2 Sheets—Sheet 1.

H. F. BROWN.

Machines for Mining and Undercutting Coal.

No. 197,090. **Patented Nov. 13, 1877.**

Fig. 3.

Fig. 1.

Fig. 2.

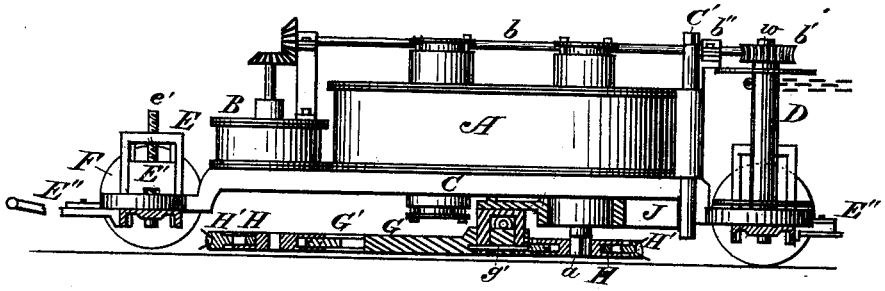


Fig. 4.

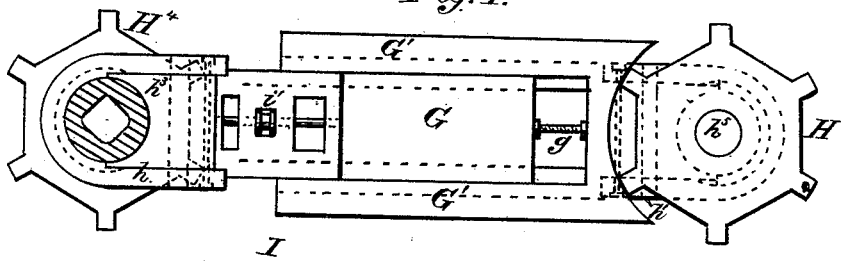
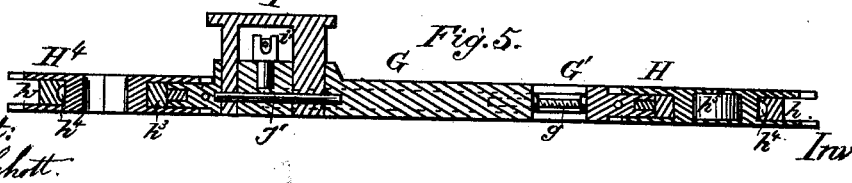


Fig. 5.



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H. F. BROWN.

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Fig. 12.

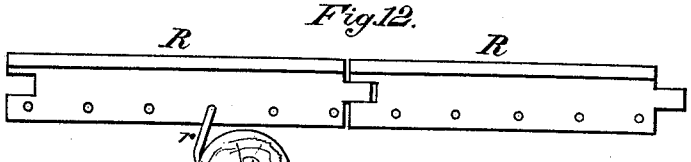


Fig. 9.

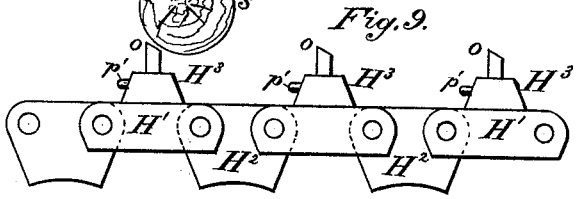


Fig. 9.

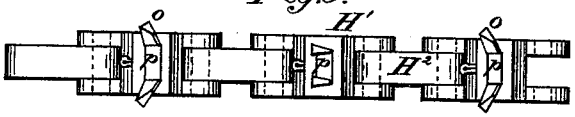
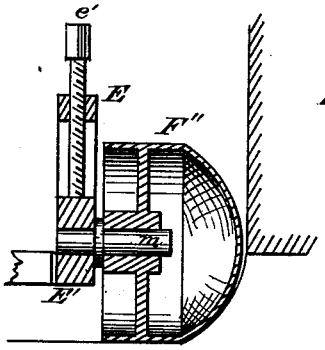


Fig. 8.



