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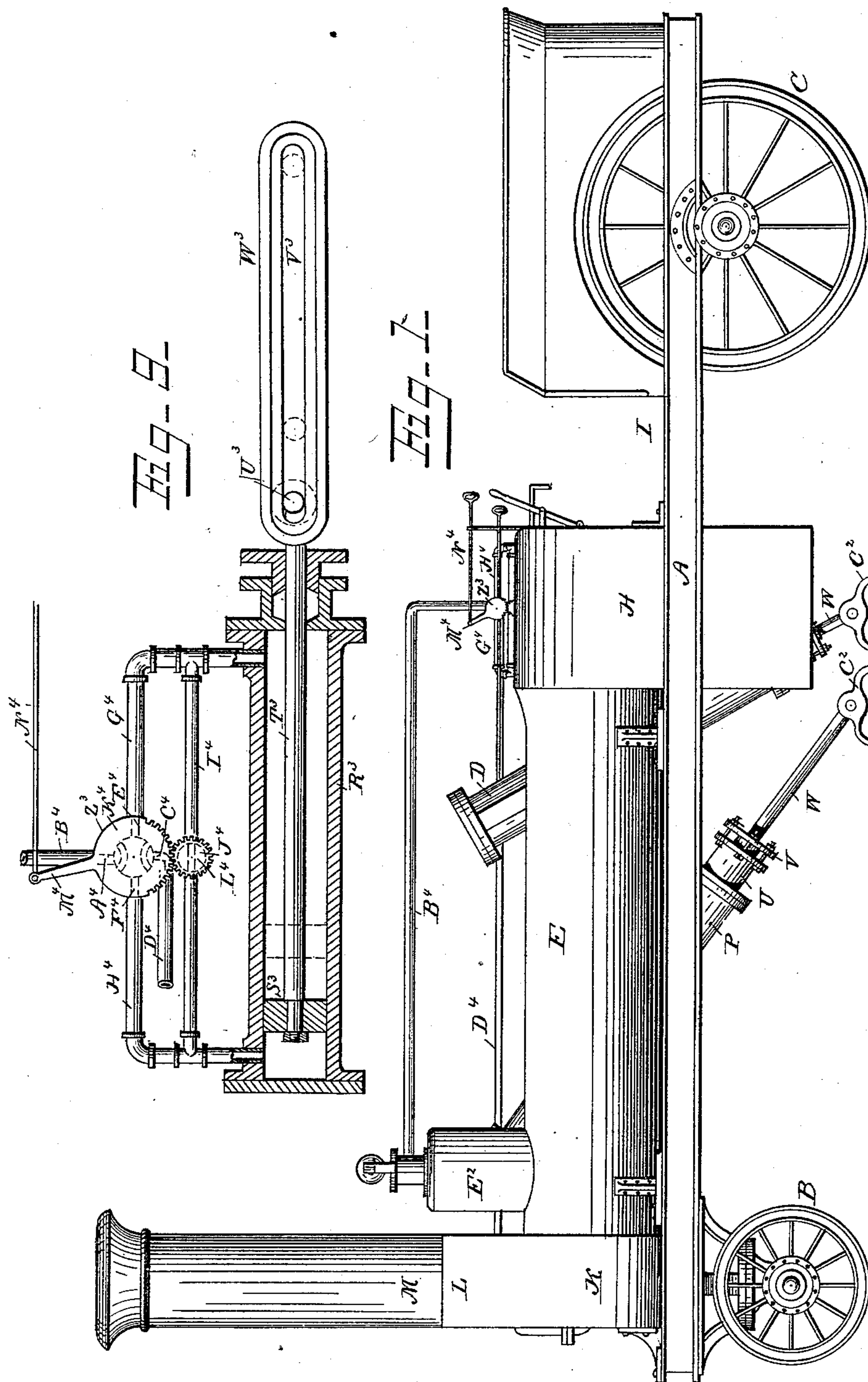
8 Sheets—Sheet 1.

W. E. RICHARDSON.

TRACTION ENGINE.

No. 278,822.

Patented June 5, 1883.



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(No Model.)

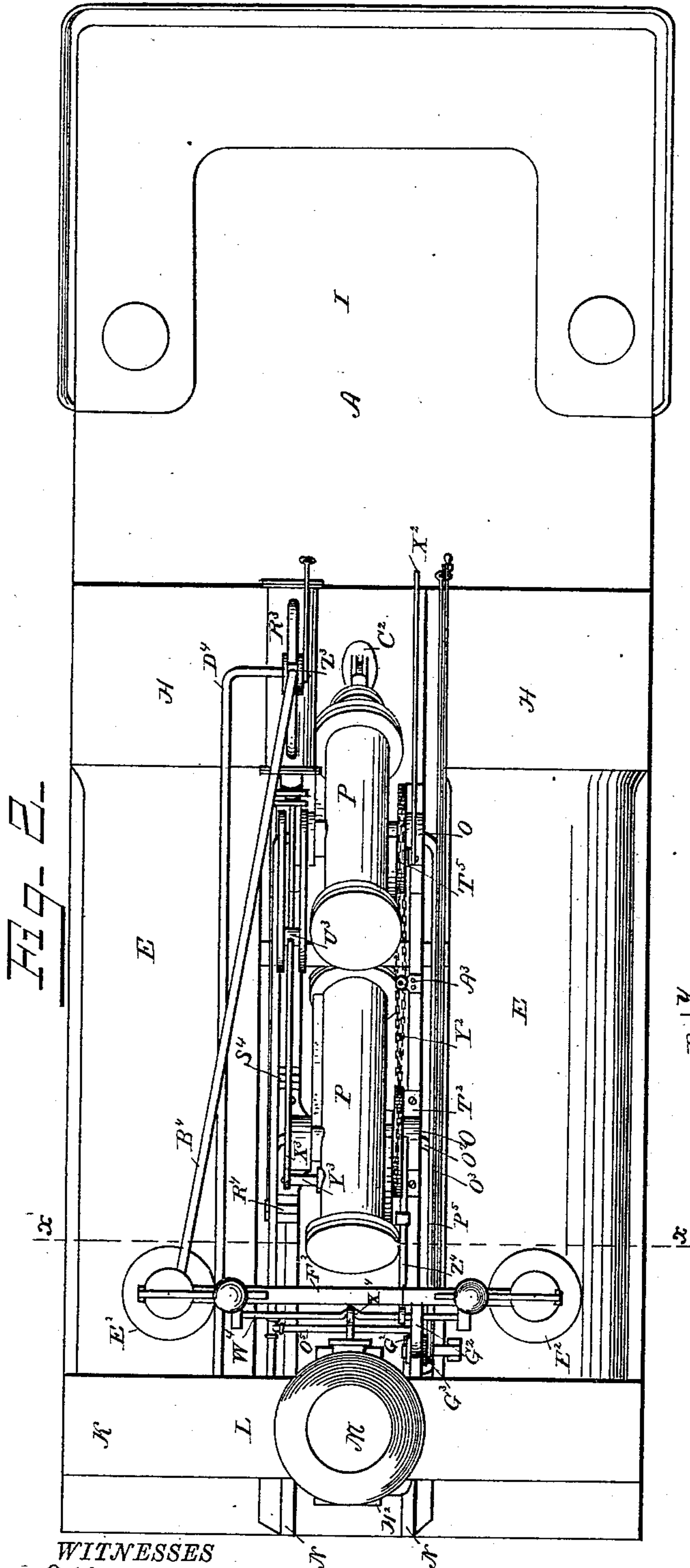
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W. E. RICHARDSON.

