(No Model.)

N. E. NASH.

VALVE GEAR FOR DUPLEX STEAM PUMPS.

No. 402,100. Patented Apr. 23, 1889

Fig. 1.

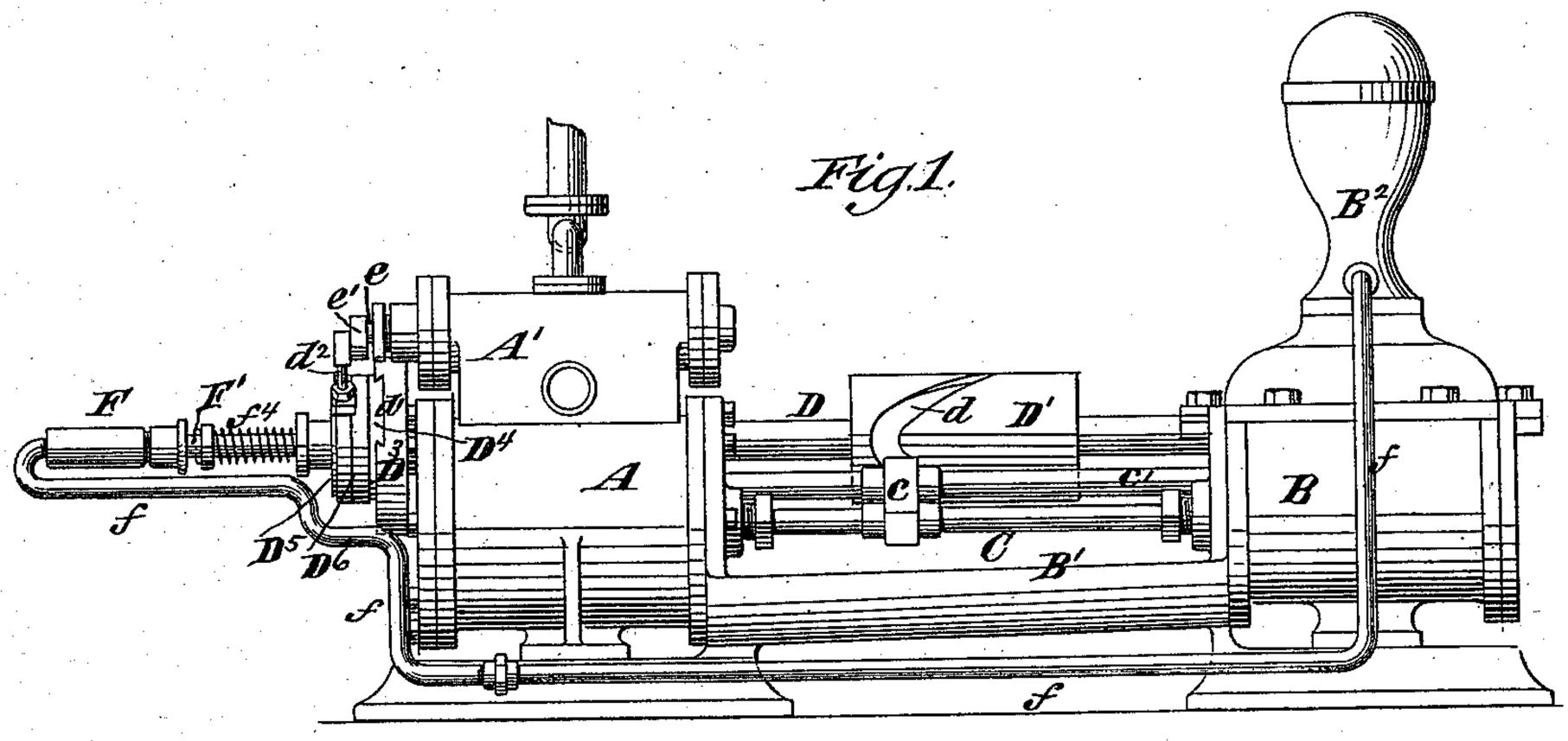


Fig. 2.

