(No Model.) 2 Sheets—Sheet 1.

J. L. LECHNER.

MINING MACHINE.

No. 483,156. Patented Sept. 27, 1892.

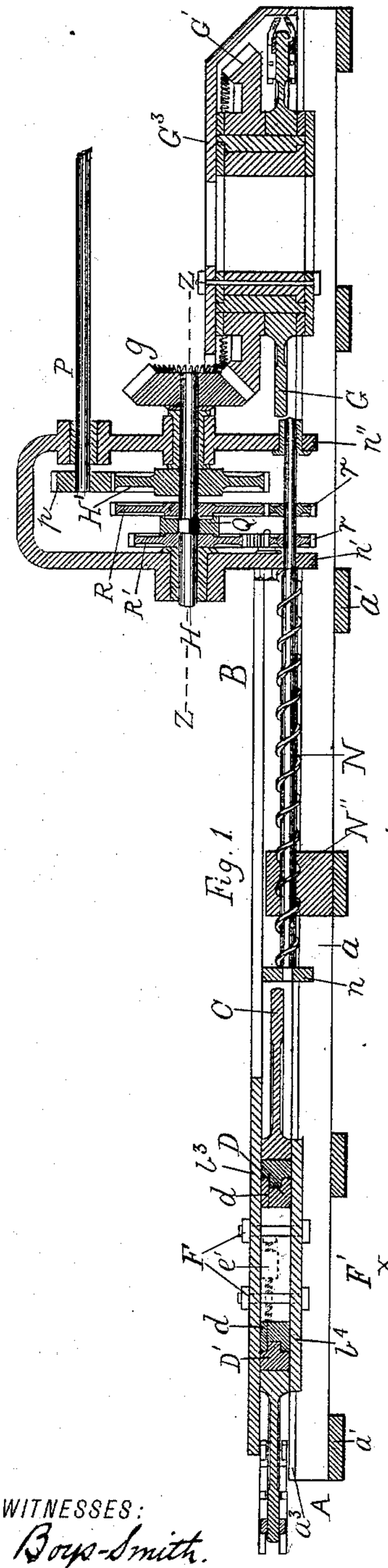

Fig. 1.

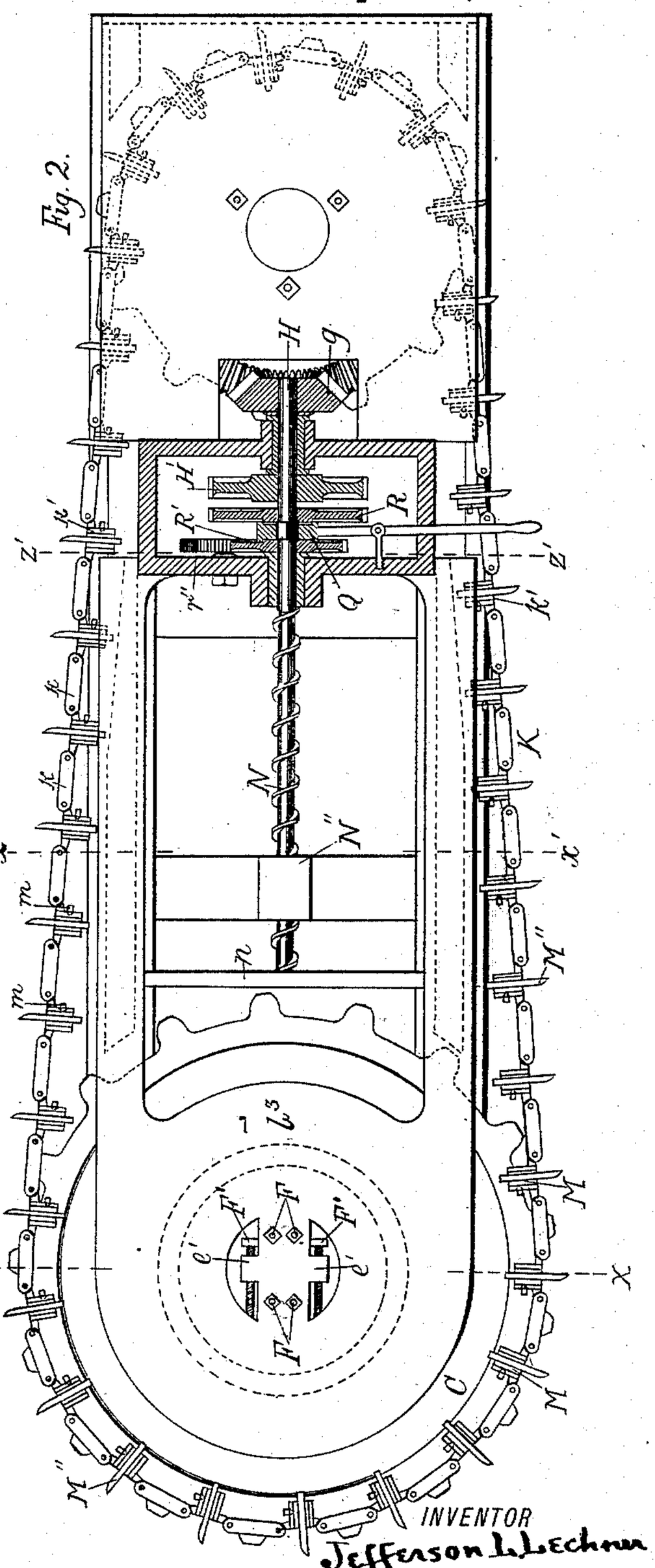

Fig. 2.

