(No Model.)

4 Sheets—Sheet 1.

# E. S. McKINLAY.

## MINING MACHINE.

No. 551,508. Patented Dec. 17, 1895.

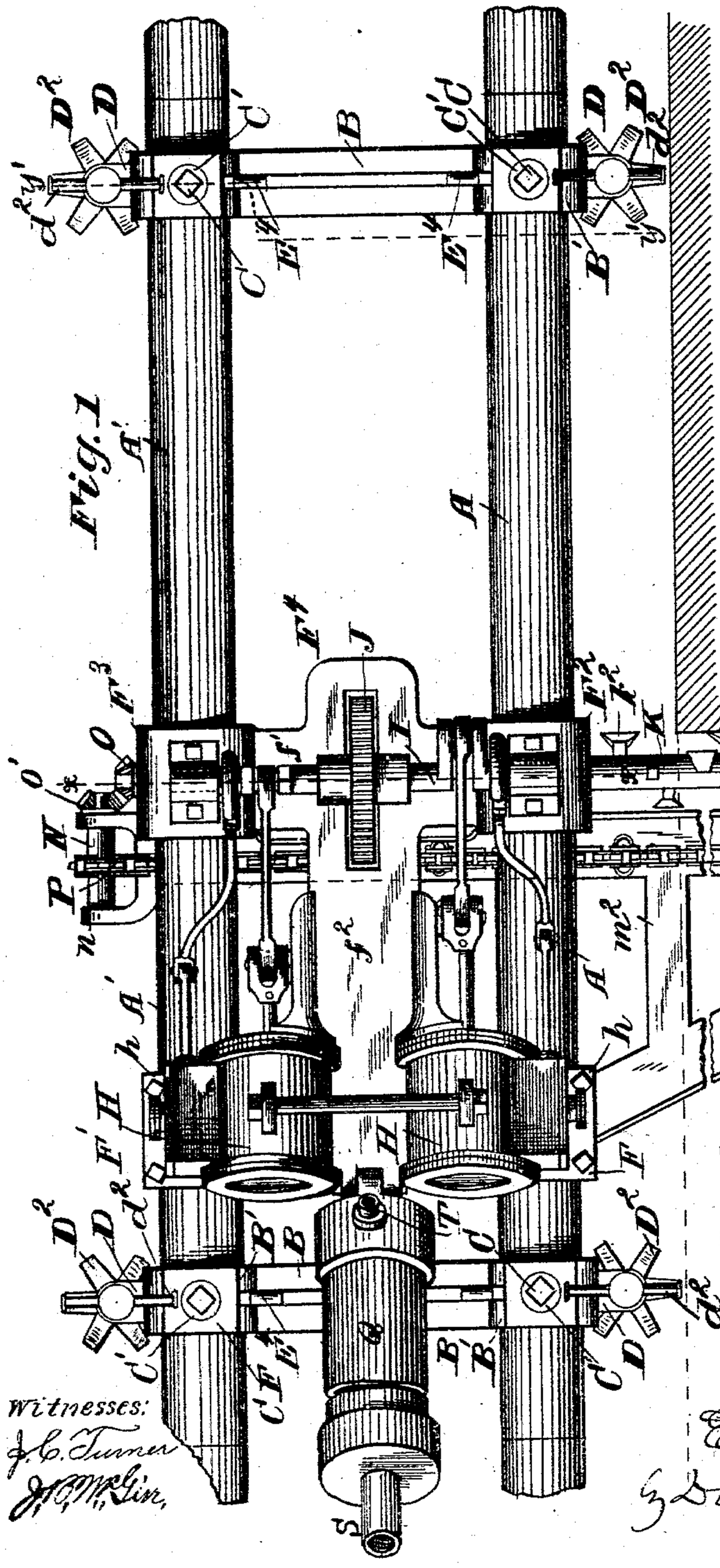


Fig. 1

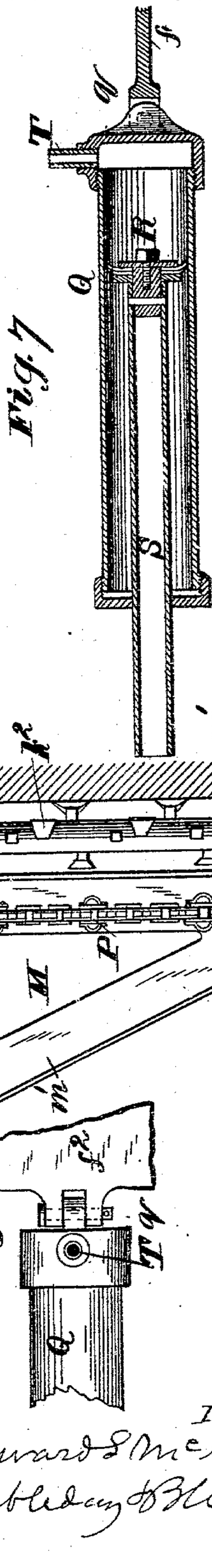


Fig. 7



Fig 8

Witnesses:
J. B. Turner
J. B. McGirr.

