

(No Model.)

H. TAYLOR.
PNEUMATIC CAR MOTOR.

No. 427,809.

Patented May 13, 1890.

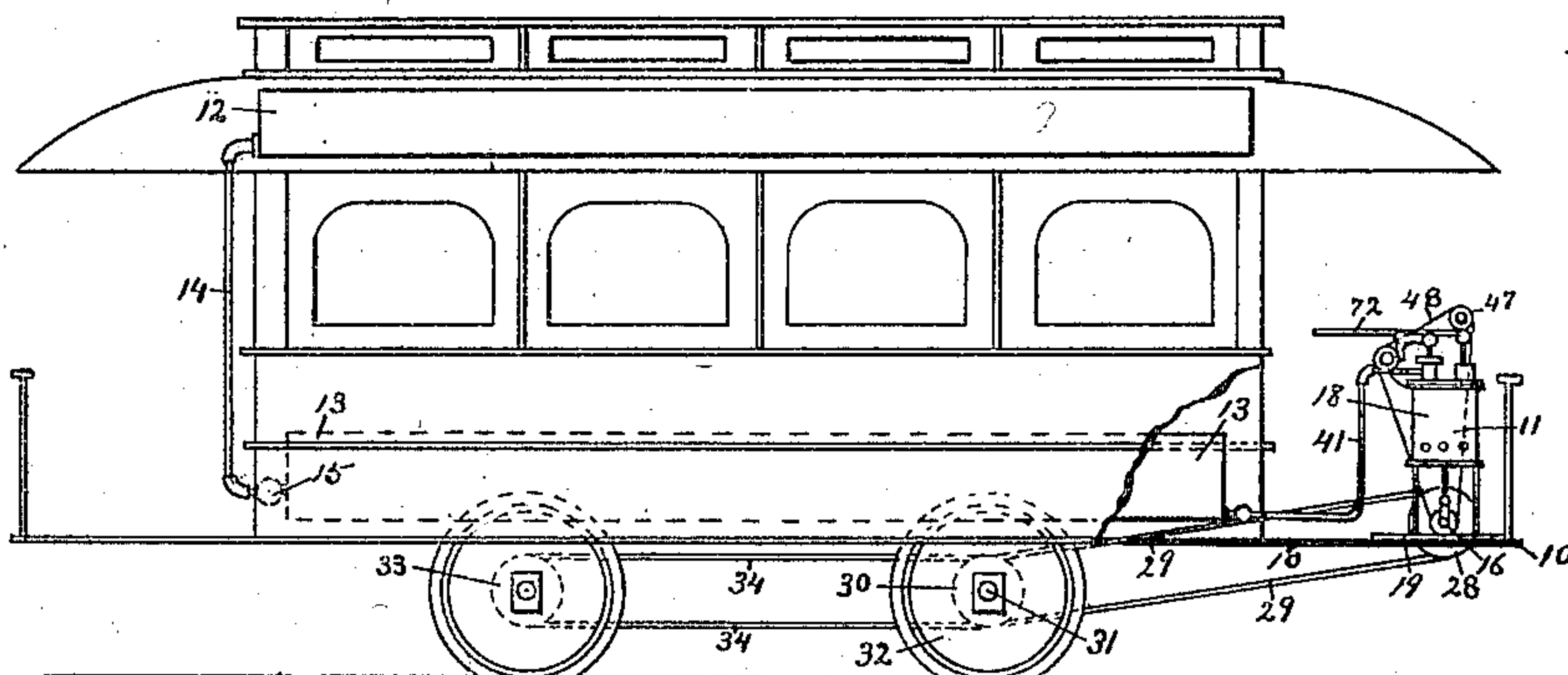


Fig. 1.

