No. 617,388. Patented Jan. 10, 1899.

E. & W. F. BAUROTH.

GAS ENGINE.

(Application filed Aug. 3, 1897.)

(No Model.) 3 Sheets—Sheet I.

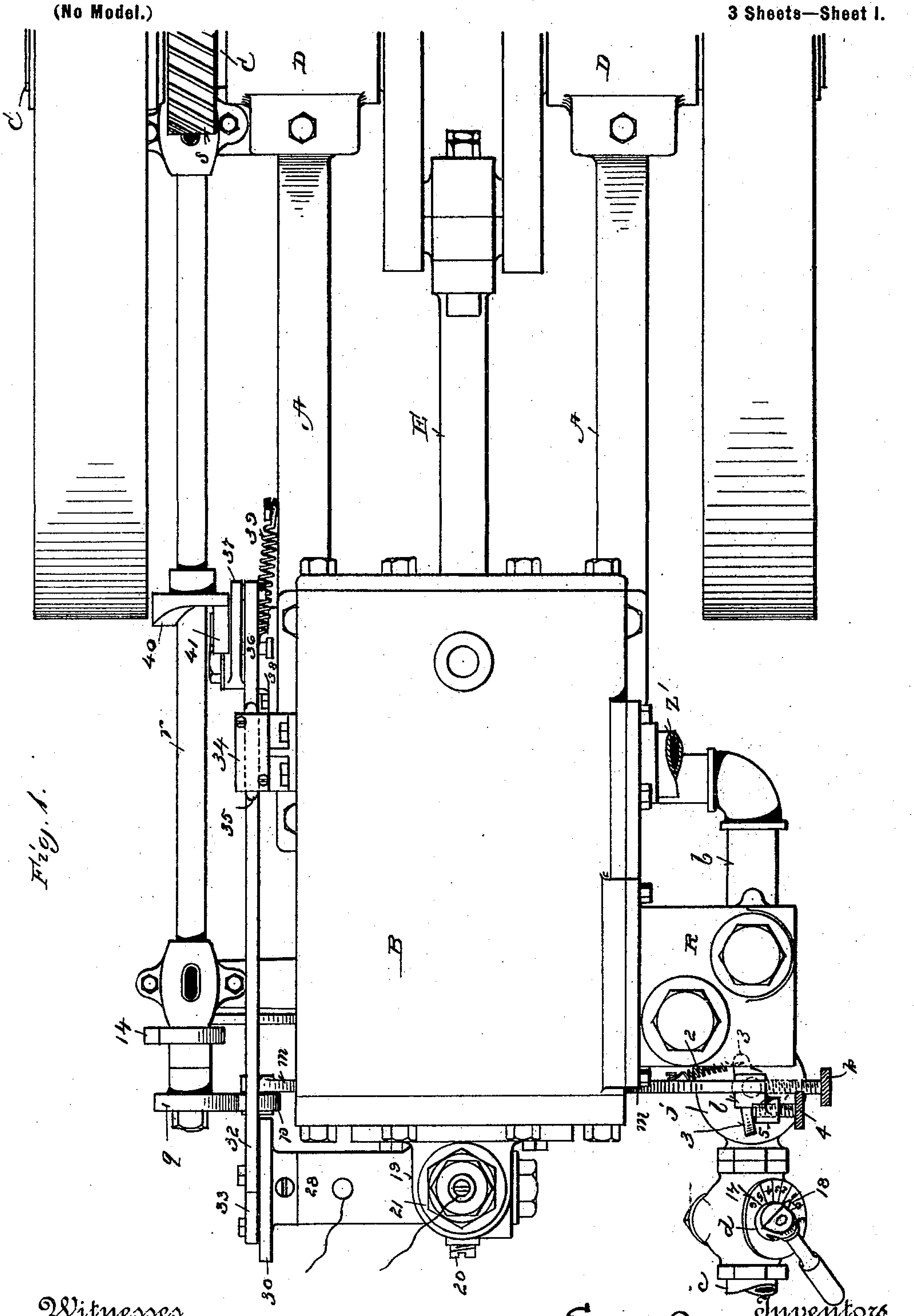

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Fig. 2.

