(No Model.) 2 Sheets—Sheet 1.

P. B. LANDGRAF.

STEAM ENGINE.

No. 521,504. Patented June 19, 1894.

Fig. 1.

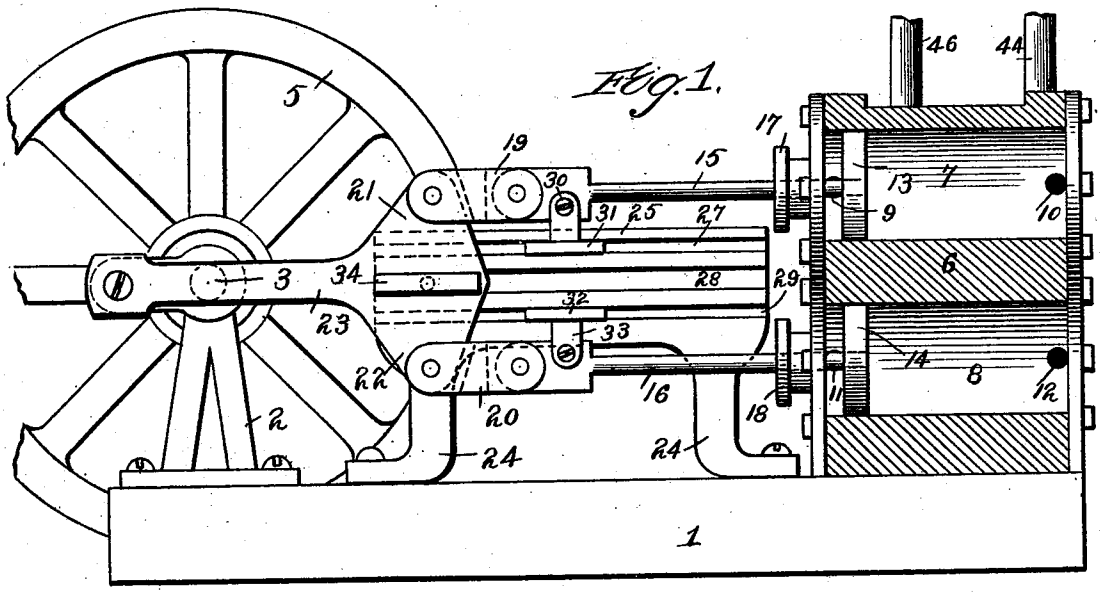
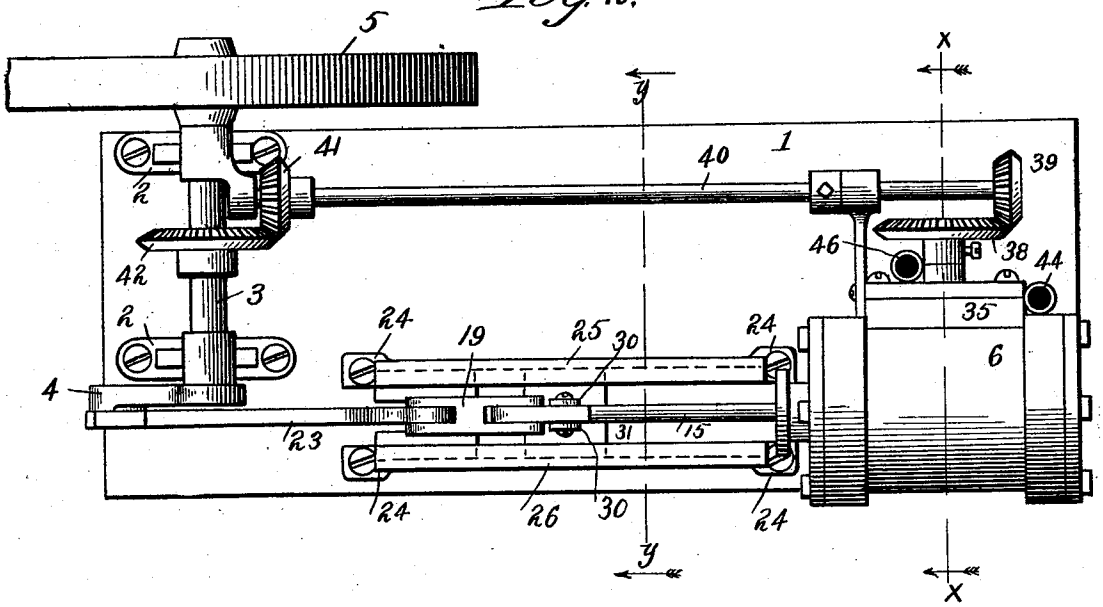


Fig. 2.