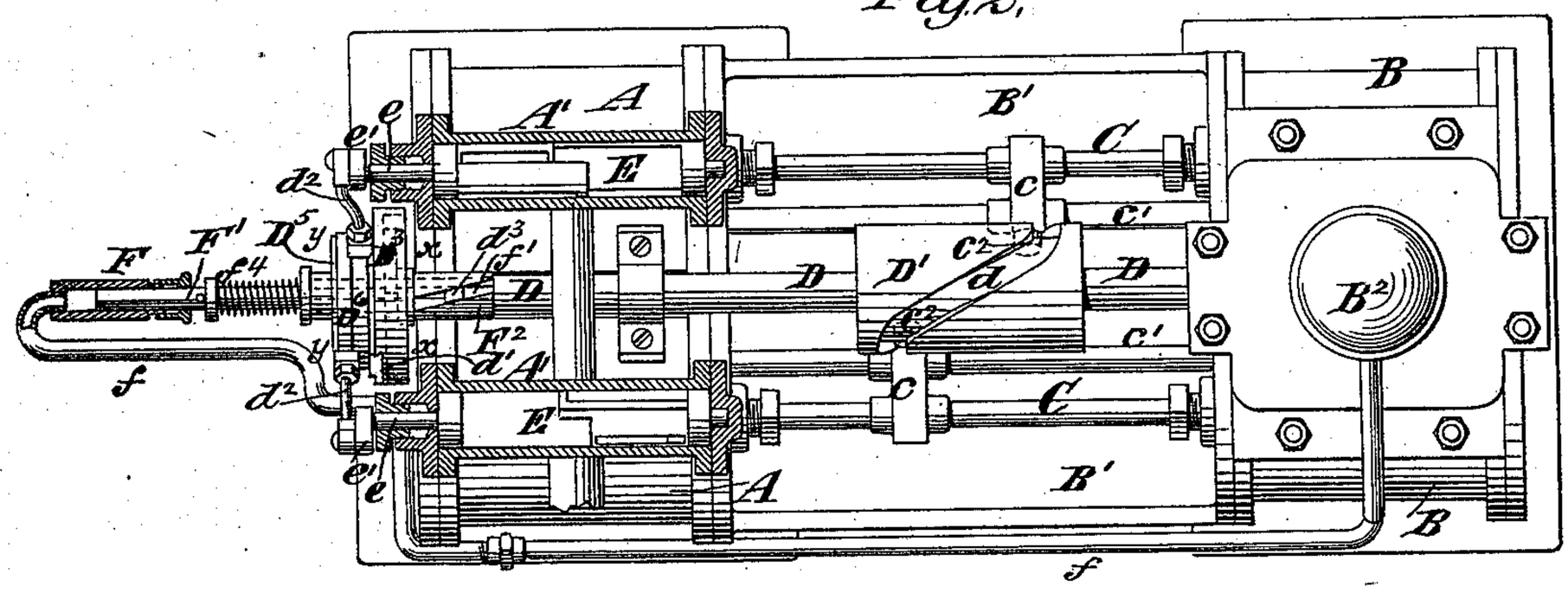


Fig. 4.

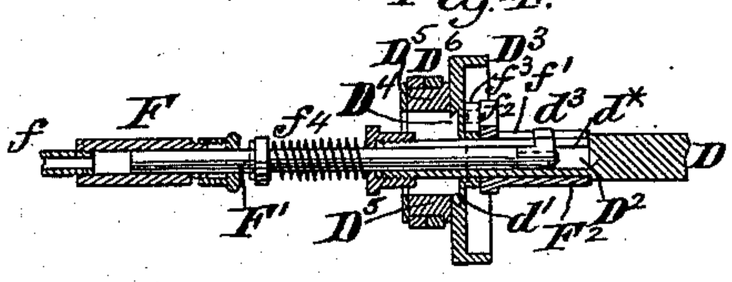


Fig. 5.

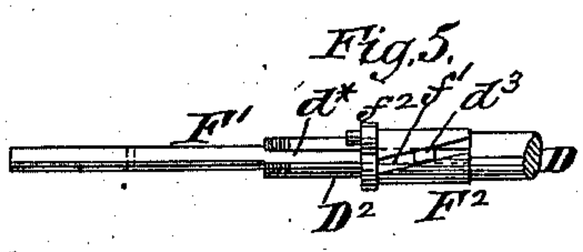


Fig. 3.

