No. 640,544. Patented Jan. 2, 1900.

W. W. DOOLITTLE.

HYDRAULIC ELEVATOR SPEED REGULATOR.

(Application filed May 29, 1897.)

(No Model.) 5 Sheets—Sheet 1.

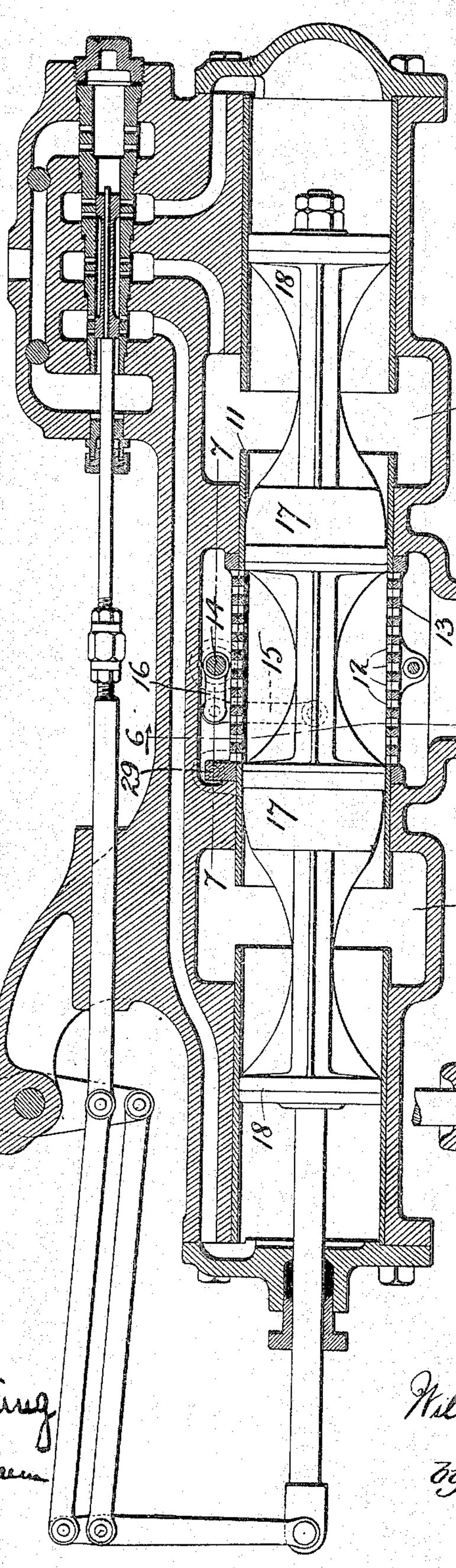


Fig. 4.

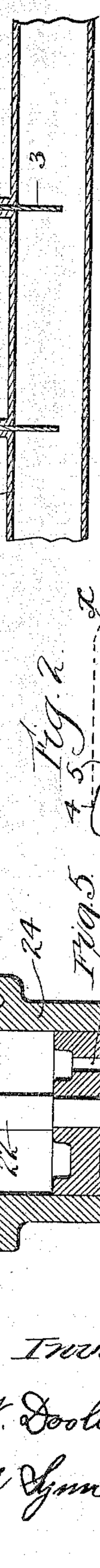


Fig. 1.

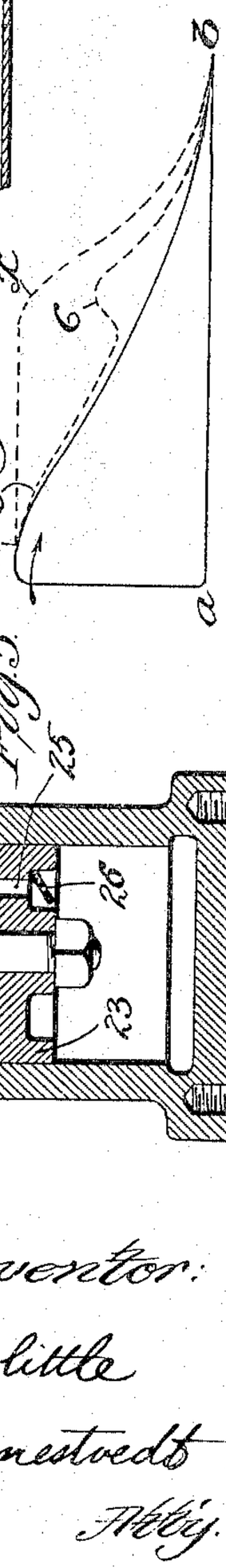


Fig. 2.

Fig. 5.

Attest:
Wm. J. Fleming
Wm. N. Pheem

Inventor:
William W. Doolittle
by Paul Synnestvedt
Atty.

No. 640,544. Patented Jan. 2, 1900.

