No. 745,814. PATENTED DEC. 1, 1903.

W. E. GIBBS.

REVERSIBLE DRIVING GEAR.

APPLICATION FILED MAR. 11, 1902.

NO MODEL. 4 SHEETS—SHEET 1.

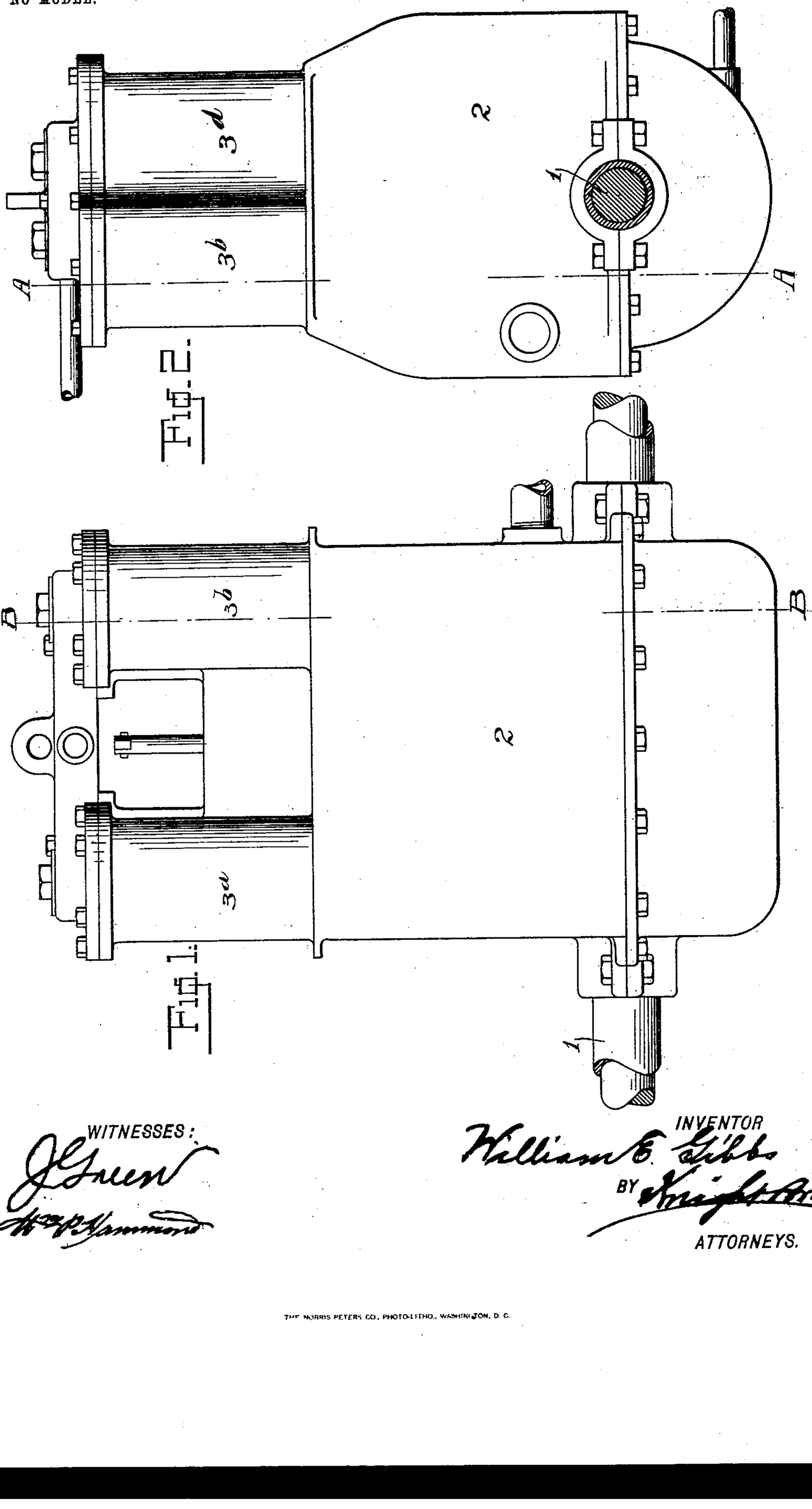

FIG. 2.

FIG. 1.

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NO MODEL. 4 SHEETS—SHEET 2.

Fig. 3.

