2 Sheets--Sheet 1.

J. LEWIS.

Locomotive-Engines.

No. 133,321. Patented Nov. 26, 1872.

Fig 1.

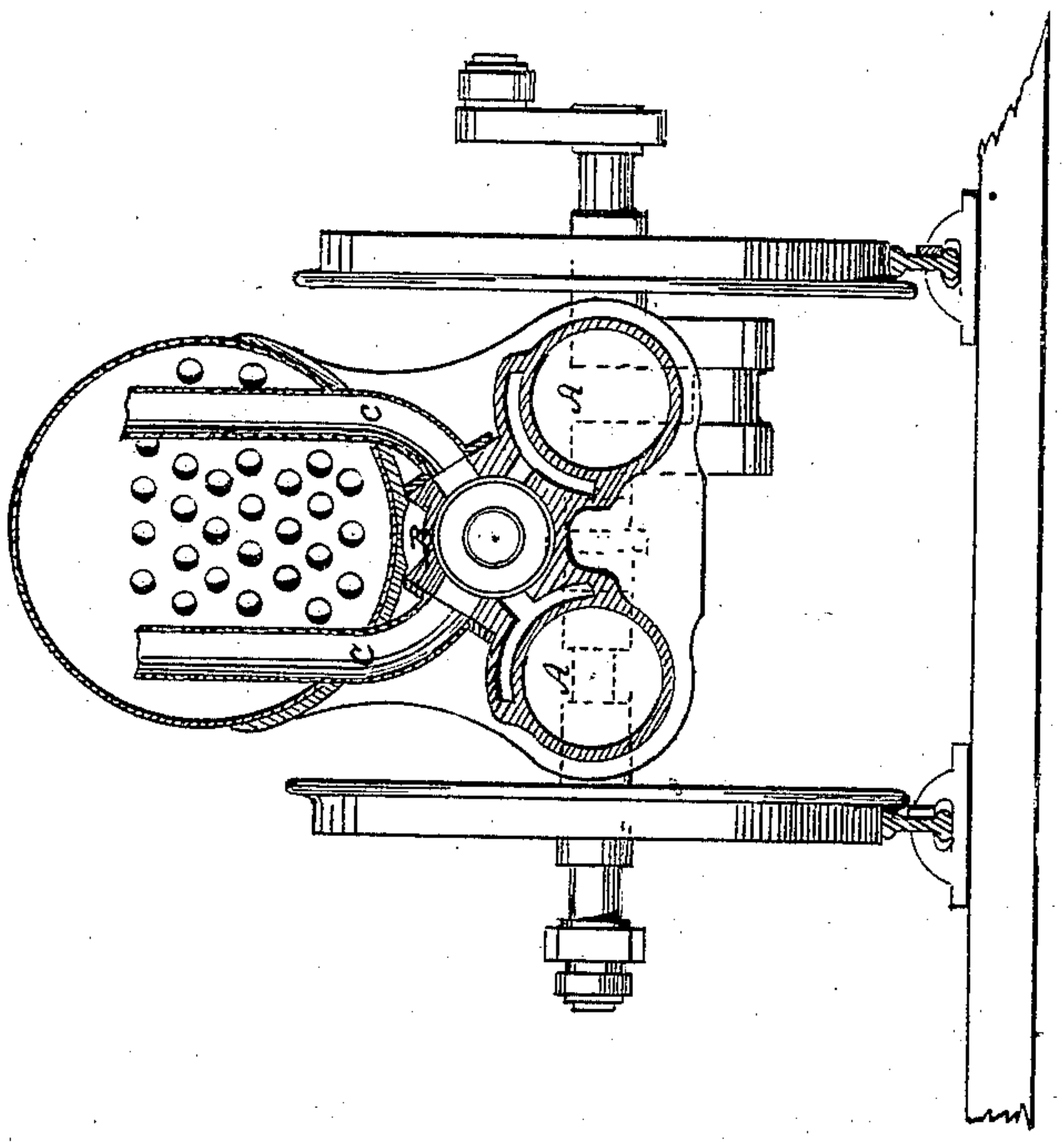


Fig 2.

Witnesses:

Heinrich F. Bruns.

John W. Munday

Inventor:

Joseph Lewis

2 Sheets--Sheet 2.

J. LEWIS.

Locomotive-Engines.

No. 133,321. Patented Nov. 26, 1872.

Fig 4.

