No. 881,502. PATENTED MAR. 10, 1908.

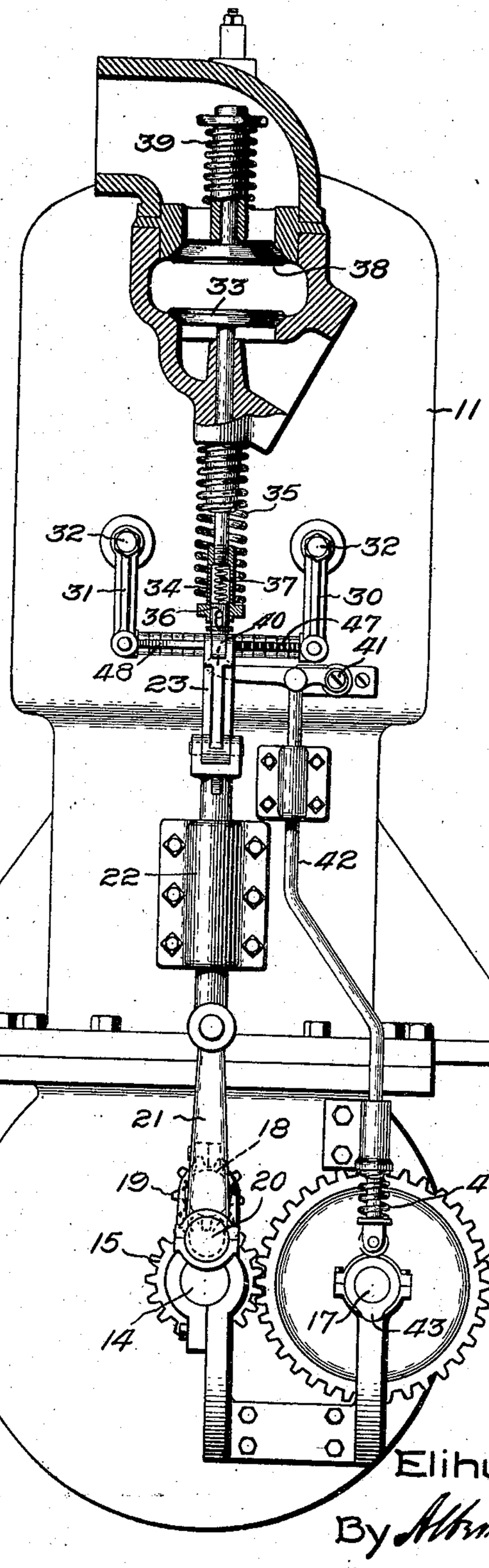
E. THOMSON.

MECHANICAL MOVEMENT.

APPLICATION FILED APR. 26, 1906.

5 SHEETS—SHEET 1.

Fig. 1.



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5 SHEETS—SHEET 2.

Fig. 2.

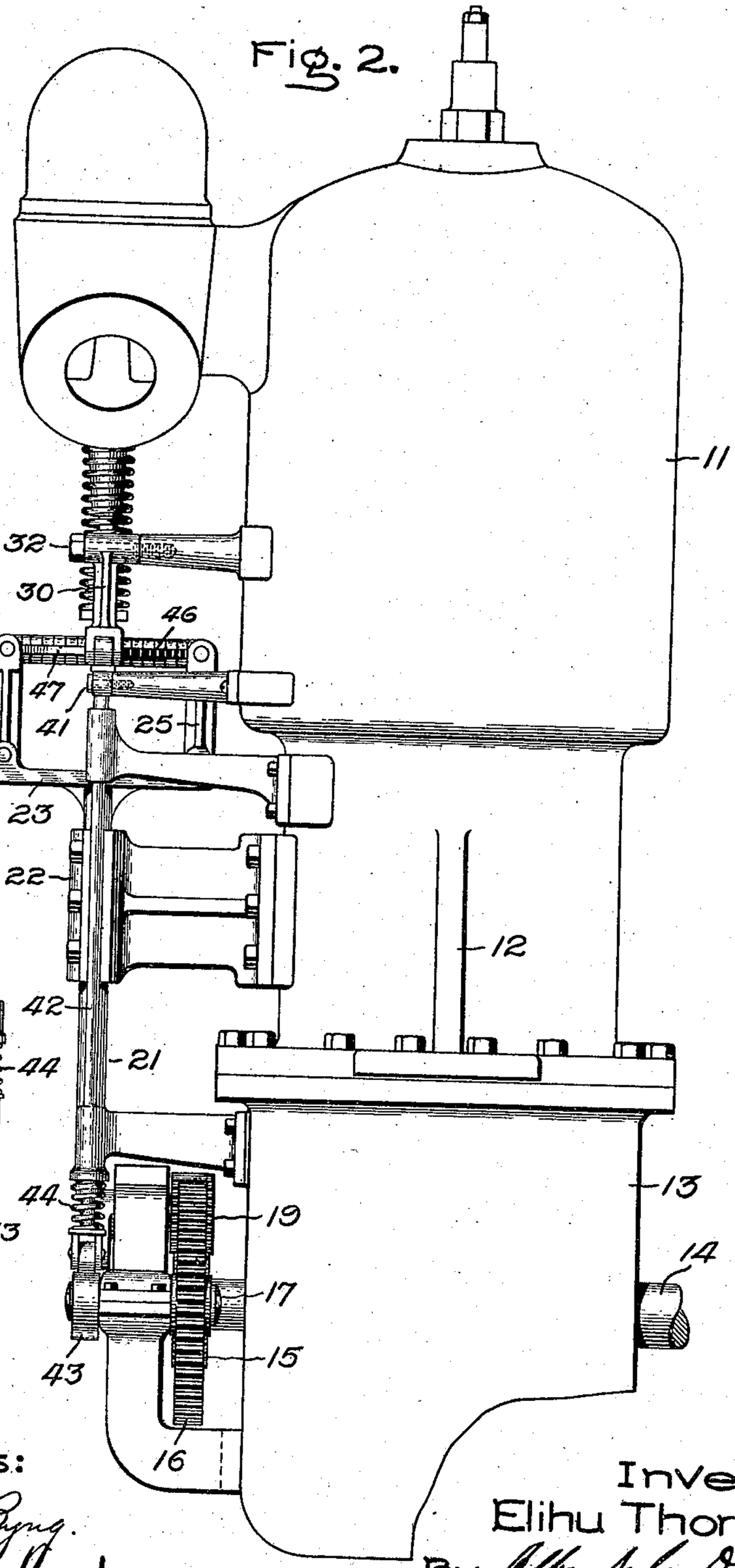
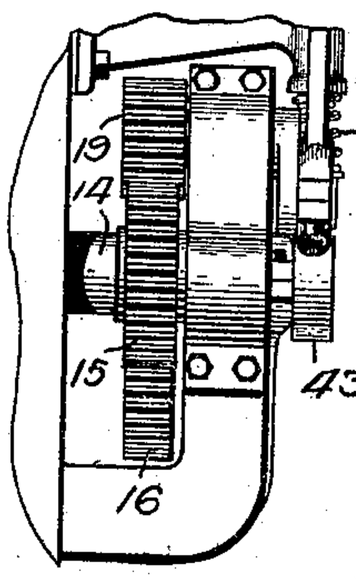