Witnesses:
Wm. N. Sheem.
Wm. F. Hemming

Inventor:
Philip B. Landgraf
by Brown & Darby Attys

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

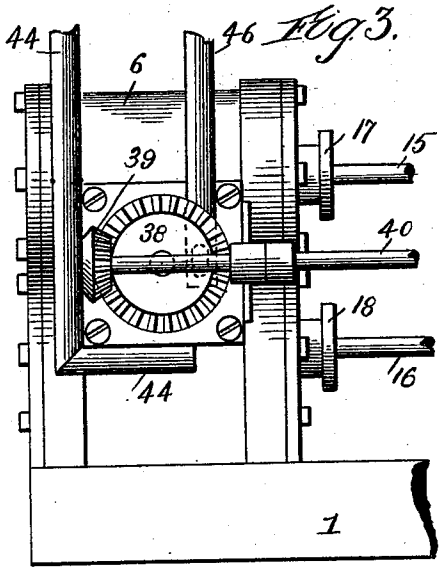


Fig. 4.

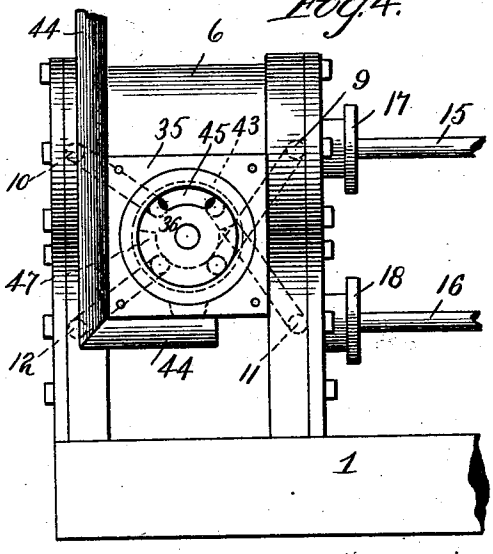


Fig. 7.

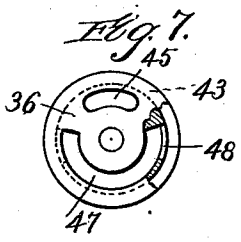


Fig. 5.

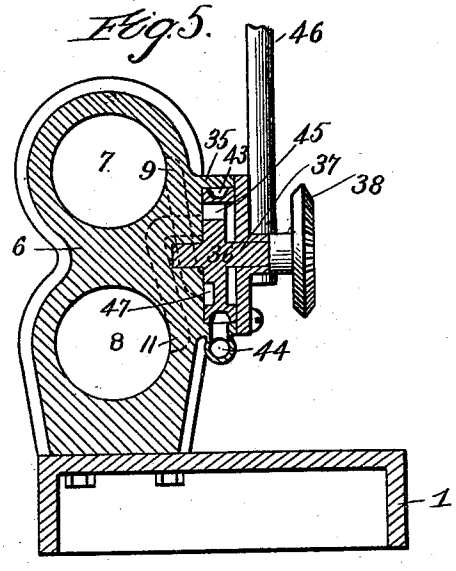
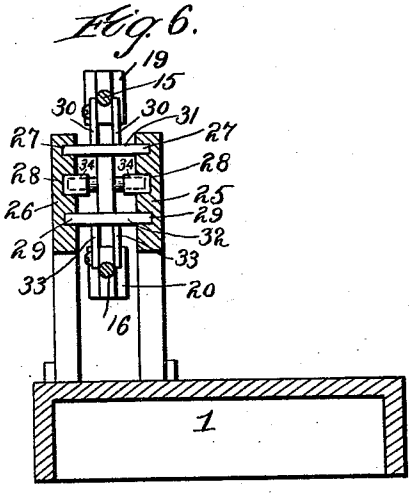


Fig. 6.



