(Model.)

3 Sheets—Sheet 1.

L. H. NASH.

MECHANICAL MOVEMENT.

No. 378,847. Patented Feb. 28, 1888.

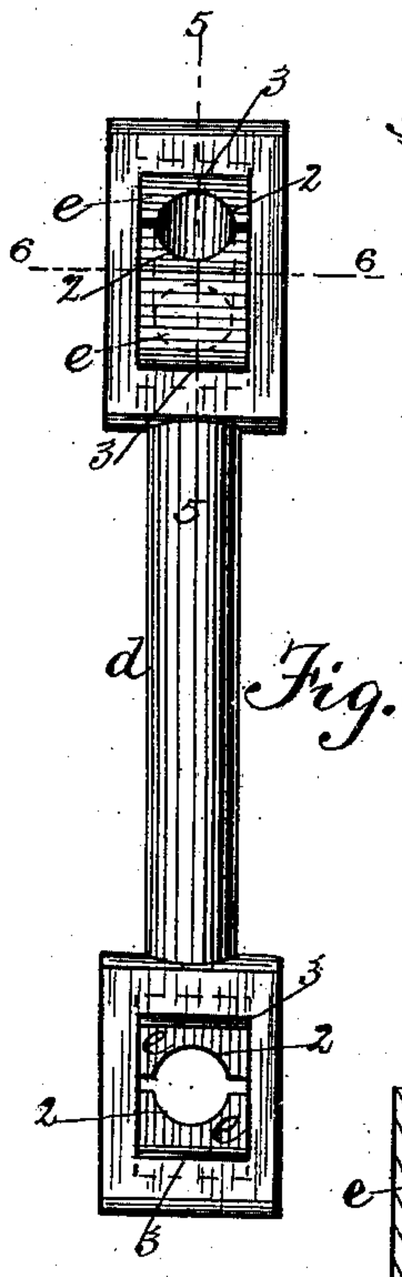

Fig. 5.

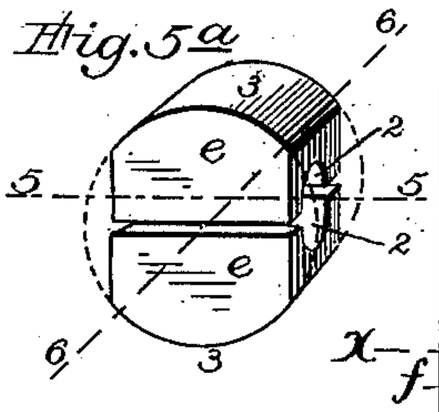

Fig. 5a.

