(No Model.) 8 Sheets—Sheet 1.

E. S. & W. A. McKINLAY.

MINING MACHINE.

No. 457,887. Patented Aug. 18, 1891.

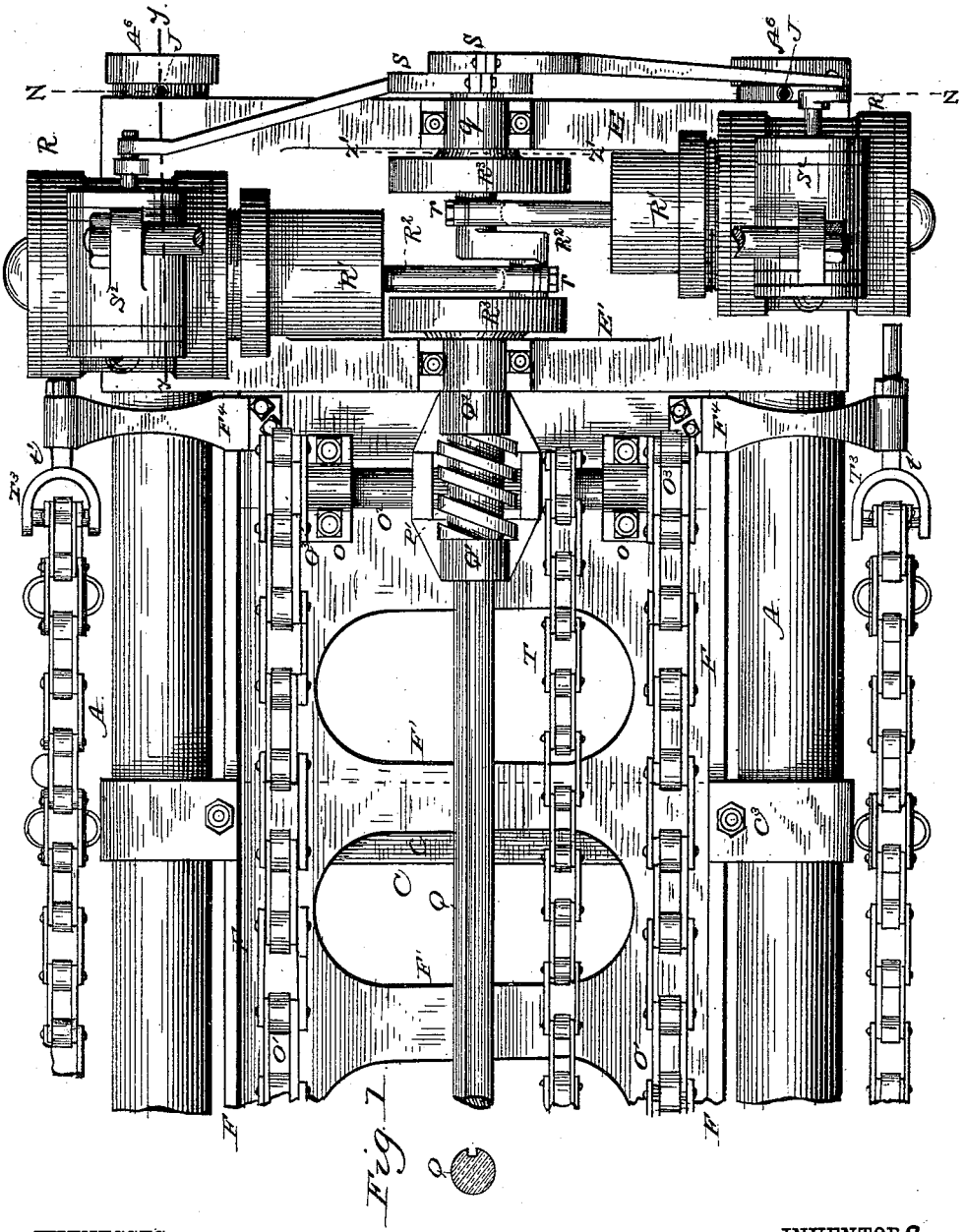

Fig. 1.

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MINING MACHINE.

