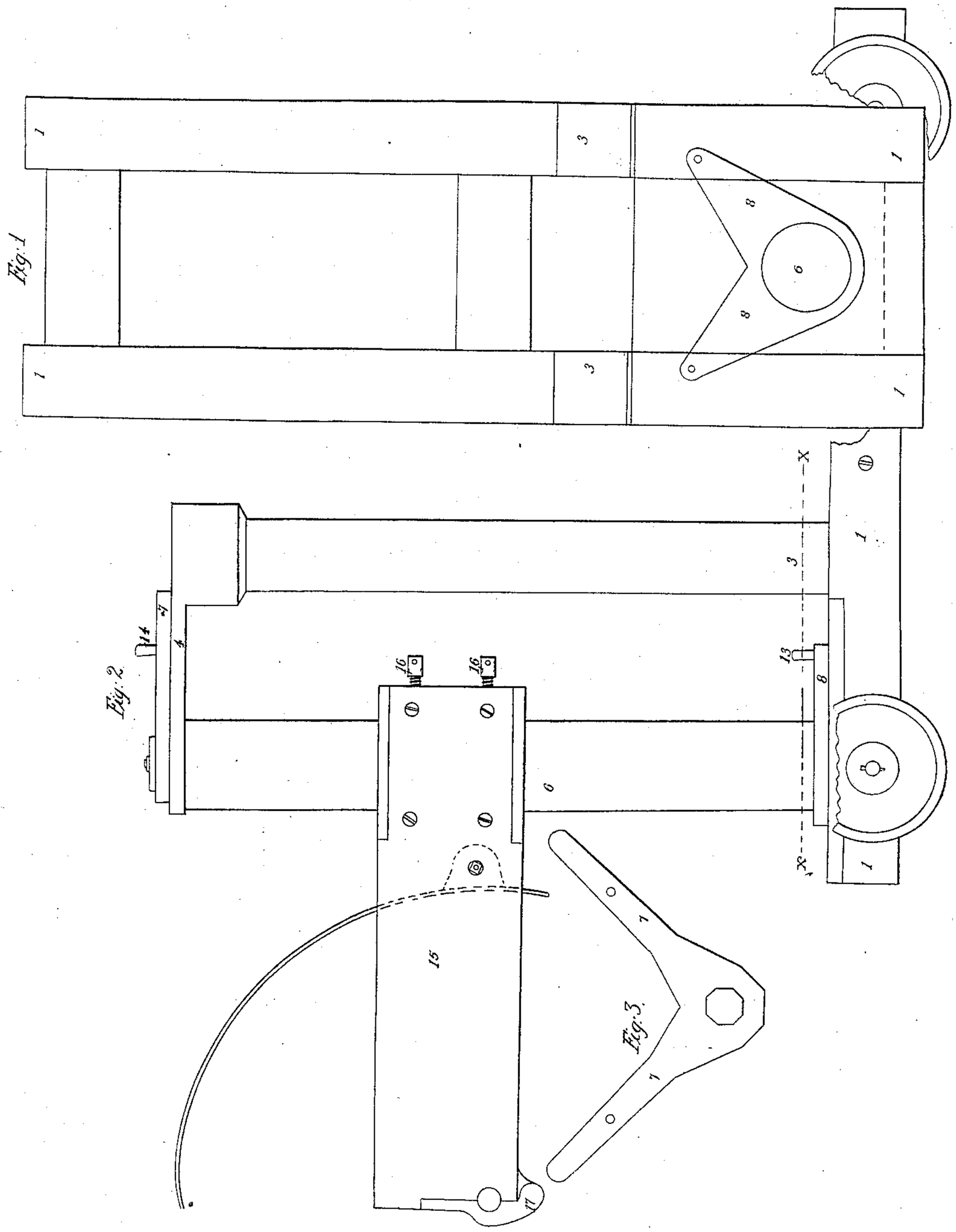
2 Sheets-Sheet 1.

L. P. Jenks,

Steam Rock-Drill.

No. 9,379. Patented Nov. 2, 1852.



