950,906.

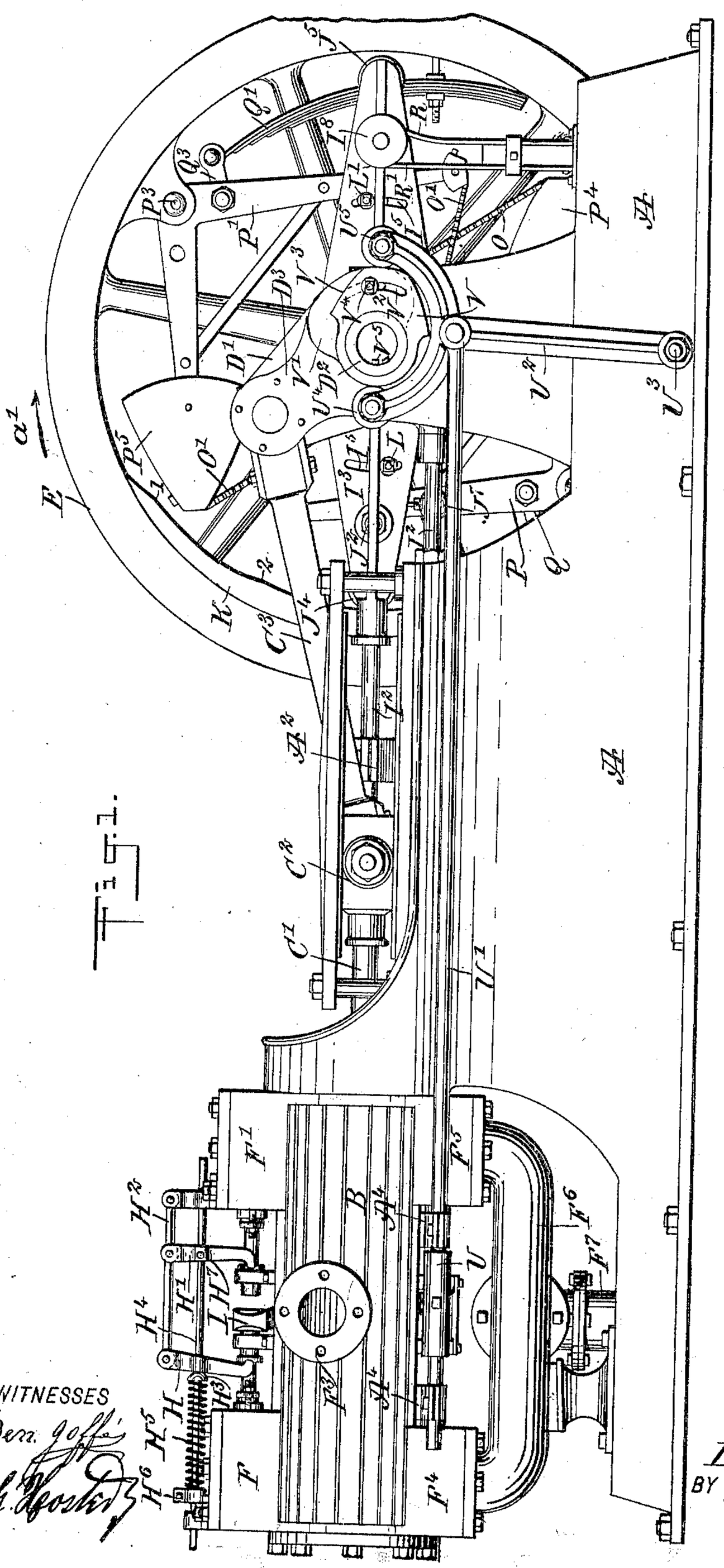
E. GARST.

STEAM ENGINE.

APPLICATION FILED NOV. 2, 1907.

Patented Mar. 1, 1910.