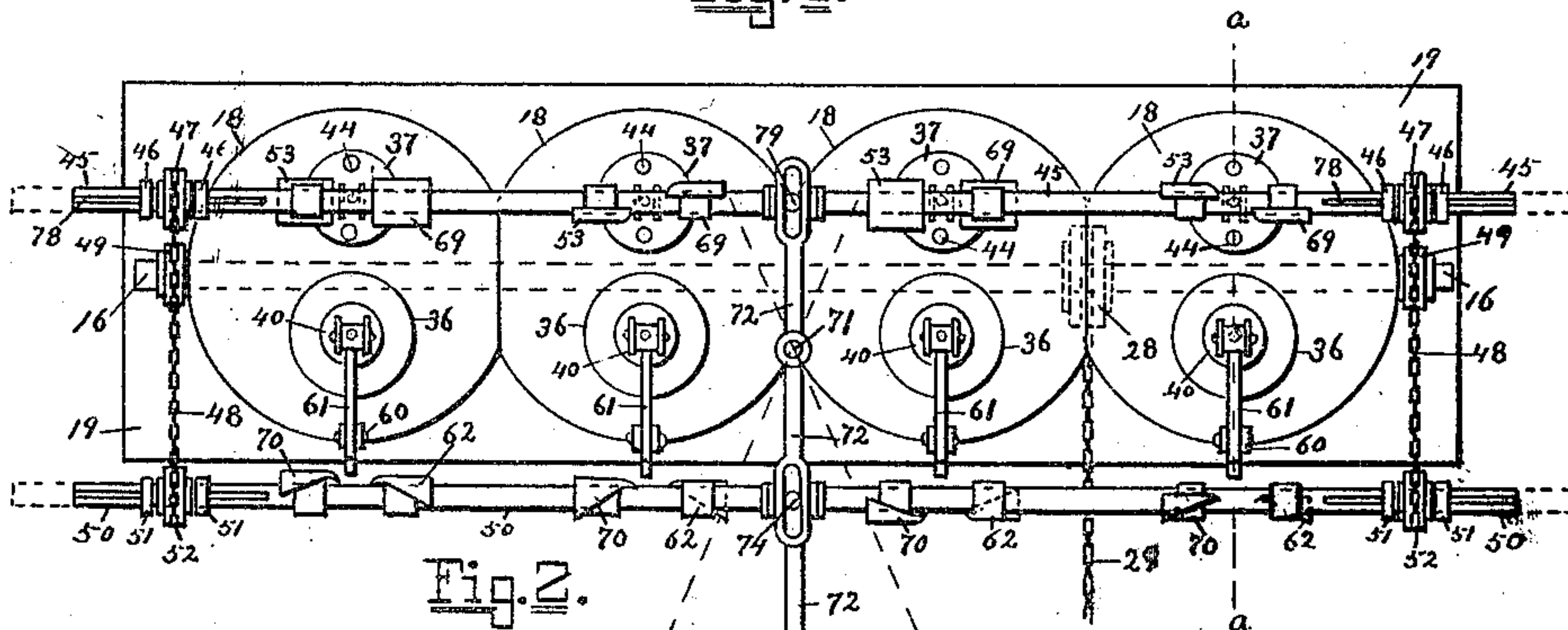


Fig. 2.

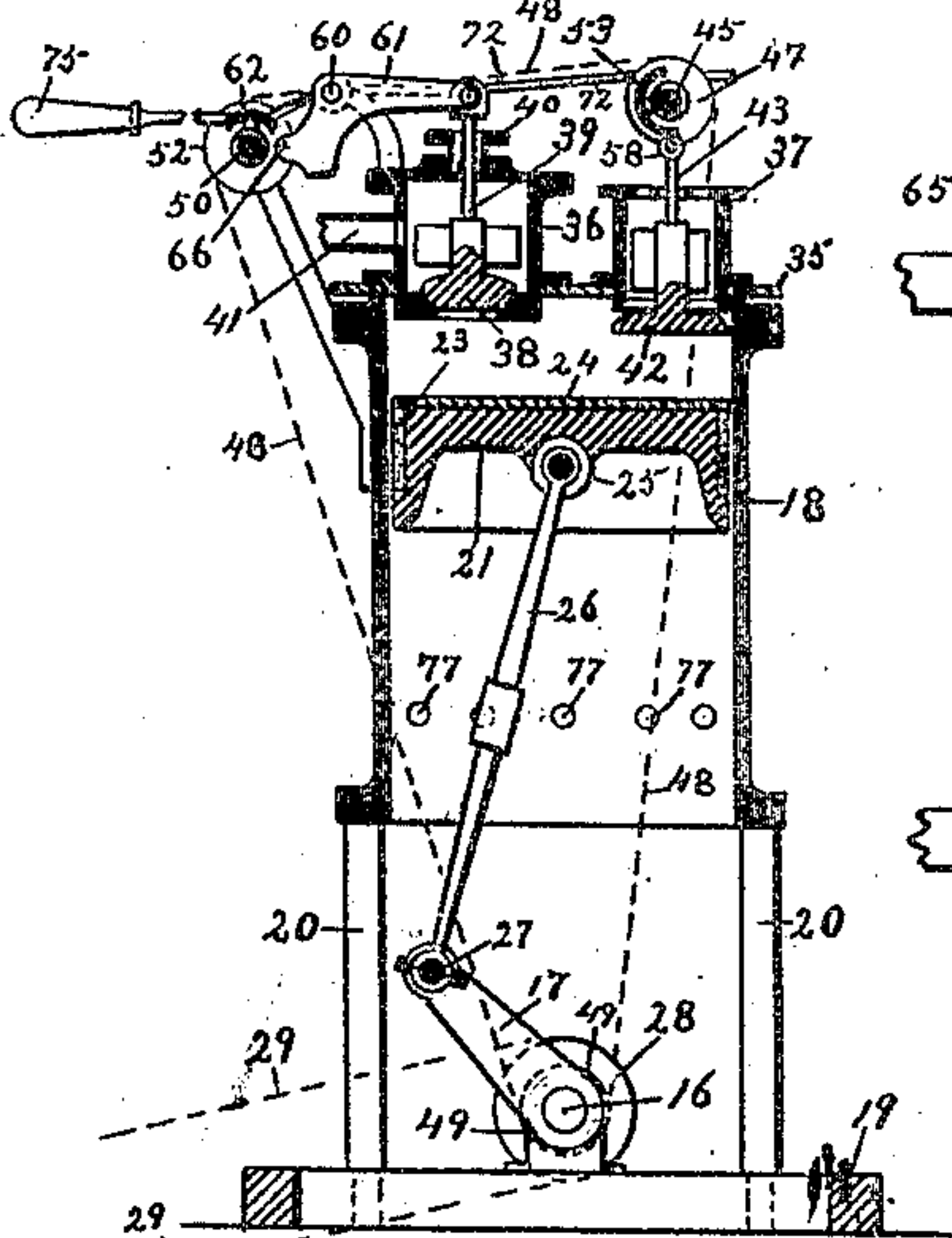


Fig. 3.