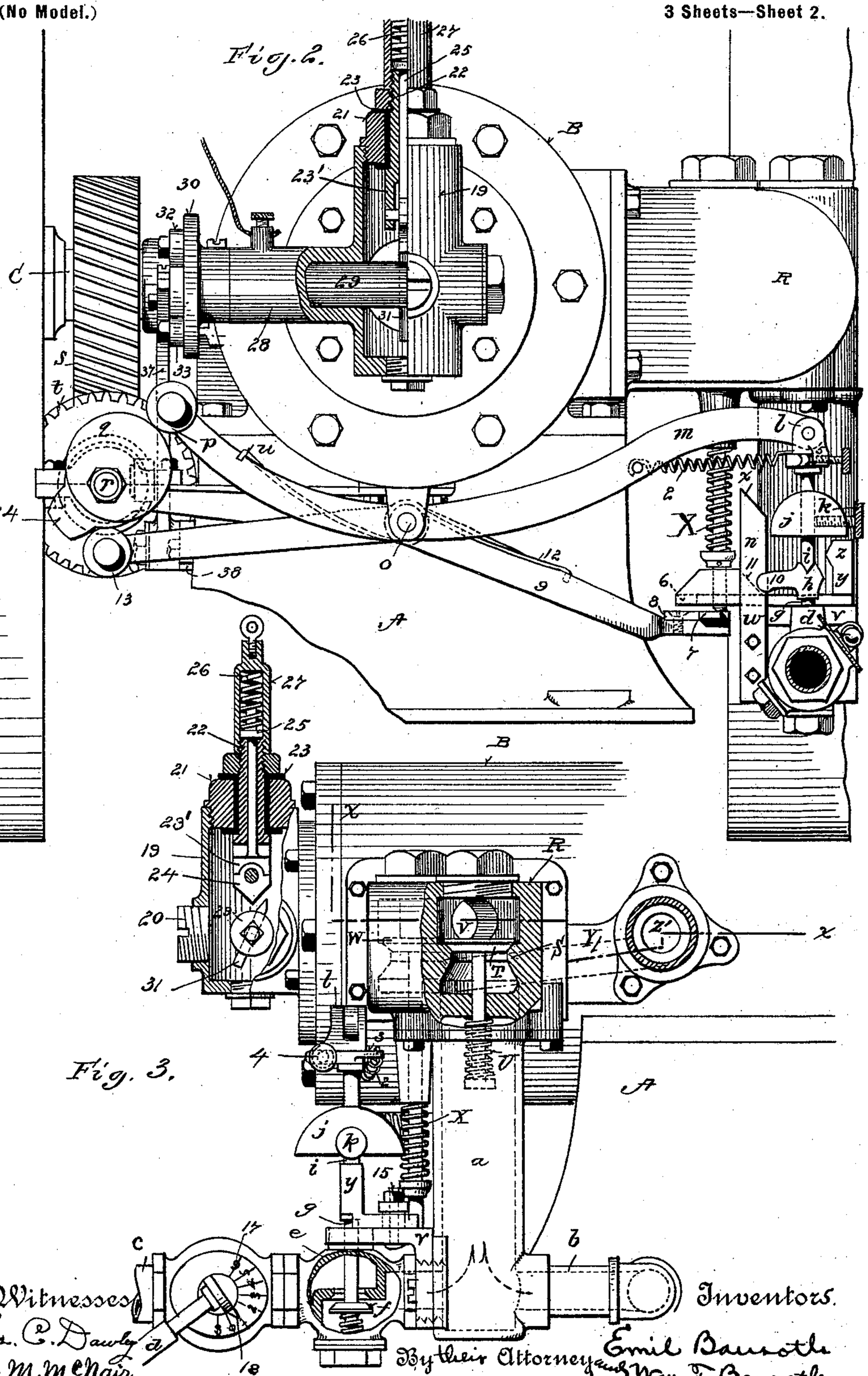

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Fig. 4.