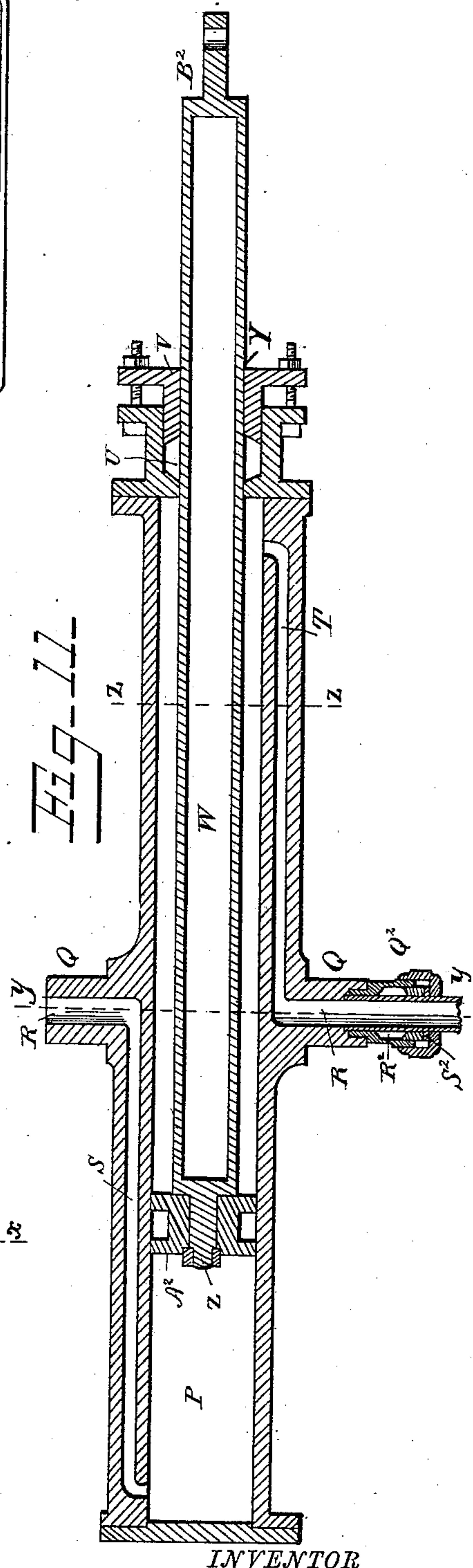
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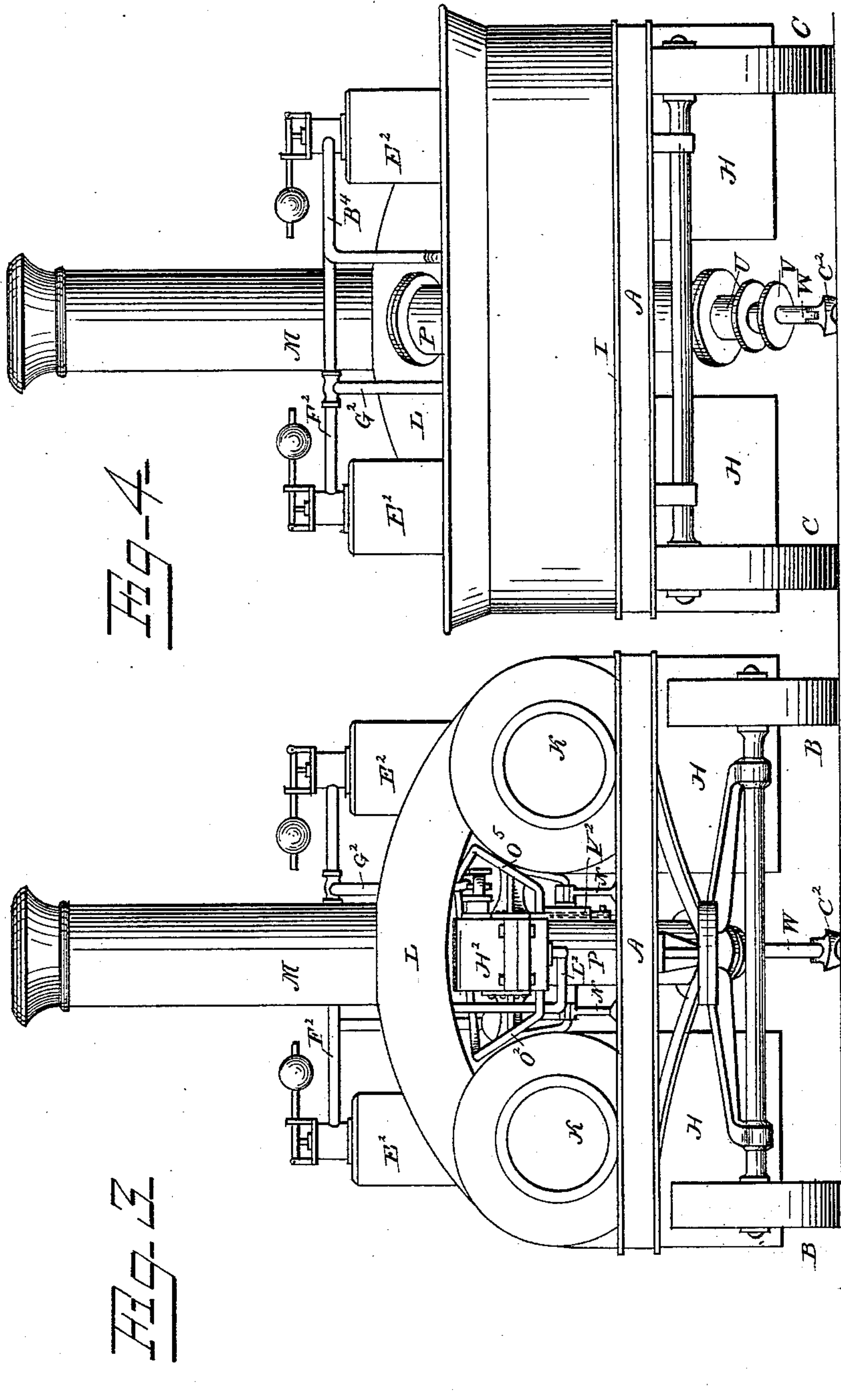
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Fig. 14.

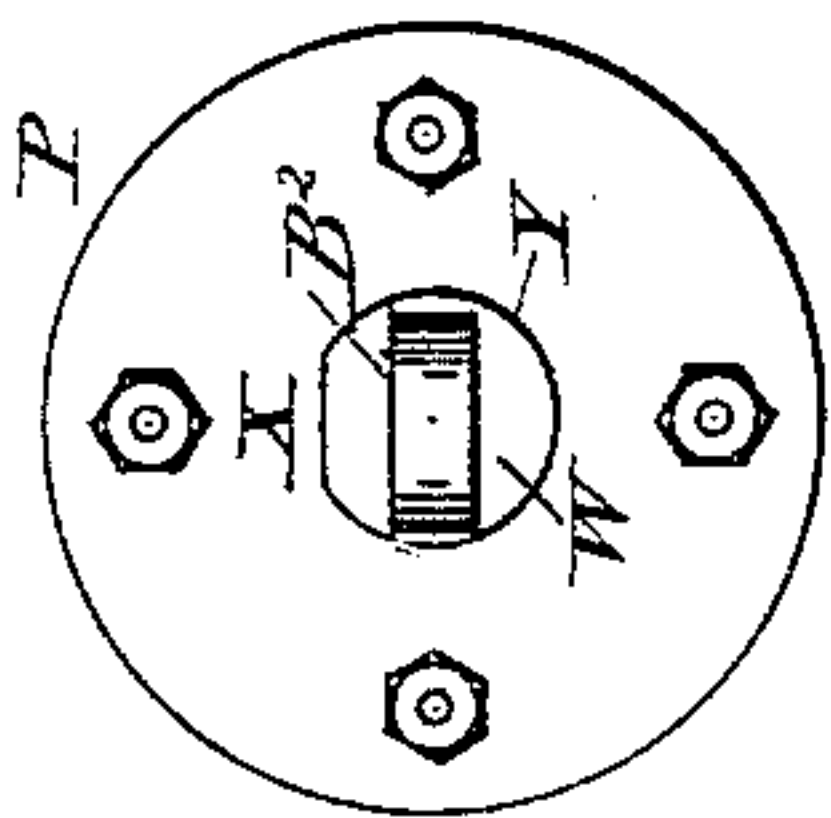


Fig. 13.

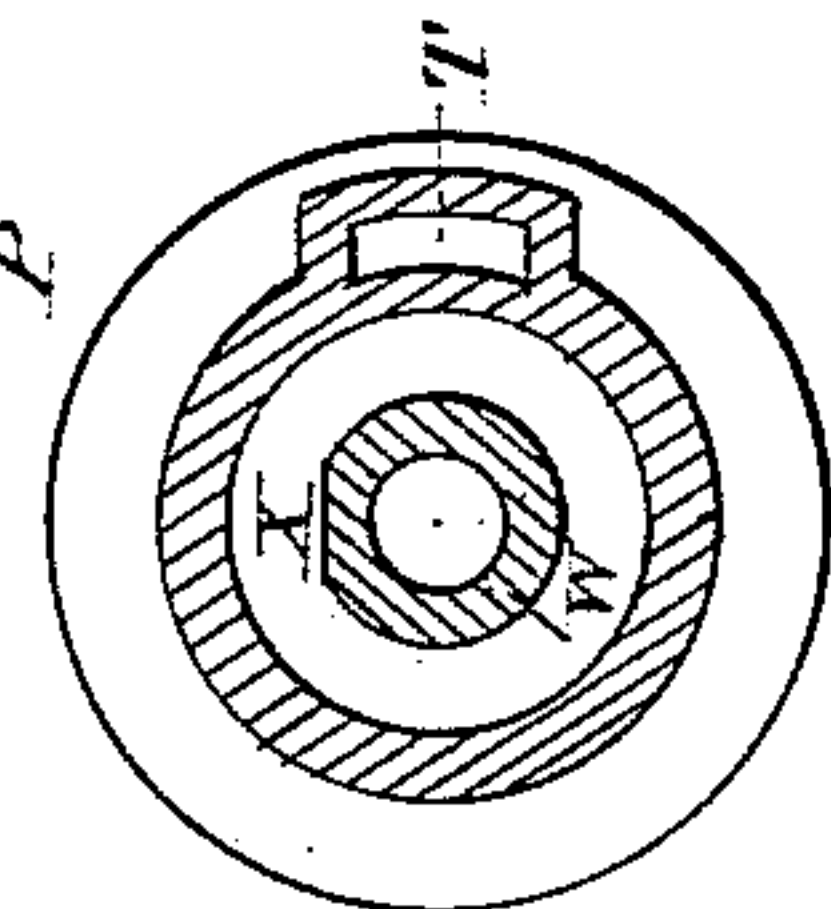


Fig. 12.