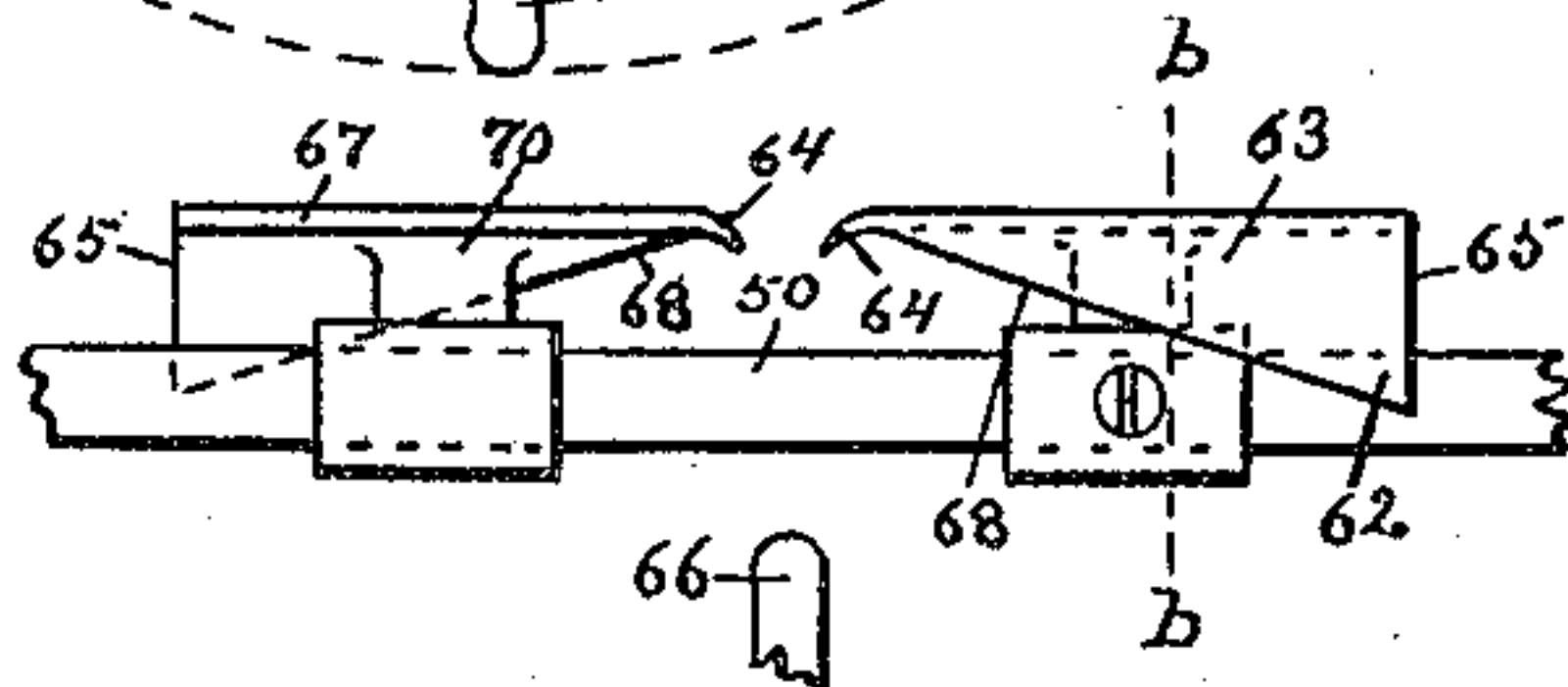


Fig. 4.

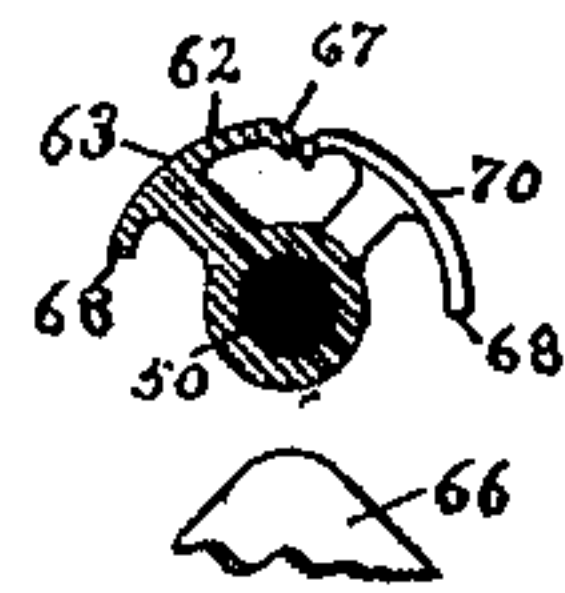


Fig. 5.

