No. 710,302. Patented Sept. 30, 1902.

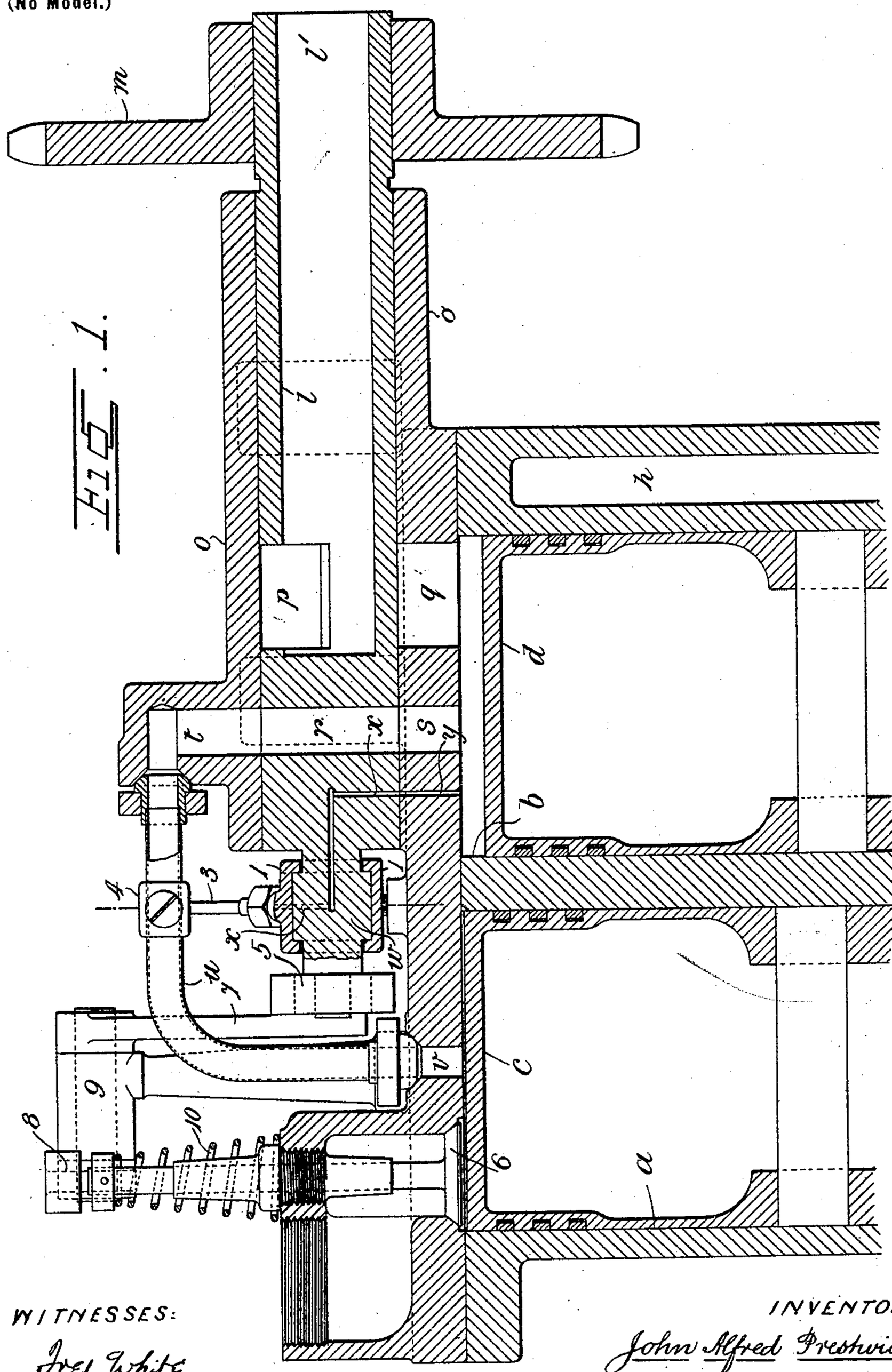
J. A. PRESTWICH.

INTERNAL COMBUSTION ENGINE.