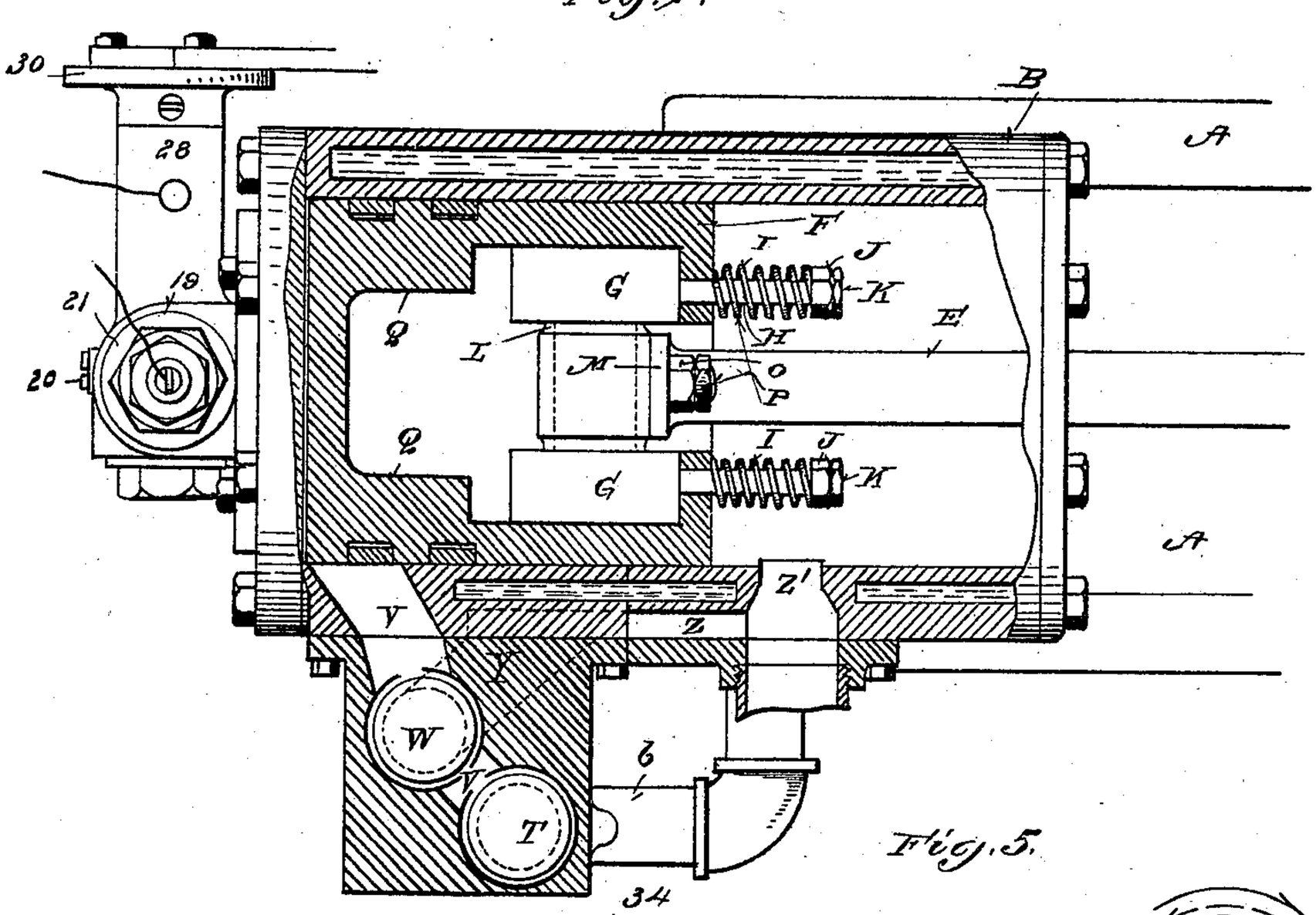


Fig. 5.

