(No Model.) 4 Sheets—Sheet 1.

H. W. ARMSTRONG.

VALVE GEAR FOR STEAM ENGINES.

No. 528,757. Patented Nov. 6, 1894.

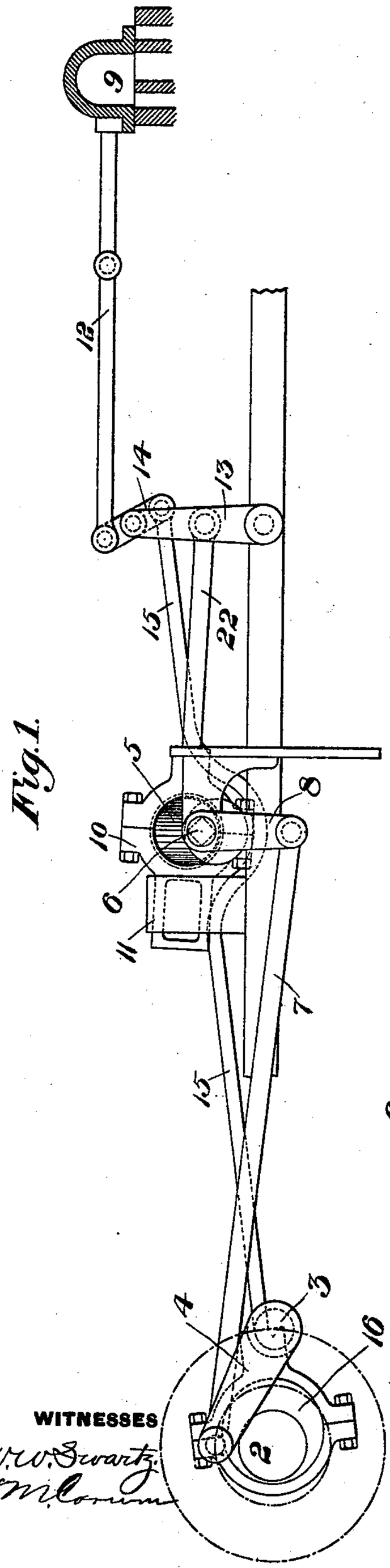

Fig. 1.

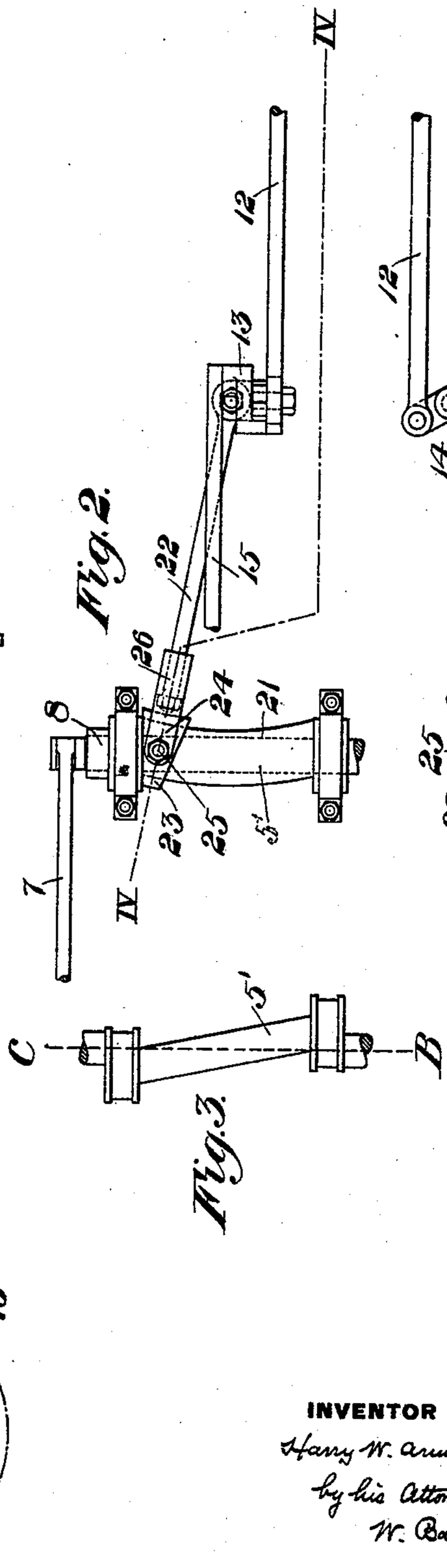

Fig. 2.