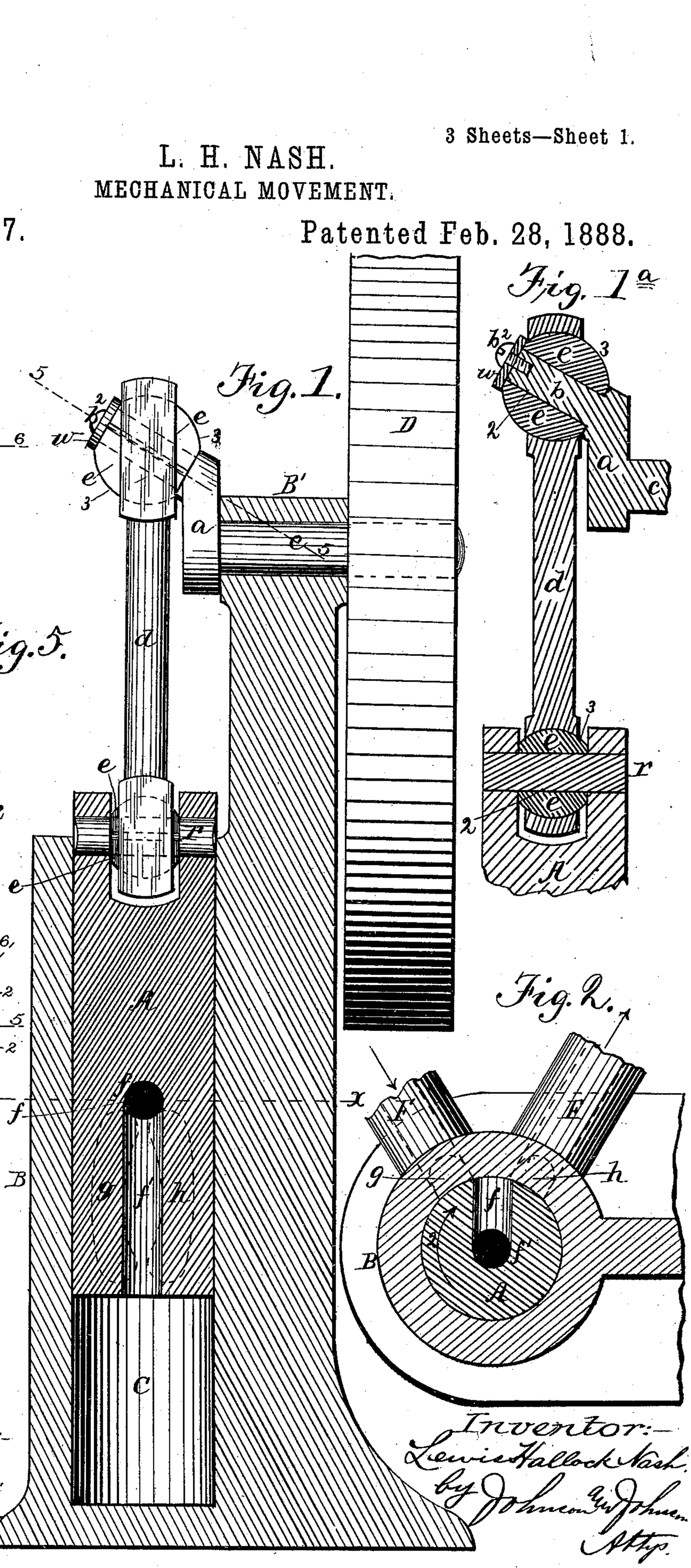

Fig. 1.

Fig. 1a.

Fig. 2.

Witnesses:-
R. S. Grant.
H. C. Huntemann

Inventor:-
Lewis Hallock Nash.
by Johnson & Johnson
Attys.

(Model.) 3 Sheets—Sheet 2.

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Fig. 3.

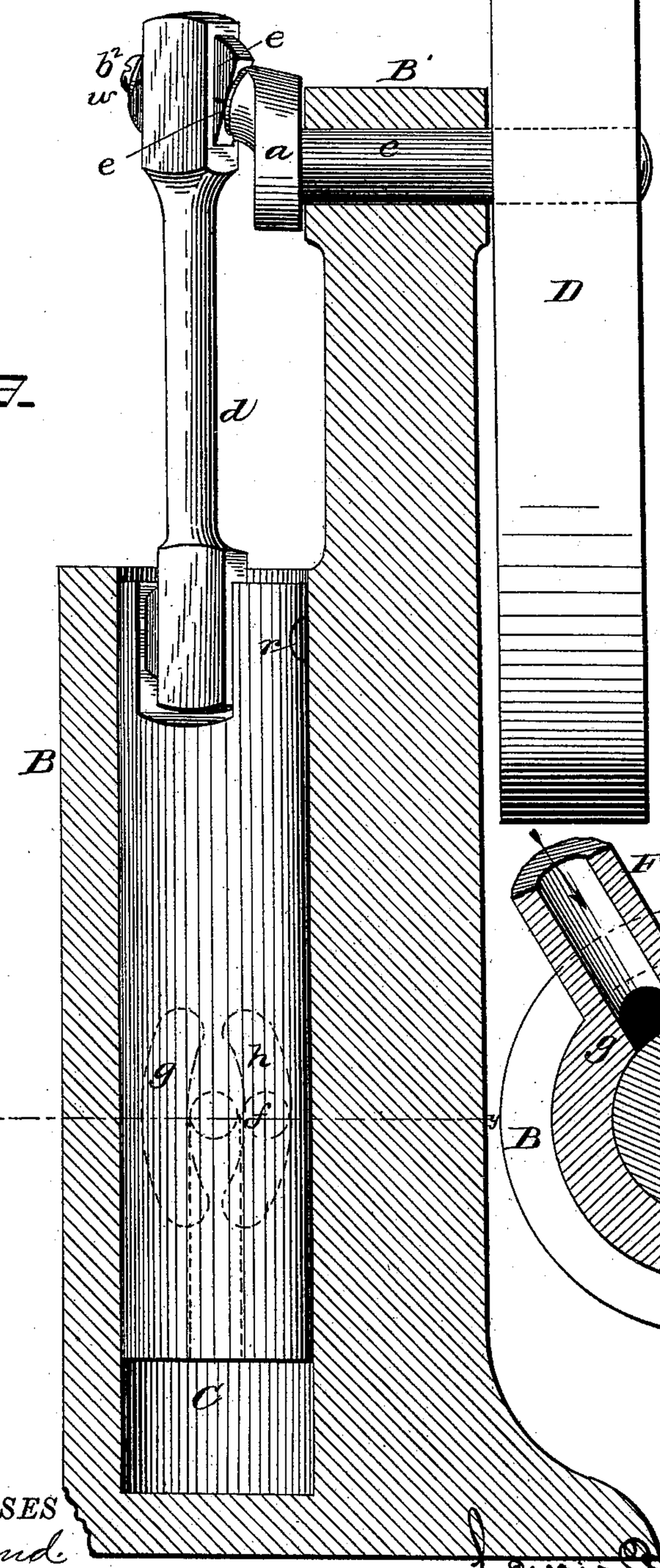
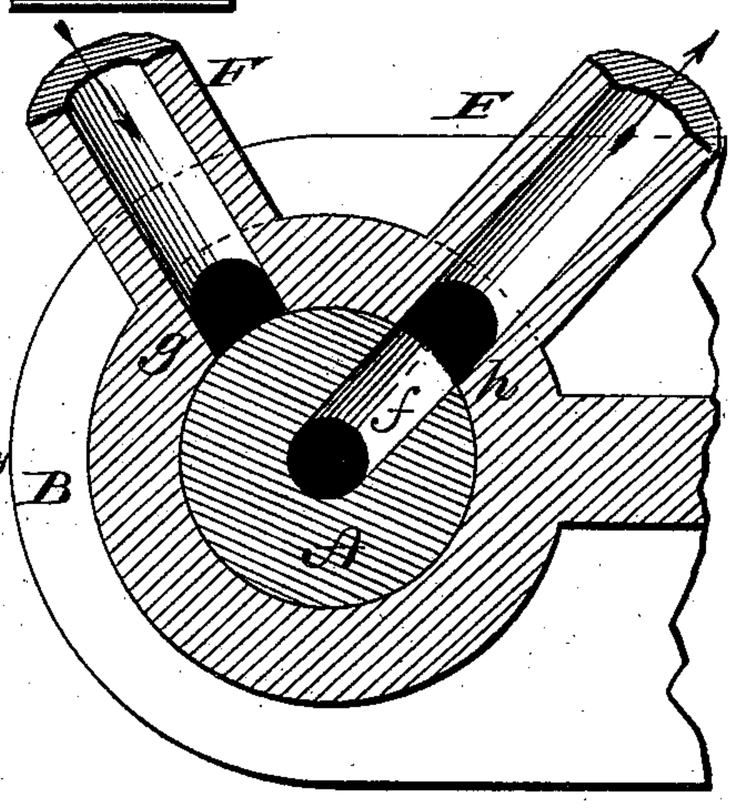