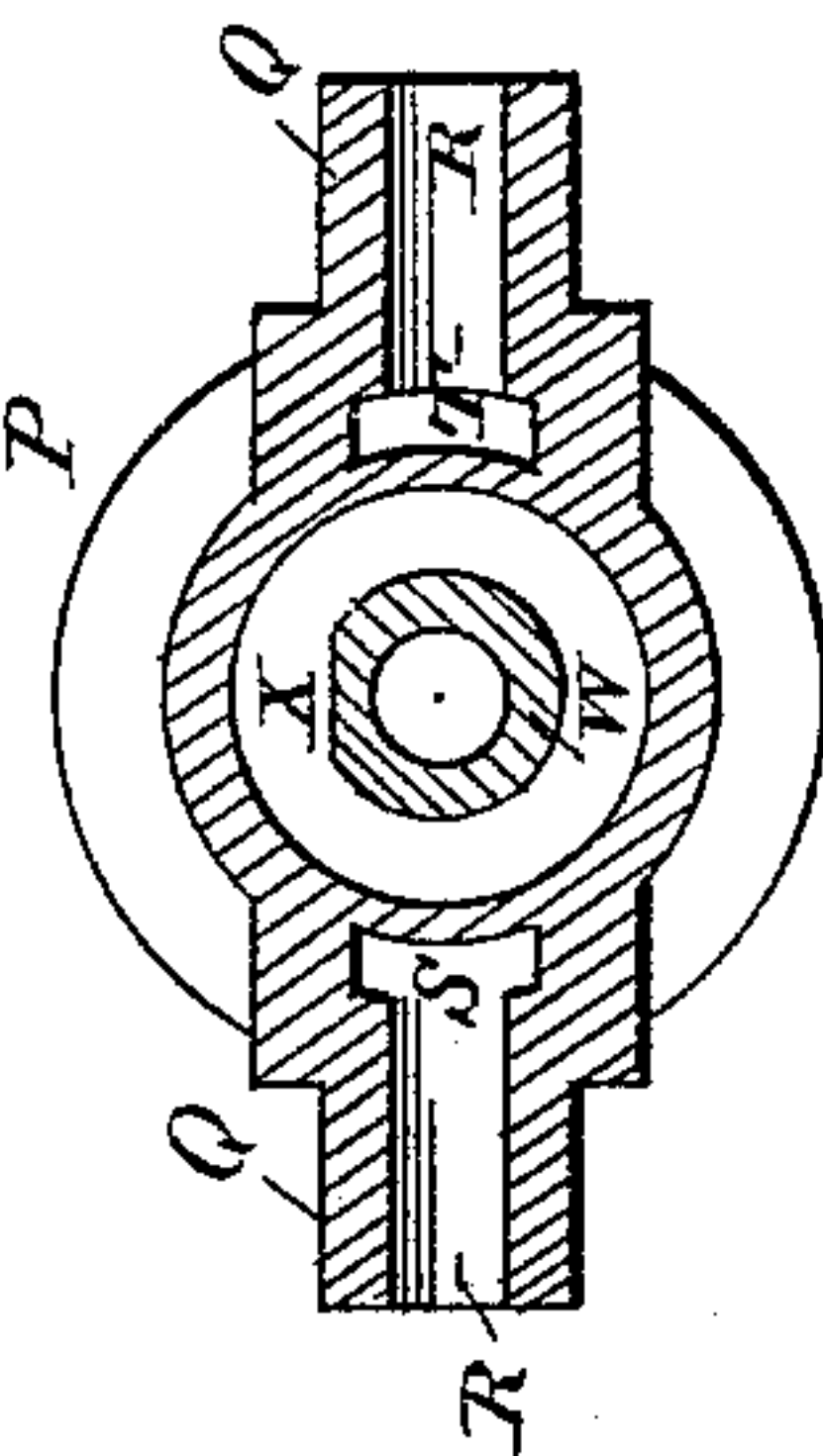
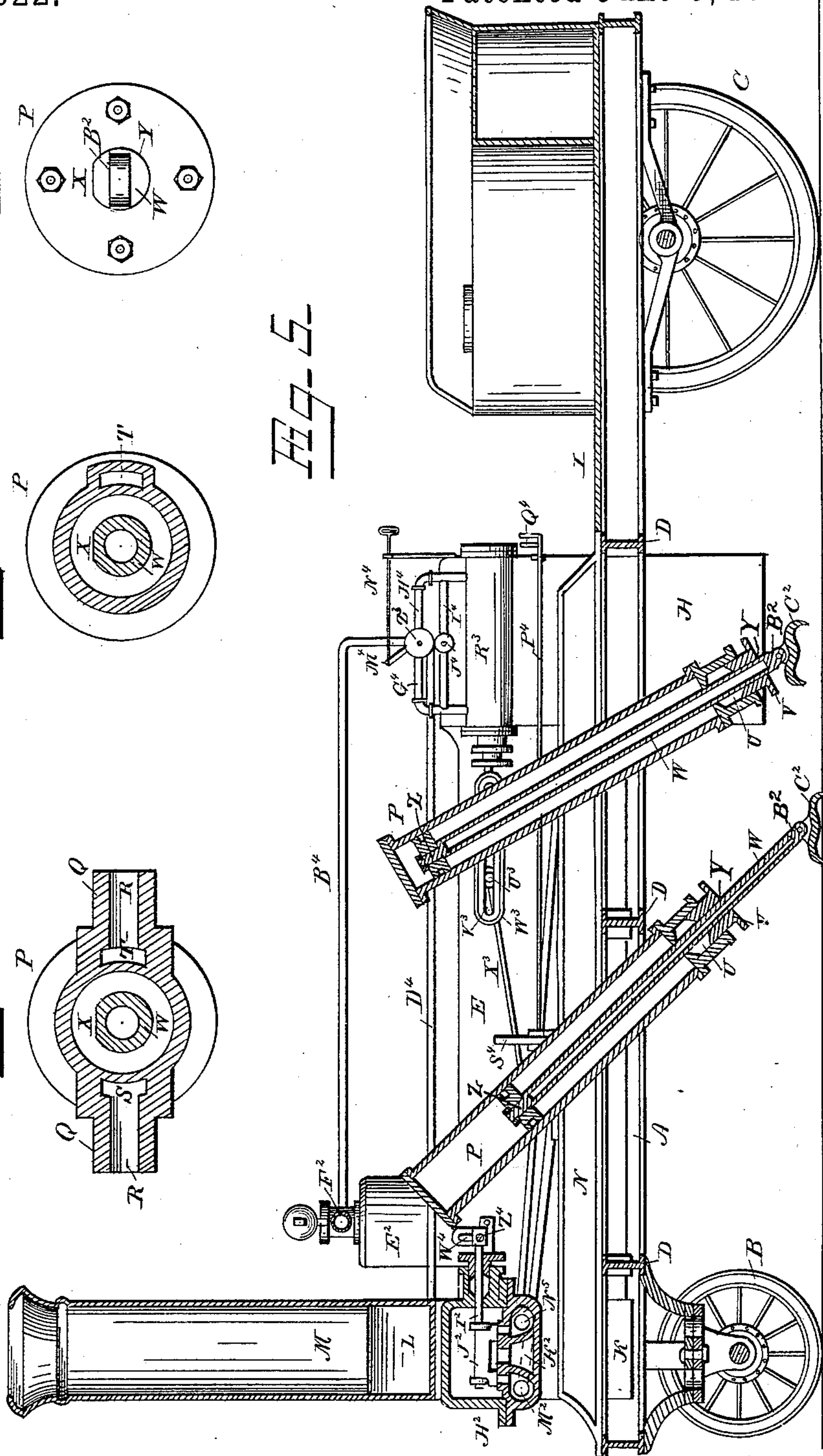


Fig. 5.