2 Sheets-Sheet 2.

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Fig. 7

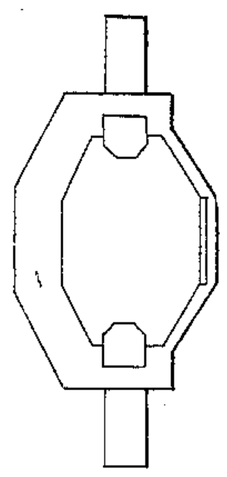


Fig. 9

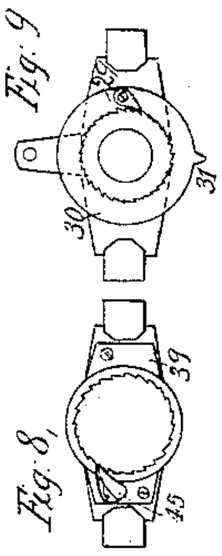


Fig. 8.

Fig. 11

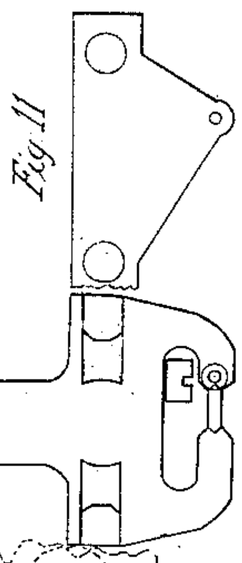


Fig. 10.

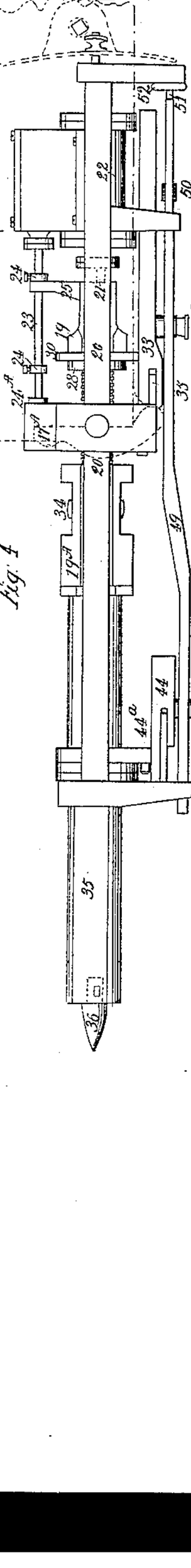


Fig. 12

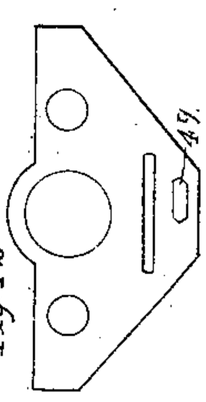


Fig. 6.