Fig. 4.



WITNESSES

F. L. Ourand.

F. D. Cowie.

INVENTOR.

Lewis Hallock Nash

By Johnson & Johnson

Attorney.

(Model.) 3 Sheets—Sheet 3.

L. H. NASH.

MECHANICAL MOVEMENT.

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Fig. 6.

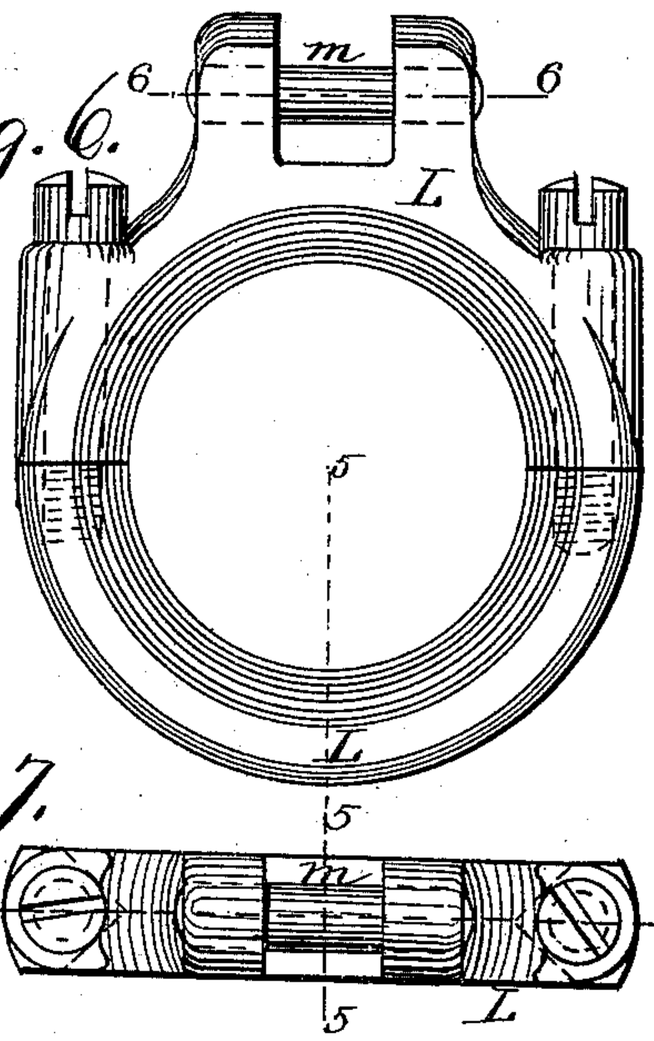


Fig. 8.

