

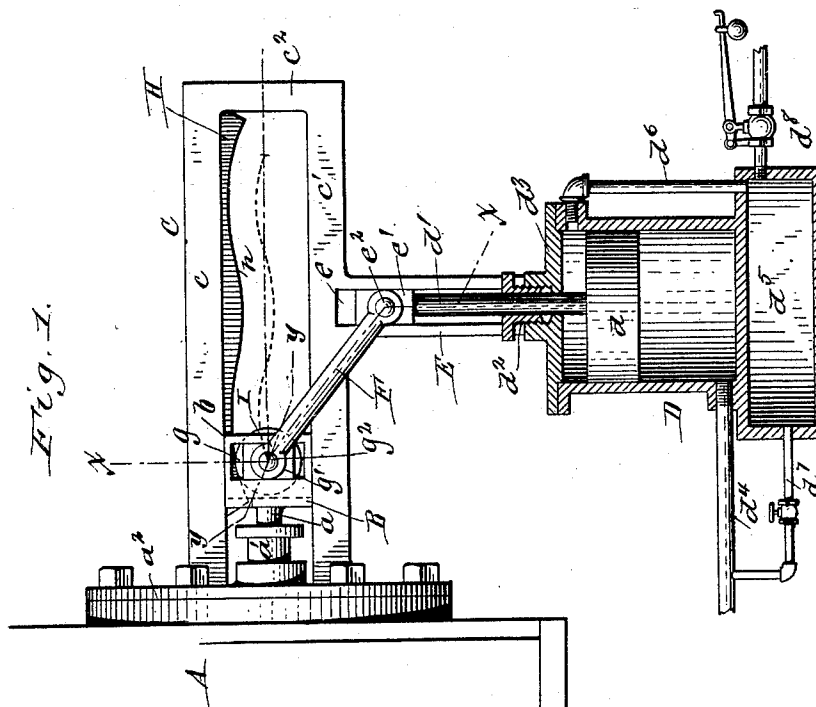
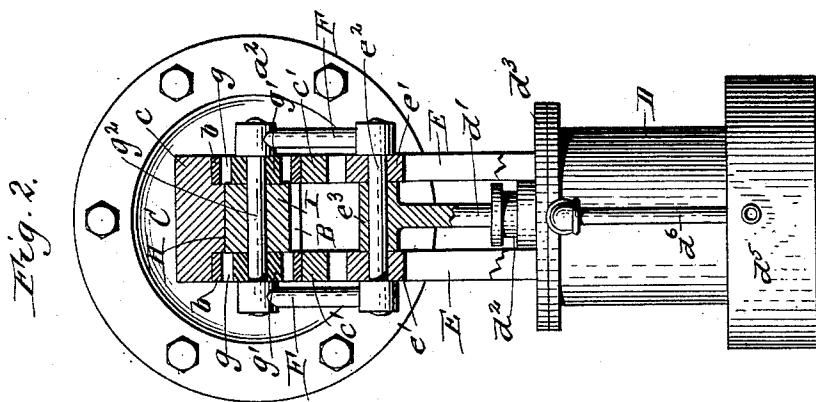
(No Model.)

2 Sheets—Sheet 1.

F. F. NICKEL.
DIRECT ACTING ENGINE.

No. 465,676.

Patented Dec. 22, 1891.



Witnesses:

Theo. L. Popp.

Emel Neuhart.

Franz F. Nickel,

Inventor.

By Wilhelm Hönne,

Attorneys.