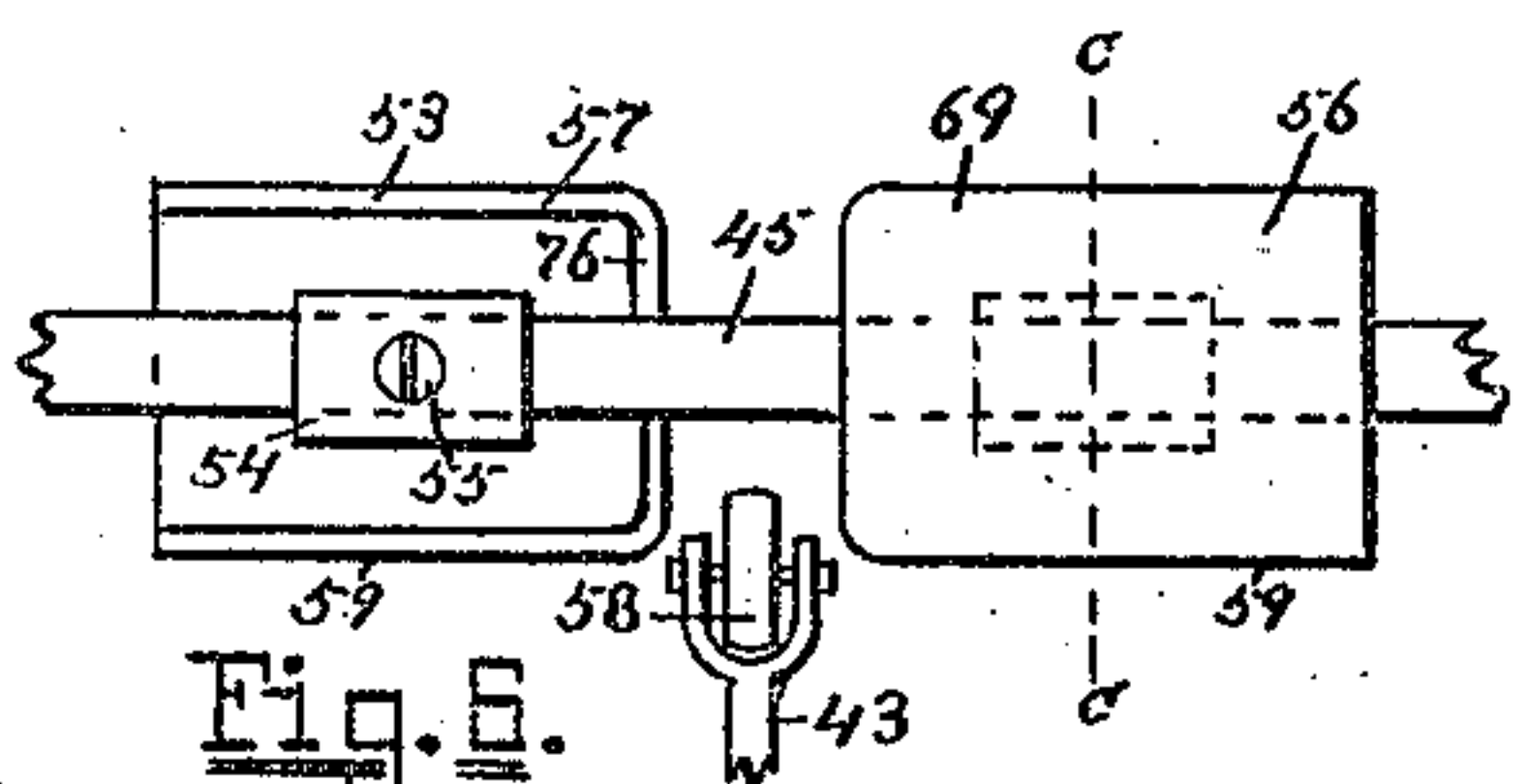


Fig. 6.

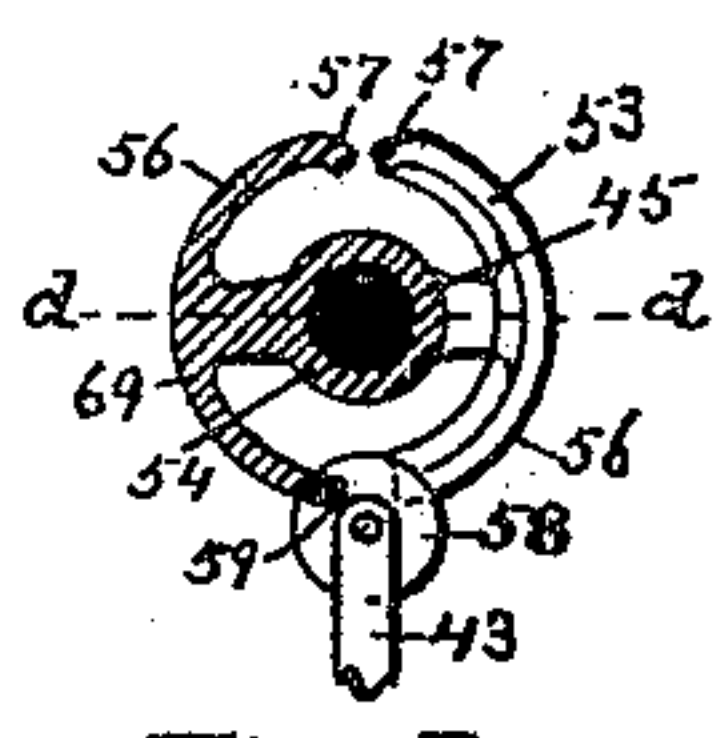


Fig. 7.