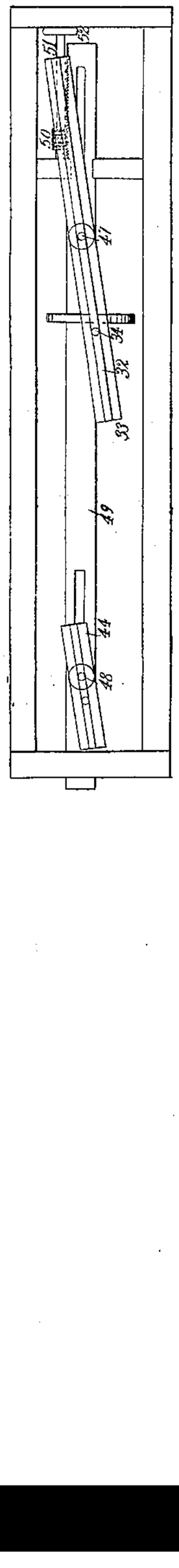


Fig. 5

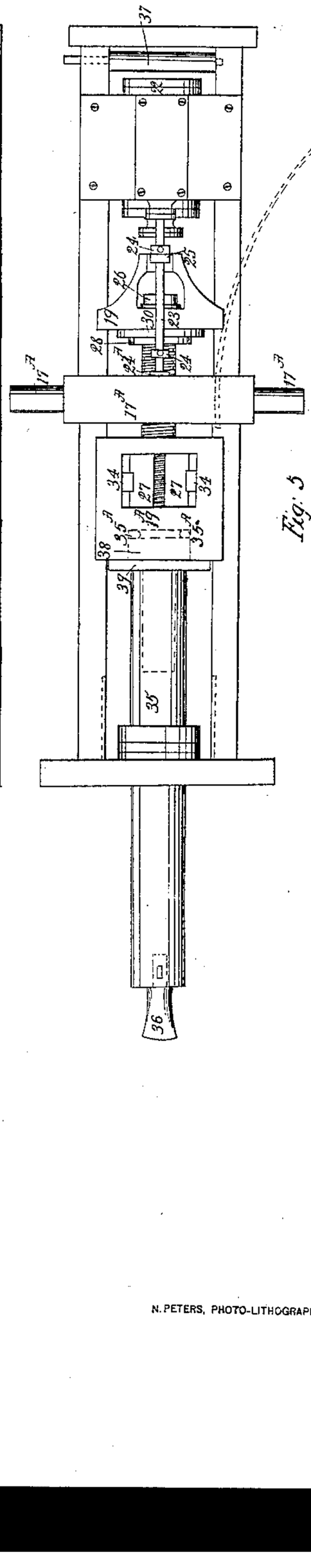


Fig. 4

Fig. 13.

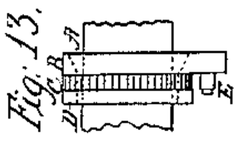
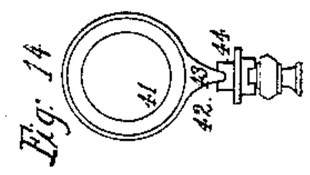


Fig. 14



UNITED STATES PATENT OFFICE.

LEMUEL P. JENKS, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO JOSEPH W. PAGE; SAID PAGE ASSIGNOR TO GEO. ARTHUR GARDNER.

MACHINE FOR DRILLING STONE.

Specification of Letters Patent No. 9,379, dated November 2, 1852.

To all whom it may concern:

Be it known that I, LEMUEL P. JENKS, of the city of Boston, county of Suffolk, and State of Massachusetts, have invented a new and Improved Combination of Machinery for the Purpose of Drilling Rocks; and I do hereby declare that the following is a full and exact description of the same, in which—

Figure 1, Plate I, is a longitudinal section taken upon the line X X Fig. 2. Fig. 2, Plate I, is a side view of the frame. Fig. 4, Plate II, is a side view of the swinging frame and apparatus connected therewith. Fig. 5, Plate II, is a top view of the same. Fig. 6, Plate II, is a top view of the diagonal grooved bars, and sliding bar hereinafter referred to, the other parts being removed. The other figures will be hereinafter referred to in their proper places.

The nature of my invention consists in providing an arrangement whereby a reciprocating motion of a drill, in combination with a rotation of the said drill, is secured in connection with a contrivance for feeding forward the said drill into the rock. With this, I have also a contrivance whereby I can at pleasure graduate the rapidity of the rotation, and also the rapidity of the feeding forward of the same, by either one movement or by two separate movements.

The construction of my machine I thus explain: I have a platform figures 1, 1, 1, 1, which may bear a steam boiler. At one end of the platform I have two standards 3, 3, Fig. 1. To the top of these two standards is attached an iron plate (4 Fig. 2) and next to the bottom on the platform another iron plate (5, Fig. 2). Each of these two plates has a hole in it, the sides of which form a bearing for the shoulder of an upright standard (6 Fig. 2). To the top and bottom of this standard (6 Fig. 2) are attached two arms (8 Figs. 1 and 2—7, Fig. 2 and 7 7, Fig. 3) which have in them holes, and in the iron plates (4 and 5 Fig. 2) are corresponding holes. Pins (13 and 14 Fig. 2) pass through these holes, and retain the arms (7 7, Fig. 3, and 8, 8, Fig. 1,) in the places desired. Sliding up and down upon this standard (6, Fig. 2) is a frame (15, Fig. 2) which being lifted in any convenient manner (I prefer to lift it by hand) is secured in the position desired by two screws (16, 16, Fig. 2). At the extreme end of this frame (15, Fig. 2) are two hinged boxes or bearings (17, Fig. 2) which hold the axle (17^{A} Figs 2 and 5) of a swinging frame (Figs. 4 and 5) which is retained in its place by means of set screws on the end of the frame connecting it to the curved arms (18, Fig. 2). This swinging frame (Figs. 4 and 5) bears two crossheads,—the one (19 Figs. 4 and 5) having a reciprocating motion (between the points 20 and 20 (see Fig. 4) on the frame)—and the other (19^{A} Figs. 4 and 5) having not only a reciprocating motion, but also a continuous progressive motion from the upper to the lower end of the frame. The reciprocating motion of the crosshead 19, (Figs. 4 and 5) I secure in divers ways, but the one which I now prefer is that effected by the advance and recession of the piston rod (21 Fig. 4) of the steam cylinder (22 Figs. 4 and 5) actuated by steam by a jointed pipe communicating with the steam boiler. This mode of action necessitates the use also of a valve rod (23 Figs. 4 and 5) and tappets (24, 24 Figs. 4 and 5) with india rubber or spiral spring (24^{A} Figs. 4 and 5) worked by the projection (25 Figs. 4 and 5) on the first crosshead (19 Figs. 4 and 5) using a crosscut valve for the purpose of simplifying the valve rod arrangement. But the reciprocating motion can be as well secured by the action of a cam worked by this cylinder and a flywheel placed on the swinging frame or,—placing the cylinder and flywheel over the boiler or on the platform, communicating the motion to the cams by means of an upright slotted shaft and cogwheels, in connection with a cogwheel on a shaft running through the bearings (17^{A} Fig. 5). The advance or percussive effect of the drill would then be secured by the use of a spring of india rubber or of metal; the same combination of double crossheads being then used. Or, I sometimes use a simple cylinder and piston on the swinging frame and let in the steam from the boiler under the piston, by a jointed rod, and propel the crossheads bearing the drill by means of an india rubber or of a metallic or other spring,—using the same combination of double crossheads.