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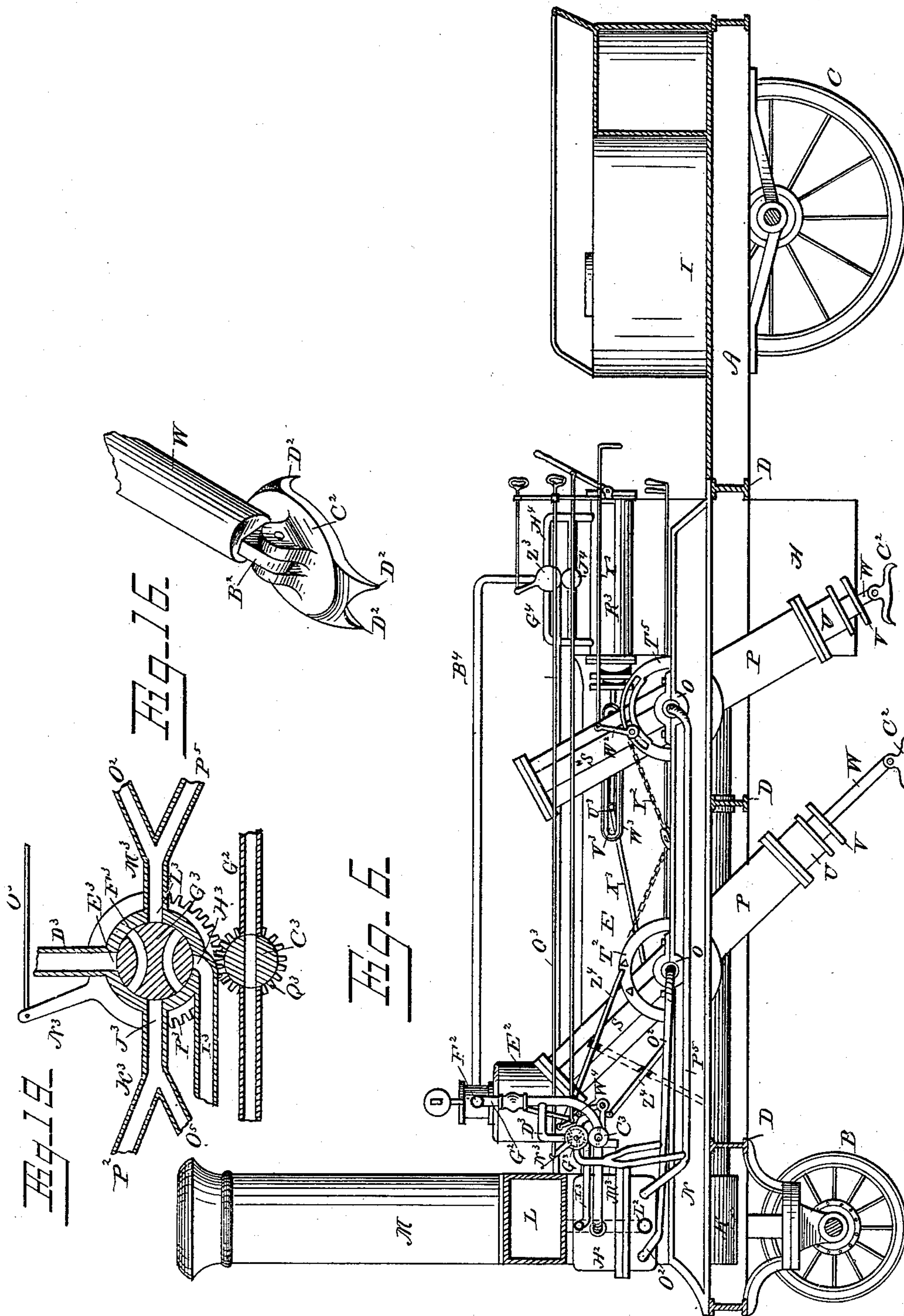
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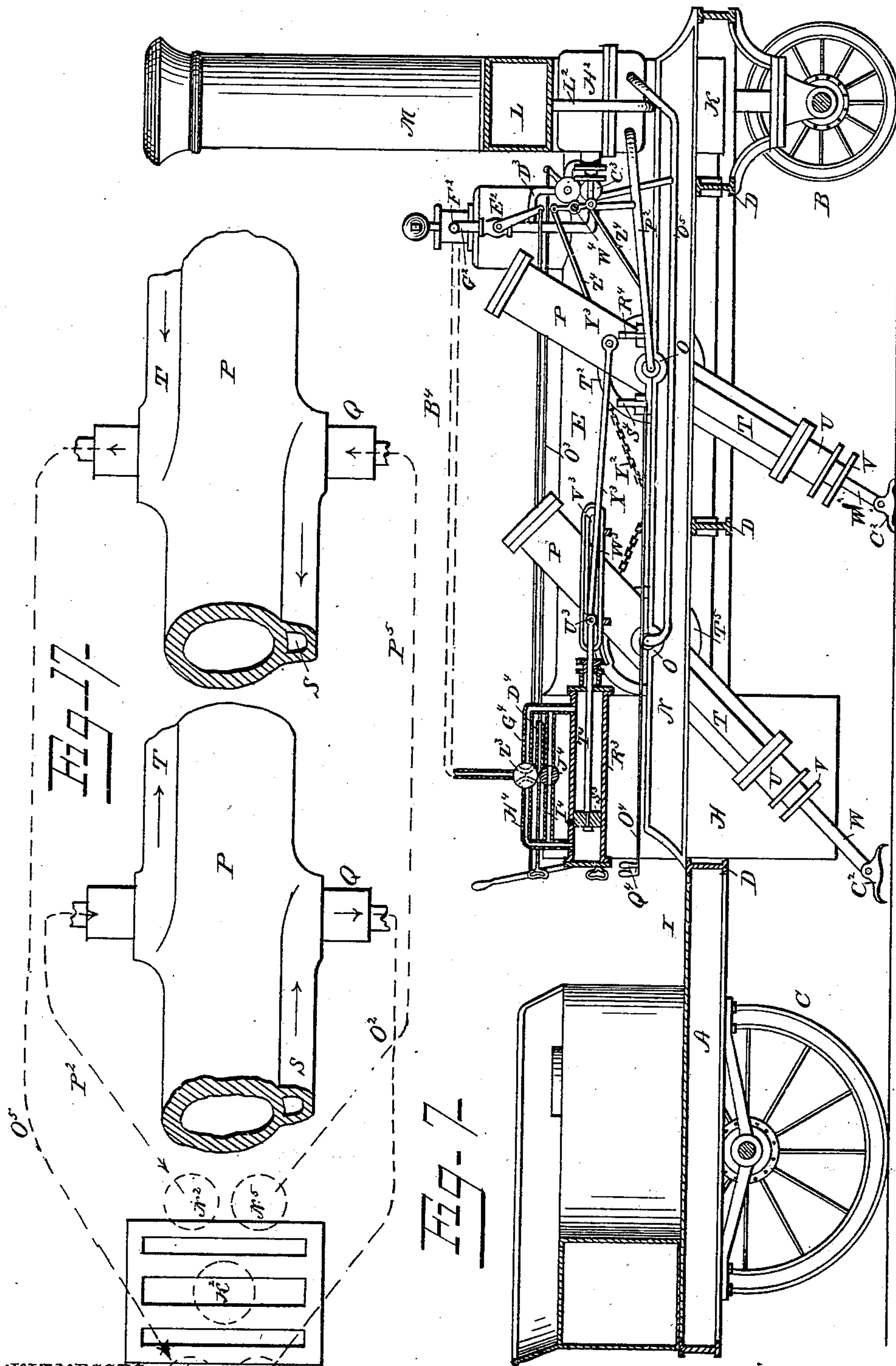
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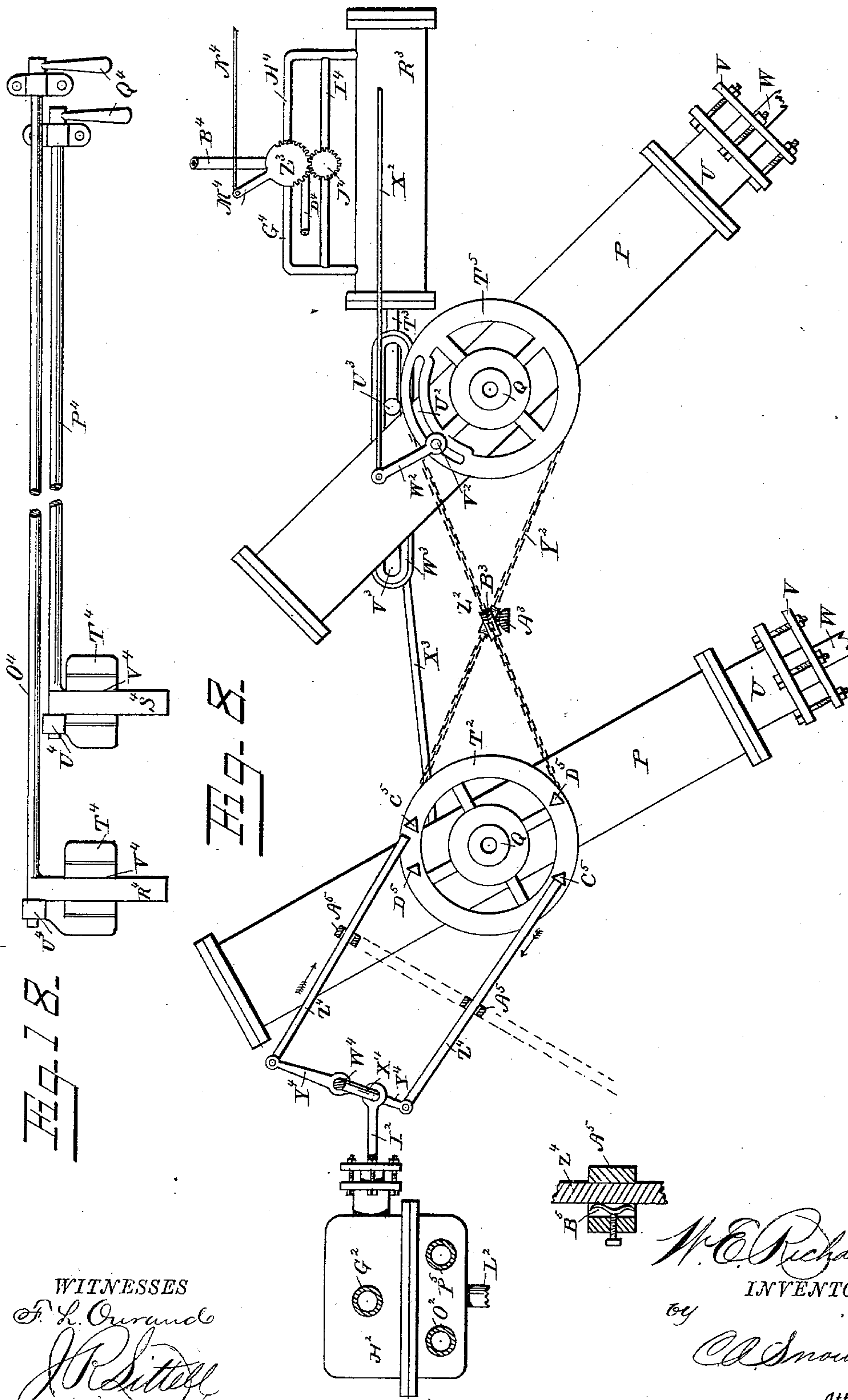