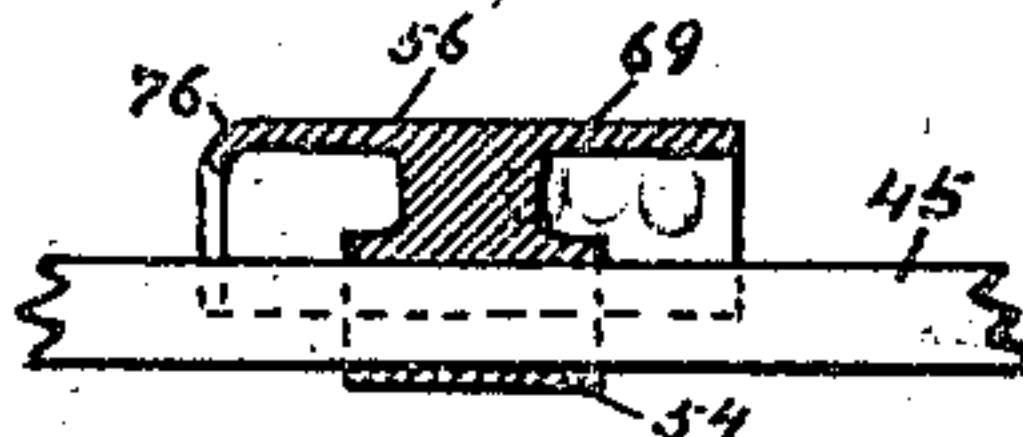


Fig. 8.

Witnesses

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Inventor

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By his Attorney

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UNITED STATES PATENT OFFICE.

HENRY TAYLOR, OF BALTIMORE, MARYLAND, ASSIGNOR OF THREE-EIGHTHS
TO HENRY TAYLOR, JR., JAMES A. TAYLOR, AND GEORGE TAYLOR, ALL
OF SAME PLACE.

PNEUMATIC CAR-MOTOR.

SPECIFICATION forming part of Letters Patent No. 427,809, dated May 13, 1890.

Application filed January 28, 1890: Serial-No. 338,437. (No model.)

To all whom it may concern:

Be it known that I, HENRY TAYLOR, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Pneumatic Car-Motors; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in pneumatic motors for the propulsion of railway-cars and other vehicles; and it consists of such construction and operation of mechanism for the actuation of the valves of the motor that it may be momentarily set to cut off the supply of air-pressure to the cylinder at any desired part of the stroke of its piston, thus obtaining the most economical results from the expansive force of the air-pressure therein, and whereby the said mechanism for operating the valves may be momentarily moved wholly out of gear, in which case, in consequence of the particular construction of the cylinder-valves, the motor will be instantly converted into a pump to be operated by the movement of the car in descending a grade, thus acting as a brake to retard the car and at the same time storing an additional supply of compressed air for future-use, all of which I accomplish by the devices hereinafter fully described and claimed, reference being had to the accompanying drawings, in which—

Figure 1 shows a side elevation of a street-car with the motor on the front platform thereof, a part of the side of the car shown removed. Fig. 2 shows a view looking down on the motor, the mechanism for actuating the valves shown in mid-position. Fig. 3 shows a vertical section through one cylinder, the section being indicated by the line *a a* in Fig. 2, the valve mechanism shown in the "head-gear." Fig. 4 shows a detail view of the cams for actuating the admis-

sion-valves, looking down thereon. Fig. 5 shows a cross-sectional view of the cams for actuating the admission-valves, the section being indicated by the line *b b*, Fig. 4. Fig. 6 shows a front elevation in detail of the cams for actuating the exhaust-valves. Fig. 7 shows a cross-sectional view of the cams for actuating the exhaust-valves, the section being indicated by the line *c c*, Fig. 6. Fig. 8 shows a longitudinal section through the exhaust-cam, the section being indicated by the line *d d*, Fig. 7.

The same numbers refer to the same or similar parts throughout the several views.

In Fig. 1 is shown a street-car having on the front platform 10 thereof the motor 11, which is operated by compressed air stored in the storage-tanks 12 and 13, one or more of these tanks 12 being placed on the top of the car, and in which is stored the desired volume of air, under about four hundred pounds pressure, a pipe 14 providing communication between the upper tank 12 and the lower tank 13, one or more of which are placed in some convenient place in the lower part of the car, it being preferred to place one of these tanks 13 under each car-seat and connect them together by a suitable pipe. In these lower tanks 13 is primarily stored a pressure of about fifty pounds to the square inch, which pressure is conveyed through the pipe 41 to the motor, which is operated thereby, this pressure of fifty pounds being maintained in the lower tank 13 by the excess of pressure that is stored in the upper tank 12, a suitable valve 15 of any of the well-known forms being located in the pipe 14, which controls the flow of the fluid through this pipe and thus in the lower tank 13 maintains the desired pressure.

In order that there may be no dead-points to the motor and that it may be readily started from any point, there are preferably employed four single-acting reciprocating engines, the cylinders 18 of which are placed side by side, as shown in Fig. 2, the main shaft 16 of which is common to all, having the cranks 17 thereon, which are operated by the pistons 21 of the respective cylinders

placed ninety degrees apart, whereby when the reversing-lever is thrown in the "ahead" or "back" gear some one of the pistons will be in such position that its valve will admit pressure thereto. As these cylinders and their parts are fac-similes one of the other, a description of one will be sufficient for the whole.