I have thus explained my mode of using the first crosshead (19 Figs. 4 and 5) and obtaining the reciprocating motion of it, and of the other crosshead (19^{A} Figs. 4 and 5) with drill thereto attached.

I will now explain how I secure the progressive advance of the second crosshead (19A Figs. 4 and 5). Turning loosely on the first crosshead (19 Figs. 4 and 5) is the head of a screw shaft (26 Fig. 5). The body of the screw shaft is enveloped by a female screw made in two pieces (27, 27, Fig. 5) borne by the second crosshead 19A and this screw shaft passes into the hollow mandrel (35, Fig. 5). The rotation of the screw shaft is effected by means of the ratchet wheel (28, Fig. 5, see also Fig. 9,) acted upon by the pawl (29 Fig. 9) borne upon the ring pawl holder (30 Figs. 4 and 5, see also Fig. 9). This ring pawl holder has a projection (31 Fig. 9) sliding in a groove (32 Fig. 6) of a diagonal bar (33, Figs. 6 and 4). This bar swings by a pivot (34 Fig. 6) through its center and is borne by the plate (35, Fig. 4), the latter screwed to or part of the solid curved axle (17A Figs. 4, 5, and 7) which axle bears the swinging frame. (Sometimes I make the pawl holder forked and substitute a diagonal rod for the diagonal grooved bar).

The diagonal grooved bar (33, Fig. 6) being placed at such angle as may be desired (by a contrivance which I will hereafter explain) the recession of the first crosshead (19, Fig. 4) partly rotates the ring pawl holder (30 Fig. 4) which, by means of the pawl (29 Fig. 9) rotates equally the ratchet wheel (28, Figs. 4 and 5, and Fig. 9) and the screw shaft (26 Fig. 5) thus lengthening the space between the two crossheads, at the same time that both the first and second crosshead are withdrawn or receded. When the second crosshead is advanced as far as the length of the frame will permit, the two parts of the female screw (27, 27, Fig. 5) are withdrawn from the screw shaft, the wedges (34, 34, Figs. 4 and 5) being for that purpose withdrawn and the second crosshead, with the mandrel (35, Figs. 4 and 5) and the drill (36 Figs. 4 and 5) attached thereto are brought back to the top of the frame by means of ropes or chains from the small windlass (37 Fig. 5) at the upper end of the swinging frame.

When I use rotary motion and a spring to actuate my two crossheads, I have also on the shaft which bears the cam, a grooved band wheel and band, which (the first crosshead being drawn back and fixed by a peg or catch) working in connection with a grooved band wheel on the end of the screw shaft (26 Fig. 5) rotates, said shaft by the same power which drives the machine, and in that case I have not two parts of the female screw, but a solid female screw cut in the body of the second crosshead. I have an iron working model constructed in this manner which works well. I would remark as to the hollow mandrel, it is not essential to make the mandrel hollow, but it is much better, as the center of the drill is then also the center of the screw shaft through which impulsion is communicated. This however could also be secured in other ways, as for instance, by having two screw shafts, one on each side of the mandrel.