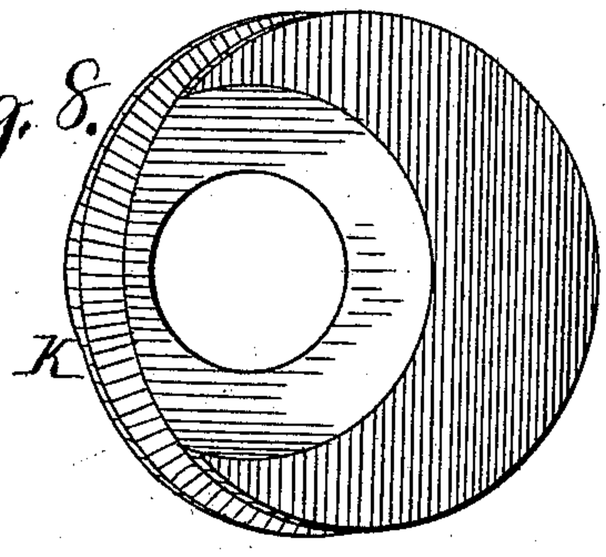


Fig. 7.

Fig. 9.

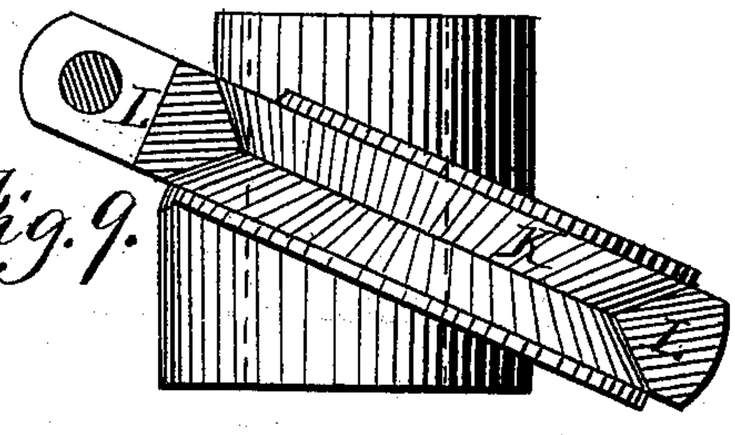


Fig. 12.

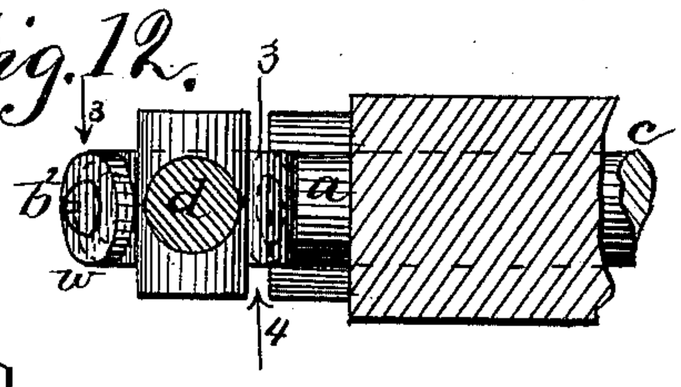


Fig. 11.