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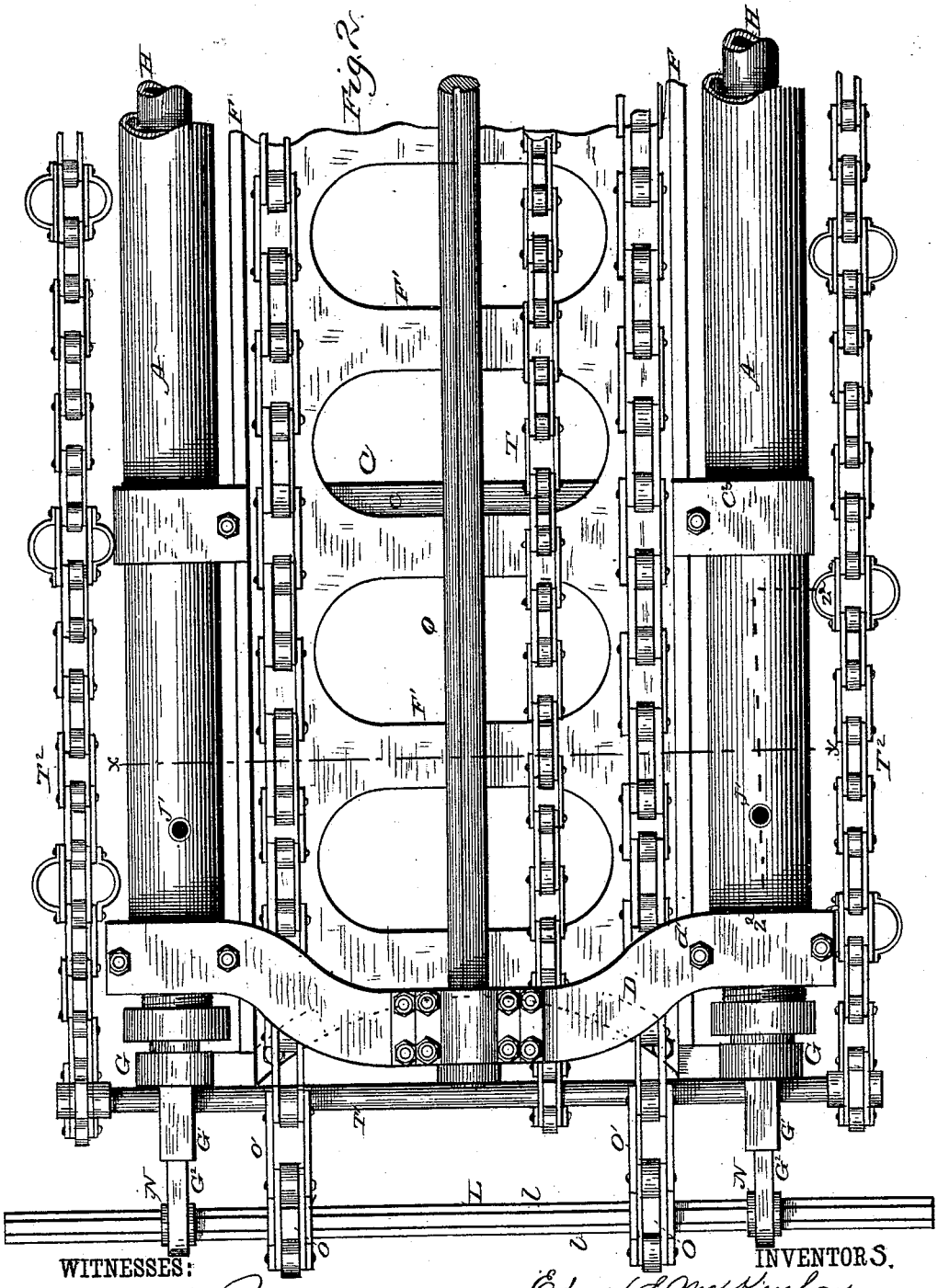
Fig. 2.



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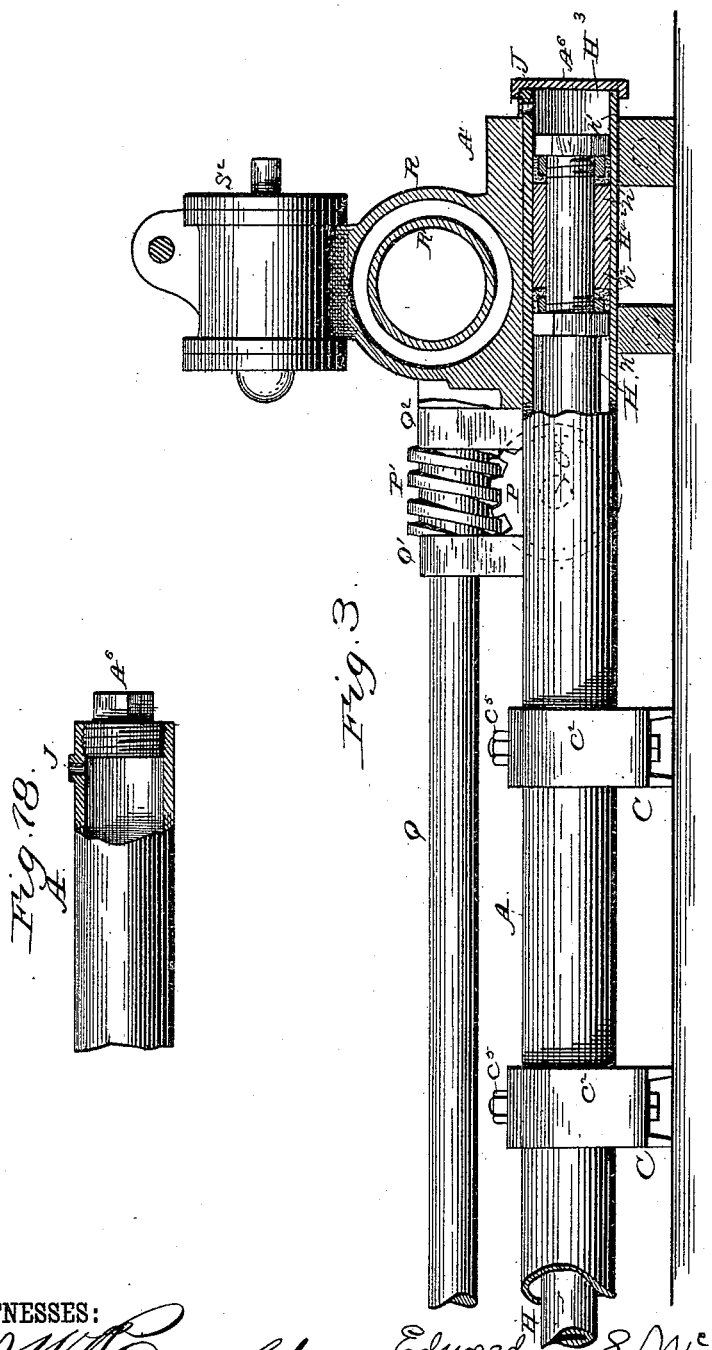

Fig. 3.