5 SHEETS—SHEET 1.



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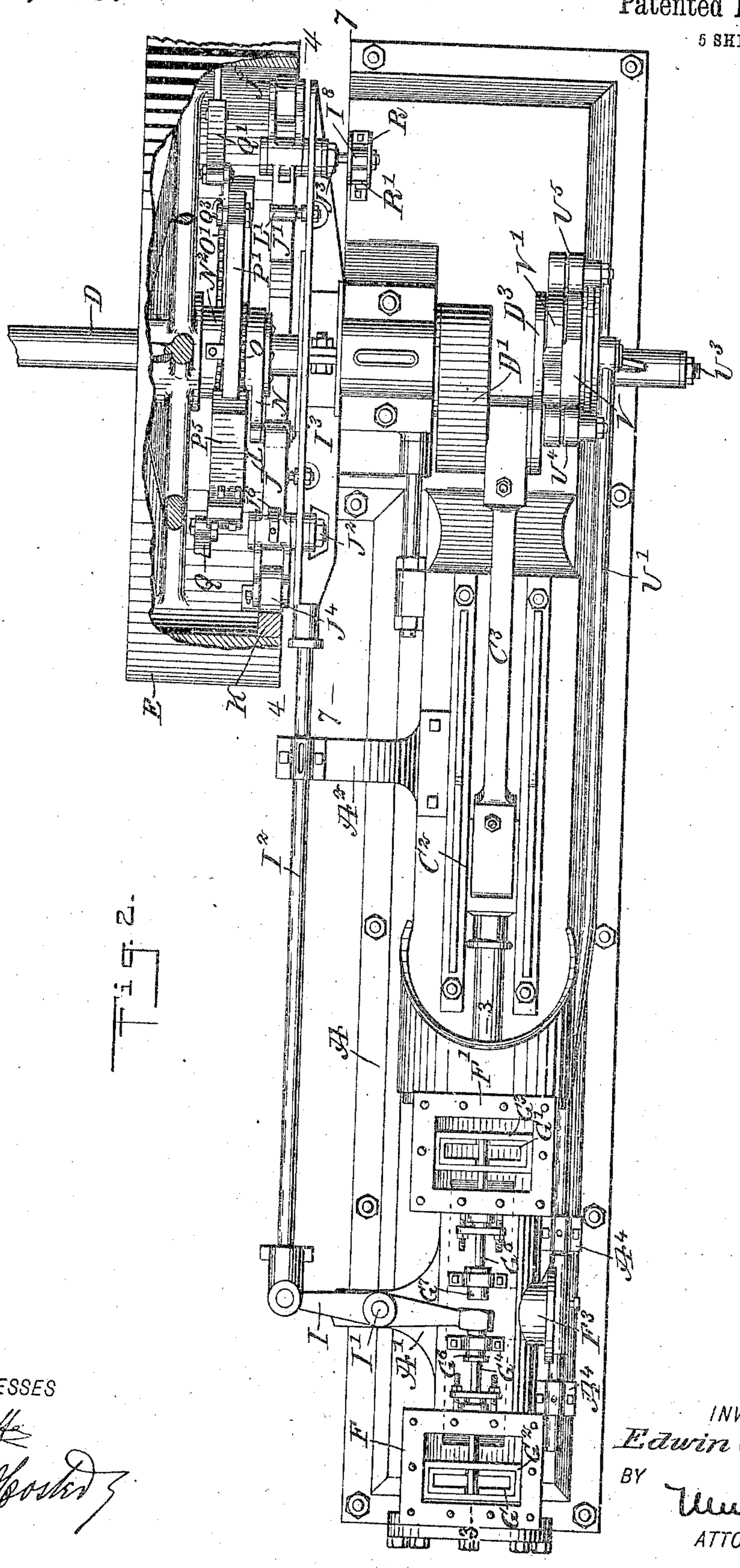

Fig. 2.

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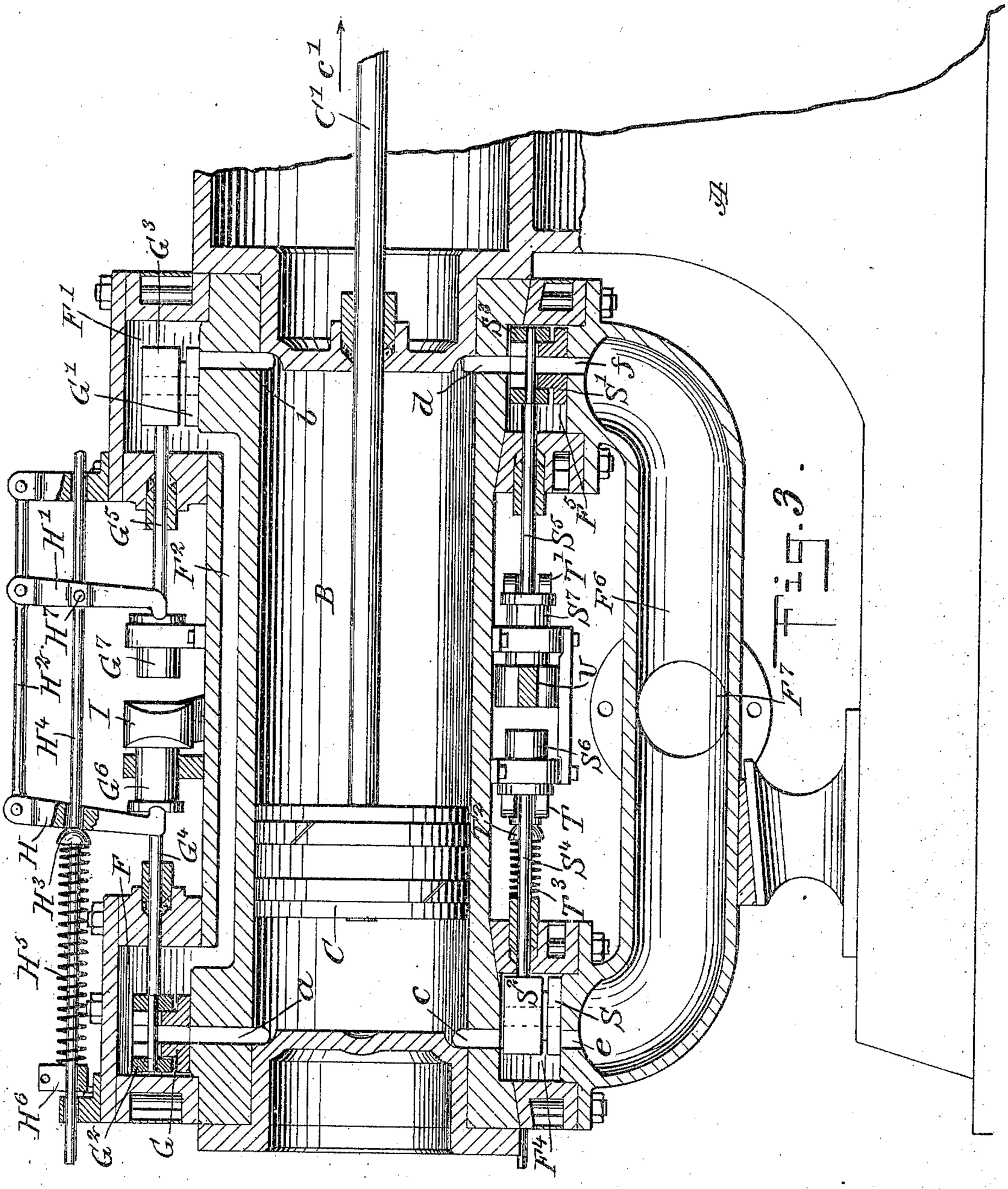