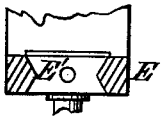


Fig. 7.

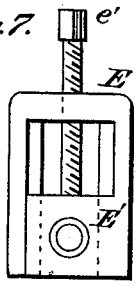


Fig. 11.

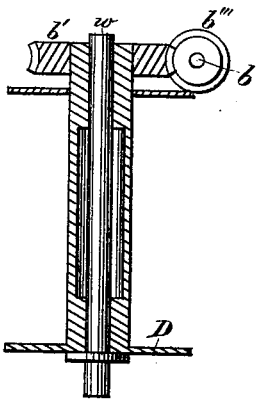


Fig. 6.

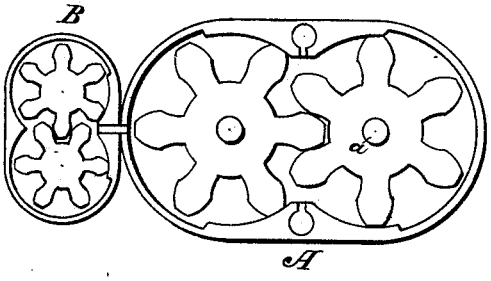
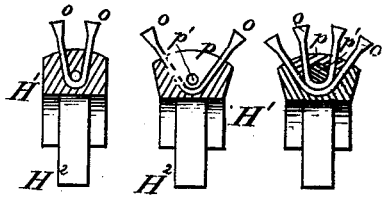


Fig. 10.



Attest:
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Inventor:
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UNITED STATES PATENT OFFICE.

HORACE F. BROWN, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN MACHINES FOR MINING AND UNDERCUTTING COAL.

Specification forming part of Letters Patent No. **197,090**, dated November 13, 1877; application filed July 19, 1877.

To all whom it may concern:

Be it known that I, HORACE F. BROWN, of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Machines for Mining and Undercutting Coal; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

The subject of this invention is an improved device for mining or undercutting coal; and relates to the peculiar construction of the chain to which the cutters are secured, the construction and adaptation of the mechananism and devices employed to guide and propel the chain, the construction of and manner of securing the cutters, the device employed to feed the machine along the face of the coal, and the arrangement and adaptation of the driving-machinery.

Figure 1 shows a plan view of my improved machine, with the cutting device extended as at work. Fig. 2 shows a side elevation of the same, with the cutting device folded under the machine, and shown in section. Fig. 3 shows a cross-section of the device used to carry and guide the chain, the manner of hanging and guiding the same, and of attaching it to the machine. Fig. 4 is a plan view, partly in section, of the device used to carry, guide, and propel the chain. Fig. 5 is a longitudinal section of the chain-carrier enlarged, and showing the hangers by which it is attached to the frame of the machine. Fig. 6 shows a plan view of the engine used to drive the chain and to drive the feed-drum. Fig. 7 shows an end view of the cross-bearers, with a cross-section of the upright portion of the same, and the manner of adjusting the axle. Fig. 8 shows a portion of the cross-bearers and a vertical cross-section of the upright portion of the same, the adjustable block, axle, and the dome-shaped wheel in its relation to the face of coal, and the overbreak of the bottom. Fig. 9 shows a side and plan view of the chain and arrangement of the cutters. Fig. 10 shows an end view of one portion or section of the chain, and the manner of securing the cutter, and the shape and construction of the cutting-points. Fig. 11 shows a vertical section of the feed-drum, the worm-gear, and the driving-worm. Fig. 12 shows the manner of joining and securing the different sections of the rail upon which the machine runs.