WITNESSES:

A. G. Boyd-Smith.

D. E. Doyle.

INVENTOR

Jefferson L. Lechner

BY

Higdon & Higdon

ATTORNEYS.

(No Model.) 2 Sheets—Sheet 2.

J. L. LECHNER.

MINING MACHINE.

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Fig. 3.

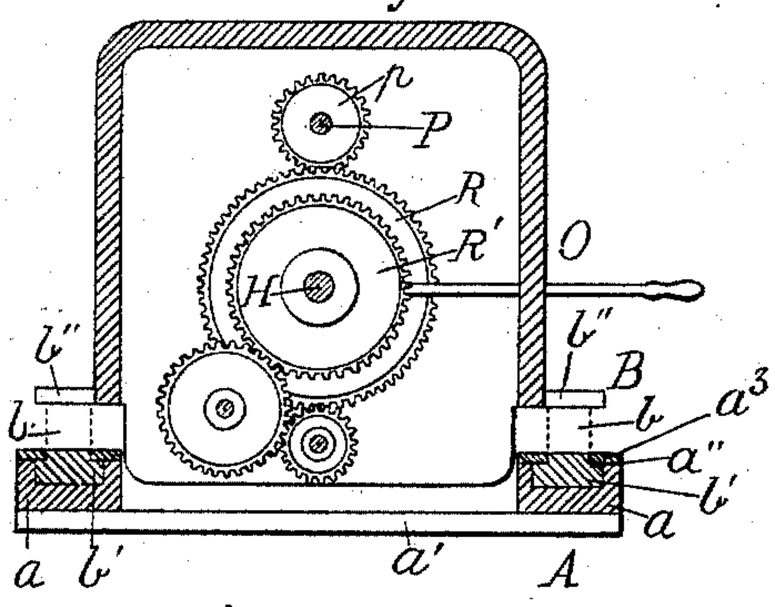


Fig. 4.

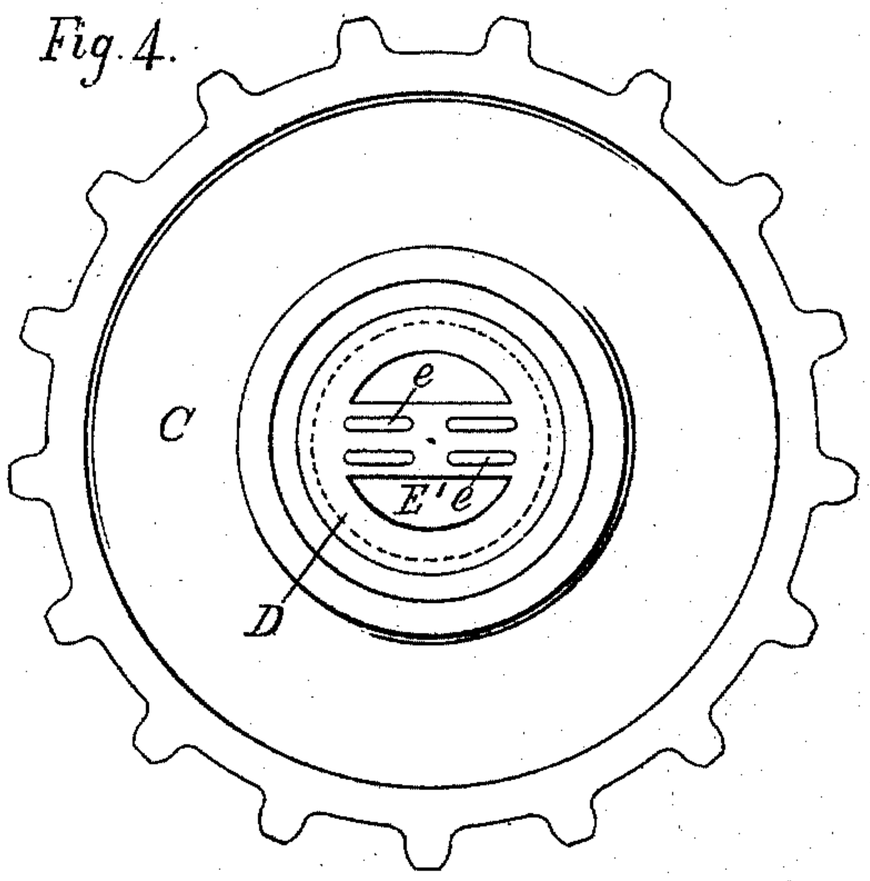


Fig. 5.