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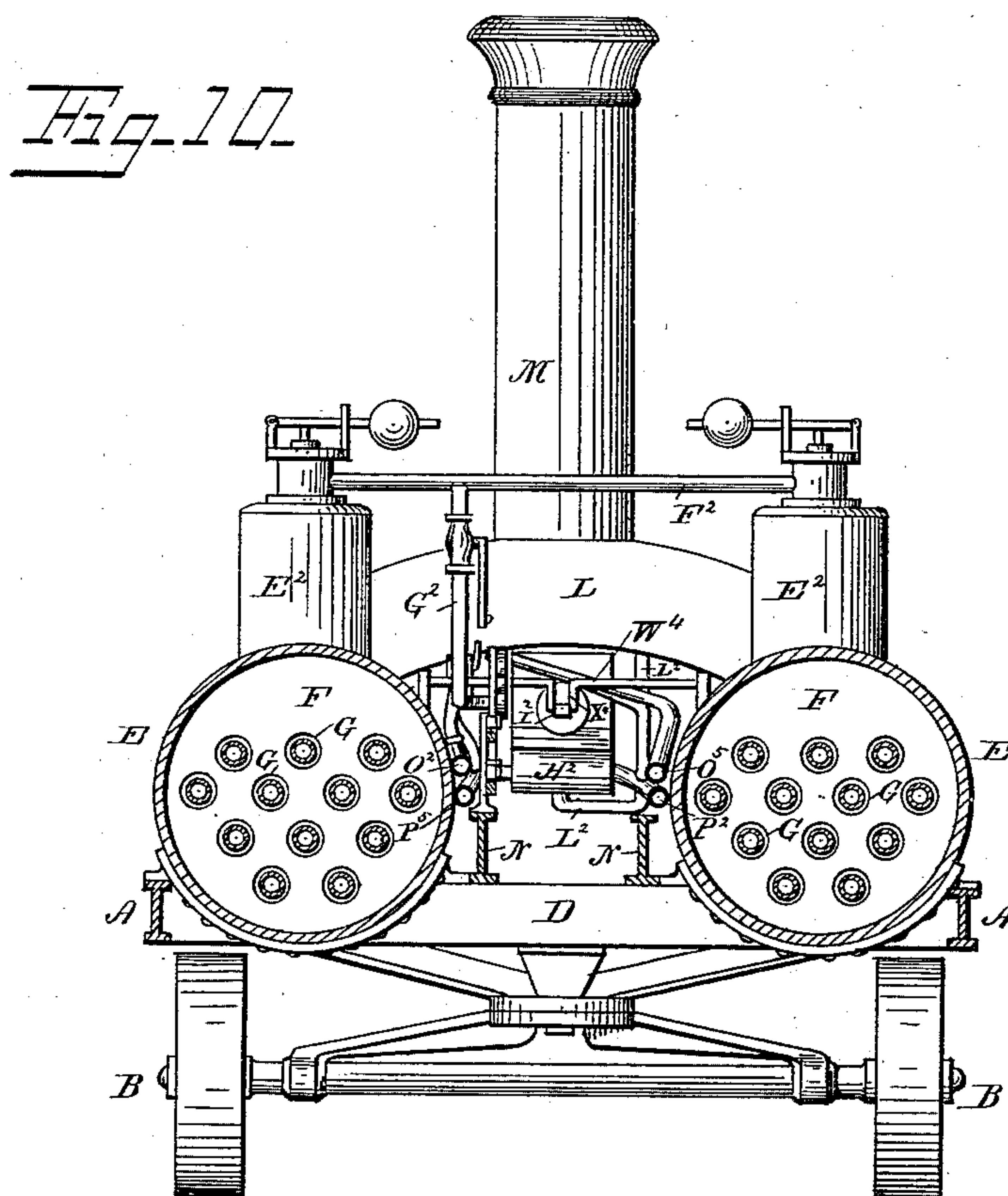
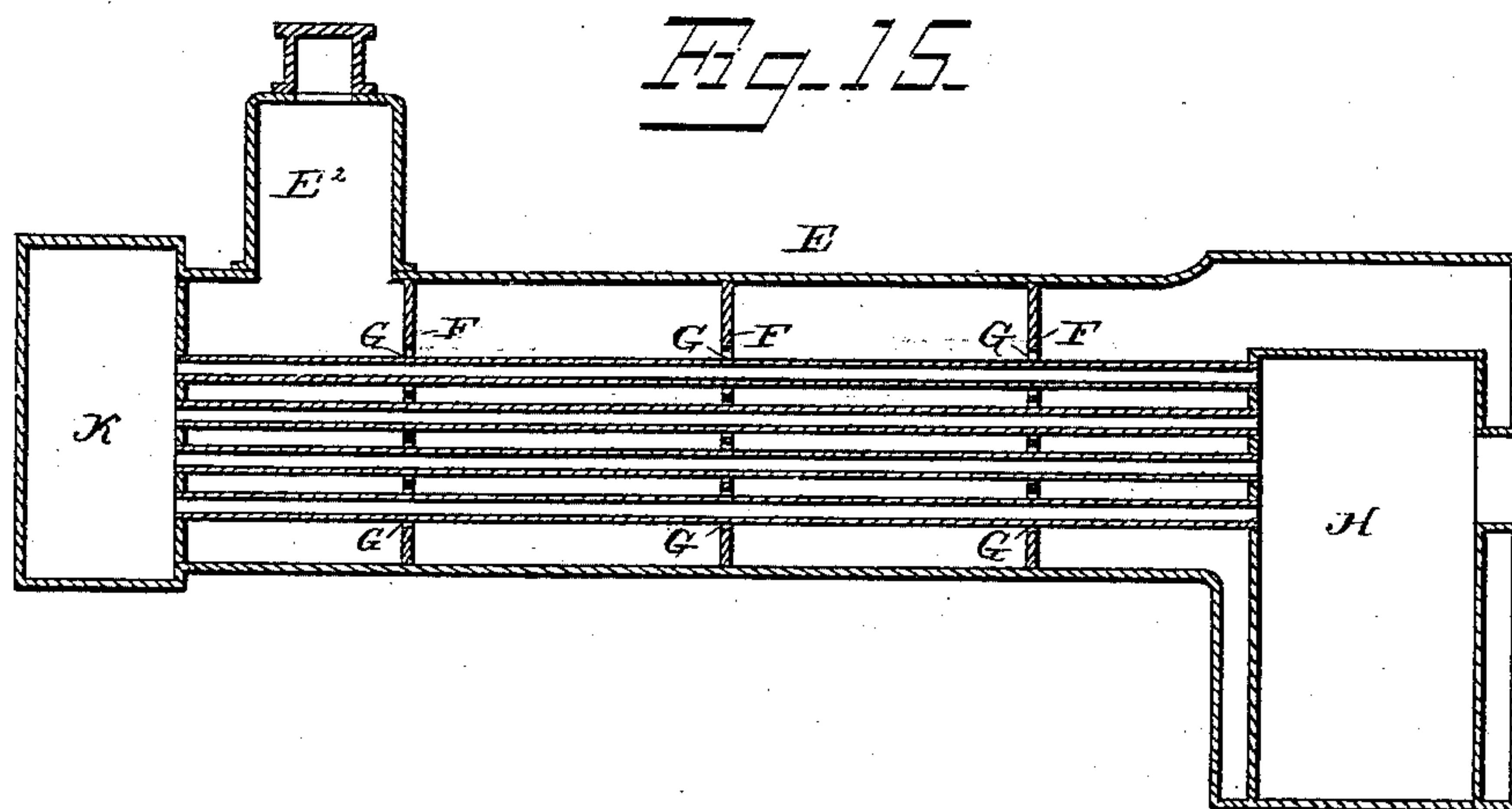
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UNITED STATES PATENT OFFICE.