Inventor:
Edward S. McKinlay
by Donbleday & Bliss
atty.

(No Model.) 4 Sheets—Sheet 2.

# E. S. McKINLAY.

## MINING MACHINE.

No. 551,508. Patented Dec. 17, 1895.

Fig. 1

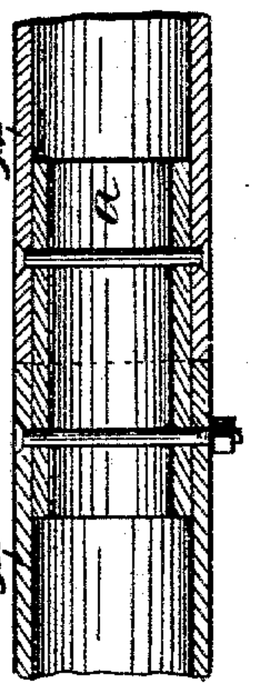


Fig. 10

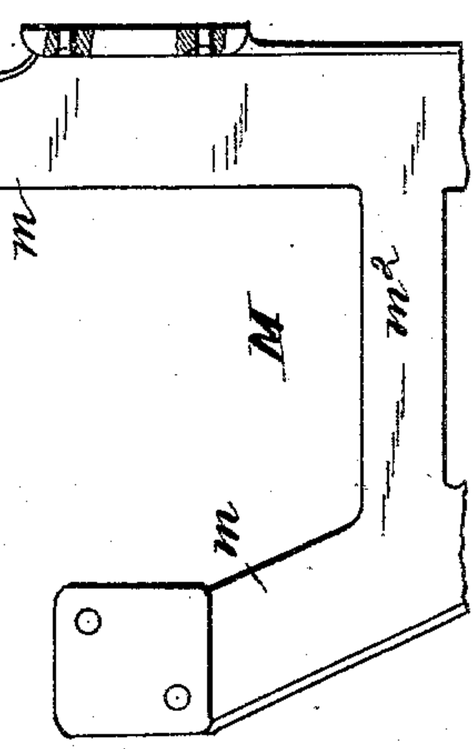


Fig. 2

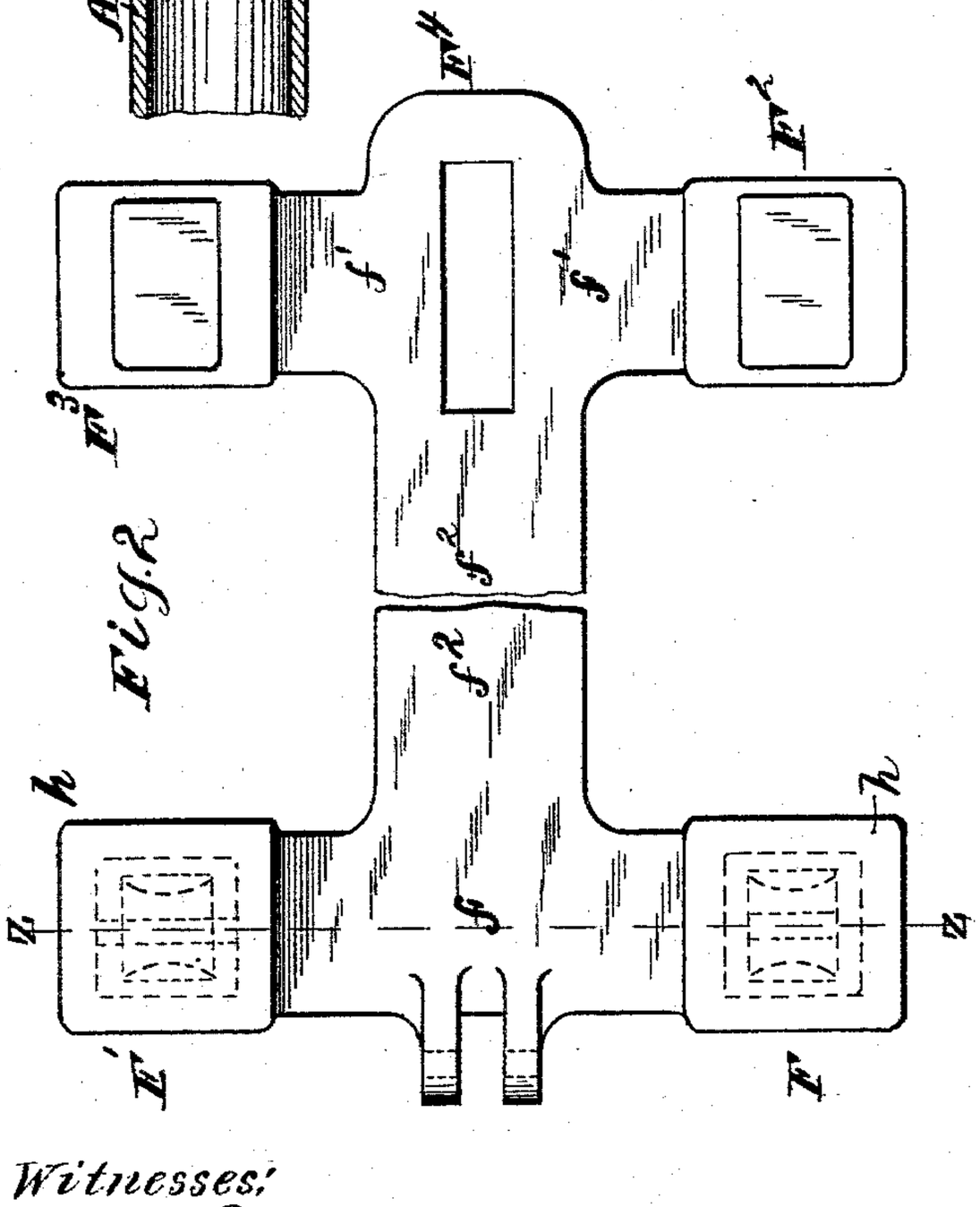
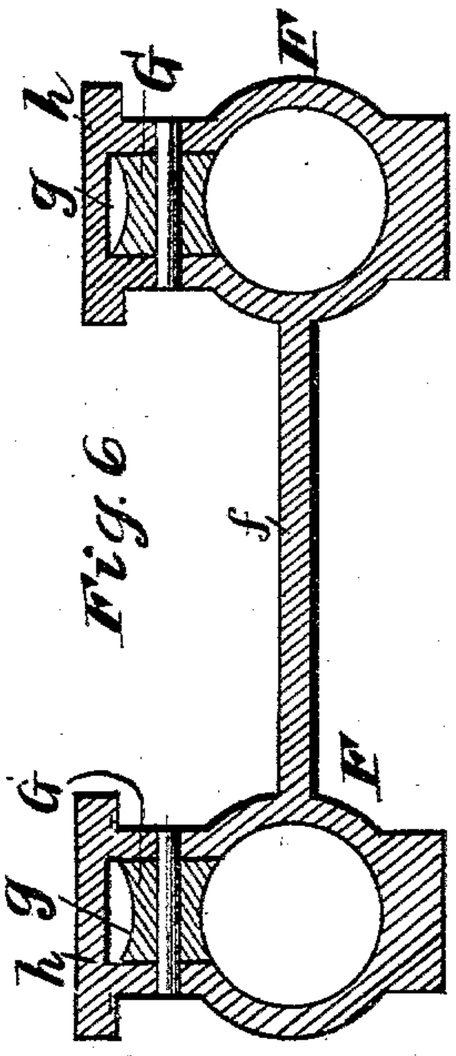