Fig. 3a.

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MINING MACHINE.

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Fig. 9.

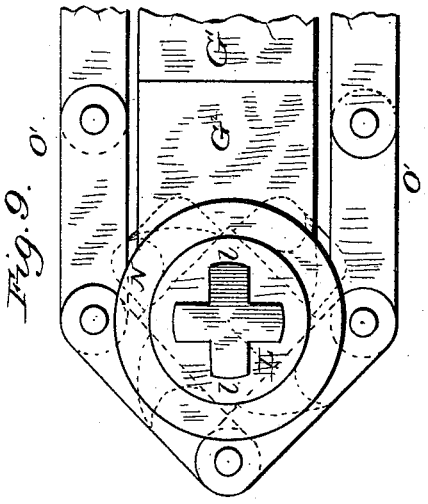


Fig. 10.

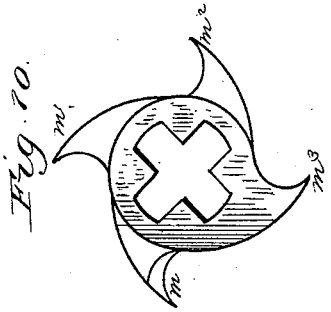


Fig. 11.

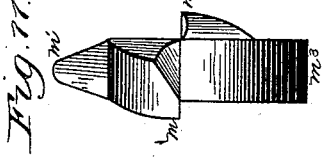
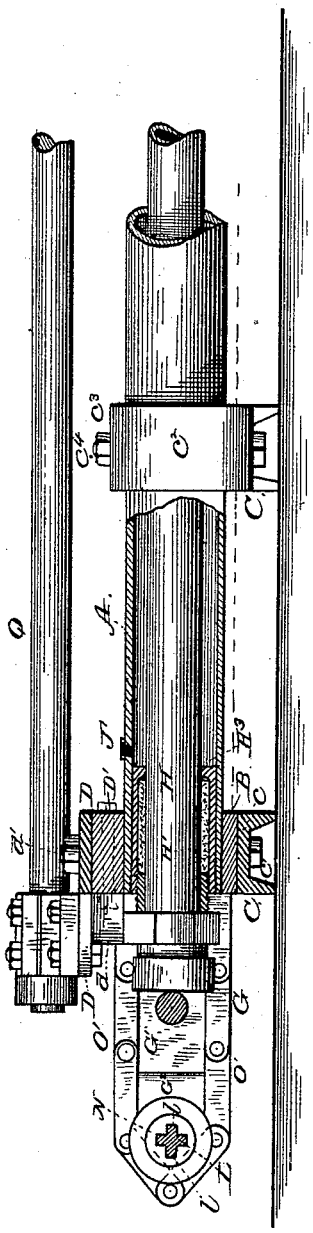


Fig. 4.



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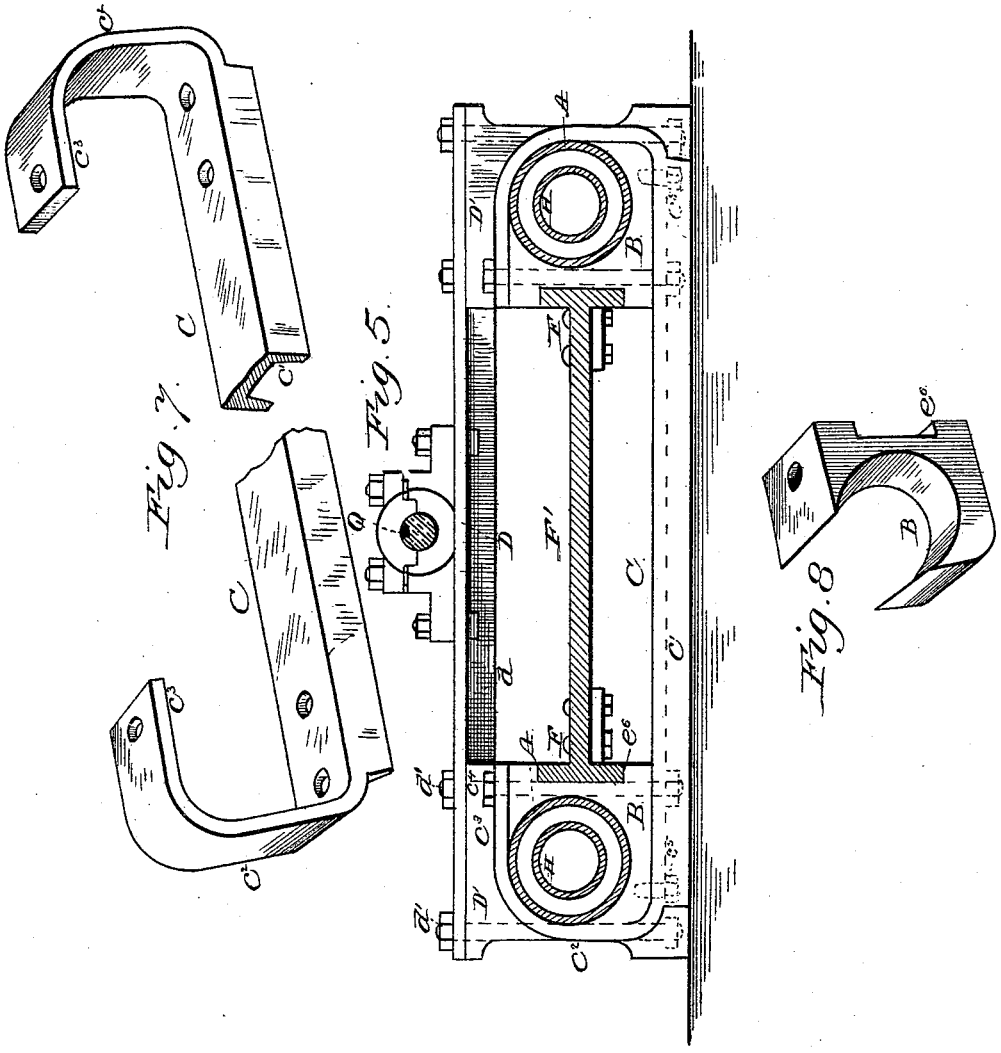

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MINING MACHINE.