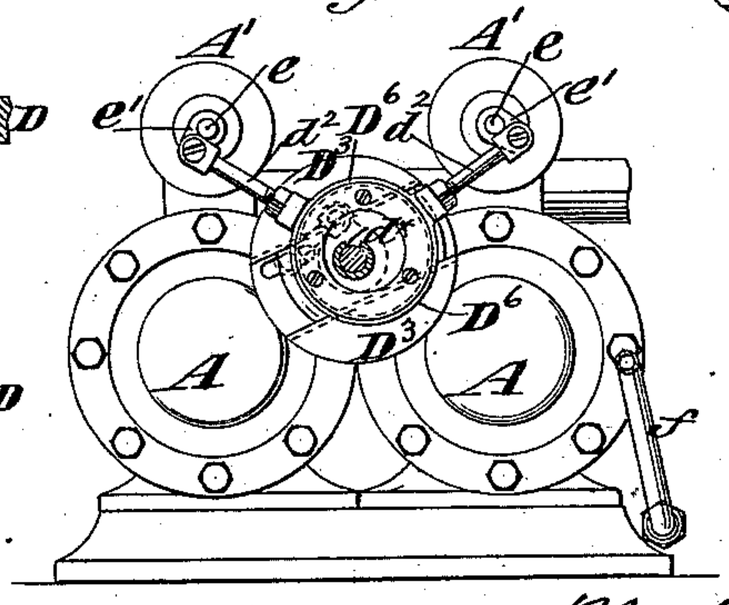
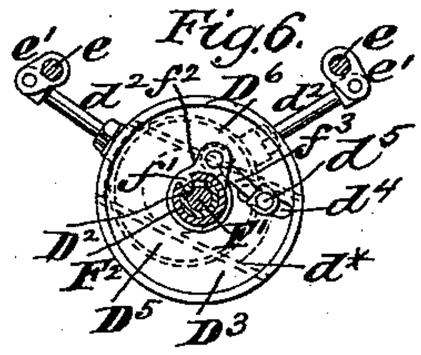


Fig. 6.



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UNITED STATES PATENT OFFICE.

NATHAN E. NASH, OF STONINGTON, CONNECTICUT.

VALVE-GEAR FOR DUPLEX STEAM-PUMPS.

SPECIFICATION forming part of Letters Patent No. 402,100, dated April 23, 1889.

Application filed December 1, 1887. Serial No. 256,623. (No model.)

To all whom it may concern:

Be it known that I, NATHAN E. NASH, of Stonington, in the county of New London and State of Connecticut, have invented a new and useful Improvement in Valve-Gear for Duplex Steam-Pumps, of which the following is a specification.

My invention relates to pumps which comprise two water and steam cylinders, or two complete pumps, having their piston-rods so connected that their continuous operation is insured without any dead-point in either pump, or which, in ordinary parlance, are connected for duplex action; and the invention relates to means whereby the steam-valves of such a pump are operated.

The object of my invention is to provide, by a simple and inexpensive construction and combination of devices, for the automatic cutting off of the steam to the steam-cylinders at any point in the pump's stroke, so that the advantages of expansive action of the steam in such a pump may be secured, and so that the point of cut off may be varied automatically according to the pressure against which the pump is operated, or, in other words, according to the amount of work to be performed by the pump.

The invention also includes a novel arrangement of parts whereby the piston-rods of the duplex pump are so connected as to impart rotary motion to a shaft extending parallel with and between the piston-rods, and whereby the length of stroke of each pump is limited, as in a pump comprising cranks and connecting-rods, so that in case of the pump working light or failing to get its water the piston or pistons cannot travel beyond the normal length of stroke and cannot strike the cylinder-head.

The invention consists in novel combinations of parts whereby the desired results are secured, and which are hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a side elevation of a duplex pump embodying my invention. Fig. 2 is a partly-sectional plan of the pump. Fig. 3 is an end elevation and section upon the plane of the dotted line *y y*, Fig. 2. Fig. 4 is a detail sectional view; Fig. 5, a plan view of certain parts hereinafter described; and Fig. 6 is a transverse section of certain parts upon the plane of the dotted line *x x*, Fig. 2.