Fig. 6.

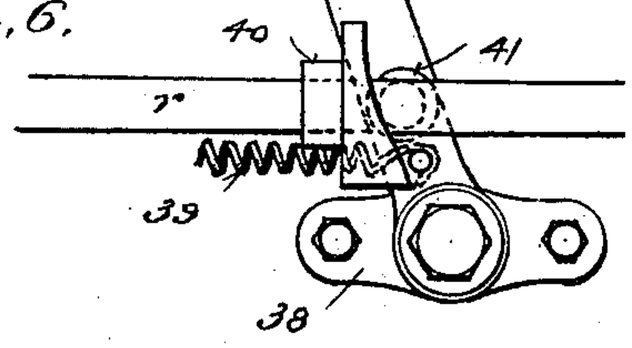
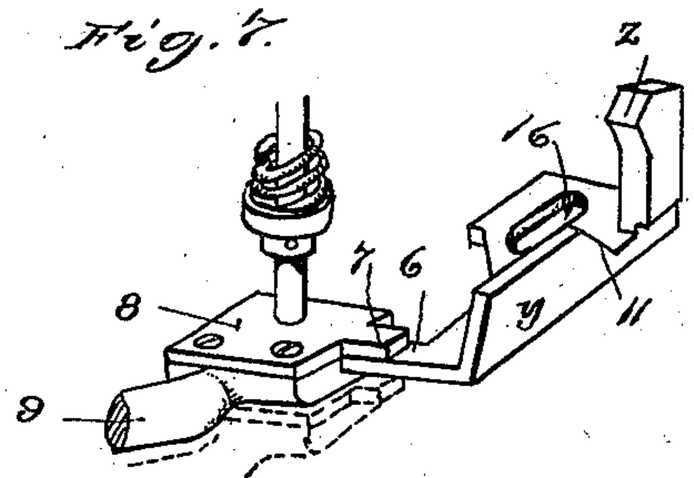


Fig. 7.



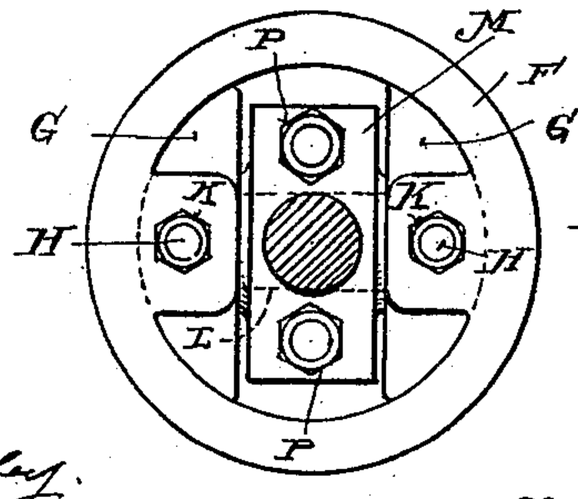


Fig. 8.

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UNITED STATES PATENT OFFICE.

EMIL BAUROTH AND WILLIAM F. BAUROTH, OF SPRINGFIELD, OHIO.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 617,388, dated January 10, 1899.

Application filed August 3, 1897. Serial No. 646,866. (No model.)

To all whom it may concern:

Be it known that we, EMIL BAUROTH and WILLIAM F. BAUROTH, citizens of the United States, residing at Springfield, in the county of Clark and State of Ohio, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to certain new and useful improvements in gas or gasolene engines.