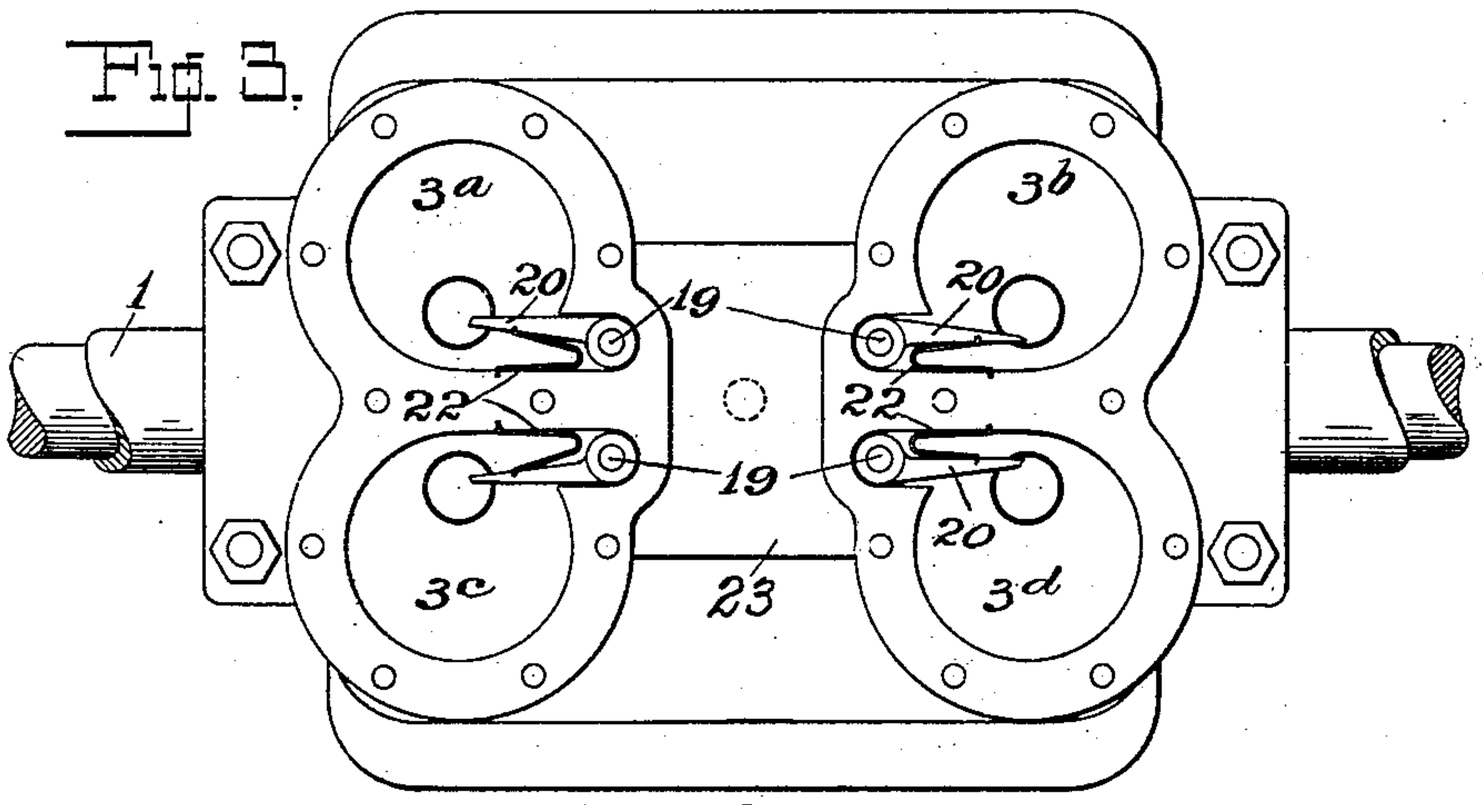
