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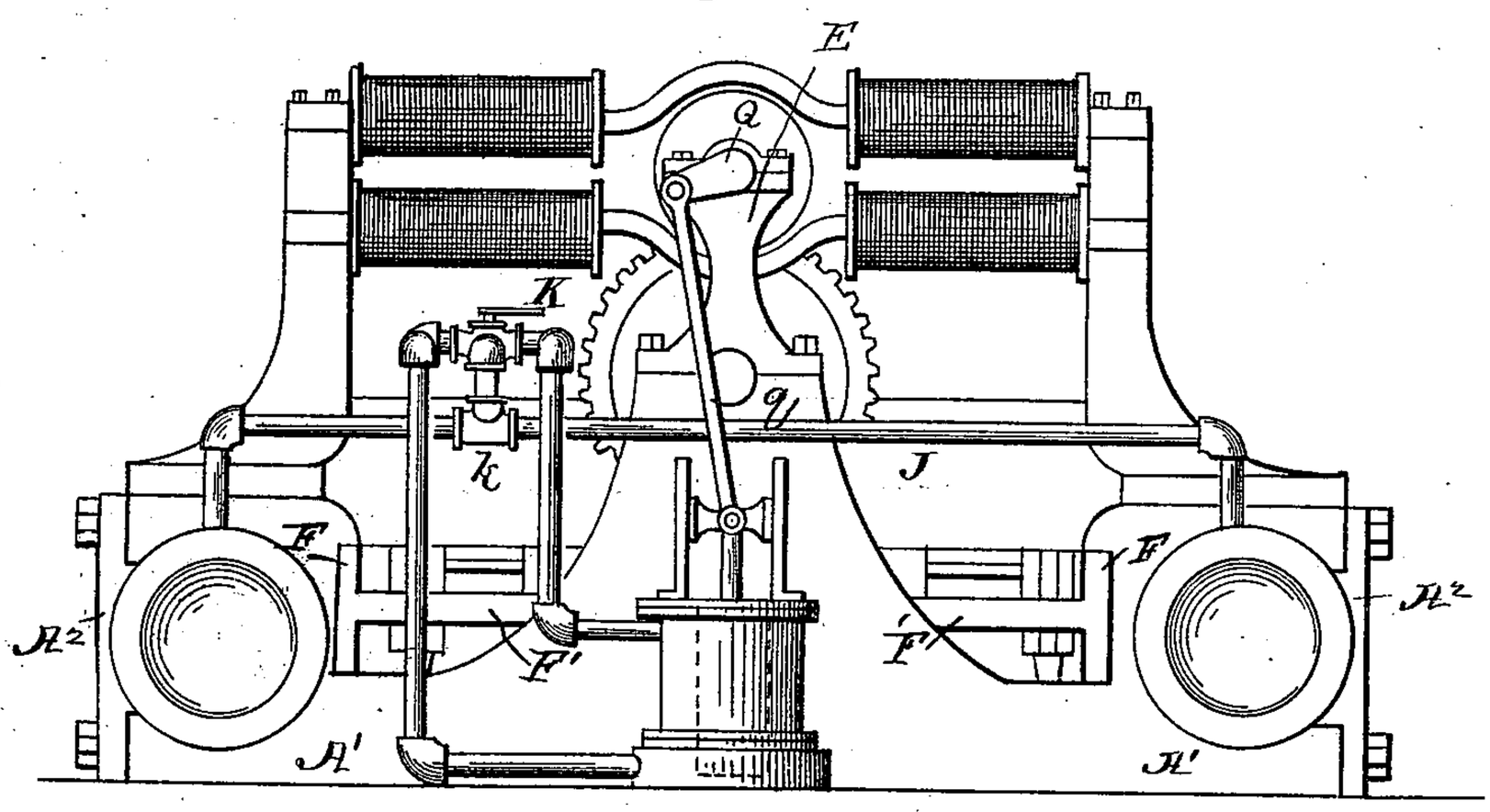
E. S. & W. A. McKINLAY.

MINING MACHINE.

No. 561,023. Patented May 26, 1896.

Fig. 1.



