2 Sheets—Sheet 1.

W. H. ELLIOT.

ROCK-DRILLING ENGINE.

No. 191,509. Patented May 29, 1877.

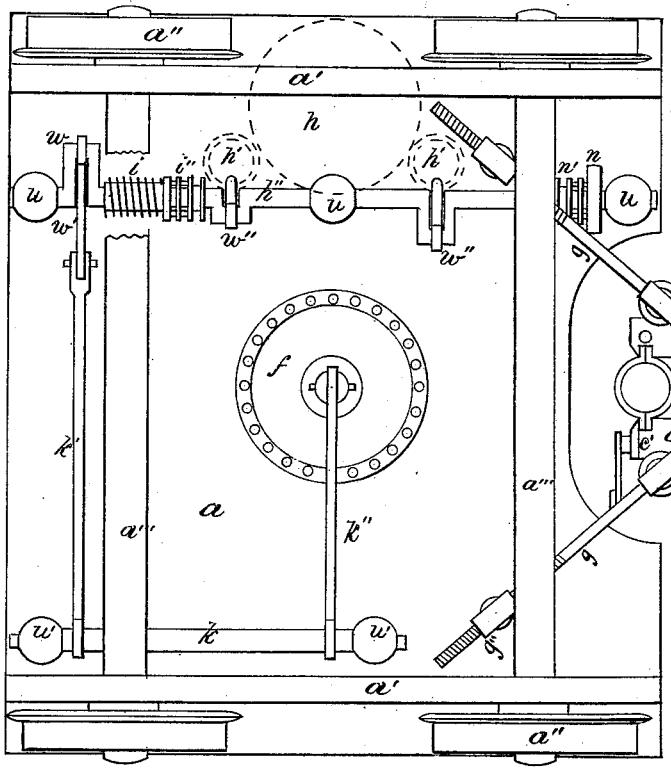

Fig. 1.

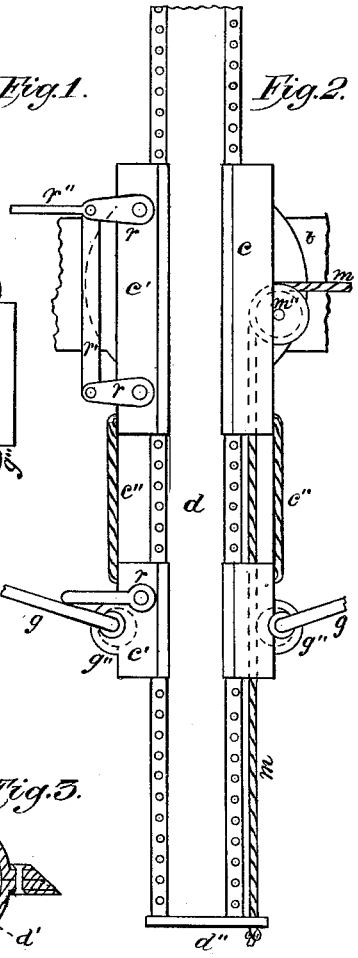

Fig. 2.

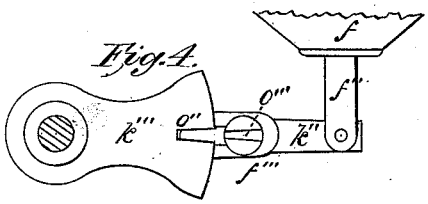

Fig. 4.

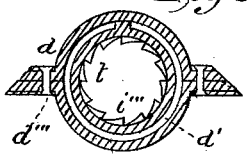

Fig. 3.

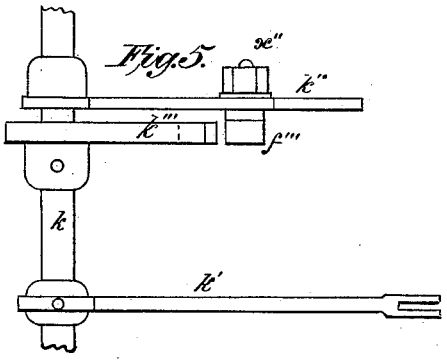

Fig. 5.