Fig. 3.

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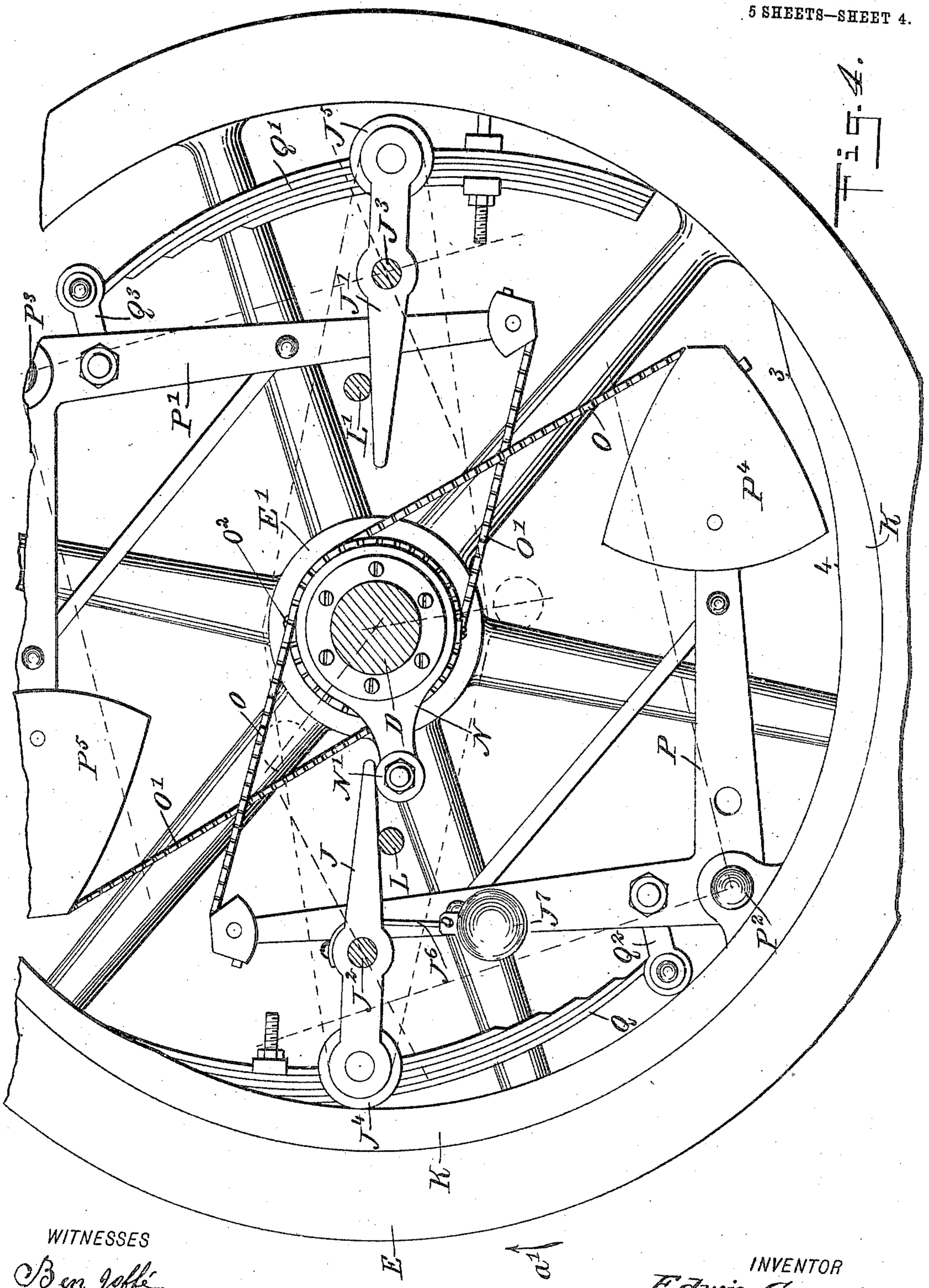

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5 SHEETS—SHEET 5.