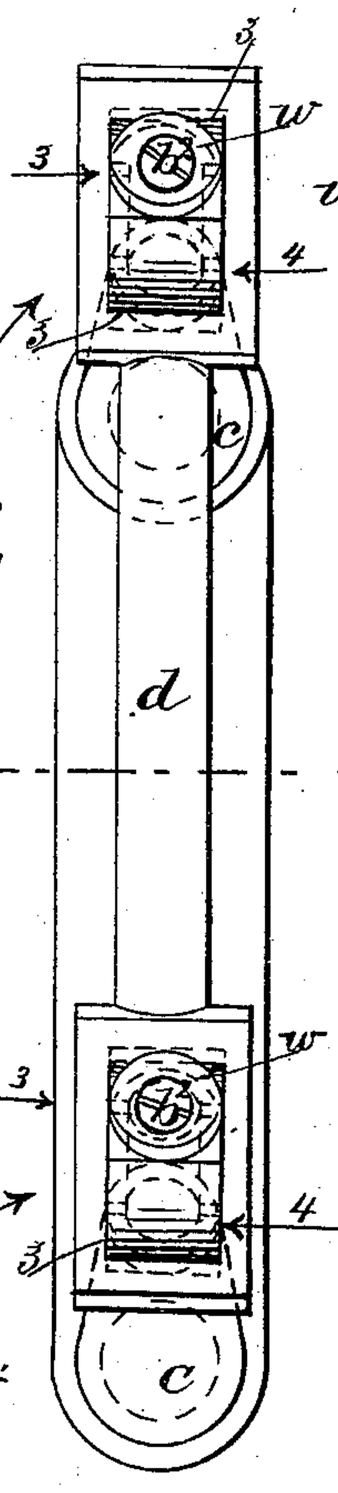
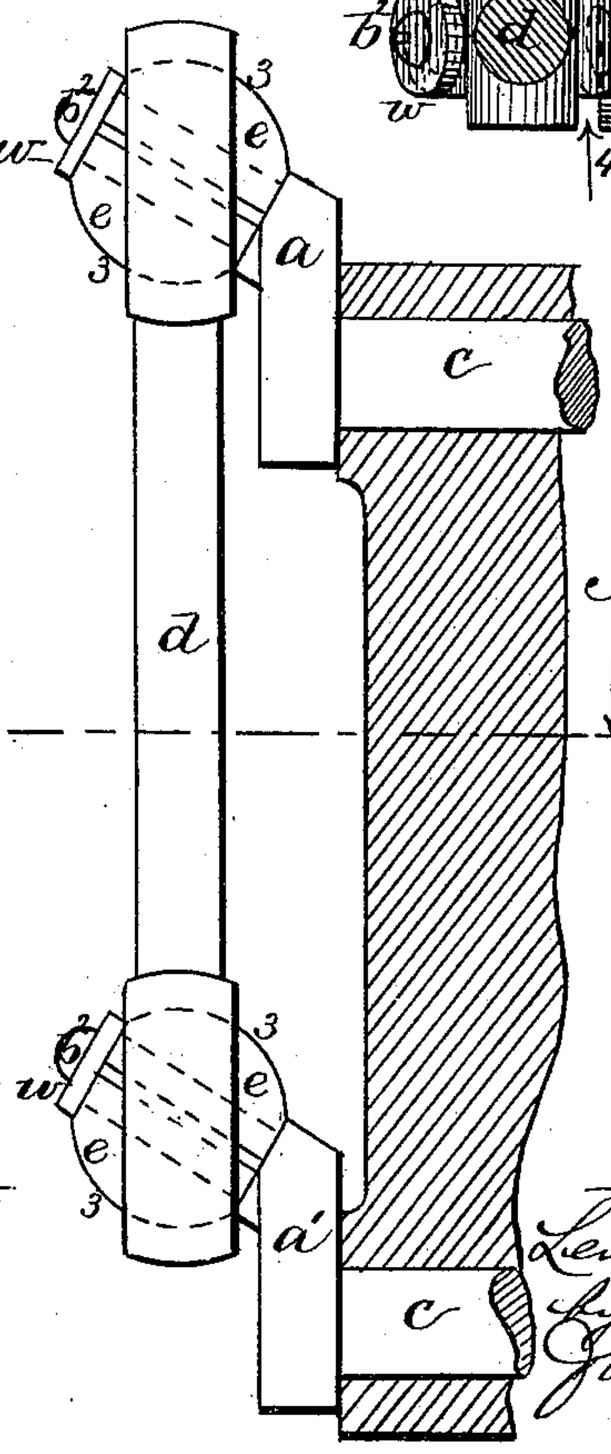


Fig. 10.



Witnesses:
R. E. Grant.
H. C. Huntemann.

Inventor:
Lewis Hallock Nash,
by Johnson & Johnson
Attys.

UNITED STATES PATENT OFFICE.

LEWIS HALLOCK NASH, OF BROOKLYN, ASSIGNOR TO THE NATIONAL METER COMPANY, OF NEW YORK, N. Y.

MECHANICAL MOVEMENT.

SPECIFICATION forming part of Letters Patent No. 378,847, dated February 28, 1888.

Application filed April 15, 1886. Serial No. 199,001. (Model.)

To all whom it may concern:

Be it known that I, LEWIS HALLOCK NASH, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented new and useful Improvements in Mechanical Movements for Valves and Shafts, of which the following is a specification.

My invention relates to the particular class of devices designated in the Patent Office as "mechanical movements;" and the objects of my improvement are to provide an improved device for converting a revolving motion into a combined reciprocating and twisting movement, whereby the reciprocating body is caused to have a partial revolution during its stroke to operate, for instance, a valve or a plunger with a positive reciprocating and twisting movement, and to operate parallel crank-shafts with a connecting-rod having a positive reciprocating and twisting motion to avoid dead-centers in the connected cranks, so that the crank to which motion is communicated through the medium of the connecting-rod is always positively operated in every position by the motion of its fellow.

My improved device is especially adapted for giving motion to a plunger-valve for operating a gas or steam engine in which the plunger forms the valve for controlling the admission and discharge of the fluids into and from the cylinder-chamber.