The special features of our invention relate, first, to the devices for actuating the gas-inlet valve; second, to devices for holding the exhaust-valve open during such time as the engine is running without gas or gasolene being admitted, so that air which is drawn in by the outstroke of the piston will be expelled on the instroke with perfect freedom to prevent the useless compression of the air and the consequent retarding of the momentum, and, third, to connecting the piston-rod with the piston by a spring-joint in such manner that when the charge is in the cylinder to undergo compression the piston will yield relatively to the piston-rod, whose stroke is fixed, enough to give space for the charge, but which piston will extend back practically the whole length of the cylinder when the exhaust-port above referred to is open, so as to entirely dispel all of the products of air that may be in or drawn into the cylinder, whereby the piston will sometimes leave a space in the cylinder and will sometimes travel back and take up or occupy such space.

In the accompanying drawings, on which like reference letters and numerals indicate corresponding parts, Figure 1 is a plan view of a gas-engine embodying our invention; Fig. 2, a rear elevation of the same with a portion of the igniting-chamber broken away; Fig. 3, a side elevation of a portion of the engine with the admission-chamber, igniting-chamber, and exhaust-pipe in section; Fig. 4, a detail partial plan and sectional view, the section being taken on the line *x x* of Fig. 3. Fig. 5 is a detail view of a portion of the mechanism for operating the movable electrode; Fig. 6, a detail elevation and partial section of the devices for actuating the movable electrode; Fig. 7, a detail perspective view of the devices for supporting the supplemental exhaust-valve during the interval when gas is not being taken in, and Fig. 8 an end elevation of the piston with the piston-rod in section.

The letter A designates a suitable bed for our engine, upon which are mounted a cylinder B and a crank-shaft C in boxes D, with a piston-rod E connected with a piston-head F by spring-joints.

Referring to Figs. 4 and 8, it will be seen that we space segmental blocks G in the piston, which have stems H, adapted to slide in holes in the end of the piston. Springs I on these stems abut against the piston and nuts J, secured by lock-nuts K. A stout pin or trunnion L is mounted in the blocks G and connected with the piston-rod in some suitable manner, as by means of passing through an eye in the end of the piston-rod and being held by a cap-plate M, secured by nuts O, held by lock-nuts P. Thus it will be seen that there is a spring connection between the piston-rod and piston, so that although the piston-rod stroke is fixed and definite the stroke of the piston is variable, having as much independent movement as is measured between the ends of the blocks G and the shoulders Q. Thus, when the instroke is made, if a charge is in the cylinder to be compressed the piston-head will yield as the charge becomes more solidified, compressing the springs I and finally bringing the shoulders Q against the blocks G, thus giving space for the compressed charge and thus also making the connection between the piston and the piston-rod solid at the time the explosion takes place. When, however, the auxiliary exhaust-port is open, as hereinafter specified, and it is desired to rid the cylinder of the residual gases or to rid it of air, the piston-head travels back full length, or practically the full length, of the cylinder. When, too, the outstroke is made, the piston projects beyond the end of the piston-rod to its full limit, because of the action of the springs and the so-called "sucking force" of the piston. This holds the piston against the outer face of the segmental blocks G. Thus we have provided for a spring or yielding connection between the piston and piston-rod by which at one time the piston will not travel fully

back in the cylinder and at another it will do so for the purposes described.

The letter R designates the admission-chamber, bolted to one side of the cylinder and having a partition S, in which is seated a check-valve T, held down by a spring U. A passage V leads from above this check-valve to the cylinder, passing over an auxiliary exhaust-valve W, seated also in the partition S and having a spring X acting between suitable shoulders to keep the valve seated. A passage Y, as shown in dotted lines in Figs. 3 and 4, leads from beneath the exhaust-valve W to an exhaust-passage Z, (shown in Fig. 4,) which opens into the exhaust-port proper Z'. When the piston makes an outward stroke, it draws in the air and gas past the check-valve T and through the passage V. When the piston makes an instroke, it will exhaust the products of combustion, gases, &c., or pure air in the cylinder, as the case may be, if the auxiliary exhaust-valve W is up. Certain devices presently to be described operate to hold it up when no gas is being taken in, as will presently be described.