Fig. 6



Witnesses:
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Inventor:
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(No Model.)

4 Sheets—Sheet 3.

# E. S. McKINLAY.

## MINING MACHINE.

No. 551,508. Patented Dec. 17, 1895.

Fig. 3

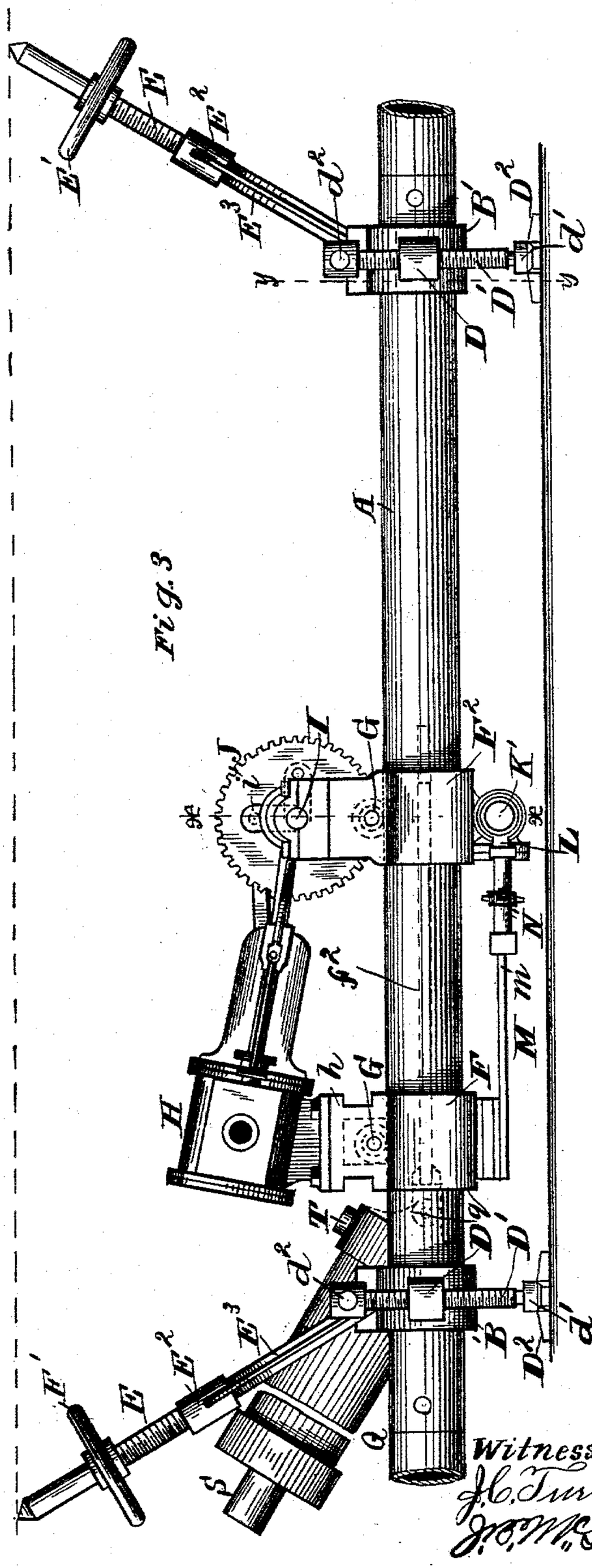

Fig. 5

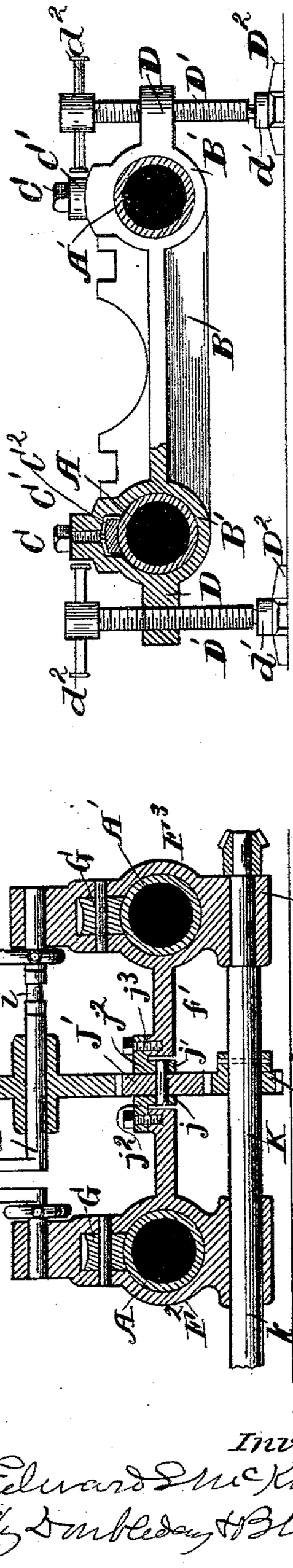

Fig. 4



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(No Model.)

4 Sheets—Sheet 4

# E. S. McKINLAY.

## MINING MACHINE.

No. 551,508. Patented Dec. 17, 1895.

