(No Model.) 3 Sheets—Sheet 1.

R. SMITH.

AUTOMATIC STEAM REGULATOR FOR PAPER MACHINES.

No. 324,601. Patented Aug. 18, 1885.

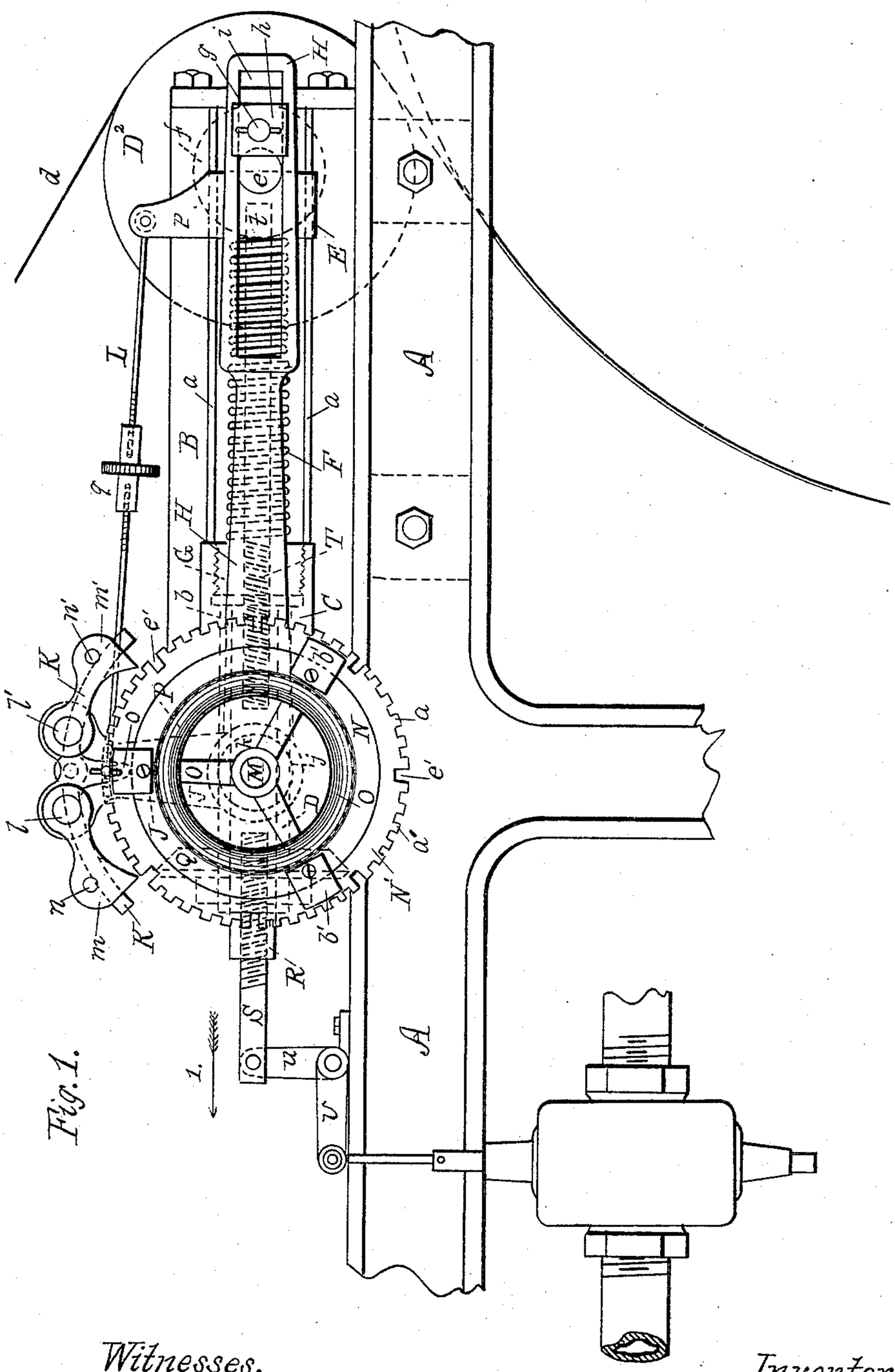

Fig. 1.

Witnesses.
H. C. Lodge.
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Inventor.
Richard Smith.
F. Curtis, Atty.

(No Model.) 3 Sheets—Sheet 2.

