2 Sheets—Sheet 1.

J. B. EADS.

CONVERTING MOTION.

No. 51,815. Patented Jan. 2, 1866.

Fig. 4.

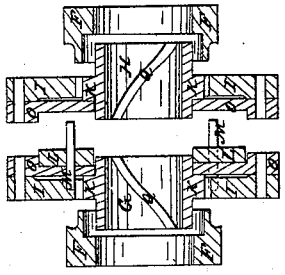


Fig. 5.

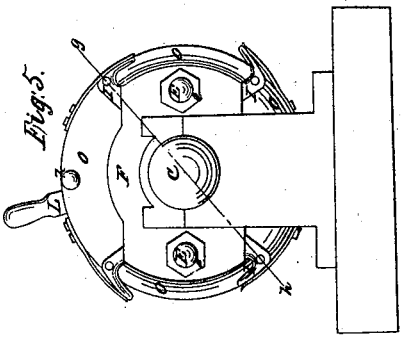


Fig. 1

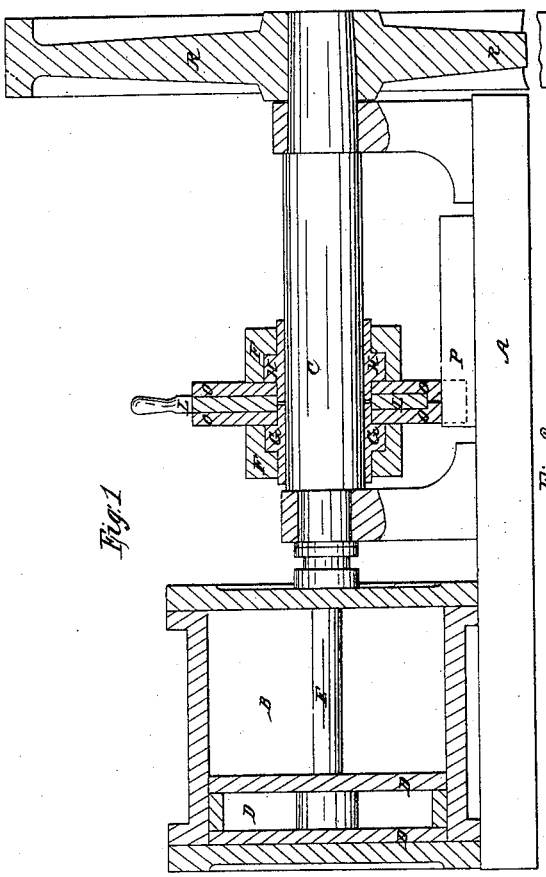
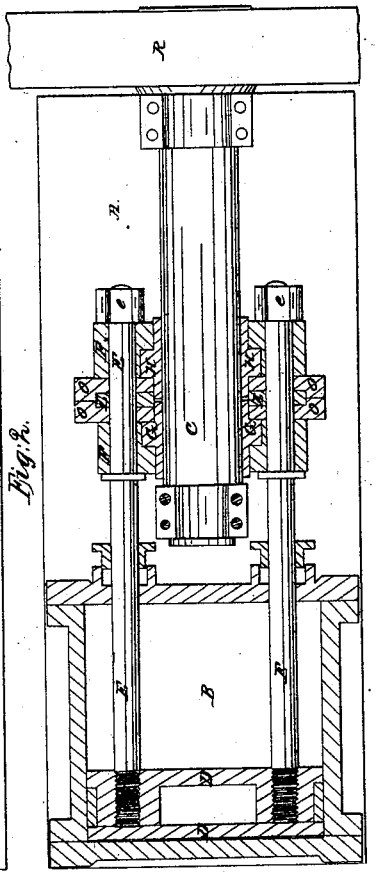


Fig. 2.



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2 Sheets—Sheet 2.

J. B. EADS.

CONVERTING MOTION.

No. 51,815. Patented Jan. 2, 1866.