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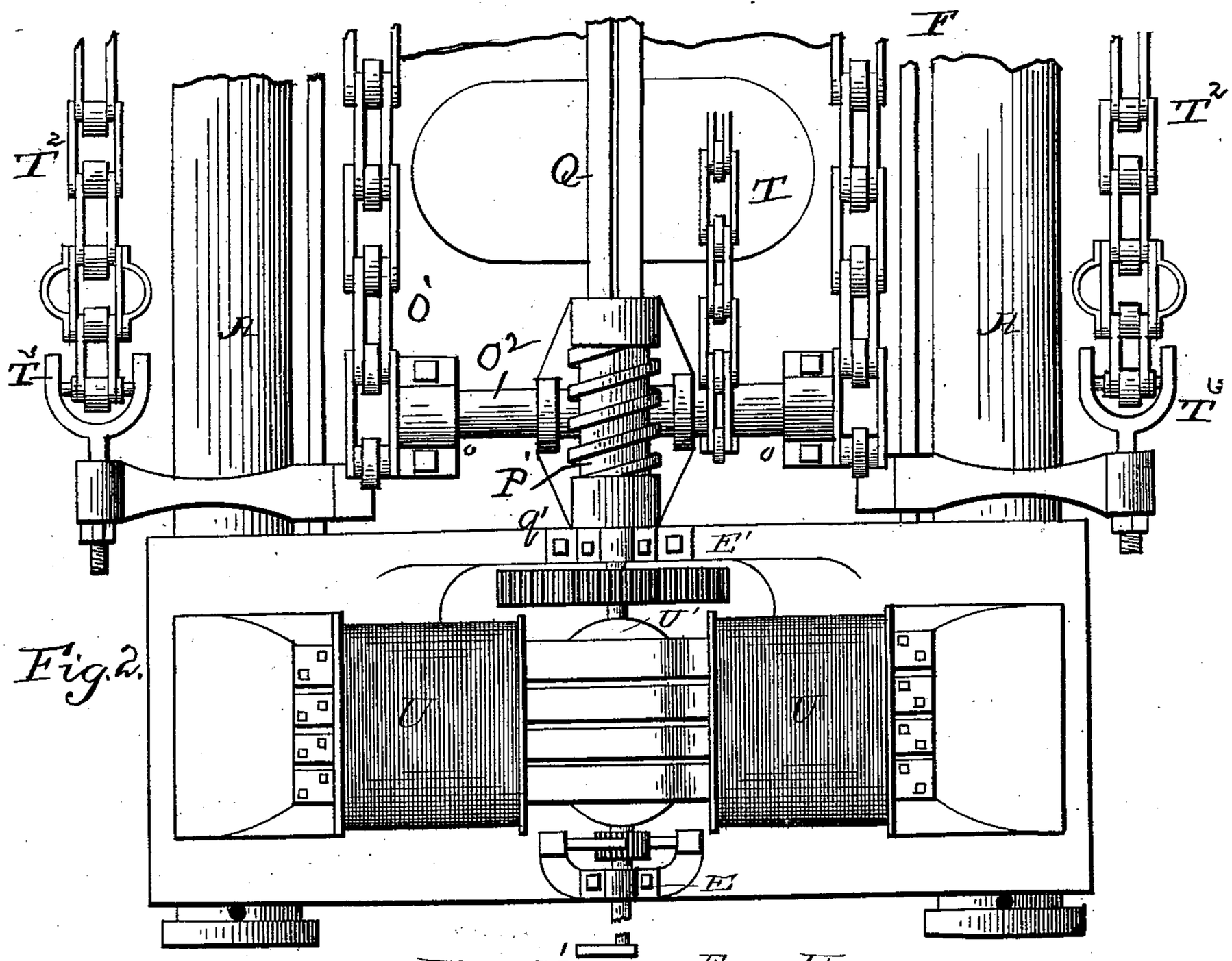

Fig. 2.