Fig. 3.



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5 SHEETS—SHEET 3.

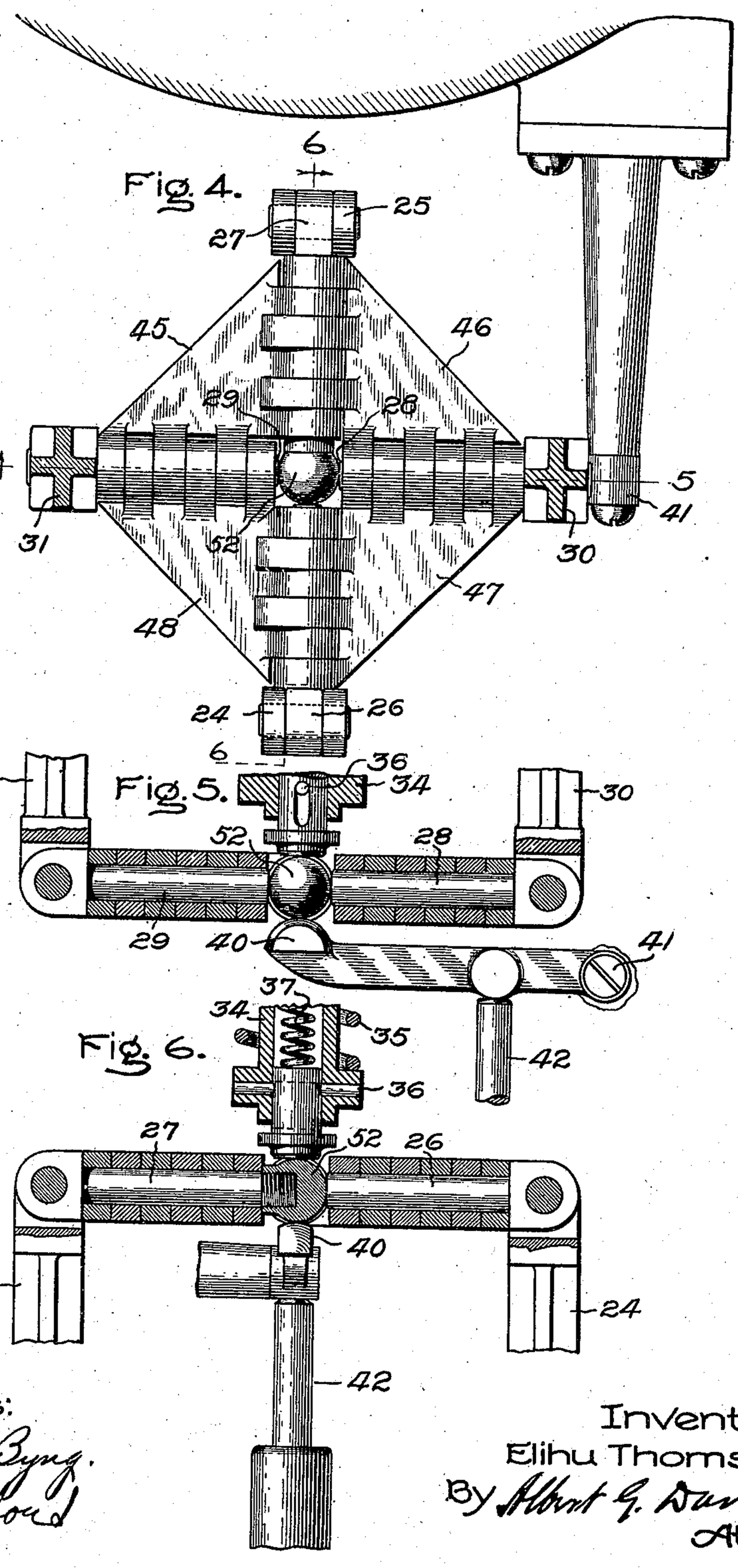

Fig. 4.