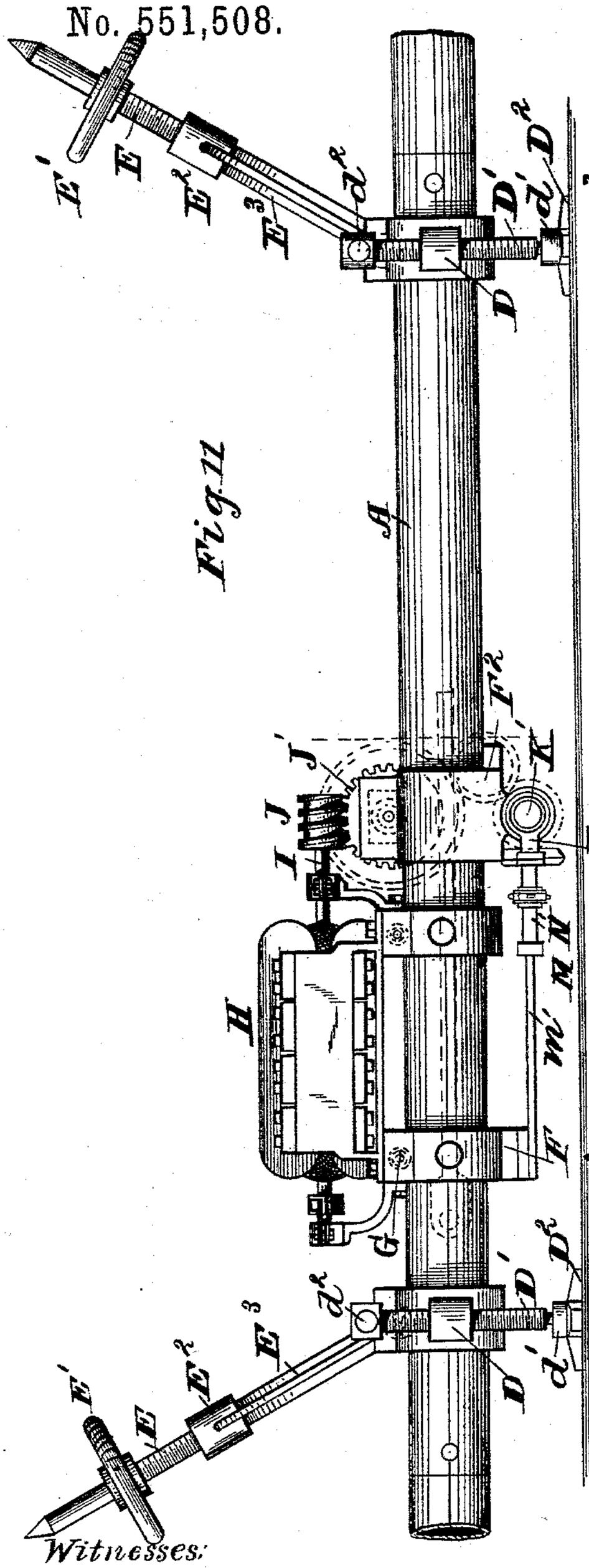

Fig. 11.

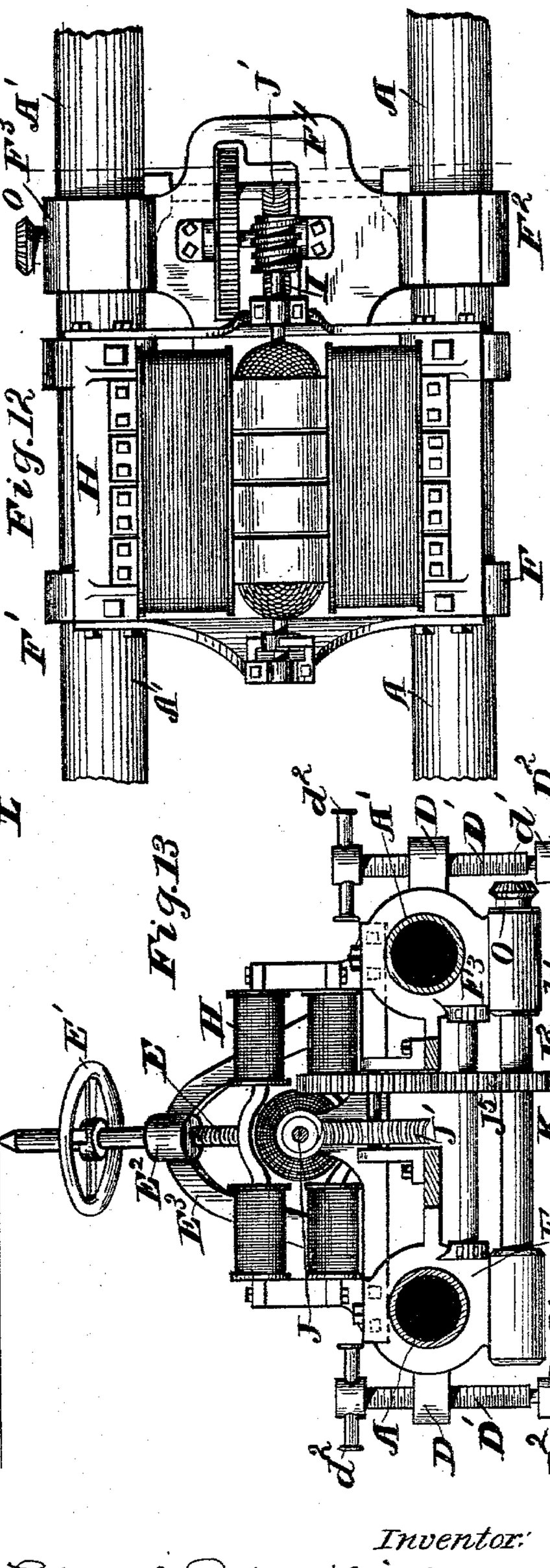

Fig. 12.



Fig. 13.

Witnesses:
J. C. Turner
J. B. McGuire.

Inventor:
Edward S. McKinlay
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# UNITED STATES PATENT OFFICE.

EDWARD S. McKINLAY, OF DENVER, COLORADO.

## MINING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 551,508, dated December 17, 1895.

Application filed July 11, 1888. Serial No. 279,696. (No model.)

*To all whom it may concern:*

Be it known that I, EDWARD S. MCKINLAY, a citizen 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.

This invention relates to improvements in machines for mining coal, it pertaining more especially to machines of the kind used in the "long-wall" system of mining, in contradistinction to what are known as "heading machines."

My improved mechanism comprises a frame adapted to be made stationary to serve as a bed and as a support for the moving parts; a carriage or traveling frame adapted to move forward and back on the said bed; a cutting mechanism, preferably of the form of a horizontally-mounted bar revolving on its longitudinal axis and shod with cutters; a bracing-frame behind the cutter-bar, with a bearing for the outer end of the latter, and extending backward and outward to the carriage, it being preferably more or less nearly triangular in general outline; power devices on the carriage for effecting the rotation of the cutting mechanism, and means for feeding forward the carriage when the cutters are in operation.

Of course I am aware of the fact that heretofore mining-machines have been used, or proposed, having more or less of the features of construction above broadly suggested; but serious difficulties have been experienced in attempting to operate the machines of the earlier forms, and as a result of them I have been led to the present improved construction.