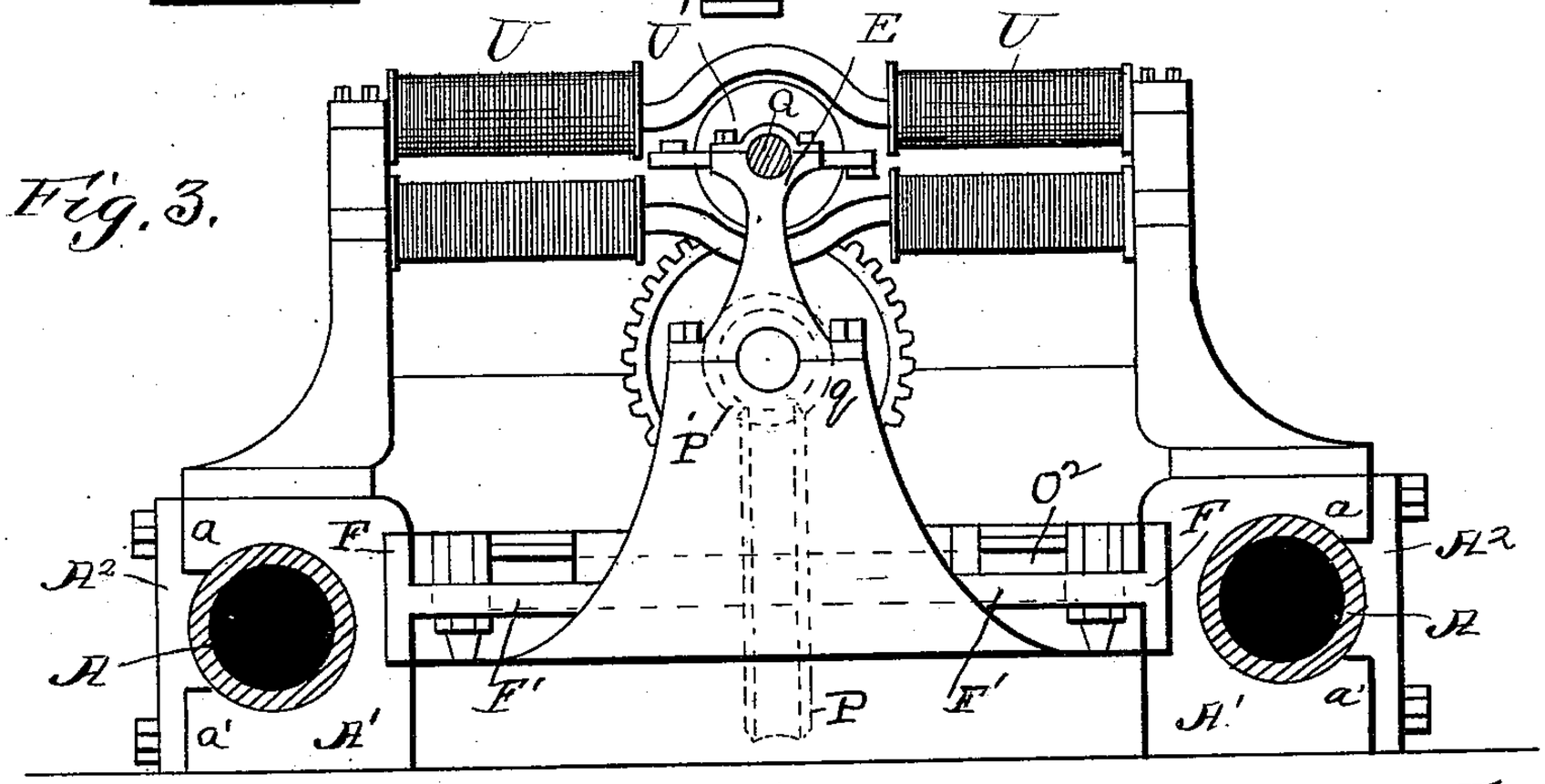

Fig. 3.

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MINING MACHINE.

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Fig. 4.

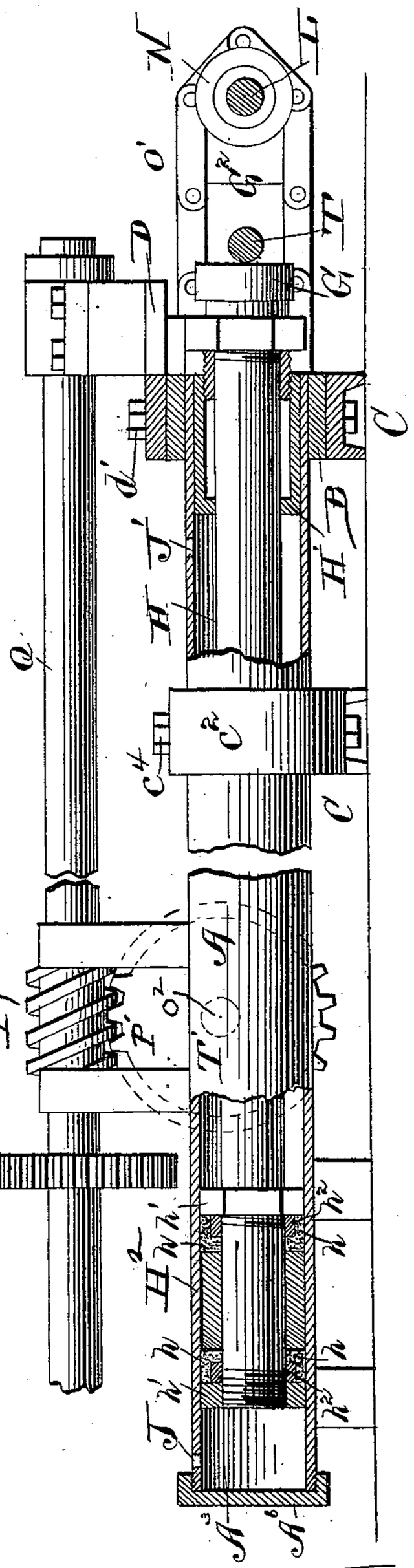
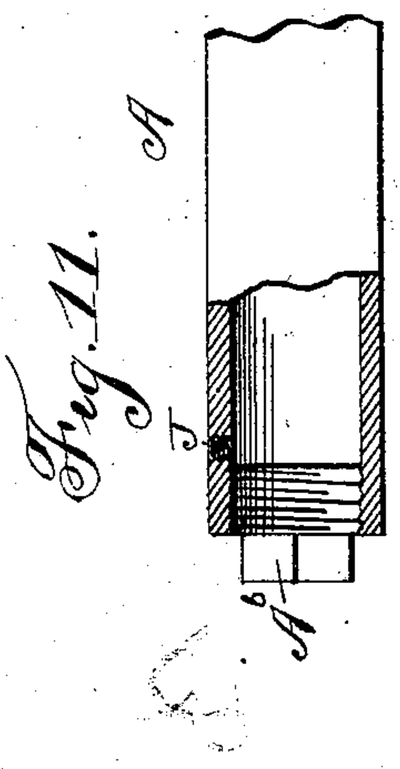


Fig. 11.