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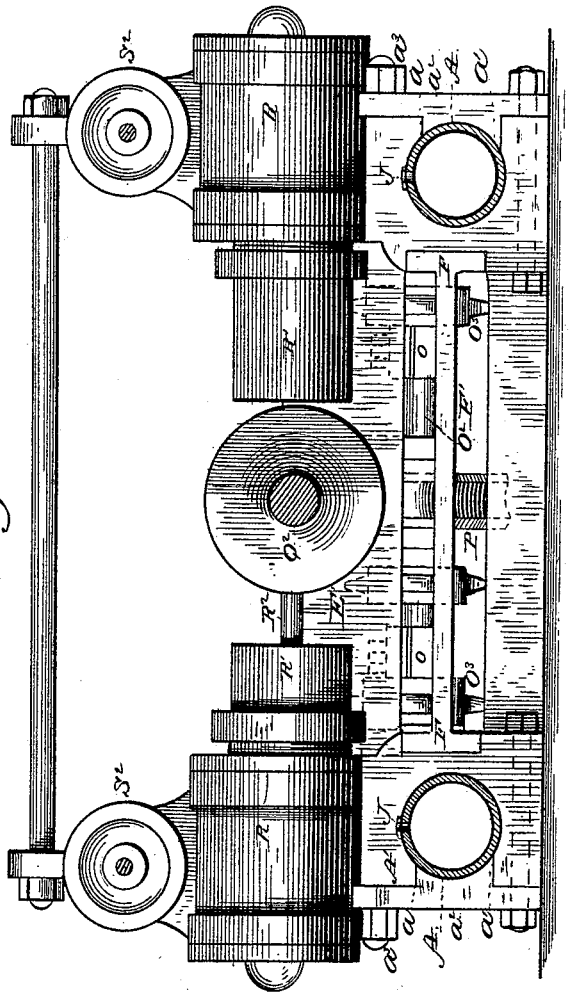

Fig. 6.

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MINING MACHINE.

No. 457,887. Patented Aug. 18, 1891.

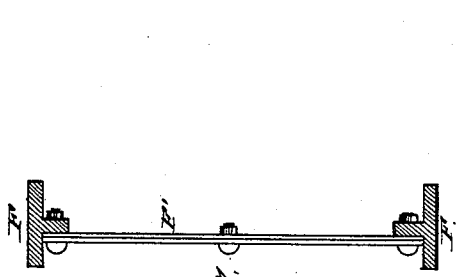

Fig. 17.

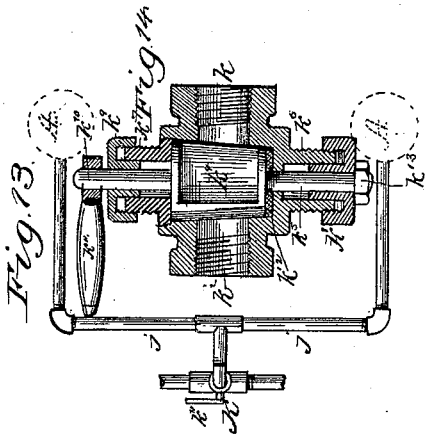

Fig. 13.

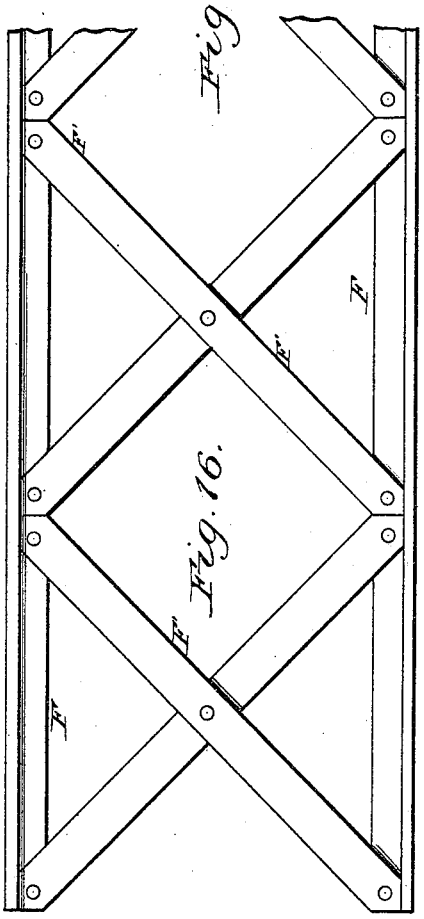

Fig. 16.

