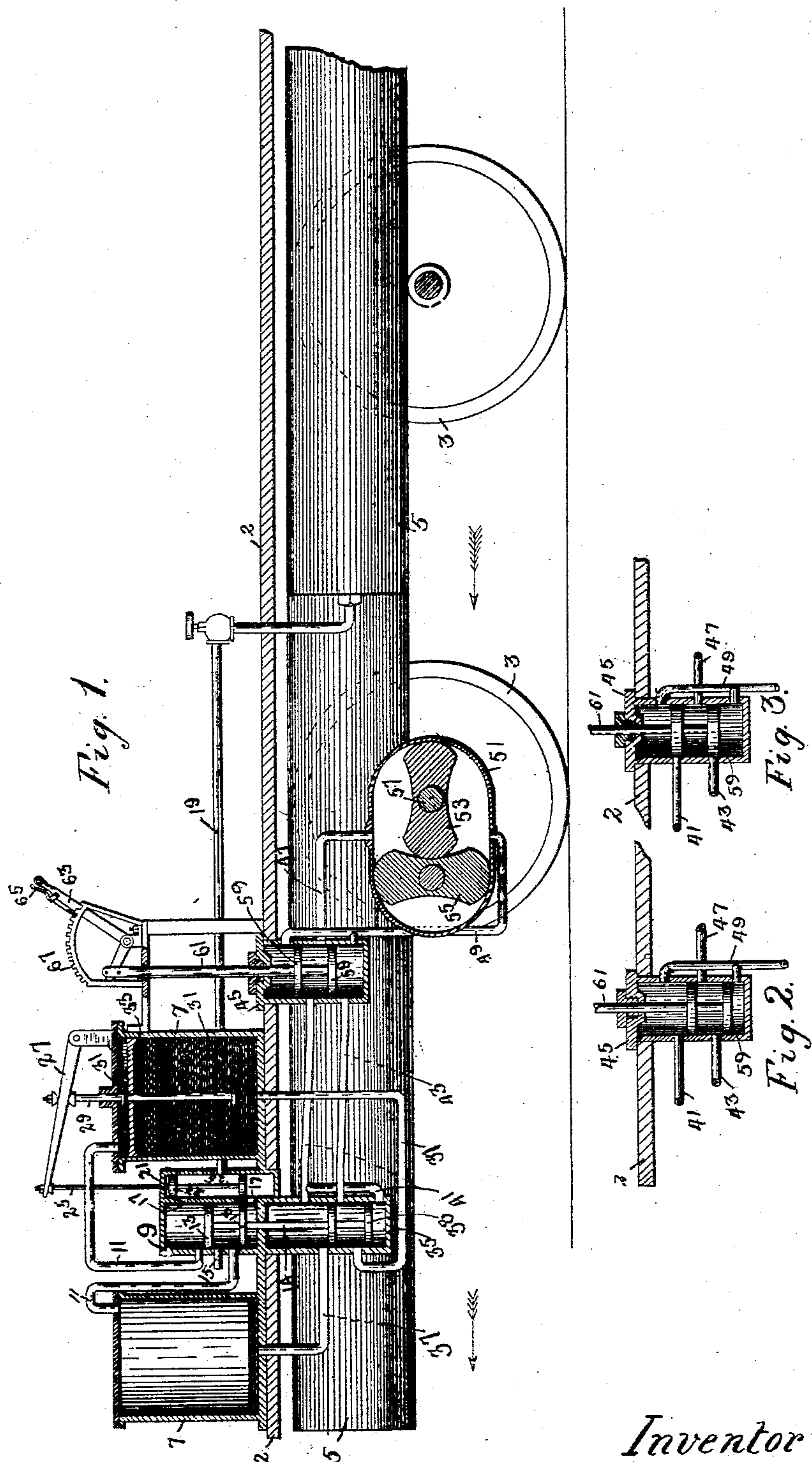


(No Model.)

W. COOPER.
PNEUMATIC HYDRAULIC LOCOMOTIVE.

No. 504,669.

Patented Sept. 5, 1893.



Witnesses.

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UNITED STATES PATENT OFFICE.

WILLIAM COOPER, OF MINNEAPOLIS, MINNESOTA.

PNEUMATIC HYDRAULIC LOCOMOTIVE.

SPECIFICATION forming part of Letters Patent No. 504,669, dated September 5, 1893.