Fig. 5.

Fig. 6.

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5 SHEETS—SHEET 4.

Fig. 7.

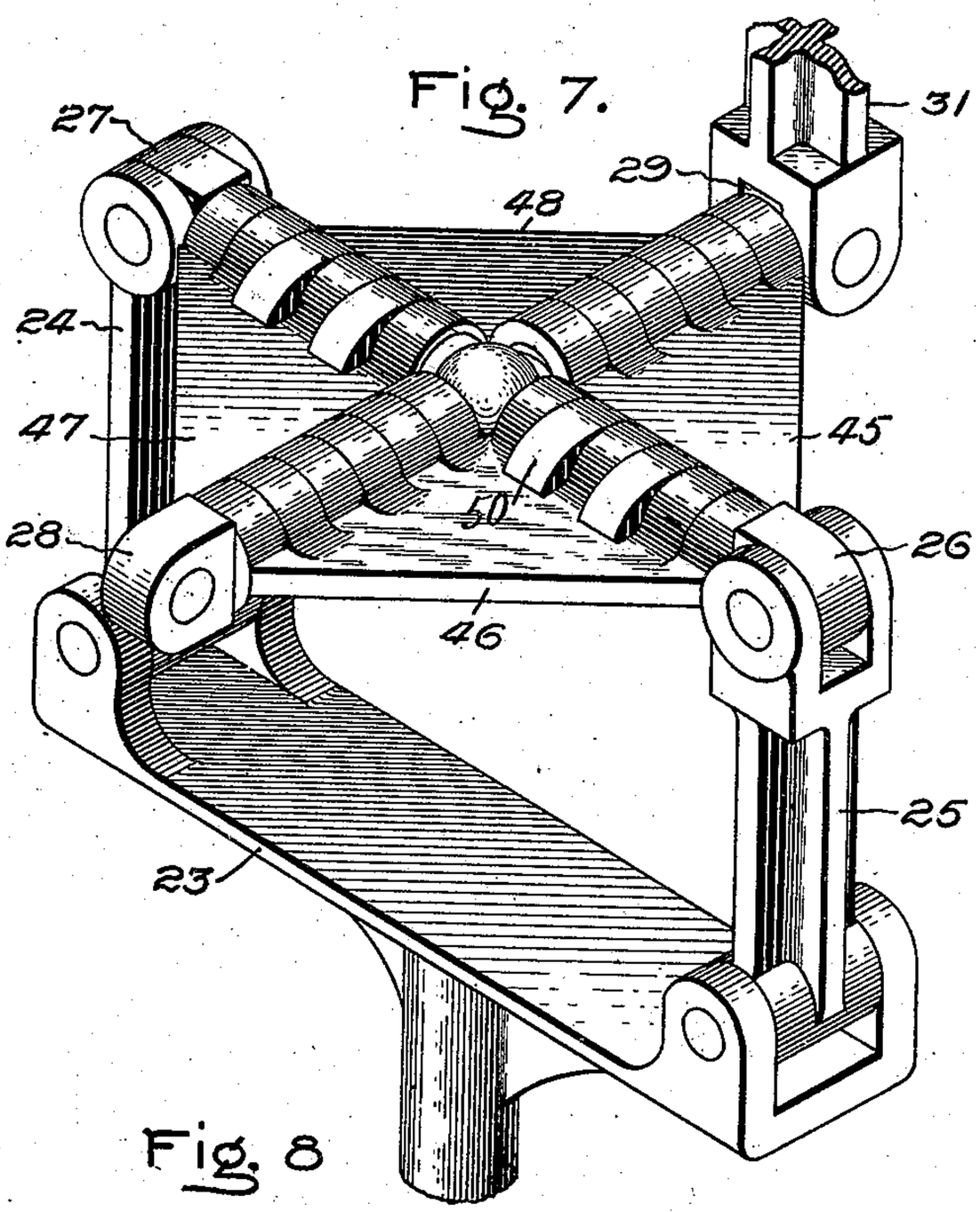


Fig. 8

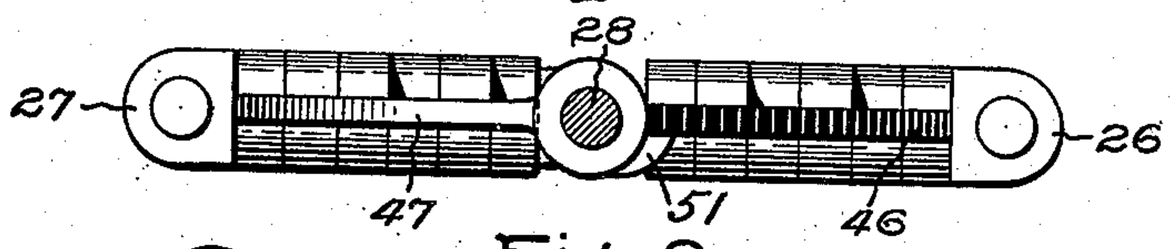


Fig. 9.

