No. 666,565. Patented Jan. 22, 1901.

H. F. SHAW.

STEAM ENGINE.

(Application filed Feb. 10, 1900.)

(No Model.) 2 Sheets—Sheet 1.

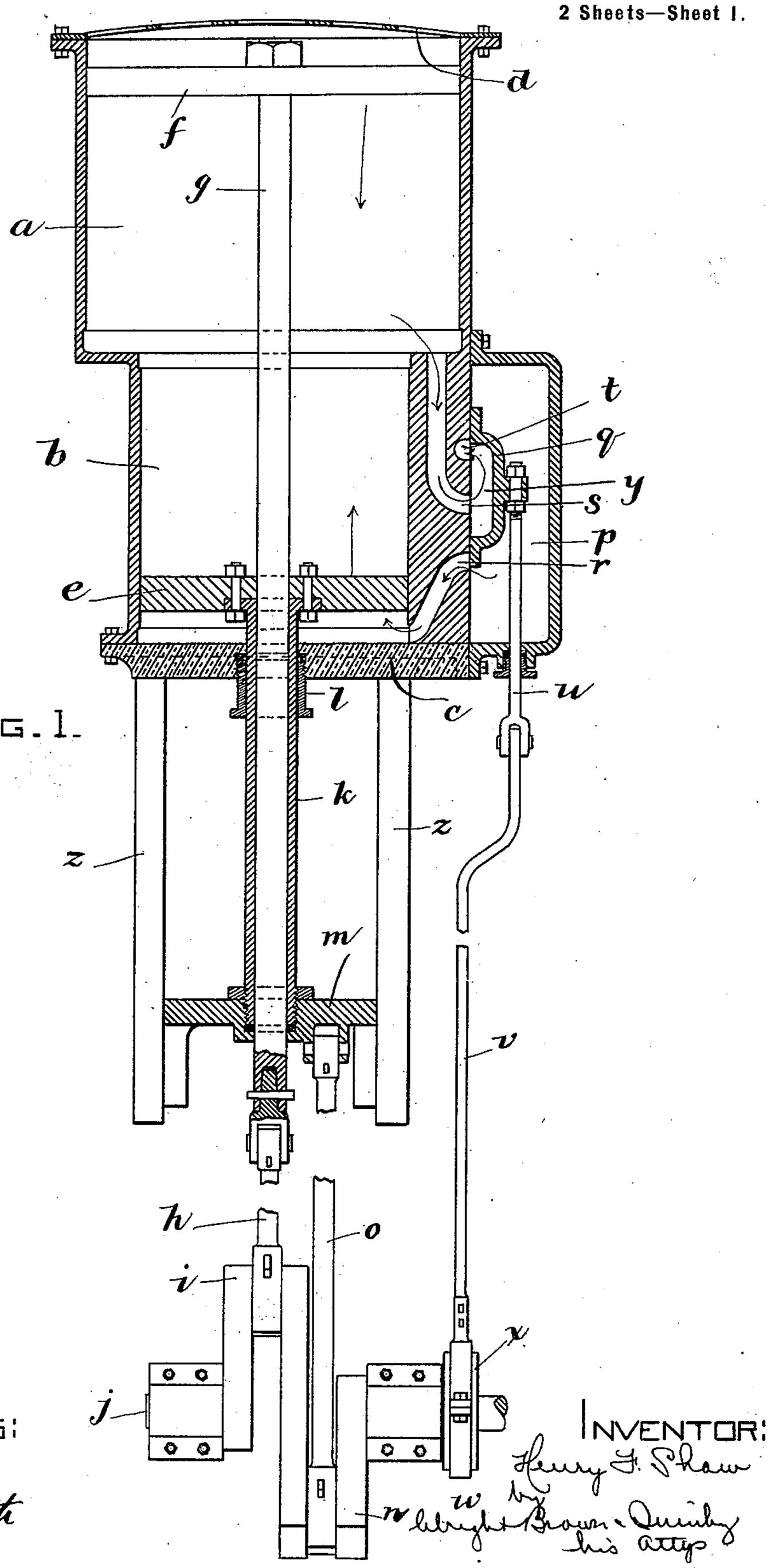

Fig. 1.