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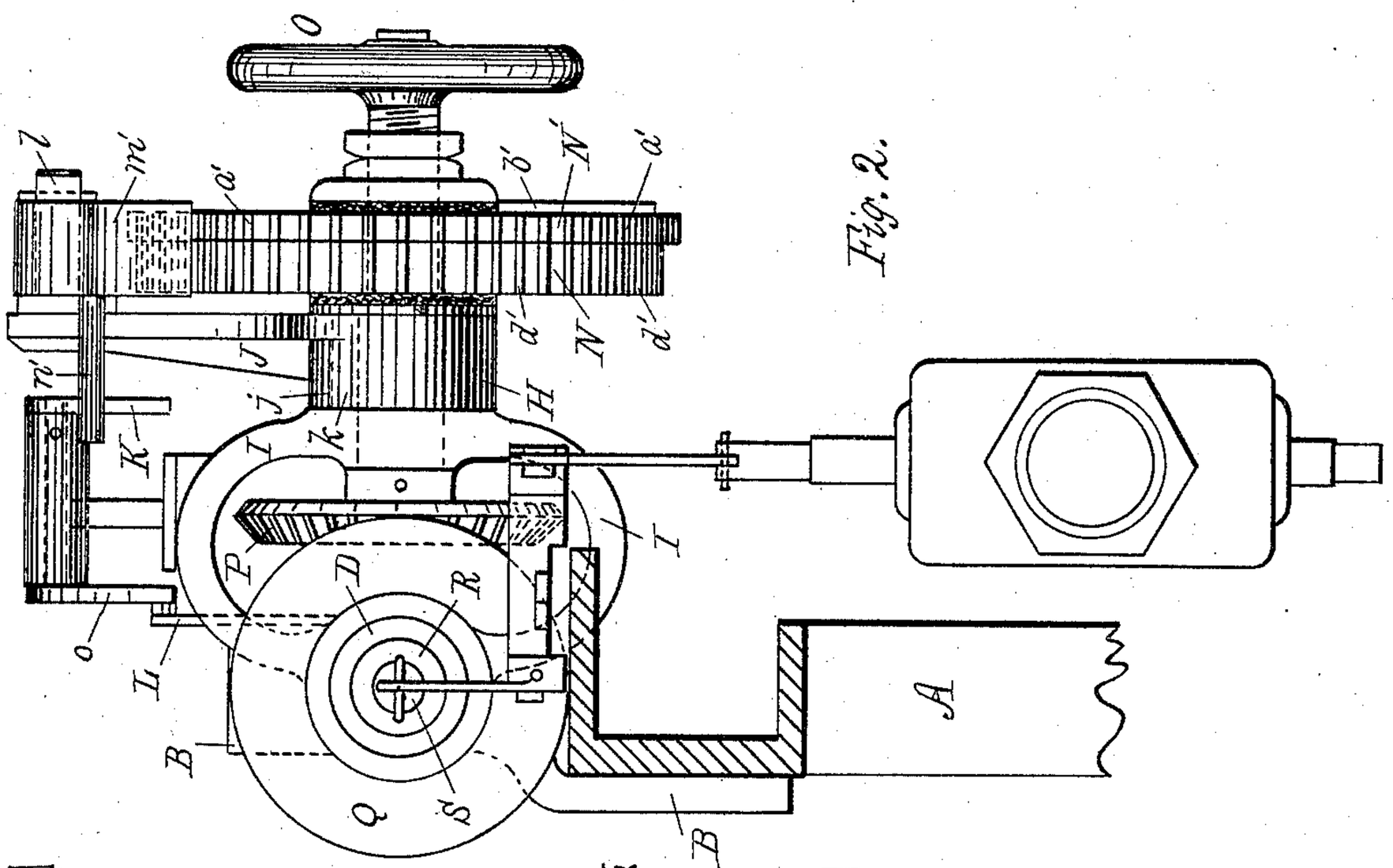

Fig. 2.

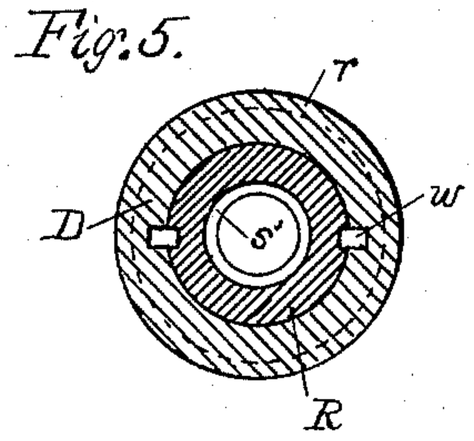

Fig. 5.

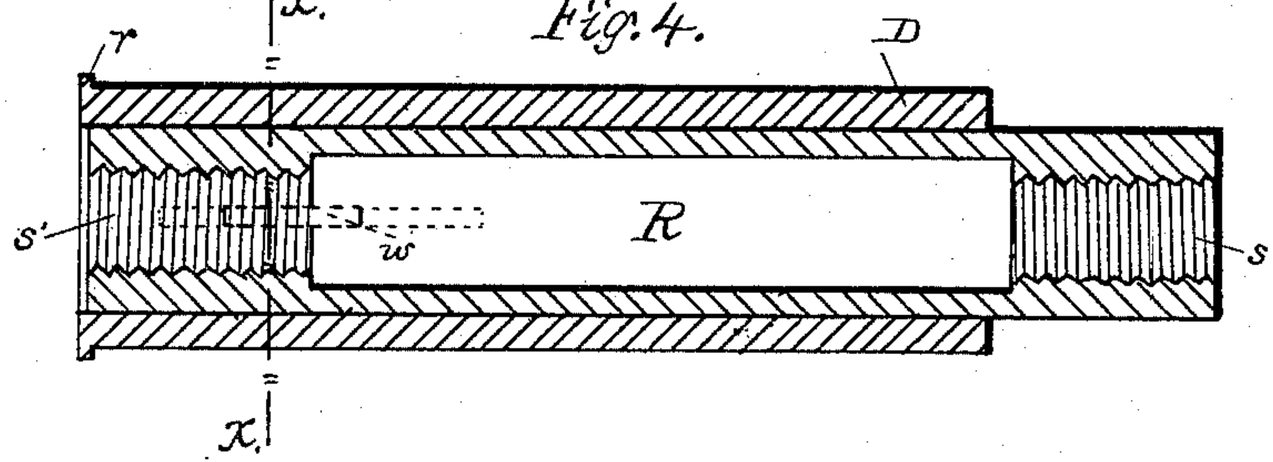

Fig. 4.