Similar letters of reference designate corresponding parts in all the figures.

A A designate the steam-cylinders, and B B the water-cylinders of the pump, each pair of cylinders being formed in one integral casting, and the pairs of cylinders being connected by a brace or trunk, B′, in a well-known manner.

C designates the piston-rods of the pump, to which the steam and water pistons (not here shown) are attached, and D designates a rotary shaft extending lengthwise between and parallel with the piston-rods C, and to which rotary motion is imparted from the piston-rods. Upon the shaft D is a cam, D′, which has an endless groove, *d*, formed spirally in its circumference, and upon the piston-rods C are arms *c* which are guided upon parallel rods *c′* and which have truck rolls or pins c^2 engaging the oblique groove *d*. By the guide-rods *c′* the truck rolls or pins c^2, upon the arms *c*, are held in engagement with the groove *d*, and by the reciprocating movement of these truck rolls or pins in a straight line they serve to impart through the groove a rotary motion to the cam D′ and the shaft D. The parts are so arranged that while the truck roll or pin c^2 of either piston-rod is in the portion of the cam-groove *d* where it has no tendency to turn the cam the truck roll or pin of the other piston-rod is operating in the oblique portion of the groove *d*, where it has a tendency to turn the cam D′ and the shaft D, and there cannot, therefore, be any dead-point or dead-center in the operation of either piston-rod, or, in other words, each piston-rod operates to turn the cam D′ while the other piston-rod is upon its dead-center. Another advantage of this cam for connecting the two piston-rods is that by it the movement of each piston-rod is limited to a stroke of definite length, as is the movement of a piston having a connecting-rod and crank which it operates or by which it is operated, and therefore when the pump is running light or fails to catch its water, and performs its stroke with but little resistance, neither piston-rod can overrun and cause its piston to strike the cylinder-heads. The piston-rods operate noiselessly upon the cam D′ without

any shock or jar, and through this cam they impart a smooth uniform rotary motion to the shaft D.

I will now proceed to describe the means through which the rotary motion of the shaft D operates to admit steam to the steam-cylinders A and the means whereby the admission of steam to such cylinders may be cut off automatically at any desired point as controlled by the pressure against which the pump is working.

Above the steam-cylinders A are the valve-chests A′, in which operate rocking valves E, having their axes lengthwise of the cylinders and which are operated through valve-stems *e*, each having upon it an arm, *e′*. The end of the shaft D which is adjacent to the steam-cylinders is hollow, as shown at D^2, and slotted, as shown at *d**, particularly in Figs. 3 and 4. Upon this end of the shaft D is fitted a head or disk, D^3, having in it a slideway, *d′*, to which is fitted a slide, D^4, carrying an eccentric or eccentrics, D^5. The straps D^6, which are upon the eccentric or eccentrics D^5, are connected by rods d^2 with the arms *e′* upon the valve-stems *e*, and as the slide D^4 and eccentrics D^5 are rotated with the shaft D it is obvious that these eccentrics act through their straps D^6 and rods d^2 to impart a rocking motion to the valves E. It is also obvious that by the movement of the slide D^4, with its eccentrics D^5, in a direction diametrically across the head or disk D^3 the throw of the eccentrics will be increased or diminished and a greater or less rocking movement will be imparted to the valves E.

F designates a regulating-cylinder to which is fitted a plunger or piston formed upon the end of the rod F′, and *f* designates a pipe, whereby the regulating-cylinder F is connected with the water-pressure space of the pump. As here represented the pipe *f* extends from the base of the air-chamber B^2, but it may extend from another water-space of the pump.