Motion is given to the operating parts of the machine by the rotary engines A and B, the cams of which lie horizontally, and the shafts stand vertical. C is a frame so shaped as to receive the engine A and B, and to rest on the cross-bearers E at each end. The cross-bearers E are pivoted to the frame C in such a manner as to be readily turned horizontally on their centers. The upright portion of E is fitted to the adjustable block E′ in such a manner as to hold it firmly, and yet allow of its free adjustment up and down by means of the screws e' e' e' e'. By this means any wheel can be raised and lowered to meet the unevenness of the bottom independently of the others, and at all times make a firm bearing to support the weight of the machine.

The cross-bearers E are controlled by means of the tongue E″, and can be pointed to help the machine around curves, or set at an angle to counteract the side draft of the machine while cutting.

The wheels F′ may be plane-flanged wheels to run on a flat rail, or double-flanged to act as a guide on a T-rail. The wheel F is a plain broad-tread wheel, and runs on the ground. F″, in addition to its flat tread, is of a dome shape at one end. This construction enables the wheel F″ to be used as a guide by allowing it to rub the wall of coal. By this means the strain of the side draft is entirely overcome.

In mining, when the undercut is made some inches below the coal, the squeeze of the roof breaks the coal some inches back of the cut, leaving a round corner at the point of the overbreak, as shown in connection with the wheel F″ in Fig. 8. Where this overbreak does not occur it is preferable to use a separate wheel, held at an angle, and so arranged as to bear against the coal on the line of the preceding cut, to counteract the side draft. By this arrangement a light wooden rail can be used for the flanged wheels, and the operation of lay-

ing the track much simplified, as where a double flange is used to guide the machine against the side draft the rail must be of iron, and very firmly secured.

The cutting mechanism consists of a series of cutting-points, secured to a chain of peculiar construction, and the devices used to guide and propel the chain. The cutting-points *o* are of steel, bifurcated in form, with the points swedged to the proper shape to present a free cutting-edge. When the substance to be cut is comparatively free, the points may be of a flat chisel shape; but when the material is hard, a diamond or angular shape is preferable.

The chain consists of an inner link or block, H^2, the outer connecting-links H^1, and the block to hold the cutting-points H^3. The blocks H^2 form the center of the chain, and project on its inner surface, forming a series of broad flat projections, which fit the grooves in the parallel guides of the female portion of the chain-carrying arm G′, and between the disk of the wheels H and H^1, and act as a guide to prevent the displacement of the chain by the pressure on the cutters. The outer links H^1 are pivotally secured to the center block H^2 by rivets. Between the two outer links H^1 the blocks H^3 are secured. These blocks are recessed to receive the cutter-points, and arranged to hold them firmly in position, the narrow cutters being secured by means of a pin or bolt, *p′*, passing through the block H^3 and between the two sides of the cutters at its lower extremity. In securing the wide points, the block P is made to fit the inner surface of the cutter, and the pin or bolt passing through H^3 and *p* secures the cutters perfectly.

The block H^3 and the links H^1 can be formed of one piece, or the block H^3 inserted and secured betreen the links H^1. The latter construction is preferable, on account of cheapness.

The device used to guide and propel the chain may be termed a "chain-carrying arm," consisting of a male portion, G, female portion, G′, and the idler sprocket-wheel H, and driving-wheel H^4. The part G consists of a central piece, grooved or tongued on its parallel sides to receive the part G′. On the shorter end of G the driving sprocket-wheel H^4 is secured by means of a strap, *h*, and the wearing-block h^3. The wheel H^4 is formed by two disks, connected together in the center by a hub. The periphery of these disks is provided with suitable cogs or teeth to engage with the outer links H^1 of the chain. In the center is formed a socket to receive the end of the vertical shaft *a*, so constructed that it can be run at such an angle as may be needed to guide the chain while at work, and yet be so secured to the shaft *a* as to prevent its turning on the same. This may be accomplished by a square or partly square socket fitting the shaft in the center, and having a clearance above and below, which will admit of the wheel H^4 being run at an angle with the shaft *a* without binding.