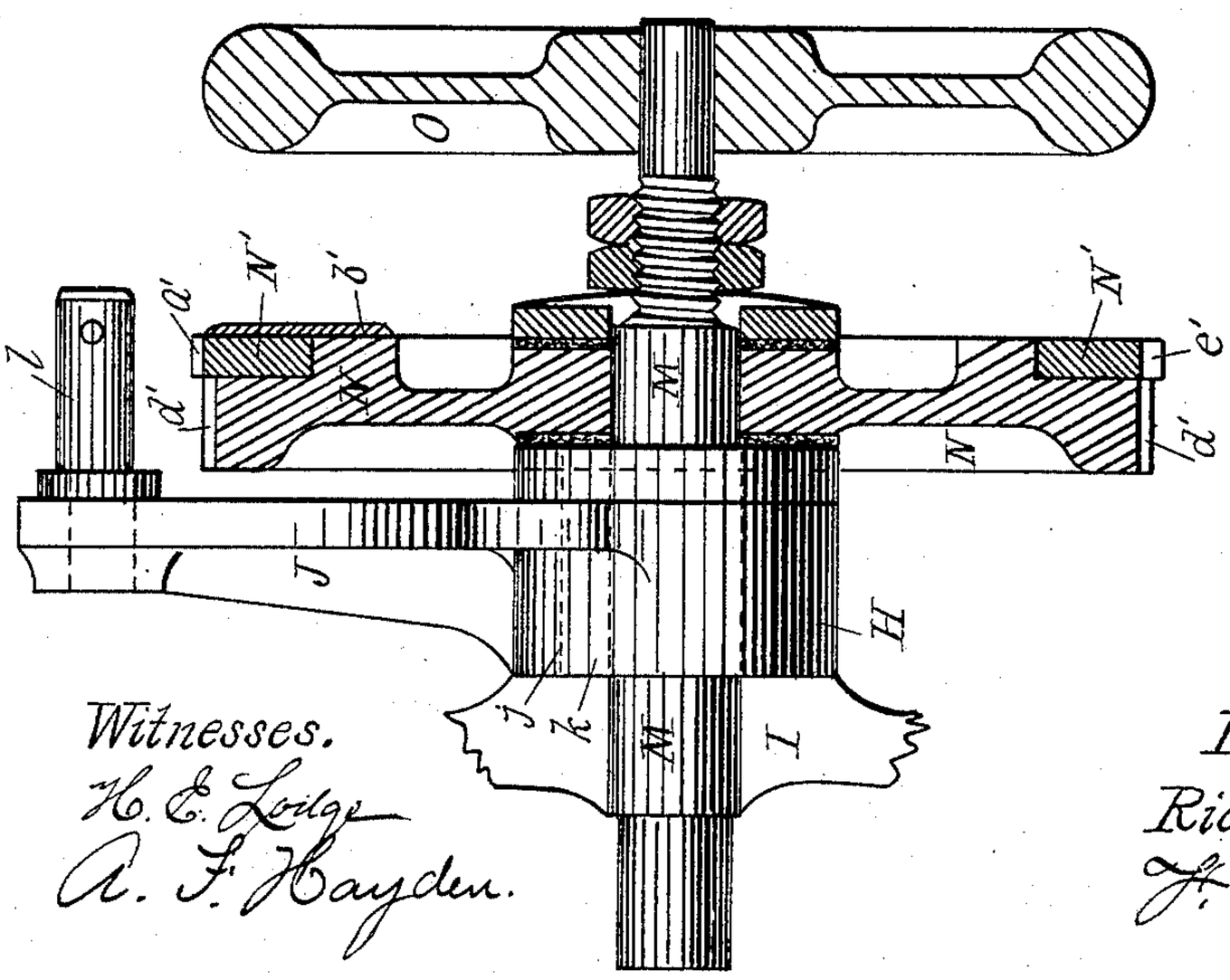

Fig. 3.

Witnesses.
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(No Model.) 3 Sheets—Sheet 3.

R. SMITH.

AUTOMATIC STEAM REGULATOR FOR PAPER MACHINES.