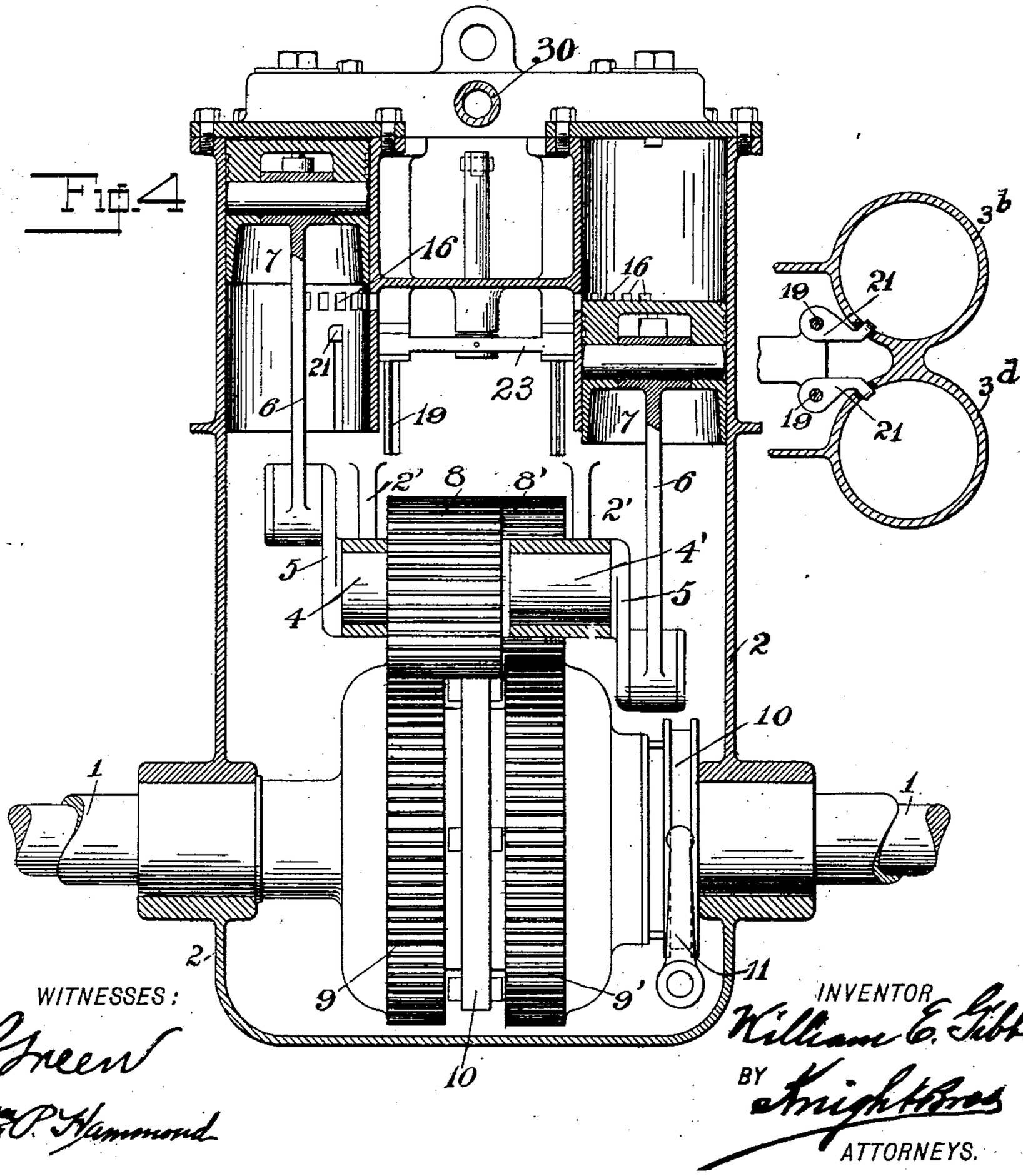