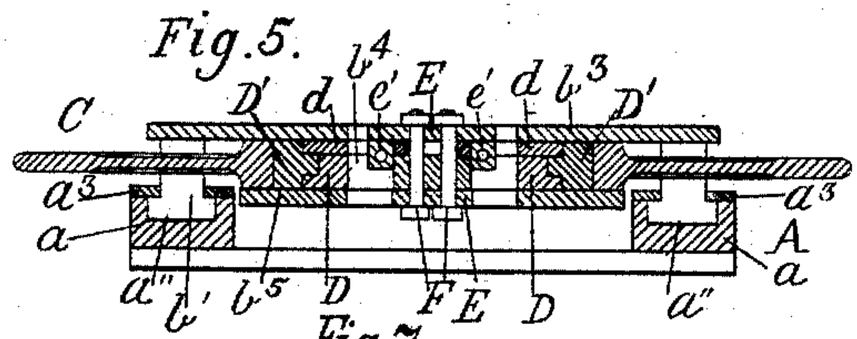


Fig. 6.

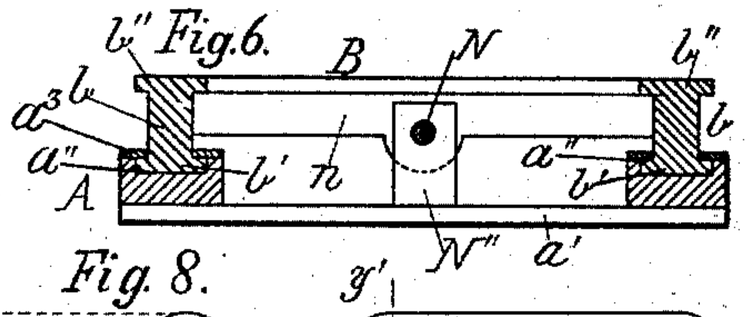


Fig. 7.

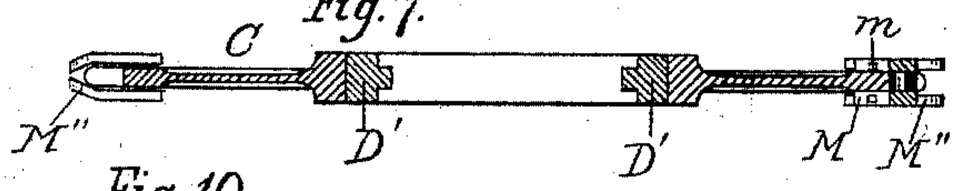


Fig. 8.

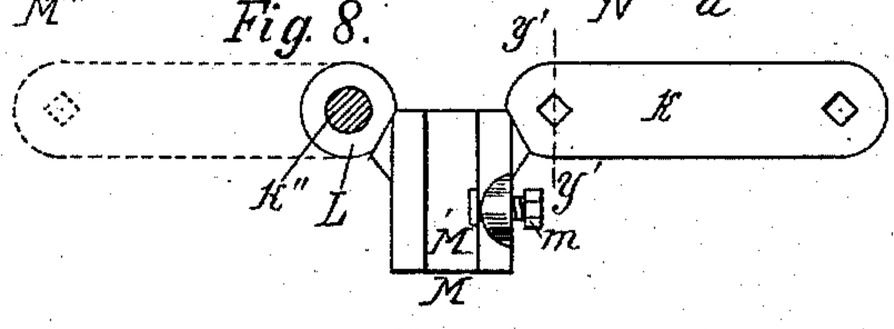


Fig. 10.

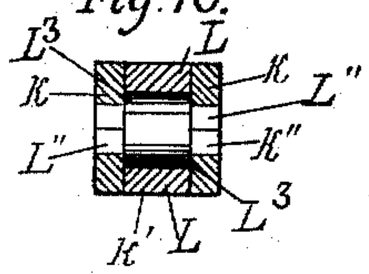


Fig. 11.

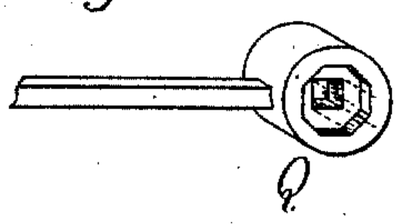


Fig. 9.