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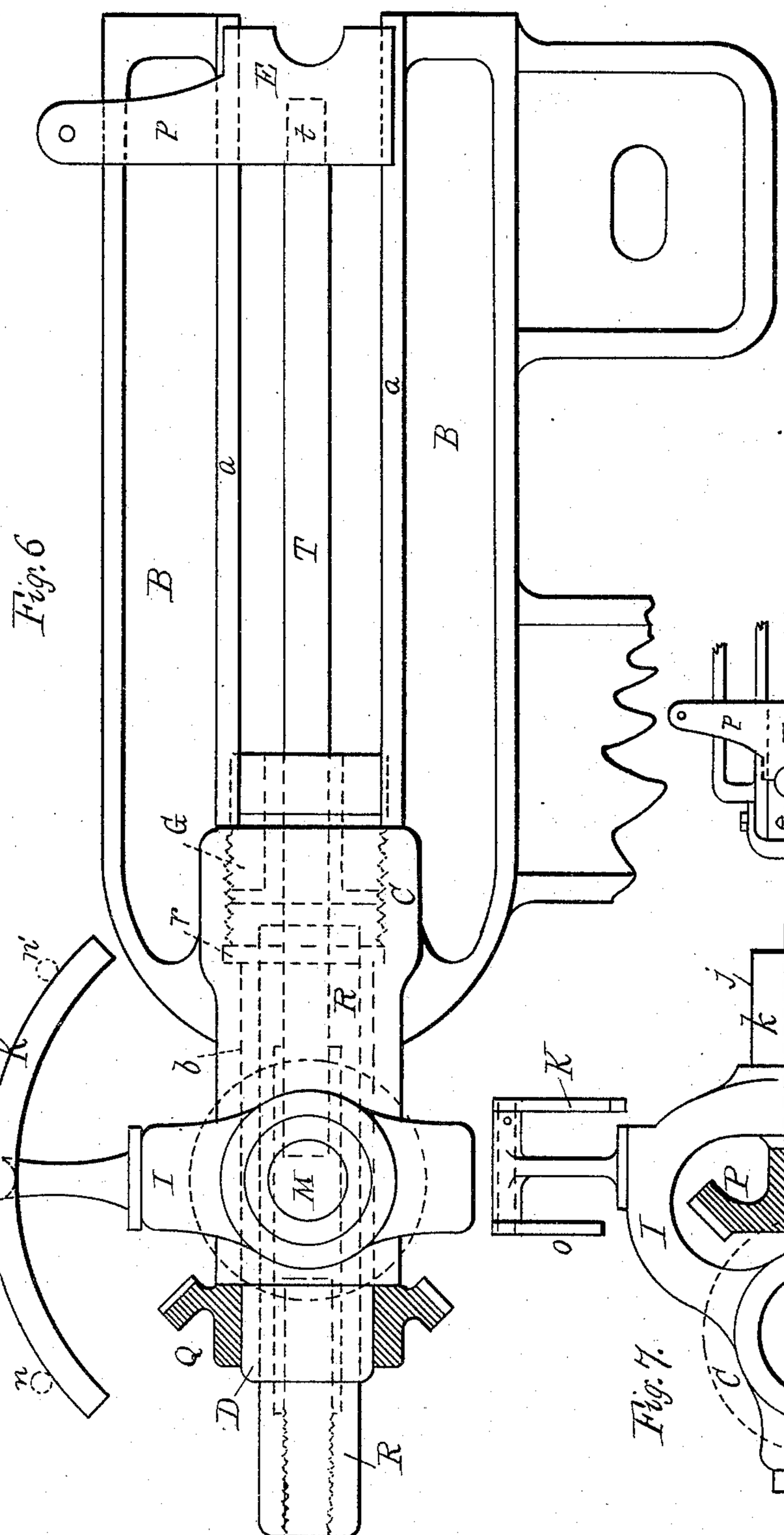

Fig. 6

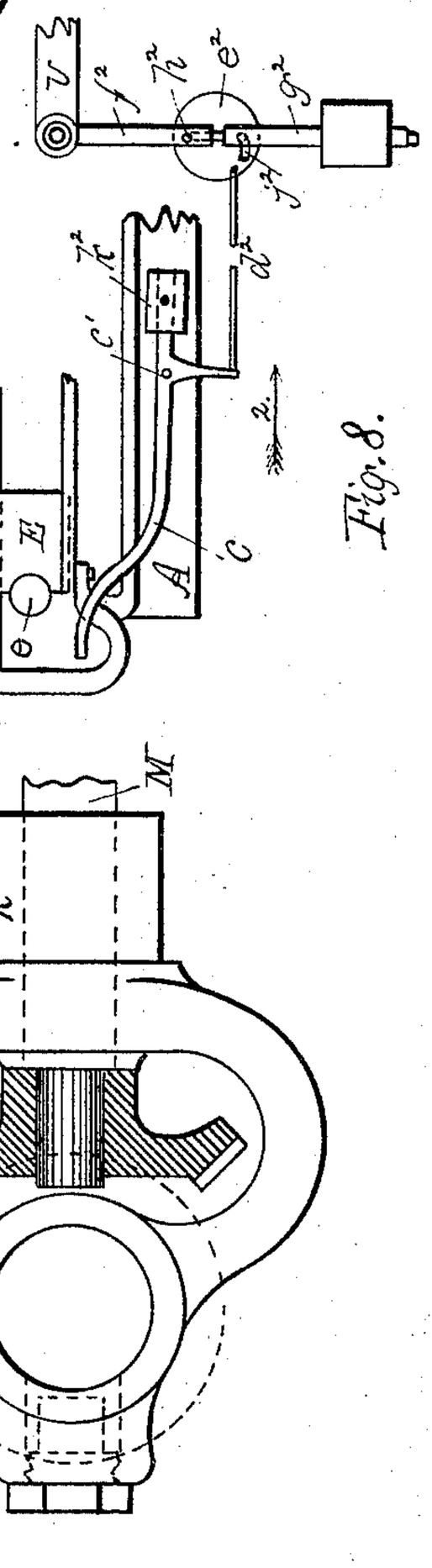

Fig. 8.

Fig. 7.

Witnesses.
H. C. Lodge.
A. F. Hayden.

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Richard Smith.
F. Curtis. Atty

UNITED STATES PATENT OFFICE.

RICHARD SMITH, OF SHERBROOKE, QUEBEC, CANADA.

AUTOMATIC STEAM-REGULATOR FOR PAPER-MACHINES.

SPECIFICATION forming part of Letters Patent No. 324,601, dated August 18, 1885.

Application filed November 12, 1884. (No model.)