Fig. 4



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NO MODEL. 4 SHEETS—SHEET 3.

Fig. 5.

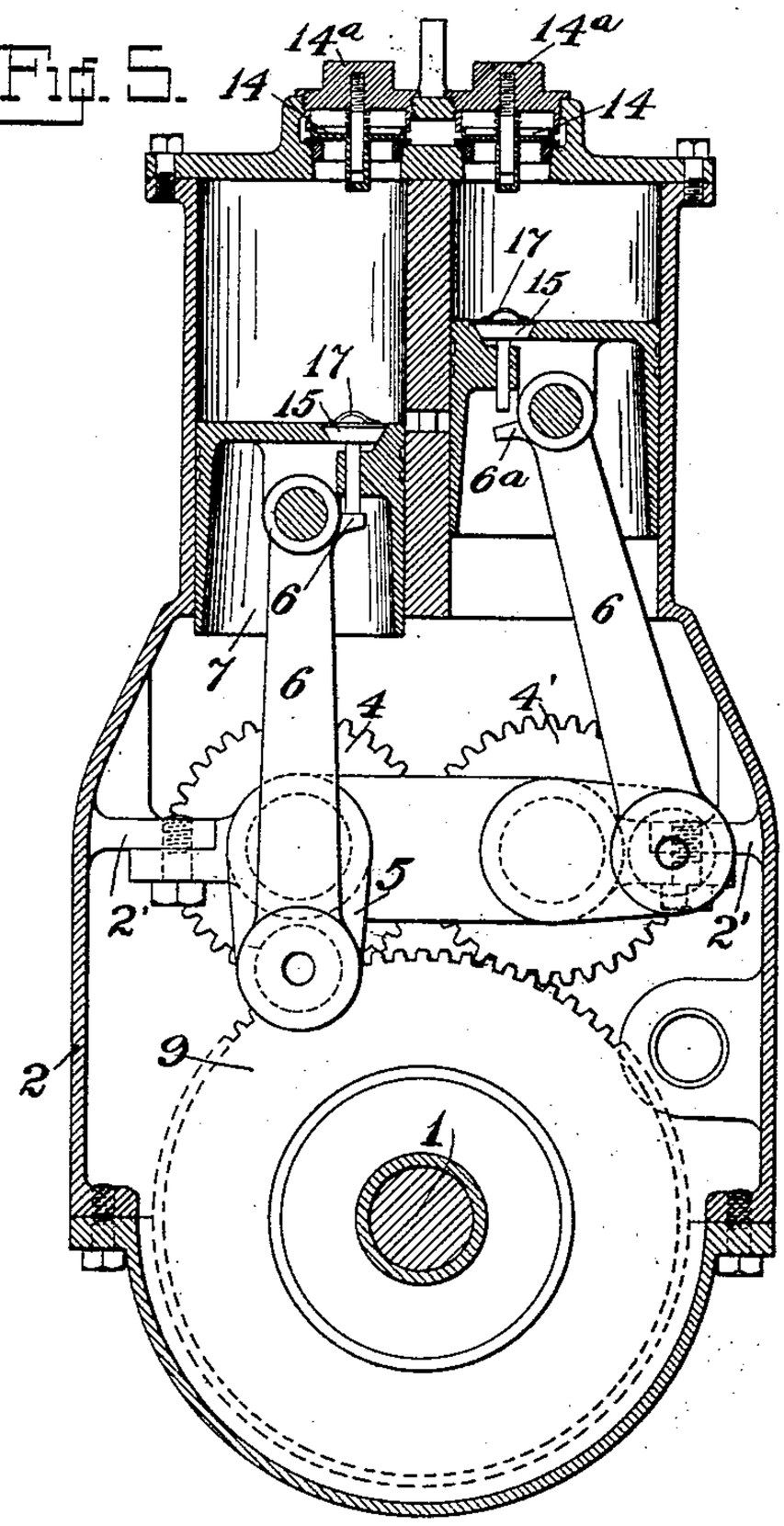
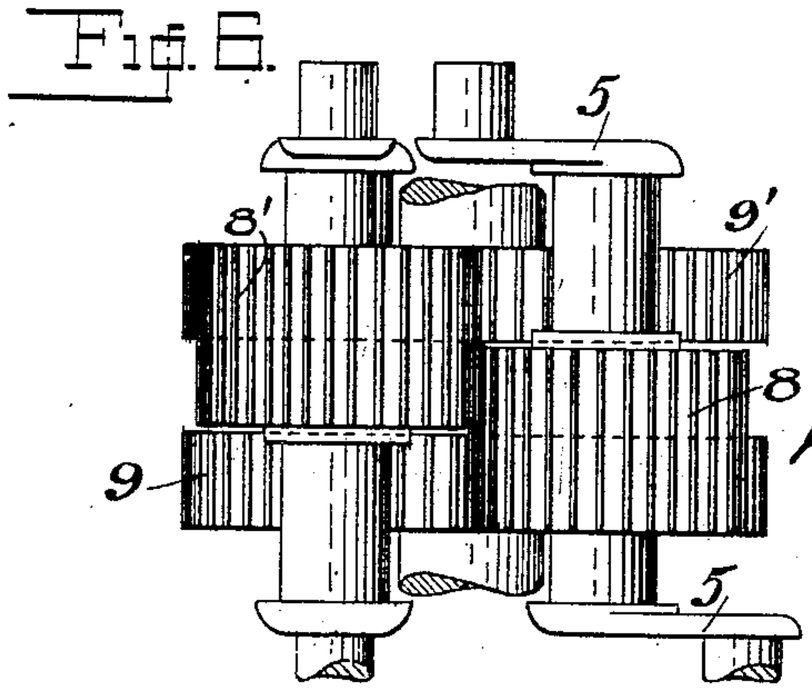


Fig. 6.



