F. A. BISHOP.

Pumping Apparatus for Raising Water.

No. 209,323. Patented Oct. 29, 1878.

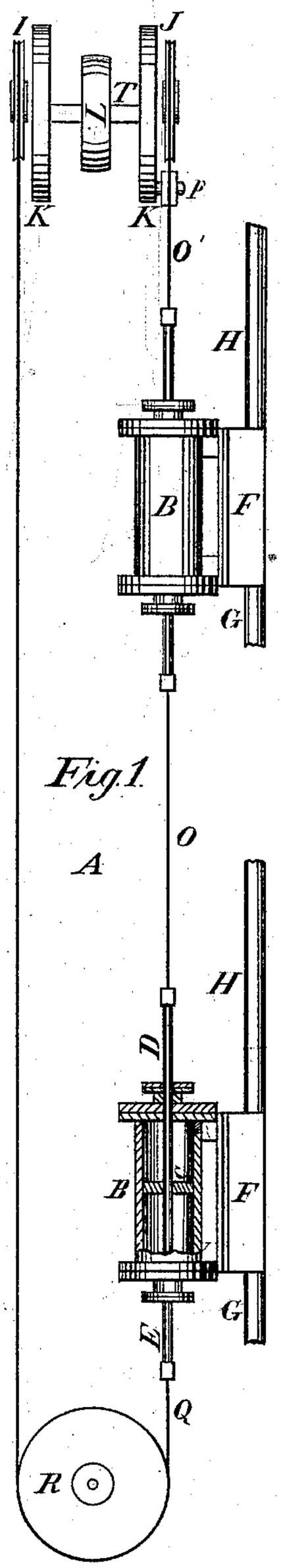

Fig. 1.