Witnesses:
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Inventor:
Henry F. Shaw
by Wright Brown & Quinby
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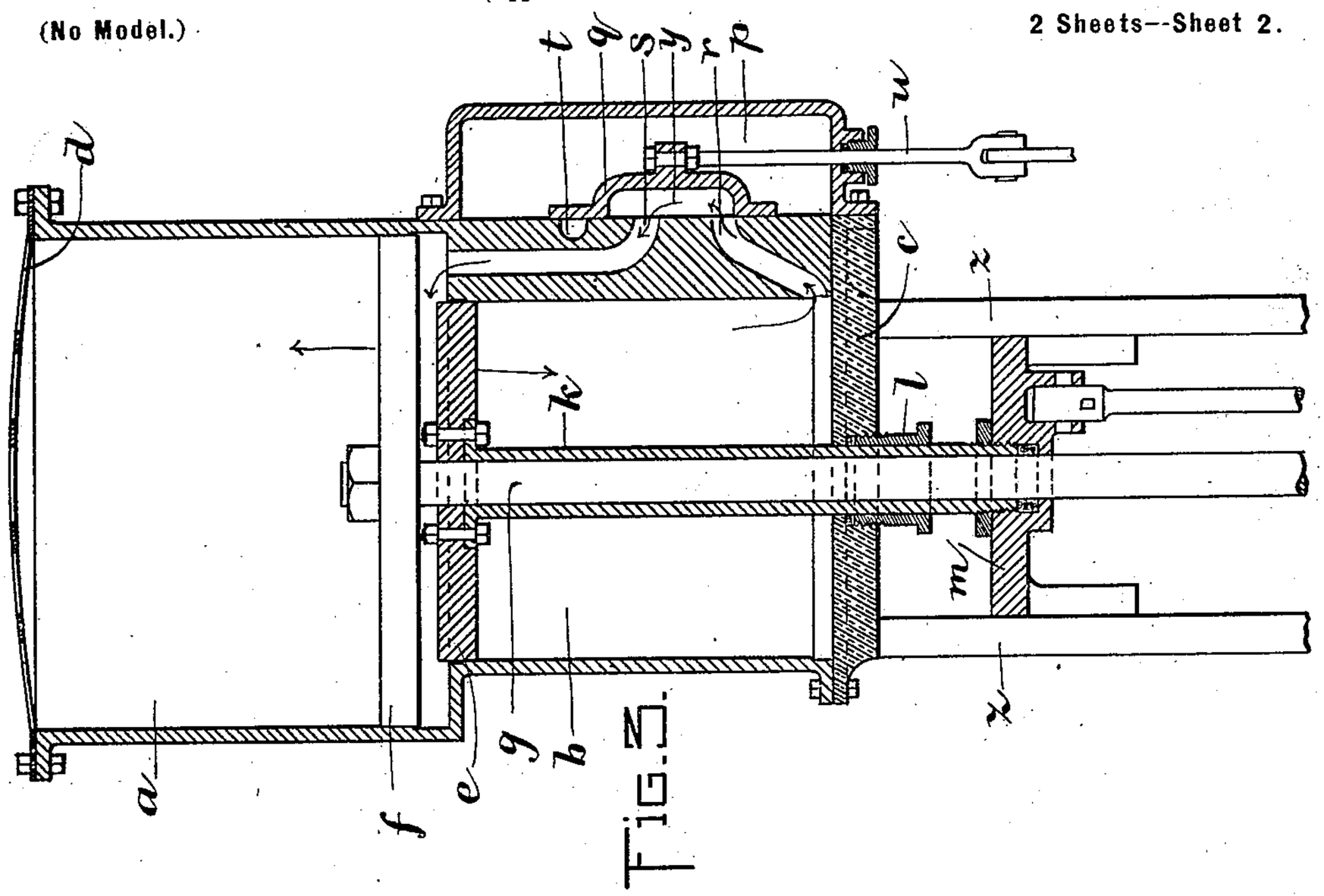

FIG. 1.