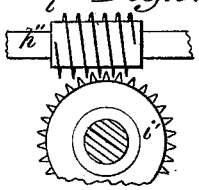

Fig. 6.

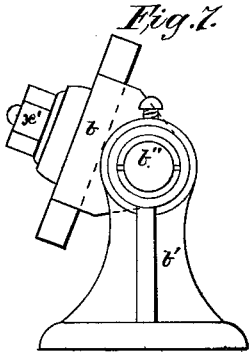

Fig. 7.

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Inventor,
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2 Sheets—Sheet 2.

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ROCK-DRILLING ENGINE.

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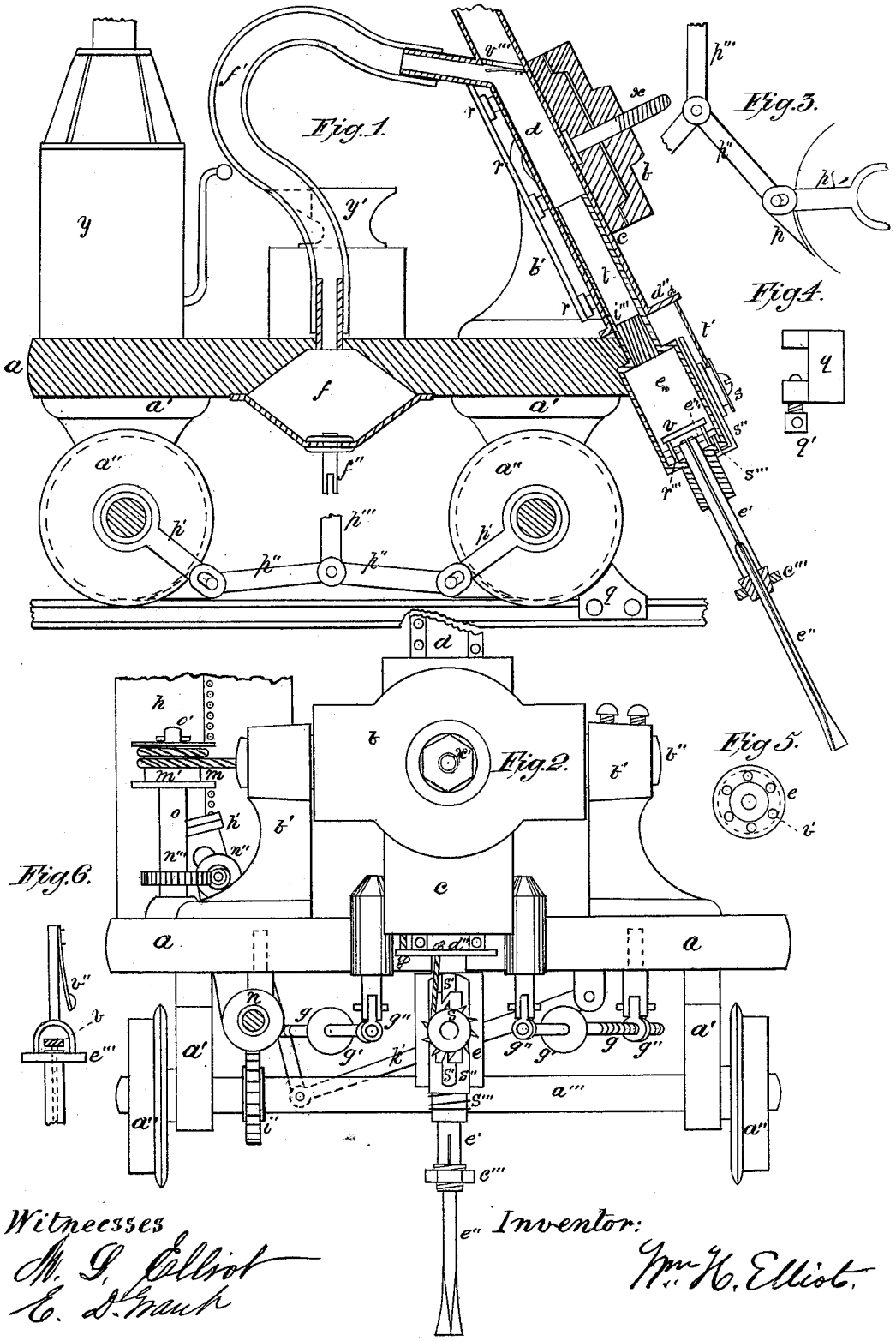