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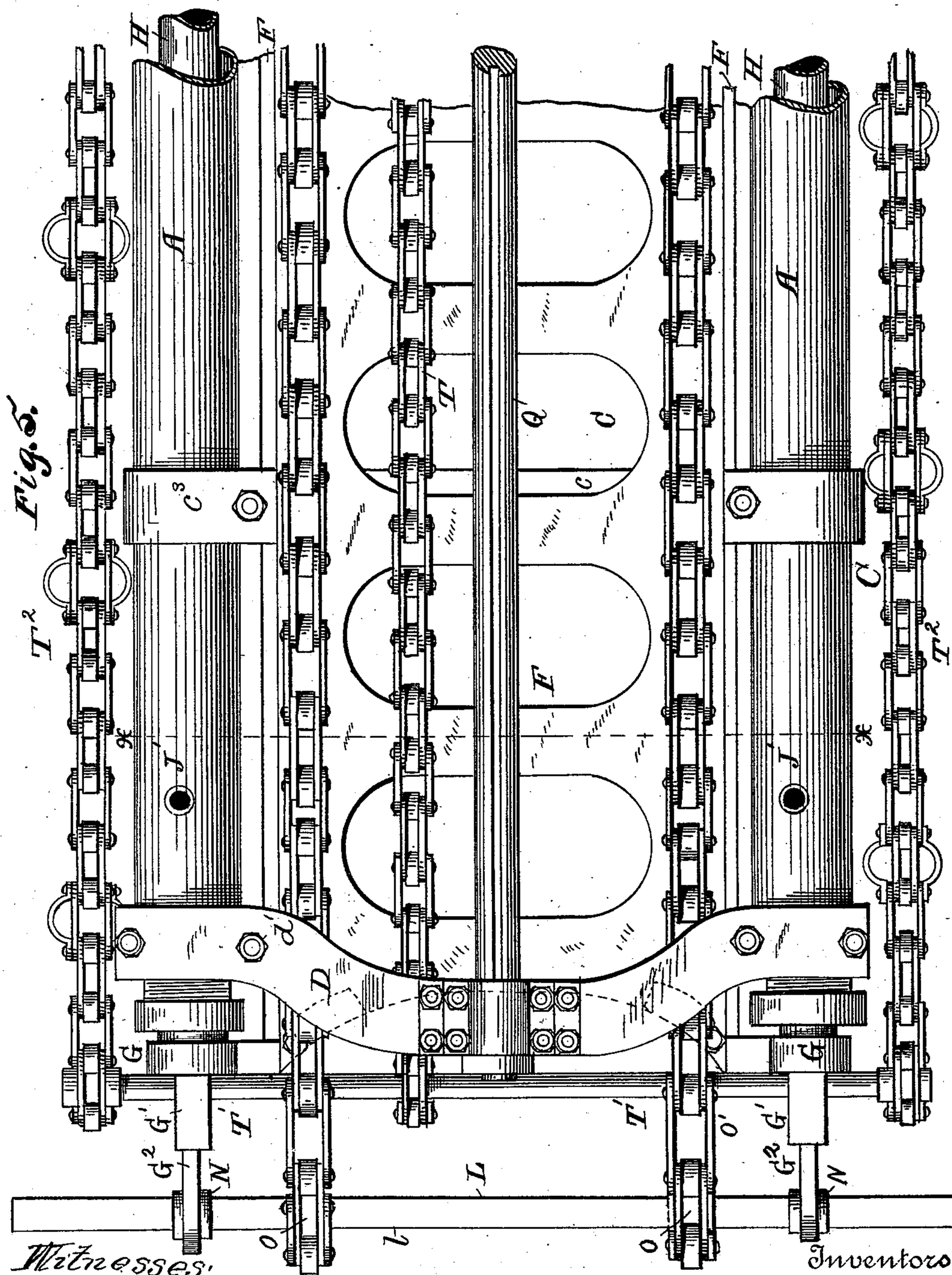
MINING MACHINE.

No. 561,023. Patented May 26, 1896.

Fig. 5.