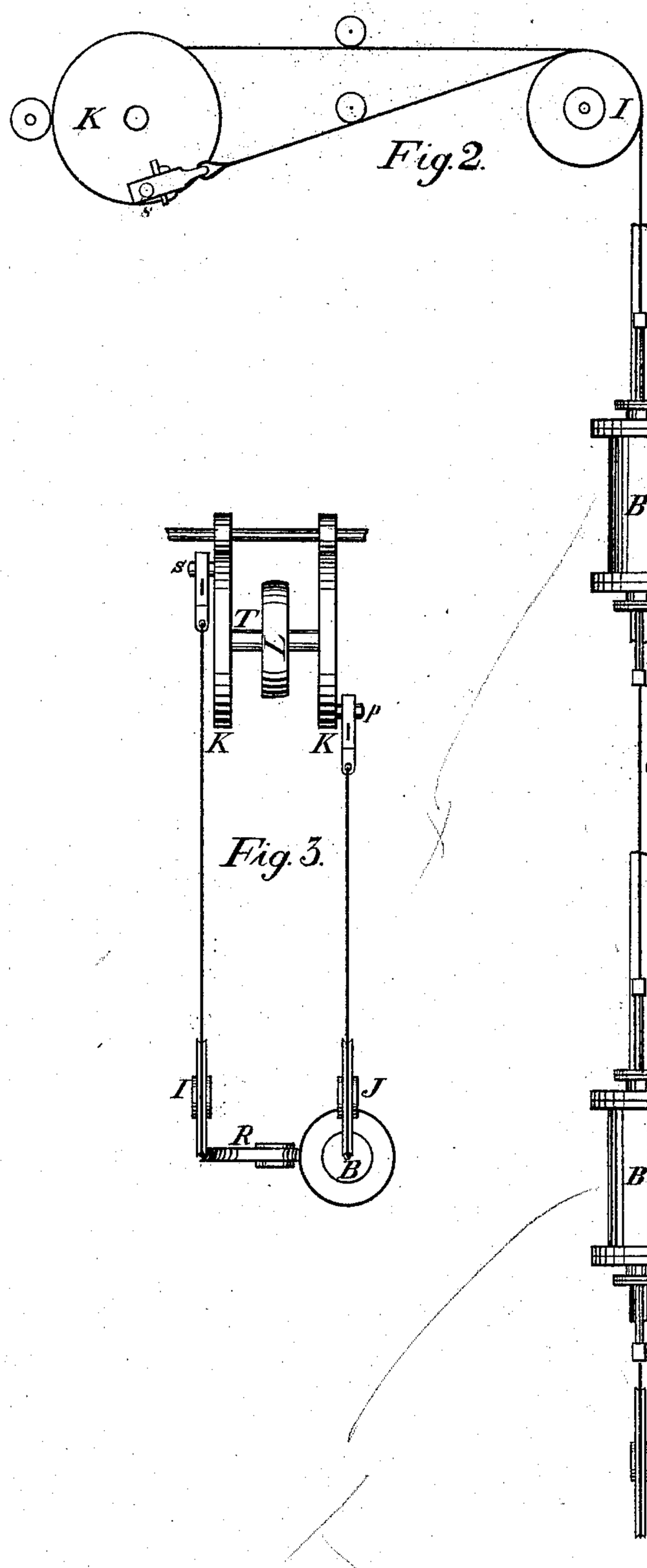

Fig. 2.

Fig. 3.

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UNITED STATES PATENT OFFICE.

FRANCIS A. BISHOP, OF SAN FRANCISCO, CALIFORNIA.

IMPROVEMENT IN PUMPING APPARATUS FOR RAISING WATER.

Specification forming part of Letters Patent No. **209,323,** dated October 29, 1878; application filed May 3, 1878.

To all whom it may concern:

Be it known that I, FRANCIS A. BISHOP, of the city and county of San Francisco, in the State of California, have invented an Improved Pumping Apparatus for Raising Water to Great Heights; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to certain drawings, forming a part of this specification and accompanying the same.

My invention has reference to a novel pumping system for raising water to great heights, but which is especially adapted for raising water out of mines and deep excavations where successive lifts are necessary to raise it to the surface.

My object is to so arrange the pumps and apply the power for operating them that the strain will be purely a tensile one and its application direct, so that lighter pumps can be used, and the heavy and cumbersome pump-rods, balance-bobs, and other weighty fixtures dispensed with, and at the same time to simplify and cheapen the connection with the motive power.

For the purpose of this specification I will describe my pumping system with especial reference to its application in a mining-shaft for raising water out of a mine or excavation, as all the conditions involved in raising water are there met with; but the system could be applied for raising water to elevated points above the surface of the ground with equal advantage.

Referring to the accompanying drawings, Figure 1 is a front elevation. Fig. 2 is a side elevation; Fig. 3, plan of crank-motion.

Let A represent the side of a mining-shaft. The pump-cylinders B B, I locate at suitable distances apart above each other, according to the required height of lift, so that the barrels of all the pumps in the system will be in a continuous line of draft.

Each pump consists of a single barrel or cylinder, B, inside of which the piston C moves. This piston has two piston-rods, one, D, extending upward through a stuffing-box in the upper head of the cylinder, and the other, E, extending downward through a stuffing-box in the lower head, both rods being in the same line.

On one side of each pump-cylinder is the valve-chamber F, with which the suction-pipe G and discharge-pipe H connect. I prefer that each pump shall be double-action, as the strain upon the engine and connections will then be more uniform than if single-acting pumps are used.

The discharge-pipe H of each pump empties into a tank with which the suction-pipe G of the pump above connects, so that I use nothing but upward-lifting valves, and the entire line of pipes, with the tanks, form a continuously-connected series.

To operate the pistons, I connect the downward-projecting piston-rod of each pump with the upward-projecting piston-rod of the pump below throughout the entire series, and this can be done either with wooden or metal rods or flexible connections, such as wire rope or chain, as preferred.

At the top of the shaft I mount two pulleys, I J, close together, one of which is in line with the line of piston-rods, and at a short distance from these pulleys I mount a short shaft, T, in suitable bearings, upon each end of which is fixed a plain wheel, K, the outside faces of which are in line with the grooves of the sheaves I J. Between these two wheels a driving-pulley, L, is secured, around which the belt which transmits the power from the engine passes.