The central portion of the carrier G may be raised to give greater strength, and is mortised to receive the hanger I, which is secured to it by means of the bolt *g′* in such manner as to be held rigid vertically and longitudinally, but loosely pivoted horizontally from side to side.

The outer or female portion of the arm G′ is fitted on its inner parallel surfaces to the part G in such a manner as to be held rigidly parallel with it, but to move freely upon the same in a longitudinal direction. The outer edges of G′ are grooved to form parallel guides for the cutter-chain and block H^2, and are in line with the peripheral space or groove between the disks of H and H^4. At the outer end of G′ the wheel H is attached by means of the strap h^1 and wearing-block h^3. The round end of the straps *h* and h^1 is hollowed out to form an oil-chamber, h^4. The chamber can be suitably packed with waste or other material, and forms a constant lubricator for the hub in the wheels H and H^4.

The wheels H may also have a large oil-chamber formed in the center, as shown at h^5. As these wheels, while the machine is cutting, are inaccessible, it is of importance to provide them thorough means of lubricating for several consecutive hours.

The advantages of this peculiar construction of the arm and chain are, first, to secure a rigid guide for the chain, and, second, to render it impossible for the chain to become choked or clogged by the cuttings, as has been the case with others constructed differently. When the arm presents a flat surface to the chain there is no means of guiding the same, and when the chain forms a groove that sits over the edge of the arm the cuttings pack in the groove as it passes on to the wheels at either end of the arm, and frequently break the chain or stop the motion entirely.

By my method of construction the trouble is entirely avoided. The point of contact between the disks of the wheels H and H^4 and the links H^1 of the chain is too narrow to hold the cuttings or other dirt, and the angles of the disks may be beveled outward slightly to make it impossible for any substance to become packed between them and the chain. The projecting portion of the center-block of the chain presents a series of points and spaces, and all cuttings or dirt that may find their way into the groove of the arm, or between the disks, will be carried along by the block H^2 and dropped in the space between the arm G′ and the wheel H^4. These projecting points may be formed by extending the block H^3 inward, or by other means; but the simplest form is by the center-block H^2, as shown. The arm G is held in position transversely by means of the standard and oscillating nut *i′* and the screw-shaft I′. The screw-shaft has a bearing in the flanges attached to J, and may be turned by means of a crank or hand-wheels. By turning the screw-shaft right or left the standard and oscillating nut are carried along, and the arm G, pivoting on the

pin or bolt g', is forced into an angular position. By this means the direction of the forward cut can be varied up or down to follow the undulation of the bottom, or to avoid interlaminated substances.

The hanger I is attached to the annular wheel J, and this annular wheel pivots on a hub projecting downward from the rotary engine A, and is held central with the vertical shaft *a*. The periphery of this annular wheel J may be toothed to engage with a pinion on the shaft C′, or made plain to form a bearing for a chain that winds upon the shaft. By turning the shaft C′ the wheel J is revolved, and the arm swung out at right angles to the frame C, where it may be secured by a ratchet and pawl on the upper end of the shaft C′, and by reversing the direction of rotation of the shaft C′ the arm is again swung under the machine.

The rail R, to support the outside of the machine, may be made of metal, broad on its under surface, and joined at the ends by male and female tongue and recess. A rail of wood with strap-iron fastened on one side is preferable. To hold the rails, holes are formed in them at frequent intervals, and a hook so arranged that one point enters the hole in the rail R, and the other is driven into the prop S. As fast as the machine feeds forward the rails are passed ahead and relaid.

The device for feeding the machine forward as fast as the undercut is made consists of a rotary engine, B, the connecting-shaft *b*, the worm-gear b', worm b''', and upright drum D.

Where the mine is comparatively level, so that the machine can be readily moved around, the rotary engine B is bolted to the frame C, and the drum D runs loose upon a shaft that is also attached to the frame C at its extremity.