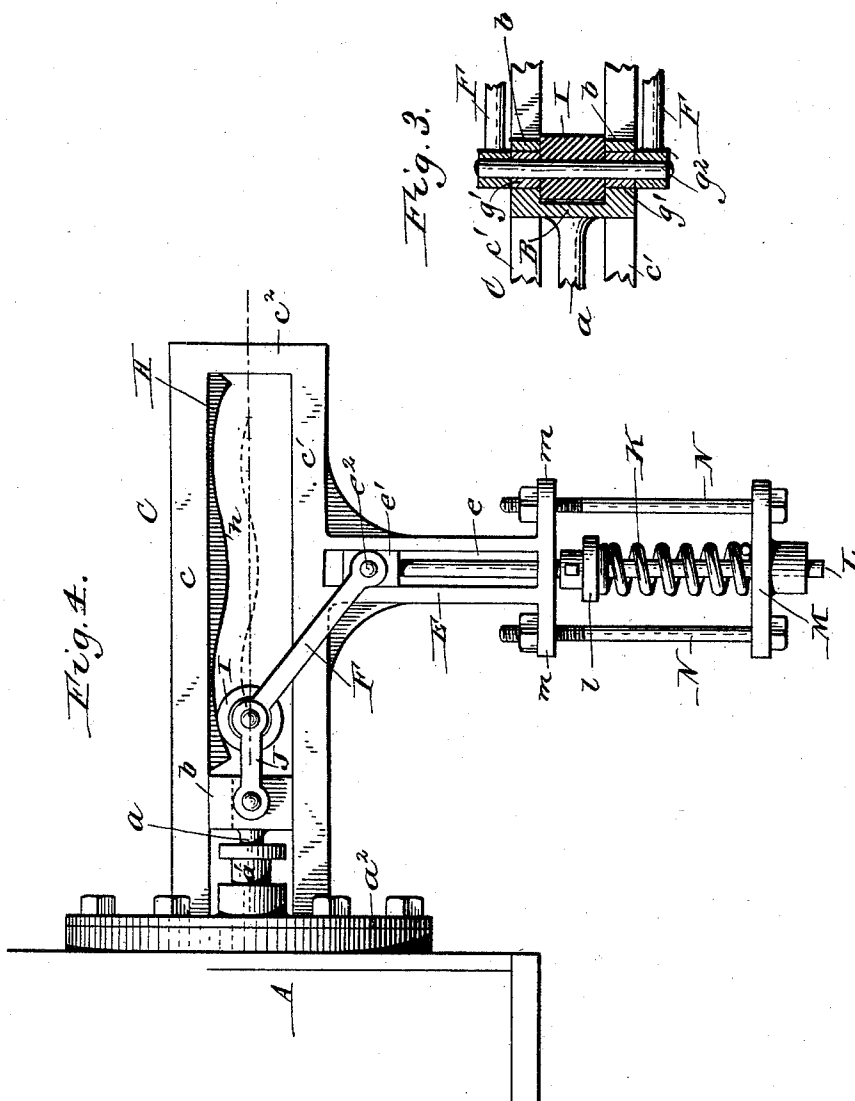
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UNITED STATES PATENT OFFICE.

FRANZ F. NICKEL, OF BUFFALO, NEW YORK.

DIRECT-ACTING ENGINE.

SPECIFICATION forming part of Letters Patent No. 465,676, dated December 22, 1891.

Application filed September 10, 1891. Serial No. 405,258. (No model.)

To all whom it may concern:

Be it known that I, FRANZ F. NICKEL, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Direct-Acting Engines, of which the following is a specification.

This invention relates to a direct-acting engine employing a compensating device which acts in opposition to the main piston during the first part of the stroke and in conjunction therewith during the last part of the stroke, thereby permitting the steam-supply to the main cylinder to be cut off after a part of the stroke has been made, the stroke being completed by the expansive force of the steam in the cylinder, aided by the gradually-increasing assistance offered by the compensating device. Heretofore this has been accomplished by oscillating compensating cylinders, having pistons connected with the piston-rod of the main steam-piston; but this construction contains numerous moving parts which soon become worn and require frequent repairing. It has also been proposed to employ a stationary cylinder arranged at right angles to the main steam-cylinder and having its piston connected with the piston of the main steam-cylinder by a link; but this causes an irregular movement of the main piston.

The object of my invention is to provide mechanism whereby the angle of the rods connecting the main piston-rod with the piston of a stationary compensating cylinder is controlled at different parts of the stroke so as to vary the effectiveness of these rods, thereby causing the engine to move with a more uniform and regular stroke.

In the accompanying drawings, consisting of two sheets, Figure 1 is a side elevation, partly in section, of one end of a direct-acting engine-cylinder provided with my improved compensating device. Fig. 2 is a vertical cross-section thereof in line *xx*, Fig. 1. Fig. 3 is a fragmentary horizontal section in line *yy*, Fig. 1. Fig. 4 is a fragmentary elevation representing a modified construction of my compensating device.

Like letters of reference refer to like parts in the several figures.

A represents the end of the horizontal cyl-

inder of a direct-acting engine, and *a* is the main piston-rod, which passes through a stuffing-box *a'* in the head *a*² of said cylinder. 55

B represents a cross-head secured to the outer end of the main piston-rod and provided on opposite sides with forwardly-extending cheeks *b b*.