Witnesses
M. G. Elliot
E. L. Gaus

Inventor:
Wm. H. Elliot

UNITED STATES PATENT OFFICE.

WILLIAM H. ELLIOT, OF NEW YORK, N. Y.

IMPROVEMENT IN ROCK-DRILLING ENGINES.

Specification forming part of Letters Patent No. **191,509**, dated May 29, 1877; application filed May 11, 1877.

To all whom it may concern:

Be it known that I, WM. H. ELLIOT, of the city, county, and State of New York, have invented certain new and useful Improvements in Rock-Drilling Engines, the object of which is to facilitate the drilling of rock for the purpose of blasting, and the nature of which is fully set forth in the following specification and claims, reference being had to the accompanying drawings.

Figure 1, Sheet 1, is a vertical section of my improved rock-drilling engine. Fig. 2 is a front view of the same. Fig. 3 is an elevation of a portion of the locking devices. Fig. 4 is a side view of the car-block. Fig. 5 is a view of the lower end of the cylinder. Fig. 6 is an elevation of a spring-pawl and its support for revolving the drill-tool. Fig. 1, Sheet 2, is a bottom view of my improved engine. Fig. 2 is a rear view of the gibways and vertical shaft. Fig. 3 is an end view of the vertical shaft. Figs. 4 and 5 are a side and top view of the rock-shaft. Fig. 6 is an elevation of a worm and gear for driving the engine along upon the track. Fig. 7 is an end view of the way-bed and its bearings, showing the bearing adjustable by screws.