In Fig. 4 I have shown a longitudinal section of the tubular portion D^2 of the shaft D, the head or disk D^3, and the slide D^4, with its eccentrics, and the regulating-cylinder F, and in Fig. 5 I have represented a plan of the end portion of the shaft and the plunger or piston-rod F′ and a plan of a sleeve, F^2, which is fitted loosely outside the tubular portion D^2 of the shaft D, and the purpose of which will be hereinafter described. As before stated, the tubular portion D^2 of the shaft D is slotted at *d**, and through this slot extends a tooth or projection, d^3, formed upon the end of the plunger-rod F′, and this tooth or projection also enters a spiral slot, *f′*, formed in the sleeve F^2. Consequently it will be seen that through the tooth or projection d^3 the sleeve F^2 is locked to rotate with the shaft D, and that by moving the plunger-rod F′ and its tooth or projection d^3 lengthwise the sleeve F^2 will, through its spiral slot *f′*, be turned slightly relatively to the shaft D and will at the same time be maintained locked to turn with the shaft D. The slight turning movement of the sleeve F relatively to the shaft, which is produced by the tooth d^3 moving lengthwise in the spiral slot *f′*, is utilized to shift the slide D^4 transverse to the length of the shaft D, and to thus alter the throw of the eccentrics D^5. I have here represented the sleeve F^2 as having an arm, f^2, through which and through a rod or link, f^3, said sleeve F^2 is connected with the slide D^4, the head or disk D^3 being provided with a slot, d^4, to receive the pin d^5, whereby the rod or link f^3 is connected with the slide D^4, as is best shown in Fig. 6.

I have shown a spring, f^4, as applied to the plunger-rod F′, and which serves to move said rod toward the left hand of the drawings, and when said rod is moved to its full limit toward the left hand the tooth d^3, through the spiral slot *f′*, holds the sleeve F^2 so as to cut off steam as early as is possible in the pistons' stroke in the cylinders A—that is to say, as early as may be desired. Supposing, now, that the pressure of liquid against which the pump is operating increases, such increased pressure will be transmitted through the pipe *f*, acting upon the plunger-rod F′, and said rod will be moved lengthwise against the force of the spring f^4. When the rod is moved lengthwise, its tooth d^3 will, through the spiral slot *f′*, turn the sleeve F^2 slightly relatively to the shaft D, and through the connection f^3 will shift the slide D^4, thereby varying the throw of the eccentric or eccentrics D^5, so as to cause them to operate the valves to cut off steam later in the stroke of the steam-pistons, or, in other words, to allow the steam to fill a greater portion of the stroke and thereby to increase the power of the pump proportionate to the pressure against which it must operate.

When the pressure of liquid against which the pump is working becomes again reduced, the spring f^4 returns the plunger-rod F′, thereby returning the sleeve F^2 and shifting the eccentrics so that the pump-valves cut off the steam earlier in the stroke of the pump-pistons.

From the above description it will be understood that the point of cutting off steam in the steam-cylinders is automatically varied in accordance with the labor which the pump has to perform, and therefore in a duplex pump having no crank-shaft or connecting-rods I secure substantially the same results as to economy of steam as have heretofore been secured only in steam-engines having an automatic cut-off.

I have described the part D^5 as an eccentric or eccentrics, because it consists of a single piece, which is here shown as wide enough to receive two eccentric-straps, D^6; but if two eccentrics were separately secured upon the slide D^4 the result would be the same.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a duplex pump, the combination, with the steam-cylinders and rocking valves having their axes lengthwise of the cylinders, of a shaft extending parallel with and between the piston-rods and provided with eccentrics connected with the valve-stems for operating them, a cam upon said shaft having an endless groove formed obliquely or spirally thereon, and arms on the piston-rods having pins or rolls engaging the groove of the cam and imparting rotary motion thereto from the reciprocating movement of the piston-rods, substantially as herein described.

2. The combination, with the steam and water cylinders and steam-valves of a duplex pump, of a rotary shaft receiving motion from the piston-rods of the pump, a head or disk secured to said shaft and carrying a slide movable diametrically across it, eccentrics on the slide and having their straps connected with the steam-valves for operating them, a sleeve turning with the shaft and having a spiral slot, a regulating-cylinder connected by a pipe with a pressure-space of the pump, a plunger or piston fitting the cylinder and having upon its rod a tooth or projection locking the sleeve to the shaft by engaging said spiral slot, and a connection between said slide and sleeve, whereby the lengthwise movement of the regulating-plunger or piston-rod will turn the sleeve relatively to the shaft and shift the slide to vary the throw of the eccentrics, substantially as herein described.

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