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APPLICATION FILED MAR. 11, 1902.

NO MODEL. 4 SHEETS—SHEET 4.

Fig. 7.

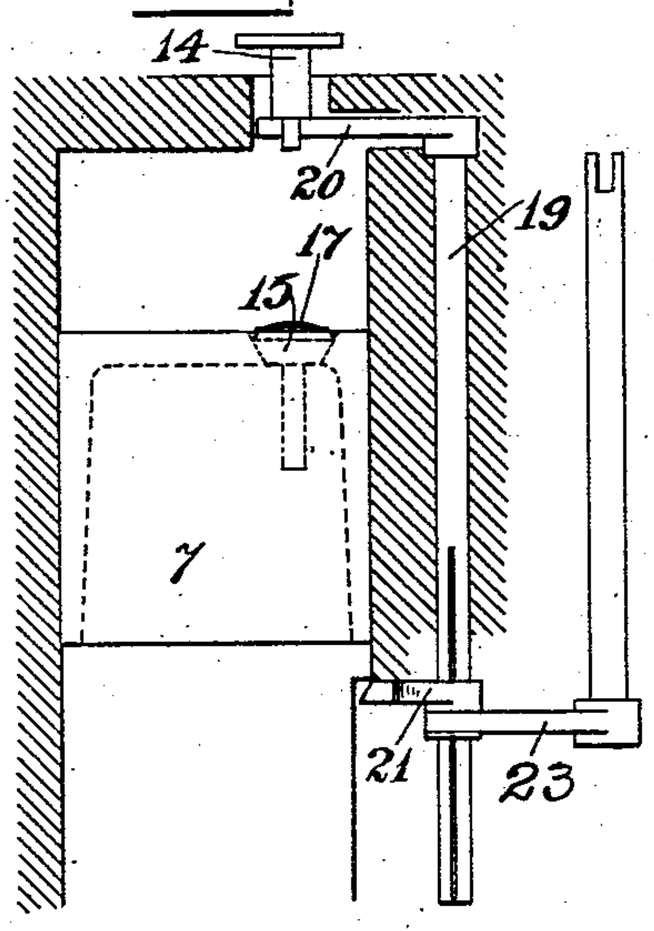


Fig. 8.