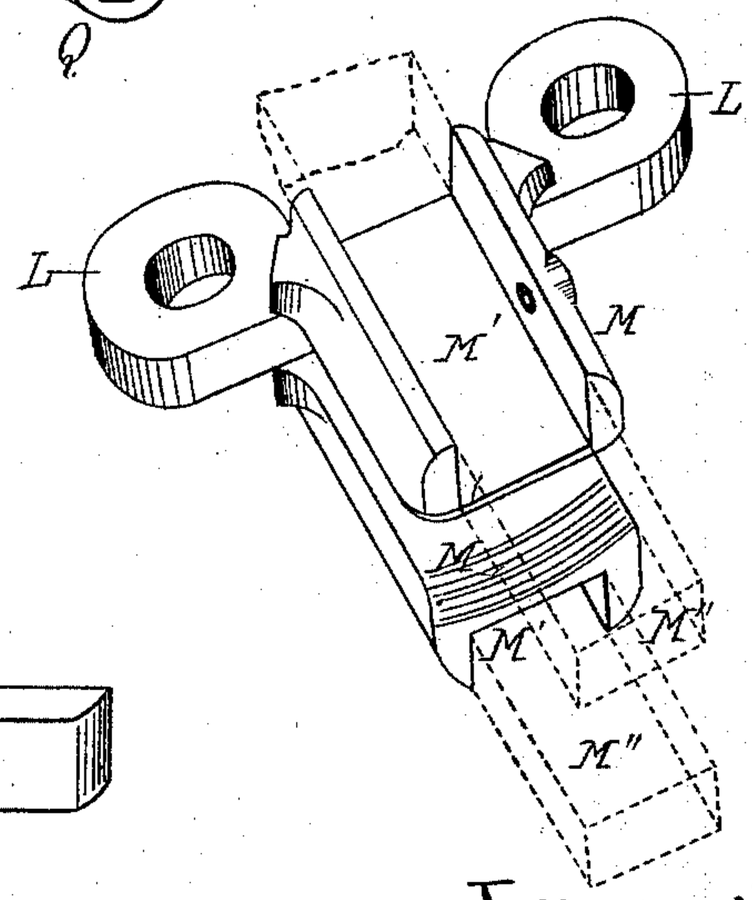
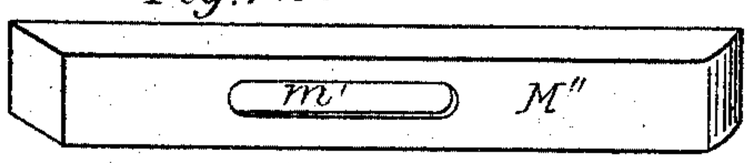


Fig. 12.



WITNESSES:

A. G. Bop-Smith.

O. E. Doyle.

INVENTOR

Jefferson L. Lechner

BY

Higdon & Higdon

ATTORNEYS.

UNITED STATES PATENT OFFICE.

JEFFERSON L. LECHNER, OF PITTSBURG, PENNSYLVANIA.

MINING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 483,156, dated September 27, 1892.

Application filed April 22, 1891. Serial No. 390,019. (No model.)

To all whom it may concern:

Be it known that I, JEFFERSON L. LECHNER, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Mining-Machines; and I do hereby declare that the following is a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention has for its object the improvement of machines for mining or undercutting coal, &c.; and it relates particularly to the construction of the cutter-chain and the means employed for carrying and guiding the same, the construction and manner of securing the cutters to the chain, whereby they may be adjusted to compensate for wear without affecting their operation or altering the angle at which they cut the coal, the construction and arrangement of the devices employed to take up slack and produce the proper tension in the chain, the arrangement of the devices employed to feed the machine forward and withdraw it from the cut, and the arrangement and adaptation of the driving machinery.

Referring to the drawings, Figure 1 is a longitudinal central sectional view of a mining-machine embodying my invention. Fig. 2 is a top plan view of the same, partly in section, on the line $z\ z$ of Fig. 1. Fig. 3 is a vertical transverse sectional view on the line $z'\ z'$ of Fig. 2. Fig. 4 is a plan view of the front chain-wheel to show the slots in the bearing for the clamping-bolts. Fig. 5 is a transverse sectional view on the line $x\ x$ of Fig. 2 through the front sprocket-wheel and bearing. Fig. 6 is a similar view on the line $x'\ x'$ of Fig. 2. Fig. 7 is a transverse detail sectional view of the front wheel, showing the cutter-chain in position thereon. Fig. 8 is a detail view of a portion of the cutter-chain to show the manner of connecting the links thereof. Fig. 9 is a detail perspective view of one of the socket-links. Fig. 10 is a detail transverse sectional view of one of the joints between the socket-links and the adjoining side links, line $y'\ y'$ of Fig. 8. Fig. 11 is a detail view of the clutch. Fig. 12 is a detail view of one of the cutters.

The stationary frame A is provided with parallel track-rails $a\ a$, which are connected by cross bars or ties $a'\ a'$, and the sliding frame or carriage B is provided with parallel side rails or **I**-shaped rails b, the lower flanges or bases b' of which fit and slide in grooves or ways a'' in the upper sides of the track-rails. Narrow retaining-strips a^3 are secured to the upper surfaces of the track-rails and project inward or toward each other over the lower flanges b' to hold the latter in place without preventing longitudinal movement. The upper flanges b'' of the **I**-shaped rails are connected at their front ends by an integral plate b^3. This plate is preferably formed as an extension of the upper flanges of the **I**-shaped rails, as shown, thereby firmly connecting the front ends of said rails.