To all whom it may concern:

Be it known that I, RICHARD SMITH, a citizen of the Dominion of Canada, residing at Sherbrooke, in the county of Sherbrooke and Province of Quebec, Canada, have invented certain new and useful Improvements in Automatic Steam-Regulators for Paper-Machines; and I do hereby 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 letters or figures of reference marked thereon, which form a part of this specification.

This invention relates to means whereby paper in process of manufacture when passing over hollow cylinders termed "driers" is to be properly and uniformly dried prior to calendering.

Hitherto it has been found very difficult to maintain a suitable but requisite varying supply of steam to driers, and thus insure a temperature dependent upon the varying thickness of the paper web passing over them—that is, for a thick sheet a greater and for a thin sheet a less temperature is required—while at the same time a constant but very slight change is to be continually made, owing to the varying pressure of steam and the thickness of the paper, at one time being slightly over and again a little under weight, owing to the flow of pulp, quality of stock, speed of the machine, or other incidental causes which may occur; but ordinary mechanical means will not suffice, unless the endless web of paper is employed as the primary operative agent to alter the steam-supply, which is in my present invention directly effected by the condition of the paper web at a certain point during its passage over the driers.

My present device consists, primarily, in employing the tension of the paper web, which is varying and dependent upon the amount of moisture contained therein directly, by means of a roll actuated by the continuous traveling endless paper web to the steam-supply valve, and thereby properly regulate it; secondly, in the relation of certain operative parts whereby further and greater change in the position of the valve is indirectly effected in addition to that directly produced upon the said valve; thirdly, in the use of the two pawls and the two ratchets, one active and one inactive, the pawls being maintained by a rocker-shield from contact with the ratchets when the sheet is being properly dried, but in case the temperature increases or diminishes, or the paper runs "heavy" or "light," the condition of the paper, being altered by such circumstances, acts at once to bring one of the two pawls in engagement with the ratchets, and effects by intervening mechanism a change in the valve either to diminish or increase the supply of steam; fourthly, in the disposition and form of the loose ratchet carried by the fixed or active ratchet-wheel, whereby the latter is intermittently employed and an interval of time must ensue between every change in the position of the valve; fifthly, in means whereby the roll over which the web passes is maintained as nearly as possible in the same position, while the pawls and ratchets operate by means of a right and left screw-threaded nut to change the length of the connecting-rods operating the valve. Thus my object is to accomplish any change in the valve that may be desired with the least possible effect upon the position of the operative roll over which the paper web passes; sixthly, in the general arrangement and adaptation of the operative parts relatively to each other, which will be more particularly hereinafter described.

The drawings accompanying this specification represent, in Figure 1, a side, and Fig. 2 an end, elevation of an automatic-steam regulator embodying my invention. Fig. 3 is an end elevation, part in section of the bell-crank lever and the two ratchets, while Fig. 4 is a central longitudinal section, of the screw-threaded nut, and Fig. 5 a cross-section of the same on line *x x* of Fig. 4. Figs. 6, 7, and 8 are side elevations of some of the operative parts in detail.

In the drawings, A represents a portion of the upper part of the side frame of a paper-machine, which supports the "driers," so called; and B a suitable standard or housing bolted to said frame, centrally provided with ways or guides *a a*, and terminating at one end in a short tubular hub, C, with a central bore, (shown at *b*,) as adapted to receive the sleeve D, to be hereinafter described.

At D^2, I have represented the ordinary

spring-actuated guide-roll now generally in use upon machines of this class, and over which the endless web of paper *d* is represented as passing. The journal of this roll is shown at *e* as suitably disposed in a box or journal, one-half of which is represented at E in the drawings as mounted and sliding in the ways *a a*, before mentioned, in the housing B, while a coiled spring, F, is disposed between the inside face of the journal *e* and the adjusting-nut G, the latter turning upon a thread formed within the bore of the hub C. A similar and corresponding spring is arranged upon the opposite or back side of the drier-frame, and in case the paper does not leave the machine properly these springs are adjusted so that it shall do so. Futhermore, upon the end of the journal *e* of the roll D^2, and outside the box, I have secured a pallet or disk, *f*, provided with a pin or stud, *g*; or a short crank-arm and pin could be substituted in lieu therefor. This pin *g* is suitably mounted in a box or journal, *h*, adapted to slide within the slot *i*, formed in one end of the bell-lever H, which is pivoted at *j* upon a short arm, *k*, the latter forming part of the bracket or frame I, which is cast with and forms an integral part of the tubular hub C of the housing B, and projects at right angles therewith. The upright arm J of this bell-lever is provided with two similarly-disposed pivots, *l l'*, upon which are loosely hung the pawls *m m'*, oppositely disposed, said pawls being furnished with two inwardly-projecting pins, *n n'*, so arranged as ordinarily to rest upon a curved or bent shield, K, and held from contact with the ratchet-wheels. This shield is mounted in a suitable bearing forming part of the frame I, while rocking movement is effected by and through means of the crank-arm *o*, pivoted in one end of the pawl-actuating rod L. The other end of said rod is connected to a short arm, *p*, projecting from the half portion of the journal-box E. This rod L is capable of being lengthened or shortened, by means of the right and left nut *q*, that the pawls may be adjusted in position to suit paper of different weight or thickness, since the pawls must both be free from contact with the ratchets when the paper is passing along in a proper condition—that is, suitably dried for paper of a certain weight. Now, it will be evident that the tension of a heavy sheet of paper, when suitably dried, will be much greater upon the journal *e* of the roll D^2 than a lighter-weight sheet, and the journal-box E will compress the spring F and carry the arm *p* inwardly, rocking the shield K and disengaging it from the pin *n'*, thus permitting the pawl *m'* to engage the ratchet, which is not desired, when adjusting the apparatus for paper of different weights; hence the rod L must be shortened until both the pawls with the tension of the then passing paper web shall stand free from the ratchets. On the other hand, if a light sheet is to be run the tension upon the roll is less and the spring F will expand, when the opposite pawl, *m*, will be allowed to drop and engage the ratchet, and therefore the rod L must be accordingly lengthened until said pawls again stand normally free from the periphery of the ratchet-wheels.