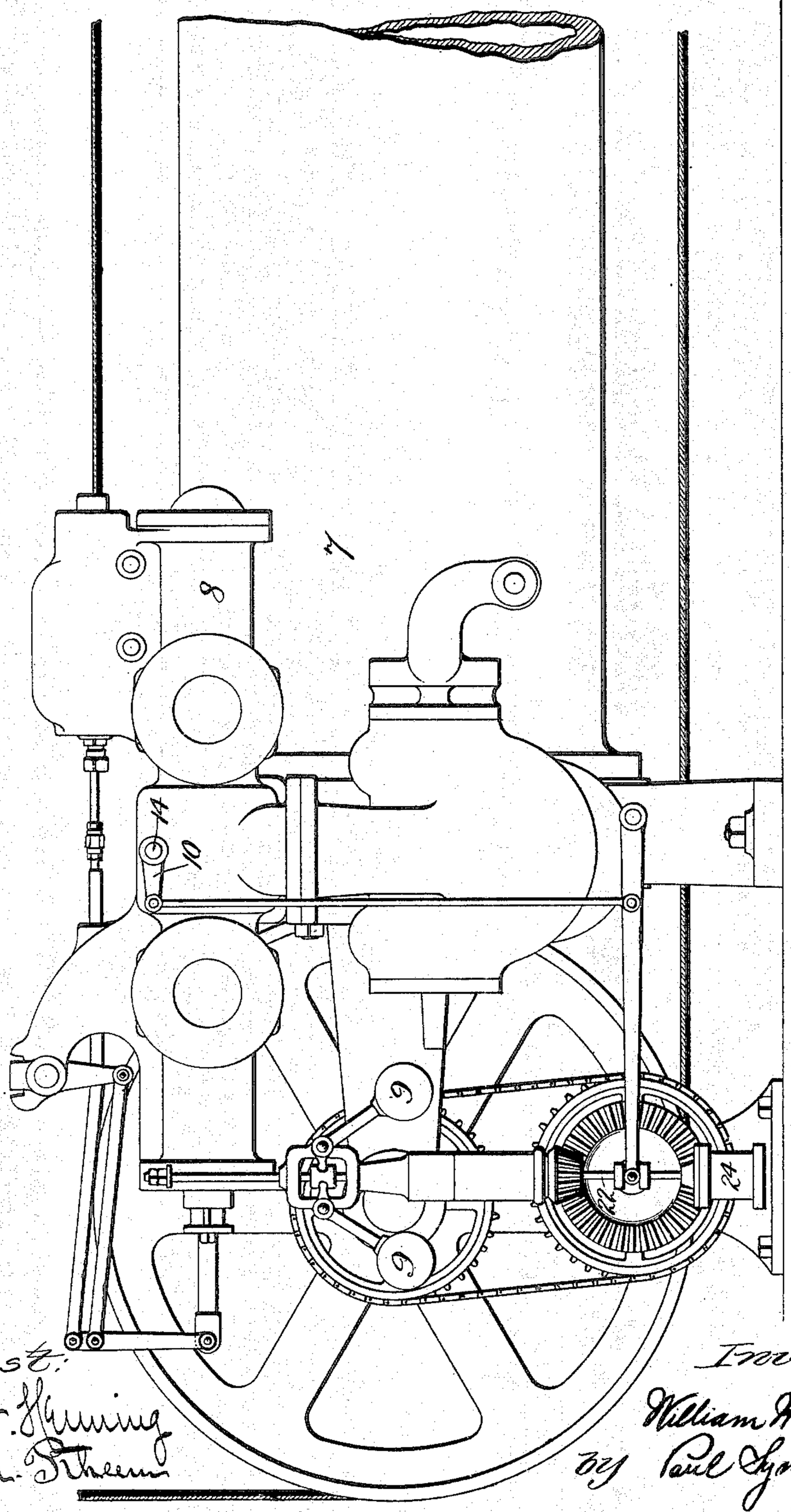
W. W. DOOLITTLE.

HYDRAULIC ELEVATOR SPEED REGULATOR.

(Application filed May 29, 1897.)

(No Model.) 5 Sheets—Sheet 2.

Fig. 3.



Witnesses:
Wm. F. Fleming
Wm. M. Theemann

Inventor:
William W. Doolittle
by Paul Synnestvedt
Atty.

No. 640,544. Patented Jan. 2, 1900.

W. W. DOOLITTLE.

HYDRAULIC ELEVATOR SPEED REGULATOR.

(Application filed May 29, 1897.)

(No Model.) 5 Sheets—Sheet 3.