A mixing-passage *a*, in the nature of a pipe or extension from the chamber R, connects with air-inlet pipe *b*, which extends at its open end within the base A. A gas-inlet pipe *c*, having a cut-off or cock *d*, and a gas-valve composed of a guide *e* and a valve proper *f*, connects also with this mixing-passage *a*. Air and gas are both drawn into this passage by the outstrokes of the engine-piston and on their way to the check-valve T become thoroughly mixed. This valve *f* we term the "gas-admission" valve; but if gasolene is used instead of gas then this gas-valve will be substituted for a gasolene-pump. The mechanism we are now about to describe for operating this gas-valve will therefore be understood to be applicable to a gasolene-pump as well as to a gas-valve, and so our description will treat the gas-valve and gasolene-pump as full equivalents in the combination embracing the devices for operating the same.

The stem *g* (valve-stem) has a notched head *h*, adapted to be struck by a hit-and-miss pin *i*, provided with an adjustable contact collar or shoulder *j*, held by a thumb-screw *k*. This pin *i* is secured to a clip *l*, pivoted to an actuating-lever *m*, fulcrumed at *o* and having an antifriction-roller *p*, operated by a cam *q*, so that the lever will vibrate up and down. This cam is secured to a rotatable shaft *r*, having suitable bearings at the side of the engine, as will be more clearly shown in Fig. 1, and driven by a worm-gear *s* on the main shaft, meshing with the worm-pinion *t*, mounted on the shaft *r*, so that the shaft receives constant rotary motion. A spring *u*, as seen in Fig. 2, holds the lever down on the cam at one end, and thereby tends to lift the other end. A bracket *v*, secured to the wall of the mixing-passage *a*, carries a fixed bar *w*, having an incline *x*, and carries a slidable or reciprocating plate *y*, having a stud with an inclined face *z*. Now when the hit-and-miss pin *i* is moved up and down rapidly by the lever *m* its contact-collar *j* will come in contact with the incline *x* and will deflect such pin enough to cause it to enter the notch in the head *h* of the stem *g* or will deflect it enough to cause it to miss the notch and pass over and strike upon the incline *z*. It will do the one or the other of these things, according to the speed with which the engine is running. It will be understood that the spring 2, connected with one end of the lever *m* and at the other to an arm 3, mounted on the pin *i* and adjusted by means of a thumb-screw 4, carried by a lug 5 on the clip *l*, will draw this pin *i* more or less inward and outward vertically. It is this tension of the spring 2 that causes the contact-collar *j* to always strike the incline *x*, and the degree that the incline will deflect the hit-and-miss pin is determined by the tension put upon the spring 2. This is determined by the speed at which you wish the engine to run. If at high speed, the tension is made greater, so that the hit-and-miss pin will strike the head *h* notwithstanding the greater tendency in high speed of the incline *x* to deflect the pin to one side. If a lower speed is desired, then the spring 2 is put under a less tension, so that a less speed will deflect the pin away from the head *h*, and thus make the engine escape taking in gas one or more revolutions or until the speed lowers.

