No. 713,860. Patented Nov. 18, 1902.

W. J. CROSSLEY & J. ATKINSON.

EXHAUST VALVE FOR INTERNAL COMBUSTION MOTORS.

(Application filed Feb. 15, 1900.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.

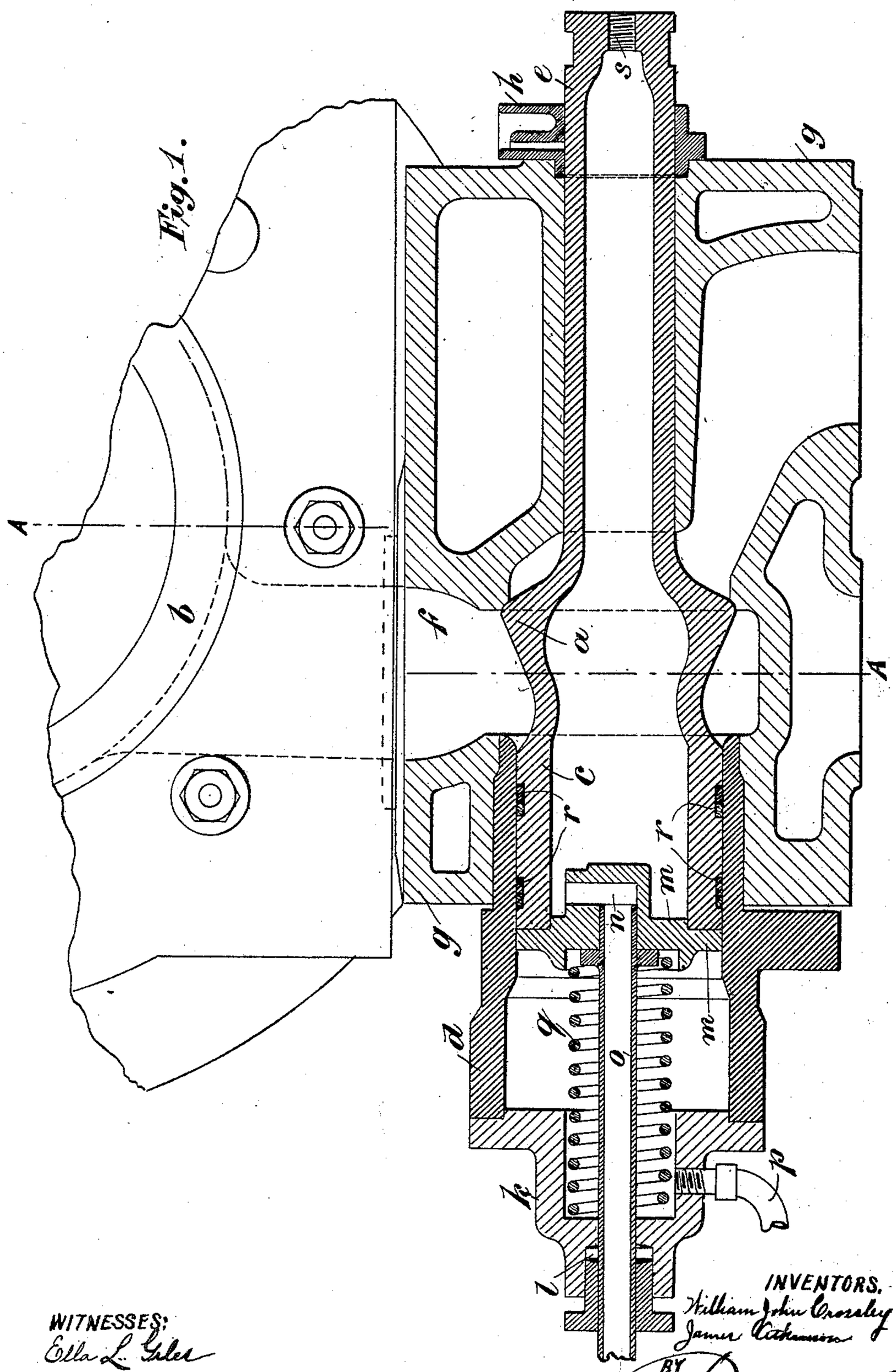

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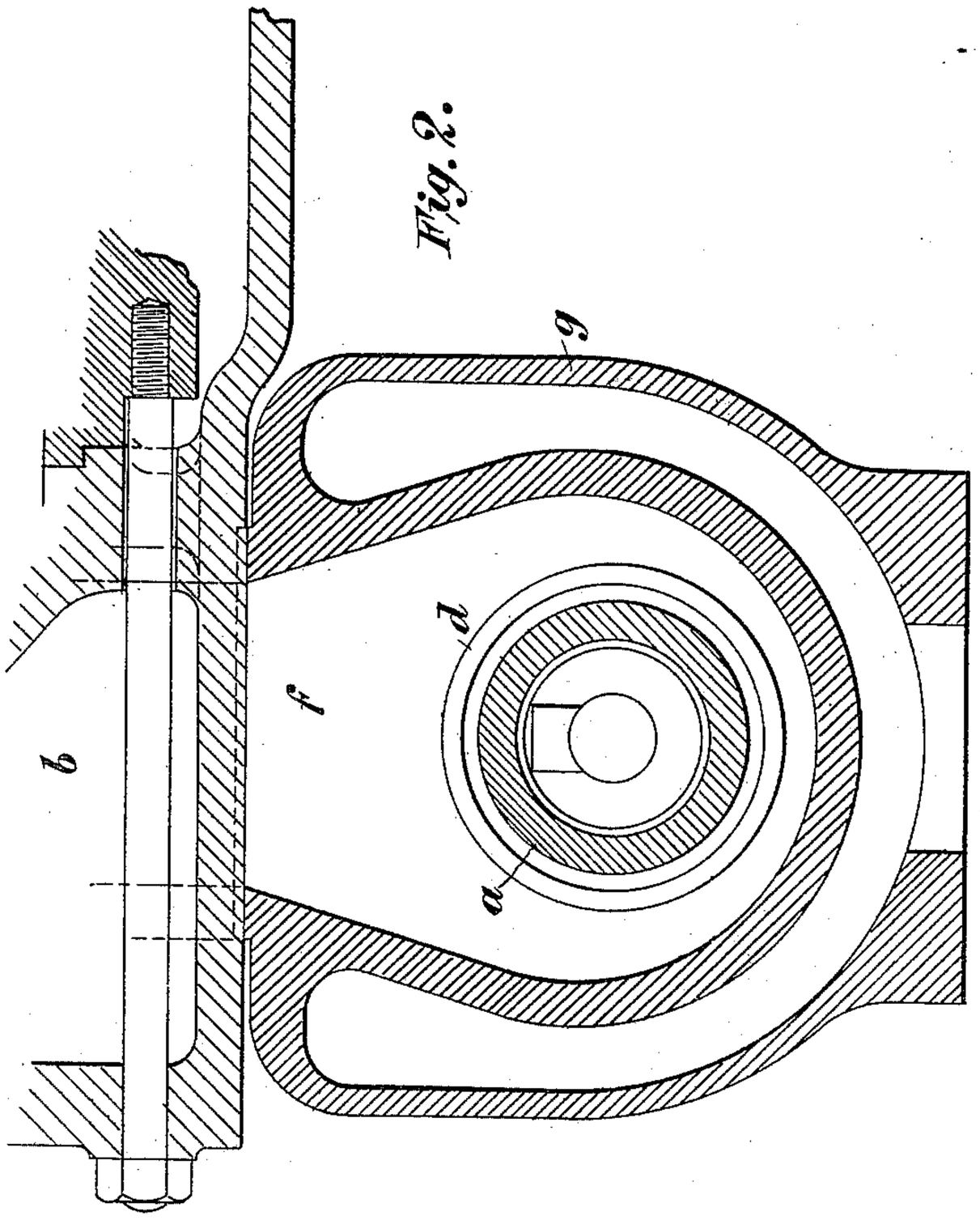
Fig. 2.



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(No Model.) 5 Sheets—Sheet 3.