WILBER E. RICHARDSON, OF MARINETTE, WISCONSIN.

TRACTION-ENGINE.

SPECIFICATION forming part of Letters Patent No. 278,822, dated June 5, 1883.

Application filed March 19, 1883. (No model.)

To all whom it may concern:

Be it known that I, WILBER E. RICHARDSON, a citizen of the United States, residing at Marinette, in the county of Marinette and State of Wisconsin, have invented a new and useful Traction-Engine, of which the following is a specification, reference being had to the accompanying drawings.

This invention relates to traction-engines or road-engines, and more particularly to that class of the same in which the motive power, instead of being applied to the drive-wheels, consists of piston-rods operated by the direct action of the steam, and provided with shoes that act directly against the road-bed in the line of travel.

My present invention consists, first, in the arrangement of the oscillating operating-cylinders between two longitudinal boilers, where- by weight is evenly distributed and steadiness and uniformity of motion insured; secondly, in the valve-gear; thirdly, in the means or mechanism for reversing the operating-cylinders in order to change the direction of travel.

My invention further and finally consists in certain improvements in the construction and arrangement of details of my improved traction-engine, which will be hereinafter fully described, and particularly pointed out in the claims.

In the drawings hereto annexed, Figure 1 is a side view of my improved traction-engine. Fig. 2 is a top or plan view of the same. Fig. 3 is a front view. Fig. 4 is a rear view. Fig. 5 is a longitudinal vertical sectional view taken through the operating-cylinders and the main valve. Fig. 6 is a longitudinal vertical sectional view taken at one side of the cylinders, so as to show in elevation the said cylinders, the steam-chest, valve-stem, and valve-gear. Fig. 7 is a longitudinal vertical sectional view taken at the other side of the cylinders and through the reversing-cylinder. Fig. 8 is a detail view of the operating-cylinders, chain-wheels, chain, and part of the reversing mechanism. Fig. 9 is a detail view, on a larger scale, of the reversing-cylinder with its steam-chest, valves, and steamways. Fig. 10 is a transverse sectional view, on the line *xx* in Fig. 2, of the machine complete. Fig. 11 is a

transverse sectional view of one of the operating-cylinders. Fig. 12 is a cross-section of the same on the line *yy* in Fig. 11. Fig. 13 is a cross-section of the same on the line *zz* in Fig. 11. Fig. 14 is an end or bottom view of the same. Fig. 15 is a longitudinal sectional view of one of the boilers. Fig. 16 is a detail view of the lower end of the piston-rod of one of the operating-cylinders, showing the pivoted shoe. Fig. 17 is a plan of the operating-cylinders, showing the several steamways, the main valve, and connections; and Figs. 18 and 19 are detail views.

The same letters refer to the same parts in all the figures.

A in the drawings designates the frame of my improved traction-engine, in the general construction of which, however, no novelty is herein claimed. It is supported upon wheels B B and C C, which may be constructed and arranged in any suitable manner, suitable provision being made for the steering of the engine either by steam-power or by hand, as may be desired. The steering-gear, however, is not shown, and it forms no part of this invention. The frame A comprises suitable transverse beams or T-irons, D D, serving to support two boilers, E E, placed longitudinally upon the frame at the sides of the latter. It is my intention to use ordinary multitubular boilers, in which, at suitable distances apart, are placed transverse partitions F F, having openings G G for the passage of the boiler tubes or flues, and of slightly larger diameter than the latter, in order that the water may be evenly distributed in the boilers. It will be seen that these partitions, while admitting of the passage of the water, will prevent any sudden flow of the latter from one end of the boiler to the other, as would be the tendency in case of the engine ascending or descending inclines.

The boiler-furnaces H H are of the ordinary construction, and in rear of these is constructed a platform, I, upon which the engineer's cab is located, together with coal and water tanks and other appurtenances. The smoke-boxes K K, at the front ends of the boilers, are connected by the breeching L of the single chimney or smoke-stack M.

N N are a pair of longitudinal beams or

girders, connecting the front and rear ends of the frame, and located between the boilers E E, as shown in Fig. 10. The beams N N are provided with boxes O O, forming bearings 5 for the operating-cylinders P P, which are constructed with gudgeons Q Q, journaled in said boxes. The gudgeons Q have openings R, connecting with passages S T, formed in the sides of the cylinders and extending from 10 the gudgeons on opposite sides to the upper and lower ends of the cylinders, respectively, terminating at a short distance from the ends, as shown in Fig. 11, in order that steam cushions shall be formed for the pistons at the end 15 of the stroke.

At the lower ends of the cylinders packing-boxes U and glands V are provided for the purpose of forming steam-tight joints around the piston-rods W. The latter are preferably 20 made tubular in order to insure great strength without excessive weight, and they have flattened sides X, Figs. 12 and 13, to prevent their turning in the cylinders, the openings Y in the glands being of course correspondingly 25 shaped. The upper ends of the piston-rods are welded, as at Z, to receive the piston-heads A², which are provided with packing in the usual manner. The lower ends of the piston-rods are likewise welded at B², and carry the pivoted shoes C². The latter are to be 30 made of steel and provided with pointed ends D², adapted to take well in the bed of the road over which the engine is to pass. As regards the construction of the shoes, however, I do 35 not wish to restrict myself, and modifications may be made in this respect without departing from the spirit of my invention.

The steam-domes E² E² of the boilers are connected by a transverse pipe, F², from which 40 a branch pipe, G², leads to the main-valve chest H², Fig. 3. The latter is by this arrangement supplied with steam equally from the two boilers, in which an equilibrium of pressure is thus maintained.

45 The pipe G² may be connected to the valve-chest either at one of the sides or at the top, whichever may be deemed most convenient.

I² is the valve-stem, and J² the valve, which latter may be an ordinary slide-valve. The 50 steam-chest H² has a centrally-located exhaust-port, K², from which the exhaust-steam may be conducted through a pipe, L², to the breeching of the chimney. At the ends of the steam-chest are two pairs of ports, (denoted, respectively, by M² M³ and N² N³ in Fig. 6.) The port 55 M² is connected by a pipe, O², with the gudgeon Q of the front cylinder, P, which is connected by the passage S with the upper end of the said cylinder. Port M³ is connected by a pipe, O³, with the gudgeon Q of the rear cylinder, which is connected by passage T with the lower end of said cylinder. Port N² is 60 connected by a pipe, P², Figs. 7 and 17, with the gudgeon Q of the front cylinder, which is connected by the passage T with the lower end of the said cylinder, and the port N³ is con-

nected by a pipe, P³, with the gudgeon Q of the rear cylinder, which is connected by passage S with the upper end of the said cylinder. 70 The pipes O² and P³, which connect with the upper ends of the respective cylinders, are larger than the pipes O³ and P², which connect with the bottoms of the said cylinders, as in the lower ends of the cylinders sufficient pressure is required to lift the piston-rods and shoes 75 only. The respective pipes are to be connected with the openings R in the gudgeons by means of expansion-joints Q², Fig. 11, of suitable construction, in order to prevent the possibility of breaking joints by the strain upon the girders carrying the cylinders. 80

At the several joints packing-boxes R² are provided, taking over collars S² upon the respective pipes near the ends of the latter, the 85 object being to form safe and steam-tight joints.