Fig. 3.

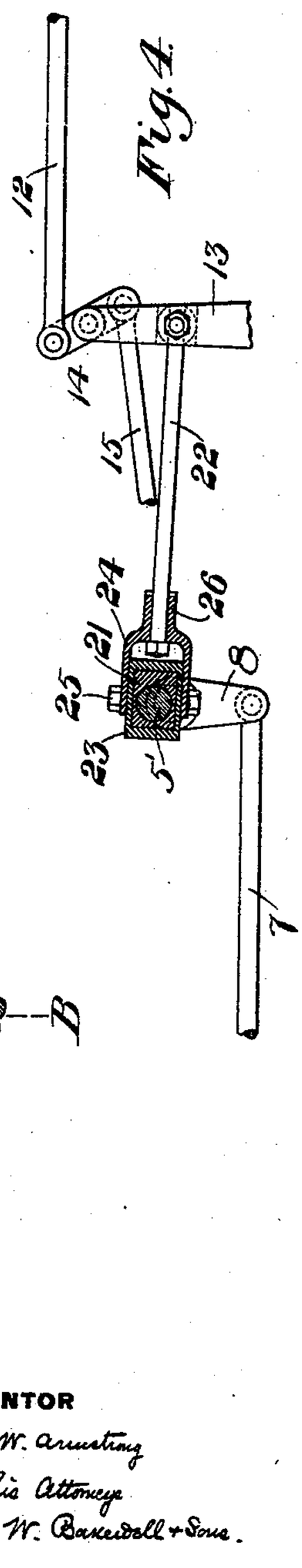

Fig. 4.

WITNESSES

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Fig. 5.

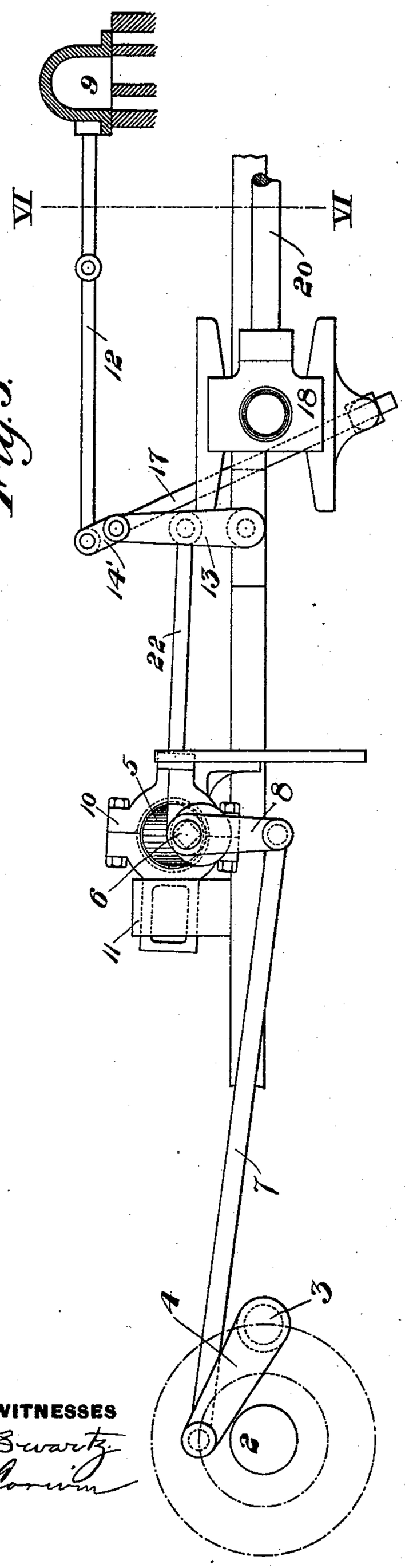

Fig. 8.

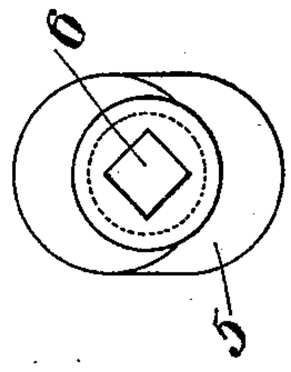

Fig. 7.