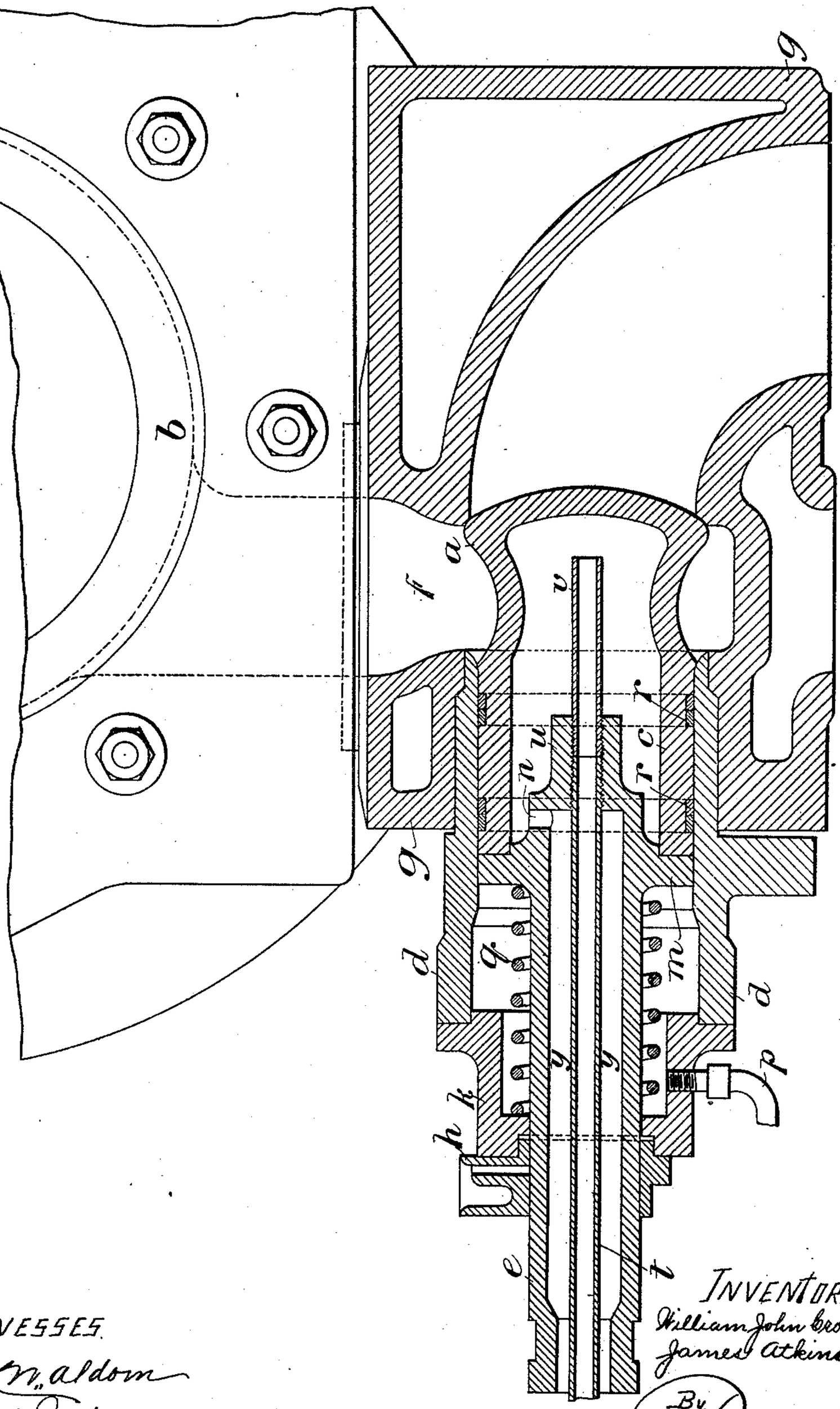

Fig. 3.

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(Application filed Feb. 15, 1900.)

(No Model.) 5 Sheets—Sheet 4.