The front chain-wheel C is mounted upon a hollow adjustable bearing D, which is arranged vertically beneath and is supported by the plate b^3. The bearing D is annular in shape and has an interior diameter which is about equal to and corresponds with a similar circular opening in the plate b^3. This circular opening b^4 is spanned by a diametrical bar E, provided with perforations or bolt-holes, and the annular bearing D is provided with a similar diametrical bar E', integral with the bearing, which is slotted, as seen at $e\ e$, Fig. 4. These slots are parallel and are arranged in pairs to align with the perforations or bolt-holes in the bar E, and vertical clamping-bolts F are arranged in the registering perforations and slots, whereby the bearing may be locked in any desired position. The under side of the bearing is covered by a bottom plate b^5, which corresponds in form with the plate b^3 and is provided with a similar opening which registers with the interior of the annular bearing. The bottom plate is also provided with perforations or bolt-holes to correspond with those in the upper plate, and the above-mentioned clamping-bolts engage said perforations or bolt-holes and thereby clamp the bearing between two parallel plates.

The annular bearing is provided on its outer

surface with an annular groove in which fits a corresponding annular rib on the interior surface of the bushing D′. The annular bearing is divided horizontally to form a removable disk *d*, whereby the said bushing may be applied without joints, the portion of the bearing above its groove forming the said disk, whereby when the disk is removed the groove is exposed for the reception of the rib on the bushing. The bar E is provided at its sides with depending ears or lugs *e′ e′*, having horizontal tapped openings in which are fitted adjusting-screws F′ F′, which bear at their front ends against the inner surface of the annular bearing and by means of which the latter may be adjusted, as hereinafter described. It will be seen that the entire bearing is covered above and beneath by the plates which extend over all the joints, and thereby exclude dust, moisture, &c. The tension or adjusting devices are arranged within the hollow bearing, where they are out of the way, but are at the same time within easy reach of the operator. The rear sprocket or chain wheel is mounted similarly to the front wheel and is provided with a gear-wheel G′, which is engaged by a pinion *g* on the main shaft H, said wheels G and G′ being inclosed in a casing G^3, which is integral, preferably, with the side rails of the sliding frame, as shown.

The cutter-chain K consists of alternate double links *k k*, which are flat and pass, respectively, upon opposite sides of the spurs on the sprocket-wheels, and single or socket-links *k′*, which carry the cutters and bear on the peripheries of the sprocket-wheels between their spurs. The socket-links are of a width which corresponds exactly with the thickness of the sprocket-wheel, whereby the sides of said links are flush with the surfaces of the wheels. The socket-links are provided at their ends with perforated ears L L, to the opposite sides of which are secured the ends of the flat links *k k*, the latter being thereby separated a sufficient distance to allow the spurs of the sprocket-wheels to pass therebetween. The flat links are connected to the socket-links by means of pins *k″*, which are provided with a round body portion L′, which fits in the circular opening in the ear L and squared or angular ends L″ L″, which fit in corresponding squared openings in the ends of the links *k*, whereby the pins turn with the flat links and rotate in the ears of the socket-links. Small shoulders L^3 at the ends of the rounded bodies of the pins prevent the double links from cramping against the ears L and interfering with the flexibility of the chain.

The socket-links are provided with parallel arms M M, which extend inward toward the center of the wheel and bear, respectively, upon opposite sides of the latter. These arms are integral with the links, and are beveled or flared at their free ends to enable the wheel to pass therebetween without unnecessary friction. The socket-links bear on the periphery of the wheel between its spurs, the length of a link being approximately equal to the distance between two adjoining spurs, and the inwardly-extending arms M are arranged on opposite sides of the link with an interval between their inner surfaces equal to the thickness of the periphery of the wheel. Therefore when a socket-link is engaged with the periphery of the wheel the arms M M bear firmly against opposite sides of the latter and prevent rocking or lateral play, and the ends of the link bear, respectively, against the adjoining spurs and prevent longitudinal play. There is no pressure on the ends of the spurs. They pass between the opposite parallel flat links and bear at their opposite edges, respectively, against the ends of the socket-links, which are connected to the ends of said flat links. The strain on the spurs is at their bases, and therefore there is but little danger of breakage. In case of lateral oscillation of the chain in that portion which is not engaged with the wheel, the inwardly-extending arms M M assist in guiding the chain so that proper engagement is made.

The arms M are provided on their outer sides with grooves M′ to receive the cutters M″. A set-screw *m* is fitted in a suitable threaded aperture in the side of the socket thus formed to clamp the cutter in place, the latter being provided in its side with a shallow groove *m′* to receive the end of the set-screw.