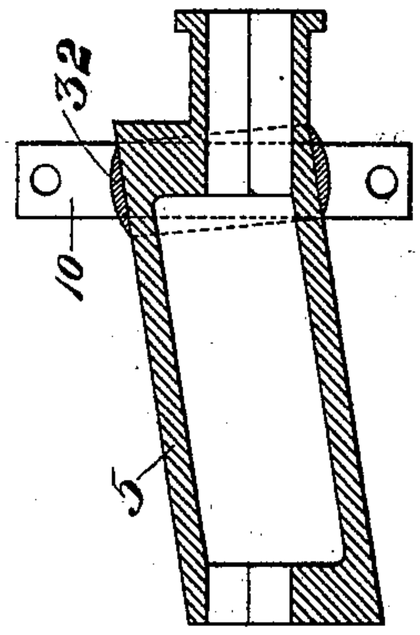

Fig. 6.

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VALVE GEAR FOR STEAM ENGINES.

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Fig. 9.

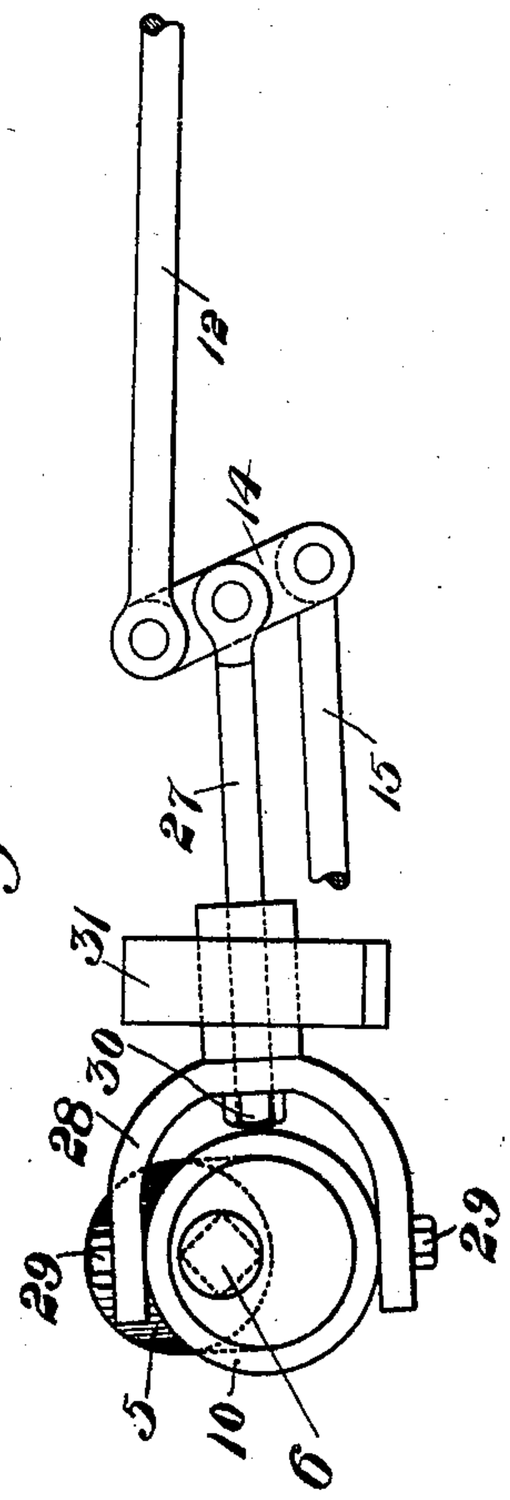
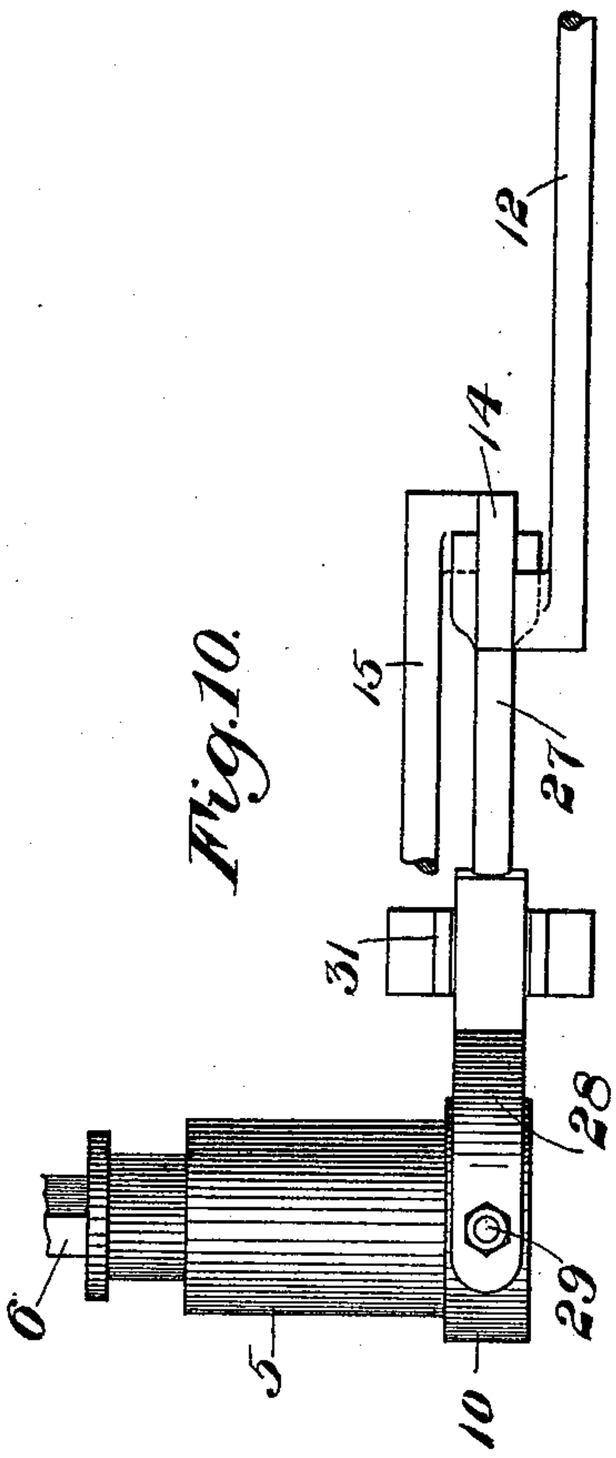