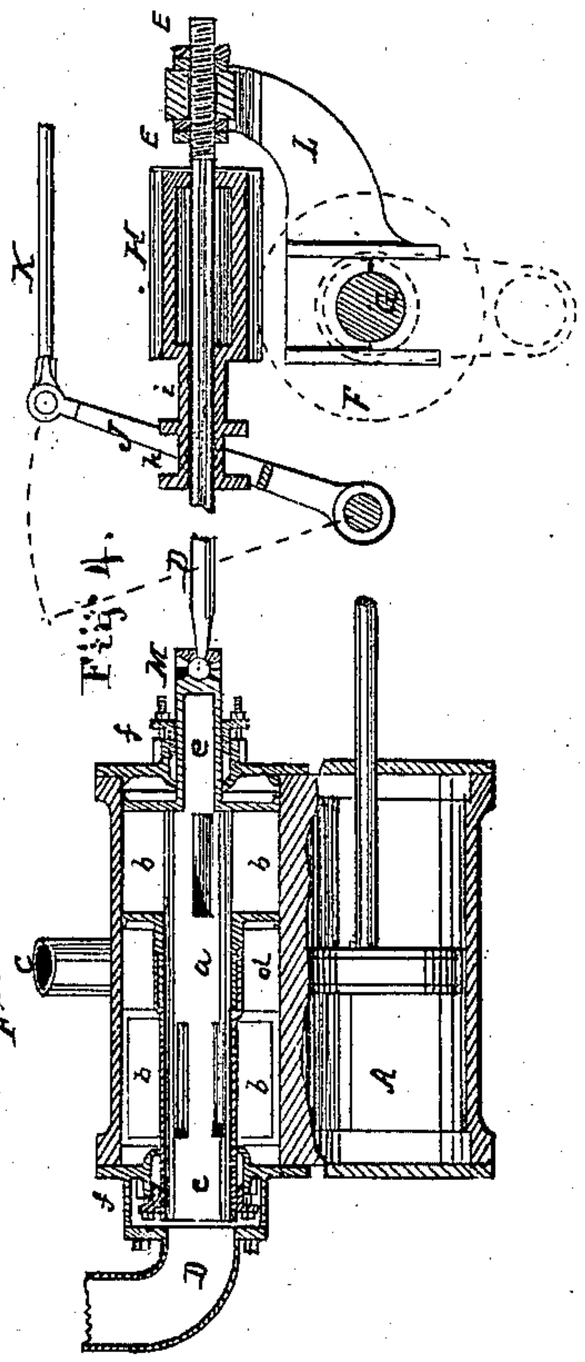


Fig 6.

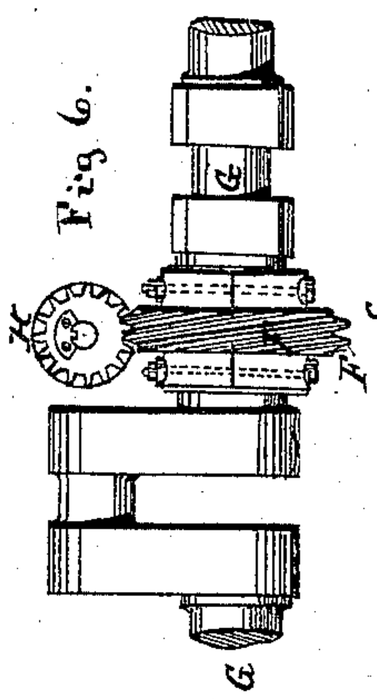


Fig 5.