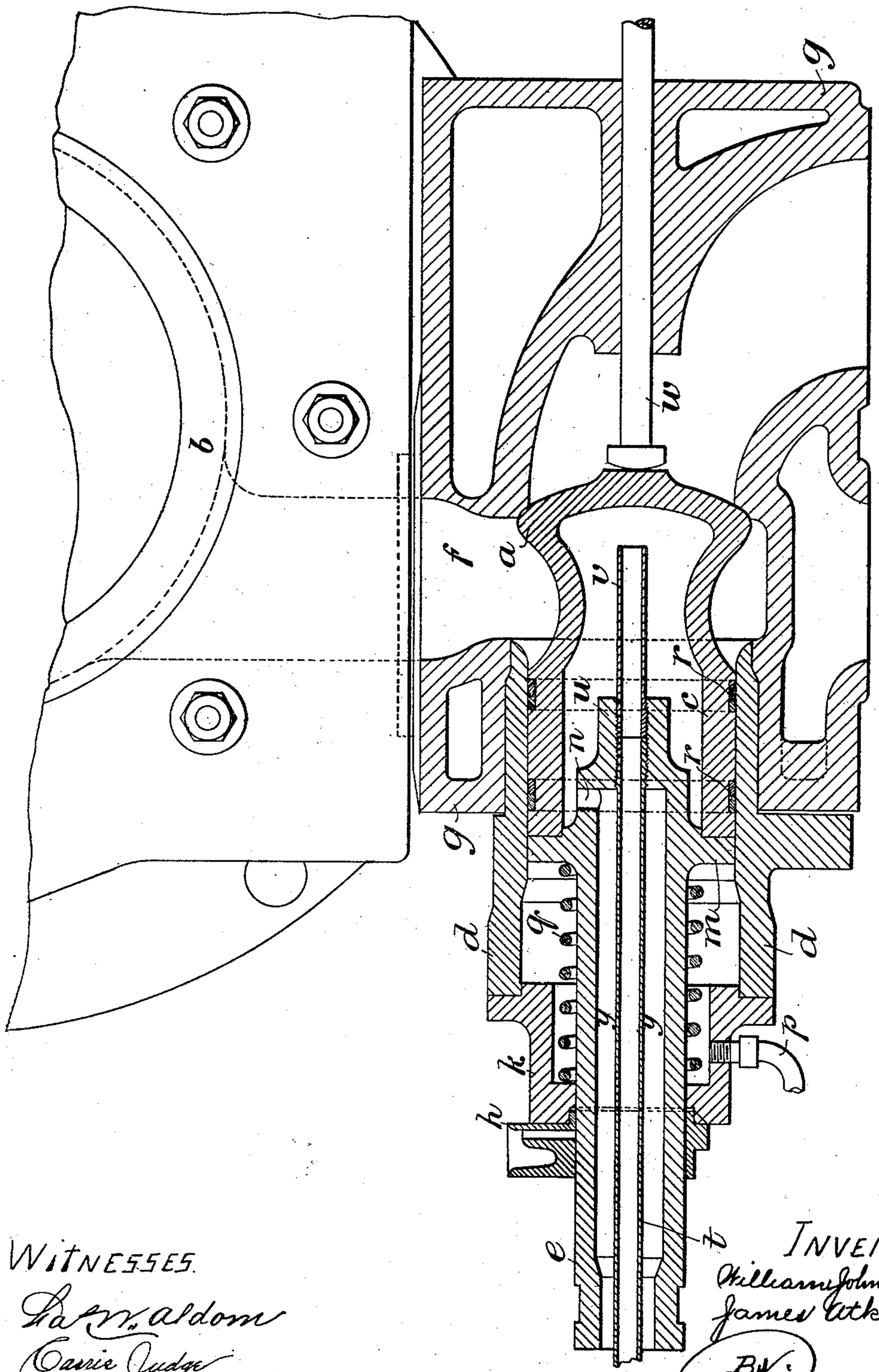

Fig. 3a.

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(Application filed Feb. 15, 1900.)

(No Model.)