(Application filed Apr. 29, 1902.)

(No Model.) 3 Sheets—Sheet 1.

FIG. 1.



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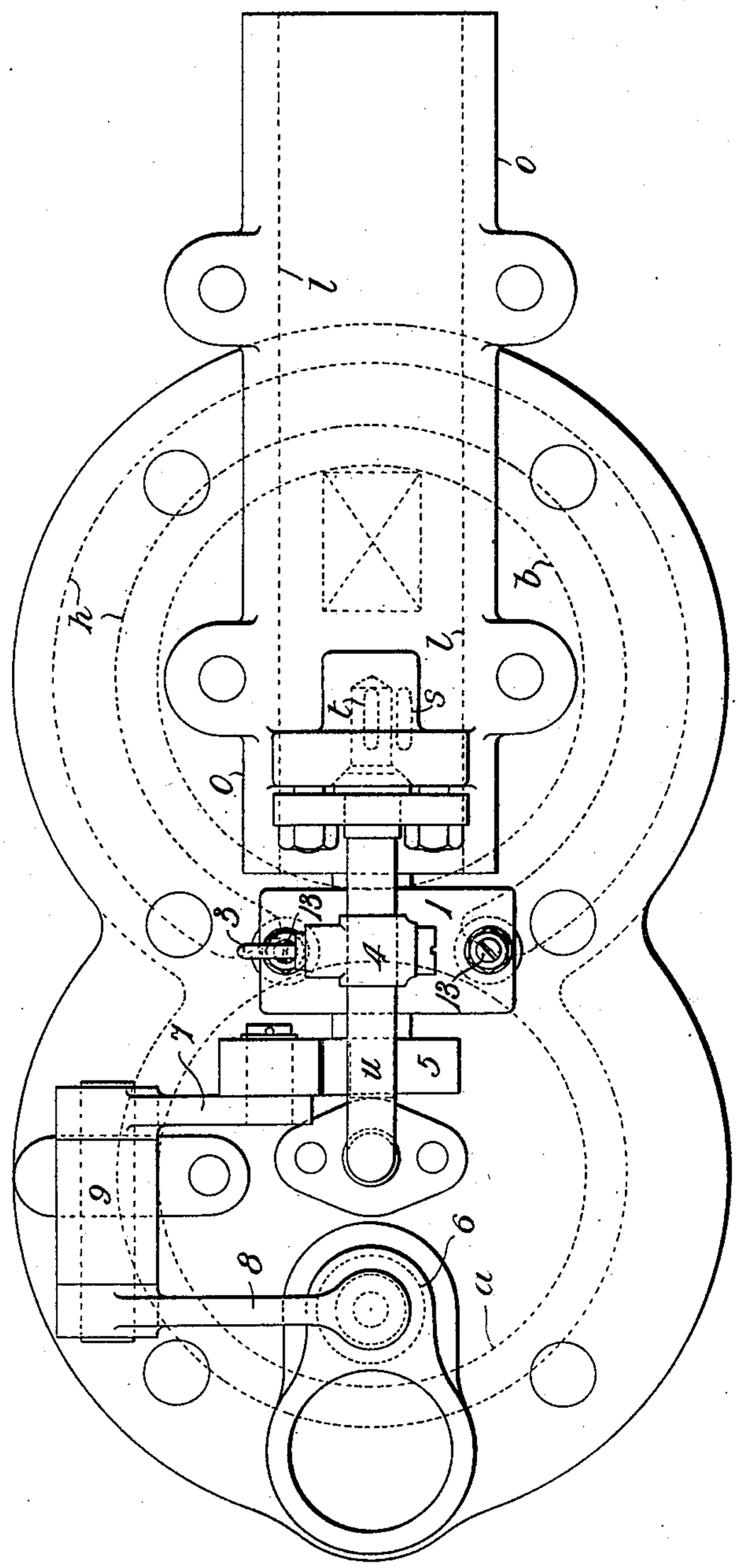
(No Model.) 3 Sheets—Sheet 2.

FIG. 2.