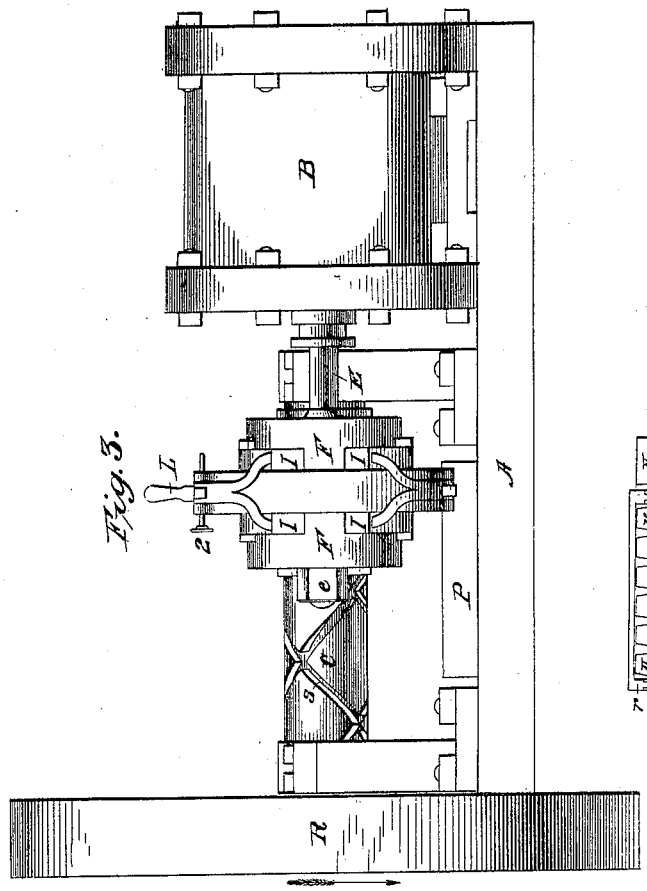
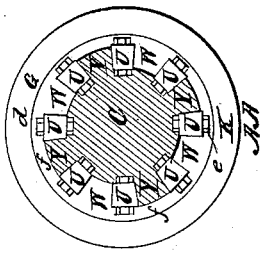


Fig. 5.



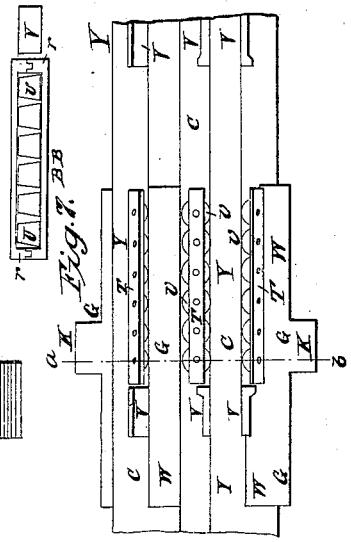


Fig. 7. Fig. 8.

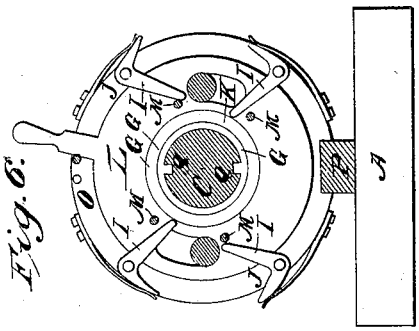
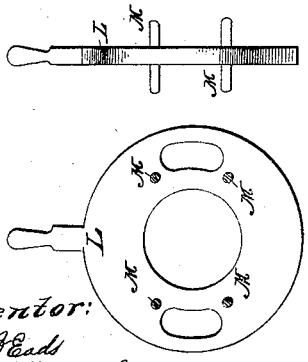


Fig. 6.



Witnesses:
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UNITED STATES PATENT OFFICE.

JAMES B. EADS, OF ST. LOUIS, MISSOURI.