An important advantage of my improved bearing over other similar devices for producing compound movement of the connecting-rod is the compact, strong, and durable construction and relation of the bearing parts for producing such compound movement.

My improved device as applied to a valve makes it possible to produce results not possible in the ordinary crank-operated slide-valve, and my improvement may be applied to any device in which an automatic valve is required—as in a pump or motor—so that the valved plunger can operate its own ports.

In the accompanying drawings I have shown my improved mechanical movement as applied to a pump or motor in which the plunger forms the valve, and I have also shown how it may be used to impart a rotary movement from one shaft to another.

Referring, now, to the drawings, Figure 1 shows a vertical central section through the plunger and its cylinder and my improved universal-joint bearing for the plunger connecting-rod in elevation, and Fig. 1ª shows the connecting-rod and its universal-joint bearings in sectional elevation. Fig. 2 is a cross-section on the line *x x* of Fig. 1. Fig. 3 is a section similar to Fig. 1, showing the plunger in elevation in a different part of its stroke. Fig. 4 is a cross-section on the line *y y* of Fig. 3. Fig. 5 shows the connecting-rod. Figs. 6, 7, 8, and 9 show different views of a twisting eccentric which will give the same movement as the crank shown in the other views. Fig. 10 shows in side view the twisting crank-connection for parallel shafts. Fig. 11 is a view of the same, taken at right angles to Fig. 10; and Fig. 12 shows a cross-section of the same on the line Z of Figs. 10 and 11. Fig. 5ª, Sheet 1, shows the bearing parts *e e* in perspective to illustrate their cylindrical form and separate bearing-surfaces.

The device consists of a shaft, *c*, mounted in suitable bearings, and which has a crank-pin, *b*, formed with its axis inclined at an angle with the axis of the shaft. A connecting-rod, *d*, for this crank is provided with two bearing-surfaces at each end, which are each of a form described about an axis at a suitable angle—preferably at right angles—to the center line of this connecting-rod, and these parts when joined form a universal connecting-bearing, which is constructed of two bearing-surfaces, each surface being turned upon an axis at a suitable angle, and preferably at substantially right angles with the axis of the other bearing-surface. One of these surfaces, 2, makes a bearing upon the crank-pin *b*, and the other, 3, makes a bearing upon the connecting-rod.

The axis of the bearing about the crank-pin (see Fig. 1) is indicated by the line 5 5. The axis of the bearing of the cylinder *e e* cannot be indicated in this figure except by a point or dot, because it is parallel to the line of vision of the observer; but in Fig. 5, which is a front view of the connecting-rod and its bearing parts *e e*, (shown in Fig. 1,) this axis is illustrated by the line 6 6, in which figure the line of axis of the crank-pin is illustrated

by the line 5 5, as in Fig. 1. Now, these lines 5 5 and 6 6 in Fig. 5, where both axes are illustrated, will be seen to be at right angles with each other. Of course they may be at other suitable angle; but there must be these two axes at least, and they must have a definite angular—preferably right-angular—relation to each other to accomplish the purpose of my present invention. It will therefore be seen that this connecting-bearing is forced to take two movements, one of which is a relative movement about the axis of the crank-pin and the other a relative movement about the axis of the bearing upon the connecting-rod, and these movements are, as shown, substantially at right angles to each other. Therefore any movement of the crank-pin which does not cause a simple motion of rotation to the connecting-bearing will cause the latter to twist, and any motion of the connecting-bearing which is not one of rotation upon the bearing-surface of the connecting-rod will impart a twisting movement to the latter, and this movement is imparted by the connecting-rod from a similar bearing at its other end to the plunger or crank to be driven thereby. When it is desired to use an eccentric in place of a crank, the axes of the bearing-surfaces have the same mutual relation to each other, and any form of universal bearing having this relation of bearing-surfaces may be used for this purpose. This motion is reversible, so that the crank may be driven by the connecting-rod instead of driving it.

At the plunger-connection the connecting-pin *r* is at right angles to the axis of the plunger and parallel with the crank-shaft, and the cylindrical bearing-pieces *e e* are shown as being retained in their proper relation to the rod by the plunger, while at the crank-connection the cylindrical bearing-pieces *e e* are shown as being confined in place upon the crank-pin by a loose washer, *w*, which is secured in place by a screw, b^2, screwed into the end of the crank-pin *b;* or the bearing parts may be confined in their proper relation to the crank-pin by any suitable means.