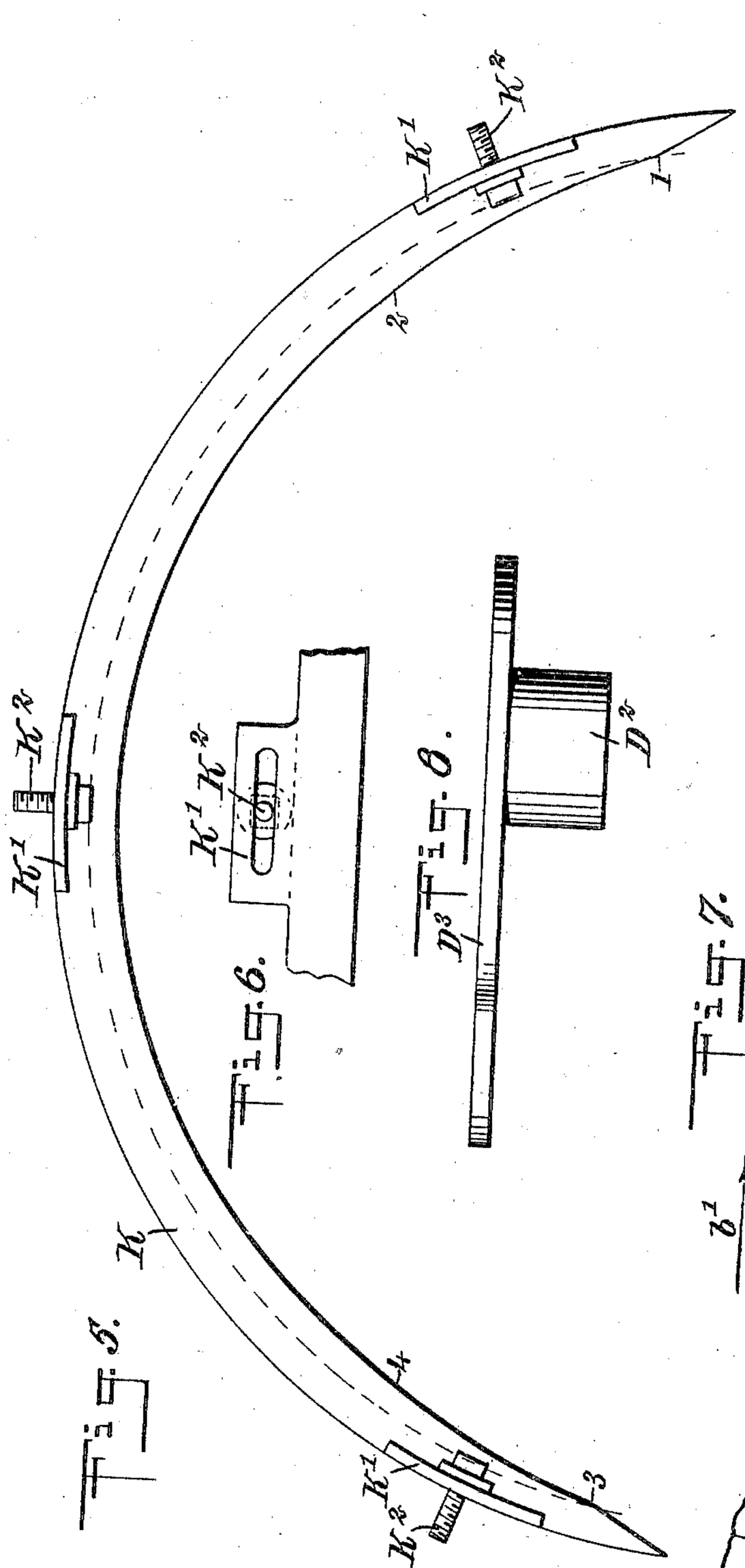

FIG. 5.

FIG. 6.

FIG. 8.