Fig. 10.



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VALVE GEAR FOR STEAM ENGINES.

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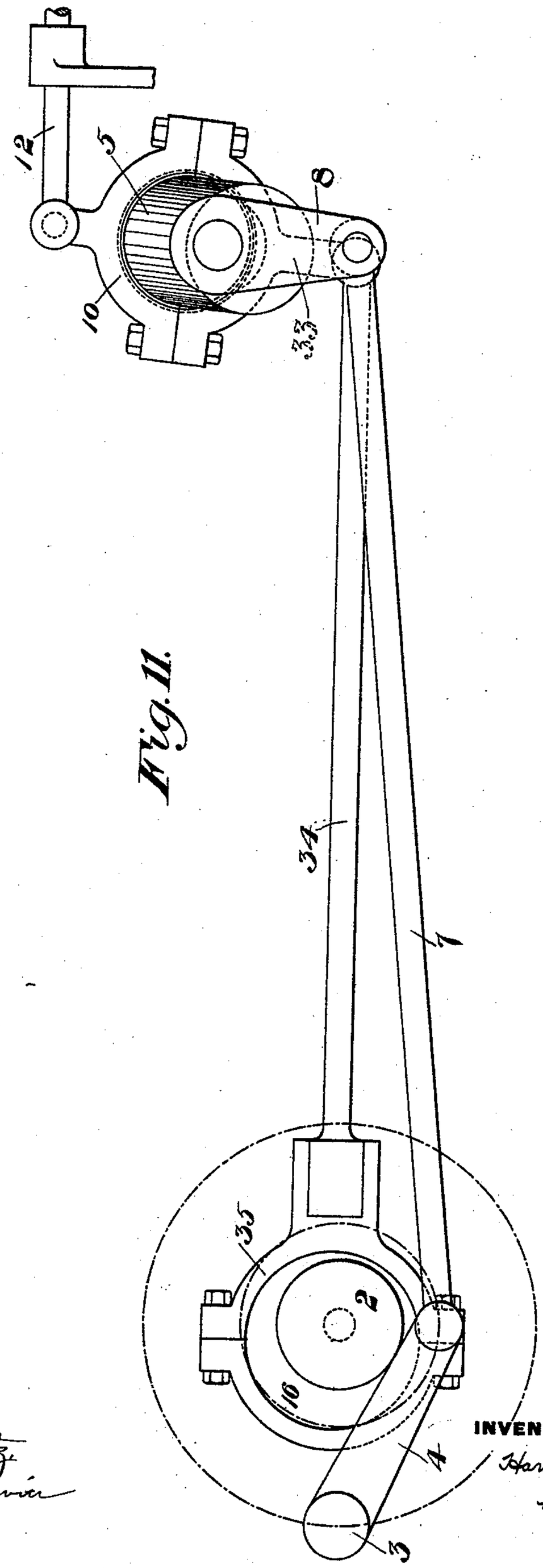