a is the body of the engine or car. *a'* are the boxes. *a''* are the wheels. *a'''* are the axles; *b*, the bed which supports the gibways *c*; *b'*, stands which support the bed *b*; *b''*, bearings of bed *b'* in the stands *b'*; *c*, adjustable gibs; *c''*, ropes which connect the lower with the upper portion of the gibways; *c'''*, tapering thread and nut on the piston-rod for holding the drill-tool; *d*, vertical shaft; *d'*, tubular lining of the same; *d''*, plate on the end of the vertical shaft to which are attached the ropes *m* and *t*; *d'''*, rivets which join together the two sections of the vertical shaft; *e*, cylinder of the rock-drill; *e'*, piston-rod; *e''*, drill-tool; *e'''*, piston; *f*, air-pump; *f'*, air-passage from the air-pump to the vertical shaft; *f''*, connecting-rod; *f'''*, locking-bolt; *g*, screw-braces between the gibways and the frame *a*; *g'*, hand-wheels on the screw-braces; *g''*, joints which connect the screw-braces at one end with the gibways and at the other end with the frame of the engine; *h*, boiler; *h'*, cylinders of the steam-engine; *h''*, crank-shaft of the same; *i* and *i'*, worm on the crank-shaft and gear on the axle; *i''*, bayonet-clutch which engages the worm *i* with the crank-shaft; *i'''*, spiral grooves for revolving the drill-tool; *k*, rock-shaft; *k'*, arm which gives movement to the rock-shaft; *k''*, arm which connects the rock-shaft with the connecting-rod of the air-pump; *k'''*, arm rigidly fixed to the rock-shaft, and which, when locked by bolt *f'''*, gives movement to arm *k''* and the air-pump; *m*, lifting-rope which raises and lowers the vertical shaft; *m'*, cylinder upon which the rope *m* is wound; *m''*, sheave which changes the position of the rope from vertical to horizontal; *n*, pulley on the crank-shaft which drives the cylinder *m'*; *n'*, bayonet-clutch which engages the pulley *n* with the crank-shaft; *n''*, pulley driven by pulley *n* by means of a belt, and is on the same shaft with the worm which drives gear *n'''*; *o*, tubular connection between gear *n'''* and cylinder *m'*, both of which are supported by and revolve upon stud *o'*; *o''*, notch in the end of arm *k'''*; *o'''*, wedge-shaped head of bolt *f'''*; *p*, shoes which lock the wheels; *p'*, arms swinging upon the hubs of the wheels and are attached at their lower ends by a loose joint to shoes *p*; *p''*, toggle-joint between the shoes; *p'''*, vertical rod which operates the toggle-joint; *q*, clamp which is fastened upon the track to block the wheels; *q'*, screw for fastening the same; *r*, screws with elongated heads for adjusting the gib *c'*; *r'*, connecting-strap between the screws *r*; *r''*, lever for operating the screws *r*; *r'''*, rods attached to valve *b* to hold it in place; (these rods pass through the piston, and touch upon the lower end of the cylinder *e*;) *s*, cylinder and crown-wheel for feeding the rock-drill; *s'*, points on the slide *s''*, which engage with the teeth of the crown-wheel; *s'''*, spring for raising the slide *s''*; *t*, hollow shank of the rock-drill; *t'*, rope which supports the rock-drill by connecting the cylinder *s* with plate *d''*; *u*, bearings of the crank-shaft; *u'*, bearings of the rock-shaft; *v*, valve over the end of the hollow piston-rod; *v'*, openings in the end of the cylinder for the admission of air; *v''*, spring-pawl for revolving the drill-tool; *v'''*, valve opening into the passage *f'*; *w* and *w'*, crank and connecting-rod which operate the air-pump; *w''*, connecting-rods of the steam-engines; *x*, bolt which holds the gib

ways upon the bed *b*; *x'*, nut for the same; *x''*, nut for locking-bolt *f'''*; *y*, smith's forge; *y'*, anvil and block.

The bed *b* turns upon its axis or bearing *b''*, and the gibways *c* swing upon the bolt or axis *x*, when the position of the rock-drill is being adjusted by the screw-bolts *g*.

My invention, as set forth in this application, consists of certain improvements upon that shown in my patent of the 26th of April, 1870, to which special reference is made.

I have shown in this application a rock-drill which is operated by the inhalation and exhalation of air by the air-pump, which operates to throw the drill-tool down by the force of the air from the air-pump, and to raise it by atmospheric pressure upon the lower side of the piston, the pressure upon the upper side having been removed by the pump. It is obvious, however, that all the devices upon my drilling-engine, in connection with the rock-drill, would operate with the same facility in giving position and support to any other rock-drill, whether it be driven by steam, air, or by revolving devices.

I employ on my drilling-engine for power a double-reversible steam-engine, so that by reversing the steam-engine I reverse the movements of any part of the drilling-engine.

To render the drilling-engine locomotive I connect the crank-shaft *h''* with the axle *a'''* by means of a worm and gear, *i* and *i'*, the worm *i* being loose on the crank-shaft, but engaged with it, when required, by means of a bayonet-clutch, *i''*, operated by a suitable lever. By this means the drilling-engine may be propelled in either direction, or left stationary while other parts of it are in motion.

To hold the engine immovable upon the track I employ shoes *p*, Fig. 1, Sheet 1. These are forced under a front and rear wheel as a wedge by toggle-joint *p''*, which is operated by vertical rod *p'''*. This rod may, in its turn, be operated by a powerful lever in such arrangement as to obtain thereby the advantage of a double toggle-joint of sufficient power to raise the wheels from the track.