I will now explain the mode by which rotation of the drill is effected. The hollow mandrel (35, Fig. 5) bears upon its upper end a ratchet wheel (38, Fig. 5, see also Fig. 8) which is sunk into a cavity in the lower part of the second crosshead. The plate (39 Figs. 5 and 8) screwed upon the lower end of the second crosshead retains the mandrel in its place. Between the end of the mandrel and the second crosshead, I sometimes place a buffer of india rubber (35A Fig. 5) or other material. Enveloping the mandrel is a cylinder (A Fig. 13 the dotted line marking its section, see also at the lower end of the swinging frame Figs. 4 and 5) with one or more friction springs on its inner surface. This cylinder bears a ring (B Fig. 13) which I call the second pawl holder as it bears a pawl (E Fig. 13) working in a ratchet wheel hereinafter mentioned. At its lower part this ring or "second pawl holder" has a projection (43 Fig. 14) sliding in a diagonal grooved bar (44, Figs. 6, 4 and 14) swinging on a pivot fixed on the plate (44a) fastened to the lower end piece of the swinging frame. Fixed tightly upon the cylinder (A Fig. 13) is a ratchet wheel (C Fig. 13) retained with additional security by the ring (D, Fig. 13) fastened tightly also to the cylinder. The recession of the mandrel with the cylinder partly rotates (by means of the pawl E) the ratchet wheel C and consequently the cylinder A and with these the mandrel and drill. On the mandrel P being again advanced (the changed position by partial rotation being retained as hereinafter mentioned) the ring B (or second pawl holder) is rotated in the contrary direction by the action of the diagonal grooved bar (44, Fig. 4) and on the repeated recession of the mandrel the partial rotation is repeated.

On commencing the operation of drilling the 1st cross-head is drawn down to the extreme length of its stroke and the cylinder (A, &c.) is slid down so as to touch the lower end-piece of the swinging-frame, and as the mandrel (and drill) are fed down, the striking of the friction cylinder (A Fig. 13) and attachments, works the said cylinder up toward the upper end of the mandrel just so fast as is required and no faster. Sometimes, (using the cylinder A, &c.) I groove the mandrel and place a spline in the cylinder and let the spline (or, I let the friction spring instead thereof) slide in the groove. Sometimes I cut ratchet teeth the whole length of the mandrel and use only the ring pawl holder B with the pawl E. Sometimes

I make the mandrel hexagonal or octagonal (or, having its section circular have a groove and spline therein) and place the ratchet wheel upon it, (with one or more friction springs) and the ring pawl holder next to it immediately upon the mandrel, (the pawl-holder with or without a friction spring upon its inner surface)—but, for the present I prefer the mode I have indicated in the model, considering these modifications as substantially the same. The mandrel (and drill) being thus rotated, I prevent its turning back to its former position by means of the ratchet wheel (38 Fig. 5. See also Fig. 8). The cavity in the 2nd cross-head being enlarged sufficiently, I place therein a solid pawl (45, Fig. 8, or two, one on each side) with a spring to throw it in place, the strain thus coming upon the solid iron of the cross-head.

The sole function of the friction cylinder is thus to tune the mandrel (the pawl 45 Fig. 8) retaining the mandrel in place, for which purpose the friction cylinder has only to overcome the friction of the mandrel on its bearings, which is very inconsiderable;—the power of the spring (which throws the pawl 45, Fig. 8, into its place) which is also inconsiderable, and any chance friction of the point of the drill against the cavity of the rock in which it works.