Application filed January 3, 1890. Renewed February 9, 1893. Serial No. 461,688. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM COOPER, of Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain Improvements in Pneumatic Hydraulic Locomotives, of which the following is a specification.

The object of this invention is to provide a locomotive particularly adapted for operating street cars, and the invention is an improvement upon that described in my former application, Serial No. 329,457, filed November 6, 1889.

In the present invention I employ pneumatic pressure for forcing a column of liquid through a suitable hydraulic motor by means of which power is applied to drive the locomotive, and I also provide means by which the direction of the liquid column through the motor may be reversed without changing the application of the pneumatic pressure or by which the flow of the liquid column may be retarded or stopped altogether, thereby preventing the motor from moving or retarding its movement and consequently stopping or slowing up the locomotive. This device not only acts as a reversing mechanism by which the motion of the motor may be reversed but it also takes the place of a brake and enables the operator to control the speed of the locomotive.

In the accompanying drawings forming a part of this specification, Figure 1 is a longitudinal vertical section showing a portion of a locomotive embodying my invention. Figs. 2 and 3 are details.

In the drawings, 2 represents a portion of the platform or frame work of a car or locomotive which may be of any suitable construction, and is provided with suitable supporting wheels or trucks 3. Supported upon this frame work in any suitable manner are one or more suitable pneumatic reservoirs 5 which may be filled with air under pressure in any suitable manner. Arranged upon this car or locomotive are suitable liquid holding reservoirs 7. A cylinder 9 is connected with these reservoirs by suitable pipes 11. A double piston 13 is arranged within the cylinder 9 being carried by a piston-rod 14 that extends also into a liquid cylinder hereinafter described. The cylinder 9 is also provided with an exhaust port 15, and with inlet ports

17 arranged above and below the double piston while the exhaust port is arranged between the two parts of said piston. By this arrangement one of the pipes 11 is connected through the cylinder 9 with one inlet port and the other is connected to said cylinder with the exhaust port 15. A pipe 19 leads from the pneumatic reservoir to an air box 21 within which the ports 17 are located. A double valve 23 secured upon a valve stem 25 is arranged in the air box 21, and this valve permits communication between the pipe 19 and one of the ports 17. A lever 27 is connected with the valve rod 25, and also with a sliding rod 29 that extends into one of said liquid reservoirs 7, and is provided with the stocks 31, and has also arranged thereon a suitable piston 33. The reservoirs 7 are each provided with an outlet pipe 37, and these pipes connect with a valve chamber 35 having arranged therein a double piston or valve 38 that is secured to the stem or rod 14 to which the double piston or valve 13 hereinbefore referred to is also secured. A pipe 41 is connected to both the upper and lower portions of the valve chamber 35, and a pipe 43 is connected to the central portion of said chamber. A second or reversing valve chamber 45 is connected to both of the pipes 41 and 43, and the pipes 47 and 49 are connected to said chamber 45, one to the central portion and the other to both the upper and lower portions. A suitable liquid or hydraulic motor is connected with the driving axle of the locomotive in any suitable manner, and is arranged to be driven by the passage of liquid through it. This motor preferably consists of a suitable casing 51 having arranged therein the rotating intermeshing pistons 53 and 55, the piston 53 being preferably secured directly upon the axle 57 of the locomotive. The pipes 49 and 47 are connected with the casing 51, and according as the liquid passes through said motor in one direction or the other the locomotive is driven forward or back. Arranged in the valve chamber 45 is a valve consisting of a double piston 59 secured upon a suitable valve stem or rod 61. A suitable lever 63 is connected with the valve stem 61, and it is provided with a latch 65 adapted to engage a notched locking plate 67.

The general construction and operation of this locomotive are the same as that described in my prior application for patent hereinbefore referred to. The liquid which is placed in the reservoir 7 is driven back and forth from one reservoir to the other passing through the motor and forming a liquid column that extends from one reservoir to the other through said motor. By means of the lever 63 and the valve mechanism operated thereby, the operator has complete control of the locomotive. By moving the valve from one position to the other in the limit of its movement, he reverses the direction of the flow of the liquid through the motor and thereby reverses the locomotive. Or, by moving the valve so as to partially close the pipes 41 and 43, where they enter said valve chambers, the passage through which the liquid flows is contracted, and thereby the speed of the locomotive is retarded. By moving the valve so as to completely close said opening a further movement of the liquid is prevented and the locomotive is stopped. This mechanism therefore serves to give complete control over the direction and speed of said locomotive. With this mechanism it is not necessary to cut off the pressure of the air from the liquid reservoirs, nor to increase or decrease the pressure upon the liquid in said reservoirs nor to change the direction of flow of the liquid except as it is done by the automatic action of the valve mechanism connected with the piston in the liquid reservoir.