The rocking or feed movement of the pawls is to be effected by means of pallet *f*, with its pin *g* journaled in the box *h* before mentioned, and since the pallet is affixed to the journal *e* of the roll D^2 it must have free horizontal movement in unison with the roll, which is longitudinally actuated by the tension of the paper; hence I have provided the slot *i*, in which said journal-box reciprocates. Moreover, the rotations of the journal *e* produces a rotary movement of the pin-pallet *f*, and the free end of the bell-crank lever H is lifted up and down in vertical paths of movement. Thus the upright arm of said lever, carrying the pawls *m m'* is rocked, and proper feed-motion of the latter is obtained.

Now, I have previously stated that I desire to obtain from the paper with its tension as a prime mover the greatest effect upon the steam-supply; or, in other words, with the least possible movement of the spring-roll D^2 the greatest change in the position of the steam-valve, and thus secure an apparatus which will be peculiarly sensitive to any slight change in the amount of moisture contained in the paper or its condition of dryness at a certain fixed point upon the machine. To produce this I must effect a rapid and sudden change in the length of certain operative parts connecting the valve mechanism with the roll, that the latter, so to speak, shall remain a fixed point; and to accomplish this, in connection with the pawls I have mounted on the bracket or frame I within the arm *k*, which is centrally bored, the shaft M. This shaft is free to revolve, and is furnished at the outer end with a ratchet-wheel, N, securely affixed thereto by friction, and provided with a hand-wheel, O. Thus the apparatus may, if desired, be operated by hand. Upon the other end of said shaft is attached the miter-gear P, meshing with a similar gear, Q. This latter gear is secured to one end of a short tubular sleeve, D, snugly fitting within bore *b* of the hub C, and retained therein by a slight shoulder, *r*, formed upon said sleeve. Within this sleeve D is disposed an elongated cylindrical nut, R, interiorly recessed, and fitted with right and left female screw-threads, as shown at *s s'*. Furthermore, I have provided two rods, S T, cylindrical or otherwise, peripherally screw-threaded at their adjacent ends, which enter and engage with the female screws *s s'*. The thread on the rod T is right handed, and that on S left-handed, while the rod T extends through the nut G, maintains the spring F, through which it runs centrally, in position, and is firmly stepped in the box E at *t*, as shown. The rod S, in alignment with T, projects in the opposite direction, and is pivoted to a connect-

ing-rod, *u*, suitably mounted upon the frame A of the driers, and thus actuates the arm *v*, and with it the valve-rod and valve.

To compel rotation of the cylindrical nut R, and still permit of slight longitudinal movement thereof, resulting from the action of the journal-box E, by and through the rod T, I have provided the exterior periphery of the said nut and the interior periphery of the sleeve D with corresponding slots or grooves, into which is fitted the spline *w*. Thus it will be seen that any movement of the gear P effects rotation of the nut R, and consequently shortens or lengthens the entire length of the rods S T when considered as a unit, while the spline-connection freely permits of the slight longitudinal movement required and as above premised.

I will now proceed to describe the peculiar and novel features of the two ratchets. As I have before stated, the main or active ratchet-wheel is shown at N as mounted upon the shaft M. This ratchet-wheel is of the usual form, but provided with a ring or secondary ratchet, N′, peripherally provided with ratchet-teeth *a′ a′*, &c., and is contained within an annular slot formed upon the side face of the main ratchet-wheel N by buttons *b′ b′*, and is free to revolve loosely thereon. Moreover, the diameter of this secondary ratchet-wheel N′ is such that the bottoms of the teeth *a′ a′* coincide with the tops or outer periphery of the teeth *d′ d′* of the ratchet N, while at intervals, as may be desired, an occasional space, *e′ e′*, is cut deeper between the teeth, so that it shall coincide with the spaces between the teeth *d′ d′*. Thus it is evident that when either of the pawls are active it simply engages the teeth *a′ a′*, and revolves the ratchet-wheel N′ without affecting the intermediate parts which operate the valve. This continues until said ratchet enters one of the slots or spaces *e′*, when it strikes against one of the teeth *d′* of the active ratchet N, and the gears P Q are moved slightly, while the length of the two rods S T are made longer or shorter, dependent upon which pawl is employed.

In order to have the pawls capable of operating both ratchets, I have made them sufficiently wide to extend across the entire faces of said ratchets.