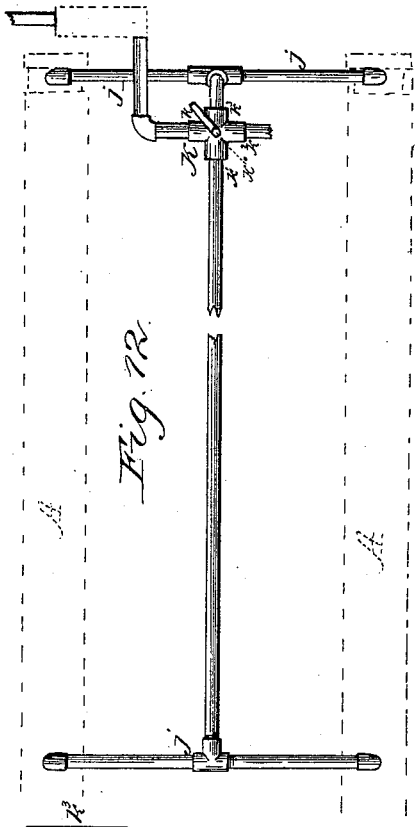

Fig. 12.

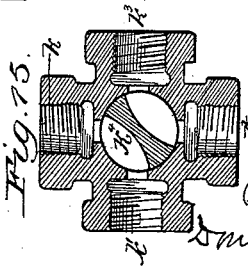

Fig. 15.

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(No Model.) 8 Sheets—Sheet 8.

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MINING MACHINE.

No. 457,887. Patented Aug. 18, 1891.

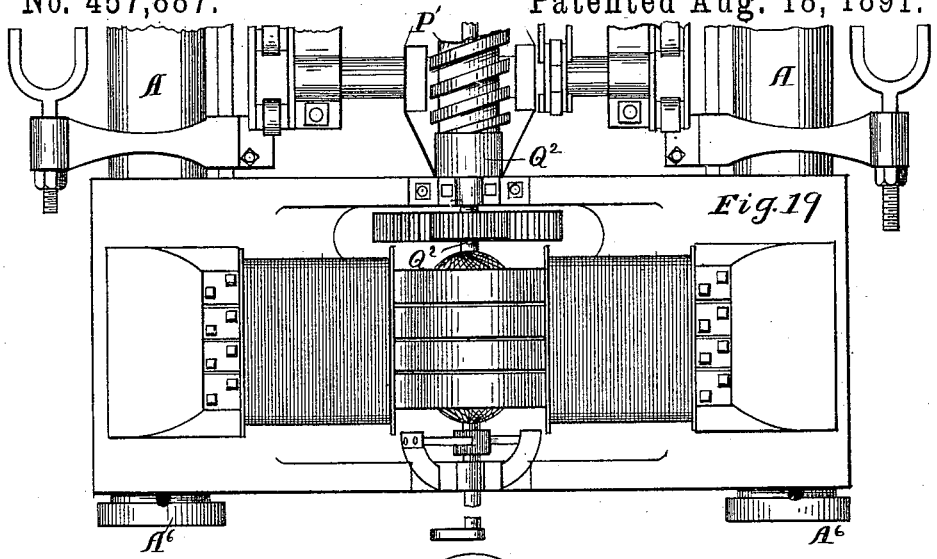

Fig. 19

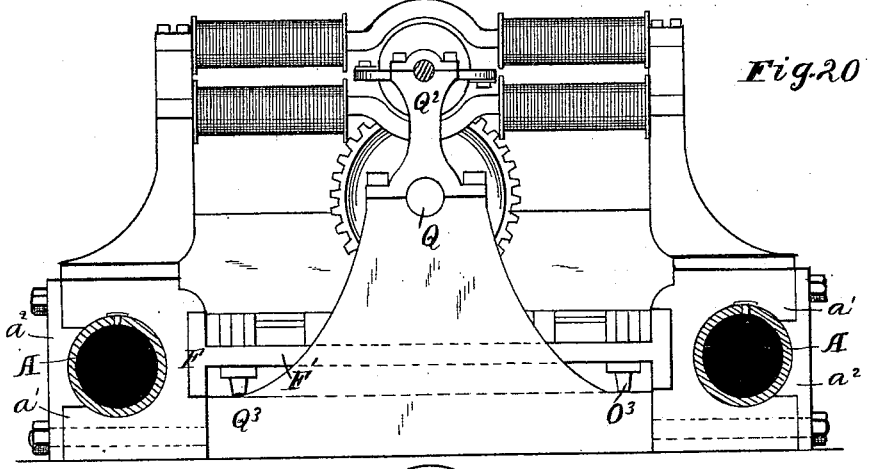

Fig. 20

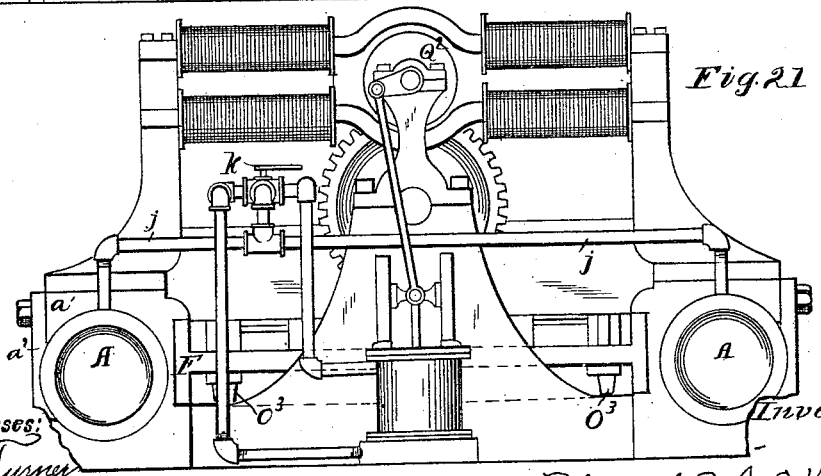

Fig. 21

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UNITED STATES PATENT OFFICE.

EDWARD S. McKINLAY AND WILLIAM A. McKINLAY, OF SOUTH PUEBLO, COLORADO.