The cutters which are used in connection with my improved mining-machine may be made of any desired length, thereby enabling them to be set out or adjusted as they become worn. The cutters are formed of a straight rectangular bar of metal of even section throughout, the outer end of which is beveled or sharpened on its rear side, and therefore it will be seen that when they become worn and are set out they attack the coal in the same manner and with the same effectiveness as before. In this respect my improved cutters differ from those which are provided with broadened or irregular outer ends, for in the latter case the cutters cannot be ground down without altering the shape.

The outer ends of my cutters may, if preferred, be bent laterally, as shown in Fig. 7, and arranged so that the outer ends of one pair incline inward or toward each other and the ends of the succeeding pair incline outward or from each other; but it will be seen that even in this case the effectiveness of the cutters is not changed by setting them out when they become worn. Thus I employ cutter-bearing arms having channels of even width throughout and cutters (preferably of rectangular bar metal) of even section throughout, whereby any desired adjustment of the latter may be had by merely loosening the set-screw and setting the tool in or out. When worn or broken, the cutter may be removed, reground, and reset to correspond with the others.

The feeding-screw N is mounted in the slid-

ing frame parallel with and midway between the side rails thereof, its front end being journaled in a cross-bar *n*, which extends between said side rails, and its rear end being journaled in bearings *n' n''* in the front and rear sides of a casing O near the rear end of the sliding frame and in front of the rear sprocket-wheel. This screw is carried by the sliding frame and operates in a nut N'' on the stationary frame. It will be observed that the feeding-screw terminates at its rear end in front of the rear sprocket-wheel, thereby enabling the latter to be arranged in the same horizontal plane with the front sprocket-wheel in order that the chain may travel in a horizontal plane. This is of importance from the fact that the chain is supported entirely by the two sprocket-wheels which are arranged, respectively, at opposite ends of the machine. There are no intermediate supports in the way of wheels or slides. The fact that the chain engages the wheel, as described, thereby preventing longitudinal movement, and also preventing sagging of the chain, obviates the necessity of intermediate supports.

Upon the main shaft H, within the casing O, is arranged the driving-wheel H', which is engaged by a pinion *p* on the power-shaft P. The main shaft also carries loose gears R R', between which is arranged a clutch Q of any suitable or preferred form. The clutch is fitted upon a squared portion of the shaft, as shown in dotted lines in Fig. 11, so as to turn therewith, and is at the same time free to slide longitudinally thereon to engage with either of the loose gears. The gear R is of large diameter and meshes directly with a pinion *r* on the spindle of the screw, and the gear R' is of small diameter and is geared to a similar pinion *r'* on said spindle through an idler *r''*. When the clutch is adjusted to lock the gear R to the shaft, the screw will be rotated rapidly, whereas when the gear R' is locked to the shaft the screw will be rotated slowly. When the clutch is engaged with the gear R', the screw will be rotated in such a manner as to cause the sliding frame to advance, and when the clutch is arranged to engage the gear R the screw will be turned in the opposite direction and cause the sliding frame to retreat. Therefore it will be seen that by this arrangement of gears the carriage will be caused to advance slowly and retreat rapidly, and by properly graduating the sizes of the gear and pinions and by the use of a greater number of idlers, if necessary, the sliding frame may be caused to advance and retreat at any desired rates of speed to suit the work which is to be accomplished.

From the foregoing description it will be seen that by means of the improved adjustable bearing the chain can be quickly and accurately adjusted and brought to exactly the desired tension without loosening any of the parts and, if desirable, without stopping the machinery. The clamping-bolts must first be loosened, thus causing the interior surface of the hollow bearing to bear directly against the ends of the tension-screws, and as the latter are always in place it will be evident that the loosening of the bolts will not in any way affect the position of the bearing or the tension of the chain. The tension-screws are then operated to force the bearing forward between the upper and lower plates until the chain is of the proper tension, after which the clamping-bolts are again tightened to relieve the tension-screws from strain and clamp the parts rigidly together.

It has been the practice heretofore to provide the frame with extension side bars or in some similar way provide for taking up the slack in the chain; but by the use of the movable bearing the adjustment is accomplished at one point and by means of two screws which are close together and can therefore be quickly and simultaneously manipulated. Furthermore, the rigidity of the parts is not impaired by the adjustment, and it can be accomplished while the machinery is in motion, and, furthermore, there is no danger of twisting the frame in the act of adjustment and impairing its strength and alignment.

Formerly it has been common to mount one of the sprocket-wheels (preferably the front wheel) in a separable or independently-movable section of the frame of the machine and connect this movable section to the main section by means of adjusting screws or bolts, whereby the two sections of the frame are relatively adjusted to effect the adjustment of the chain. The absolute rigidity of the frame of a machine of this kind is essential to its effective operation, and where the frame is divided and the parts are connected by adjusting-screws the necessary rigidity is lost. I have found, therefore, that by preserving an integral structure in the frame and arranging an adjustable bearing at the front end of the frame and secured thereto firmly by means of suitable clamping-bolts I secure the advantages of adjustment without weakening the parts or diminishing the effectiveness of the machine.