Witnesses
Wm. M. Sheem.
Wm. L. Fleming

Inventor:
Philip B. Landgraf
by Brown & Darby Attys

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

PHILIP B. LANDGRAF, OF CHICAGO, ILLINOIS.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 521,504, dated June 19, 1894.

Application filed February 17, 1894. Serial No. 500,452. (No model.)

To all whom it may concern:

Be it known that I, PHILIP B. LANDGRAF, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification.

This invention relates to steam engines, and its object is to provide a construction whereby dead centers are entirely overcome.

A further object is to provide a steam engine simple in construction, efficient in operation and easily manipulated.

A further object is the provision of a novel and efficient valve mechanism for a double cylinder steam engine.

With these objects in view the invention consists in the construction, location of parts and their relative arrangement all as will be more fully hereinafter described, as illustrated in the accompanying drawings and finally pointed out in the appended claims.

Reference is now had to the accompanying drawings forming a part hereof and to the various views thereon and to the numerals of reference, and wherein—

Figure 1 is a side elevation of my improved steam engine, the double cylinders being shown in vertical central longitudinal section and with one of the guide plates for the pistons and connecting rod removed. Fig. 2 is a plan view of my steam engine complete. Fig. 3 is a view in side elevation of the double cylinders and valve operating mechanism, parts being broken off. Fig. 4 is a view similar to Fig. 3, with certain parts removed or omitted. Fig. 5 is a vertical cross sectional view taken on the line x, x, Fig. 2, looking in the direction of the arrows. Fig. 6 is a vertical cross sectional view taken on the line y, y, Fig. 2 and looking in the direction of the arrows. Fig. 7 is a detail view in front elevation of the valve for the double cylinders, a part being broken out to show the connection between the exhaust opening in the face of said valve and the circumferential or peripheral groove therein.

Similar reference numerals refer to similar parts wherever they may occur throughout the several views of the drawings.

1 designates a suitable base plate upon which my improved engine is supported, and to which it is bolted. In suitable standards 2, bolted to the base plate is journaled the main shaft 3. This shaft is provided with the usual crank arm 4 and it also may be provided with the usual fly-wheel, 5, though in some cases the fly-wheel may be dispensed with if desired.

6 designates a single casting for the double cylinders 7 and 8. This casting is suitably bolted or secured to the base plate.

It will be understood of course that while I prefer to cast or form the cylinders in a single casting, they may be formed separately and suitably joined together.

Each cylinder is provided with two steam ports,—top cylinder 7 having the ports 9 and 10 and lower cylinder 8 having ports 11 and 12,—communicating with the interior thereof. Each cylinder is provided with an ordinary piston 13, 14, to each of which is attached a piston rod, 15, 16 passing through suitable stuffing boxes 17, 18. The end of each piston rod is pivoted in the end of a bifurcated link 19, 20, the other end of each link being also bifurcated and pivoted, each to an arm or wing, 21, 22 of the connecting rod 23 which is connected to the crank arm 4 for driving main shaft 3.

Supported in suitable brackets or standards 24 secured or bolted to the base plate are two castings or guide plates 25, 26, provided with registering grooves or guide ways on their inner opposing faces as seen at 27, 27, 28, 28 and 29, 29. A guide plate 31 adapted to slide in the pair of registering grooves or guideways 27, 27, on the inner or meeting faces of plates or castings 25, 26, is suitably attached to and depends from upper piston rod 15, or to a flattened head on the end thereof, by means of two ears or lugs 30, 30, as clearly shown in Figs. 1, 2 and 6 of the drawings. A similar guide plate 32 is attached to and projects vertically from the lower piston rod 16, or a head on the end thereof, by means of similar ears or lugs 33 and said plate is adapted to be received and guided in the pair of registering grooves 29, 29, on the inner or meeting faces of the castings or plates 25 and 26 as clearly shown in Figs. 1 and 6. On each face of the end of the connecting rod 23, farthest from crank arm 4 is pivoted a guide flange or plate 34, 34. These

guide flanges are adapted to be received and guided in the grooves 28, 28, in the casting or guide plates 25, 26.