It sometimes becomes necessary to move the rock-drilling engine out of danger from blasting before the holes are finished, and to bring it back again and complete the unfinished holes. To facilitate the readjustment of the rock-drill in such cases to the unfinished holes I employ clamps *q*, which are immovably fastened, one upon each track. Against these clamps the wheels of the car are forced and fastened before the holes are commenced; and to readjust the rock-drills to the holes it is only necessary to force the wheels against the clamps again and fasten them, as before, when the readjustment will be found perfect. The track should be provided with indentations, into which projections on the clamps should fit, so as to prevent the clamps from being driven along on the tracks by the force of the wheels.

When the drilling-engine has been brought to the right position and fastened by the shoes and clamps, the rock-drill is brought to the right point to operate upon the rock by the adjustment of the vertical shaft *d*, to the lower end of which the rock-drill is attached.

To raise and lower the shaft *d*, I connect the crank-shaft with the cylinder *m'* by means of pulley *n* on the crank-shaft, belted to pulley *n''* on the same shaft with the worm which drives the gear *n'''*. This gear has a tubular connection, *o*, with the cylinder *m'*. The pulley *n* is loose upon the crank-shaft, but is engaged with it by means of a bayonet-clutch, *n'*, so that by these connections the cylinder *m* may be made to run one way to wind up the lifting-rope and raise the shaft *d*, or to run the other way to unwind the lifting-rope and lower the shaft *d*, or it may be disengaged from the crank-shaft by the clutch, so as to leave the shaft *d* stationary while other parts of the drilling-engine are in operation. When by these means the rock-drill has been lowered to within proper distance of the rock, it may be adjusted over the right point by means of the screw-braces *g*, operated by the hand-wheels *g'*. These braces are attached at their forward ends to the lower end of the gibways, and at their rear ends to the body of the engine by joints *g''*. They are lengthened or shortened to give the required position to shaft *d* by screwing through the rear joints. These braces should be arranged at about right angles to each other; and, as they are attached to the gibways, and not to the vertical shaft, the latter device can be moved up and down independently of the braces.

When the drill-tool has been adjusted over the right point on the rock, the nut *x* is turned fast, and the adjustable gib *c'* is brought down upon the flange of shaft *d* by screws *r*. These screws, being connected together by strap *r'*, are all turned at once by lever *r''*; then, by means of the hand-wheels, one screw is made to strain a little against the other, by which means the vertical shaft *d* becomes perfectly rigid.

When it becomes necessary, in the process of drilling, to withdraw the drill-tool for any purpose, the adjustable gib *c'* is loosened by depressing lever *r''*, when the vertical shaft will be free to be raised or lowered.

When it becomes necessary to give to the rock-drill a horizontal movement, the nut *x'* has to be loosened, when the required change of position may be effected by turning the screw-braces.

The diaphragm air-pump *f*, being connected with the crank-shaft by means of rock-shaft *k* and its arms, makes one complete movement for each revolution of the cranks. While the pump is being closed, the air within it is forced through the elastic tube or passage *f'*, and through the vertical shaft *d*, into the cylinder *e* above the piston. This drives the drill-tool down upon the rock. Just before the piston reaches the lower end of the cylinder, the rods *r'''*, which are attached to the valve *v*,

strike the lower head of the cylinder and raise the valve from its seat on the upper end of the piston-rod, when the air or steam, if steam be used, rushes down through the hollow piston and through the hollow drill-tool, coming out between the lips of the same, into the hole in the rock at the bottom, blowing out all the chips and rock-dust.