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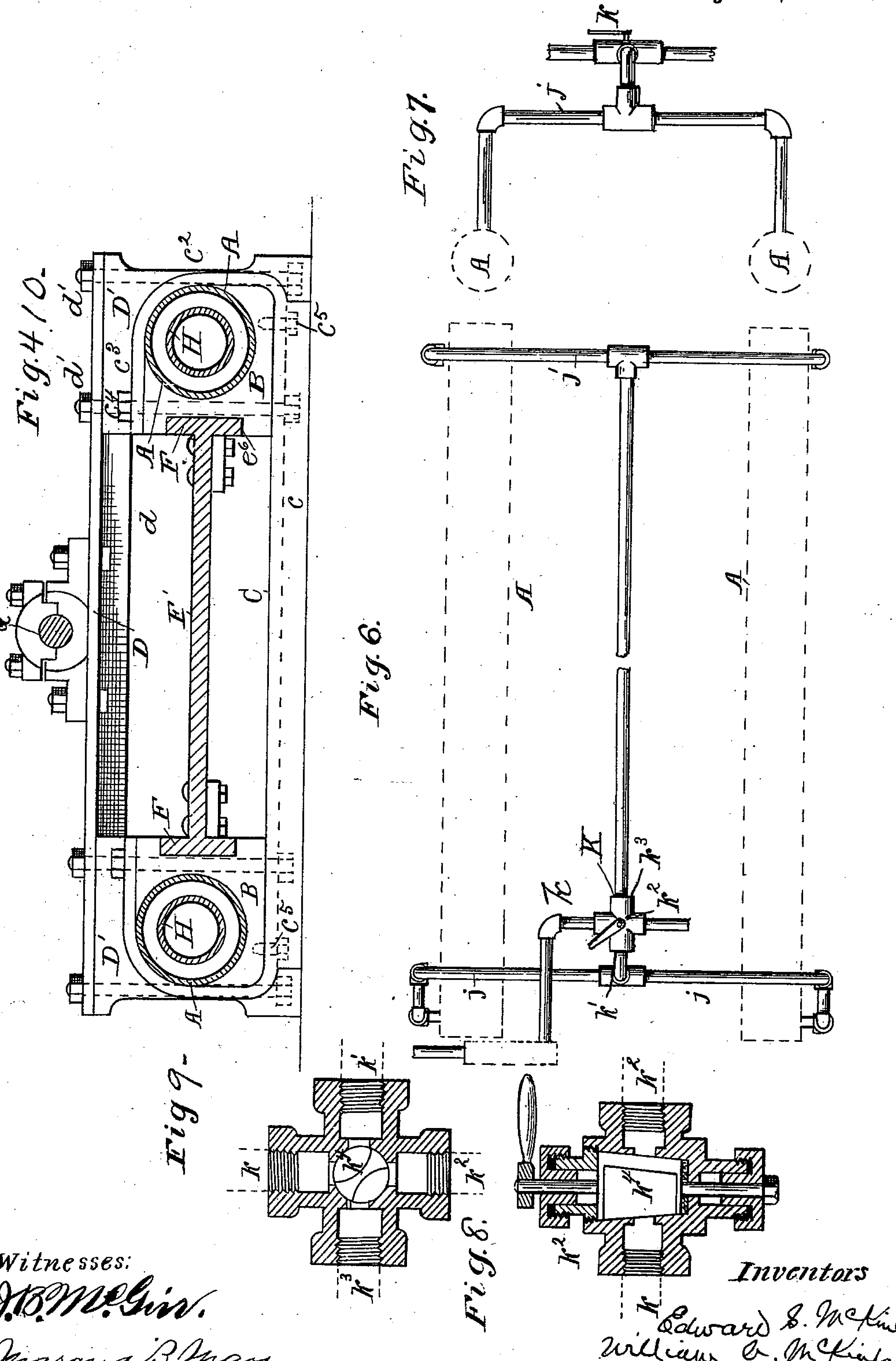
MINING MACHINE.

No. 561,023.

Patented May 26, 1896.



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UNITED STATES PATENT OFFICE.

EDWARD S. McKINLAY AND WILLIAM A. McKINLAY, OF DENVER, COLORADO.

MINING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 561,023, dated May 26, 1896.

Original application filed March 15, 1884, Serial No. 124,318. Divided and this application filed June 15, 1889. Renewed April 17, 1896. Serial No. 588,049. (No model.)

To all whom it may concern:

Be it known that we, EDWARD S. McKINLAY and WILLIAM A. McKINLAY, citizens of the United States, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Mining-Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

Figure 1 is a rear elevation of a machine embodying our improvements. Fig. 2 is a plan view of the rear end. Fig. 3 is a section across the rear ends of the feed-tubes, the pump and piping being detached. Fig. 4 is a side view of the machine, the motor being removed. Fig. 5 is a plan view of the front part of the same. Fig. 6 shows in top plan an arrangement of the feed and exhaust pipes which may be used for moving the sliding carriage forward and back. Fig. 7 is a view of the same from the rear. Fig. 8 is a section, on an enlarged scale, of the four-way cock shown in Figs. 6 and 7. Fig. 9 is a horizontal section through the same. Fig. 10 is a section on line $x\,x$, Fig. 5. Fig. 11 shows the rear end of one of the feed-tubes with a modified form of stopper.

A A represent metallic tubes, each extending substantially the length of the stationary portion of the machine. These tubes are intended to serve as the side connecting parts of the main frame, and also to serve purposes to be hereinafter set forth. At the rear end of the machine the tubes are clamped in castings or blocks, such as shown at A′, these blocks being preferably formed substantially as shown—that is to say, with outward extensions $a\,a'$—there being between these parts a curvilinear recess into which the end of the tube fits.

A^2 is a metal block fitting against the outer side of the end of the tube and adapted to be bolted tightly against the block or casting A′ by bolts and nuts, as shown at a^2. The block or casting A^2 also extends upwardly to points considerably above the tube for the purpose of forming or mounting therein a steam or air cylinder and for supporting other parts of the mechanism, as will be hereinafter set forth.

At the front end each tube A is mounted in a block or casting B, which has a curvilinear recess or socket adapted to receive it.