Where the incline of the bottom of the mine makes it difficult to move the machine against the grade, it is preferable to put the feeding mechanism upon a separate frame provided with wheels, so that it may be run ahead and used to draw the machine after it.

The shaft of the engine B may be run direct to the worm-gear on the drum D, or may be connected by means of gears or other devices.

The drum D is hollow, and has a bearing upon the upright shaft *w*. The object of this method of construction is to get a long bearing-surface for the drum as it revolves, and to get the longest possible drum for winding purposes.

To move the machine forward, the rope or chain used is hitched to some point ahead and secured to the drum D. The speed of the engine B determines the travel of the drum D and determines the rate of feed. The engine B can be run between twenty-five and five hundred rotations per minute, and governed instantly by the throttle-valve, thus giving any possible degree of feed required. To unwind the rope or chain, the worm b''' is thrown out of gear with the worm-gear b' by means of the sliding box or its equivalent b'', which leaves the drum loose, and the rope or chain can be run off by hand.

Air may be supplied to the engine B from the cams of the engine A after it has done the work there, but before it is exhausted to the open air. By this means no additional air is used to drive the feed.

The advantage of a rotary-feed engine is the great range of speed that can be attained without oscillation. The advantages of a rotary engine, as arranged to drive the cutting apparatus of the mining-machine, are compactness, simplicity, and the absence of oscillation that accompanies a reciprocating engine where the bed of the same is not a solid foundation. These engines A and B can be run either way, making a right and left hand machine.

I am aware that coal-mining machines have been used wherein the cutting-points were fastened to a chain that was supported by a projecting arm, and carried over wheels at either end; but I am not aware of any machine in which a continuous groove was formed in the arm and wheels, and a projecting portion on the chain to run in such groove, as and for the purposes I have described.

I am also aware that coal-mining machines have been fed up to their work by means of a drum and chain operated by a system of gears, ratchets, &c., also by means of a windlass or winding-drum operated by hand-power; but I am not aware of any device that formed a separate and distinct power operating independently of the main engine, or that was supplied by air that had already performed its labor in the main engine.

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

1. In a machine for mining or undercutting coal, the combination of an oscillating self-adjustable chain-carrying arm with a cutter-chain composed of alternate blocks and links pivoted to each other, the former having their points projecting inwardly and embracing the sprocket-wheels between their spurs, and the latter provided with recesses for the reception of cutting-points, as specified.

2. A self-adjusting chain-carrying arm constructed in two parts, and so arranged that the outer part slides over the inner for nearly its whole length, and having a groove formed in the parallel sides of the outer part to receive and guide the chain, substantially as and for the purpose specified.

3. The combination, with the wheels H and H^4 and chain-carrying arm, of the hollow strap *h*, forming the oil-chamber h^4, substantially as described.

4. In combination with the arm G, the hangers I, bolt g', screw-shaft I′, standard, and oscillating nut i', to enable the arm G to be transversely inclined and held in position, substantially as described.

5. In combination with the hanger I and shaft C′, the annular wheel J, for the purpose described.

6. For feeding a coal-cutting machine, the rotary engine B, in combination with the shaft *b*, worm-gear *b′*, worm *b‴*, the sliding box *b″*, and the hollow drum D, in the manner and for the purpose described.

7. The bed-plate C, in combination with the engines A and B and the cross-bearers E, formed of a single piece of iron, as and for the purpose set forth and described.

8. The cross-bearer E, pivoted to the frame C, in combination with the tongue and pin E″, in the manner and for the purpose described.

9. In combination with the cross-bearer E, the screw *e′*, the block E′, and axle T, as and for the purpose described.

10. The dome-shaped wheel F″, or its equivalent, for the purpose described.

11. The rail R, perforated with a series of holes for the reception of the dog *r*, in the manner set forth.

12. For a coal-cutting machine, the bifurcated cutting-points, constructed and secured to the chain as shown and described.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

HORACE F. BROWN.

Attest:

ARCHELAUS PUGH,

C. F. EHNES.