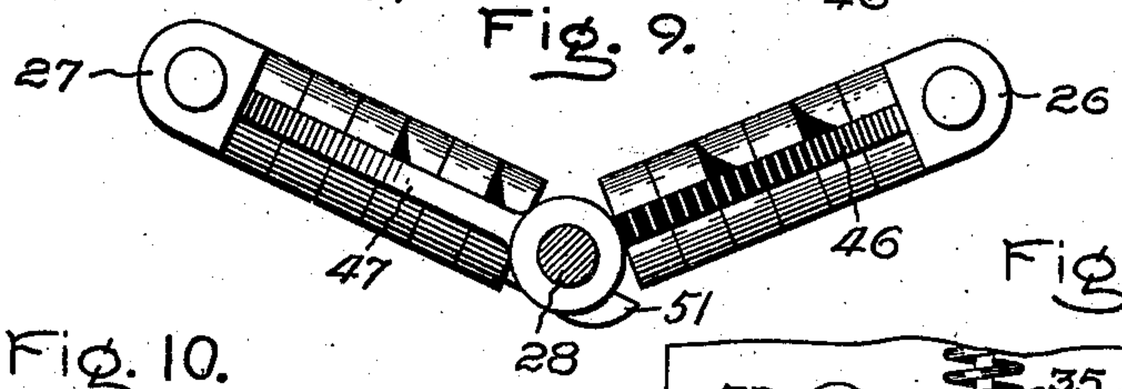


Fig. 10.

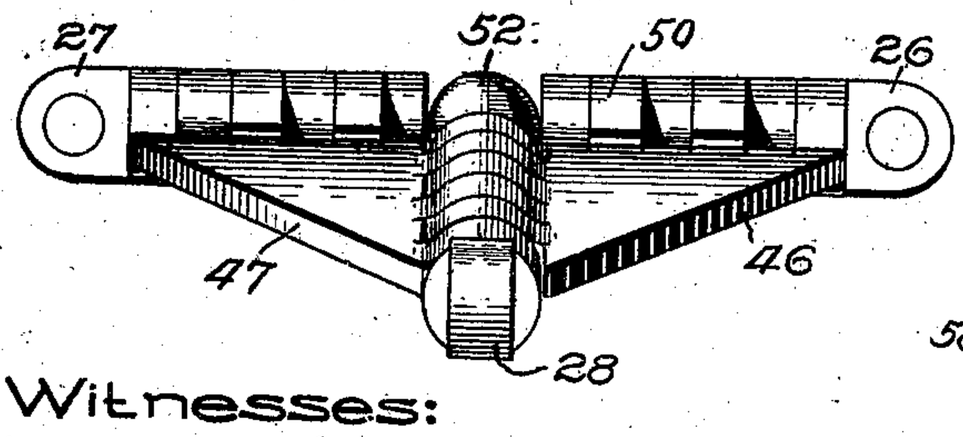
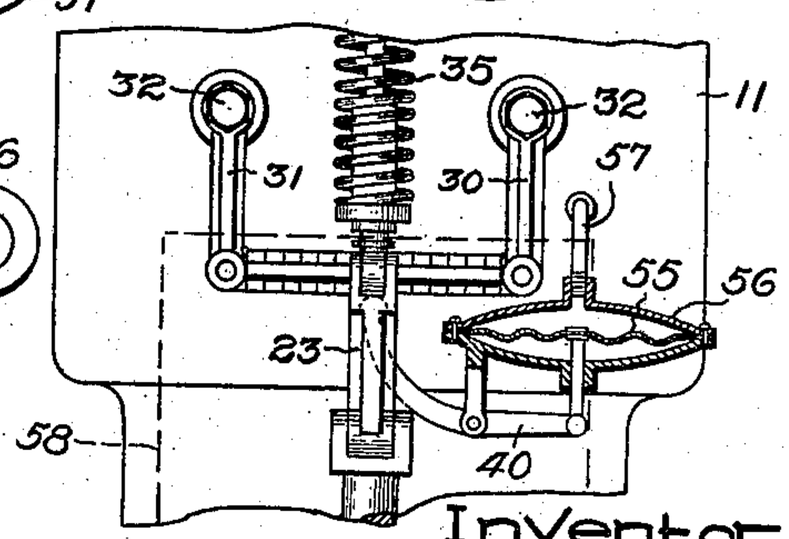


Fig. 11.



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5 SHEETS—SHEET 5.

Fig. 12.

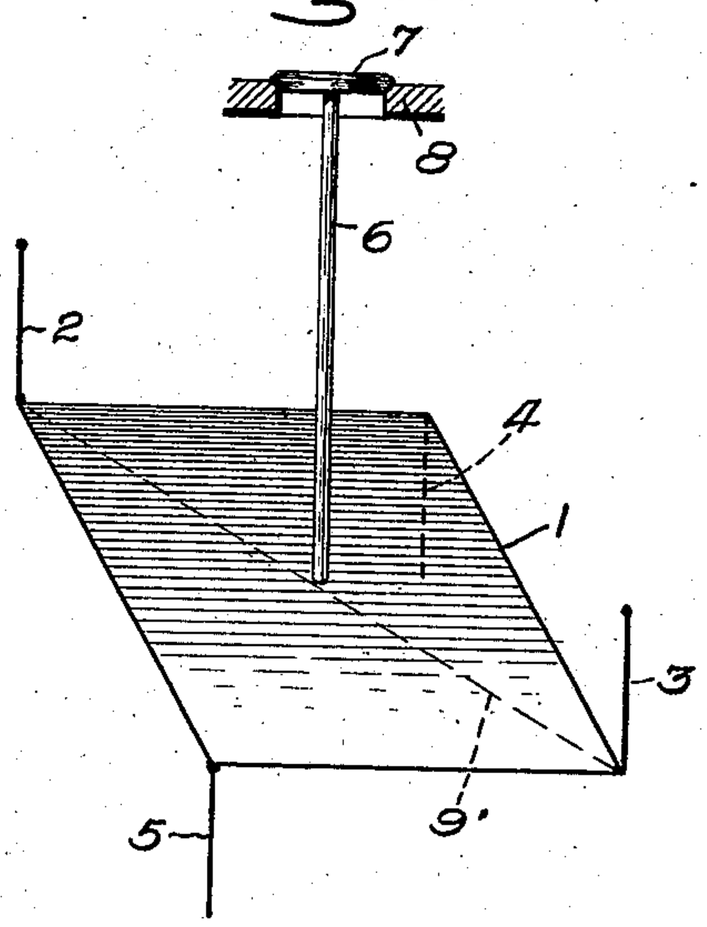


Fig. 13.