C represents a cross-brace or sill-piece extending from side to side of the machine, it having a horizontal part c and an upwardly-extending inwardly-curved bar or plate $c^2\,c^3$, the part c^3 lying upon the upper side of the casting or block B and the part c lying below the same.

At c^4 there is a through-bolt passing from the upper side of the part c^3 to the lower side of the part c, and by means of this the block or casting B, the bar or sill C, and the tube A are firmly clamped together.

c^5 represents a supplemental short bolt which may be driven into a threaded socket in the block or casting B to assist in clamping the same tightly to the bar or sill C.

At points of sufficient number between the two end fastenings of the tube A there are arranged other cross tying and bracing devices substantially similar to that above described for the front end of the tubes. One of these fastening devices is lettered in detail, and the parts thereof will be found to correspond substantially to those last above enumerated—that is to say, there is a block or casting B more or less surrounding the tube, and a bar or sill C extending from side to side and extending upwardly and inwardly at the ends, it being bolted firmly to the block or casting. In the construction shown there are three of these intermediate sets of cross bracing and binding devices, although we do not wish to be limited to any specific number; nor, in fact, are the other parts of the invention limited to any particular devices for connecting together the two sides of the frame or of clamping the side tubes in place, or clamping the bars which might be used in place thereof, so far as they operate merely as side supports for the machine; but we have devised this form of cross bracing and binding device to overcome difficulties which have been experienced in operating machines of this class.

The rest of the main stationary frame is constructed as follows:

D is a cross bar or beam extending from the front end of one of the tubes A across to the front end of the other, it being preferably of the shape of a T-beam, the cross-web d of

which is arranged horizontally. It is preferably curved, so that the central portion thereof projects slightly forward, as will be seen by examining the drawings.

D' D' are bars or blocks of metal which rest upon the upper plates or bars c^3, which latter constitute parts of the cross-bars or sills C, as above described. These bars or blocks D' are of such height as to fit snugly below the flange or web d of the beam D, and the block is bolted to said beam, as shown.

d' d' is a bolt by means of which the beam and the block D' are firmly fastened in place.

At the opposite or rear end of the machine there is a standard or upright E, adapted to provide one of the bearings for the main shaft or the devices which operate it, and at a short distance in front thereof there is a standard E', which furnishes another bearing for the main shaft, the bar or beam just above described providing the front bearing therefor. Upon the frame whose parts are thus constructed and arranged there are supported a sliding frame, mechanism on the sliding frame for effecting the cutting of the material, and mechanisms for operating the cutting devices in whatever position the cutters may be situated.

The sliding frame is arranged on a horizontal plane between the top and bottom planes of the stationary frame, and it may be constructed either of a web or plate or of several webs, plates, or bars extending from side to side of the machine, together with bars or guides at the sides adapted to fit in ways. When formed of metal in one piece, it has two T-bars or flanges, as shown at F, these being joined by webs or bars F', extending across from one guide-flange F to the other. The way in which each of these two guide-flanges moves is formed in the aforesaid blocks or castings A' B B, these having on their sides rectangular or other suitably-shaped recesses, as shown at e^6. These are made sufficiently smooth and arranged true relative to each other, so that the sliding frame can move forward and back without interference. At each front corner there is a strong connecting-piece G, which unites the sliding frame to the devices which move it forward and back. This is preferably made of forged metal. From the front side of these connecting-pieces extends a bearing-piece G', in which is mounted the shaft that drives the clearing-chains, as will be described; and from the forward ends of the bearing-pieces G' extend the shoes or bearing-pieces G^2, in which are supported the cutter-shaft.

We will now describe the means which we employ for carrying the sliding frame forward and back.

H H represent piston rods or tubes mounted within and arranged to travel longitudinally through the tubes A A. Each is at the front end secured to one of the connecting-pieces by screw-threads or other suitable device and passes through a gland or stuffing-box H' in the forward end of the tube A, and this (the gland or stuffing-box) may be of any suitable character.

At the rear end the piston-rod carries a head H^2, which fits as tightly as practicable the tube A; but to insure an air-tight fit a packing material is inserted at h, which may consist of leather or any other suitable substance. The packing and the piston-rod are held in place by means of nuts h' h' and washers h^2, the nuts driving the washers toward the piston-head and tending to crowd the packing outward against the inner surface of the tube. The rear end of each tube is closed tightly by means of the threaded stopper or block A^6.

The piston-rod shown is hollow, although we do not wish the other features of the invention to be limited to one of this character. However, by having it hollow we are enabled to overcome difficulties that are met with in driving devices of this character. The air, steam, water, or other driving agent which is used to advance the piston not only presses against the head H^2, but also exerts its pressure through the whole length of the piston and against the surface which closes the forward end thereof. As a result the force is exerted at a greater advantage, as it is applied nearer to the points of resistance, and, moreover, tends to pull the piston-rod through the tube rather than to push it.

The parts are so constructed and related as that there shall be air-chambers A^3 at each end of the tube when the piston-head is completing its stroke, these tending to prevent the piston from being driven against the closing-surfaces at either end, the air in the chambers acting as powerful cushions to prevent the piston from moving too far.