IMPROVED METHOD OF CONVERTING A RECTILINEAR MOTION INTO A ROTARY MOTION.

Specification forming part of Letters Patent No. **51,815**, dated January 2, 1866.

To all whom it may concern:

Be it known that I, JAMES B. EADS, of the city and county of St. Louis, in the State of Missouri, have invented a new and useful Method of Converting a Rectilinear Motion into a Rotary Motion, which is applicable to steam and other engines, and to other mechanical purposes; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being to the accompanying drawings, making a part of this specification, in which—

Figure 1 represents a longitudinal vertical section of a steam-engine constructed upon my improved method, the section being made through the axis of the cylinder and shaft. Fig. 2 represents a sectional plan of the same engine, the section being made likewise through the axis of the cylinder and shaft. Fig. 3 represents a side view of the same engine. Fig. 4 represents a longitudinal section through the two nuts and the parts immediately appertaining to them, by which the shaft is caused to revolve, the parts being opened to give a better view of them. Fig. 5 is an end view of the engine, the fly-wheel from that end being removed. Fig. 6 is a representation of the manner of reversing the rotation of the shaft, and shows the means by which the nuts are kept from revolving in one direction while left free to turn in the other. Fig. 7 shows a method of using friction-rollers between the nuts and the shaft, by which the friction against the threads or grooves on the shaft may be avoided.

To enable those skilled in the art make and use my invention, I will now proceed to describe the same with reference to the drawings.

The letters of reference in all the figures will refer to the same parts on each of the figures where those parts appear.

The bed-plate A is made to sustain the cylinder B and the shaft C, the axes of the two latter parts being coincident.

To the piston D are secured the two piston-rods E E, Fig. 2. The other ends of these rods pass through the parts or nut-holders F F, which are securely held on the rods between the collars, on the latter and the nuts *e e*. Within the nut-holders F F are retained the nuts G and H. These are made free to turn within the holders F F when they are not held by the pawls or stops I I or J J, Figs. 3, 4, 5, and 6. Each nut has four of these stops, two of which are used on opposite sides of it, to press against the flange or raised part of the nut K, Figs. 4 and 6, and prevent the nut, by jamming, from turning in one direction, while it is left free to turn in the other.

By moving the two pawls I I from each nut and letting the other two, J J, Fig. 6, come in contact with the nut, the direction of its rotation is at once reversed, and as the nuts and shaft must constantly turn in the same direction the motion of the shaft is at once reversed. These pawls are thrown out or brought in contact with the nuts by the circular piece L, through which the four pins M M M M, Figs. 4 and 6, are inserted, the ends projecting on either side of L, and so placed that when ring L is turned a little in one direction two of these pins lift four pawls J J, Figs. 4 and 6, while the other four, I I I I, are left in contact with the nuts. When L is moved in the opposite direction the four pawls I I I I will be raised and J J be lowered into contact with the nuts. The pawls may be held to this contact by springs, as shown on Fig. 6. They may also be increased in number, and their shape may be so modified as to make the same one act in either direction. The piece L is held in its place by being inclosed within the plates O O, and within which it is made to move freely so far as to lift one set or the other of the pawls. The plates O O have a groove cut through them at the bottom in the line of their axes, which groove fits over the guide P, fastened to the bed-plate and parallel with the shaft, the object of which is to prevent the plates O O and the nut-holders F F from rotating when the piston moves the nuts back and forth on the shaft. These plates O O hold the pins to which the pawls are secured, and on which they vibrate when moved by the piece L.

On the shaft C are chased four spiral grooves, two turning in one direction and two in the opposite direction. These grooves are seen on the shaft on Fig. 3 and in dotted lines on Fig. 2. In one pair of these grooves the nut G has its threads Q Q, Figs. 4 and 6, fitted, and into the other pair of grooves, S S, are fitted the threads of the nut H.