In the drawings I have shown one form of the machine embodying the features of improvement, this being selected for purposes of illustration, and it will be readily seen by those skilled in such devices that there can be more or less modification without departing from the spirit of the invention.

Figure 1 is a top plan view of one of the improved machines. Fig. 2 is a plan of some of the parts, the others being removed to more clearly show the relations of those illustrated. Fig. 3 is a side elevation. Fig. 4 is a vertical transverse section on the line $x\,x$, Fig. 3. Fig. 5 is a similar section on the line $y\,y$, Fig. 3. Fig. 6 is a transverse section on the line $z\,z$, Fig. 2. Fig. 7 is a partial longitudinal section of the feed-cylinder and its piston and rod. Fig. 8 is a partial top plan view of the same. Fig. 9 is a vertical section showing the coupling for the side bars of the bed. Fig. 10 shows the cutter-supporting frame. Figs. 11, 12, and 13 show a machine modified in the driving-motor.

As shown in the drawings, the bed-frame is mainly composed of tubes A A′, they being preferred on account of the greater strength in proportion to the weight of metal, though a framing can be constructed of other well-known parts. This frame can be made as long as is required. I have shown a simple and advantageous method of uniting the tube-sections longitudinally. *a* is a short section of tubing of an exterior diameter equal to the interior diameter of the tubes A A′. It is utilized by inserting it part way into the adjacent ends of the tube-sections. It can be fastened to one of the tubes permanently and to the other detachably, or it can be made rigid with both as requirements may dictate. This frame is fastened in place by means of jack-screws, with frames and girts joining one side tube A with the other A′. The joining girts or bars are formed with a central part B and with large eyepieces B′ at the ends, the latter fitting snugly to the exterior surface of the tubes A A′ and yet being adapted to move thereon when necessary. They can be clamped rigidly to the said tubes by means of the set-screws C mounted in threaded bosses or nipples C′ integral with the eyepiece B′, the screws being adapted to engage with clamping-blocks $C^2$ fitted in seats in the parts B′ and adapted to bear against the tubes.

The eyepieces B′ have laterally-projecting lugs D provided with vertical threaded apertures and with them the screws D′ engage, these having expanded foot-pieces $D^2$ with sockets at $d'$ in which are stepped the lower ends of the screw-rods D′. At the upper ends of the latter there are wrench-rods $d^2$ by which the screws can be turned so as to lift the parts B A A′ upward.

E E represent jack-screws each having a

hand-wheel E′ and being adapted to engage with a threaded eye $E^2$ carried by the large stirrup $E^3$. The lower ends of the legs of the latter fit into sockets at $E^4$ on the cross-bar B. The screws E are adapted to reach up to and be forced against the roof of the mine and when they are turned in the proper directions they firmly bind the framework in proper position.

By means of the screws D′ the machine can be adjusted relatively to the horizon into any position ordinarily required, and at the same time the said screws can be utilized to co-operate with the screws E to firmly brace the whole machine.

The tubes A A′ serve as a support for the operating and movable parts of the mechanism. The latter comprise the power devices and the cutting devices and such means for supporting them as will constitute a suitable carriage.

I prefer to provide four large eyepieces F F′ $F^2$ $F^3$ and to cast them integral with the carriage-plate having the cross-bar portions $f f'$ and the longitudinal connecting part $f^2$; but these or their equivalents may be made separately and secured together in any suitable way. The eyepieces F F′ $F^2$ $F^3$ have an interior diameter such that they can fit snugly to and yet slide upon the side tubes A A′. Each is formed with a cavity $g$ wherein can be mounted an antifriction-roller G adapted to rest upon the upper exterior surface of one of the tubes, as will be readily understood from an examination of the drawings. The sliding parts of the mechanism are virtually suspended on these antifriction devices, so that there is but little resistance offered by the stationary parts to those moving thereon.

The parts F F′ at the rear of the carriage are formed with seats at $h$ upon which the engine-cylinders H are bolted. The front parts $F^2$ $F^3$ of the carriage are projected upward somewhat and are formed with bearings for the crank-shaft I, the cranks $i$ $i'$ of which are respectively connected with the engines. The crank-shaft carries a gear-wheel J which meshes with a wheel J′ on a horizontal axis in or nearly in the plane of the carriage-plate $f f' f^2$, and which in turn drives a pinion $J^2$ connected with a cutting mechanism to be described. The carriage-plate is projected forward somewhat as at $F^4$ to provide sufficient strength and is formed with an opening to permit the mounting of the wheel J′. This shaft $j$ is mounted in boxes at $j'$ which are carried by plates $j^2$ bolted to the top of the carriage-plate as shown at $j^3$.

Through the parts last described power is transmitted from the engines to the cutter-bar, which is indicated as a whole by K K′. The forward eye parts $F^2$ $F^3$ of the carriage are extended downward somewhat below the tubes A A′ and are formed with transverse bearings at $k$ $k'$ in which the cutter-bar K is mounted. The cutter-bar is extended laterally from the side of the machine to the required distance and the laterally-extended portion is provided with cutters $k^2$. If preferred, the projecting part K′ may be made separately from the part K mounted on the carriage; but under most circumstances I prefer to make them in one piece.