Fig. 6

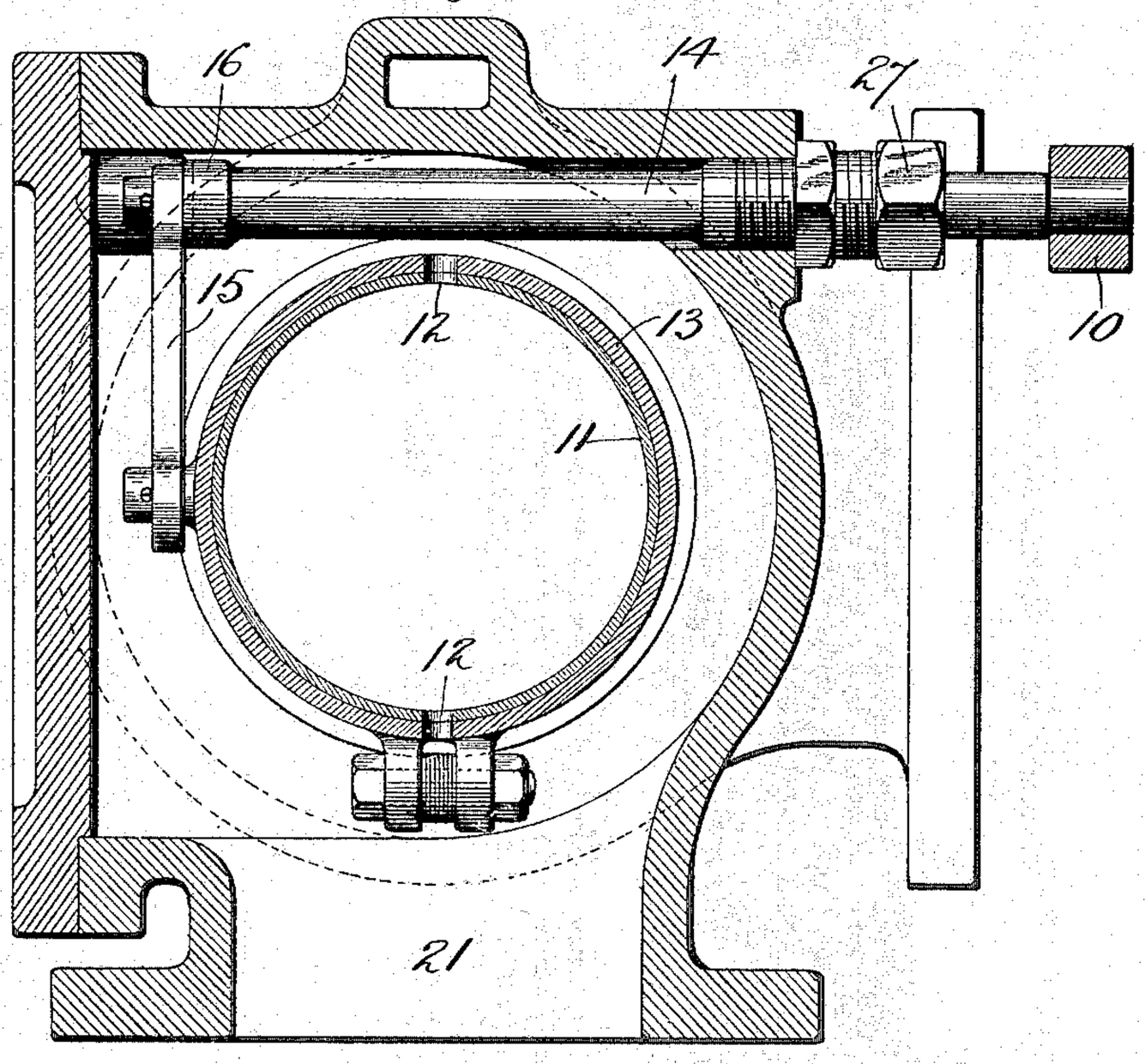
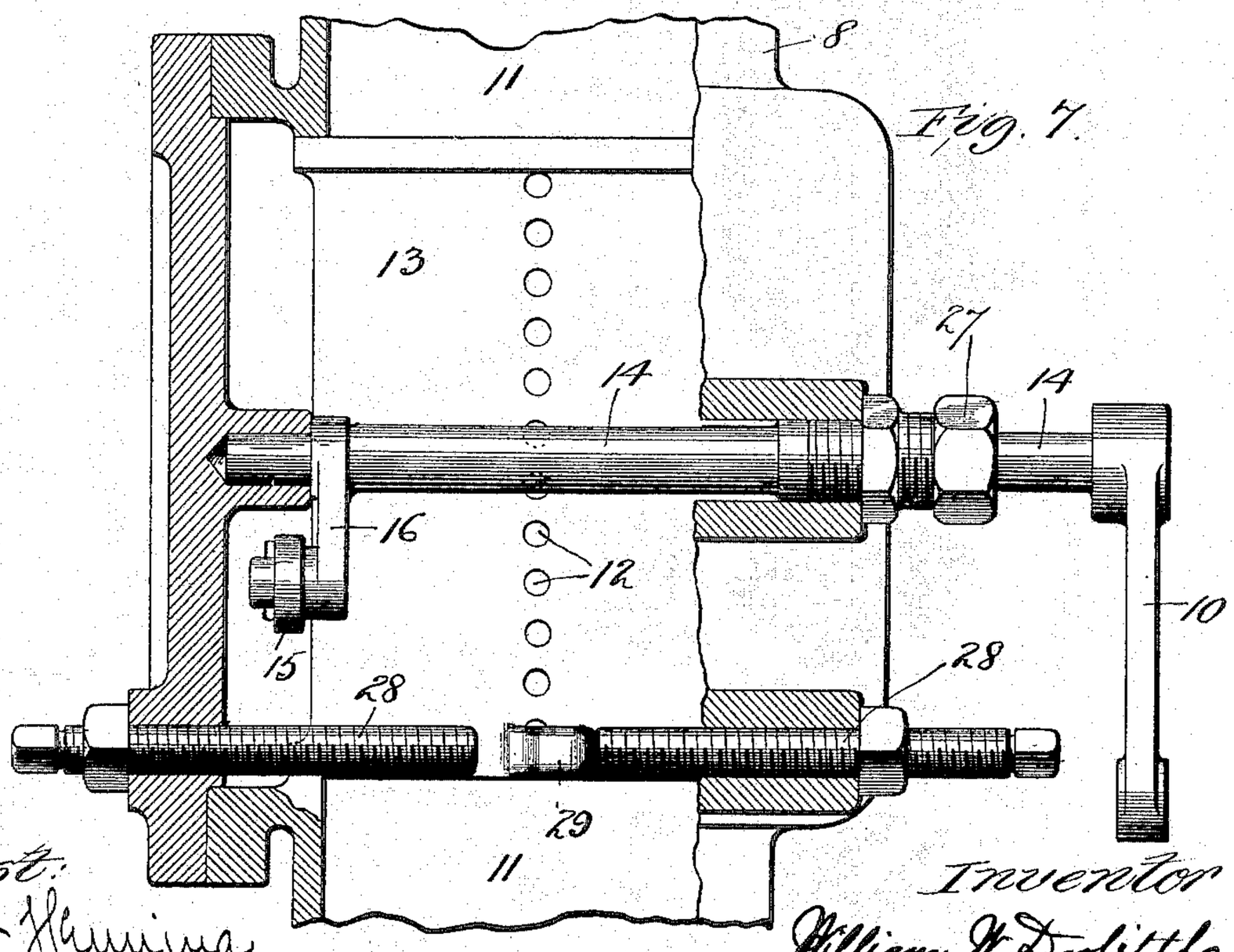


Fig. 7.



Witnesses:
Wm. F. Fleming
H. N. Rheem

Inventor
William W. Doolittle
by Paul Synnestvedt
Atty.

No. 640,544. Patented Jan. 2, 1900.

W. W. DOOLITTLE.

HYDRAULIC ELEVATOR SPEED REGULATOR.

(Application filed May 29, 1897.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 9.