The improved chain is provided with socket-links, which fit between the spurs or lugs on the wheel and are of sufficient width to cover the face or edge of the wheel, and the parallel arms which bear against opposite sides of the wheel steady the cutters and prevent twisting and jamming. Furthermore, by arranging a cutter upon each side of the socket-link or by arranging the cutters in pairs and opposite to each other upon a single link which bears firmly upon the face of the periphery twisting is avoided and all straining of the wheel and chain is prevented. The cutters lie close to the surface of the wheel, and as they fit snugly for a considerable portion of their length in the sockets breakage

is almost impossible and they are braced and steadied, and thereby enabled to resist a greater strain and operate more effectively than if they were allowed to project a considerable distance without support. The sockets extend outward to the outer surfaces of the links and therefore support the cutters close to their cutting ends. The screw is journaled upon the sliding frame, thereby doing away with the use of complicated gearing, such as keyway-shafts, &c., all the moving parts being carried by said frame. The pinions which are secured to the spindle of the screw and by which the power is applied thereto are arranged between two adjacent bearings, thereby preventing the screw from springing, sagging, or twisting. As the carriage advances and the screw passes farther through the stationary nut the power end of the screw or that end to which the power is applied is brought nearer to the nut or nearer to the work which it is designed to perform. The most difficult part of a cut is when the sliding frame is near the limit of its forward stroke. The deeper the cut is made the greater is the strain upon the machinery. As the back pressure or thrust increases the power approaches the nut in my machine and the effectiveness of the feeding device is increased in proportion. The back-pressure is liable when there is a considerable length of screw between its power end and the nut to cause the screw to bend or twist and jam in the nut, thus stopping the machinery; but by causing the power to approach the work as the strain increases these difficulties are avoided.

It will be seen that the journal of the front chain-wheel is fully covered and protected from dust and dirt by the top and bottom plates before described, the rear wheel is inclosed in a casing G^3, and the operating mechanism is arranged in the casing O, where it is entirely inclosed and protected. Thus none of the moving parts, with the exception of the chain, are exposed, and therefore the danger of the machine becoming clogged by having its gears and bearings filled with coal-dust and the like is reduced to a minimum.

It will be seen by reference to the drawings that the front chain-wheel is of larger diameter than the rear wheel, thereby causing the opposite sides of the cutter-chain to converge toward the rear end of the machine. This is to prevent the cutters in rear of the center of the front wheel from cutting or coming in contact with the sides of the "cut" in passing in or out. It is desirable to have only those cutters in front of the center of the wheel engage the coal, and by drawing the sides of the chain toward each other, as they are shown in the drawings, this is accomplished. When the front and rear wheels are of the same diameter, so that the sides of the chain are parallel, the cutters in rear of the center of the front wheel come in contact with the sides of the cut and are liable to jam and interfere with the smooth operation of the machinery. Furthermore, the cutters on the side of the chain which is approaching the front wheel are liable to catch before that portion of the chain is properly seated upon the wheel, and thus throw the parts out of their proper relative positions.

It will be understood that the side of the chain which approaches the front wheel is the "slack" side and is liable to swing slightly as it moves, thereby increasing the danger of causing the cutters to catch in the side of the cut and throw the chain from the wheel. By reference to Fig. 2 of the drawings it will be seen that by providing the smaller rear wheel, as described, the guiding-arms M on the single or socket links engage the front wheel before the ends of the cutters are in a position to engage the side of the cut, and therefore the socket-links are firmly seated before the cutters begin to operate. It will also be seen that the chain is carried entirely by the said wheels without any necessity for supplementary support, thereby reducing the friction and economizing the power.

The webs of the I-shaped rails at the front end of the sliding frame are cut away to allow space for the operation of the front sprocket-wheel, which projects at its sides beyond said I-shaped rails, as shown clearly in Fig. 2.

As above mentioned, the cutters are arranged in pairs, one cutter being upon one side and the other upon the other side of the chain and directly opposite the first. The outer or cutting ends of these cutters may be turned laterally, as described, those of alternate pairs being bent inward or toward each other and those of the intermediate pairs being bent outward or from each other, thereby making each alternate pair convergent and the intermediate pairs divergent. By this arrangement the actual cutting-surface or cutting-edge of each pair of cutters is equal to only one-half the width of the cut in the coal; or each pair of cutters removes only one-half of the coal which is necessary to make the desired width of cut. Thus the pairs of divergent cutters cut two parallel grooves in the face of the coal, the grooves being upon opposite sides of a central core, and the combined widths of said grooves being equal to the width of the core, and therefore equal to one-half of the desired cut. The following pair of convergent cutters removes the intermediate core, which obviously offers but slight resistance thereto. By this arrangement but little more than one-half the power is necessary to operate the cutter-chain than would be required if each pair of cutters removed the coal from the entire width of the cut. By disposing the members of each pair of cutters directly opposite each other the cut is made straight and true and all straining and twisting are avoided. The arrangement of the grooves or sockets for the cutters outside the plane of the links and also outside the plane