In order to permit of the twisting movement herein described, the connecting-rod must be provided with a device for connecting it to the operating parts, between which it forms the connecting member, which device I call a "compound" bearing connection or part, and this device must be so formed as to permit of two motions—first, a motion of revolution with respect to the crank-pin or plunger, and, second, a motion of revolution with respect to the connecting-rod. The first motion is provided for by suitable bearing-surfaces fitting upon the crank-pin, and the center line of such bearing-surface I call the "axis of the bearing-surface upon the crank-pin," represented by the line 5. The second motion is provided for by suitable bearing-surfaces fitting upon the connecting-rod, and the center line of such bearing-surface I call the "axis of the bearing upon the connecting-rod," represented by the line 6. The said axis of the bearing-surface upon the crank-pin and the said axis of the bearing-surface upon the connecting-rod I call collectively the "axis of rotation." These bearing-surfaces are of a form such as can be turned in a lathe about two separate axes—for instance, cylinder-surfaces—and the two axes should be inclined at a suitable angle to each other, preferably at right angles. They thus permit of motion in two directions about axes of rotation inclined at a suitable angle to each other.

While an important feature of the invention relates to the angular relation of said axes, the form of bearing-pieces may be varied without destroying the said axial relation; and I do not confine my invention to the exact mechanical structure of the parts herein described.

Referring to Figs. 6, 7, 8, and 9, which I have described as showing different views of a twisting eccentric, which will give the same movement as the inclined crank-pin device shown in other views, it will be seen that the inclined eccentric, Figs. 8 and 9, is the equivalent of the inclined crank-pin, because, referring to Figs. 6 and 7, the eccentric-strap has the bearing-pin *m*, which joins the connecting-rod, (not shown,) and the axis-line 6 6 of this strap-pin is the same as the axis-line 6 6 described in connection with Fig. 5ª, while the bearing portion of the eccentric-strap that fits on the eccentric is turned in a lathe about the axis-line 5 5, which corresponds to the axis-line 5 5 of Fig. 5ª, so that such axis-lines 5 6 in the several figures have the same angular relation and produce identical movements of the connecting-rod.

The shaft *c* is supported in a bearing, B′, and a fly-wheel, D, is secured to the shaft for receiving or imparting motion to said shaft.

I have shown a system of ports adapted to control the inlet and the outlet of the water from the cylinder-chamber when operating as a pump or hydraulic motor in which the plunger A has a side port, *f*, connected at all times with the cylinder-chamber through the vertical passage *f′*.

The cylinder has an inlet-port, *g*, and an outlet-port, *h*, formed in its side walls, so that in the motion of the plunger its side port, *f*, will open communication with the inlet-port *g* while the chamber C is filling, and will open communication with the outlet-port *h* while the chamber is discharging its contents. This action is best seen in Figs. 1 and 3, wherein the case-ports are shown in dotted lines.

From the connections described it will be seen that any point of the plunger will describe an oval path with respect to the inclosing-cylinder, and also any point of the cylinder will describe an oval path on the plunger. In Fig. 1 the plunger is at the end of its upstroke, and at this point it has a revolving motion in the direction of the arrow 2 in Fig. 2, so that the port *f* has just closed the inlet-port *g* and is about to open the discharge-port *h*, moving toward the position shown in Fig. 3, in which

the ports *f* and *h* are shown in dotted lines in communication for the free escape of the water. When the piston reaches the bottom of its stroke, it will have a twisting motion in the reverse direction, and will close the port *h* and open the port *g*, so that the water can flow into the chamber C during the forward movement of the piston.

Since the path of the port *f* is an oval, it will always travel over the same portion of its path at the same portion of the stroke of the piston, and by suitably forming the inlet and discharge ports *g* and *h* it may be made to admit the charge at any point of the stroke of the piston and cut off the admission at any other desired position, so as to control the inlet and discharge of the fluid in any desired manner. It is this feature that renders the invention of such great utility as a means for operating a valve; and it may be used as well to control the admission and discharge of the fluid for a second cylinder-chamber as well as for its own cylinder-chamber. My improvement therefore contemplates the use of such a plunger-valve for operating a steam or a gas engine, as well as for the purpose shown in Figs. 1 to 5. The form of the ports *g* and *h*, at their opening into the chamber C, is oblong in vertical direction, to conform to the path described by the port *f* of the plunger, while the pipe-connections F for the case-ports are connected with the latter, as in Figs. 2 and 4.