At the outer end the cutter-bar has a supplemental bearing in a shoe L, which is formed upon or secured to a bracing-frame that is situated back of the cutter-bar. This frame as a whole is indicated by $m$, it having, when made as shown, a bar or plate $m$ which lies substantially parallel to the line of the cutter-bar and a backwardly and outwardly extending bar or plate $m'$, and one or more cross-bars $m^2$. The part $m'$ is bolted to the rear eyepiece F of the carriage and preferably joins the part $m$ near the shoe and bearing at L. Thus the bracing-frame gives a strong and firm support for the cutter-bar, preventing bending or displacement of the latter if any of the cutters should strike a hard unyielding substance. This frame also supports the mechanism which removes the cuttings from behind the cutter-bar. The part $m$ is extended across the machine under the carriage to the opposite end of the cutter-shaft K and carries a short chain-shaft N mounted in bearings at $n$. This shaft receives power from the shaft K through bevel-wheels O O′ and it engages with the chain P which extends to the distant end of the cutter-bar, there being a second chain-shaft N′ mounted upon the aforesaid frame $m$ $m'$ or immediately behind the end of the cutter-bar.

When the machine is in operation, the motion of the shaft K K′ is transmitted through wheels O O′ and shaft N to the chain which is caused to engage with the slack or cuttings made by the bar and draw them out from the kerf and into and across the open space between the ground and the bed and thus prevent them from piling up near the face of the coal. The carriage is advanced upon the bed-frame while the cutting is being effected by means of the following devices.

Q represents a cylinder which is mounted upon the bed in the rear of the carriage. It is provided with a piston R and a piston-rod S, which is preferably hollow, as shown. An air, steam, or other motive agent can be admitted to it from the feed-pipe at T. The cylinder is united to the carriage-plate $f$ by a hinge at $q$.

In Figs. 11 to 13 a machine is illustrated modified as to the power devices. Instead of employing an engine, I mount on the carriage an electric motor H, having its armature-shaft I provided with a worm J, engaging with and actuating a worm-wheel J′. This latter wheel J′ is on a cross-shaft which is provided with a spur-wheel meshing on a smaller wheel on an intermediate shaft, which in turn drives gear-wheel $J^2$ on shaft K. The armature-shaft is mounted in bearings or standards

which project upward from the carriage-plate. The other parts of the machine are similar to those in the machine above described.

The operation of the machine will be readily understood from the above description and on examining the drawings.

The machine is placed so that the carriage shall move substantially parallel to the wall of coal, the cutter-bar being inserted into an under-cut produced in any preferred way. The bed is put into the desired position by means of the adjusting devices. Generally it will want to be substantially horizontal, but not always, for, as is well known, the veins of the coal vary in their position relative to the horizon. It is desirable to have the kerf formed as near the bottom of the vein as possible, so as to avoid the necessity of subsequently removing the layer of coal between the kerf and the floor. The means of adjustment which I provide are of value in this connection. If the circumstances are such that the carriage can make a long traverse on the bed, the cross-connecting parts B B′ are slipped along the parts A A′ to the required distance and are then clamped firmly by means of the devices at C C′ C². As the side supports A A′ are independent of each other so far as any rigid fastening is concerned, they can be extended to any required distance by adding sections in front or in the rear if necessary, so that a cut can be made the whole length of the long wall virtually without removing the machine at all, although it is true both the carriage and the bed will change their positions by reason of the onward travel of the carriage and by reason of consecutive adding of sections to the front ends of the side supports and removing sections from time to time from the rear end if necessary. After sections have been added to the side supports in front, the cross-connecting parts B B′ with their jack-screws and adjusting-screws can be released from the roof and loosened relatively to the bed, and again slipped forward and then fastened to both bed, roof and floor for another onward movement of the carriage. After the bed has been put into proper position firmly, the air or other motive agent is admitted to the cylinders H and also to the feeding-cylinders Q. The engines through the crank-shaft I and the gear-wheels J J′ J² transmit rotary motion to the cutter-bar K K′ and at the same time the carriage is pressed forward by means of the feed-cylinder and piston.

It is well known that there are serious objections to any of the ordinary "positive feeds," such as racks and pinion, threaded bars and nuts, &c., on account of the varying resistance offered by the material attacked by the cutters. These difficulties have been particularly serious in attempting to operate long-wall cutting-machines as heretofore made, because the sudden increase in resistance made at frequent intervals by the cutting apparatus gives sudden reactionary strains on the carriage and bed-frame, and this has been the case heretofore to such an extent that, as is well known, there has never been any successful long-wall cutting-machine, although numerous forms have been proposed and tried. These difficulties I overcome by employing, in combination with a laterally-extending cutting mechanism, a non-positive feeding device—that is to say, one in which the carriage shall be advanced by an agency adapted to yield if the resistance to the cutters should increase beyond a certain degree. In operation, the carriage and cutter-bar advance through the softer material with a speed proportional to its hardness and proportional to the pressure in the feed-cylinder Q and to its several dimensions. If substances such as sulphur balls or veins are met by the cutters and they resist the advance of the cutters with a back-pressure too great for the last-described ratio, the feed device will remain more or less nearly stationary; but the cutters continue revolving at a high rate of speed, in fact at a somewhat higher speed than when they were advancing with a normal rapidity, and this increase in the speed of the cutters when cutting through a harder body I have found to be a matter of great advantage. After the obstructing mass has been passed, the air-feed device will again press the carriage forward.