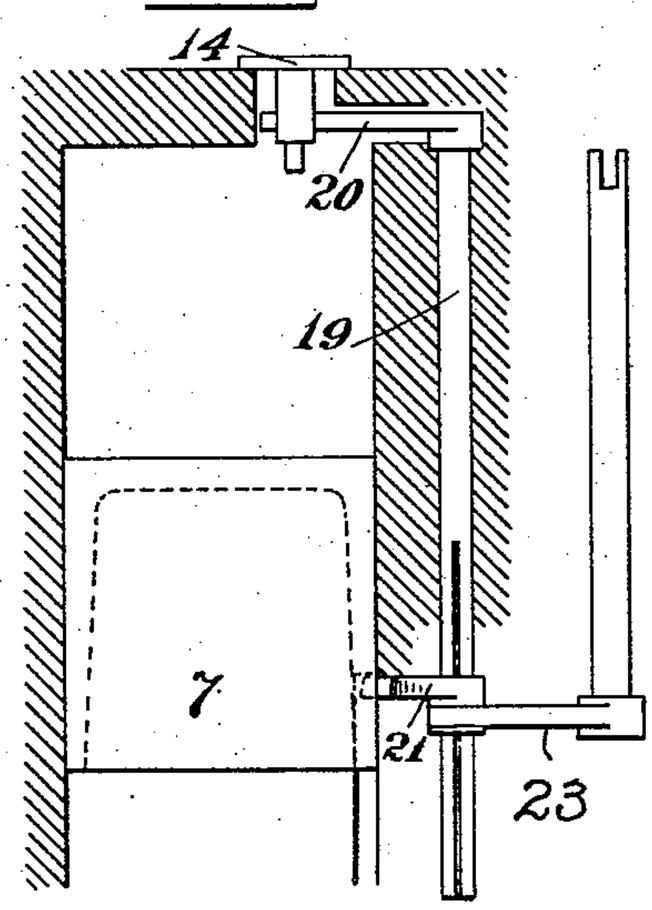
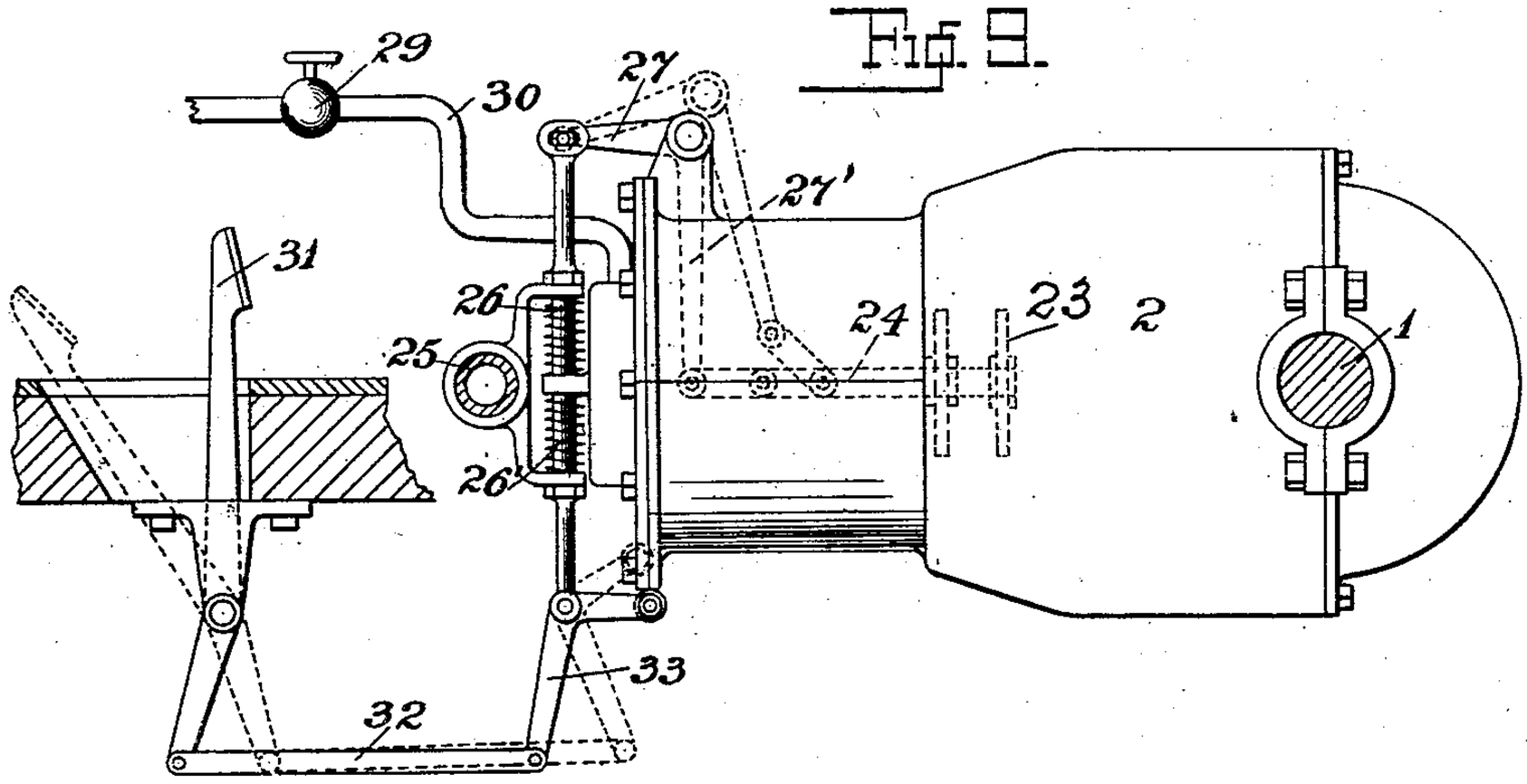


Fig. 9.