The air or driving agent is admitted to one end of the tube A through an aperture J and at the other end through an aperture J'. With these communicate tubes j j', to which the air passes from a four-way cock K, the latter having four ports k k' k^2 k^3. Through the port k enters the air or other elastic agent, and from the port k^2 escapes the air or other material which has been exhausted from the tube. A rocking valve k^4 can be so arranged as to throw the feed into either end and at the same time permit the exhaust from the other end through the port k^2.

The operation of the parts of the device just described will be readily understood. The valves in the four-way cock are so adjusted as that the air shall enter the rear ends of the tubes A behind the piston, and said air exerting behind the piston-head its pressure and also against the closing-surface at the front ends of the piston-rods compels the latter to advance and carry with them the sliding frame and the cutting apparatus and the means for removing the cut material. When the sliding frame or carriage has advanced the full extent of throw, it is withdrawn by changing the position of the valve in the four-way cock, which allows the

air to exhaust from the rear side of the pistons and supply to the front sides of the piston-heads. It will be seen that the area at the front of the piston-head is much less than that at the rear, and, as a result, there is less pressure on the return movement than during the advance, as much more power is required to force the frame forward than to withdraw it. This area can be varied by using a larger or smaller piston-rod, as will be seen.

We will now describe the mechanism by which the cutting is effected and the means by which power is transmitted to the cutters.

L is a cutter-bar mounted in shoes G^2, and to which may be attached cutters of any of the well-known kinds.

On the cutter-bar there are sprocket-wheels O, with which engage chains O′, the latter extending backward to the shaft O^2. This shaft is mounted at *o* in frame F F′. It is driven by worm P′, which engages with the worm-wheel P. Worm P′ slides upon shaft Q and is rotated thereby, there being a feather-and-groove connection between them. Shaft Q is mounted on the bed, there being a bearing for it at the front end on cross-bar D and at the rear in a bearing at *q*′.

The shaft Q is continuously rotated by a rotary electric motor situated at the rear end of the machine and rigidly secured to the bed.

U U indicate the field-magnets, and U′ the armature. As it is desirable to have the latter rotate at a comparatively high speed, we employ a small pinion and a relatively larger wheel on the shaft Q. The motor in this case not only transmits power to the cutting mechanism, but is used for operating the air-condensing devices. A motor of the character last indicated is in many mining regions a matter of great convenience, as the power can be carried to the point where it is needed much more readily and economically than can the fuel necessary for the generation of steam, and the conductors for carrying the electricity necessary can be provided and managed much more easily and cheaply than the ducts or pipes which are necessary when compressed air is carried over a considerable distance.

As this application is a division of the one filed by us heretofore on the 15th day of March, 1884, Serial No. 124,318, we will here state that use may be made of any electric motor well known at the time of our invention. We have herein shown one which as concerns the details of its construction was well known at that time, it being illustrated in a patent, No. 271,042, to Curtis and Crocker.

We believe ourselves to have been the first to have provided for the arrangement of a power-transmitting motor of this sort in the way shown in respect to the parts of a mining-machine.

Those acquainted, practically, with machines of this sort will readily appreciate the advantages incident to the electric motor illustrated in comparison with the air or steam engines which have been heretofore in use. There are several matters particularly characteristic of these mining-machines. First, they must be exceedingly strong; second, they must have power devices of relatively very high power; third, they must be adapted to be moved at any moment, and, fourth, they must occupy but little area, either horizontally or vertically—that is to say, they must be light, strong, compact, and yet be capable of applying great power to drive the cutters.

The weight and size of whatever engine is used are limited, which is also true of the whole machine, in order that it may be readily manipulated in low contracted spaces. To get, therefore, the requisite power in the limited space permitted, use must be made of very high-speed engines, those generally in use making in the neighborhood of one thousand strokes per minute and generating a power approximating twenty-horse power. By having these rapid movements of the engine parts their size and weight can be reduced; but the rapidity and great number of the engine-strokes are matters of serious inconvenience. Each stroke reacts upon the machine, tending not only to loosen and impair its parts, but also to throw the whole machine out of the desired place. To overcome this, heavy and cumbersome "jacks" or braces have to be carried around with the machines, and before putting the latter in motion the braces are secured to the roof and pressed tightly down upon the machine to prevent the strokes of the engine from causing the machine to react or move backward or laterally. It is to obviate these troubles that stationary engines are mounted upon strong foundations; but of course such foundations are out of the question in respect to these portable, though high-power, mining-machines. All of these difficulties are almost entirely obviated by the use of an electric motor such as we have shown. The armature revolves continuously and smoothly. Neither the bed-frame nor the carriage experiences any material vibration. The nuts, bolts, and other detachable parts are not loosened, and in this particular we provide mechanism of the nature of a fly-wheel to preserve a continuous action upon the cutters, whose work is constantly varying, as is well known, from a minor resistance to one causing almost a complete stoppage.