When the hit-and-miss pin misses the head *h* and gas is accordingly not admitted, the hit-and-miss pin must actuate the plate *y*, so as to hold the auxiliary exhaust-valve up to permit the escape of all of the products of the previous explosion that may not have escaped through the exhaust-port proper and to permit any fresh air that may be drawn into the cylinder to be exhausted during the strokes due to momentum. To do this, the hit-and-miss pin strikes the incline *z* and shifts the plate *y*, so that its projection 6 will pass under the projection 7 of the plate 8 on the lever 9. The auxiliary exhaust-valve stem rests upon the plate 8 and is lifted by the lever 9 at the proper time relatively to each instroke of the piston, but is let down in time to hold in the charge undergoing compression, unless, indeed, the plate *y* has been shifted so as to place the projection 6 under the lug 7. In that case that end of the lever 9 remains held up, and hence the auxiliary exhaust-valve is held up for the purpose stated. Now, then, when the engine resumes the normal speed and the hit-and-miss pin *i* again strikes the head *h* the projection 10 of the head strikes the incline 11 on the plate *y* and shifts the plate in the other direction, so that its projection 6 will pass from under the lug 7 and immediately let the auxiliary exhaust-valve down. Thus the plate *y* is shifted first in one direction and then in the other, according to whether the hit-and-miss pin misses the head

h or resumes striking it. The lever 9 is held down at one end by a spring 12 and up at the other, so as to bring its roller 13 in contact with the cam 14 on the shaft *r*. A bolt 15 serves to connect the plate *y* with the bracket *v*, such bolt passing through a slot 16 in the plate.

A scale 17, with a pointer 18, serves to indicate the quantity of gas being admitted, so that the operator may know the proportion of gas to air.

We will now refer to a form of sparking device. A sparking-chamber 19 is bolted to the rear of the cylinder-head and provided with an opening closed by a plug 20, so that gasolene can be poured into the chamber to be used in making the initial start, as hereinafter described. In the cap 21 of the chamber is fitted a bushing 22, insulated by material 23, and having its lower end bifurcated to form jaws 23′, in which is pivotally mounted a swinging contact-piece 24, adapted to come in contact with a spring-held stem 25 when it is swung to either side. This stem is provided so that the spring 26 can be housed in a sleeve 27, sufficiently remote from the heat not to be affected by it, and yet provide a yielding means that will cause the swinging contact 24 to quickly return to normal position after being deflected to one side by the wiping action of the contact-point of the other electrode. The foot 28 of the stem 25 fits down on the contact-point 24. This constitutes one of the electrodes. The other electrode consists of a horizontal shaft 29, mounted in a bearing-sleeve 28, extending from the chamber 19, and at one end has a disk 30 secured to it and at the other a pin 31, forming a contact-point. This electrode is given a reciprocating rotary motion or rocking motion, so that the point 31 sweeps against one side of the contact 24, and when the next cycle of operation is accomplished it sweeps against the other side, sparking each time.

We will now refer to the preferred means, though not the only means, for imparting the reciprocating rotary motion to the rocking electrode. It consists of pitmen 32 and 33, connected with the disk 30 and arranged to slide in a tubular guide 34, mounted on the side of the cylinder or otherwise supported. The pitmen rest one upon the other, as shown in Figs. 5 and 6, and a spring 35 acts to press the uppermost pitman as the undermost recedes down into line with the actuating-finger 36, which the spring also bears down on. This finger is mounted on the arm 37, pivoted to a bracket 38, secured to the bed. A spring 39 draws the arm toward a cam 40, mounted on a shaft *r*, so that an antifriction-roller 41, mounted on the arm, will constantly bear against this cam. When the thick side of the cam comes around against the roller 41, the arm is thrust rearward and the finger 36 engages with whichever of the pitmen happens to project farthest forward. The cam is so timed that when one explosion is to be effected one of the pitmen is actuated and when the next explosion is to be effected the other of the pitmen is actuated. Thus the contact-point 31 is moved against first one side and then the other of the contact-point 24. Between the strokes the point 31 remains still. Thus this mechanism sets up an intermittent rotary reciprocating motion.

Referring again to the main exhaust-port Z′, it will be understood that when the piston is given an outstroke by an explosion its heel passes and uncovers this port and the outer limit of the stroke is reached. When, however, the piston is making an outstroke due to momentum and is drawing in a charge, the blocks G are in contact with the inturned end of the piston, and consequently the exhaust-port Z′ remains closed.