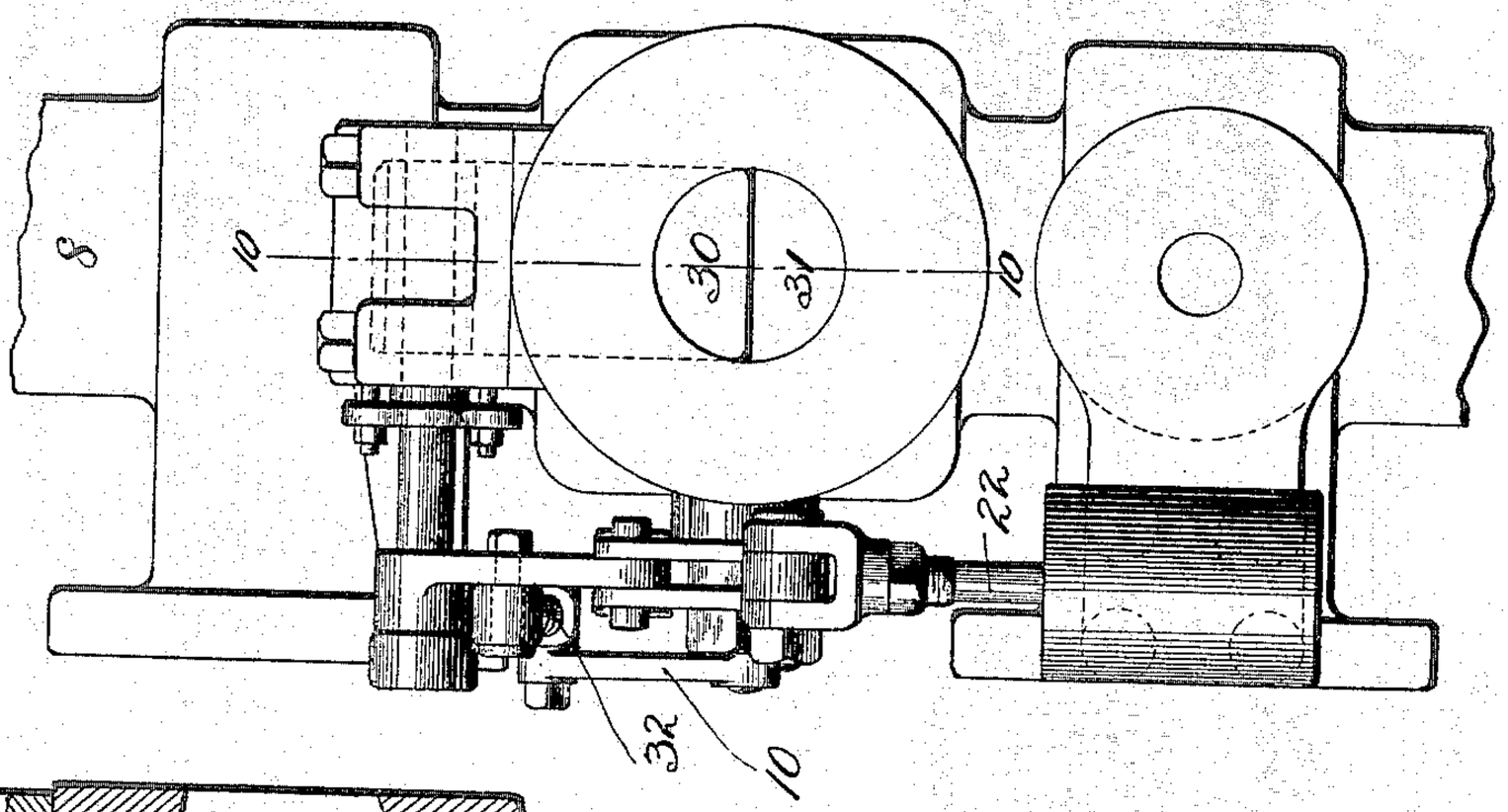


Fig. 10.

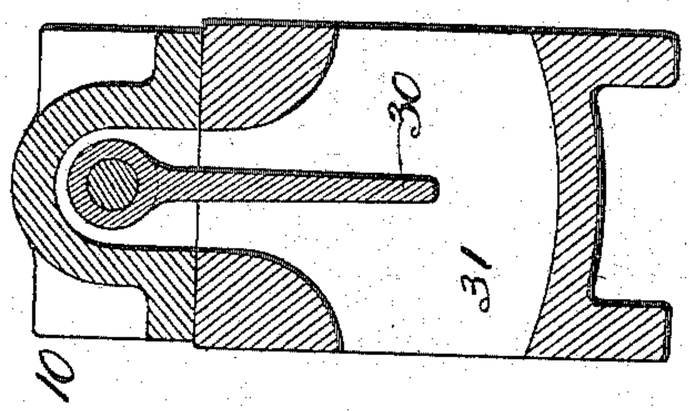
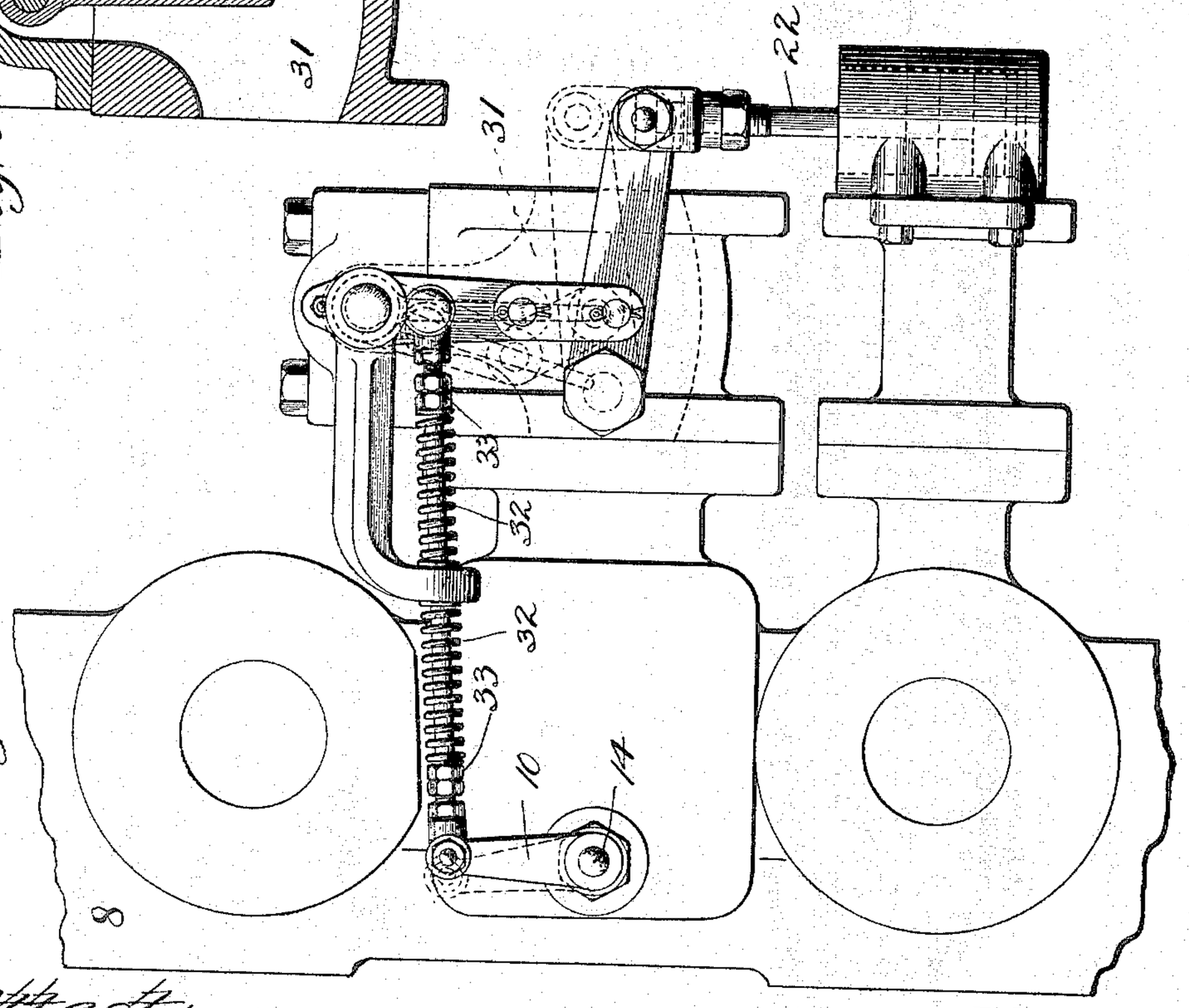