C represents a horizontal guide-frame, in which the cross-head of the main piston-rod is guided. This guide-frame consists of parallel bars *c c'*, having guideways which bear, respectively, against the upper and lower sides of the cross-head and are secured at their inner ends to the head of the cylinder and are connected at their outer ends by a vertical bar *c*². 60

D represents the compensating cylinder, which is arranged at right angles to the main cylinder below the horizontal guide-frame and midway between the ends of the reciprocating movement of the main cross-head. 65

d represents the piston of the compensating cylinder, and *d'* its piston-rod, which passes upwardly through a stuffing-box *d*². 70

*d*¹ is a pipe connected with the lower end of the compensating cylinder, whereby steam, water, air, or other fluid under constant pressure is admitted into the compensating cylinder below the piston. 75

*d*³ represents a tank arranged underneath the compensating cylinder and receiving the fluid which is expelled from the upper part of the compensating cylinder through a pipe *d*⁶ when the compensating piston moves upwardly. The tank *d*³ serves to make the whole arrangement adjustable. A pipe *d*⁷ supplies it with part of the motor-fluid until that pressure is obtained for which the safety-valve *d*⁸ is set. This pressure acts upon the upper side of the compensating piston in opposition to the pressure of the motor-fluid. The difference between these two pressures is then the effective pressure. By adjusting the weight on the safety-valve the pressure in the tank, and with it the effective pressure, will be changed. 80

The upper end of the compensating piston rod is guided in its vertical movements by vertical guide-frames E, arranged on opposite sides of said rod and extending from the lower bars *c'* of the horizontal guide-frame to the upper head of the compensating cylinder. 85

These guide-frames E are provided with vertical ways e , which receive sliding bearings or blocks e' , secured by a transverse pin e^2 to a cross-head e^3 , formed at the upper end of the compensating piston-rod.

F represents connecting-rods, whereby the cross-heads of the main piston-rod and the compensating piston-rod are connected. These connecting-rods are arranged on opposite sides of the horizontal and vertical guide-frames, and are pivoted with their lower ends to opposite ends of the pin e^2 , passing through the cross-head of the compensating piston-rod.

g g represent vertical guideways formed in the cheeks b b of the main cross-head, and g' g' are sliding bearings or blocks arranged in said ways. The upper ends of the connecting-rods are pivoted to these sliding blocks g' by a pin g^2 , passing transversely through these blocks.

H represents a longitudinal guide-rib formed on the under side of the upper bar c of the horizontal guide-frame and provided on its under side with an undulating or serpentine bearing-face h , whereby the inclination of the connecting-rods E is controlled, so as to produce a uniform movement of the main piston during its entire stroke.

I represents an anti-friction roller, which is journaled upon the pin g^2 , between the sliding blocks g' , and bears against the undulating face of the rib H, which extends over the entire distance through which the roller reciprocates. The undulating surface rises gradually at the beginning from the normal straight line in which the main piston-rod reciprocates to about one-sixth of the stroke, then descends gradually until it crosses the normal line at about one-third of the stroke, then passes below the normal line until it reaches the middle of the stroke, then rises and crosses the normal line at about two-thirds of the stroke, and continues to rise above said line to about five-sixths of the stroke, then descends again, and terminates in the normal line at the end of the stroke. The curvature on the front and rear sides of the middle of the undulating surface is identical, so that the effect upon the roller and the connecting-rods in traveling over the same is alike in both the forward and backward stroke of the main piston.

Assuming the parts to be in the position represented in Fig. 1, the engine-piston in commencing its stroke travels from left to right. During the first part of the stroke the power developed in the main steam-cylinder is resisted by the pressure of the fluid in the compensating cylinder against the lower side of the compensating piston, which resistance is transmitted to the main piston-rod by the connecting-rods. The parts are so proportioned that the opposition of the compensating cylinder is greatest at the beginning of the stroke. As the main piston-rod advances the angle of the connecting-rods gradually decreases, and

the latter are thereby rendered less effective in their opposition to the forward movement of the main piston-rod. When the engine has made one-half of its stroke, the connecting-arms are brought into a vertical position at right angles to the main piston-rod, and thus offer no resistance to the main piston-rod. As the main piston-rod proceeds upon its stroke the operation is reversed and the pressure upon the compensating piston aids the main piston-rod and offers gradually-increasing assistance to the end of the stroke, owing to the constantly-changing angle of the connecting-rods in favor of the compensating cylinder. During the return stroke of the engine the operation is precisely the same.

It has been found in practice that the angle which the connecting-rods assume at the beginning of the stroke causes them to offer too great a resistance to the main piston-rod, while near the middle of the stroke the straightening of the connecting-rods causes the main piston-rod to obtain too great a leverage over the compensating cylinder, thereby producing an irregular stroke of the engine. This irregular action of the compensating cylinder is avoided by the undulating face h , against which the roller at the upper ends of the connecting-rods bears, and which causes the angle between the connecting-rod and the direction in which its upper end moves to be different from what it would be if the roller or the upper point of connection traveled in a straight line.