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UNITED STATES PATENT OFFICE.

WILLIAM E. GIBBS, OF FANWOOD, NEW JERSEY, ASSIGNOR OF ONE-HALF TO HENRY BERG, OF ORANGE VALLEY, NEW JERSEY.

REVERSIBLE DRIVING-GEAR.

SPECIFICATION forming part of Letters Patent No. 745,814, dated December 1, 1903.

Application filed March 11, 1902. Serial No. 97,692. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM E. GIBBS, a citizen of the United States, residing at Fanwood, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Reversible Driving-Gear, of which the following is a specification.

This invention relates to improvements in fluid-pressure engines, and particularly in steam or compound air engines, some features of the invention being, however, applicable to gas-engines or other similar motive devices.

The invention comprises an improved mounting and gearing for a plurality of engine-cylinders and their shafts, so as to enable them to work together in a balanced and efficient manner and to enable the engine to propel the driven device, such as a vehicle, in either direction without reversing the engine-shaft. In connection with steam and similar engines my invention also comprises improved valve mechanism for giving efficient exhaust and admission and for providing variable cut-off in admission. Means are also provided in this connection for regulating the cut-off in accordance with the load or for enabling the operator to vary the speed for special conditions.

By arranging the apparatus so that the engine's shafts never have to reverse their movement I am enabled to use pop-valves which are comparatively simple and yet efficient, and the regulation of such devices is also greatly simplified.

In the accompanying drawings, Figure 1 is a side view of the engine, and Fig. 2 an end view thereof, showing the general arrangement of the cylinders and casing. Fig. 3 is a plan view with the cylinder-heads removed, showing valve-tripping devices; and Fig. 3^a is a detail view of another part of such devices. Fig. 4 is a vertical longitudinal section on the line A A in Fig. 2. Fig. 5 is a transverse vertical section on the line B B in Fig. 1. Fig. 6 is a plan view of the gearing between the crank-shafts and main shaft. Figs. 7 and 8 are vertical sections, somewhat diagrammatic, of a cylinder and the pop-valves thereof, showing two different positions of operation. Fig. 9 shows the application of the engine to vehicle-driving or similar purposes when the load is variable and a combined automatic and manual control is desired.

1 represents the main or driven shaft, which turns in bearings in a casing or frame 2, on the top or end of which are mounted or formed the four cylinders 3^a 3^b 3^c 3^d. Two bridge-pieces 2′ are detachably secured to the casing 2 and extend across same to support the bearings for shafts 4 4′, whose cranks 5 are connected by rods 6 to the pistons 7 of the respective cylinders. The two cranks on the same shaft are situated one hundred and eighty degrees aground, while the two shafts have the crank planes ninety degrees apart, thus not only avoiding any dead-center, but giving almost absolute balance and neutralization of vibration. The two shafts 4 4′ turn in opposite directions and carry gears 8 8′, engaging one another and also respectively engaging large gears 9 9′, connected to the driven shaft 1, the gears 8 8′ being wide enough so as to overlap and interengage by their inner parts while their outer parts engage the respective gears 9 9′. Said gears 9 9′ are mounted loose on the shaft 1 and are alternately connected thereto by a reversing-clutch (indicated at 10) controlled in usual manner by a clutch-lever 11.

Each cylinder is provided in its head with admission pop-valve 14 and in the piston with exhaust pop-valve 15. An additional exhaust connection is preferably provided consisting of ports 16 in the side of the cylinder, through which pressure may be relieved when the piston is fully extended, any surplus pressure then blowing out through these ports. As the piston moves in from this point it is desirable to keep the exhaust pop-valve open to prevent compression, and for this purpose I provide a lug 6^a on the con-

necting-rod 6, which in this movement engages the pin of the pop-valve to hold said valve open. After the piston has reached and passed its innermost position the crank passing to the other side causes the lug 6ª to be tipped away from the valve-pin and allows the valve to remain closed. The effect of this construction is to insure that the engine can only run in one direction, since the cylinder is open to exhaust when the crank is on one side, and, as will be hereinafter shown, the admission-valve is not opened until the piston reaches dead-center position.

