leak through a defective joint, or from accidental rupture of the pipe. The unbalanced pressure on the abutment G now becomes less than the tension of the spring H′, which instantly lifts the stem H, allowing the exhaust-valve D to close and the pump to start, supplying to the main reservoir a surplus pressure above the normal to be available to restore the train-pipe pressure and release the brakes; but this condition of things is not permanent during the entire time the train-pipe pressure may remain below the normal, for if it remain so for any length of time the surplus fluid-pressure in the main reservoir at length reaches a point where it will overbalance the surplus strength of the spring H′ and move the stems downward, thereby stopping the pump; but since the degree of surplus strength in the spring H′ depends upon the amount of reduction in the pressure that has taken place in the train-pipe it is evident that the degree of surplus pressure that must be developed in the main reservoir to overbalance the spring H′ will not always be the same, but will bear a certain fixed ratio to the reduction of pressure in the train-pipe—that is to say, if a reduction of five pounds pressure below the normal in the train-pipe requires an excess of two pounds above the normal in the main reservoir to stop the pump, then a train-pipe reduction of twenty pounds will require an excess of eight pounds in the main reservoir to accomplish the same result; but since it is desirable to restore the normal train-pipe pressure as quickly as possible when the brakes are to be released, and since a greater main-reservoir pressure is required to do this when the train-pipe reduction has been considerable than is required when the reduction in the train-pipe has been moderate, it will be seen that my governor automatically meets the requirements of every case and stops the pump when and only when the proper main-reservoir pressure has been attained to quickly restore the normal train-pipe pressure. The consumption of steam is therefore exactly proportional to the work that the pump has to do, and unnecessary pumping, involving waste of steam and wear of the pump, is prevented. This automatic regulating feature is a most important function of my governor. It can be regulated within certain limits by means of the devices shown in Figs. 1, 6, 7, 8, and 9. The stem H is here shown divided into two parts, which are united by a loose adjustable joint. I prefer the construction shown, in which the lower end of the upper stem H^2 is formed into or provided with a headed pin L. A flanged nut or nipple N slides freely on the pin above the head *l* and is adjustable upon the end of the stem H, where it can be locked by a jam-nut *n*. These nuts are accessible through the open sides of the frame A^3 when the slip-cover A^6 is removed.

By means of the flanged nut N and headed pin L, I am able to regulate the degree of surplus pressure pumped into the main reservoir when the train-pipe pressure is reduced. It will be noticed that the vertical play of the upper stem H^2 is greater than that of the lower stem H. Suppose the play of the stems to be, respectively, one-sixteenth and one thirty-second of an inch, the latter being of course a sufficient amount of movement to open the exhaust-valve. Let the head *l* be set, as shown in Fig. 1, so that there is left between it and the stem H a space of one thirty-second of an inch—enough to absorb the entire surplus movement of the upper stem H^2. Put the normal pressure on the abutment K and it will depress the upper stem H^2 until it strikes the lower stem H, the flanged nut allowing the pin L to slide through it. (See Fig. 6.) When the normal pressure in the lower chamber is reached, the lower stem will move down freely a thirty-second of an inch and open the exhaust-valve, the stems remaining as shown in Fig. 7. The upper stem has a capacity of further downward movement; but the normal pressure in chamber I′ is not sufficient to compress the spring H^3 enough to let the stem H^2 drop any farther. In this position the flanged nut N just touches the head *l*, so that any reduction of pressure in the main-reservoir chamber will instantly lift the lower stem and start the pump.

With the parts standing as shown in Fig. 7, suppose the train-pipe pressure to be reduced. The lower stem H instantly rises, there being a clear space of one thirty-second of an inch between it and the head *l*. The pump at once starts and slowly increases the pressure in the main reservoir above the normal. Under this increased pressure the abutment K tends to move farther downward, but is opposed by the stem H, which is just touching the head *l*. The opposing force is due to the unbalanced upward tension of the spring H′, which has been liberated by the reduction of fluid-pressure in the chamber I. This unbalanced tension holds up the stem H until the surplus abnormal pressure in the main reservoir has risen high enough to overcome it and force the two stems downward. As has been previously stated, this surplus abnormal pressure will always bear a fixed ratio to the amount by which the train-pipe pressure has been lowered. In this way the surplus main-reservoir pressure is always proportional to the loss in the train-pipe pressure, so that the latter can be quickly restored when the time comes, and yet no unnecessary work is put upon the pump.