Again assuming the parts to be in the position represented in Fig. 1, the upper ends of the connecting-rods are carried upward during the first sixth of the stroke by the roller which travels against the upwardly-curved portion at the beginning of the undulating face, thereby shifting the angle of the connecting-rods into a position in which they are less effective in resisting the forward movement of the main piston-rod. As the main piston-rod proceeds the upper ends of the connecting-rods are carried downwardly until they are in the normal line at about one-third of the stroke. As the main piston-rod approaches the middle of the stroke, the upper ends of the connecting-rods are carried below the normal line, which compels the main piston to force the compensating piston down a greater distance than it would if the upper ends of the connecting-rods traveled on the normal line. After the main piston has passed the middle of its stroke the operation is reversed and the upper ends of the connecting-rods travel upwardly on the incline of the undulating face, thereby rendering the compensating cylinder more effective than it would be if the upper ends of said rods traveled in the normal line. At about two-thirds of the stroke of the main piston-rod the upper ends of the connecting-rods cross the normal line and then pass above the same to about five-sixths of the stroke, after

which the upper ends of the connecting-rods are again carried downwardly and finally reach the normal line at the end of the stroke.

By carrying the upper ends of the connecting-rods downwardly toward the end of the stroke the effectiveness of the compensating cylinder does not increase as fast as it would if the movement took place in the normal line. By carrying the upper ends of the connecting-rod above and below the normal rectilinear line in which the main piston-rod reciprocates, the advantage which the main piston-rod and compensating cylinder gain over each other at different parts of the stroke is so modified as to produce a uniform movement of the main piston during its entire stroke. During the return stroke from right to left the angle of the connecting-rods is modified in the same manner as in the forward stroke. As different forms of direct-acting engines will present different conditions, the undulating face may be varied to meet the requirements of each particular case.

As represented in Figs. 1, 2, and 3, the upper ends of the connecting-rods are made vertically movable in the main cross-head. This construction may, however, be modified. For instance, in the modified construction represented in Fig. 4 the upper ends of the connecting-rods are connected to the main cross-head by links J. In the construction represented in Figs. 1 and 2 the compensating pressure is derived from a fluid acting upon a piston in a compensating cylinder. Spring-pressure may be substituted for the fluid-pressure, as represented in Fig. 4, in which K represents a coil-spring, which surrounds a vertical presser-rod L. The spring bears with its upper end against a collar I, secured to the presser-rod L, and with its lower end against a cross-head M, movably mounted upon the lower end of the presser-rod and connected to ears m m, formed on the vertical guide-frame by bolts N N. By tightening or loosening the bolts the tension of the spring can be regulated.

I claim as my invention—

1. The combination, with the main cylinder, its piston and piston-rod, and a compensating presser-rod arranged at an angle to the main piston-rod, of a connecting-rod movably attached to the piston-rod and the presser-rod,

and a guide whereby the angle of the connecting-rod is modified to produce a uniform movement of the main piston, substantially as set forth.

2. The combination, with the main piston-rod and a compensating presser-rod arranged at an angle to the main piston-rod, of a connecting-rod pivoted with one end to said presser-rod and movably attached with its opposite end to said piston-rod, and a guide whereby the upper end of the connecting-rod is shifted so that its angle is modified during the stroke of the piston-rod, substantially as set forth.

3. The combination, with the main piston-rod having a reciprocating movement and a compensating presser-rod having a reciprocating movement at right angles to the main piston-rod, of a connecting-rod pivoted at one end to the presser-rod and movably attached at its opposite end to the main piston-rod, and a guide-frame provided with an undulating guide, against which the movable end of the connecting-rod bears, whereby the angle of the connecting-rod is modified during the reciprocating movement of the main piston-rod, substantially as set forth.

4. The combination, with the main piston-rod provided with sliding bearing-blocks, of a compensating piston-rod, a connecting-rod pivoted with its opposite ends to said bearing-blocks, and the compensating rod and a guide-frame having an undulating guide which shifts the sliding blocks during the stroke of the main piston-rod, substantially as set forth.

5. The combination, with the main piston-rod having a cross-head provided with guide-ways and sliding bearing-blocks arranged in said ways, of a compensating piston-rod arranged at right angles to the main piston-rod, a connecting-rod pivoted at one end to the compensating rod and pivoted with its opposite end to the sliding bearing-blocks by a pin, a guide-frame provided with an undulated guide, and a roller mounted on said pin and resting against said guide, substantially as set forth.

Witness my hand this 31st day of August, 1891.

FRANZ F. NICKEL.

Witnesses:

JNO. J. BONNER,
FRED. C. GEYER.