By the construction above described the pistons and the connecting rod are accurately guided and steadied in their reciprocations and at the same time a slight oscillation of the connecting rod is permitted, and thus is produced an exceedingly effective and at the same time a simple construction, and by this construction in connection with the valve arrangement presently to be described, the provision of complicated, easily disarranged, objectionable and expensive mechanism for overcoming dead centers is entirely obviated, for in the present construction the dead centers are overcome by the action of the engine itself.

The construction, location and relative arrangement of the valve gear will now be described.

On the face of casting 6, is cast a valve chest 35, adapted to receive valve 36. Ports 9 and 10 of cylinder 7 and 11 and 12 of cylinder 8 communicate with this valve chest at equi-distant points in a circular path as clearly shown in Fig. 4. It will be observed that each pair of steam ports 9 and 10 of cylinder 7, for instance communicate at diagonally opposite points with the steam chest. The same is true of the pair of ports 11 and 12 and the purpose of this arrangement will presently appear more fully.

Circular valve 36 is adapted to be received in the valve chest and is suitably journaled to rotate therein. This valve is provided with an outwardly projecting hub 37 adapted to receive thereon a gear wheel 38 adapted to mesh with gear-wheel 39 on shaft 40, journaled in suitable bearings and carrying on the other end thereof a gear wheel 41, meshing with a gear 42, mounted on main shaft 3. The rotation of the main shaft is thus transmitted through gear wheels 41, 42, shaft 40, gears 39 and 38, to the rotary valve 36, as will be readily understood by reference to Fig. 2. Valve 36 is constructed with a circumferential or peripheral groove 43, which serves as an exhaust passage. An exhaust pipe 44 communicates with steam chest 35 at the lower part thereof and at a point directly in communication at all times with exhaust passage 43 formed in the periphery of valve 36. A circular slot 45 is formed through valve 36 and the length thereof is slightly greater than the distance between two contiguous steam ports 9, 10, 11 and 12 opening into the steam chest. Live steam is admitted to the steam chest through any suitable pipe as 46, and passes through the opening 45 in valve 36 into the ports 9, 10, 11 and 12, as will more clearly hereinafter appear. A groove 47 is formed on the inner face of valve 36 and is adapted to be continually in communication with at least two of the steam ports 9, 10, 11, 12 during the rotations of the valve. This groove is in constant communication with the peripheral groove 43 as clearly shown at 48, Fig. 7; but does not communicate with that part of the valve chest which receives live steam from the inlet supply pipe 46.

The operation is as follows: Supposing the valve to be in the position shown in Fig. 4, that is, when the pistons and connecting rod have reached the inner limit, as shown in Fig. 1, of their stroke. Steam is admitted to steam chest 35 through opening or pipe 46. It passes through opening or slot 45 in valve 36 and a portion of the steam enters the upper cylinder through port 10, and a portion enters the lower cylinder through port 11. The steam admitted to the upper cylinder performs work on the rear face of the piston head and thus exerts a pushing action, while the steam admitted to the lower cylinder through port 11 performs work on the opposite face of the piston head in said cylinder and exerts a pull on its piston rod. The combined action of this push on one piston and pull on the other at the point where said rods have reached the limit of their outward stroke and consequently when the crank is on its dead center, causes the connecting rod to be tilted and thus forced off the dead center. This action causes a slight rotation of the main shaft which rotation is communicated to the valve which thereupon closes port 10 and admits a constantly increasing supply of steam to the lower cylinder through port 11 until a full head of steam is admitted to said cylinder by the entire opening of said port. During the time live steam is being admitted to the two cylinders through ports 10 and 11 the other ports 9 and 12 are in communication with the exhaust grooves or passages 47, 43 and exhaust pipe 44. When steam is cut off from port 10 by the rotation of valve 36, the crank arm is traveling through the first quarter of its rotation from the horizontal, and the entire load is carried by the lower cylinder; this continues to be the case until the valve reaches a point in its rotation where it admits steam to port 9, Fig. 4. This occurs when the crank arm has reached its extreme lowest point of travel. In the mean time port 10 is opened into exhaust passage 47 permitting the upper cylinder to exhaust. The entire load then shifts to the upper cylinder until the opposite dead center is reached. The reverse of the action above described then takes place, the point where the crank is on its dead center corresponds to the point in the rotation of the valve where steam is admitted at the same time to ports 9 and 12, thus causing an outward pull on the piston head in the upper cylinder, which cylinder has up to that time been carrying the load, and a push on the piston in the lower cylinder, to which the load is upon further rotation of the valve transferred. It will thus be seen that upon each complete revolution of the main shaft and consequently of the valve, the load is completely shifted four times, twice to each cylinder.