Should it be desired to vary the ratio between the loss in the train-pipe pressure and the corresponding surplus pressure in the main reservoir, it can be done by means of the flanged nut N, as follows: Suppose the parts to be as shown in Fig. 1. Let the nut N be screwed down until the head *l* and the stem H come in contact. This puts upon the upper spring H^3 an additional compression, owing to the stem H^2 having been drawn down one thirty-second of an inch. The degree of fluid-pressure necessary to move the abutment K has therefore been raised, and this increase must be overcome by an increased surplus or abnormal pressure in the main reservoir before the exhaust-valve can be opened. Since the flanged nut can be adjusted to any point within this range of movement of the head *l*, it is evident that the surplus pressure to be pumped into the main reservoir can be regulated within certain limits with great nicety, inasmuch as it depends not only upon the loss of pressure in the train-pipe, but also on the amount of extra tension put upon the upper spring by the nut N.

In case it is desired to operate a throttle-valve which requires the stem to descend when the pressure in the chambers is reduced, the construction shown in Fig. 2 is available. The relative position of the abutments is here reversed, the larger ones being uppermost, so that when the pressure in either of the chambers is reduced the springs tend to force the stems downward. The upper stem is provided with a set-screw O, tapped into its end and adapted to come in contact with the top of the lower stem. A lock-nut P secures the set-screw when it has been properly adjusted. The set-screw and lock-nut may also be used in combination with the flanged nut N and headed pin L in the governor, (shown in Fig. 1,) if desired. Such an arrangement as this is illustrated in Fig. 9 and provides for the most delicate adjustment of the parts.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination, with a throttle-valve, of a movable stem adapted to control said valve, the stem being composed of two parts united by a loose joint, permitting each part to have a movement independent of the other, two movable abutments subjected to fluid-pressure and connected, respectively, with the two parts of the stem to move them in one direction, and two springs connected, respectively, with the parts of said stem to act counter to the pressure on the abutments, substantially as described.

2. The combination, with a valve D, of a two-part stem H H^2, two movable abutments G K, connected, respectively, with the stems H H^2 and subjected, respectively, to different normal fluid-pressures, two springs H′ H^3, connected, respectively, with the stems H H^2 and each adapted to balance the normal pressure on the abutment connected with its respective stem, and an adjusting device for varying the space between the two stems H H^2, substantially as described.

3. The combination, with the two movable stems H H^2, of the headed pin L on one stem and the flanged nut N on the other stem, engaging with said pin, and the set-screw O, for adjusting the length of one of the stems, substantially as described.

4. An automatic governor for the air-pump of a fluid-pressure brake system, consisting of a valve controlling the admission of steam to the pump, a stem controlling the movements of the valve, two movable abutments connected with said stem, one subjected to the main-reservoir pressure and the other to the train-pipe pressure, and one or more springs connected with said stem and set to balance the normal main-reservoir pressure and the normal train-pipe pressure, substantially as described.

5. An automatic governor for the air-pump of a fluid-pressure brake system, consisting of a valve controlling the admission of steam to the pump, a stem controlling the movements of the valve, said stem being made in two independently-movable parts, a movable abutment connected with each part and subjected one to the main-reservoir pressure and the other to the train-pipe pressure, a spring connected with each part and set to balance the normal pressure on its abutment, and a loose adjustable connection between the two parts of the stem, whereby the reduction of pressure on either abutment will cause the steam-valve to be opened for a longer or shorter period, substantially as described.

6. An automatic governor for the air-pump of a fluid-pressure brake system, consisting of a valve controlling the admission of steam to the pump, a stem controlling the movements of the valve, said stem being made in two independently-movable parts, a movable abutment attached to each part, one subjected to the main-reservoir pressure and the other to

the train-pipe pressure, the former having a range of movement in excess of the latter, a spring connected with each part of the stem and adjusted to balance the normal pressure on its abutment, and an adjustable loose connection uniting the two parts of the stem, permitting a play between them not greater than the range of movement of the part controlled by the train-pipe pressure, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JACOB A. STEININGER.

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