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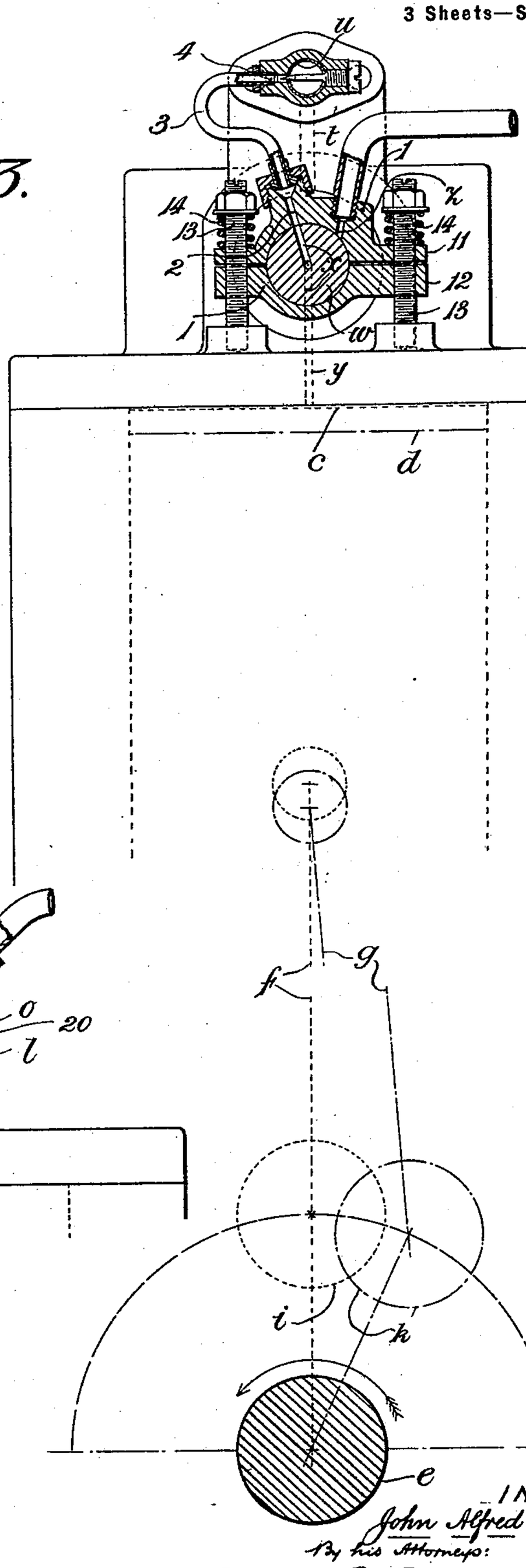

FIG. 3.