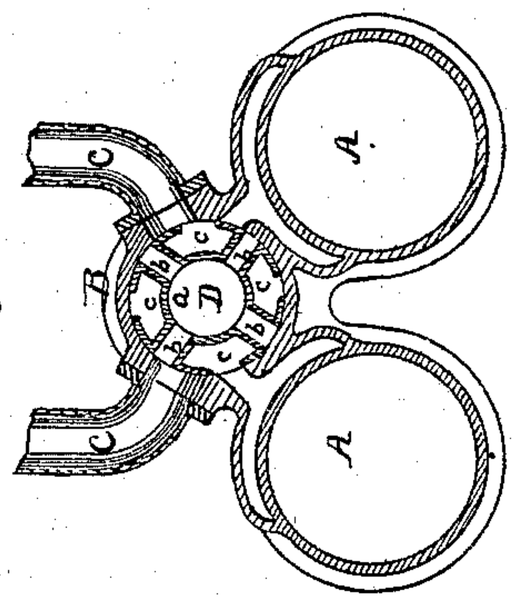
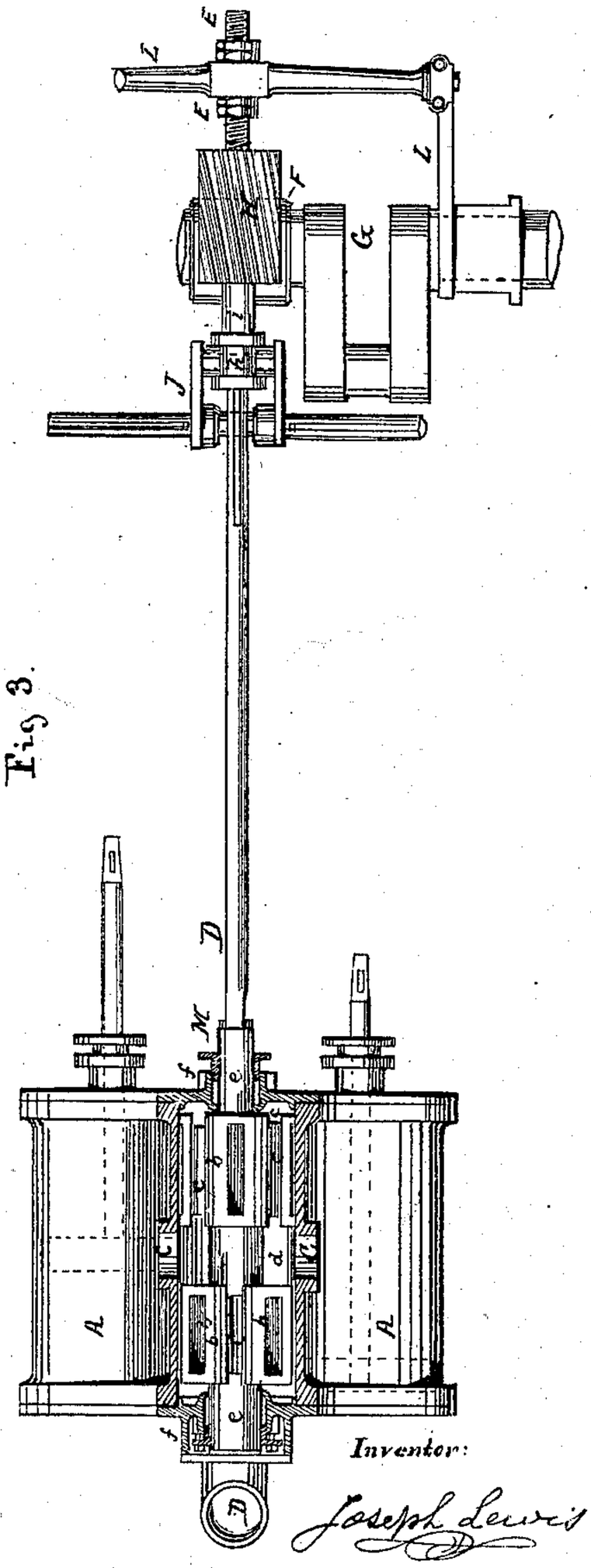


Fig 3.



Witnesses:

Heinrich L. Bruns.

John W. Munday

Inventor:

Joseph Lewis

UNITED STATES PATENT OFFICE.

JOSEPH LEWIS, OF MANCHESTER, ENGLAND.

IMPROVEMENT IN LOCOMOTIVE-ENGINES.

Specification forming part of Letters Patent No. **133,321**, dated November 26, 1872.

To all whom it may concern:

Be it known that I, JOSEPH LEWIS, of Manchester, England, have invented certain Improvements in Locomotive-Engines, of which the following is a specification:

Nature of the Invention.

The object of this invention is to simplify the valve-gear of locomotive-engines, and thereby the general construction of the machine.

The ordinary slide-valve commonly employed in locomotives is well known to be very defective, and the valve-gear, link-motion, eccentrics, &c., complicated and expensive, consuming a large amount of power in friction, creating a necessity for frequent and expensive repairs.

This invention proposes to abandon entirely the present system of valves and valve-gear and to substitute a new system, which consists in the employment of one rotating equilibrium-valve, placed between the two cylinders and parallel therewith, the two cylinders and valve being brought close together, so that the cranks upon the driving-shaft will be as near as possible to the center of the track, thus lessening the oscillation caused by the alternating revolution of said cranks, and consequently lessening the strain and wear produced by said oscillation. The value of the "inside" cylinder system—that is, placing the cranks between the wheels instead of outside—is well understood as being safer and running steadier at high rates of speed, and would be generally adopted, but with the ordinary slide-valve gear, consisting of so much machinery, it is almost impossible to crowd it in between the wheels and make it sufficiently strong, rendering, in any event, cleaning, oiling, and adjustment difficult and tedious, even where the gage is broad enough to make such disposition of the machinery practicable.