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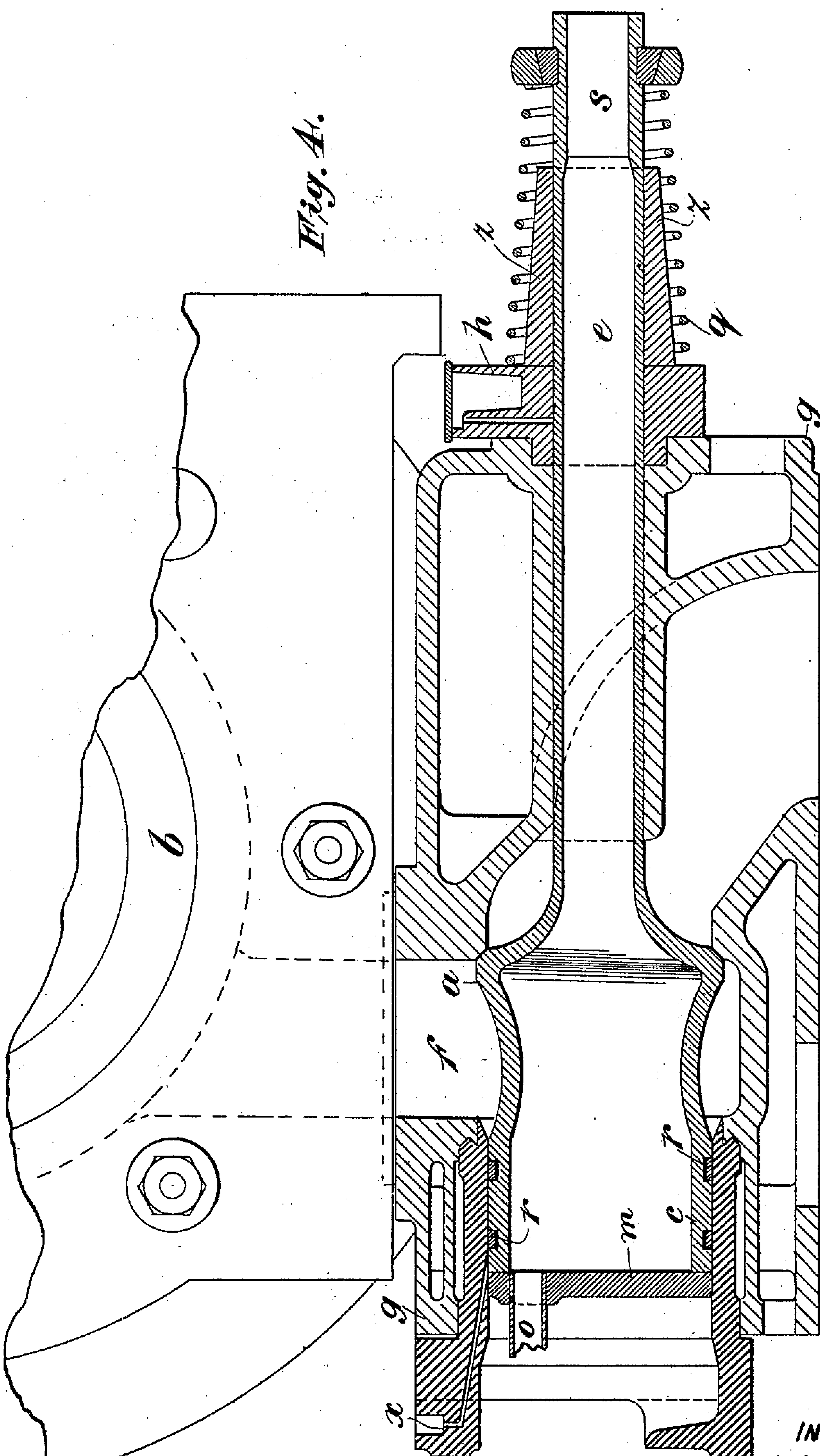
Fig. A.



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UNITED STATES PATENT OFFICE.

WILLIAM JOHN CROSSLEY, OF MANCHESTER, AND JAMES ATKINSON, OF MARPLE, ENGLAND.

EXHAUST-VALVE FOR INTERNAL-COMBUSTION MOTORS.

SPECIFICATION forming part of Letters Patent No. 713,860, dated November 18, 1902.

Application filed February 15, 1900. Serial No. 5,326. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM JOHN CROSSLEY, residing at Openshaw, Manchester, and JAMES ATKINSON, residing at the Woodlands, Marple, England, engineers, subjects of the Queen of Great Britain and Ireland, have invented certain new and useful Improvements in Exhaust-Valves for Internal-Combustion Motors, (for which we have applied for Letters Patent in Great Britain, No. 14,578, dated July 15, 1899,) of which the following is a specification.

Our invention relates to improvements in exhaust-valves for internal-combustion motors such as those of the "Otto" or four-stroke type. Its object is to reduce the load on the exhaust-valve so as to relieve the gear for opening this valve.

The exhaust-valve of an Otto-type motor frequently has to be opened against a pressure of upward of forty pounds per square inch, and in a large engine requiring a large valve this becomes a heavy load to be overcome by the opening-gear.

Our invention consists in an exhaust-valve for internal-combustion motors having a piston or enlargement somewhat less in diameter than the valve, whereby the force holding the valve on its seat amounts only to the difference between the pressure of the gas acting upon the area of the valve and that acting on the piston, the valve and piston being kept cool by means of water circulating through them.