MINING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 457,887, dated August 18, 1891.

Application filed March 15, 1884. Renewed January 22, 1891. Serial No. 378,652. (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 South Pueblo, in the county of Pueblo 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 top plan view of the rear end of the machine. Fig. 2 is a top plan view of the remainder of the machine at the front end. Fig. 3 is a view, partly in side elevation and partly in section, the section being taken through the left-hand side of the machine on a line corresponding to that indicated by *y y*, Fig. 1, said line being, however, in said figure on the right-hand side of the machine. Fig. 4 is a view, partly in side elevation and partly in section, of the machine at the front end, the section being taken on line z^2 z^2, Fig. 2. Fig. 5 is a cross-section of the machine on the line *x x*, Fig. 2. Fig. 6 is a view partly in elevation from the rear of the machine and partly in section, the air-tubes being shown in section on the line *z z*, Fig. 1, and the crank-wheel support being in section on the line *z' z'*, Fig. 1. Fig. 7 shows in perspective one of the cross-sills or braces. Fig. 8 shows in perspective one of the metal supporting-blocks combined with the side tubes. Fig. 9 shows in elevation the end of the cutter-bar and of the adjacent parts on a scale larger than that in Fig. 4. Fig. 10 is a side or face view of one of the cutters detached. Fig. 11 is an edge view of the same. Fig. 12 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. 13 is a view of the same from the rear. Fig. 14 is a section, on an enlarged scale, of the four-way cock shown in Figs. 12 and 13. Fig. 15 is a central horizontal section of that shown in Fig. 14. Fig. 16 shows, in top plan, a modified form of the sliding carriage. Fig. 17 is a cross-section of the same. Fig. 18 shows the rear end of one of the feed-tubes with a modified form of stopper at the rear end. Figs. 19, 20, and 21 illustrate a modified form of motor for driving and feeding the cutting apparatus.

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^3. The block or casting A' 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*, together with webs or flanges *c'*, on the lower part, and having 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 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 a 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, 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 *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 Fig. 2.

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 *d*, and the block is bolted to said beam, as shown at *d*.

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 for pushing forward and retracting the sliding frame, mechanism on the sliding frame for effecting the cutting of the material, and mechanism 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 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 or bar F to the other. The "way" in which each of these two guide flanges or bars 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 each 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 G by screw-thread or other suitable device, and passes through a gland or stuffing-box H′ in the forward end of its 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, which fits as tightly as practicable the tube A; but to insure an air-tight fit, a packing material is inserted at H^4, 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 A is closed tightly by means of a threaded stopper or block, as shown at A^6.

The piston 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 elastic agent which is used to drive the piston forward not only presses against the head, 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 to 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 push it.

The parts are so constructed and related as that there shall be air-chambers H^3 at each end of the tube when the piston-head is completing its strokes, 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 employed, 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. With the supply-pipe at K^2, there is combined a pressure-regulator having its parts so arranged as that thereby the pressure of the air or other elastic agent can be regulated to correspond to the work which is being done. This may be of any well-known or preferred style, and therefore need not be here shown or described in detail.

The operation of the parts of the device just described will be readily understood. The valves in the four-way cocks are so adjusted as that the air shall enter the rear ends of the tubes A behind the piston, and said air, exerting its pressure behind the piston-head and also against the closing-surface at the front end of the pistons compels the latter to advance and carry with it the sliding frame F F′, together with the cutting apparatus and the means for removing the cutting material. When the sliding frame or carriage has advanced to the full or desired extent of throw, it is withdrawn by changing the positions of the valves in the four-way cocks which allow the air to exhaust from the rear side of the pistons and supply it to the front side of the piston-head. It will be seen that the area from 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 carry the frame forward than to withdraw it. This area can be varied by using a larger or smaller piston, as will be seen.

We will now describe the mechanism by which the cutting is effected, and by means of which power is transmitted thereto.

L represents a bar or shaft, which is mounted in the shoes or bearers G^2, as aforesaid. This shaft is not circular, but of another shape in cross-section. We do not wish to be limited to any particular sectional shape for this bar or shaft, as shapes of many styles can be used which will effect the purpose at which I aim. In the construction shown in Figs. 2, 4, and 9, the bar gives in cross-section an equal-armed cross, there being four arms, as shown at l. Upon this bar or arm there are arranged side by side a series of cutters, each having a hub or central supporting-piece, together with one or more outwardly-extending cutter-arms. These arms may be cast with or formed separately from and afterward secured to the hub portion. Preferably each is cast with its parts integral, it being made of very hard iron, chilled, with four cutting-points dressed by subjection to the action of emery or other suitable way. Instead of this material, use may be made of steel or any other that is desired. As shown, the points or cutting edges of the cutter section or washer are made to differ one from the other. The one at m is so arranged as to cut along the plane of the right-hand face, the one at m' cuts along the central plane, the one at m^2 cuts along the plane of the left-hand face, while the one at m^3 has its cutting-edge substantially parallel with the axis of rotation, so as to effect a scraping action over the lines of cut. This overcomes difficulties which have been experienced in the use of cutters in machines of this general class. The object is to preserve continually an uneven or rough surface of material in the path of the cutter, a surface of this character being much more easily cut than when a smooth or polished one is made by a series of scraping-cutters, one following another. The cutting edges or points of the cutter sections or washers can be arranged to extend laterally into the plane of the adjacent sections or cutters, so as to have one point overlap another and assist it in cutting, so that in case one of the points should be broken or marred there will not be a stoppage of the cutting action at that point. Such a construction is clearly shown in Figs. 10 and 11.