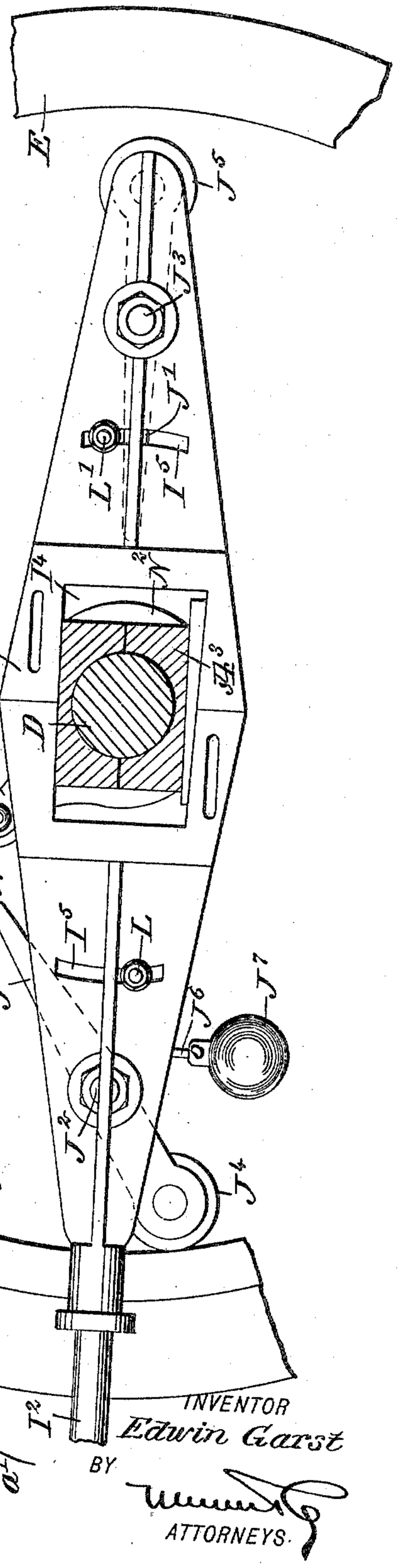

FIG. 7.

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UNITED STATES PATENT OFFICE.

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STEAM-ENGINE.

950,906. Specification of Letters Patent. Patented Mar. 1, 1910.

Application filed November 2, 1907. Serial No. 400,369.

To all whom it may concern:

Be it known that I, EDWIN GARST, a citizen of the United States, residing near Dayton, in the county of Montgomery and State of Ohio, have invented a new and Improved Steam-Engine, of which the following is a full, clear, and exact description.

The invention relates to single-cylinder reciprocating steam engines, and its object is to provide a new and improved steam engine, arranged to insure an easy and uniform running under varying loads, and to allow adjusting of the engine according to the work and to cause the engine to run in either a forward or a backward direction.

The invention consists of novel features and parts and combinations of the same, which will be more fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a side elevation of the improvement; Fig. 2 is a plan view of the same, parts being in section and the steam chest covers being removed; Fig. 3 is an enlarged sectional side elevation of the engine cylinder and the valve mechanisms for the admission and exhaust of the motive agent, taken on the line 3—3 of Fig. 2; Fig. 4 is an enlarged sectional side elevation of the governor and the releasing device for the admission valves, taken on the line 4—4 of Fig. 2; Fig. 5 is an enlarged side elevation of the cam for the admission valve shifting device; Fig. 6 is a plan view of part of the same; Fig. 7 is an enlarged side elevation of the actuating device for the admission valves, the section being on the line 7—7 of Fig. 2, and Fig. 8 is a plan view of carrier for the cams employed for opening and releasing the exhaust valves.

On the engine frame A is mounted the cylinder B, in which reciprocates the piston C having its piston rod C′ attached to the usual cross head C^2. The cross head is connected by a pitman C^3 with the crank arm D′ of the engine shaft D, and the engine shaft is provided with a pulley E, carrying a centrifugal governor, as hereinafter more fully described. The ends of the cylinder B are provided with the admission ports *a* and *b* and the exhaust ports *c* and *d*, the said admission ports *a* and *b* leading into the valve chests F and F′ which are connected with each other, as shown, by a channel F^2 having a connection F^3 with the steam supply pipe, so as to supply both chests F and F′ with live steam. In the steam chests F and F′ are the slide valves G, G′ controlling the admission ports *a* and *b*. The said valves have their yokes G^2, G^3 provided with stems G^4, G^5, which extend toward each other to the outside of the steam chests F and F′, the outer ends of the said stems G^4, G^5 being provided with heads G^6, G^7, which are engaged at their inner faces by levers H, H′, fulcrumed on a rod H pivoted to a bracket attached to the steam chest F′. The lever H is engaged by a button H^3 held on a rod H^4 mounted to slide longitudinally in suitable bearings arranged on the steam chests F and F′, and the said button H^3 is pressed on by a spring H^5 coiled on the rod H^4 and resting with its outer end on a collar H^6 adjustably attached to the rod H^4, to permit the tension of the spring H^5 to be regulated. The rod H^4 is pivotally connected at H^7 with the lever H′, and as the said rod H^4 is spring-pressed and the said button H^3 engages the lever H, it is evident that the latter holds the admission valve G normally in a closed position, while the steam pressure holds the admission valve G′ normally in a closed position.