By using a single rotating valve to supply both cylinders I am enabled to condense the actuating and reversing gear into a small compass, applied to the center of the crank-shaft between the cranks, leaving ample room for the cranks without crowding upon a narrow-gage engine; and this combination and arrangement constitute the first part of my invention. The second part of my invention consists in a novel mechanism for actuating the rotating valve from the crank-shaft by means of a long and short screw gear or worm and pinion attached one to the crank-shaft and one to the shaft of the rotating valve, the pinion being arranged to slide on its shaft by means of levers to change the lead of the valve and reverse the engine acting on the worm fixed on the center of the crank-shaft, as will be hereinafter more fully explained. The third part of my invention relates particularly to the rotary valve made in two parts, as will be explained. The fourth part of my invention relates also to the valve; and consists in constructing the steam-passages to take steam at both ends and in the middle, and the employment of four or more such passages in each valve to reduce the surface speed, as will be explained. The fifth part of my invention consists in making the the rotary valve slightly conical from end to end, and swung in stuffing-boxes or their equivalents, to allow of a longitudinal adjustment to accommodate the unequal expansion and contraction, as will be hereafter explained. The sixth part of my invention relates to the method of connecting the valve-shaft and actuating mechanism by means of a ball-and-socket or universal joint, to prevent the disarrangement incident to the motion of the engine, as will be explained.

In the accompanying drawing which forms a part of this specification, Figure 1 represents an end view of part of a locomotive, showing the cylinders and valve-casing in cross-section, illustrating my invention applied to inside cylinders. Fig. 2 is a similar view of the same applied to an outside-cylinder engine. Fig. 3 represents a top or plan view of the cylinders and driving and reversing gear, showing the valve in horizontal section. Fig. 4 is a central longitudinal section of Fig. 3, showing also one of the cylinders in section. Fig. 5 is a transverse vertical central section of the cylinders and valve, and Fig. 6 is a view of a portion of the crank-shaft and valve-shaft driving and reversing gear.

Like letters of reference made use of in the several figures indicate like parts.

To enable those skilled in the art to make and use my invention, I will proceed to describe the same with particularity, making use in so doing of the aforesaid drawing by letters of reference thereto.

General Description.

A A represent the cylinders, and B the valve-casing. These cylinders and valve-casing are placed beneath the boiler and relatively in the position they occupy at Fig. 1 of the drawing, the valve being placed between the cylinders and a little above or below them. The rotary equilibrium-valve, which fits into the casing B, is constructed so as to supply and exhaust from both cylinders. C C are the induction-pipes, and D the exhaust-pipe, exhausting from the hollow center of the valve. The valve consists of a cylindrical tube, *a*, with radial hollow arms, *b*, extending out to the valve-casing and forming passages for conveying the exhaust steam from the ports to the interior of tube *a*. Between these radial arms are alternating spaces, *c*, communicating with a central annular space, *d*, forming steam-passages. The radial arms and alternating spaces are arranged at each end, so that the spaces of one end come in line with the arms of the other, so that an exhaust is presented at one port of a cylinder, while a supply-passage is presented at the other. This peculiar arrangement of arms and spaces makes the valve very difficult to cast with precision. I therefore make it in two parts, to fit one within the other, making that portion of the tube *a* at the annular space *d* of double thickness, one slipping over the other. This construction enables me to adjust the parts to the greatest nicety to one another, and to the ports in the cylinders, before securing them together, insuring a perfect action and lessening the labor of construction. The passages or spaces *c* are constructed so as to take steam at both ends and at the annular space *d*, a communication being had around the ends of the arms *b*. This arrangement gives a most perfect balance to the valve. The expansion and contraction of this class of valves by heat are most serious difficulties to overcome, especially in a locomotion-engine. To obviate this difficulty of unequal expansion and contraction between the valve and its casing, I make the aperture in the casing and the valve very slightly conical, say about three-sixteenths of an inch in a length of thirty inches, more or less, and swing the valve by its trunnions *e e* in stuffing-boxes *f f*, which I prefer to pack with asbestus packing. In this condition the valve is movable longitudinally upon the trunnions. Now, by a proper means, I move the valve back longitudinally until the surfaces are no longer in contact, and space enough left between the said surfaces of the valve and casing to allow for their unequal expansion and contraction, and I fix the parts permanently in this position. The space necessary between the two at all sides to work free and safe under all temperatures and pressures, I find, by experiment, to be less than one five-hundredth part of an inch, and that the loss of steam occasioned by this intentional leakage is less in quantity than one-sixth part of that consumed in overcoming the friction of the two slide-valves, eccentrics, and link-motions of an ordinary locomotive-engine valve-gear; and the additional advantage is gained that the escape of steam thus between the surfaces acts as a lubricator, and keeps the surfaces free from grit and dirt and gumming of oil, prevents, to a great extent, pounding in the cylinders, and, the surfaces not being in actual contact, gives to the valve an indefinite durability, rendering it almost perfectly frictionless and balanced. The slight loss of steam directly up the chimney by this want of contact is unimportant compared with the many advantages thus gained.