In Figs. 10, 11, and 12 I have shown my improved mechanical movement as applied to two twisting-crank connections by a universal-joint connecting-rod, Fig. 11 being a front view, and Fig. 12 a section taken on the line *z z* of Fig. 10. In Fig. 10 I have shown the two cranks *a a'* in the position known as the "dead-center" in ordinary forms of crank-connections, and it is only necessary to describe the action of my crank-connection in this position to give the twisting action, since in other positions the action is the same as in the ordinary form of crank-connection. Referring, then, to Fig. 10, it will be seen that in its revolving motion the outer end of the crank-pin is moving faster than the inner end, and therefore the rod *d* will have a twisting motion imparted to it, as indicated by the arrows 3 and 4 in Figs. 11 and 12, the forces acting as a couple at the inner and outer ends of the crank-pin bearing. This twisting motion of the connecting-rod is imparted to the crank-pin *b'* by forces acting as a couple upon the crank-pin, and since the elements of this couple act to greater advantage upon the outer end than upon the inner end of the crank-pin it will cause the crank *a'* to revolve in the same direction as the crank *a*. As the crank leaves this position the pulling action of an ordinary crank is added to the twisting action of the connection until the cranks are at the other center, when the twisting action again carries it along; hence with this connection there is no dead-center; but the crank *a'* is driven with a positive movement throughout its entire revolution.

Figs. 6, 7, 8, and 9 show an eccentric-and-strap connection adapted to produce the same twisting motion as the crank shown in Fig. 1. In this modification the eccentric-bearing K is turned to a surface whose center line makes an angle with that of the shaft. The eccentric-strap L has a bearing-pin, *m*, to which the connecting-rod is pivoted, so as to swing, preferably, at right angles to the motion of the eccentric-strap, and thus the bearing of the eccentric-strap on the eccentric, combined with the bearing of the rod on the pin *m*, constitutes a form of universal-joint connection equivalent to and operating substantially like that shown in Figs. 1 to 5.

It will be understood that I do not confine myself to the specific form of joint-connection which I have shown and described so long as the construction and relation of the bearing-surfaces are as described, nor to any specific construction of valve-ports of the plunger or cylinder, as they may be arranged in such mutual relation in each case as to perform the functions required of the valve, nor to any specific construction of device to which compound motion is imparted.

I have stated that the path described by any point of the plunger or of the cylinder will describe an oval path in the movement of the former; but it will be understood that such path is not necessarily a true oval, but a figure of the oval class, and it may be egg-shaped or heart-shaped, as may be effected by the inclination of the connecting-rod or the form of the universal-joint bearing used. In any case, however, such path will be a continuous curve and operate substantially as described.

The eccentric universal-joint coupling will be found preferable whenever the motion is to be transmitted from a portion of the shaft in which it would be inconvenient to form a crank.

From the foregoing it will be seen that my improved device requires a peculiar form of bearing-connection between the connecting-rod and the crank or eccentric in order to produce the required movement. The axis of the bearing with the crank must make a considerable angle—preferably a right angle—with the bearing upon the connecting-rod, and hence the motion of the driving-crank will cause the bearing to twist as well as revolve upon said crank-bearing, and since the bearing of the connecting part upon the connecting-rod is inclined to the bearing upon the crank the rod will be forced to turn in a different plane, and the mutual adjustments of these two movements in different planes will result in a twisting movement, substantially as described.

It will be observed that my invention, irrespective of the work to which it is applied, is broadly covered by the concluding claims, and also that said claims are not specifically di-

rected to the device as applied to a plurality of shafts for overcoming a dead-center, as herein described. Such specific application of my invention I reserve for future applications.

I claim—

1. The combination of a connecting-rod, a shaft, an inclined crank-pin attached to said shaft, and a compound bearing part joining said crank-pin and connecting-rod adapted to permit motion in two directions about axes having an angular relation to each other, substantially as described.

2. The combination of a shaft having an inclined crank-pin, a plunger, a connecting-rod, and compound bearing parts for each end of said rod joining it with said crank-pin and said plunger, said compound bearing parts each being adapted to permit of motion in two directions about axes having an angular relation to each other, substantially as described.

3. The combination of a shaft having an inclined crank-pin, a body to which motion is communicated, a connecting-rod, and compound bearing parts for each end of said rod, joining it with said crank-pin and said body, said compound bearing parts each being adapted to permit of motion in two directions about axes having an angular relation to each other, substantially as described.

4. The combination, with the case B, having the chamber C and inlet and outlet ports, of a plunger having a port communicating with said case-ports, a connecting-rod, a crank-shaft having its crank-pin inclined to the axis of the shaft, a fly-wheel, D, and bearing parts *e e* for each end of the connecting-rod, having cylindrical interior and exterior bearings arranged at right angles to each other, substantially as described.

5. The combination of the crank-shaft having the axis of its crank-pin inclined to the axis of said shaft, a cylindrical plunger having the ports *f f'*, and an inclosing-case for said plunger having the ports *g h*, with the connecting-rod *d*, the bearing-pieces *e e*, formed with interior and exterior bearings, and the plunger connecting-pin *r*, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

LEWIS HALLOCK NASH.

Witnesses:

H. W. BRINCKERHOFF,

WILLIAM C. WESTERVELT.