I have now to describe another feature in my machine. In drilling soft rocks the rate of progression is of course more rapid than in operating as those which are harder. But the soft rocks have in them frequently veins of a much harder substance, as for instance, mica, slate, with veins of quartz, or lime-stone with the same veins. These veins are of varying thickness, and when they are reached, the operator has of course, no means of knowing whether they are one inch or twenty or more inches in thickness. Still it is essentially necessary for the safety of the machine to vary the rate at which the drill is fed forward, and this, when the rate of striking is one, two, or three hundred blows per minute, must either be done instantaneously or the machine must be stopped;—otherwise a breakage of the machine results. In diminishing the rate of advance of the drill also, it is important to diminish the rate of its rotation, thus modifying the rapidity of drilling in both ways. The object of the simple contrivance I now describe, is to effect this end. The lower sides of the grooved bars (3, 3, and 4, 4, Fig. 6) are also grooved and in these grooves respectively, slide the pins or adjusters (47 and 48, Fig. 6). These adjusters are fastened by set screws (47^{A} and 48^{A} Fig. 4) attached to them in slots, respectively, in the sliding bar (49 Figs. 4 and 6) borne by projections or plates at the lower end of the swinging frame and just above its center. This sliding bar is advanced or receded by means of the rack on its side (seen in Fig. 6) in which plays a worm or screw (50 Figs. 6 and 4) borne by the small shaft (51, Figs. 6 and 4) which shaft has a hand wheel (52 Figs. 6 and 4) by means of which it turns. It will thus be seen on inspection that supposing the pins (47 and 48 Fig. 6) are fixed (by means of their set screws) at such points in their respective slots (see Fig. 6) as will secure 8 rotating movements of the mandrel to a complete revolution, and an advance of the 2nd crosshead and mandrel (and drill) at the rate of 4 inches per minute,—then, by turning the hand-wheel (52 Figs. 4 and 6) the sliding bar, (49 Figs. 4 and 6) is drawn backward almost instantaneously, and the pins 47 and 48, sliding in the under-side grooves,—the angle of the grooved bars (respectively to the line of the back and forward motion of the cross heads) is thus changed, and (according to the amount of the recession of the sliding bar) the rate of turning of the drill is changed to, say 15 movements to a complete revolution, and (the rate of turning of the screw shaft being diminished) the advance of the cross heads (and drill) is diminished to that of say 1 inch per minute. It will be seen that by sliding the pins (47 and 48 Fig. 6) in their respective slots, the proportionate rate of rotation and advance may be varied within all necessary practical limits, entirely at the pleasure of the operator.

This account of the construction of the machine, it will be seen, includes also an account of the mode of working it. The steam being let into the steam cylinder, by any convenient method the piston, cross-heads and drill are driven down, when, the valve rod being drawn down, the steam is let into the under part of the piston and the drill recedes. I will only add that the drill being secured by a key or in any convenient method, in the end of the mandrel, is changeable at pleasure. The rate of working is to be graduated by the operator according to his judgment, by turning the hand-wheel (52 Fig. 4).

One of the most important features of my combination is that of the double cross-heads, by means of which I obtain the facility of effecting reciprocating action at a certain locality on the swinging frame, say at the upper end (placing then either my steam cylinder, piston and valve rod or my spring with cam shaft, or my spring and steam cylinder) the mandrel and drill being at the same time advanced into the work. Another important feature is that of the sliding bar and arrangement of the diagonal bars or rods. I find in practice, the want of it is very detrimental. A third feature, but a minor one, is that of the hollow mandrel. It has an advantage over any

arrangement by which the screw shaft runs on side of the mandrel, or runs upward through the piston rod, in that the lengthening of the screw shaft does not necessitate the lengthening of the swinging frame. I have used the term "swinging frame" but I sometimes use the frame fixed, either vertically or horizontally (the last for tunneling work) and sometimes I swing it sidewise, sometimes not. Another important feature is that of the friction cylinder attachments for rotating the mandrel and drill.

The arrangement of the mandrel head, pawl and ratchet wheel, as sunken into the cross-head, I believe to be an original and valuable improvement, but I do not think it necessary to claim it. The same remark applies to that of the crosscut valve as applied to steam drills, though since my invention of it, I have learned that a similar arrangement has been applied to pumps. The same remark as to originality and value applies to the arrangement of the bars or rods, to effect the turning movements, as swinging on their center, but I do not feel certain as to the priority and have not at present the opportunity to ascertain. I therefore do not claim that peculiarity. The side swinging of the frames bearing the drill, is also a new and valuable feature, but I do not think it necessary to claim it. But the claims which I do make herein as for my own invention I thus express.

I claim—

1. The arrangement (in a swinging or other frame) for the purpose of drilling rods, of two cross heads, the one, with a reciprocating motion, and the other connected therewith and bearing the drill, with a reciprocating and progressively advancing motion, substantially as described, and this, however such alternate advance and recession may be effected.

2. I also claim the arrangement of, substantially, a sliding bar for the purpose of changing both the rate of rotation, and the rate of advance of the drill by one movement for the purpose and in the manner substantially as described.

3. I do not claim the ratchet wheel and pawl holder operated by the inclined groove by itself, but I claim the making the ratchet cylinder or equivalent rotating arrangement slide upon the mandrel or drill stock as the same advances in such manner as that the pawl holder projection retains its place in the inclined groove, substantially as herein described.

LEML. P. JENKS.

Witnesses:

JOSEPH W. PAGE,

HARVEY JEWELL.