Fig. 8



Attest:
Wm. F. Fleming
Wm. N. Rheem

Inventor
William W. Doolittle
by Paul Synnestvedt
Atty.

No. 640,544. Patented Jan. 2, 1900.

W. W. DOOLITTLE.

HYDRAULIC ELEVATOR SPEED REGULATOR.

(Application filed May 29, 1897.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 12.

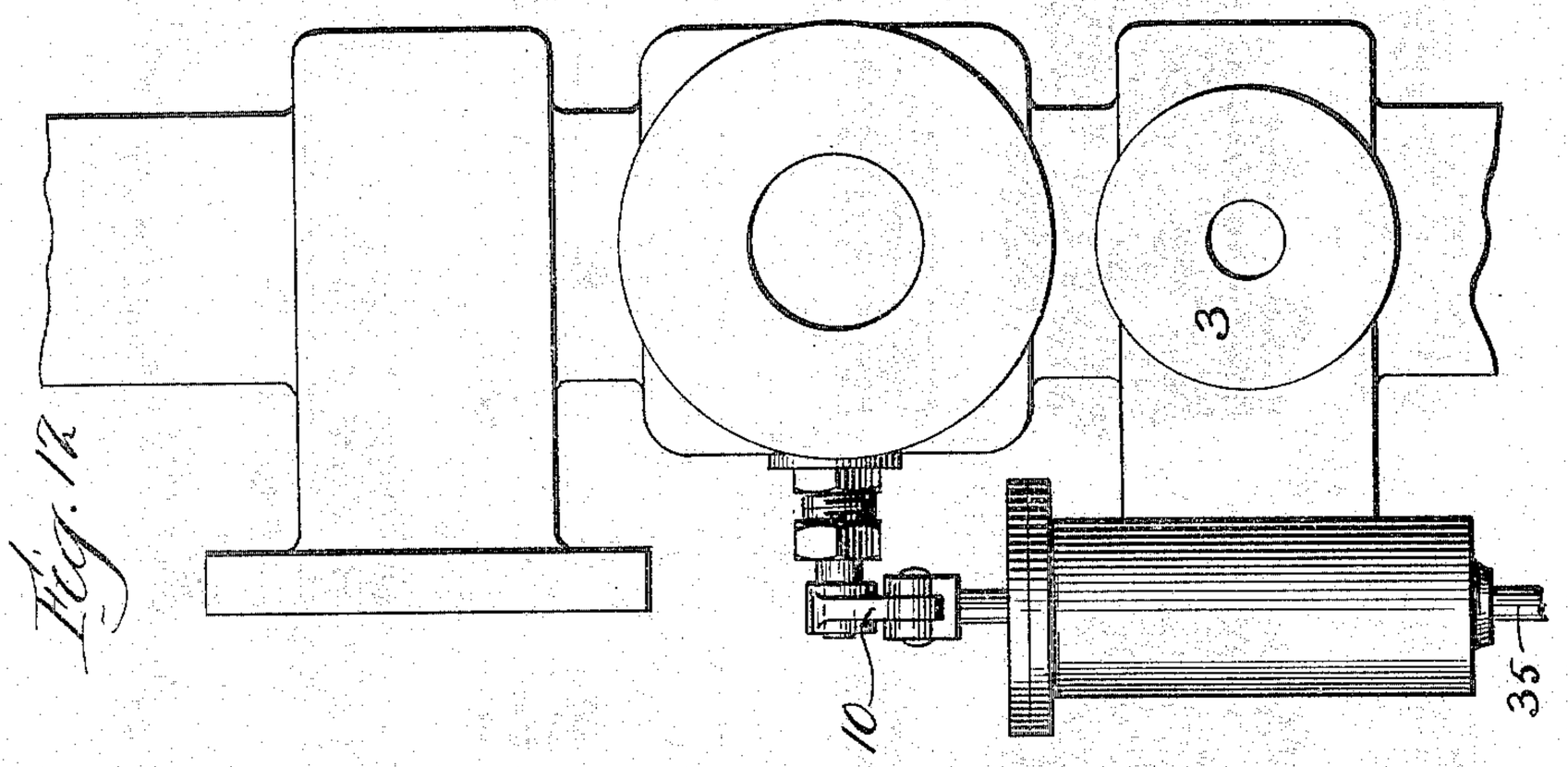
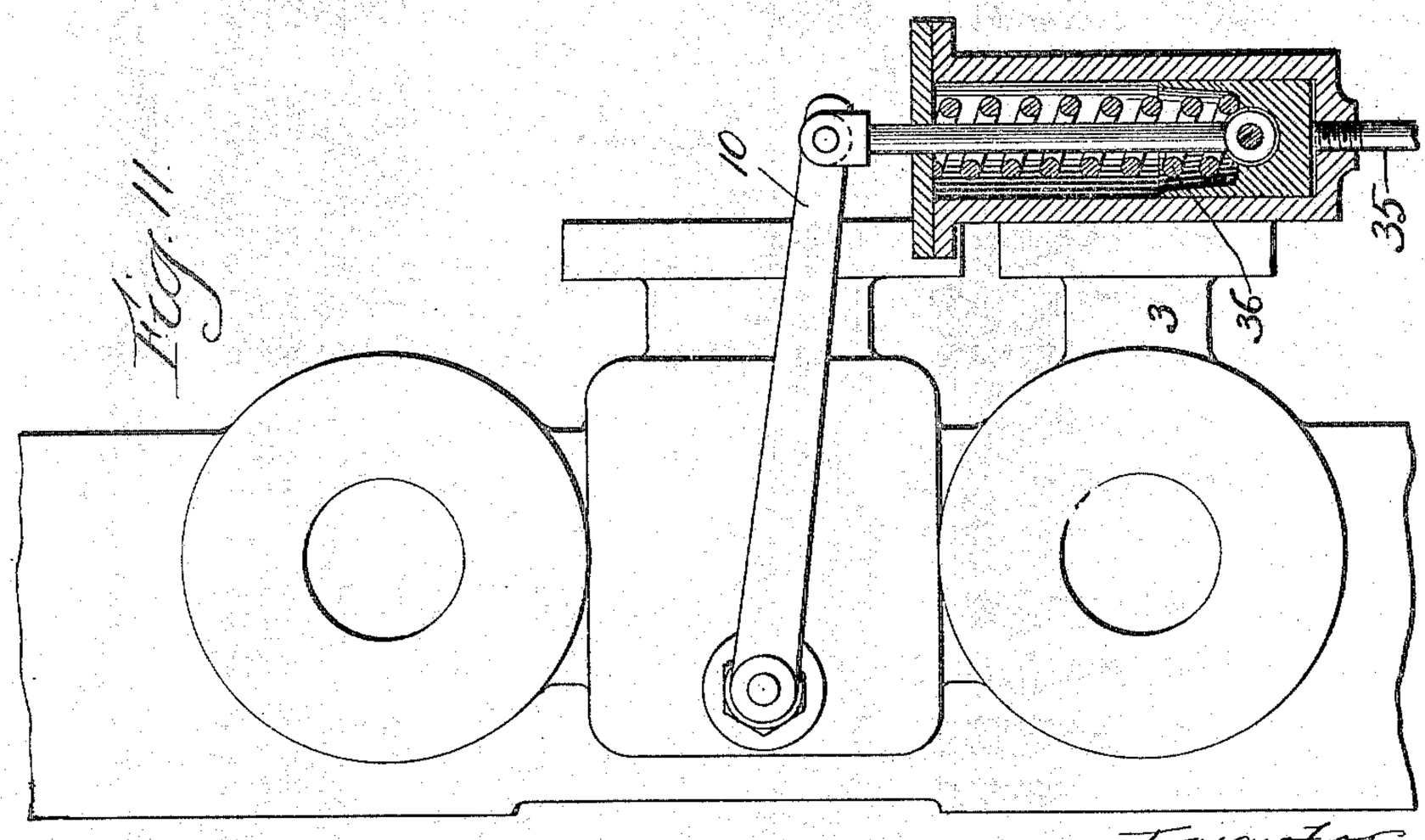


Fig. 11.



Attest
Wm. F. Hemmeg
Wm. H. Rheem.

Inventor
William W. Doolittle
by Paul Symmestvedt Atty.

UNITED STATES PATENT OFFICE.

WILLIAM W. DOOLITTLE, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE OTIS ELEVATOR COMPANY, OF NEW JERSEY.

HYDRAULIC-ELEVATOR SPEED-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 640,544, dated January 2, 1900.

Application filed May 29, 1897. Serial No. 638,824. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. DOOLITTLE, a citizen of the United States, residing in Chicago, Cook county, Illinois, have invented certain new and useful Improvements in Hydraulic-Elevator Speed-Regulators, of which the following, taken in connection with the accompanying drawings, is a specification.

Various constructions have been heretofore proposed for regulating or controlling the speed of the elevator-car and preventing its exceeding a certain predetermined maximum. Among other difficulties which have been encountered in the use of these prior constructions there are two in particular which I desire to note and which it is the object of my invention to overcome.