Now in order to open the valves G and G′ against the tension of the spring H^5 the following shifting device is provided: Between the heads G^6, G^7 extends one end of a transverse shifting lever I fulcrumed at or near its middle at I′ on a bracket A′. The other end of said lever I is pivotally connected with the rod I^2 of a slide I^3 receiving a periodic sliding movement to actuate the lever I to cause said lever I to open either of the admission valves G or G′ against the tension of the spring H^5, as hereinafter more fully explained. Now when the several parts are in the position shown in Figs. 1, 2, 3 and 4, the valve G is held open by the lever I and against the tension of the spring H^5, while the other admission valve G′ is held in a closed position by the action of the spring H^5. The rod I^2 of the slide I^3 is mounted to slide in a suitable bearing arranged on a bracket A^2, and the slide I^3 is provided with an elongated recess I^4 into which fits a bearing A^3, forming an exten-

sion of the bearing for the main shaft D, the said bearing A^3 being held on the frame A of the engine.

Now in order to impart a periodic sliding movement to the slide I^3, the following arrangement is made: Levers J and J′ are fulcrumed at or near their middle at J^2 and J^3 on the slide I^3, and the outer ends of the said levers J and J′ carry friction rollers J^4, J^5 adapted to be engaged by a cam K adjustably secured to the inner face of the rim of the wheel or pulley E which is secured on the main shaft D, as previously mentioned. The levers J and J′ normally rest upon stops L and L′ adjustably secured in slots I^5 arranged on the slide I^3, and the lever J is held against its stop L by the action of a cord or chain J^6 attached thereto, and carrying a weight J^7, as plainly indicated in Figs. 5 and 15. The other lever J′ is held against its stop L′ by the self-balancing friction roller J^5. Now when the engine is running, the rotation of the wheel E brings the cam K alternately in contact with the friction rollers J^4 and J^5, so as to periodically shift the slide I^3 in a longitudinal direction forward and backward, to move the valves G and G′ alternately into open positions against the tension of the spring H^5.

The cam K is provided with slotted flanges K′ (see Figs. 5 and 6), which are engaged by bolts K^2, for adjustably securing the cam K to the rim of the wheel E. The said cam K is provided near each beveled end with the cam portions 1—2 and 3—4, of which the cam portion 1—2 engages the friction rollers J^4, J^5 to shift the slides longitudinally when the engine is running forward, that is, when the shaft D and the wheel E are turning in the direction of the arrow *a′*. When the engine is set for running in the reverse direction then the cam portion 3—4 acts on the friction rollers J^4, J^5, for shifting the slide I^3 longitudinally. Now during the time the cam portion 1—2 (or 3—4) is in engagement with the friction roller J^4, the slide I^3 is shifted in the direction of the arrow *b′* to open the valve G′, and when the said cam portion 1—2 is in engagement with the friction roller J^5 then the slide I^3 is shifted in the reverse direction of the arrow *b′* to open the admission valve G. During the time the concentric portion of the cam K extending from 2—4 (4—2) is in engagement with the corresponding friction roller J^4 or J^5, the corresponding valve G′ or G is held open until the corresponding lever J or J′ is tripped by the releasing mechanism, to be presently described, so that the spring H^5 can instantly close the corresponding valve G′ or G, thus cutting off the steam at the desired point.

A friction roller N′ on the end of a revoluble arm N is adapted to engage the inner end of the lever J or J′, and the hub N^2 of the arm N is mounted to rotate loosely on an extension E′ of the hub of the wheel E (see Fig. 4). Around the hub N^2 of the arm N are passed the sprocket chains O and O′, secured at one point by a suitable fastening device O^2 to the hub N^2, and the ends of the said sprocket chains O and O′ are secured to the terminals of bell crank levers P and P′ fulcrumed at P^2 and P^3 on the rim of the wheel E. The said bell crank levers P and P′ are provided on one arm with weights P^4 and P^5, for swinging said levers outwardly when the engine is running and the wheel E is rotating. Springs Q and Q′ held on the wheel E are connected by links Q^2, Q^3 with the other arm of the bell crank levers P and P′. Now when the engine is running, the weights P^4, P^5 swing outward, and swing the bell crank levers P and P′ against the tensions of their springs Q which causes the chains O and O′ to rotate the hub N^2 of the arm N, to change the position of the arm N whereby to bring the friction roller N′ sooner or later in contact with the inner ends of the levers J and J′. The contact of the roller N′ with the levers moves the friction roller J^4 or J^5 out of engagement with the cam K, and releases the slide I^3 and the lever I, thus permitting the spring H^5 to instantly close the valve G or G′. The cam K is adjustable on the wheel E, in order that the lead of the valves G and G′ may be varied, to vary the speed of the engine. When the cam K is advanced in the direction of the arrow B′, the speed of the engine is increased and when it is moved in the opposite direction, the speed is decreased.