I do not desire to be limited to the precise form or position of the slots *e′ e′*, as they may be made singly or in a series containing any number, especially in running heavy papers, where the change in the valve would not be sufficient in case the slots were located singly; but I consider the teeth, which intervene between said slots and the entire arrangement of the active and inactive ratchet-wheels, a very important part of my invention, since it is by this means I secure a uniform temperature, dependent upon the weight of the paper, the speed of the machine, the pressure of the steam, or other slight incidental circumstances; whereas if I employed an active ratchet the paper, varying in tension continually, would operate to keep the valve constantly changing, and the paper would never be subject to the same temperature for any two successive intervals of time. Now, it is evident that the pawl, after entering a slot, *e′*, has moved the valve, and I desire a short time to elapse to permit the effect in the change of the steam-supply to be felt throughout the driers. Now, during that interval, the pawl travels upon the periphery of the inactive ratchet rotating it. If, however, the change in the steam-supply was sufficient to bring the paper to a proper degree of dryness, then the pawl is disengaged from the ratchet-teeth *a′ a′*, and both pawls then stand at their normal or inactive position, as shown in Fig. 1. On the contrary, if the change above described did not vary the steam sufficiently one way or the other the pawl would continue to rotate the ratchet-wheel N′ until a second slot or space, *e′*, was reached, when a further change to effect the valve is accomplished. I have thus endeavored mechanically to effect the change and pause or interval of time which would ordinarily occur if the supply were regulated at will by the machine-tender, who would change the supply more or less and then await results, and if the change was not sufficient would again make a further alteration until the desired result was obtained.

It will be understood by referring to Fig. 1 that the arrangement of parts is such that the tension of the endless paper web over the roll D^2 produces direct action upon the valve-rod to admit more or less steam, as is required, by means of the box E and rods T and S, which are united by a cylindrical screw-threaded nut, R, the latter being free to move longitudinally within the sleeve D by reason of the groove and spline connection. The apparatus as thus constructed would be a practical but not an efficient and satisfactory one, and I therefore combined and arranged the various operative parts, as heretofore premised, which shall lengthen or shorten the rods S T or their equivalents, and thus approximately maintained the roll D^2 stationary. In case the paper web breaks for any cause whatsoever, it is well to shut the valve and stop the supply of steam entirely; and in order to render the closing of the valve dependent upon the cessation of the web in traveling over the roll D^2, I have arranged the journal *e* of said roll in the half-box E, so that it shall drop out of its bearing and strike the end of a weighted lever, *c*. pivoted at *c′* to the frame of the machine A. Furthermore, a pendent arm, c^2, is securely attached to said lever and pivoted to a long arm, d^2, connected to a cam e^2, disposed upon the upper portion of the valve-stem, which in this particular instance is formed in two parts, f^2 g^2. These two parts are loosely united, as shown in Fig. 8, while to operate said parts and close the valve I have pivoted the cam at h^2 to the upper part, f^2, and to the lower portion, g^2, I have disposed a pin, i^2, moving in

a tangential slot, j^2, cut in the cam. Hence the operation of the device is as follows: When the paper web parts, the roll D^2 is free to leave its bearing in the journal-box E and drops down upon the end of the lever *c*, which is depressed against the weight k^2 at the other end, and the arm c^2 and connecting-rod d^2 are thrust in the direction of arrow 2, Fig. 8, rotating the cam e^2 upon its pivot h^2. This compels the pin or stud i^2 to traverse the stud j^2, and the lower part of the valve-stem g^2 is forced downward and away from the upper part, which during this action remains stationary or fixed downward, and the valve is entirely closed. When the operator passes the paper web around the roll D^2 in "mending up," the latter is lifted by the tension of said web and raised from its seat, where it now is resting upon the lever *c*, and returned to its normal position in the journal-box E. When this occurs, the gravity-weight k^2 then exerts its influence to restore the lever *c* to its former position, while the movement of the cam is reversed and the valve opened and restored to the same position in which it was before the paper broke. The valve-stem is now in a position to act as a unit or integral piece, and is operated by the relative changes in the rods S T, as hereinbefore fully described and explained.