By a cap or nut on the ends of the cutter-bar the cutter sections or washers are held in place, and when it is necessary to change the cutters one of the end caps or nuts can be unscrewed and the cutter-bar withdrawn from all the washers, or from as many as it is desired to remove. After new or sharpened cutter-sections have been substituted, the bar can be shoved back on the line of the central apertures and be fastened again in place. When the parts are constructed in this way, much of the trouble and inconvenience heretofore experienced in adjusting and setting the knives, &c., is obviated.

At N N are the bearings for the shaft L, these consisting of flanged collars with central apertures conforming in cross-section to the cutter-bar.

On the cutter-bar there are one or more driving sprocket-wheels O, and these may be of any suitable character.

O′ O′ are the chains which extend backward from these wheels to the chain-driving shaft O^2. This is mounted in bearings at $o\,o$, carried by the sliding frame F F′. The sprocket-wheels O^3 are preferably situated just outside of the bearings o, as shown. The shaft O^2 is driven (in the mechanism shown) by a worm-wheel P, carried by said shaft, which receives power from a worm P′ above it. This worm is feathered upon a shaft Q, which extends from the front to the rear end of the stationary frame. The worm is carried to and fro along the shaft by means of uprights $Q'\,Q^2$, secured to and rising from the sliding frame, one bearing against one end of the wheel and the other against the other.

When the shaft Q is revolved, the worm P′ revolves with it, which in turn drives the worm-wheel P, and the latter moves the chains O′, and therefore rotates the cutter-bar L. As the worm P′ is permanently in engagement with the shaft, no matter what position it may be in longitudinally of the machine, the cutters can be kept constantly revolving thereby. The shaft Q is, in the construction shown, rotated by a compound trunk-engine, one cylinder being situated upon one side of the shaft and the other upon the other. We prefer to employ engines of the character shown fully and described in another application of ours, and therefore as reference can be made thereto the construction and advantages of such an engine need not be herein fully described. In general, however, it may be said that R R are the cylinders, within which are the trunk-pistons R′ R′. The latter carry the piston-rods R^2 R^2, pivoted respectively to the crank-pins r, carried by the crank-disks R^3 R^3. The portion Q^2 of the shaft is attached to the outer crank disk R^3, and is mounted in the bearing at q.

S S are the eccentrics by which the rocking valves are operated, the latter being situated in the steam-chests S^2 S^2, respectively, above the cylinders R. The cylinders, as hereinbefore stated, are preferably mounted in upwardly-projecting portions of the rear castings or blocks A′. The said castings or blocks of metal may be bored out to provide cylinder-chambers.

T is a chain driven also by the shaft O^2, and in turn driving the shaft T′, which carries the clearer-chains T^2, these being adapted to engage with and draw backward the chips and cuttings thrown out by the cutters. At the rear end the chains are supported in short shafts t', carried by yokes T^3, adjustably supported in brackets F^4, whose inner ends are bolted to the sliding frame.

In Figs. 14 and 15 we have shown, on an enlarged scale, the parts constituting the four-way cock which has been alluded to. By examining the said figures it will be seen that the parts thereof are of a peculiar form, whereby they are especially adapted for the work here intended. The valve proper k^4 is mounted by means of a shaft or pintle, as shown at k^5 k^{10}, the part k^5 passing outwardly through a threaded projection k^6, and the part k^{10} projecting in the opposite direction through a threaded projection k^7.

k^8 and k^9 are threaded caps or closing devices adapted to be fastened securely in place upon the said projections k^6 and k^7, and they are provided with interior sleeves or small cylinders which fit within the threaded projections k^6 and k^7 and provide bearings for the parts k^5 and k^{10}. If desired, a packing material may be inserted inside of the inner ends of the said interior cylinders, so as to make perfectly-tight joints.

The valve proper k^4 is tapering and fitted within a tapered recess, the valve consisting of two end disks and an intermediate plate, which, in cross-section, is preferably of the shape shown in Fig. 15.

At k^{12} a packing can be inserted, and at k^{13} there is a nut by means of which the valve can be drawn tightly into its seat. It will be seen that if any wear should occur upon any of the surfaces depended upon to close the passage-ways, the wear can be taken up by increasing the tension of the nut k^{13}, the conical or tapering form of the valve allowing it to be drawn more or less downward into the narrower part after wear has occurred. To permit the ready insertion of the valve, the part k^7 is formed separately from the other parts of the joint and is attached thereto tightly by means of a screw-thread, as shown clearly in Fig. 14. However, we do not wish to be limited to the details of the arrangement of the pipes by which the air is supplied to and exhausted from the cylinders or the details of the four-way cock, though at present preferring the form shown in Figs. 14 and 15; nor do we wish to be limited in all respects to the location and arrangement of the feed-tubes, for it will be seen that a single tube could be successfully applied, especially if it be arranged centrally, the other parts of the machine to be modified in the manner which will be obvious to those acquainted with these mechanisms. Moreover, it will be seen that other motor mechanism can be substituted for the trunk-engines shown. We also use electric motors for the purpose of transmitting power to the cutting mechanism and for operating the air-condensing devices.

The modified form last referred to is illustrated in Figs. 19, 20, and 21, wherein are shown the same parts that are shown in Figs. 1 and 6, except that the motor mentioned above is substituted for the engines in said figures, it being the common and well-known form of motor shown in Patent No. 271,042 to Curtis and Crocker, and the condensing apparatus for the air above referred to is also illustrated, it being a common form of compressing-cylinder. The air-pipes in Fig. 21 are the same as those in Fig. 12. However, we do not herein claim these features—to wit, those relating to the electric motor for rotating and advancing the cutters.

A motor of the character last indicated is in many mining regions a matter of great advantage, 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.