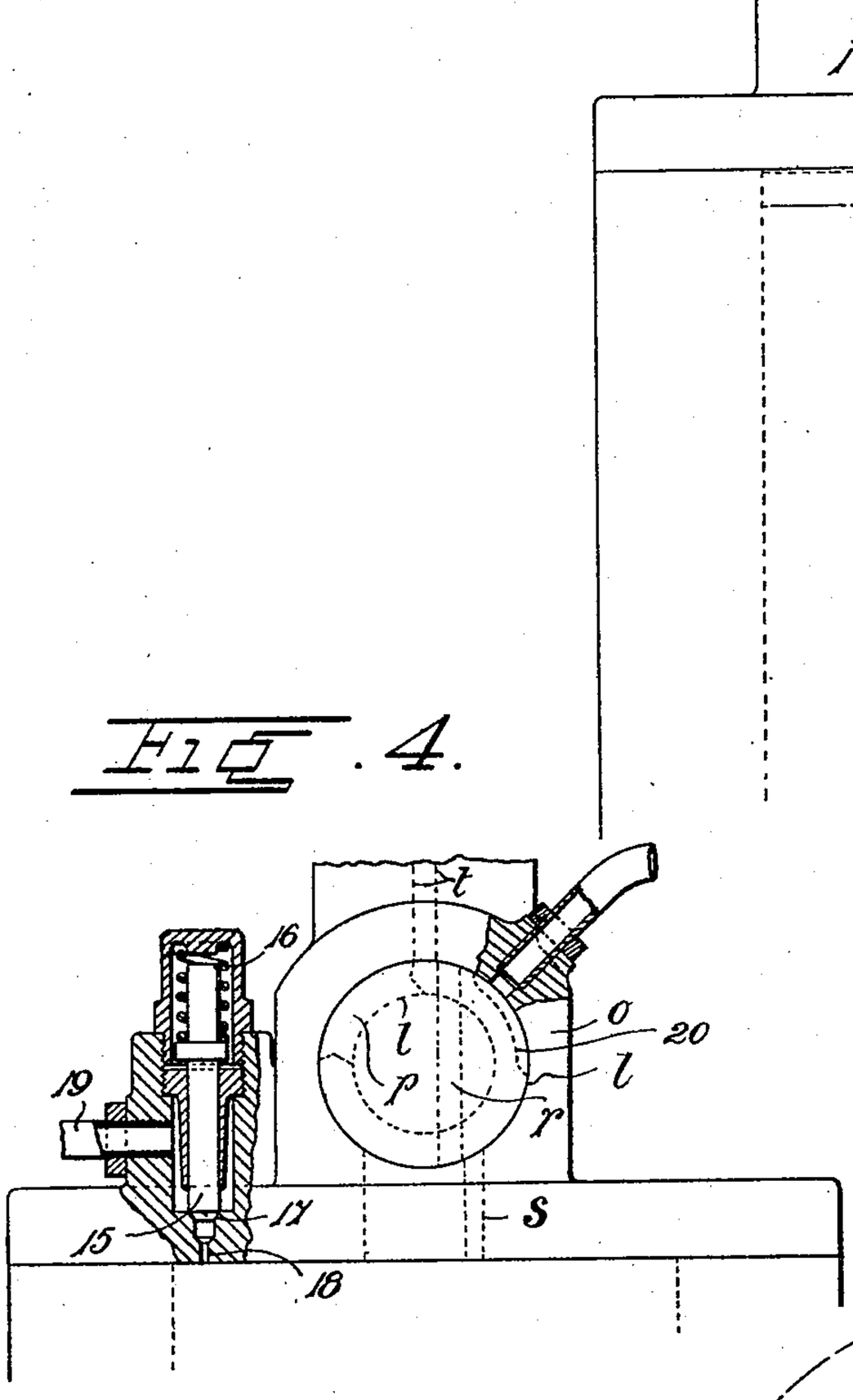

FIG. 4.

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UNITED STATES PATENT OFFICE.

JOHN A. PRESTWICH, OF TOTTENHAM, ENGLAND.

INTERNAL-COMBUSTION ENGINE.

SPECIFICATION forming part of Letters Patent No. 710,302, dated September 30, 1902.

Application filed April 29, 1902. Serial No. 105,165. (No model.)

To all whom it may concern:

Be it known that I, JOHN ALFRED PRESTWICH, engineer, of 744 High road, Tottenham, in the county of London, England, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal-combustion engines, and more particularly to oil-engines and oil-motors such as are used for propelling motor-vehicles.

The object of the invention is to secure greater efficiency, simplicity, and reliability and to eliminate some of the disadvantages of the four-stroke or Otto cycle.

It is well known that in internal-combustion engines an increase in the pressure of compression without the addition of heat before ignition increases the efficiency; also, that if the ignited mixture is expanded in a comparatively cold cylinder the efficiency is reduced. There is a limit to the pressure of compression in the Otto cycle, owing to the liability to premature explosion of the mixture by contact with the hot cylinder. The control of the ignition is a difficult matter in small engines unless accomplished electrically, which adds complications. To overcome these difficulties and according to my invention, I use two cylinders the pistons of which are arranged one in advance of the other, the piston of one cylinder serving to compress the charge of air without heating the same, (apart from the heat of compression,) the progressive motion of the pistons then serving to displace or transfer the compressed charge from the comparatively cool compression-cylinder to the hot working cylinder without passing into an intermediate receiver and without appreciable alteration in volume. In an oil-engine the charge of oil is sprayed into the connecting-channels between the cylinders or into the heated cylinder at or about the time when the air is transferred from one cylinder to the other. The oil may be sprayed or injected by a portion of the compressed charge of air passing through a suitable by-pass in connection with the oil-supply or a separate compressed-air receiver may be employed.