As the cam 40 is symmetrical, it will operate the arm 37 irrespective of the direction of rotation of the shaft *r*. The result of this is that we can start our engine by turning the main shaft backward or forward. Thus if the engine stops with the piston on the outstroke we can start up by turning it back, because our sparking device will spark in either direction without breaking. We do not, therefore, in such case have to turn the main shaft forward when it makes an instroke and another outstroke to draw in the charge and instroke to compress it. In this starting apparatus we pour a small quantity of gasolene into the chamber by removing the plug 20.

Referring again to the springs I, which permit of a yielding connection between the piston-rod and piston, it will be seen that they are mounted on the part of the stems of the blocks G which extends beyond the piston toward the open end of the cylinder. By thus locating the springs they are subjected to much less heat, and consequently the temper of these springs is not destroyed by the intense heat generated at every explosion. These springs will therefore last much longer, and at the same time produce the required work, than if they were otherwise located.

Having thus fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a gas-engine, the combination with a cylinder and a piston-rod, of a piston connected therewith by a slidable joint having a fixed limit in one direction and a yielding or spring limit in the other direction, the cylinder having an exhaust-passage which is uncovered by the piston when it shifts in one direction relatively to the piston-rod.

2. In a gas-engine, the combination with a cylinder having an auxiliary exhaust-port near one end, of a piston-rod, and piston, slidable blocks in the piston and connected with the piston-rod, shoulders back of the blocks, and springs acting between the blocks and the piston, said exhaust-port being uncovered by the piston when it shifts in one direction relatively to the piston-rod.

3. In a gas-engine, the combination with a charge-inlet device having a stem or rod with a V-shaped notch in one of its ends, and a hit-and-miss pin, and means to actuate the pin, of a tension device to draw the pin in one direction and a fixed device adapted to engage with the pin and divert it against the action of the tension device, whereby when the momentum of the pin is such as to equalize the tension of the tension device and the diversion of the diverting device the pin will strike within the V-shaped notch in said stem and actuate the inlet device, and whereby when the momentum of the pin overcomes this harmony of tension and diversion, the pin will miss the inlet device.

4. In a gas-engine, the combination with a charge-inlet device and a hit-and-miss pin, means to actuate it, a tension device and a diverting device, of an auxiliary exhaust-valve, means to lift it and a shiftable device adapted to maintain and support it and to withdraw from it, said shiftable device being actuated in one direction by the pin when it misses the inlet device and in the other direction when it hits the inlet device.

5. In a gas-engine, the combination with a charge-inlet device, a hit-and-miss pin, means to actuate it, a tension device for the pin, an inclined surface to divert the pin against the tension device, a shiftable plate having two inclines, one to be actuated by the pin when it raises the inlet device and the other to be actuated by the inlet device when the pin hits it, an auxiliary exhaust-valve, and means to lift it, said plate being adapted to be engaged with said means to support the valve and to disengage from it to release the valve.

6. In a gas-engine, the combination with a gas-inlet valve, a notched head on its stem, a lever, means to operate the lever, a hit-and-miss pin actuated by the lever, a collar or projection on the pin, an inclined surface adapted to be engaged by said collar or projection, a shiftable plate having two inclined surfaces, an auxiliary exhaust-valve, a lever to lift it, and means to operate the lever, said plate being adapted to engage said lever to hold the valve up and disengage therefrom to drop the valve, said pin being adapted to operate the valve-stem and to operate said plate in one direction and said head to operate the plate in the other direction.

7. In a gas-engine, the combination with an auxiliary exhaust-valve and means to lift it, of a shiftable plate having two inclines, and a hit-and-miss pin, and an intermediate device, and means to actuate the pin, whereby the pin will operate the plate in one direction and through said intermediate device will operate the plate in the other direction for the purpose described.

In testimony whereof we affix our signatures in presence of two witnesses.

EMIL BAUROTH.
WILLIAM F. BAUROTH.

Witnesses:
OLIVER H. MILLER,
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