The threads of the screws may be upon the shaft, if desirable, and may be many in num-

ber and of any desired length. They may also be placed each set on a different portion of the shaft, so as not to cross each other, in which case the parts shown on Fig. 4 would be modified to suit the same.

By increasing the pitch of the screws a larger proportion of the power of the steam or element used in the cylinder will be developed, as the friction produced by the thrust of the shaft against the rests in which it rotates will be inversely as the pitch.

From the foregoing description it will be readily seen that when the piston D moves the nut-holders F F in the direction of the fly-wheel R, the nut G, being moved over the shaft, will be turned in one direction, and the nut H, similarly moved, will be turned in the opposite direction, the shaft meanwhile remaining still. Now, if the piece L be moved so as to throw one set of pawls in contact with each nut, only one of the nuts will be held from turning, both sets of pawls thrown in acting in but one direction, while the nuts act in opposite directions. The result will be that the nut which is held from turning will, as it is moved toward the wheel R, cause the shaft to turn in the opposite direction from which this nut would be turned if it were released, and therefore in the same direction in which the other nut is turning. We will suppose the nut G to be held by the pawls while being driven toward the wheel R. This wheel and shaft will then be forced to turn in the direction of the arrow on the said wheel, Fig. 3, while the nut H, corresponding in the grooves S S, will turn not only with the shaft, but more rapidly, in proportion as the grooves wind around the shaft with greater or less pitch. If these grooves make half a turn around the shaft in the length of the piston's stroke, the nut G will have caused the shaft to make half a revolution, while the nut H, making this half-revolution by being turned with the shaft, makes still another half-revolution by being moved throughout the length of the stroke in the spiral direction of the grooves S S. The instant that the piston moves in the other direction the action of the nuts is reversed. If the nut H were not held by its pawls it would revolve in a direction opposite to that of the arrow; but being firmly stopped by them it compels the shaft to continue revolving in the direction of the arrow. The nut G being released goes through the same operation just explained with reference to H, and is brought back to its starting-point again, having made one entire revolution on the return-stroke. Thus the shaft is kept revolving continually, one-half revolution to each stroke, while the nuts, making no part of a revolution, while alternately forcing the shaft round, make each one an entire revolution when being returned to their respective starting-points of work.

It will be seen that if the piece L be moved so as to bring one set of pawls in contact with each nut, the shaft, whether in rest or motion, can only be turned in the one direction permitted by those pawls, but will rotate freely in that direction, so that if the shaft carry a wheel possessing sufficient momentum there will be no stop at the instant of reversing the direction of the piston, and much less momentum will be necessary to accomplish this than in the crank-engine, because the rotating force is applied throughout the entire stroke, causing the last instant of the half-revolution to be made as rapidly as any other part of it. A weight which would overcome all momentum of the wheel R could be nevertheless wound up by this engine passing the dead-points without difficulty, while the same thing would be impossible with the single-crank engine.

The pawls may or may not be made to catch in indentations or teeth on the surface of the nuts. If properly made they will be sufficiently effective on a plane surface by their friction, which will be increased by the resistance. The nuts may be likewise held by a system of teeth cut in them at their ends, or on the sides of the flange K. A clutch fitting in these would be arranged in the nut-holders E E, and these clutches would be alternately thrown out or in, according as each nut was required to hold. L, when moved, is retained by the keeper Z. A continuous rotary motion of the shaft may be produced with one nut alone, used as described, in connection with the fly-wheel or with pawls, to prevent the shaft from turning back, applied to it just as they are to the nut.

At Fig. 7 I have shown a method whereby the friction between the nut and the shaft may be greatly lessened. The grooves or threads of the shafts are drawn parallel with the axis of the shaft, instead of spirally around it (as they of course would be) for the purpose of illustration only, and so as the more easily to show the manner of introducing the friction-rollers U U between the threads of the nut and the shaft. A A represent a section of the nut, shaft, and eight of the rollers, on the line *a b* of Fig. 7. The shaft C is represented in the shading, the nut G in black, and the rollers U in yellow.