Each of the cylinders is provided with a chain-wheel mounted upon the gudgeon at one of its sides concentrically with said gudgeon. The chain-wheel T², upon the front cylinder, is 90 firmly and permanently secured in the position shown, while that upon the rear cylinder, which is denoted by letter T³, is journaled loosely upon the gudgeon. The chain-wheel T³, Fig. 8, is provided with a segmental slot, U², through which passes a set-screw, V², which 95 is screwed tightly into the body of the cylinder, to which the chain-wheel T³ may thus be secured in any desired position. The set-screw V² is provided at its outer end with an arm or crank, W², to which is pivoted a rod or handle, X², extending rearwardly to within convenient reach of the engineer, who, by manipulating the said rod, may loosen or tighten the set-screw whenever occasion shall demand, as 100 will be hereinafter set forth. The chain-wheels T² and T³ are connected by a chain, Y², which is crossed between the said wheels, as will be seen at Z², so that the cylinders, which are in this manner connected, will swing or oscillate in opposite directions. At the point Z² a guide, 110 A³, is provided, having friction-rollers B³ at right angles to each other, which serve to guide the opposite sides of the chain and prevent them from wearing against and being caught in each other when the engine is in operation. 115

The steam-pipe G² is provided with a stop-cock, C³, which is normally open to permit the passage of live steam to the steam-chest. D³ is a pipe which is connected with and takes steam from either the main steam-pipe F² or 120 one of the boilers direct. Pipe D³ is connected to one of the passages, E³, of the casing F³ of a four-way valve, G³, the opposite passage of which, H³, is connected by a pipe, I³, with the exhaust-pipe L². One of the side passages, J³, of the casing F³ has a Y-pipe, K³, the branches of which are connected with the pipes P² and O³, leading to the lower ends of the cylinders. The other side passage, L³, has a Y-pipe, M³, the branches of which are 125 connected with the pipes O² and P³, leading from the steam-chest to the upper ends of the work- 130

ing-cylinders. The valve G^3 , which is normally closed, has a handle or lever, N^3 , to which is pivoted an operating-rod, O^3 , extending to within reach of the engineer, and by means of which the valve may be operated.

Upon the valve G^3 is fitted a cog-wheel, P^3 , meshing with another cog-wheel, Q^3 , of half the diameter, upon the stop-cock or valve C^3 , to which reference has been made above.

It will be seen from the foregoing that by turning the valve G^3 a one-eighth of a turn a one-fourth turn is given to the valve or stop-cock C^3 , which is thereby closed, thus cutting off communication between the boilers and the steam-chest. On the other hand, communication is at the same time established, through the valve G^3 and its connections, between the live-steam supply and the lower ends of the operating-cylinders and between the upper ends of the cylinders and the exhaust, thus causing the pistons, piston-rods, and shoes appertaining to both cylinders to be simultaneously raised to the fullest extent possible. This is necessary when it is desired to reverse the engine, as will be hereinafter described, as it would otherwise be impossible for both of the cylinders to be reversed, inasmuch as the piston-rod and shoe of at least one of them would be in the way.

The normal position of the cylinders P P , when the engine is traveling in a forward direction, is, as will be seen by reference to the drawings, with their upper ends tilted or inclined forwardly. The push or throw of the shoes upon the piston-rods will then be in a rearward direction, thus forcing the engine in a forward direction. By the connecting-chain the cylinders are forced to oscillate in opposite directions, thus causing the pushing or operating parts of the two cylinders to operate alternately, as will be readily understood. When it is desired to reverse the direction of travel, it is therefore necessary to reverse the cylinders, so that their upper ends shall be inclined rearwardly instead of forwardly, or vice versa, as the case may be. To effect this result easily and conveniently, I avail myself of the reversing mechanism which I shall now proceed more fully to describe with reference to the drawings.

R^3 is a suitably constructed and arranged longitudinal cylinder, which may be mounted upon brackets at the side of one of the boilers.

S^3 is the piston and T^3 the piston-rod, which latter extends through the front end or head of the cylinder, and is provided with a transverse pin or cross-head, U^3 , which slides in slots V^3 in suitable guides, W^3 , bolted or otherwise secured in position.

X^3 is a connecting-rod or pitman, connecting the cross-head U^3 with the front cylinder, P , to the side of which it is pivoted, at Y^3 , some distance above its gudgeons.

Z^3 is a four-way cock or valve, the casing of which has four passages. One of these, A^4 , is connected by a pipe, B^4 , with the boiler from

which live steam is thus taken. The opposite passage, C^4 , is connected by a pipe, D^4 , with the exhaust. The remaining two passages, E^4 and F^4 , are connected by pipes G^4 and H^4 , with the front and rear ends of the cylinder R^3 , respectively. The valve Z^3 is normally closed; but it may, by a one-eighth turn in either direction, be opened so as to connect either end of the cylinder with the live-steam supply, while the other end of the cylinder is, by the same operation, connected with the exhaust.

I^4 is a pipe connecting the pipes G^4 and H^4 , and provided with a centrally-located stop-cock or valve, J^4 , which is normally open, but which may, by a one-fourth turn, be closed so as to cut off communication between the two ends of the cylinder. Light toothed wheels K^4 and L^4 connect the valves Z^3 and J^4 , as shown, in the proportion of two to one, so that when the valve Z^3 is turned one-eighth of a revolution, which is sufficient for its operation, the valve J^4 shall at the same time be turned one-fourth of a revolution, which is required to place it in the desired position. The valve Z^3 has a suitable lever or handle, M^4 , to the upper end of which may be pivoted an operating-rod, N^4 , terminating within convenient reach of the engineer.

O^4 P^4 , Fig. 18, are a pair of longitudinal shafts or rods, journaled in suitable bearings beside each other, and provided at their rear ends with handles Q^4 , convenient to the engineer. The shafts or rods O^4 and P^4 terminate, respectively, in front and in rear of the front cylinder, P , of the engine, and they are provided with arms or stops R^4 and S^4 at right angles to the said rods. These stops are normally in a vertical position, so as not to interfere with the operation of the cylinder, the length of the stroke of which is determined by mechanism which will be hereinafter described.

T^4 T^4 are strong metallic plates, suitably bolted in position, and having lugs or ears U^4 , forming bearings for the front ends of the rods or shafts, and provided with grooves or channels V^4 to receive and hold the stops securely when lowered for operation, as will be presently described.

W^4 , Fig. 8, is a suitably-arranged transverse shaft, having a crank, X^4 , connected with the stem I^2 of the main valve J^2 . The rock-shaft W^4 is also provided with upwardly and downwardly projecting arms Y^4 Y^4 , to which are pivoted rods Z^4 Z^4 , as shown. The rods Z^4 pass through suitably-arranged sockets, A^5 , in which are placed strong flat springs B^5 , bearing against the rods Z^4 , in order to prevent the latter from being accidentally displaced. The chain-wheel T^2 of the front cylinder is provided with four laterally-projecting studs, C^5 C^5 , and D^5 D^5 , arranged substantially as shown in the drawings. When the cylinders are in position to propel the engine in a forward direction the studs C^5 engage the rods Z^4 , and when the cylinders are reversed the studs D^5 are thrown into action. The studs, when the

engine is in motion, alternately strike the upper and lower rods, Z^1 , thereby serving to operate the main valve. This valve-gear, it will be seen, is exceedingly simple, and it serves to operate the valve suddenly and quickly, as is required.

The operation of my invention will be readily understood from the foregoing description, taken in connection with the drawings hereto annexed. The main steam-pipe is provided with a valve to regulate the supply of steam to the cylinders. When the valve is open steam passes into the steam-chest, and from thence, through the ports and passages herein described, to the top of one of the cylinders and to the bottom of the other. In one of the cylinders the piston is thus raised or lifted, while in the other it is forced downwardly, thus pressing the pivoted shoe at the lower end of the piston-rod against the road-bed. The cylinder being already slightly inclined, this pressure will not only force the machine ahead, but at the same time further tilt the cylinder until the piston-rod has completed its throw. Let it be supposed that it is the front cylinder which has reached this position. The rear cylinder will in the meantime, actuated by the chain by which the two cylinders are connected, have reached an approximately vertical position, and its piston will have been raised to its utmost limits. One of the rods Z^1 will now be struck by one of the studs C^5 upon the chain-wheel T^2 , thus reversing the main valve and causing the live steam to pass into the bottom of the front cylinder and the top of the rear cylinder, thus throwing the latter into action while the piston in the former is being raised or lifted. When the front cylinder approaches a position approximating the vertical, the other rod Z^1 is struck by one of the studs C^5 , and the main valve is thus again reversed, causing the live steam to pass again into the top of the front and into the bottom of the rear cylinder, as before.

When it is desired to reverse the direction of travel of the engine the first thing to be done is to raise the pistons in both of the cylinders to their utmost limits, in order to lift the shoes off the ground. This is done by simply operating the valves C^3 and G^3 in the manner described. The former of these cuts off the supply of live steam to the main-valve chest, while the latter opens a steam-supply to the lower ends of both the cylinders, while both their upper ends are at the same time connected with the exhaust. The valves Z^3 and J^4 are next operated. During the operation of the engine the piston S^3 , in the cylinder R^3 , has had a short reciprocating motion in the said cylinder, or, more properly, in one end of the latter, impelled by the throw of the cylinder with which its piston-rod is connected. The pipe I^4 being unobstructed, the steam or air contained in the cylinder R^3 has by this action been "churned" from end to end of the latter. By opening the valve Z^3 the valve J^4

is simultaneously closed, and live steam is admitted into the proper end of the cylinder R^3 . At the time of operating valve Z^3 , or just before, the set-screw V^2 , which connects the chain-wheel T^5 with the rear cylinder, P , should be loosened. The piston S^3 is moved by the pressure of the steam to the opposite end of the cylinder R^3 , thus reversing the position of the operating-cylinders. The set-screw V^2 is now again tightened, the several valves C^3 , G^3 , Z^3 , and J^4 are again reversed, and the engine is then ready for work, as before, with the sole exception that the studs D^5 D^5 have been thrown into action in place of the studs C^5 C^5 , this being made necessary by the changed position of the front cylinder.