As the piston-rod rises the valve *v* again rests upon its seat, and remains there by its weight until again raised, as before described, at the proper moment for blowing out the chips. A small valve in the upper part of the piston-rod, opening downward, would prevent the rock-dust from being drawn up into the cylinder by the suction of the air-pump. While the pump is being opened the air in the cylinder passes into the pump, raising the piston by atmospheric pressure, the external air passing freely through the openings *v'* in the lower head of the cylinder. The shaft *d* has a diaphragm in it just above the opening into it from the air-passage *f'*. In this diaphragm I place a small valve, *v'''*, which opens into the air-passage while the pump is inhaling. This supplies to the apparatus a volume of air equal to that lost through the drill-tool in blowing out the chips. By this construction all the air which passes into the apparatus is taken in at the top of the shaft *d* where the air is free from dust.

I revolve the drill-tool by means of spring-pawl *v''*, which passes into spiral grooves in the lower part of the shank *t* of the rock-drill. These grooves are so shaped that the pawl will readily run out of one groove into the next one in going up, but will follow the groove in its downward movement, which gives a revolving motion to the drill-tool. I support the drill by elongating the upper portion of it into the form of a shank to the cylinder *t*. This shank passes up into the tubular guide or way *d'*, which lines the lower end of vertical shaft *d*. These devices are so constructed that the shank will not turn upon its axis, but will slide freely longitudinally, so as to feed the rock-drill downward, as the hole in the rock deepens. The rock-drill is held up by the wire-rope *t'*, which is wound around the cylinder *s* at its lower end, and fastened at its upper end to plate *d'*. The weight of the rock-drill tends to revolve the crown-wheel and cylinder *s*; but these devices are prevented from revolving by the points *s'* on slide *s''*. As the hole in the rock deepens the piston begins to drive down the slide *s''* by coming down upon the end of the pin *s'''*, which projects up into the cylinder. This liberates the teeth of the crown-wheel from the lower point *s'*. It then immediately revolves till the upper point *s'* catches a tooth, when the spring *s'''*, which has been depressed by the downward movement of the slide, drives the slide up, disengaging the upper point *s'* from the teeth of the crown-wheel, which allows it again to turn a little, till the lower point *s'* engages the next tooth, and so as often as the piston drives down the slide *s''* to the right point the crown-wheel and cylinder are permitted to revolve and feed the rock-drill down as the hole deepens.

To disengage the air-pump from the cylinder, it is only necessary to slip the elastic tube off from its attachment at either end. Figs. 4 and 5, Sheet 2, show a different and a better method of accomplishing that object. Arm *k''* is loose upon the rock-shaft, while arms *k'* and *k'''* are pinned fast. The bolt *f'''* slides longitudinally on arm *k''*. While this bolt is disengaged from the arm *k'''*, the rock-shaft communicates no motion to the pump; but to set the pump in motion it is only necessary to slide bolt *f'''* along till its wedge-shaped head *o'''* passes into the wedge-shaped notch *o''*, and then turn the nut *x''* fast, when the arms *k''* and *k'''* will move together, and give motion to the pump.

The advantages of supporting and feeding the rock-drill by means of shank *t*, extended above the cylinder, are found in removing farther from the dust and grit of the rock the sliding surfaces upon which the rock-drill moves; also, in removing from immediately around the rock-drill cylinder the cumbrous machinery which is necessary to support it, and provide for its movement in feeding.

I employ on my rock-drilling engine a smith's forge, *y*, and an anvil and anvil-block, *y'*. There is a very great advantage in having, in connection with the engine that wears out the tools, the means of repairing them; otherwise it would be necessary to be constantly moving the smith's forge and his tools.

I construct my vertical shaft in two or more sections, as shown in Fig. 3, Sheet 2, in the same manner that sectional tubing is constructed for wrought-iron bridges, except that the holes for the rivets in the flanges are countersunk, and the heads of the rivets finished off level with the surface, as shown at *d'''*. These flanges are then planed true to slide in the gibways.

The flanges may, if desired, be made stronger and more durable by placing a plate of steel on each side of them, and riveting the steel plates and flanges all together, as shown. I prefer the form of flanges shown in Fig. 3, Sheet 2.