Fig. 11.

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UNITED STATES PATENT OFFICE.

HARRY W. ARMSTRONG, OF OAKMONT, PENNSYLVANIA.

VALVE-GEAR FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 528,757, dated November 6, 1894.

Application filed October 5, 1893. Serial No. 487,232. (No model.)

To all whom it may concern:

Be it known that I, HARRY W. ARMSTRONG, of Oakmont borough, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Valve-Gears for Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a side elevation of my improved apparatus, showing the main shaft or axle of the engine, the oscillating variable eccentric, and its connection with the valve. Fig. 2 is a plan view of a modified construction of the variable eccentric. Fig. 3 is a rear elevation of a part thereof. Fig. 4 is a vertical section on the line IV—IV of Fig. 2. Fig. 5 shows a modified construction of the parts illustrated in Fig. 1, the difference shown being that the mechanism for giving lap and lead to the valve is actuated directly from the cross-head, whereas in Fig. 1 it is actuated directly from an eccentric on the main shaft. Fig. 6 is an end elevation of the parts shown in Fig. 5, shown as if in vertical section on the line VI—VI of Fig. 5. Figs. 7 and 8 show the construction of the variable eccentric illustrated in Figs. 1 and 5. Fig. 7 shows it in longitudinal axial section, and Fig. 8 shows it in end elevation. Figs. 9 and 10 show modified constructions of means for connecting the variable eccentric with the valve. Fig. 9 shows the same in side elevation, and Fig. 10 shows it in plan view. Fig. 11 is another modified construction of the apparatus.

The object of my invention is to provide an efficient, cheap and simple reversing gear for steam engines.

In the drawings (Fig. 1), 2 represents the main axle of a locomotive.

3 is the crank-pin of the driving-wheel, and 4 is a crank-arm attached to the crank-pin and traveling therewith as the driving-wheel rotates.

The travel of the valve is imparted by an oscillating variable eccentric 5, which is set on a shaft 6 extending horizontally crosswise of the locomotive and journaled in suitable bearings. The eccentric 5 is shown in Fig. 1 as having the shape of a hollow cylindrical barrel (see Figs. 7 and 8), and the shaft 6 passes diagonally through the barrel, and is made of square or angular shape, so that the barrel can be moved lengthwise thereon for the purpose of varying the travel of the valve, as hereinafter stated. The purpose of making the shaft square or angular is to cause the barrel or eccentric to oscillate with the shaft. The same object may be secured by connecting these parts with a feather and spline connection. A suitable reversing lever (not shown in the drawings) is employed for moving the eccentric longitudinally on the shaft in order to vary its position thereon. The shaft is oscillated by means of a pitman 7, which connects the crank-arm 4 with a crank-arm 8, projecting from the shaft. As the driving-wheel rotates, the revolution of the crank-arm 4 will produce a rotatory oscillation of the crank-arm 8 and shaft 6 with the eccentric 5, which is mounted on the latter. For the purpose of connecting the variable eccentric with the valve 9, I employ an eccentric-strap 10, which surrounds the variable eccentric and is mounted in suitable guides 11, which keep it in a single plane as it is moved by the eccentric. The eccentric-strap is connected with a valve-rod 12 by intermediate mechanism, which may consist of a rock-arm 13, the function of which is to magnify or multiply the throw of the eccentric and to enable an eccentric of small throw and of shorter and more compact size to be employed, and another vibratory arm 14 the function of which I shall explain hereinafter.