We do not in this application claim any of the features relating to the cutting devices, but reserve to ourselves the right to claim all novel matters relating thereto in another application. Nor do we herein claim anything

except what is specifically set forth in the following claims, and we jointly disclaim in favor of E. S. McKinlay solely those features relating to the tubular side pieces of the stationary frame; also, to the use of said tubes as feed-cylinders; also, to the features of construction relating to the feed piston-rods; also, to the arrangement of the engines by which the cutters are operated, and also to the use in mining-machines of this character of an elastic feed by air-pressure, &c.

We are aware of the fact that heretofore use has been made of devices for feeding forward a drill by means of hydraulic pressure. In the mechanisms alluded to a vertical frame has been employed to which have been clamped vertically-arranged feeding-cylinders and also a support for a revolving and advancing drill-shaft, the latter being supported entirely independently of the feed-cylinders and carrying cutters revolving in a plane transverse to the axes of the feed-tubes. In our construction the tubes at the sides of the machine are utilized as the connecting and supporting devices of a frame for receiving the lateral or transverse and especially the downward pressure and thrust of the sliding frame, said tubes, in fact, constituting the most important part of the stationary frame, and the removal of either of them would necessitate the taking of the machine to pieces, substantially, which demonstrates the intimate correlation between these tubular connecting-pieces (as being the essential part of the supporting-frame) and a sliding cutter-frame supported thereon. By having the side connecting-pieces made tubular we gain the advantage of great increase of strength for resisting lateral strains and pressure in proportion to the weight of metal employed in their construction, and we believe ourselves to be the first to have constructed a mining-machine of the general character of ours with a frame having this great advantage incident to it.

In the drilling mechanisms heretofore employed and above alluded to, the main frame was constructed and acted in relation to the sliding part entirely independently of its relations to the feed-tubes, it being, in fact, a third structure in the apparatus, whereas in our mechanism there is no such independent frame. Again, in these drilling-machines referred to the feed-cylinders have been arranged vertically, and there has been no special aim to brace them together strongly at the rear ends as well as at the forward, they not requiring such connection owing to their peculiar relationship to the other parts of the machine. We provide a strong bracing from end to end in order that the comparatively wide sliding frame shall be properly supported upon them without the danger of binding or cramping at any point. In accomplishing this we prefer to utilize the devices which support the engine, said devices being provided with apertures suitable for receiving the rear ends of the tubes. Other equivalent means, however, in place thereof can be used, and, in fact, we do not desire the other features of the invention to be limited to those manifested by the feed-tubes and which have been above set forth.

We are also aware of the fact that use has been made of piston-rods containing interior chambers and slotted walls for the purpose of having said walls forced outward by the pressure of the driving agent; but the constructions embodying these features are not analogous to the feed-tubes, pistons, and piston-rods in our case. We accomplish several ends by the tubular piston-rods which we have shown. In the first place we make it possible to apply the pressure at points sufficiently far forward to prevent to a very material extent straining, binding, or cramping any of the parts, and this is a matter of great advantage when a long travel is to be accomplished. Again, regardless of the particular point at which power is applied, we by using hollow pistons of enlarged diameter preserve the rquisite strength in the rod proper, and at the same time greatly reduce the area of pressure during the return travel.

We prefer to have the piston made of a tube running from the piston-head forward far enough to permit it to be during the most of the forward travel in front of the front end of the cylinder.

We do not claim any of the inventions shown or described in the patent in the British patent to Wm. Mather and F. M. Lechner, No. 3,095, of 1881, being aware of the fact that there is more or less similarity of construction so far as relates to having the engines arranged horizontally and gearing the crank-shaft directly to the chain-driving shaft, although it will be noted that there is a radical difference in that the engines in our machine are on the stationary bed and are not "mounted on the carriage," as shown and described in the said British patent.

We do not herein claim anything relating specifically to the combination with the other parts of the machine or any of them of the electric motor.

What we claim is—

1. The combination, with the sliding frame and the stationary frame having longitudinal connecting-pieces at the side, of the supporting-blocks B, lying partly below and partly inside of the said connecting-pieces of the stationary frame, each block having an aperture or recess upon one side to receive said longitudinal connecting-piece, and a way upon the other side for guiding the sliding frame, substantially as set forth.

2. The combination, with the sliding frame and the stationary frame having the longitudinal connecting-pieces at the sides, of the supporting-blocks partly below and partly inside of said longitudinal connecting-pieces, each block having an aperture or recess upon one side to receive one of said longitudinal connecting-pieces and a way upon the other side

for guiding the sliding frame, and the cross-girts C, which support the blocks B and at the ends are turned upward and clamped to the said side longitudinal connecting-pieces of the stationary frame.

3. The combination, with the horizontally-sliding and non-rotating frame and the stationary frame having the longitudinal connecting-pieces at the sides, of the cross-braces having the central parts thereof below the said side longitudinal connecting-pieces, and the detachable blocks B, independent of each other and interposed between the said side longitudinal connecting-pieces and the cross-braces and clamps which secure together the braces, the blocks, and the said side longitudinal connecting-pieces, substantially as set forth.

4. The combination of the stationary frame having the side longitudinal connecting-pieces, the supports for the front ends of the said side longitudinal connecting-pieces, the blocks A′ A′ at the rear ends of the said connecting-pieces having apertures or openings to receive the clamps, the engine supported upon said blocks, and the plates or braces a^2, situated in the said apertures or openings for clamping the said side longitudinal connecting-pieces.

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

EDWARD S. McKINLAY.
WILLIAM A. McKINLAY.

Witnesses:
F. C. LAKE,
W. R. GREGG.