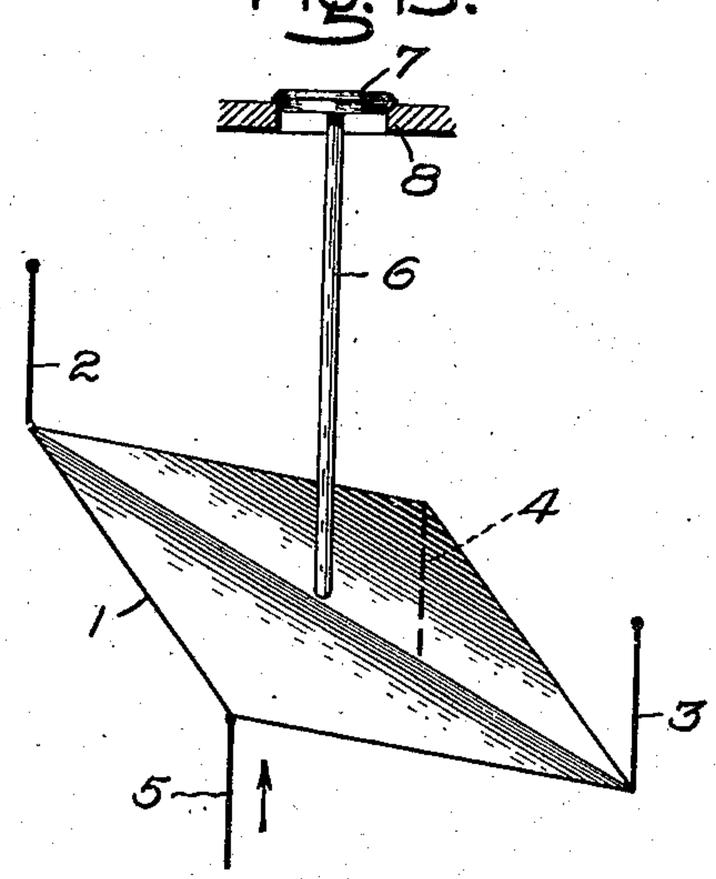


Fig. 14.

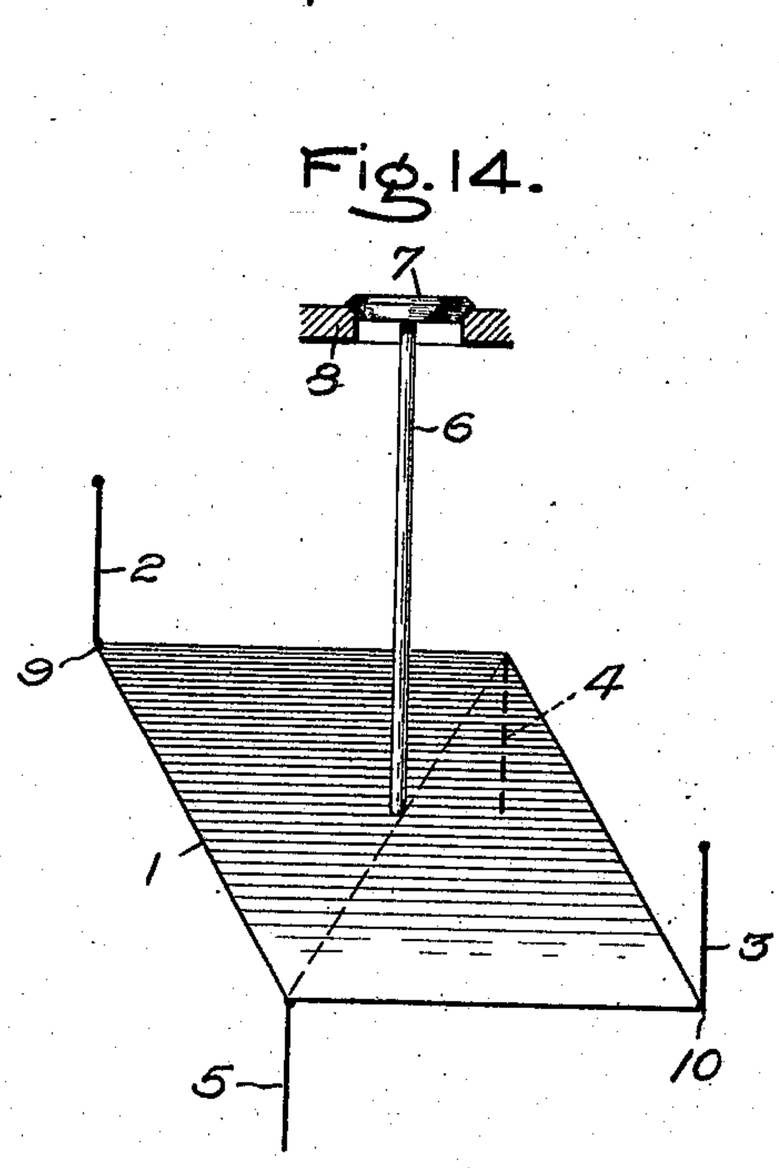
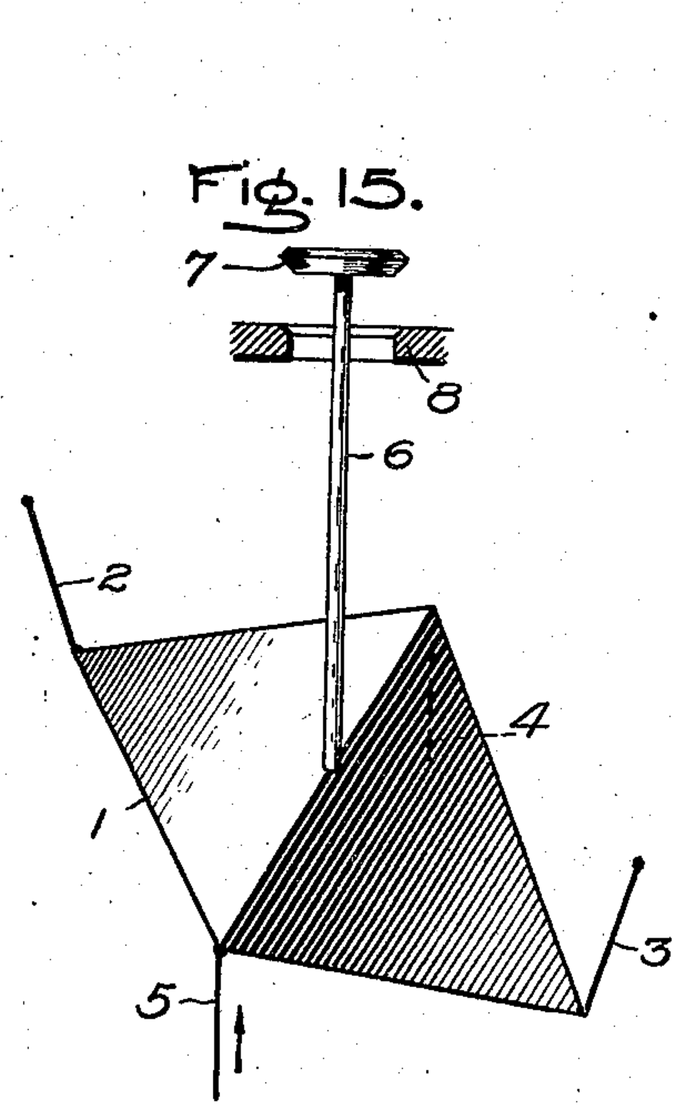