The end of the upper piston-rod of the series is connected with a cable, chain, or other flexible connection, which passes up over the pulley J. The opposite end of this flexible connection is attached to a wrist-pin, *p*, on the outside face of the wheel K, that is in line with it. The end of the lower piston-rod is also connected with a cable or flexible connection, Q, which passes down under a vertical sheave, R, the pin or journal of which is solidly fixed below the lower pump in such relation that one edge of the sheave is adjusted to the line of draft. Thence the cable-chain or metal or wooden rods extend upward parallel with the line of pumps and over the guide-sheave I, and its opposite end is attached to a wrist-pin, *s*, on the opposite wheel K.

The crank-wheels K K, Fig. 3, as above mentioned, are placed at the extremities of the short shaft T, to which the power of the engine is applied either by a belt to the pulley L or by pinions meshing into teeth on said

crank-wheels, as shown at Fig. 3. The wrist-pins *p s* are set diametrically opposite each other, so that as the crank-wheels rotate a reciprocating motion is communicated to the pump-pistons while the engine or other motor maintains a regular and uniform motion in one direction. The length of the piston-stroke will be equal to the distance between the two wrist-pins, and can be regulated as required.

It will be seen that this application of the double crank gives to a double-acting pump not only equilibrium, but slower motion at the beginning and end of each stroke, allowing time for the non-elastic fluid dealt with to adjust itself in a measure to the conditions which a more rapid motion requires.

The cable side of the apparatus between the sheaves R I is of such character and is so weighted as to balance the pistons C and their connections on the opposite side. To compensate for expansion and contraction caused by the difference of temperature, suitable weighted tightening-wheels will be connected with the cable-chain or rope near the crank-wheels, and for adjustment of the connections in the mine turn-buckles will be used.

When the direction of the line of pumps is to be changed—as, for instance, in passing from perpendicular to incline, or in any direction—I use flexible connections at the deflecting-points, and pass them over or under or on either side of the sheaves, according to the character of the deflection, thus enabling me to follow the sinuosities of a shaft incline or working. I am thus able to establish a system of direct-acting pumps for lifting water to great heights, which requires no heavy and cumbrous machinery. It enables me to use smaller pumping-cylinders and operate them with a more rapid motion, with less strain upon the engine, and at the same time preserve a most perfect balance of weights in all the moving parts.

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

1. One or more pump-cylinders, B B, located at intervals one above another in the shaft or incline, each cylinder having a piston, C, which is provided with two piston-rods, D E, the upper piston-rod of each pump being connected with the lower piston-rod of the pump above in a connected series, and the lowermost piston-rod being attached to a flexible connection, Q, which passes under a fixed sheave or pulley, R, thence up parallel with the piston-rods and their connections, over a guide-sheave, I, to a crank-wheel, K, while the upper piston-rod of the series is also attached to a flexible connection, which passes up over a guide-pulley, J, and to a reverse crank-wheel, K, the whole combined and arranged to operate substantially as above specified.

2. A connected series of direct-acting pumps, arranged in the length of an endless cable or flexible connection, and operated by reverse cranks K K, mounted upon a shaft, T, to which the power of the engine is applied, substantially as and for the purpose above described.

3. In a series of direct-acting pumps which are connected in whole or in part by flexible connections, the sheaves I J, for deflecting the strain and direction of the line of piston-rods and cylinders where required, substantially as above specified.

4. The device of the double cranks K K, mounted upon opposite ends of the shaft T, and having their wrist-pins placed diametrically opposite each other, in combination with the connected line of piston-rods and their flexible connections, for the purpose of imparting to the pistons a reciprocating motion, and at the same time preserving a uniform tension at every part of the stroke, substantially as herein set forth.

In witness whereof I have hereunto set my hand and seal.

F. A. BISHOP. [L. S.]

Witnesses:
SAML. S. MURFEY,
J. H. PURKITT.