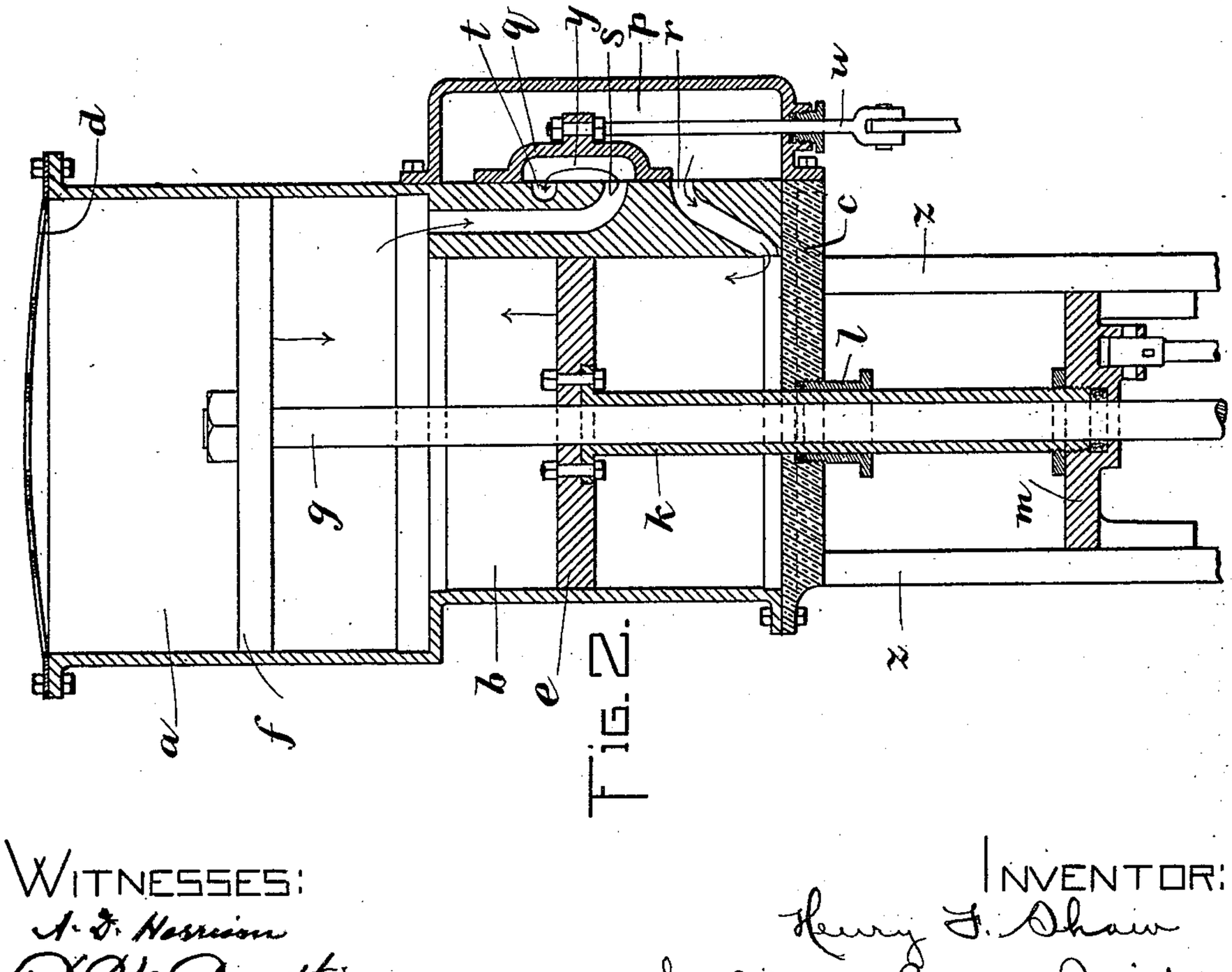

FIG. 2.

WITNESSES:
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INVENTOR:
Henry F. Shaw
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UNITED STATES PATENT OFFICE.

HENRY F. SHAW, OF ROXBURY, MASSACHUSETTS, ASSIGNOR TO THE SHAW MOTOR VEHICLE COMPANY, OF BOSTON, MASSACHUSETTS.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 666,565, dated January 22, 1901.

Application filed February 10, 1900. Serial No. 4,753. (No model.)

To all whom it may concern:

Be it known that I, HENRY F. SHAW, of Roxbury, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification.

This invention has relation to compound steam-engines, and has for its object to provide certain improvements therein whereby the pistons will be oppositely acting to lessen or prevent vibration, and thereby adapt the same for use on motor-carriages and other analogous mechanisms.

In motor-carriages in which steam or gas engines are employed serious inconvenience has been experienced from the constant vibration caused by the engines. Many comparatively delicate mechanisms are employed on carriages of the character referred to, and they become broken and dislocated from the jarring and vibration, causing endless repairs and great annoyance. To prevent the vibration, I employ an engine which is mechanically balanced with respect to the pistons and their connected parts, two pistons being used and being arranged to move oppositely.

The invention consists of a steam-engine comprising a low-pressure cylinder and a high-pressure cylinder arranged in axial alinement and having their interiors freely communicating with each other. In each of the cylinders is placed a piston, the two pistons being connected to the same crank-shaft and being arranged to move in opposite directions. Suitable valve mechanism is employed to admit steam into the high-pressure cylinder and from thence into the low-pressure cylinder, whereby the pistons will operate alternately upon the crank-shaft. By means of this movement of the pistons in opposite directions they counterbalance each other and prevent vibration of the engine, as will be readily understood.

The details of construction of the engine are fully set forth in the accompanying specification, taken in connection with the drawings.

Referring to said drawings, Figure 1 represents in longitudinal section an engine embodying my invention, the pistons and valves being in the position assumed by them just as the valve is beginning to admit live steam to the high-pressure cylinder. Fig. 2 represents a similar view with the parts in the position at the time when the cutting off of the live steam is just about to occur. Fig. 3 represents a similar view with the parts in position to admit the steam from the high-pressure cylinder to the low-pressure cylinder.