In the accompanying drawings, which illustrate our invention, Figure 1 is a longitudinal section through an exhaust-valve arranged and constructed according to one form of our invention. Fig. 2 is a cross-section on the line A A of Fig. 1. Fig. 3 is a longitudinal section through an exhaust-valve arranged and constructed according to a second form of our invention. Fig. 3^{A} is a longitudinal section through an exhaust-valve arranged and constructed according to a third form of our invention. Fig. 4 is a longitudinal section through an exhaust-valve arranged and constructed according to a fourth form of our invention.

Referring in the first place to Figs. 1 and 2, a is the exhaust-valve and f the exhaust-port leading from the cylinder b. The valve a works horizontally and has attached to it at one side the piston c, working in the cylinder d, and at the other side the hollow stem e, which projects through the valve-casing g and the oil-gland h, the valve, piston, and stem being all hollow. The valve a is slightly greater in diameter than the piston c, and the cylinder d is telescoped inside the casing g or otherwise removably attached to the casing, so that the withdrawal of the cylinder allows the valve to be removed. The cylinder d is provided with a cover k and a stuffing-box l, and the piston has fixed to it a cap m, in which is bored an angular hole n, opening toward the top of the inside of the piston. Into the hole n is screwed a pipe o, which passes through the before-mentioned stuffing-box l. The piston c is provided with rings r r, rendering it nearly gas-tight; but what gas leaks through into the cylinder d is led away by the pipe p to any suitable outlet. The spring q for closing the valve may be placed, as shown, in the cylinder d. The cooling-water enters the hollow stem e at its end s and escapes by the hole n and the pipe o, before mentioned, the position of the outlet n preventing the accumulation of air or steam inside the piston and valve. The valve may be operated by means of its stem e by any usual valve-lifting mechanism. It will be seen that as the diameter of the piston c is only slightly less than the diameter of the valve a there is only a small force tending to hold the valve against its seat. In large engines where a large exhaust-valve is needed it is important that the valve shall be nearly balanced and that the small difference between the pressure of the gases on the whole area of the valve and that acting on the piston shall act in such a manner as to tend to hold the valve against its seat.

Referring now to Fig. 3, we construct in this modification the valve-stem e in one piece with or attached to the piston-cap m, and we pass the stem through the cylinder-cover k and the oil-gland h. In this modification the valve is closed at the end where the stem was attached in our previous modification, and we enter the cooling-water through a pipe t,

passing through the hollow stem *e* and screwed into the internal projecting boss *u* of the piston-cap *m*. Another pipe *v*, forming a continuation of the pipe *t* and also screwed into the boss *u*, conveys the water to the valve *a*, the water returning by the hole *n* and the annular space *y* in the stem *e*. The valve-spring *q* may be contained in the cylinder *d*, as in our previous modification, and a pipe *p* is provided as before to draw off the gases leaking past the piston *c*. The valve is actuated by means of the hollow stem *e*.

The form of our invention shown in Fig. 3A resembles the form just described, with this difference that the valve is actuated by the pusher-rod *w* instead of by the hollow stem *e*. The pusher-rod presses against but is not attached to the valve.

Referring now to Fig. 4, we arrange the valve-stem in this form as in our first; but we make the valve-closing spring *q* in a conical form and place it on a conical sleeve *z*, situated on the valve-stem *e* outside the gland *h*. In this modification also we make the cylinder *d* open-ended and we screw the water-pipe *o* into the upper part of the piston-cap *m*. A lubricating-hole is shown at *x*. In all our forms instead of the valve working horizontally it may work vertically, the piston *c* being above the valve and the cooling-water entering and escaping, as before described.

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

1. In an internal-combustion engine, in combination, an exhaust-valve, a piston attached to the exhaust-valve, which valve is of somewhat greater diameter than said piston, a removable liner in which the piston works gas-tight, water inlets and outlets to the piston and valve, both of which latter are hollow and adapted to contain water, substantially as described.

2. In an internal-combustion engine in combination, a hollow exhaust-valve *a*, a hollow piston *c* formed in one piece with said valve *a* which is of somewhat greater diameter than the piston *c*, a removable liner *d* within which the piston *c* works, a spring adapted to return the valve to its seat after opening, water inlets and outlets to the piston and valve, substantially as described.

In witness whereof we have hereunto set our hands in presence of two witnesses.

WILLIAM JOHN CROSSLEY.
JAMES ATKINSON.

Witnesses:
ALFRED MARSHALL NISH,
JAMES ALFRED COOKE.