Referring to Fig. 3, there is supported from the bed-plate 19 by the columns 20 the cylinder 18, in which is free to move the piston 21, that is of the form shown, the depth of the piston being sufficient to form a proper guide therefor in its reciprocating movement, suitable packing 23 and a follower 24 serving to make an air-tight joint between the piston and the cylinder.

Formed centrally on the bottom surface of the piston is the lug 25, to which is pivoted the upper end of the connecting-rod 26, the other end thereof being suitably connected to the crank-pin 27, whereby in the reciprocating movement of the piston a rotating movement will be imparted to the shaft 16 through the crank 17 and the connecting-rod 26.

Fixed to some suitable part of the main shaft 16 is a driving-pulley 28, from which a rotating movement is conveyed through the chain belt 29 to a corresponding pulley 30, Fig. 1, that is fixed to the axle 31 of the car-wheel 32, a second set of pulleys 33, if they should be desired, serving to convey movement from the front axle 31 to the rear axle of the car through a chain belt 34.

On the cover 35 of the cylinder are placed the admission-valve chamber 36 and the exhaust-valve chamber 37, where through the air-pressure is alternately admitted to and released from the upper surface of the piston 21, the admission-valve chamber 36 having therein the admission-valve 38, that is of the ordinary single-puppet form shown, the stem 39 extending through a stuffing-box 40, which, when drawn outward, will cause the valve 38 to be moved outward from the cylinder, thus opening communication with the cylinder, through which the air-pressure from the pipe 41 will flow to the upper surface of the piston and cause it to move downward. In the exhaust-chamber 37 is provided an exhaust-valve 42, that is of the single-puppet form, and is opened by an inward movement thereof, as shown in Fig. 3, the stem 43 extending outside the chamber 37, and provided on the end thereof with the roller 58, by which this valve 42 is moved inward by the valve-actuating mechanism at the proper time, and the pressure on the upper surface of the piston exhausted and escaping to the air through the holes 44 in the casing 37. It will be seen from the construction of these valves 38 and 42 that the air-pressure normally tends to hold them in the closed position, and in order to cause each of these valves to open and close at the proper position of the piston, and thus alternately admit thereto and release

therefrom the air-pressure, there is employed mechanism for the actuation thereof of the following description.

Referring to Fig. 2, there is extended over the entire width of the four cylinders 18, and immediately over the exhaust-valve stems 43 thereof, the exhaust-shaft 45, that is supported at each end by a suitable bearing 46, in which it is free to rotate and to be moved longitudinally in either direction therein, these bearings 46 being made of the forked form shown, so as to hold in position between the jaws thereof the pulley 47, by which a rotating movement is imparted to this shaft 45 by the chain belt 48, which passes over the top of said pulley 47 and conveys movement thereto from the driving-pulley 49, that is fixed to the main shaft 16, this driving-pulley 49 being of the same size as the pulley 47, whereby the main shaft 16 and the exhaust-shaft 45 will be caused to rotate in unison.

In order that a longitudinal movement in either direction may be permitted the rotating shaft 45 through the pulley 47, as is frequently required in mechanics, the said pulley 47 is provided with an ordinary feather that moves in a suitable slot 78 in the shaft, by which common device these movements are permitted.

Extended the entire width of the motor and in front thereof is the rotating shaft 50, that operates and controls the admission of air-pressure to the cylinders 18 through the valves 38, this shaft being supported by the bearings 51, in which it is free to be rotated and moved longitudinally in either direction, a pulley 52, of the same size and construction as the pulley 47, previously described, serving to impart a rotating movement to this shaft 50 by means of the chain belt 48, that passes over the top thereof, and thus causes this shaft to rotate in unison with the main shaft 16. To impart a coincidental longitudinal movement to these shafts 45 and 50, there is fulcrumed to the cylinder-cover 35 by the fulcrum-pin 71 the reversing-lever 72, one end 79 of which is pivoted to the exhaust-shaft 45, and at a point equidistant from the fulcrum-pin 71, on the other side thereof, the lever 72 is pivoted to the shaft 50 by the pin 74, whereby when the free end 75 of the reversing-lever is moved to the right or left a longitudinal movement in opposite directions, one to the other, will be imparted to the said shafts 45 and 50.

To cause the exhaust-valves 42 to be opened and closed at the proper time when the engine is in the "ahead" motion, there is fixed to the shaft 45 the cam 53, which consists of a sleeve 54, Figs. 6, 7, and 8, that fits around the shaft 45 and is secured in proper position by a set-screw 55. Extended from this sleeve is the surface 56, that is of semi-cylindrical form, the curved edge 57 of which will in the rotating movement of the cam be brought in contact with the roller 58, with which the end of the exhaust-valve stem is provided, this

cam being so set on the shaft 45 that when the piston 21 is on the bottom center the edge 57 will be brought in contact with the roller 58, the exhaust-valve 42, moved downward thereby and opened, the roller 58 remaining in contact with the surface 56 until the cam has made one-half of a revolution and the piston is on or near the top center, when the leaving edge 59 of the cam will have passed the roller 58, and the air-pressure that will be presently admitted at this point of the piston's stroke will cause the exhaust-valve 42 to be closed. In order that these cams may be placed in such position that the roller 58 will be out of the path of the rotating movement thereof when the car is on a descending grade and the power of the motor not needed, these cams are so placed on the shaft 45 that when the reversing-lever 72 is in its middle position (shown in Fig. 2) the cam will be to one side of the roller 58, which will be out of the path of its rotating movement, thus permitting the shaft 45 to rotate without affecting the valve. In order that these cams may properly operate the valve when the free end 75 of the lever is moved to the extreme left, they are made of sufficient length to admit of this longitudinal movement of the shaft 45 and at the same time have within its path of rotation the roller 58.