Fig. 15.



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UNITED STATES PATENT OFFICE.

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MECHANICAL MOVEMENT.

No. 881,502. Specification of Letters Patent. Patented March 10, 1908.

Application filed April 26, 1906. Serial No. 313,734.

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing at Swampscott, in the county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Mechanical Movements, of which the following is a specification.

The present invention consists in a novel mechanical movement. It is of general application, and as illustrative of one application is shown in connection with the exhaust valve of a four cycle gas engine. It is to be understood, however, that the invention is not to be construed as being limited to said use.

The invention has for its object to provide a means for transmitting motion from one element, as, for example, a part which is constantly in action, to another element which is periodic in its action.

For a consideration of what I consider to be the novel features, attention is called to the following description and claims appended thereto.

In the accompanying drawings illustrating one of the embodiments of my invention, Figure 1 is a side elevation of a four cycle gas engine with certain of the parts broken away for the purpose of illustration; Fig. 2 is a front elevation of the same; Fig. 3 is a detail view showing the gearing between the main shaft and the valve operating mechanism; Fig. 4 is a plan view of the flexible member; Fig. 5 is a sectional view taken on line 5—5 of Fig. 4; Fig. 6 is a sectional view of the said member taken on line 6—6 of Fig. 4; Fig. 7 is a perspective view of the flexible member through which motion is transmitted to the valve; Fig. 8 is a view in side elevation of the flexible member; Fig. 9 is a similar view of the flexible member showing the hinged parts depressed; Fig. 10 is a view of the flexible member showing it flexed on an axis at right angles to that of Fig. 9; Fig. 11 is a detail view of a slight modification wherein the means for controlling the flexible member is actuated by the exhaust from the engine, and Figs. 12 to 15 inclusive, are diagrammatic and illustrate the movements of the flexible member and the part or parts actuated thereby.

The principle of my invention can be best understood from the following: Assume a square plate of thin spring metal, two of the diagonally opposite corners being connected to one support, for example of forked shape and the other two connected to a corresponding support extending in the opposite direction. From this it follows that one axis passes through one pair of corners, and a second axis at right angles to the first passes through the second pair of corners, the axes occupying a common horizontal plane. Under the conditions specified the plate has a tendency to remain perfectly flat and will resist to a considerable extent any tendency for one pair of diagonal corners to move with respect to the other pair and bend the plate. Now by a suitable means, deflect the center of the plate so that the axes at their point of crossing no longer occupy exactly the same plane. The plate will then bend freely in one direction, but not in the other. One of the axes of the plate passing through the corners acts as a pivot while the other is inactive. Now by deflecting the plate at the center in the opposite direction, the axis is changed from the first mentioned pair of corners to the other. In other words, the axis which was inactive has become active while the other one that was active has become inactive.