of the wheel enables the cutters to be made of any desired length, so as to permit of repeated regrinding and resetting without diminishing the effectiveness of the cutters. It will be seen that the sides of the links are flush with the sides of the cutter-wheel, whereby the channeled arms bear against opposite sides of the wheel and receive support and rigidity therefrom, thus stiffening the chain and giving lateral rigidity to the cutters.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a machine for mining coal, in combination, the sprocket-wheels, the endless chain composed of alternate double and single links, said single links being provided upon opposite sides with parallel radial arms having longitudinal channels in their outer walls, the set-screws mounted upon said arms and projecting into the said channels, and cutters of even section throughout fitting in said channels and provided with longitudinal grooves with which the inner ends of the set-screws engage, substantially as specified.

2. In a machine for mining coal, in combination, the sliding frame or carriage having parallel horizontal plates, the hollow bearing clamped between said plates and capable of forward and rearward adjustment, the sprocket-wheel mounted upon said bearing and adjustable therewith, the tension-screws mounted in supports upon the plates to engage the bearing, and the cutter-chain carried at its front end by said wheel, substantially as specified.

3. The combination, in a mining-machine, with a frame or carriage, of the bearing for the cutter-chain wheel, consisting of a hollow ring provided with a diametrical bar provided with slots, and clamping-bolts carried by said frame or carriage and engaging the slots in the diametrical bar, substantially as and for the purpose specified.

4. In a machine for mining coal, in combination, the frame or carriage having parallel horizontal plates, the circular adjustable bearings arranged vertically between said plates and provided with parallel slots upon opposite sides of its diameter, the clamping-bolts carried by said plates and engaging the slots in the bearing, and the cutter-chain wheel mounted upon said bearing between the parallel plates, substantially as specified.

5. In a mining-machine, the combination, with a frame provided with parallel upper and lower plates, of a hollow annular bearing for the chain-wheel, arranged between said plates and provided with a diametrical slotted bar, the clamping-bolts carried by the parallel plates and engaging said slotted bar, and tension-screws mounted on the frame within the hollow bearing and engaging the latter, substantially as and for the purpose specified.

6. In a mining-machine, the combination, with the frame having parallel horizontal plates, one of which is provided with an opening spanned by a diametrical bar, of the hollow bearing arranged between the plates and registering with the said opening, the bearing being provided with a diametrical bar having longitudinal slots, the clamping-bolts secured at their ends in the parallel plates and engaging the slotted bar, and the tension-screws carried by the frame within the hollow bearing and engaging the interior walls thereof, substantially as and for the purpose specified.

7. In a machine for mining coal, in combination, the frame or carriage having parallel horizontal plates, the hollow bearings arranged between said parallel plates and carrying the cutter-chain wheel, and the tension-screws mounted in tapped ears upon one of said plates and bearing at their ends against the interior surface of the said bearing, substantially as specified.

8. The combination of the sliding frame having side I-shaped rails, the upper flanges of which are connected at the front end of the frame by a plate b^3, the journal disposed beneath said plate and connected thereto by clamping-bolts, the sprocket-wheel mounted upon said journal and operating between the flanges of said I-rails, the webs of said rails being cut away at their front ends, and the cutter-chain carried by said wheel, substantially as specified.

9. In a machine for mining coal, in combination, the carriage having parallel I-shaped side rails, the horizontal plate connecting the upper flanges of said side rails, the front sprocket-wheel arranged beneath said plate and mounted upon a bearing which is secured to the same, said sprocket-wheel projecting at its periphery slightly beyond the front and side edges of the plate, the rear sprocket-wheel smaller than the front wheel and arranged in a casing at the rear end of the carriage, the cutter-chain carried by said wheels and provided with cutters which lie upon opposite sides of the plane of the wheels, the main shaft geared to the rear sprocket-wheel and mounted in a casing O in rear of the latter, and the feeding-screw mounted at its front end in a cross-bar n, which extends between the side rails of the carriage and at its rear end in the front and rear sides of the casing O and engaging a stationary nut N″ on the stationary frame, said screw being geared to the said main shaft, substantially as specified.

10. In a machine for mining coal, in combination, the carriage having a horizontal plate, a hollow exteriorly-grooved bearing formed in two horizontal separable sections, an annular bushing formed in a single piece and interiorly ribbed, as described, a wheel fitting upon the bushing, and a cutter-chain carried by the latter, substantially as specified.

11. In a machine for mining coal, in combi-

nation, the carriage having a horizontal front plate, a hollow bearing having an exterior groove and formed in two separable horizontal sections, the bolts to secure the separable sections together and to the plate, the bushing to encircle the bearing, formed in a single piece and provided with an interior annular rib to fit in the groove of the bearing, the sprocket-wheel, and the cutter-chain, substantially as specified.

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

JEFFERSON L. LECHNER.

Witnesses:

EUGENE INGOLD,

VAN W. LECHNER.