To operate the admission-valves 38 there is fulcrumed from a bearing 60 the bell-crank 61, one arm of which is pivoted to the valve-stem 39 and the free arm thereof is provided with a contact-projection 66, which in the ahead motion of the motor will be in the path of the cams 62, that are fixed to the shaft 50, and which are so timed with the movement of the piston 12 as to cause the admission-valve 38 to be opened thereby when the piston is near or on the top center. These cams 62 are of the same general construction as the exhaust-cams 53, just described, with the exception that the surface of contact 63 of the cams 62 are cut away to the triangular form shown in Fig. 4, the vertex 64 of the triangle being nearer and the first to be brought in contact with the point 66 of the bell-crank when the reversing-lever 72 is moved to the left, the mid-position of the reversing-lever 72 shown in Fig. 2, placing the cam to one side of the contact 66, as shown in this figure, thus permitting the shaft 50 to be rotated without affecting the admission-valves 38. As stated, the surface of these cams 62 is of the triangular form shown in Fig. 4, the curved edge 67 in the rotating movement of the cam coming the first in contact with the point 66, and is made of this curved form to permit the said point 66 to ride easily thereover. The base 65 of the triangle, which provides for the greatest length of time the valve 38 is to be kept open, is equal in length to one-quarter of the circle described by this part of the cam, whereby when the reversing-lever 72 is moved to the extreme left the contact-point 66 will trav-

erse this part of the cam at the base, and the admission-valve 38 will be kept open during one-half of the stroke of the piston, any movement from this point toward its mid-position of the reversing-lever causing the contact-point to traverse that part of the triangular surface 63 that is nearer the vertex 64, and thus sooner pass over the leaving edge 68 that forms the hypotenuse of the triangle. Thus it will be seen that the reversing-lever may be moved just sufficient for the vertex 64 to operate the bell-crank 61, in which case the opening and closing of the admission-valve 38 will be almost instantaneous and the air-pressure admitted to the cylinder during a very small part of the stroke, and thus perform the work of moving the piston by its expansibility.

As stated, the cranks 17 of the respective cylinders 18 are set ninety degrees apart. In consequence of this arrangement the movement of the reversing-lever 72 from its mid-position to the left will cause some one of the valves 38 to be raised by its cam 62, which will be in proper position therefor, and thus admit the air-pressure to the cylinder and start the engine. For the same reason the exhaust-cams 53 will be in such position as to cause the opening of the proper exhaust-valves 42 by this longitudinal movement of the shafts 45 and 50. In order that these valves 38 and 42 may be easily operated by this longitudinal movement, the vertex 64 of the admission-cam 62 is curved inward, as shown in Fig. 4, and the front end 76 of the exhaust-cam 53 is curved inward in the same manner as shown in Fig. 8, thus forming a wedge of these ends of the cams in their longitudinal movement.

To provide for a reverse movement of the motor in backing the car, there are placed on the shaft 45 a set of exhaust-cams 69 and on the shaft 50 a set of admission-cams 70, these cams being of like construction and operation as the exhaust-cams 53 and admission-cams 62 previously described for the ahead movement, they being so placed on their respective shafts 45 and 50 that a movement from the mid-position of the reversing-lever 72 to the right will cause the roller 58 to be in the path of the cam 69 and the contact-point 66 to be in the path of the cam 70, and thus, in the manner described for the ahead motion, cause a reverse movement of the motor.

The manner of operating is as follows: The tanks 12 and 18 having been charged with the necessary pressure of compressed air, when it is desired to start the car ahead the free end 75 of the lever 72 is moved to the extreme left, which movement will cause the shaft 50 to be moved in the same direction therewith, and the cams 62 thereon brought in such position that the point 66 of the bell-crank will be in the rotating path thereof. By this movement to the left of the lever 72 the exhaust-shaft 45 will be moved to its extreme position to the right, and the exhaust-cams 53 thereon