I will now describe my invention as applied to an oil-engine and with reference to the accompanying drawings, in which—

Figure 1 is a section through the cylinders and valve-gear, and Fig. 2 is a plan. Fig. 3 is a side elevation of the cylinders, showing the position of the piston with regard to the crank-shaft and other parts of the valve-gear in section. Fig. 4 is a detail of the valves, showing the means for obtaining a separate compressed-air supply for ejecting the oil in an oil-engine and for assisting in starting the engine.

Referring to Figs. 1, 2, and 3, *a* and *b* are two cylinders fitted with pistons *c* and *d*, respectively, said pistons being connected to the crank-shaft *e*, Fig. 3, by connecting-rods *f* and *g* (shown diagrammatically) in the usual manner. The cylinder *b*, which is used to compress the charge of air, is kept cool by water-jacket *h* or other suitable means. *a* is the working cylinder, in which combustion and expansion take place. The crank *i* of the cylinder *a* and the crank *k* of the cylinder *b* are so set that the piston *c* travels slightly in advance of the piston *d*, the distance apart being determined by the pressure of compression required. The valves provided for controlling the admission, exhaust, and oil-injecting devices comprising a main rotary valve *l* in the form of a tube open at one end. Said valve is rotated by a chain-wheel *m*, driven from the crank-shaft at a suitable speed, and said valve rotates in suitable bearing or casing *o*, formed upon the end of the cylinder, and has a port *p*, adapted to open and close communication between its hollow part and the compression-cylinder *b* by a port *q*. The said rotary valve *l* also has a through-port *r*, opening communication at the proper time between a port *s* in the compression-cylinder and a passage *t*, leading by a pipe *u* and port *v* to the working cylinder *a*. The said rotary valve is also provided with an oil-controlling valve *w*, formed by an extended portion having ports *x*, adapted to open and close communication between the ports *y* from the compression-cylinder, an oil-supply port *z* in an inclosing casing 1, (see Fig. 3,) and also open connection at the proper time with an oil-discharge port 2, leading by a suitable pipe 3 to a nozzle 4 for injecting the oil into

the connecting-pipe *u* between the compression and working cylinders *b* and *a*. The said rotary valve also serves by a further extension in the form of a lever 5 to actuate the exhaust-valve 6 of the working cylinder through connecting-levers 7 and 8, pivoted in a bearing 9. The said exhaust-valve is kept in closed condition in the usual manner by a spring 10. The casing 1, which incloses the oil-valve *w* of the rotary valve, is formed in two parts 11 12 for convenience in fitting the same over the part *w*. The said parts 11 and 12 are secured together by bolts 13, which have intervening springs 14.

Fig. 4 shows an arrangement for storing compressed air, which may be used for starting the engine or, if required, in some cases for injecting the oil into the working or motor cylinder. 15 is a loaded valve kept under pressure of a spring 16 upon a seating 17 over a passage 18, leading from the compression-cylinder, so that when the valve is open by the pressure of air in the cylinder a small quantity of the air passes by the port 18, past the valve 17, and by connecting-pipe 19 to a suitable reservoir, from which it is drawn as required by being connected to a port 20 in the rotary valve, said port opening communication at the proper time between the compressed-air reservoir and the port *t*, through which port the compressed air passes to and actuates the piston *c* in the working cylinder *a*.

It will be obvious that the valve *l* may be made solid and that the air-admission port *p* in the rotary valve may open communication to the atmosphere through another port opposite the port *q* in the casing.