The slide I^3 is provided with a friction roller I^8 (see Figs. 1 and 2), which is adapted to abut alternately against the free ends of springs R and R′ attached to the main frame A, in order to hold the slide I^3 normally in a central position and to check its momentum when shifted by the action of the cam K on the friction roller J^4 or J^5.

The exhaust ports *c* and *d* open into exhaust chests F^4 and F^5, in which are mounted to reciprocate exhaust valves S and S′ adapted to connect the ports *c* and *d* with ports *e* and *f*, leading from the chests F^4, F^5 to an exhaust pipe F^6. The exhaust pipe has an outlet F^7, for carrying the exhaust steam to a suitable place of discharge. The exhaust valves S and S′ are engaged by yokes S^2, S^3 having their valve stems S^4 and S^5 extending toward each other, and the terminals of the valve stems carry heads S^6, S^7 which are engaged by levers T, T′, similar to the levers H and H′. The lever T is engaged by a button T^2, pressed on by a spring T^3 held on a rod S^4, similar to the button H^2, spring H^5 and rod H^4, so that further description of this part of the mechanism is not deemed necessary, it being understood

that by the action of the spring T^3 the valves S and S′ are normally held in a closed position.

Between the heads S^6 and S^7 extends the free end of an arm U secured on a longitudinal rod U′, mounted to slide in suitable bearings A^4, arranged on the cylinder B, and the said rod U′ is pivotally connected with a lever U^2 fulcrumed at its lower end at U^3 on the main frame A. The upper end of the lever U^2 is in the form of a fork, carrying at its terminals double friction rollers U^4, U^5 engaged by cams V and V′ mounted on the hub D^2 of a cam carrier D^3 secured to the wrist pin of the crank arm D′, so as to turn with the latter when the engine is running. The cams V and V′ are provided with elongated segmental slots V^2, V^3 which are engaged by a bolt V^4 also held on the carrier D^3, to securely fasten the cams V and V′ in position on the carrier D^3, and to permit the adjustment of the cams to open the valve S or S′ sooner or later, as may be desired. Set screws V^5 screw in the hub D^2, and engage the hubs of the cams V and V′, to assist in holding the cams firmly in position on the cam carrier D^3. The front cam V is shaped to act on the friction rollers U^4 and U^5, to impart a swinging motion to the lever U^2, to shift the rod U′ longitudinally. The shifting of the rod causes the arm U to move either valve S or S′ into an open position against the tension of the spring T^3, and the rear cam V′ acts alternately on the friction rollers U^4, U^5, to permit the exhaust valves S and S′ to close by the action of their spring T^3. From the foregoing it will be seen that the exhaust valves S and S′ are wholly independent in opening and closing the admission valves G and G′, and the exhaust valves S and S′ have an independent opening and closing relative one to the other. Both sets of valves, however, that is, the admission valves G, G′ and the exhaust valves S, S′, close by the action of their springs H^5 and T^3, respectively.

The operation is as follows: When the several parts are in the position illustrated in Figs. 1, 2, 3 and 4, and the engine is running, then the valves G and S′ are open, while the valves G′ and S are closed, so that live steam can pass from the steam chest F by way of the valve G and port *a* into the outer end of the cylinder B, to push the piston C therein forward in the direction of the arrow *c*′. The exhaust steam in front of the piston C can now pass out of the cylinder B by way of the ports *d*, *f*, valve S′ and exhaust pipe F^6. The rotation of the main shaft D and the wheel E with its centrifugal governor causes the arm N to revolve, so that the friction roller N′ finally comes in contact with the end of the lever J, whereby the lever J is tripped, and when this takes place the slide I^3, rod I^2 and lever I are released, to permit the spring H^5 to immediately close the valve G to shut off the steam from the cylinder B at the desired point of cut-off. Now it is evident that when the engine is running beyond a normal rate of speed, the centrifugal governor by the action of its weighted levers P and P′ causes the turning of the arm N, to bring the friction roller N′ sooner into engagement with the lever J, whereby to release the slide I^3, rod I^2 and lever I correspondingly sooner, and to permit the valve G to close sooner and thus cut off the steam correspondingly soon. When the piston C reaches the end of its stroke in a forward direction then the cam portion 1—2 of the cam K comes in contact with the other friction roller J^5, and on the advancement of the cam K the friction roller J^5 travels on the cam portion 1—2, so that the slide I^3 is shifted from the right to the left, whereby the lever I engages the head G^7, to push the valve G′ into an open position. When this takes place, the live steam passes from the steam chest F′ by way of the port *b* into the inner end of the cylinder B, to cause the piston C to travel in the reverse direction of the arrow, that is, outward on its return stroke. Now in accordance with the speed of the engine, the lever J′ is tripped by the centrifugal governor sooner or later, to release the slide I^3 and lever I, to permit the spring H^5 to close the valve G′ at the desired point of cut off. The exhaust valves S, S′ are controlled by a release gear, which is not, however, automatic in its action as is the release gear for the admission valves G, G′, as above explained, but the exhaust valve release gear can be set by the operator to open and close the exhaust valves at any point of the stroke of the piston C. The rotation of the carrier D^3 turns the cams V, V′ so that the latter alternately act on the friction rollers U^4, U^5 to open the exhaust valves S, S′ at the proper time, and to release the arm U whenever it is desired to allow the spring T^3 to close the exhaust valves S and S′. Now as the cams V and V′ are adjustable one relative to the other and relative to the carrier D^3, it is evident that the exhaust valves can be opened and allowed to close by the action of their spring T^3 whenever desired.