The operation of the entire device embodying my invention is as follows, and I suppose, furthermore, that the paper *d* has been passed over the roll D^2, the operator using the hand-wheel O to regulate the steam-supply until the web has attained the desired dryness: The tension of the paper web from the roll D^2 and its journal *e* has forced the journal-box E back and compressed the spring F to a position which it would assume whenever the condition of the paper is just right. This movement has also pushed the arm *p* inward, and the pawl *m'* has dropped upon the periphery of the inactive or loose ratchet wheel N'. It will therefore be necessary to shorten the rod L until both pawls stand free from the ratchets, and remain at this, their normal position, whenever the paper is being properly dried, and no change of the valve is desired. This change in the length of the rod is very easily and quickly accomplished in my present invention and arrangement of parts, being shortened when the paper-machine is changed from a light to a heavy paper and lengthened when an opposite change is effected. The automatic steam-regulator, as it now stands, (see Fig. 1,) is supposed to have been properly adjusted for the sheet *d*, and I will proceed to describe the operation of the various parts relatively one to the other in maintaining a proper drying of the web as it is run over and round the driers. So long as the paper is subjected to the requisite temperature the pawls remain inactive, upheld by their pins *n n'*, which rest upon and are supported by the shield K; but, suppose the driers become overheated and the sheet is being overdried, immediately the tension of the sheet *d* upon the roll D^2 increases, and the spring F is compressed by the slight travel of the journal-box E inward upon its guides *a a* in the housing B. The arm *p*, being thrust in the same direction, rocks the shield K, and the part upon which the pin *n'* rests is withdrawn from contact with the latter and depressed, when the pawl *m'* is free to drop by gravity upon and engage the teeth of the loose ratchet-wheel N'. It will be understood that the rotations of the roll D^2 upon its shaft *e* revolves the pin-pallet *f*, and the free end of the bell-lever H reciprocates vertically, and thus transmits rocking motion to the upright arm J, which carries the pawls *m m'*, and the latter one is actively employed. This feed-motion of the pawl *m'* advances the loose or inactive ratchet N' until one of the deep notches *e'* arrives under the nose of said pawl, which is permitted to enter and engage with some one of the teeth *d' d'*, &c., of the active pawl N, and the latter is compelled to rotate. This slight rotation of the latter transmits motion to the miter-gear P, affixed to the other end of the short shaft M, which meshes with the gear Q, attached to the sleeve D, and the latter, by means of the spline and groove connection, compels a slight partial rotation of the nut R, and the two rods S T are moved apart, which lengthens each an equal amount, thus partially closing the valve and diminishing the supply of steam. It will be evident that the pressure of the paper upon the roll D^2 against the pressure of the spring F maintains the latter approximately as a fixed point. Thus when the rods S T are lengthened, as above described, slight longitudinal movement of the nut R within the sleeve D is produced in the direction of arrow 1—an amount equal to the increased length of said rods. When this result is accomplished, which occurs almost simultaneously with the movement of the roll D^2 inward, the pawl *m'* continues to advance the loose ratchet N'. Now, if the change of the valve was sufficient, the paper has become more moist and the tension upon the roll D^2 diminished, when the latter moves slightly away from the pressure of the spring F toward its original position, and the pawl *m'*, lifted from the ratchet by the shield K, comes against the pin *n'* by the action of the rod L, which moves back with the arm *p* upon the journal-box E. On the contrary, if the change in the valve was not sufficient the roll D^2 is still maintained against the pressure of the spring F, and the pawl *m'* continues to advance the loose ratchet-wheel N' until a second notch or slot, *e'*, is reached, when a second similar change in the valve is made, and this continues until the supply is properly adjusted. If the paper is not sufficiently dried the roll D^2 moves away from the pressure of the spring F, and the end of the shield K, upon which rests the pin *n* of the pawl *m*, is depressed, when the latter becomes active and a reverse movement of the

operative parts is effected from that accomplished by the pawl *m'*; hence the rods S T are retracted within the nut R and their length diminished, thereby opening the valve to admit a greater supply of steam.

I claim—

1. The combination, with a continuous traveling paper web, of a device operated mechanically thereby to automatically increase or diminish the steam-supply according to the necessities of the paper web, substantially as stated.

2. In steam-regulators operated automatically by the condition of a continuous traveling paper web, the loose ratchet-wheel, operating as described, by which an interval of time is caused to elapse after every change in the position of the valve, substantially for purposes stated.

3. In automatic steam-regulators operated by the paper web, the combination, with the spring-actuated roll, of the right and left screw-threaded nut and its operative parts, whereby the length of the rods connecting with the valve are altered to effect changes in said valve and increase or diminish the supply of steam, substantially as herein described.

4. In an automatic steam-regulator, the combination, with the roll D^2, its movable journal-box E, and arm *p*, of the adjustable rod L, connecting with and operating the shield K to permit the pawls to become active or inactive, substantially as and for purposes herein set forth.

5. In an automatic steam-regulator for paper-making machines, the combination, with the spring-actuated roll D^2, shaft *e*, and pin-pallet *f*, secured thereto, of the slotted pivoted bell-crank lever H, whereby the latter is reciprocated, and by means of the arm J proper feed-motion is imparted to the pawls, substantially as stated.

6. In an automatic steam-regulator, the combination, with the bell-crank lever H, furnished with the pawls *m m'* and their pins *n n'*, of the pivoted rocking shield K, connecting-rod L, and operative journal-box E, to render the pawls either active or inactive, while at the same time proper feed-motion is obtained, as and for the purposes described.

7. The combination, with the rock-lever H and arm J, carrying the pawls *m m'*, of the active ratchet-wheel N and the loose ratchet N', whereby the former is intermittently employed, substantially as and for the purposes herein set forth.

8. In an automatic steam-regulator, the combination, with the spring-actuated roll D^2, operated by the paper web, bell-crank lever H, ratchet-wheels N N' and their operating mechanism, of the gears P Q, sleeve D, and screw-threaded nut R, with the rods S T, all operating, substantially as explained, to regulate the supply of steam, for the purposes herein described.

9. In automatic steam-regulators, the ratchet-wheel provided with the notches upon its periphery, mounted and operated substantially as and for purposes stated.

10. In steam-regulators operated automatically by the condition of a continuous traveling paper web, the combination, with the paper web and its roll, of the lever actuated by the rotation of said roll, whereby the lever and its operative parts regulate the valve according to the necessities of the paper web, substantially as described.

11. In automatic steam-regulators, the combination, with a steam-supply valve and an actuating-roll, of the connecting parts adjustably disposed and operated by said roll to regulate the valve, substantially as and for purposes stated.

12. In automatic steam-regulators, the combination, with the paper web and its roll, of mechanism automatically actuated by said roll upon breaking of the web to simultaneously close the valve, substantially as stated.

13. In steam-regulators, the combination, with the roll D^2, operated by the paper web, of the weighted lever *c*, and the cam e^2, whereby upon breaking of the paper web the roll is permitted to actuate said lever and its operative parts to close the valve, substantially as described.

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

RICHARD SMITH.

Witnesses:
H. E. LODGE,
A. F. HAYDEN.