This method of constructing the vertical shaft is at once practical and comparatively cheap, puts the metal into the strongest possible shape, and provides the necessary guides for giving it vertical movement, and, if need be, provides a passage for steam, air, or other means of driving the rock-drill through it. It also affords a convenient place within it for a weight for holding the rock-drill down against the action of the drill-tool.

The gibways shown in Fig. 2, Sheet 2, are divided, the lower part being suspended from the upper part by ropes, and the screw-braces being attached to the lower portion by ball-and-socket joint. The advantage of this arrangement is in bracing the vertical shaft at

a point much lower down than it would be practical to do otherwise.

In raising the vertical shaft and rock-drill above the surface, the lower part of the gibways would be brought up against the upper part by plate d'', so that this construction would have the effect of very long gibways in holding the vertical shaft while the rock-drill is at work, and very short ones when it becomes necessary to raise the rock-drill above the surface.

The joints g'' herein shown are each composed of two parts—a stud which turns upon a vertical axis, and a nut which is pivoted to the stud and has a movement upon a horizontal axis, whereby a universal movement of the braces at each end is allowed.

It may be seen by reference to Fig. 2, Sheet 1, and to Fig. 2, Sheet 2, that the metallic lifting-rope m is attached to the lower end of shaft d, passes up through the gibways c, over sheave m'', and out through the axis b'' of the bed b, and is then wound upon a cylinder.

By this arrangement the rope is delivered at the same point whatever may be the position of the parts with which it is in connection. The vertical shaft may be raised and lowered by means of a rack and pinion so applied that the driving-shaft of the pinion will pass through the axis b'', but I prefer the wire rope arranged as shown.

For several reasons the axles of the rock-drilling engine should be divided at the center, so that each wheel would be on the end of an independent axle; each axle should have two bearings, both on the inside of the wheels; the axles should be turned their entire length of one size, so as to fit the boxes at any point. They should also be provided with adjustable collars to run against the boxes, so that the wheels could be readily adjusted to variable gages.

The car and its appendages herein described are adapted to the use of steam rock-drills. As the steam-drill and the generator of the steam would both be carried upon the car, the steam-passages therefore would be comparatively short, and would be subject to little or no waste by condensation. But if, for any reason, compressed air should be preferred, the condensing pump and reservoir would take the place of the air-pump herein shown. It is also equally adapted to the use of the diamond or revolving rock-drill, which may be driven by a revolving shaft supported by or within the hollow shaft d, or to the use of the crank rock-drill, as shown in my patent before mentioned.

Having described my invention, what I desire to have secured to me by Letters Patent of the United States, is—

1. The combination of braces g, provided with joints g'', or their equivalents, with the gibways and with a car, substantially as and for the purpose specified.

2. The construction of the hollow vertical shaft d, provided with flanges, which are fitted to, and combined with, gibways, substantially as and for the purpose specified.

3. The arrangement of the lifting-rope m, in connection with shaft d, gibway c, pulley m'', and the axis of the bearing b'', substantially as specified.

4. The opening through the piston-rod and the drill-tool, in combination with pump f and air-passage f', whereby the same pump is made to operate the rock-drill and to blow out the chips, substantially as and for the purpose described.

5. The elongation or shank t extending up from the rock-drill cylinder, in combination with a guide or way, d', when said guide is made adjustable on axes x and b'', and supported upon a car, as and for the purpose specified.

6. The strap r', in combination with the screws r, provided with elongated heads, with the adjustable gib and with the shaft d, substantially as and for the purpose specified.

7. The combination of the crown-wheel and cylinder s, points s', slide s'', with its pin projecting into the cylinder, and rope t', with a rock-drill, whereby the same is supported and fed downward, substantially as specified.

WM. H. ELLIOT.

Witnesses:
M. L. ELLIOT,
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