In the simplest form of the invention a thin sheet of metal is provided as the flexing member, but for those cases where considerable work has to be done, it is better to make said member out of separate pieces and pivotally connect them, the axes of the pivots occupying a common plane and crossing each other at the center. The flexing member may be round, square or other shape as best suits the requirements.

Referring to Figs. 12 to 15 inclusive, the essential elements of the improvement will be described. 1 represents the flexing member, made in this instance of a plate of sheet metal, 2 and 3 parts of a fixed support secured thereto at diagonally opposite points, and 4 and 5 parts of a movable support or motor also secured to the said member at diametrically opposite points. 6 represents a means for transforming the movements of the member 1 into useful work. In the present illustration it is shown as being a stem connected to a valve 7 having a seat 8. The dotted line 9′, Fig. 12, represents the active axis of the flexing member. The support comprising parts 4 and 5 attached to opposite corners of the plate is now free to

be moved up and down within its prescribed limits so long as its movements do not cause a change in the relation of the axes.

In Fig. 13 the support 4—5 is shown as having been moved upward by a certain amount, but the valve and its stem remain unaffected because the axis of movement has not changed.

In Fig. 14 the axis 9′ has been shifted to the opposite corners by slightly deflecting the center of the plate upward. Parts 2 and 3 are hinged to a fixed support and are therefore fixed in their vertical position, while the parts 4 and 5 are a part of the movable support or motive device. Since the points 9 and 10 cannot rise or fall due to the character of the support 2—3, disregarding the fact that the parts are pivoted, and the support 4—5 can, it follows that any up and down motion of the latter will be communicated to and move the valve stem.

Fig. 15 shows the effect of moving the flexible member upward by means of the support or motive device 4—5. Instead of operating a valve, it is quite evident that I may substitute other devices when it is desired to impart longitudinal movement under certain conditions, and under others to permit the device to remain at rest or even to be acted upon by a different mechanism. The downward deflection of the plate may be accomplished by the valve stem 6 and the upward deflection by a device acting on the under side as will appear later.

Referring to Fig. 1, 11 represents the cylinder of a four cycle gas engine supported by a frame 12 of suitable construction. The crank is inclosed by a casing 13 bolted to the under side of the frame. In the casing are bearings for supporting the main shaft 14. On the main shaft is a gear 15 meshing with a gear 16 on the low speed shaft 17. The relation of the gears is such that the shaft 17 revolves half as many times as the shaft 14. Situated above the main shaft is a short secondary shaft 18 that is driven by a gear 19, meshing with the gear 15 on the main shaft. The relation of the gearing is such that the shaft 18 revolves twice as fast as the main shaft. On the end of the secondary shaft 18 is a crank having a crankpin 20, the latter being connected to a connecting-rod 21. The rod is suitably guided at 22, and on the upper end is provided with a fork 23 of the character best shown in Fig. 7. Referring to said figure, 24 and 25 are pivotally supported uprights that are slotted at their upper ends to receive the pins 26 and 27 that form one axis of the flexible member 1. 28 and 29 are the pins forming the other axis of the flexible member 1, and these in turn are supported by uprights 30 and 31, Fig. 1, the said uprights being pivotally supported at their upper ends by pins or other supports 32. 33 represents the exhaust valve having a stem that projects downwards from the cylinder casing and on the lower end is provided with a sleeve 34, having a shoulder at its lower end arranged to form an abutment for the compression spring 35. The spring 35 tends at all times to seat the exhaust valve.

Inside of the sleeve is mounted a pin 36, Figs. 1 and 5, that is capable of a certain amount of motion in a longitudinal direction independently of the sleeve 34 and the compression spring. This pin is normally urged in a downward direction by a compression spring 37. This pin and the spring form a device for controlling the action of the flexible member in one of the phases of its operation, as will appear later. Situated above the exhaust valve is an admission valve 38, Fig. 1, that is normally held against its seat by the spring 39, but opens on the suction stroke to admit fuel to the cylinder. In order to control certain of the movements of the flexible member a lever 40 having a well rounded end is situated below said member, and under certain conditions of operation the end of the lever is adapted to engage the said member and force the center portion upwardly, thereby determining which of its axes shall be active. This lever is pivoted at 41, and its motions are controlled by the rod 42. Upon the lower end of the rod is a roller that engages with the cam 43 on the half-speed shaft 17. A compression spring 44 normally keeps the free end of the lever 40 and the rod 42 in the position shown. As the parts are arranged, the piston of the engine is about to start on its compression stroke. This means that by the time it is nearing the end of the firing stroke the cam 43 will have reached the roller on the end of the rod 42 and raised it, at the same time causing the flexible member 1 to transmit motion to and raise the exhaust valve 33. As soon as the motion of the shaft carries the cam 43 out from underneath the roller the exhaust valve is permitted to close, and the reciprocating movements of the connecting rod 21 and the part 23 on the flexible member are not transmitted to the exhaust valve. In other words, once for every two revolutions by the main shaft, the exhaust valve is opened and the flexible member performs useful work, and during the remaining portion of the two revolutions the flexible member is idle in that it does not communicate motion from the reciprocating connecting-rod 21 to the exhaust valve.

Owing to the fact that the wear and tear on a thin plate of sheet metal would in most cases be too great, I make the flexible member out of four principal parts 45—46 and 47—48, Fig. 4. Extending through the hinges are pins 26—27, and 28—29, Figs. 4 and 7, as previously described. The plates 45—48, and 46—47, treated as pairs, are so hinged

together that they cannot be depressed along the axis of pivots 26—27, but a pressure from the under side will cause them to move like the parts of a hinge about said pivots. On the other hand, the plates 45—46, treated as one pair, and 47—48, treated as the other, are so arranged that centrally applied pressure from above will deflect the flexible member downward from its normal plane, the plates moving on pivots 28—29 as the axis.