The first difficulty of the two referred to arises from the necessary relation between the control exercised by the speed-regulator and the governing action of the operating-valve. To make this point more clear, I would refer to the diagram shown in the accompanying drawings, which is marked Figure 1, in which 1 represents the passage-way through which fluid is supplied to the operating-cylinder, the fluid flowing in the direction indicated by the arrow. As a diagrammatic representation of the operating-valve I have shown a vertical sliding gate 2, adapted to be moved up and down to open and close the fluid passage-way. At 3 I have shown another vertically-sliding gate or valve, which is to represent the valve mechanism of a speed-regulator. When it is desired to start the elevator-car, the speed-regulator valve 3 will of course be in the open position and the operating-valve 2 will be closed, the gradual opening of the operating-valve 2 not being at this time in any way interfered with by the valve 3. We will suppose next that valve 2 has been opened wide and the car has attained a speed at which the regulator will begin to act to close off the opening at the valve 3 and that such closure continues until there remains but one-fourth of the full size of the passage-way freely open. It is obvious that if now it be desired to stop the movement of the car the operating-valve 2 will have to be closed nearly three-fourths of the way before any appreciable effect will be produced on the movement of the car. In other words, as may be seen from the above explanation, the operation of a speed-regulator arranged as shown in Fig. 1 interferes with the perfect control of the movement of the car through the operating-valve, and it is to be noted that this objectionable result will be produced in every case where the speed-regulating valve and the operating-valve proper are arranged to restrict the fluid passage-way at separate and distinct points whether the operating-valve be placed between the speed-regulating valve and the cylinder, or vice versa. The same difficulty arises in any construction in which, while controlling the same port or ports, the speed-regulating valve has a movement so related to that of the operating-valve that when the speed-regulating valve is partly closed the operating-valve must move to a point of closure approximately the same as has been reached by the speed-regulating valve before it begins to take effect. For example, supposing in the arrangement shown in Fig. 1 the vertically-moving sliding gates were constructed to operate on opposite sides of a single-ported partition controlling the same port or ports through the same, then when the speed-regulating valve had half-closed the opening the operating-valve would have to travel through one-half of its entire or normal stroke before it would begin to produce any effect on the movement of the car. On the other hand, if the speed-regulating valve or in this case the sliding gate be constructed to open in a direction at right angles to the direction of movement of the sliding gate of the operating-valve (still supposing them to be arranged on opposite sides of a single-ported partition, so as to control the same port or ports) the partial closure effected by the speed-regulating valve will in no wise interfere with the control exercised by the operating-valve at any part of its stroke—*i. e.*, the operating-valve will begin to produce an effect on the car as soon as it starts to move, the port which it controls having been simply made narrower and not shorter. Approximately the same result could be obtained if the two sliding gates were arranged to move in the same direction on opposite sides of a single partition containing a large number

of ports if the speed-regulating valve be constructed with an equal number of ports registering with the first-named ports, so that on movement it would partially throttle each small port, but still leave the operating-valve free to exercise the requisite control over the passage-way throughout the whole of its travel.

From the above it may be clearly seen that while to overcome the difficulties mentioned it appears to be necessary that the speed-regulating valve and the operating-valve should act upon the same port or ports, and while it would seem simplest to accomplish this by arranging the two valves to act upon the same port or ports in different directions—say at right angles to each other—the latter element of construction is not so essential, but may be replaced by some other plan, if preferred, provided only that the construction be always such that the speed-regulating valve may diminish the fluid passage-way in a manner which will not interfere with the normal action of the operating-valve at any portion of its movement.

The second difficulty to which I have above referred arises under the following conditions: Supposing the operating-valve to be wide open and the speed-regulating valve to have acted to close the fluid passage-way, say, three-fourths of the way and that now the operating-valve is moved to cut off the supply of fluid to the cylinder and stop the car, as soon as the operating-valve reaches a point of closure at which the speed of the car becomes materially reduced the speed-regulating valve, if it operates suddenly, will by a rapid opening permit a sudden increase in the pressure in the passage-way, and thereby cause violent lurching of the car. To better illustrate this, I have constructed a diagram marked Fig. 2, in which the line 4 represents the gradual closure of the operating-valve to stop the car when there is no interference from any speed-regulating valve, and the dotted line marked 5 represents the action of the fluid and the consequent movement of the car which is produced when the speed-regulating valve opens suddenly as soon as the speed of the car begins to be reduced from the closure of the operating-valve, the violent lurch received by the car being represented by the hump at 6.

Briefly stated, the objects of my invention are to effect such a combination between the speed-regulating valve and the operating-valve as will permit the operation of each without interference from or with the other and to construct the speed-regulating valve mechanism so as to permit the same to be closed as rapidly as the circumstances of the case may require, but to prevent its being suddenly opened when the speed of the car begins to decrease, and thus to avoid the violent lurching of the car which has been above referred to.

For the better understanding of my invention, the scope of which will be particularly pointed out in the claims, reference may now be had to the balance of the accompanying drawings, in which—

Fig. 3 represents a side elevation of the end of a horizontal elevator-cylinder having my improvement applied thereto, the means by which the movement of the speed-regulating valve is secured being in this figure a common form of revolving ball-governor. Fig. 4 is a vertical section through the operating-valve, showing the application of the speed-regulating valve thereto. Fig. 5 is a vertical section through the dash-pot which I use to prevent the sudden opening of the speed-regulating valve. Fig. 6 is a section taken on the line 6 6 of Fig. 4. Fig. 7 is a horizontal section on the line 7 7 of Fig. 4. Figs. 8 and 9 are an end and side view, respectively, of a modified form of mechanism for actuating my speed-regulator valve. Fig. 10 is a section showing a detail of the last-mentioned modification; and Figs. 11 and 12 are a side and end view, respectively, of still another modified form of mechanism for actuating my speed-regulator valve.