Fig. 7 is a side view of the shaft with one-half of the nut, excepting the threads of the same, removed, by which the threads of the nut, as at W W, are run between the friction-rollers, the latter being retained between the two threads Y Y and Y Y of the shaft. The friction-rollers are retained in their respective positions by the bars T T, Figs. 7, and B B, into which the axles of the rollers are inserted. As some difficulty would present itself in having these axles inserted in neatly-fitting sockets in the two bars when spirally made, the sockets can be made so large as to admit of collars or bushings being put on the axles from the outside when the rollers are put between the bars, and they will be retained in their places by the nut and the shaft, leaving nicely-fitting pivots. The rollers and bars

which hold them will, of course, only make half the length of stroke made by the nut, and they will be kept from displacement by the bars coming in contact with the stops V V, placed at the proper distances from each end of the bars and secured to the shaft.

The friction caused by the longitudinal thrust upon the shaft, and existing in the rests of the same, may be prevented by the use of friction-cones, as they are used to prevent friction at this time on many propellers navigating the ocean, by receiving the thrust of the screw. By the use, however, of two cylinders and two pairs of nuts arranged to act in opposite directions at the same time and upon the same shaft, this friction may be entirely avoided. In this manner the momentum of the pistons and nuts, with their casings and rods, would be counteracted by each other, and thus the alternating of their movements would cause some of that vibratory motion of the crank-engine so unprofitable and so destructive to the machinery. One or both of these cylinders could be made with hollow piston-rods and annular pistons, the shaft passing through one or both cylinders, or both of them might be placed with their axes coincident with each other and with the shaft—one at each end of the shaft, or both at one end.

The nut-holders and plates O O, which form the casing in which the nuts are held, may be prevented from turning without the use of the guide P by placing guides on each side of the casing, and between the rubbing-surfaces rollers may be introduced to prevent friction; or the casing may be kept from turning by being held by the usual combinations of rods and levers used to produce parallel motion in other engines, and well known to all engineers.

By my method of constructing engines, as described, greater lightness, more compactness, increased strength, and greater regularity of motion can be obtained than in any form of the crank-engine known, and with greater simplicity of the parts, and at less cost. Every portion of it admits of being made by machinery, thus facilitating the construction thereof.

I have shown no method of reversing the valve or valves of the cylinder, as any of the known methods are applicable to the form of engine described. Cams for the purpose may be used on the shaft; but I should prefer the method used in the cylindrical steam fire-engine, where the steam and water pistons are placed similarly to the piston and nut-casing herein described.

It will readily be seen that if the nut-casing be permanently held upon rests upon which it can freely rotate, and the shaft were moved back and forth through it without being permitted to turn, the effect would be to revolve the casing instead of the shaft. Hence, if to the piston D we attach only a single central piston-rod, and to the end of this rod we secure that portion of the shaft C upon which the spiral grooves are cut, and support the casing with the nuts and their pawls, as described, upon rests. upon which it will rotate with its axis coincident with that of the piston and shaft, we may convert a rectilinear motion of the shaft in a line with its axis, into a circular one of the casing and nuts, pawls, &c., if the shaft be prevented from turning as it is forced by the piston back and forth through the nuts. The rotary motion thus produced may be made available by surrounding the casing with a band-wheel or a circular rack, from which the power could be emitted; or the casing might form the head of a shaft whose axis would be placed coincident with that of the nuts and steam-cylinder.

With pawls applied to keep the casing from turning back, or with a fly-wheel for the same purpose, a continuous rotary motion will be produced by one nut alone, the screw forcing it round throughout one stroke, and the momentum of the fly-wheel continuing the rotation during the return-stroke if no fly-wheel be used.

Having thus fully described my invention, what I desire to secure by Letters Patent is—

The converting of a rectilinear motion into a rotary one by the use of nuts, screw-shafts, and pawls or stops, substantially as described.

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Witnesses:

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