Referring to Fig. 7 the projections 50 on the upper side of the flexible member prevents the pressure from above from deflecting said member on the axis 26 and 27. The projections 51 on the under side of the flexible member permit the said member to be deflected, or the equivalent, the ends of the parts 26 and 27 and the members 25 and 24 connected thereto to rise. On the end of the pin 27, Fig. 6, is a ball 52 with which the other three pins 26, 28 and 29 engage. On the upper side of the ball rests the spring-pressed plunger 34 which tends at all times to cause the pins 28 and 29, supported by the links 30 and 31, to act as the active axis, while the uprights 24 and 25 connected to the outer ends of the pins 26 and 27 move up and down under the action of the connecting-rod 22 without in any way affecting the position of the exhaust valve. Engaging with the under side of the pawl is the rounded end of the lever 40. This lever may be pressed upward by mechanical means when desired, or by fluid pressure, or by a combination of both.

In Fig. 11 is shown a modified arrangement for actuating the lever 40 for determining which way the flexible member shall yield. It comprises a diaphragm 55, inclosed within a suitable casing 56, to which pressure is admitted by the pipe 57. The piston 58 of the engine, shown in dotted lines, has just uncovered the port leading to the pipe 57, so that the upper side of the diaphragm is subjected to the pressure of the contents of the cylinder. This pressure is transmitted to the lever 40 by a suitable means. The said lever acts on the flexible member in the manner previously described.

Briefly the action of the invention is as follows: The crank shaft is turned around by the piston and in turning drives the half-speed shaft 17 and also the double-speed shaft 18. The crank-pin 20 driven by the shaft 18 moves the connecting-rod 21 and parts 23, 24 and 25 united therewith up and down, the axis of the flexible member being the pins 28—29. At the proper time for the cylinder to exhaust the cam 43, Fig. 1, raises the rod 42 and its attached lever and the latter presses on the ball 52 which raises it slightly and the axis of movement is transferred to the pivots 26—27. In other words, the axis that was active has now become inactive, and the formerly inactive one has become active. This means that the next succeeding stroke of the parts 21, 23, 24 and 25 will bend the flexible member in the manner shown in Fig. 15 and open the exhaust valve. As the flexible member straightens out on the downward stroke the springs 35 and 37 and part 36, Fig. 1, will restore the condition existing before said lever 40 acted, it being understood that the cam 43 has passed out from under the roller. This action is repeated for every cycle.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. A driving and a driven element, in combination with a flexible member having different axes and arranged to transmit motion between said elements, and a means for determining which axis will be active and the direction of flexure of the said member.

2. A driving and a driven element, in combination with a flexible member connected to the driving element and acting on the driven element, the axes of the connections occupying a common plane and crossing each other, the said parts being so arranged that when one axis is active motion is imparted directly from the driving to the driven element and when the other axis is active the driving element is free to move without moving the driven element, and a means determining which axis shall be active.

3. A driving and a driven element, in combination with a flexible member connected to the driving element and acting on the driven element for imparting motion from one to the other, and comprising hinged plates, the axes of the hinges extending across each other, and a means for bending the plates at one hinge or the other depending on whether or not motion is to be transmitted from one element to the other.

4. A driving and a driven element, in combination with a flexible member comprising a plate divided into parts and hinged together, the axes of the hinges crossing each other, a means for connecting the member with said elements, a means acting on one side of the flexible member for causing it to bend on one of its axes and transmit motion from one element to the other, and a second means acting on the other side of the member for causing it to bend on the other axis and prevent the transmission of motion between the elements.

5. A driving and a driven element, a flexible member for transmitting motion from

one to the other, a hinged support attached to one element and connected to the member at two points, a second hinged support attached to the member at two points and angularly displaced from the first, and a means arranged in opposition to the driven element for deflecting the member along one axis.

6. A driving and a driven element, in combination with a flexible member arranged to transmit axial motion from the driving to the driven element when flexed in one direction and to permit the driving element to move freely when flexed in the opposite direction, and a means for periodically flexing the said member in one direction.

7. A driving and a driven element, in combination with a flexible member arranged to transmit motion between said elements when flexed in one direction and not in the other, a means for periodically flexing the said member in one direction, and a means for flexing the said member in the opposite direction when it is desired to prevent the movements of the driving element from being transmitted to the driven element.

8. A driving and a driven element in combination with a flexible member arranged to transmit motion from one element to the other and having two axes only one of which is active at a time, a means connecting said member with one element, a supporting means connected with the other, a device acting on one side of the said member for flexing it on one axis to produce simultaneous movements of the elements and said means, and a second device acting on the other side for flexing the member when it is desired to have one element and its connecting means move independently of the other.

9. A driving and a driven element, in combination with a flexible member arranged to transmit motion from one to the other, a means which tends at all times to flex the member in one direction to prevent simultaneous movement of the elements, and a second means which periodically overcomes the first and causes simultaneous movements of the elements.

10. A driving and a driven element, in combination with a flexible member for transmitting motion from one element to the other, a means for rendering the said member ineffectual for transmitting motion from one element to the other, and a means responding to fluid pressure changes for flexing the member in a manner to cause one element to move the other.

In witness whereof, I have hereunto set my hand this twenty-fourth day of April, 1906.

ELIHU THOMSON.

Witnesses:
JOHN A. MCMANUS, JR.,
HENRY O. WESTENDARP.