As before stated, the variable eccentric 5 is movable longitudinally on its oscillatory shaft 6, within the eccentric-strap 10, which is held from motion endwise of the eccentric by means of the guides 11. When the middle of the variable eccentric is brought opposite to the eccentric-strap 10, the eccentric-strap is then substantially opposite the place where the axis of the eccentric and its axis of rotation coincide, so that no substantial reciprocatory motion is then transmitted to the valve through the eccentric-strap and its connections; but if the eccentric be moved lengthwise, so as to bring the eccentric-strap to points near to its ends, the eccentric-strap and the valve will be caused to move reciprocally by the oscillation of the eccentric, the travel of the valve being the greater as the eccen-

tric-strap is moved farther from the middle point of the eccentric. The valve-travel may therefore be checked and the engine stopped by bringing the middle part of the eccentric opposite to the strap, and the engine may be reversed by bringing the middle of the eccentric to the opposite side of the strap from that on which it is at any given time.

In order to prevent binding of the eccentric within the eccentric-strap and to accommodate the eccentric-strap to the varying positions which the eccentric occupies therein, I interpose between the eccentric and the strap a ring 32, which fits around the eccentric and has its exterior surface shaped like the section of a sphere. The interior of the eccentric-strap is shaped so as to fit the surface of this ring, and the eccentric rotates freely within the ring and is capable of being moved lengthwise therein.

If the parts were constructed as I have described, and the eccentric-strap connected directly with the valve without any means for modifying the action of the motion transmitted by the variable eccentric, the device would not operate satisfactorily because it would not give lead to the valve. For the purpose of giving the lead, I employ a supplementary device which as shown in Fig. 1, comprising a rocking-arm 14, interposed in the connection between the valve 9 and the variable eccentric. In the case shown in Fig. 1, it is pivoted at the middle to the outer end of the rock-arm 13. At one end it is pivotally connected to the valve-rod 12, and at the other end it is pivotally connected to an eccentric-rod 15, which extends from an eccentric-strap surrounding an eccentric or cam 16 on the main shaft. The rotation of this main shaft will rotate the eccentric 16 and will produce a reciprocation of the eccentric-rod 15 and oscillation of the arm 14, thereby producing a motion of the valve-rod 12, which is supplementary to and modifies the motion imparted to said rod by the variable eccentric 5. This supplementary motion gives to the valve the desired lead, which is essential to its proper action. The extent of the lead which is thus given may easily be determined according to the necessities of each case by those skilled in the art, the lead being variable by changing the throw and position of the eccentric on the main shaft, or the length and position of the rock-arm 14.

Instead of imparting the supplementary lead-motion to the valve by an eccentric on the main shaft, it may be imparted by other moving parts of the engine. Thus, in Figs. 5 and 6, I show the rocking-arm 14′ provided with an extension 17 connected to the cross-head 18 of the piston-rod 20, so that the reciprocation of the piston-rod shall rock the arm 14′ with the same result as above described.

The construction shown in Fig. 1 may also be modified by dispensing with the rock-arm 13, and connecting the rod of the eccentric-strap 10 directly to the middle pivotal point of the rocking-arm 14, as shown in Figs. 9 and 10. This construction is not so desirable, however, as that in which the rocking-arm 13 is employed, for said rocking-arm by multiplying the motion of the variable eccentric as above explained, enables the apparatus to be made of much more compact and convenient size than would be possible otherwise.

In the modification shown in Figs. 2, 3, and 4, the variable eccentric is constituted by an oscillatory horizontal shaft having a portion 5′, which is set at an angle to its axis of rotation B, C, and on the shaft 5′ is set a barrel or box 21, which is preferably quadrilateral in cross-section, and is curved in the arc of a circle, whose center is the outer pivotal point of a rod 22, hereinafter described. A sliding collar or strap 23 is set on the barrel 21, and the rod 22, which is pivoted to the arm 13 so as to be capable of a horizontally swinging motion, is provided at its other end with a yoke 24, pivotally connected to the collar by diametrically opposite bolts or pins 25. The yoke is also connected with the rod by a swivel-connection 26, giving to the parts the capabilities of motion of a universal joint. The apparatus, other than as just described, may remain the same as in Fig. 1, and the shaft 5′ is rocked through a crank-arm connected to the crank-arm 4 on the eccentric of the main shaft. As this shaft is rocked, it will impart to the rod 22 a reciprocating motion, and will cause the valve to travel, the length of throw varying according to the distance of the collar 23 from the middle of the barrel. No substantial motion is transmitted when the collar is at the middle point of the barrel. Suitable means (not shown) are employed for moving the collar along the barrel, and thus reversing the motion of the engine or varying the travel of the valve.