My improved traction-engine is simple in construction and easily manipulated. It is direct acting, and is exceedingly powerful. It will be found useful for all purposes for which traction-engines may be used, and especially for sleighing, hauling logs, and the like.

By making proper modifications in the construction and arrangement of details three or more operating-cylinders may be employed in lieu of only two, as herein shown. It is probable that by such arrangement a more even and steady motion may be acquired. I would therefore have it understood that three or more operating-cylinders may be used whenever it shall be found desirable without departing from the spirit of my invention.

I claim as my invention and desire to secure by Letters Patent of the United States—

1. The combination, in a traction-engine, of the frame, two boilers arranged longitudinally upon the said frame at the sides thereof, and the operating-cylinders arranged between the said boilers, as and for the purpose set forth.

2. In a traction-engine, the combination, with steam-generating mechanism, of two or more oscillating cylinders, the piston-rods of which are provided with pivoted sharp-pointed shoes adapted to bear directly against the road-bed over which the machine is traveling, against the direction of travel, substantially as set forth.

3. In a traction-engine, the combination of a pair of boilers arranged longitudinally upon the frame of the machine, oscillating cylinders arranged between the said boilers and having the lower ends of their piston-rods provided with shoes adapted to bear against the road-bed, and mechanism for supplying steam alternately to the upper and lower ends of the said cylinders, as set forth.

4. In a traction-engine, the combination, with oscillating cylinders, arranged substantially as described, and having suitable packing boxes and glands, of the tubular piston-rods, flattened on one side to prevent their turning in the cylinders, and welded at their upper and lower ends to receive the piston-heads and the pivoted shoes, respectively, substantially as set forth.

5. The combination of the frame, the boil-

ers mounted longitudinally upon the same at the sides thereof, the longitudinal beams or girders, the cylinders having laterally-projecting gudgeons, by which they are mounted to oscillate upon the said girders, and means for supplying steam alternately to the upper and lower ends of the said cylinders through openings in the gudgeons and passages in the sides of the cylinders, substantially as set forth.

6. In a traction-engine, the combination, with the cylinders having laterally-projecting gudgeons by which they are journaled in position, substantially as shown, of chain-wheels arranged upon the gudgeons at one side of the cylinders, and connected by a crossed chain, substantially as set forth.

7. The combination of the oscillating cylinders, the chain-wheels arranged upon the gudgeons of the same, the crossed connecting-chain, and a suitable guide arranged at the crossing of the chain to prevent friction of the sides of the latter against each other, substantially as set forth.

8. In a traction-engine, the combination of steam-generating mechanism, oscillating cylinders having piston-rods provided at their lower ends with pivoted sharp-pointed shoes adapted to bear and push against the road-bed over which the machine is traveling, means for supplying steam alternately to the upper and lower ends of alternate cylinders while the other ends of said cylinders are connected with the exhaust, chain-wheels mounted upon the gudgeons of the said cylinders, and a crossed chain connecting the said chain-wheels, substantially as and for the purpose set forth.

9. In a traction-engine substantially as described, the two boilers arranged longitudinally upon the frame, and having their steam-domes connected by a transverse pipe, from whence the main steam-pipe leads to the valve-chest, as set forth.

10. In a traction-engine substantially as described, a pair of multitubular boilers arranged longitudinally upon the frame at the sides of the latter, and having their smoke-boxes connected by the breeching of a single smoke-stack or chimney, substantially as set forth.

11. The combination of the boilers arranged longitudinally upon a frame at the sides of the latter, the oscillating cylinders arranged between the said boilers, a transverse pipe connecting the steam-domes of the boilers, the main-valve chest, pipes connecting the latter with the steam-supply and with the exhaust, two sets of ports arranged in front and in rear of the exhaust-port, pipes connecting the forward ports with the upper end of one cylinder and with the lower end of the other, pipes connecting the rear ports with the opposite ends of the respective cylinders, the reciprocating slide-valve, and mechanism for operating the latter, substantially as described.

12. The combination of the oscillating cylinders constructed with laterally-projecting

gudgeons having openings connected by steam-passages with the upper and lower ends of the said cylinders, the steam-chest, pipes connecting the same with the steam-supply and with the exhaust, pipes connecting the upper and lower ends of alternate cylinders with the steam-supply, pipes connecting the lower and upper ends of alternate cylinders with the exhaust, a stop-cock in the main steam-pipe, a pipe connecting the main steam-supply with the exhaust, and a four-way cock located in the said pipe and having passages connected, respectively, with the pipes leading to the upper ends of the cylinders and those leading to the lower ends, whereby, by turning the said cock, steam may be admitted simultaneously into the lower ends of both cylinders while their upper ends are at the same time connected with the exhaust, as set forth.

13. The combination of the main valve, a transverse shaft arranged in front of the same and having a crank connected with the valve-stem by a pivoted rod, arms projecting upwardly and downwardly from the said shaft, rods pivoted to the said arms, guide-sockets for the said rods equipped with tension-springs, the oscillating cylinders, the chain-wheels, and studs projecting laterally from the front chain-wheel, and arranged to bear against and actuate the valve-operating rods, substantially as set forth.

14. The combination, with the oscillating cylinders having chain-wheels connected by a crossed chain, and actuated by steam, substantially as described, of an independent cylinder having an independent valve mechanism and having its piston-rod connected by a pivoted rod with one of the cylinders, which may thereby be reversed when required, substantially as set forth.

15. The combination of the oscillating cylinders, the reversing-cylinder having its piston-rod connected by a pivoted rod with one of the said cylinders, a chain-wheel secured permanently upon the gudgeon of one of the cylinders, a chain-wheel mounted loosely upon the gudgeon of the other cylinder and having a segmental slot, a set-screw fitted in said slot and securing the chain-wheel to the cylinder in any position required, mechanism convenient to the engineer for manipulating the said set-screw, and a crossed chain connecting the chain-wheel, substantially as set forth.

16. The combination of the rear oscillating cylinder, the chain-wheel journaled upon the gudgeon of the latter and having a segmental slot, a set-screw fitted in the said slot and connecting the chain-wheel adjustably to the cylinder, an arm or lever projecting upwardly from the end of the said set-screw, and a connecting or operating rod pivoted to the said arm, substantially as set forth.

17. The combination of the oscillating cylinders, the reversing-cylinder, the piston-rod of which is connected by a pivoted rod with one of the cylinders, mechanism for admitting

steam simultaneously into the lower ends of both the oscillating cylinders while their upper ends are connected with the exhaust, and the pivoted stops, one of which may be lowered in front or in rear of one of the cylinders, as the case may be, so as to check it at the proper point before reversing, as set forth.

18. The rock-shafts provided with handles or levers at their rear ends, and having arms or stops at their front ends, substantially as described, in combination with grooved or channeled plates adapted to receive the said stops and hold them securely when in operation, as set forth.

19. The combination, with the grooved or channeled stop-plates having lugs or ears, as herein described, of the rock-shafts having their front ends journaled in the said lugs or ears, and provided with stops adapted to rest in the grooves of the channeled plates, substantially as and for the purpose set forth.

20. The combination of the reversing-cylinder, a live-steam pipe connected to both ends of the same, a pipe connecting the branches of the live-steam pipe and provided with a stop-cock, a four-way cock arranged in the live-steam pipe, and adapted to connect either end of the reversing-cylinder with the live-steam supply and the other end with the exhaust, the piston, piston-rod, cross-head, guides, and connecting-rod, and the oscillating cylinders, substantially as set forth.

21. The combination, with the four-way cock of the reversing-cylinder, of the stop-cock in the pipe connecting the branches of the live-steam-supply pipe, and toothed wheels arranged upon the said four-way valve and stop-cock and meshing with each other, the said toothed wheels being so arranged and proportioned that when one of the valves is operated the other shall be correspondingly and properly operated at the same time, as and for the purpose herein set forth.

22. The herein-described improved traction-engine, the same consisting, essentially, of the frame, two boilers arranged longitudinally at the sides of the same, the oscillating cylinders arranged between the boilers and having piston-rods equipped with pivoted shoes, mechanism for supplying live steam alternately to the upper and lower ends of alternate cylinders, and the reversing mechanism comprising means for raising the pistons simultaneously in both cylinders, and for reversing them while the pistons are in this position, substantially as and for the purpose herein shown and specified.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in presence of two witnesses.

WILBER ELCON RICHARDSON.

Witnesses:

AMOS HOLGATE,
GEORGE CLARK.