placed in such position that the roller 58 on the valve-stem 43 will be in the path thereof. In the manner described this movement of the lever 72 will cause the opening of the proper admission and exhaust valves, and by the pressure from the tank 13 the motor will be started in the ahead motion, and through the chain belt 29 and pulleys 28 and 30 move the car ahead. When the car is traveling on a level or slight down grade, where a less power is required for its propulsion, the reversing-lever 72 is moved to some point nearer its mid-position, whereby the contact-point 66 of the bell-crank will be brought in the path of that part of the triangular cam 62 that is nearer its vertex 64, and will consequently sooner reach the leaving edge 68 thereof, when the admission-valve 38 will be closed and the remainder of the stroke of the piston completed by the expansion of the air in the cylinder, these cams 62 being so placed, if necessary, that the contact between the point 66 and the cam will be at the vertex 64, when the admission-valve 38 will be almost instantly opened and closed, and thus by the expansion of the air in the cylinder economically utilize this power. In this movement of the lever 72 to use the air-pressure more expansively the movement of the exhaust-valves 42 will not be affected thereby, as the parallel form of the exhaust-cams 53 will cause their respective valves to remain open during the full stroke of the piston in any position of the lever 72 from its mid-position. When descending a grade, where a brake force is needed to the car, and whereby the main shaft 16 will be caused to rotate by the descending car, the reversing-lever 72 is placed in the mid-position shown in Fig. 2, in which position the rollers 58 will be out of the path of the cams 53 and the bell-cranks 61 out of the path of the cams 62, and in which case the exhaust-valve 42 and the admission-valve 38 are free to be operated by the action of the air in the reciprocating movement of the piston 21, which will then act as an air-pump driven from the car-axle 31 through the chain belt 29, the valve 42 becoming the induction-valve through which the air will be drawn from the atmosphere on the downstroke of the piston 21, and on the upward stroke thereof this air in the cylinder will be forced through the valve 38, that now becomes an eduction-valve, and into the tank 13, thus storing an additional supply of compressed air therein for future use of the motor, and at the same time acting as a retarding force to the car on the descending grade. In the cylinder 18 is shown a line of holes 77, which are open to the atmosphere and are so placed that they will be just above the piston 21 when it is on the bottom center, and serve for the escape therethrough of the air in the cylinder when the piston is at this point, this escaping air carrying with it any moisture that may have accumulated, and thus avoiding any bad consequences that might arise

from the freezing of this water, these holes 77, when the motor is employed as a pump, in the manner described, insuring a cylinder full of air when the piston 21 is on its bottom center. If it should be desired to back the car, the reversing-lever 72 is moved to the extreme right, when the backing-cams 69 and 70 will be caused to operate the valves 38 and 42 in a manner similar to that described for the ahead movement, the triangular form of the cams 70 admitting of the same variation of cut-off as in the ahead movement.

It will be seen that in lieu of the chain belt 48, that is herein shown for causing the shafts 45 and 50 to rotate in unison with the main shaft 16, there may be employed bevel-gearing or any of the other well-known devices for this purpose.

Having described my invention and the manner of operating, what I claim, and desire to secure by United States Letters Patent, is—

1. The combination of the cylinder 18, the piston 21, the connecting-rod 26, the crank 17, the main shaft 16, the valve 38, for the admission of fluid-pressure to the piston, the valve 42, for the release of fluid-pressure from the piston, the shaft 50, free to be rotated and to be moved longitudinally, the shaft 45, free to be rotated and to be moved longitudinally; the cam 62, fixed to the shaft 50, by which the valve 38 is operated, the cam 53, fixed to the shaft 45, by which the valve 42 is operated, means for causing the said shafts 45 and 50 to rotate in unison with the main shaft 16, and means for imparting a longitudinal movement to the said shafts 45 and 50, for the purpose set forth.

2. The combination of the cylinder 18, the piston 21, the connecting-rod 26, the crank 17, the main shaft 16, the valve 38, for the admission of fluid-pressure to the piston, the valve 42, for the release of fluid-pressure from the piston, the shaft 50, free to be rotated and to be moved longitudinally, the shaft 45, free to be rotated and to be moved longitudinally, the cam 62, fixed to the said shaft 50, for operating the valve 38, the curved surface 63 of the said cam 62 being of a triangular form, the cam 53, fixed to the shaft 45, by which the valve 42 is operated, the surface 56 of said cam 53 being of a semi-cylindrical form, means for causing the said shafts 45 and 50 to rotate in unison with the main shaft 16, and means for imparting a longitudinal movement to the said shafts 45 and 50, for the purpose set forth.

3. The combination of the cylinder 18, the piston 21, the connecting-rod 26, the crank 17, the main shaft 16, the air-storage tank 13, the valve 38, through which communication is established between the said cylinder and air-storage tank, the said valve 38 being moved outward from the said cylinder to establish the said communication, the valve 42, through which communication is established between the said cylinder and the atmosphere, the said valve 42 being moved inward toward the said

cylinder to establish the said communication therethrough, the shaft 50, free to be rotated and to be moved longitudinally, the shaft 45, free to be rotated and to be moved longitudinally, the cam 62, fixed to the shaft 50, for operating the valve 38, the cam 53, fixed to the shaft 45, by which the valve 42 is operated, means for causing the said shafts 45 and 50 to rotate in unison with the main shaft 16, and means for imparting a longitudinal movement to the said shafts 45 and 50, for the purpose set forth.

4. The combination of two or more cylinders 18, placed side by side, each of said cylinders being provided with a piston 21, a connecting-rod 26, a valve 38, for the admission of fluid-pressure to the piston, and a valve 42, for the release of fluid-pressure from the piston, a main shaft 16, provided with the cranks 17, the said main shaft being common to all the cylinders, the shaft 50, extended the en-

tire width of all the cylinders, the said shaft being free to be rotated and to be moved longitudinally, the shaft 45, extended the entire width of all the said cylinders, the said shaft 45 being free to be rotated and to be moved longitudinally, the cams 62, fixed to the said shaft 50, by which the said cylinder-valves 38 are operated, the cams 53, fixed to the said shaft 45, by which the cylinder-valves 42 are operated, the lever 72, by which a longitudinal movement is imparted to the shafts 45 and 50, and means for causing the said shafts 45 and 50 to rotate in unison with the main shaft 16, for the purpose set forth.

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

HENRY TAYLOR

Witnesses:

WM. L. BAILIE,
JNO. T. MADDOX, Jr..