To adjust the valve as above, perfectly and truly, the end of the valve-shaft D, at its outer bearing, may be cut with a thread, and lock-nuts E E applied. The valve is made with four supply and four exhaust passages at each end, and is so placed relatively to the cylinders that the steam is fed and received in proper succession while the valve revolves in one direction.

The valve could be made with two or six or eight supply and exhaust passages at each end; but I prefer to make four, because of a peculiar advantage of timing the revolution of the valve and crank-shaft, and a distribution of power is thus gained. It is obvious that the more passages there are around the circumference of the valve the slower must its motion be compared to that of the crank-shaft. In the valve with four steam and four exhaust passages, above mentioned, the valve revolves once while the crank-shaft four times.

The means employed for revolving the valve are as follows: F is a worm-wheel, having four threads, and is affixed rigidly to the center of the crank-shaft G to revolve therewith. H is an elongated worm-pinion with sixteen teeth upon the valve-shaft D. The worm F engaging the pinion H revolves the valve in the proportion of one to four. The elongated pinion H is fitted by grooves and keys to slide longitudinally upon the shaft, and, being constantly in mesh with the teeth of the worm F, said pinion cannot be moved along its shaft in either direction without a partial revolution, by reason of the diagonal course of its teeth; sliding it backward or forward must necessarily turn the valve so as to alter its relative position to the ports. And this is equally true whether the engine is in motion or still, as is sufficiently obvious. By this simple means of sliding the pinion upon the worm, I am enabled to change, as above, the relative position of the valve to the ports—in other words, change the lead on the valve and reverse the movement of the engine in a manner corresponding precisely to the reversal and change by the link-motion in ordinary slide-valve gear; but by far simpler means and with much greater accuracy and precision and gradation.

To bring the sliding pinion in command of the engine-driver a groove, *h*, is made upon

the elongation *i* at the front of the pinion H, which is engaged by a lever, J, from the free arm of which extends a rod, K, back to the cab of the engine at the driver's hand, being fitted there with the customary lock-lever and graduated arc.

It is evident from the above that to produce the reverse motion in this or any other rotating valve, without deranging the other connections with the crank, it is only necessary to have a convenient means of revolving the valve in either direction just sufficient to change the lead on the ports. The method shown in the drawing is the most advantageous on account of the convenience of applying the fixed narrow worm-wheel, which takes up so little space upon the crank-shaft. But in outside-cylinder engines, or where, by reason of other circumstances, there is space enough, it is obvious that an equivalent mechanism would be to employ a short pinion fixed on the valve-shaft in lieu of the elongated sliding pinion, and to slide the worm-wheel sidewise upon the crank-shaft. Where practicable this is indeed the simpler arrangement.

To retain the worm and pinion in gear under the vibration and motion of the locomotive, the outer end of the shaft D is borne in a framework, L, from the axle-boxes of the crank-shaft, and its inner end is attached to the trunnion of the valve by a ball-and-socket joint, M.

Although the mechanisms hereinabove described are particularly adapted to locomotive-engines, it is obvious that they may be applied to engines and motors of various kinds with like good effect.

Claims.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, with a rotary valve, of a worm-pinion upon the valve-shaft and a worm-wheel upon the crank-shaft, when the pinion is fitted to slide upon the valve-shaft engaging a fixed worm upon the crank-shaft, or when the worm is fitted to slide upon the crank-shaft engaging a fixed pinion upon the valve-shaft, constructed and operating substantially as specified.

2. The rotary valve for locomotive-engines, made at each end with four supply-passages, *c*, taking steam at both ends and in the middle at the annular space *d*, and with four exhaust-passages, *a*, as described and shown.

3. The conical rotary valve, swung in the conical valve-casing by trunnions in stuffing-boxes, or by equivalent means, and movable longitudinally within the casing, so that the space between the surfaces may be adjusted, for the purpose and substantially as specified.

4. The combination of the rotary valve, valve-shaft D connected thereto by a ball-and-socket or universal joint, M, and borne in a frame, L, at the other end, and the gear-wheels H F borne upon the valve-shaft and crank-shaft, respectively, substantially as and for the purpose specified and shown.

JOSEPH LEWIS.

Witnesses:
JOHN W. MUNDAY,
HEINR. F. BRUNS.