Figs. 9 and 10 show a connection between the variable eccentric and the rocking-arm 14 somewhat different from that illustrated in Figs. 1 and 7, in that, instead of using the spherical section-ring 32, I make the eccentric-strap of annular form and connect it with the eccentric-rod 27 by a yoke 28 and a trunnion-connection 29, said yoke having a swivel connection 30 with the rod, thus affording a universal joint. In such case, I may dispense with the guide for the eccentric-strap, and provide the rod 27 with a squared portion adapted to reciprocate in a guide-box 31.

In Fig. 11 I show the apparatus without the arms 13 and 14. In this case, the strap 10 of the eccentric 5 is connected directly to the valve-rod 12, and the supplementary motion is imparted by connecting a projecting arm 33 of said strap to the eccentric 16 by means of a pitman 34 and eccentric strap 35.

Substantial advantages are obtained from the oscillation of the variable eccentric, as distinguished from continuous rotation thereof. It prevents the difficulty resulting from the vertical shifting in position of the driving-shaft, which would impair the action of the

continuously rotating eccentric, and has in its operation no dead center point.

Other advantages of my invention not herein enumerated will be appreciated by those skilled in the art.

I claim—

1. In valve gear for engines, the combination of a valve, a substantially horizontal variable eccentric barrel or shaft of variable throw adapted to impart travel to the valve and connected therewith, means for varying its eccentricity and causing it to reverse the travel of the valve, and a second power connection which connects the valve with one of the moving parts of the engine and is adapted to modify the action of the variable eccentric and to impart lead to the valve; substantially as described.

2. In valve-gear for engines, the combination of an oscillatory variable eccentric barrel or shaft, a connection extending therefrom to the valve, and a second intermediate power-connection which connects the valve with one of the moving parts of the engine, and is adapted to modify the action of the variable eccentric and to impart lead to the valve; substantially as described.

3. In valve gear for engines, the combination of a main valve adapted to connect the steam ports of an engine alternately with the supply and the exhaust ports, a valve-reciprocating mechanism of variable throw, having an interposed rocking arm connected with the valve, and adapted to impart travel thereto, means for varying the throw of the valve-reciprocating mechanism and for reversing its action, and a second power-connection connecting the rocking-arm with one of the moving parts of the engine and adapted to modify the action of the variable reciprocating mechanism and to impart lead to the valve; substantially as described.

4. In valve-gear for engines, the combination of a substantially horizontal oscillatory barrel or shaft of unequal eccentricity relatively to the axis on which it oscillates at different points of its length, and a yoke mounted thereon and connected with the valve, said parts being capable of relative end motion to vary the throw of the eccentric-barrel or shaft, and means for oscillating the latter; substantially as described.

5. In valve gear for engines, the combination of a main valve adapted to connect the steam ports of an engine alternately with the supply and the exhaust ports, a variable eccentric and yoke, a rocking-arm interposed in the connection between the valve and the variable eccentric and adapted to magnify the action of the latter, said variable eccentric being adapted to impart travel to the valve, means for varying its eccentricity and for reversing its action, and a second rocking arm interposed in the connection between the first named arm and the valve, and actuated by one of the moving parts of the engine; substantially as described.

6. In valve-gear for engines, the combination of a rotatory or oscillatory variable eccentric shaft or barrel, a strap thereon, and a valve-rod pivotally connected to the strap, and having also a swivel joint; substantially as described.

7. In valve gear for engines, the combination of a main valve adapted to connect the steam ports of an engine alternately with the supply and the exhaust ports, a variable eccentric and yoke, a rocking arm interposed in the connection between the valve and the variable eccentric, said variable eccentric being adapted to impart travel to the valve, means for varying its eccentricity and for reversing its action and a second rocking-arm interposed in the connection between the first named arm and the valve, and actuated by an eccentric on the engine-shaft; substantially as described.

In testimony whereof I have hereunto set my hand.

H. W. ARMSTRONG.

Witnesses:
W. B. CORWIN,
THOMAS W. BAKEWELL.