The engine comprises the cylinders *a* and *b*, of which the former is for low-pressure steam and the latter is for high-pressure steam. They are placed end to end, as shown, and open from one end to the other, one end of cylinder *b* being closed by the cylinder-head *c*. The outer end of the cylinder *a* is closed by a perforated plate *d*, which admits air into the outer end of said cylinder.

In the cylinder *b* is the piston *e*, there being a piston *f* in the low-pressure cylinder, through which a piston-rod *g* extends, through the cylinder *b* and the piston *e*, to the connecting-rod *h*, which is attached to the crank *i* of the crank-shaft *j*. The piston-rod for the piston *e* is in the form of a sleeve *k*, which passes through a stuffing-box *l*, attached to the cylinder-head *c*, said sleeve encircling the rod *g* and being connected to a sliding cross-head *m*, which slides in guides *n*, attached to the cylinder-head *c*. Said cross-head is connected to a crank *n* on the crank-shaft *j* by a connecting-rod *o*. The two cranks *i* and *n* are arranged at an angle diametrically opposite each other or at an angle of one hundred and eighty degrees, so that when said pistons move they move in opposite directions, as will be readily understood. The piston *f* and the rod *g* for the low-pressure cylinder are substantially equal in weight to the piston *e*, the hollow rod *k*, and the cross-head *m*, as will be observed from the drawings, so that the engine is mechanically balanced. Consequently when the two pistons move in opposite direcions the equilibrium is not affected.

Attached to the side or top of piston *e* is a valve-chest *p*, in which is placed a slide-valve *q*. From the chest ports *r* and *s* extend to the high-pressure and low-pressure cylinders, respectively, there being an exhaust-port *t*, as shown. The valve *q* is connected by a valve-

stem *u* and by a rod *v* with the eccentric-strap *w* of the eccentric *x*, fast upon the shaft *j*. Boiler-steam is fed into the valve-chest by a suitable pipe or duct and is admitted by the duct *r* to the outer side of the piston *e*, this taking place when the valve-crank *m* is at the end of the outstroke of the piston *e*. Steam is continuously admitted until the parts reach the position shown in Fig. 2, when it is cut off and acts expansively to force the piston to the inner end of the cylinder. During this movement of the piston *e* the rotation of the crank-shaft causes the piston *f* to approach the piston *e*, the exhaust from the cylinder *a* passing through the duct *s* into the outlet *t* to the chamber *x* in the valve *q*. Then the valve is shifted into the position shown in Fig. 3 to permit the steam to escape from the cylinder *b* through the ducts *r* and *s* and the chamber *x* in the valve to the low-pressure cylinder, the two pistons being now close to each other. The piston *f* is subjected to an unbalanced pressure equal to the amount by which the pressure of the steam exceeds that of the atmosphere and is forced outward in its turn, causing the partial rotation of the crank-shaft. As the pressure is equal on both sides of the piston *e*, the latter is moved outward, the expansion in the low-pressure cylinder continuing until the pressure therein is reduced to the back pressure, after which the energy due to the momentum of the moving parts completes a cycle of operations and brings the mechanism to the position where steam is admitted for the next stroke. Thus it will be seen that the crank-shaft is rotated a half-revolution by the high-pressure steam and the completion of the revolution is effected by the low-pressure steam.

The construction which I have described is particularly applicable for motor-vehicles, since the two pistons may be connected directly to the driving-shaft, the vibration being *nil* or so little as not to injure or jar the delicate parts of the mechanism.

Having thus explained the nature of the invention and described a way of constructing and using the same, although without having attempted to set forth all of the forms in which it may be made or all of the modes of its use, I declare that what I claim is—

1. A balanced engine comprising a low-pressure cylinder, a communicating high-pressure cylinder, the two cylinders being placed end to end, a piston in each of said cylinders, the rod for one piston passing through the other piston, and means for admitting steam first on one side of the piston of the high-pressure cylinder and then between the two pistons, the weight of oppositely-moving parts being substantially equal.

2. A balanced engine comprising a low-pressure cylinder, a communicating high-pressure cylinder, the two cylinders being placed end to end; a piston in each of said cylinders, and a rod connected to each piston, in combination with a shaft having cranks at an angle of one hundred and eighty degrees to each other, the piston and rods being connected to said cranks, the weight of oppositely-moving parts being substantially equal.

In testimony whereof I have affixed my signature in presence of two witnesses.

HENRY F. SHAW.

Witnesses:
MARCUS B. MAY,
P. W. PEZZETTI.