Referring now more particularly to Fig. 3, it will be seen that there is shown an elevator-cylinder 7, to which is attached an operating-valve 8 and operating in connection with which there is a ball-governor 9, connected by means of gearing and levers with the rocker-arm 10. Returning to Fig. 4, it will be seen that my operating-valve consists of a piston-valve operating within a cylindrical casing 11, in which are a series of ports 12. Surrounding this cylindrical casing I have provided a rotatable cylinder 13, having therein ports adapted to register with the ports in the cylindrical casing 12, and thereby control the extent of opening of the latter. The cylindrical sleeve 13 is connected with the shaft 14 of the rocker-arm 10 by means of the link 15 and the additional rocker-arm 16, so that as the ball-governor 9 moves the rocker-arm 10 up or down the sleeve 13, surrounding the cylindrical casing 11, will rotate to open or close the ports of the operating-valve. The controlling-valve proper consists of four pistons, the two inner ones of which I have marked 17 and the outer ones 18. The operation of this valve is not new, and in itself constituting no part of my present invention will not be described with much detail herein. No. 19 is the inlet and 20 the exhaust passage-way, 21 being the opening leading to the elevator-cylinder. If now the pistons 17 be moved to the right to the extreme limit of their travel, the fluid-pressure will flow in from 19 through the ports 12 to the cylinder connection 21 and operate the car. When the pistons 17 are moved to the left, the fluid-pressure will escape from the cylinder through the ports 12 to the exhaust opening or cavity 20 and produce a reverse movement of the car. Now whichever way the car is moving, whether up or down, if the

speed of the same becomes too great the more rapid rotation of the ball-governor raises the rocker-arm 10 and by means of the connections 15 and 16 rotates the sleeve 13, partially throttling the openings 12. Attention is now particularly called to the fact that by the arrangement shown and described this throttling of the openings 12 is done in such a manner as not to interfere in any way with the operation of the operating-valve. Thus the movement of the operating-valve pistons 17 is at once effective in governing the operation of the car and continues its control through the entire length of such movement, whereas if the speed-regulating mechanism had throttled the openings in such a way that it would be necessary for the operating-pistons to move through any material portion of their stroke before taking effect upon the area of the fluid-pressure passage the result would be a serious interference with the proper control of the operation of the car. To illustrate this, let it be supposed (referring to Fig. 2) that the distance from *a* to *b* represents the time consumed in making a normal stop. If the operating-valve has to travel, say, through one-half of its stroke before it takes effect, the available time of the stop will be shortened one-half, which I have represented by the diagram line marked X, a result obviously not favorable to smoothness or certainty of operation.

Referring now again to Fig. 3, it will be seen that to the lower end of the governor-rod 22 I have attached a motion-retarding device in the form of a dash-pot plunger 23, operating within a dash-pot cylinder 24. (Shown more in detail in Fig. 5.) In the plunger 23 I have arranged a passage or opening controlled by a check-valve 25, which permits the upper movement of the dash-pot and the consequent closing of the ports 12 as rapidly as may be necessary for checking the speed of the car, but which when in closed position, by reason of the small orifice 26, only permits the opening of the ports 12 very slowly, for reasons hereinbefore explained.

Referring now to Figs. 6 and 7, it will be seen that the rocker-shaft 14 is arranged with a stuffing-box 27, so as to prevent leakage around the same, and, as shown in Fig. 7, I have provided adjustable stops 28, constructed to engage a projecting lug 29 on the sleeve 13, which obviates excessive movement of the same.

In the construction heretofore described I have shown a speed-regulating valve or sleeve 13 as operated by a ball-governor 9. It is possible to secure the movement of the speed-regulating valve or sleeve by other means—such, for example, as a moving vane or float within the fluid-pressure passage-way. One form of such an arrangement I have illustrated in Figs. 8, 9, and 10, 30 being the moving vane introduced in the fluid passage-way 31, leading to the elevator-cylinder. This vane 30 is connected by means of a rocker-shaft and suitable arms to the rocker-arm 10 and has for the purpose of keeping it normally in a central position a couple of springs 32, provided with adjustable nuts 33. Attached to this rocker device is the dash-pot plunger 23, which operates substantially in the manner hereinbefore described in connection with the ball-governor mechanism.

The operation of the last form is as follows: As the speed of the car increases the flow of the fluid through the passage-way 31 becomes more rapid and causes a deflection of the vane 30 to one side or the other, depending upon whether the car is going up or down, and the deflection of the vane 30 by means of the connections to the rocker-arm 10 operates the rotating sleeve 13, before described.

In Figs. 11 and 12 I have shown still another modified form of mechanism for actuating my speed-regulating valve. In this construction a piston 34 is connected to the valve-arm 10, and this piston being balanced between the pressure in the elevator-cylinder (admitted through the pipe 35) and the spring 36 responds to every variation in the cylinder-pressure to open or close the regulating-valve, and thus control the speed. This arrangement, however, constitutes no part of my present invention, but forms the subject-matter of an application filed by Richard T. Crane, and is therein more fully described.

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

1. In a hydraulic elevator the combination with a car, a cylinder, a supply and exhaust port for said cylinder, and an operating-valve and a speed-governor valve both controlling said port, of manual and automatic devices connected with said car and operating said valves, substantially as described.

2. In a hydraulic elevator the combination with a car, a cylinder, a supply and exhaust port for said cylinder, and an operating-valve and a speed-governor valve both controlling said port, said operating-valve acting in one direction and said speed-governor valve acting in a different direction, of manual and automatic devices connected with said car and operating said valves, substantially as described.

3. In a hydraulic elevator the combination with a car, a cylinder, a supply and exhaust port for said cylinder, and an operating-valve and a speed-governor valve both controlling said port, of manual devices connected with said car and operating said operating-valve, and automatic devices constructed to operate said speed-governor valve, substantially as shown and described.

4. In a hydraulic elevator the combination with a car, a cylinder, a supply and exhaust port for said cylinder, and an operating-valve and a speed-governor valve, both arranged to control said supply and exhaust port, of manual devices connected with said car and operating said operating-valve, automatic de-

vices constructed to operate said speed-governor valve, and a motion-retarding device constructed to restrain sudden action of said speed-regulating valve, substantially as described.

5. In a hydraulic elevator, in combination, a car, a cylinder, a port in connection with said cylinder, an operating-valve to open and close said port, a speed-regulating valve to vary the size of said port, manual devices connected with said car to operate said operating-valve, and automatic devices constructed to operate said speed-regulating valve.

WILLIAM W. DOOLITTLE.

Witnesses:
T. F. KENNEDY,
PAUL SYNNESTVEDT.