In order to run the engine in the reverse direction, it is only necessary to change the position of the cam K diametrically on the wheel E and to shift the chain J^6 and its weight J^7 from the lever J to the lever J′ and to reverse the cams V and V′ relative to each other. When the engine is running and the wheel E turns in the reverse direction of the arrow *a*′ then the cam portion 3—4 of the cam K acts alternately on the friction rollers J^5 and J^4, to shift the slide I^3 so as to open the valves G, G′ alternately,

to admit steam to the cylinder B in the reverse order, as above described, so that the engine is caused to run backward.

It is understood that the levers J and J′ are normally disposed in a longitudinal direction and hence the inclined portion 1—2 of the cam K in engaging the friction rollers J^4, J^5 causes an alternate shifting of the levers J, J′ and hence of the slide I^3 from the left to the right and from the right to the left as long as the wheel E rotates in the direction of the arrow *a*′. When the engine is set for running in the reverse direction the inclined portion 3—4 of the cam K becomes the active one and successively engages the friction rollers J^5, J^4 to shift the levers J′ and J and hence the slide I^3 from the right to the left and from the left to the right respectively.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. A steam engine provided with spring-pressed admission valves normally closed by the action of their spring, a shifting lever for engagement with the stems of the said admission valves, a slide connected with the said shifting lever, levers fulcrumed on the said slide, a revoluble cam for alternately engaging the said slide levers to move the slide alternately in opposite directions for opening the admission valves against the tension of their spring, and an automatic releasing device for the said slide levers to disengage the same from the cam to allow the admission valves to close by the action of their spring.

2. A steam engine provided with spring-pressed admission valves normally closed by the action of their spring, a shifting lever for engagement with the stems of the said admission valves, a slide connected with the said shifting lever, levers fulcrumed on the said slide, a revoluble cam for alternately engaging the said slide levers to move the slide alternately in opposite directions for opening the admission valves against the tension of their spring, a releasing arm for alternately engaging the said slide levers to move the same out of engagement with the said cam, and a governor connected with the said releasing arm for controlling the position thereof to release the slide levers from the cam and allow closing of the admission valves by the action of their spring.

3. A steam engine provided with spring-pressed admission valves normally closed by the action of their spring, a shifting lever for engagement with the stems of the said admission valves, a slide connected with the said shifting lever, levers fulcrumed on the said slide, a revoluble cam for alternately engaging the said slide levers to move the slide alternately in opposite directions for opening the admission valves against the tension of their spring, a releasing arm for alternately engaging the said slide levers to move the same out of engagement with the said cam, a wheel on the engine shaft carrying the said cam, and a centrifugal governor on the said wheel controlling the said releasing arm.

4. A steam engine provided with spring-pressed admission valves normally closed by the action of their spring, a shifting lever for engagement with the stems of the said admission valves, a slide connected with the said shifting lever, levers fulcrumed on the said slide, a revoluble cam for alternately engaging the said slide levers to move the slide alternately in opposite directions for opening the admission valves against the tension of their spring, a releasing arm for alternately engaging the said slide levers to move the same out of engagement with the said cam, a wheel on the engine shaft carrying the said cam, the said releasing arm being mounted to turn on the hub of the said wheel, and a governor mounted on the said wheel controlling the position of the said releasing arm and carrying it around.

5. A steam engine provided with a wheel on the engine shaft, a centrifugal governor on the said wheel, a cam on the said wheel, an actuating device for opening the admission valves of the engine actuated by the said cam, and a revoluble releasing arm for the said actuating device to disconnect the latter from the said cam, the said releasing arm being carried around by the said governor and its position controlled by the latter.

6. A steam engine provided with a wheel, a cam on the wheel, weighted spring-pressed bell crank levers fulcrumed on the said wheel, a releasing arm mounted to turn loosely and axially on the said wheel, chains secured to the bell crank levers and passing around the hub of the said releasing arm to carry the arm around and to turn the same independent of the wheel.

7. A steam engine provided with a wheel, a cam on the wheel, weighted spring-pressed bell crank levers fulcrumed on the said wheel, a releasing arm mounted to turn loosely and axially on the said wheel, chains secured to the bell crank levers and passing around the hub of the said releasing arm to carry the arm around and to turn the same independent of the wheel, and means for securing the chains in place on the hub of the arm.

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

EDWIN GARST.

Witnesses:
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EVERARD B. MARSHALL.