Referring now to the operation of the improved engine, on the outstroke of the piston *d* the port *p* is opposite the port *q* and a charge of air is drawn into the cylinder *b* through said ports *q* and *p* and the hollow portion of the valve *l*, which is open at its end *l'*. On the return stroke of the piston *d*, the port *p* having moved to closed position and no ports being open, air is compressed in the cylinder *b* at the point of highest compression. The piston *c* being in advance of the piston *d* will be at or about the end of its stroke, and the port *r* in the valve *l* now opens communication between the cylinder *b* through a port *s*, passages *t u*, and port *v* to the cylinder *a*. Before arriving at this position and during the previous operations the passage *x* in the part *w* will have passed into communication with the oil-supply port *x*, the oil from a tank and under pressure being forced into and more or less filling the said passage *x*. Further rotation of the part *w* with valve *l* cuts off the passage from the oil-supply, and just previous to the opening of the port *r* in the main valve *l*, or it may be just previous to the piston *c* moving to the end of its stroke, the passage *x* is brought to the position shown in Figs. 1 and 3, opening connection at one end with the port *y* and the other with the port 2, so that compressed air from the compression-cylinder passes through the passage *z* and forces the charge of oil therein out by the nozzle 4 into the tube *u*, where the oil is vaporized by the heat of the tube and by the air from the compressor. The piston *c* now moves outward and at the same time the piston *d* moves to the end of its stroke, thus forcing or transferring the compressed charge of air from the compression-cylinder *b* to the working cylinder *a*, the air picking up the charge of vaporized oil in its passage through the tube *u*. The working cylinder *a* is highly heated by the previous explosions, and the degree of compression is so arranged that the heat is sufficient or more than sufficient to cause ignition to at once take place, being assisted by the further expansion of the charge of air and oil on coming into the highly-heated cylinder. On the return stroke of the piston *c* the products of combustion are discharged by the exhaust-valve 6, which has been opened at the proper time by the further rotation of the valve *l* acting through its lever 5 and the connecting-levers 7 and 8. While the charge is expanding and actuating the working piston *c*, the other cylinder *d* is compressing a charge of air for the next outstroke of the piston *c*. It will thus be seen that an explosion is obtained at each outstroke of the piston *c*, and at the same time by the employment of the second cylinder with this piston slightly behind the piston *c* any degree of compression can be obtained without rendering the charge liable to premature ignition. Also by this arrangement the air does not come into contact with the heated surfaces until or just about the time when the mixture is to be ignited. Consequently the working cylinder can be kept comparatively hot, so as to further expand instead of cooling the expanding gases, whereby the best effects and advantages of such expansion while under compression are obtained. The engine may be governed by cutting off or reducing the oil-supply.

The compressed-air-supply chamber referred to as being charged by the check-valve 15 (shown in Fig. 4) may also serve to supply a sufficient quantity of air under pressure for assistance in starting the engine by admitting said compressed air to the working cylinder.

What I claim, and desire to secure by Letters Patent, is—

1. The improvements in internal-combustion engines comprising the combination of a compression-cylinder, a working cylinder, a piston in the compression-cylinder, a piston in the working cylinder moving in advance of the piston in the compression-cylinder, a rotary valve, an air-admission port in said valve coinciding at the proper time with an admission-port in the compression-cylinder, a discharge-port in said rotary valve coinciding at the proper time with a discharge-port from the compression-cylinder, and a compressed-air-admission port to the working cylinder,

an oil-supply valve formed by an extension of said rotary valve, an oil-charging port in said valve, a corresponding oil-supply port in the valve-casing, a compressed-air-inlet port in the path of travel of one end of said oil-port and leading to the compression-cylinder, an oil-discharging port in the valve-casing at the other end of the oil-passage, connections between said port and the compressed-air channel between the cylinders, an exhaust-valve in the working cylinder, a means for actuating said exhaust-valve by the rotation of the main valve, means for rotating the valve from the crank-shaft of the engine, all substantially as and for the purpose set forth.

2. The improvements in internal-combustion engines, comprising the combination with two cylinders and pistons arranged respectively for compressing and exploding the charge, of a rotary spindle forming the inlet and outlet valve to the compression-cylinder and the oil measuring and discharging device, and also having means for operating the exhaust-valve of the working cylinder and means for rotating said spindle-valve at the proper speed from the crank-shaft of the engine, substantially as and for the purpose set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JOHN A. PRESTWICH.

Witnesses:
HENRY A. PRYOR,
ALFRED B. CAMPBELL.