The admission pop-valves 14 have pins projecting into the cylinder sufficiently to be struck by the piston or a part carried thereby just as the latter reaches the inner end of its stroke. I prefer to place the exhaust-valve 15 so that it will strike the admission-valve in this manner, thereby insuring that the exhaust-valve is closed before admission takes place. Moreover, by placing the valves in line in this manner I am enabled on removing the cover 14ª of the admission-valve and the admission-valve to gain access to the exhaust-valve and the latter being made sufficiently small to remove it without dismantling the piston and crank connections. A spring 17 on the exhaust-valve serves to ease off the impact with the admission-valve and serves also the more important function of allowing the piston to reach very close to the "dead point" before opening the admission-valve and then quickly throwing the said valve open to its full extent. When this valve is thus opened, it is caught and held open by detent means to admit steam or working fluid to the cylinder during a greater or less portion of the outstroke, this detent means being then released by tripping means to allow the admission-valve to close. Said detent and tripping means comprises rock-shafts 19 for the several cylinders extending parallel to the cylinder-axis and carrying arms 20, engaging with the stems of the respective valves 14, and arms or lugs 21, extending into slots in the cylinder-walls. Springs 22 press on the arms 20, so as to cause them to enter beneath the valve-stems as soon as the valve is lifted, and as any arm moves in this manner the turning of the corresponding rock-shaft 19 causes its arm or lug 21 to enter the cylinder-space in the path of the piston, and as the piston passes this lug it engages the end of same, which is inclined, so as to press the lug back and turn rock-shaft 19 and arm 20 back to normal position, thus tripping or releasing the pop-valve 14, which is immediately closed by the steam or fluid pressure. I prefer to make the lug or arm 21 adjustable along the rock-shafts 19, so as to vary the point of cut-off, and to effect this regulation simultaneously for all the cylinders I provide a frame or spider 23, attached to a rod 24, sliding parallel to the rock-shafts 19 and engaging under the hubs 20′ of said arms or lugs, which hubs 20′ are splined on said shafts. I have shown in Fig. 9 means whereby the position of this cut-off-regulating frame 23 may be controlled either by the attendant or automatically, the engine being here shown as it would be arranged in connection with a vehicle. The main shaft 1 would in this case be the driving-axle of the vehicle and supports one end of the engine, while at 25 is shown a rod or bar that forms a part of the truck-frame and supports the other end of the engine through spring-supports 26 26′. A lever 27, pivoted to the engine-frame and also to a bracket on the truck-frame bar 25, is connected by link 27′ with the cut-off-regulating rod 24, above referred to, so that oscillations of the outer frame, resulting from changes in torque due to changes in load, cause movement of the frame 23 to vary the cut-off, so as to increase the amount of steam admitted during each stroke and hold the engine up to a given speed under varying loads. 29 indicates a throttle-valve in the steam-supply pipe 30, which serves to shut off the steam from the engine entirely and to throttle the supply to any desired extent, so as to hold the engine down to a given speed. The portion of the steam-supply pipe 30 connecting with the engine is made flexible for this purpose. Thus the speed at which the engine will run depends on the position of the throttle-valve, and the automatic regulating means holds the engine to that speed in any given position of the throttle-valve under variations of load.

When the engine is at rest, the automatic means will be at the position of quickest cut-off, as there is no pressure tending to turn the engine around its shaft; but if it should result from this that the cut-off is too great to allow of starting under load the attendant may momentarily throw the automatic mechanism over—for example, by a pedal 31, connected through link 32 and lever 33 to swing the engine upward around the main axle—so as to lengthen the period of admission to an extent sufficient to enable starting.

Having thus described my invention, the following is what I claim as new therein and desire to secure by Letters Patent:

1. In a reversible driving-gear, the combination with a plurality of reciprocating driving parts and parallel shafts connected thereto, of overlapping and intermeshing driving-gears on said shafts, parallel driven gears meshing respectively with the non-overlapping parts of the gears aforesaid, and a shaft adapted to be connected with either one of said driven gears.

2. The combination of a plurality of reciprocating driving parts, parallel shafts connected thereto, and intermeshing gears carried thereby, the casing inclosing said shafts,

and bridges removably attached to said casing and containing bearings for said shafts, so as to take the working strain of said gears.

3. The combination with a plurality of reciprocating driving parts and crank-shafts and connecting-rods therefor and overlapping gears thereon; of a main shaft, reversing-gears thereon, and clutches for engaging one or the other of said gears whereby the main shaft may be driven in either direction, substantially as described.

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