We are aware of the fact that it has been proposed to employ an electric motor in connection with a rotary drill mounted on the axis of the armature and to support said drill and motor at one side only by a standard, which could be fastened to the rock or other material, as is shown in Patent No. 255,236, to C. E. Ball, dated March 21, 1882; but it would be impossible to accomplish our purposes with a mechanism of that character. We provide a carriage supplemental to the cutting apparatus and to the bed and give the motor uniform support on all sides in relation

to the bed. Again, in the said earlier-proposed construction in the Ball patents an independent mechanism was provided for controlling the feed. We, on the contrary, have all the movements governed by the motor, and if for any reason it should slow down the advance of the cutters will be correspondingly reduced, and vice versa.

We are also aware that it has been proposed to produce the reciprocation of a pick-cutter by an electric motor, as is shown, for instance, by the British Patent No. 2,327 of 1863. A mechanism of this sort has incident to it the very disadvantages which are above referred to as being incident to air and steam engines—viz., that the blows and jars from the reciprocating movement are disastrous to the machine or necessitate that it should be built with heavy parts to resist the blows. Nor in the said earlier-proposed construction was there any such arrangement of bed and carriage as we provide, adapted to receive uniformly on all lines the reaction from the cutting apparatus.

In the aforesaid earlier application provision was made for supplying the feeding-tubes with air from devices actuated by the motor on the machine. For this use may be made of any style of pump or compressor adapted to supply the feed-tubes with a feed or driving agent. We have shown devices of well-known form for this purpose and believe ourselves to be the first to have provided the combination, with the bed, the sliding carriage, and the electric motor, of the means whereby the motor can be caused to directly advance the sliding carriage and also to draw it back.

It will be observed that the present machine differs materially from machines of other classes which have been made permanently stationary or from those having the bed mounted on wheels or trucks. With either of the latter there do not exist the difficulties that we have to overcome in the use of the electric motor, the bed in our case having the longitudinal side bars resting loosely on the ground—that is, directly in contact with the ground—although the machine is portable and must be moved every few minutes.

We do not herein claim anything more than what is specifically set out in the claims, having either jointly or solely heretofore filed other applications for the remaining features which we believe to be novel and patentable in the construction shown—that is to say, we do not herein claim the means for joining the feed-tubes or side longitudinal connecting-pieces to the cross-bars of the bed, having presented claims therefor in an earlier application, on which was granted Patent No. 457,887 to us, dated August 15, 1891, and from which application the subject-matter of this present application was removed as a division; nor do we herein claim, broadly, any of the matters incident to the air-feed tubes for moving the carriage, they being embodied in the application of the present E. S. McKinlay, dated June 15, 1889, and serially numbered 314,386; nor do we herein claim, among other things, any of the features of construction relating to the supporting-blocks and the connecting-pieces provided with ways or guides for the carriage, these forming the main features of the said earlier application; nor do we claim, specifically, the combination, in a mining-machine, of the bed, the carriage, the cutting apparatus on the carriage, a chain for imparting power to the cutting apparatus, and an electric motor having a continuously-revolving armature mounted upon and secured to the carriage and moving forward and back therewith in fixed relations to the cutting apparatus, together with the carriage-moving mechanism and slowing-down gearing for transmitting the power from the armature to the cutting apparatus and to the carriage-moving mechanism; but with respect to the matters that are included herein it will be noted that they can be embodied in more or less modified forms of machines within the class of the present one. Sometimes the cutters at the front end of these "front-thrust" of "breast" machines have the power applied to them by means of a long heavy chain engaging with the bar which holds the cutters; sometimes the cutters are secured directly to the chain, as illustrated in the German Patent No. 6,848, and in United States Patent No. 287,032, of October 23, 1883, to S. C. Lechner. In either case the difficulties above referred to are experienced, the driving action is apt to be irregular and jerky because of the presence of the heavy chain-links and the inertia incident to their numerous pivots and to the changes of direction which they must follow during their travel. These difficulties are overcome in machines of any of these sorts when they are provided with power generating and transmitting parts substantially such as described.

What we claim is—

1. In a mining-machine, the combination with the portable bed having the longitudinal bars resting loosely on the ground, a carriage mounted on and movable along said bed, and the continuously-moving cutting apparatus mounted horizontally on said carriage and acting across the front end thereof, of the electric motor permanently secured to the machine and supported uniformly, substantially, in relation to both of the side parts of the bed, whereby the machine is held against vibration from the power parts, and having a continuously-rotating armature connected by continuously-revolving gearing to the aforesaid cutting apparatus, substantially as set forth, whereby said cutting apparatus is driven by a train of continuously-rotating (in contradistinction to reciprocating) devices from and including the armature, substantially as set forth.

2. In a mining-machine, the combination of the portable bed having side bars resting loosely on the ground, the carriage supported and sliding on said bed, the continuously-moving transversely-mounted cutting apparatus at the front end of the carriage, the chain for imparting power to the cutting apparatus, the rotary electric motor permanently secured to the machine and uniformly, substantially, supported with respect to both of the side bars of the bed, and the gearing connecting the continuously-revolving armature of the said motor with the chain-driving devices.

In testimony whereof we affix our signatures in presence of witnesses.

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WILLIAM A. McKINLAY.

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