While I have shown the connecting rod provided with an enlarged or flanged head to which the links 19, 20, are pivoted I do not desire to be limited thereto as any other suitable construction may be employed to effect the same result. I may also in the case of large engines designed to do heavy work, strengthen said connecting rod by means of suitable braces if it should be necessary to do so.

In lieu of the specific gearing shown for transmitting rotary motion to the valve I may employ any other suitable gearing for accomplishing this object.

Any ordinary reversing mechanism may be employed for reversing the engine and it runs as well in either direction.

As reversing mechanisms are well known I have not deemed it necessary to illustrate any specific form thereof.

I may also, in cases where it may be desirable, substitute a slide valve for the rotary valve shown without departing from the spirit and scope my invention.

Many other variations may be made without departing from the spirit and scope of my invention and therefore I desire to be understood as not limiting myself to the exact details of construction shown and described.

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

1. In a steam engine a rotary valve having a peripheral groove, an opening for live steam and a groove for the exhaust steam; as and for the purpose set forth.

2. In a steam engine a rotary valve having a peripheral groove in constant communication with the exhaust pipe, a slot therethrough in constant communication with a source of live steam, and a groove on the inner face thereof communicating with said peripheral groove; as and for the purpose set forth.

3. In a double cylinder engine having ports for each cylinder, a valve chest, a steam pipe connection for admitting steam to said chest, a valve seated in said chest having a slot through which the live steam may pass into the cylinders, and also provided in one face with a groove in constant communication with an exhaust passage, and means for moving said valve; all substantially as and for the purpose set forth.

4. In a double cylinder engine a valve chest, two steam ports for each cylinder communicating with said valve chest at equi-distant points in a circular path, the ports of each cylinder communicating at diagonal points in said chests, a valve having a live steam opening therein of a length slightly greater than the distance between two contiguous openings of the said ports, and also having suitable exhaust passages, means for operating said valve, and suitable steam and outlet pipes all combined and arranged as and for the purpose set forth.

5. In a steam engine provided with double cylinders, pistons arranged in said cylinders, a steam chest, suitable steam and exhaust connections communicating therewith, a pair of steam ports for each cylinder communicating with said steam chest at diagonally opposite points said points of communication being equi-distant from each other in a circular path, a rotary valve having a slot therethrough for the passage of live steam, of a length slightly greater than the distance between the openings of two contiguous cylinder ports, and also having a groove on its inner face in constant communication with the exhaust connection and with two or more of said openings thus forming an exhaust passage as and for the purpose set forth.

6. In a double cylinder a valve chest, two steam ports for each cylinder communicating with said chest, said points of communication being arranged at equal distances apart in a circular path, the two openings of each cylinder being arranged diametrically opposite each other, steam supply and exhaust pipes and a valve having a single live steam opening and suitable exhaust passages; as and for the purpose set forth.

7. In a double cylinder steam engine the combination with cylinders, piston rods, main shaft and connecting rod having pivotal connection on opposite sides of a central longitudinal line thereof with each of said piston rods, of a single valve for controlling the admission of steam to each cylinder, adapted to admit live steam simultaneously to one end of one cylinder and to the opposite end of the other cylinder at each dead center; as and for the purpose specified.

8. In a steam engine the combination of the cylinder, piston rod, connecting rod, main shaft, a rotary valve for controlling the admission and exhaustion of steam to and from the cylinder, having a hub projecting through the valve chest, a gear mounted on said hub outside of said chest and suitable gearing intermediate the main shaft for driving said gear and rotating said valve; as and for the purpose specified.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, this the 14th day of February, 1894.

PHILIP B. LANDGRAF.

Witnesses:
S. E. DARBY,
J. LAWRENCE GERRY.