It is desirable in my invention that the piston, 33, should fit tightly in whichever one of the combined gas and liquid tanks, 7, it is placed, so as to form a movable partition between the liquid below and the gas above said piston. The pressure which drives the liquid back and forth from one to the other of the combined gas and liquid tanks, 7, may, of course, be derived from compressed air stored in the reservoir, 5, as above described, or it may be derived from gas generated in said reservoir by any one of a number of well known chemical means; the method of producing gas under pressure being no part of my invention, which consists in the apparatus for utilizing said pressure.

The motor used in my invention may be any one of a class of hydraulic motors known as positively acting motors, in which the pressure of the fluid and not its weight or impact acts to drive the motor, which is so constructed that it passes a definite quantity of the liquid at every revolution no matter what the pressure under which the liquid is forced into the motor, or what the load may be under which the motor is operating.

I am aware that a hydro-pneumatic elevator has been constructed in which two alternately acting compressed air and liquid tanks are employed to alternately force a column of liquid from one tank against one side of the piston which drives the elevator, while a similar column of liquid on the oppo-

site side of said piston is forced into the other tank, and vice versa; and I am also aware that a motor for cars, &c., has been constructed in which a pump is used to force liquid through a motor, thence into a liquid tank, from which the liquid is drawn by the pump; and I make no claim to such constructions.

I claim as my invention—

1. The combination in a locomotive, of a driving axle, a rotary motor connected with said axle, a casing for said motor, two or more combined gas and liquid tanks, liquid passages connecting each tank with said casing at opposite sides of the motor, so as to admit the fluid at either side thereof and exhaust the same at the opposite side, for the purpose of propelling the motor in either forward or backward direction, liquid passages connecting said tanks with each other, means for forcing a liquid piston or column of water alternately from one tank into the other through said motor, so as to drive the same continuously in the same direction, an intermediate valve chamber, and a reversing and controlling valve located in said chamber through which said column of liquid is forced in its passage from tank to tank through said motor, and means for operating said valve, whereby the motor may be controlled, and the direction of flow of the liquid column through the motor casing reversed, so as to reverse the motor, without changing the application of the pneumatic pressure, or reversing the flow of the liquid column passing from tank to tank, substantially as described.

2. The combination of a positively acting hydraulic motor, two or more combined gas and liquid tanks, a pipe connecting the lower portion of one tank with one side of said motor, and a second pipe connecting the lower portion of another tank with the other side of said motor, whereby the liquid contained in one tank may be driven through the motor into the other tank in a continuous column, together with an inlet for compressed gas on the upper portion of each of said tanks, valves controlling the flow of gas in said inlets and the flow of liquid in said pipes, a piston and piston rod in one of said tanks and apparatus connected therewith by which said valves are operated by the rise and fall of liquid in said tanks, and a reversing valve through which the liquid conducting pipes above described pass, and by which the direction of flow of liquid from said pipes through said motor may be reversed and controlled, substantially as described.

3. The combination of a positively acting hydraulic motor, two or more combined gas and liquid tanks, a pipe connecting the lower portion of one tank with one side of said motor, and a second pipe connecting the lower portion of another tank with the other side of said motor, whereby the liquid contained in one tank may be driven through the motor into the other tank in a continuous column, together with an inlet for compressed gas in

the upper portion of each of said tanks, valves
controlling the flow of gas in said inlets and
the flow of liquid in said pipes, connecting
apparatus whereby said valves are operated
5 simultaneously, a tightly fitting piston in one
of said tanks which is driven in one direction
by the liquid acting upon one side thereof
and in the other direction by the gas acting
upon the other side thereof, suitable connect-
10 ing mechanism extending from said piston to
the valve operating apparatus, and a revers-

ing valve through which the liquid conduct-
ing pipes above described pass, and by which
the direction of flow of liquid from said pipes
through said motor may be reversed and con- 15
trolled, substantially as described.

In testimony whereof I have hereunto set
my hand this 30th day of December, 1889.

WILLIAM COOPER.

In presence of—

A. C. PAUL,

S. W. ROBERTS.