Although I have shown in the drawings a machine of the long-wall-cutting type and have above referred to that class more particularly, yet it will be seen that a number of the features of my invention can be readily applied to machines of the other form—to wit, the heading-machines—to advantage. Thus, for instance, I believe myself to be the first to have arranged the three essential elements of a mining-machine—to wit, the stationary bed, the carriage, and the cutting apparatus—in the way I have shown and described whether the cutting apparatus is thrust forward in front or projected laterally. It is well known that one of the chief objects with undercutting-machines is to produce the kerf as near the floor-line as possible.

In the present construction, it will be seen I virtually suspend the cutting apparatus below the carriage and below the bed, and by the devices which accomplish this and those which effect the vertical adjustment the cutters can be taken as close to the floor-line as is desired. The engines project above the bed and the cutting apparatus lies below the bed so that the parts of the carriage are well balanced and cramping or binding on the bed is avoided, the feeding device being applied between the power mechanism and the cutting apparatus. However, in this respect, there can be more or less modification without departing from the essential features of the invention.

What I claim is—

1. In a mining machine, the combination with the horizontally moving carriage and the cutting apparatus thereon, of the bed having clamping devices for securing the machine to the roof and to the floor of the mine, means for adjusting the bed relatively to the floor and two parallel side supports for the carriage arranged horizontally and secured independently of each other to the said clamping devices, a feed mechanism for moving the carriage relatively to the bed, and gearing for actuating the cutters while the carriage is advancing, substantially as set forth.

2. In a mining machine, the combination with the carriage and the cutting apparatus thereon, of the bed having parallel extensible side supports for the carriage, and the cross supports detachably connected to both of said parallel side supports, the support on one side being movable independently of that on the other, each being provided at the ends with means, substantially as set forth, for joining it to another similar support whereby the bed can be extended, substantially as set forth.

3. In a mining machine, the combination with the carriage and cutting apparatus, of a bed having parallel extensible side supports formed of hollow tubing, and the cross bars or frames detachably secured to the said supports inside of their ends, said cross bars being supported on the floor independently of each other and of the side supports, substantially as set forth.

4. In a mining machine, the combination with the carriage and the cutting apparatus thereon, of the bed having the cross bars or frames clamped on vertical lines to the roof and floor of the mine, and the horizontal side supports for the carriage formed of hollow tubes in sections detachable from each other, and detachably secured in horizontal seats in the said cross bars or frames and joined together by tubes inserted into those aforesaid, substantially as set forth.

5. In a mining machine, the combination with the horizontally moving carriage and the cutting apparatus thereon, of the bed having two or more cross bars or frames adapted to be clamped in position on vertical lines, and horizontal side supports for the carriage formed of tubing in sections, said sections being joined end to end, and adapted to be passed through apertures or seats in the said cross bars or frames, substantially as set forth.

6. In a mining machine, the combination with the carriage and the cutting apparatus thereon, of the bed having side supports for the carriage formed of hollow tubing and the cross bars or frames each provided with two apertures adapted to receive one of said tubes and means substantially as described for vertically adjusting each end of each of the said tubes independently of the others, substantially as described.

7. In a mining machine, the combination with the carriage and the cutting apparatus, of the bed having the side supports for the carriage formed of hollow tubes in sections united end to end and the cross connecting pieces having eyes adapted to slide longitudinally in either direction along the side supports, and over the joint between the tube sections, as set forth.

8. In a long wall, or side-cut mining machine, the combination with the side supports A A′, of the bed, of the cross connecting bars B B, having eyes or guides B′, the laterally projecting bars or arms D, the clamps C $C^2$, the screws for binding said clamps, the screws D′, and the jack or binding screws E, substantially as set forth.

9. In a mining machine, the combination with the bed and the carriage, of the laterally projecting cutter bar, the cleaner chain parallel to and behind the cutter bar, the chain driving shaft transverse to the cutter bar and the bevel wheels respectively on said cutter bar and said chain shaft connected directly together, substantially as set forth.

10. In a mining machine, the combination with the bed, the carriage sliding thereon, and means for securing said bed stationarily to the floor and roof, of the feeding mechanism for the carriage consisting of a piston and cylinder, the cylinder being hinged to the carriage and the piston bearing against an abutment independent of the bed, whereby power is applied directly to the carriage to move it, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

EDWARD S. McKINLAY.

Witnesses:
WM. A. McKINLAY,
LUCIUS P. MARSH.