GANG DRILL TUNNELING MACHINE
Max J. Deano, Los Angeles, Calif., assignor to Troy Investments, Inc., Santa Monica, Calif., a corporation of California
Application March 29, 1951, Serial No. 218,210
9 Claims. (Cl. 262—7)

This invention relates to gang drill tunneling machines, and it has among its salient objects and purposes:

To provide a gang drill tunneling machine which is self-contained, with power plant and control mechanisms therefor, as a part thereof, and which includes a series of cooperating drilling units held in parallel relationship with each other, and spaced around a horizontal center, each unit including a drill tube, with a drill bit in its end, with power connections for rotating it, and also for oscillating it longitudinally, and for feeding said drilling units forwardly and sidewardly in a drilling operation;

To provide in a machine of the character referred to, a series of similar outer drilling units, each of said outer drilling units being movable axially away outwardly and inwardly, relative to the axis of the machine and of said first mentioned drilling units, whereby to enlarge the area to be drilled;

To provide in connection with each of said drilling units, a drill tube with drill bit in its end, and a small tube therethrough for conveying air and water or other means up to the drill bit during the drilling operation for clearing away the dust and small particles from the drill bit, and for keeping the drill bit cool, with means connected therewith for supplying air under pressure and water thereto;

To provide in connection with each drill unit and its drill tube, a feed screw, with means for driving all of said feed screws simultaneously for feeding said drill units forwardly together in the drilling operation;

To provide in a machine of the character referred to an instrument board with the control instruments thereon and connections therefrom for controlling the different operations of the drilling units;

To provide in such a machine, power operated jacks at opposite sides thereof, and operable to be thrust outwardly into holding engagement with the sides of the tunnel being bored, whereby the machine is firmly anchored and held steady for the drilling operation;

To provide a gang drill tunneling machine supported for powerful movement to and from the work, with manually controlled power means for moving the same as a unit to and from the drilling position;

Other objects and advantages of the invention will appear from the following more detailed description of one practical embodiment thereof, taken in connection with the accompanying nine sheets of drawings, in which:

Figure 1 is a side elevation of a gang drill tunneling machine, embodying my invention, with parts broken away to reduce the size of the figure;
Figure 1A (Sheet 5) is a view of one of the supporting and carrying arches, as seen from the position of line 1A—1A, Fig. 1;
Figure 2 is an enlarged view of a gang of driving gears for the feed screws, as seen from the position of line 2—2, Fig. 1, with a part broken away;
Figure 2A is an edge view thereof, taken at line 2A—2A;
Figure 3 is a view taken on line 3—3, on Fig. 1, showing a series of stubs of flexible shafts for driving the feed screws, one of which can be seen in Fig. 19 (Sheet 7);
Figure 4 is an enlarged view looking from the position of arrow 4, on Fig. 1, being the front of one of the supporting and bearing heads;
Figure 5 is an enlarged fragmentary view of one of the bearing members of the unit, as seen at arrow 5, Fig. 4, which bearing member is mounted on the inside of the square head, and through which unit a drill tube, a screw drive, a water and air tube, and tie-rods of the unit pass;
Figure 5A is a sectional view looking down on said view from line 5A—5A, on Fig. 5, with the walls of the square supporting and bearing head in section;
Figure 6 is an enlarged plan view with parts broken out and in section, showing one of the drill units, including the drill tube, a driving shaft with intermeshing gears for driving the drill tube, and with a small tube for water and air through said drill tube;
Figure 7 is a vertical sectional view of the parts shown in Fig. 6, with parts broken out to reduce the size of the figure, and also showing the feed screw for feeding the drilling unit forwardly;
Figure 8 is an end view of a drill bit, showing a drill bit as seen from the line 8—8 on Fig. 7;
Figure 9 is a fragmentary longitudinal sectional view of the end of a drill tube, showing how the drill bit is screwed into the end of said drill tube;
Figure 10 is an enlarged fragmentary, longitudinal sectional view, at line 10—10, Fig. 7, showing an angular cam groove for oscillating the drill tube longitudinally as it is rotated;
Figure 11 is an end elevation looking at the end of a part of Fig. 10, from the position of line 11—11 thereof;
Figure 12 is a side view of one of the jointed, adjustable driving members for driving the feed screws for feeding the drill tuber;
Figure 13 is an enlarged cross sectional view taken on line 13—13, Fig. 12, to show one of the telescoping interlocking devices;
Figure 14 is a fragmentary view showing a connection from a drum to a toggle link for moving said toggle link, as seen in Fig. 19 (Sheet 7) in dotted lines;
Figure 15 is an enlarged view of a universal joint;
Figure 16 is an enlarged view of a cone clutch for connecting the motor M' for driving the screws which feed the drills forwardly;
Figure 17 is a sectional view taken on line 17—17 on Fig. 16;
Figure 18 is an enlarged side view of one of the movable drilling units, as seen looking from arrow 18, on Fig. 4 (Sheet 7), showing the lateral adjustment in light dotted lines;
Figure 18A shows a detail of a pivot bearing, as seen from line 18A—18A, Fig. 18;
Figure 18B shows a detail in section, as seen on line 18B—18B, Fig. 18;
Figure 19 is an enlarged fragmentary side view, also showing certain adjustments in light dotted lines, and showing how one of the outer or movable drill units can be moved laterally inwardly;
Figure 19A is a detail of a support seen from the arrow 19A on Fig. 19;
Figure 20 is a vertical sectional view taken on line 20—20, on Fig. 1, showing some of the supporting and bearing members, seen in side elevation in Fig. 1, which are movable forwardly and rearwardly in the feeding operation, and one of which is seen in Fig. 7;
Figure 21 is a schematic or diagrammatic view showing the various operating parts and their connections, with control mechanisms as will be found on the control or instrument board;
Figure 22 is an enlarged side elevation of a drill tube, with a modified mechanism for imparting the longitudinal vibration thereto, with parts in section; and
Figure 23 is a fragmentary perspective view of the end of an intermediate member seen in Fig. 22.

Referring now in detail to the drawings, the entire operating structure is movably suspended from a suitable track, such as an I-beam 1, by means of supporting arch members, as 2 and 3, one of which is seen in Fig. 1A (Sheet 5), with a platform 5 therewith. Said arch members have carrier wheels, as 6, 6, adapted to said I-beam, as shown. One of said arch members as 3, Fig. 1, has one of its wheels provided with a driving sprocket 7, driven by a sprocket chain 8, from a motor 9 and its sprocket 9', whereby said structure can be moved along said I-beam, 1, and from the work. Spring means, as 10, illustrated in Fig. 1A (Sheet 5), holds the wheels 6, 6, on the I-beam 1.
3

An instrument board B is shown on the rear of the machine, Fig. 1, with the entire power mechanism supported on the platform 5, and which includes the motor drive 12, with a compressor thereon, as 13–15; a main power unit 14, from which a sprocket chain 15 is driven and which runs to 16, on which a sprocket 17, with worm 18, seen also in Figs. 2 and 2A, said worm 18 being in mesh with a worm gear 19, Fig. 2A, which is in axial alignment and connected with a motor drive 12, with 17, and thus, as 18, seen also in Figs. 2 and 2A, said worm 18 being in mesh with a worm gear 19, Fig. 2A, which is in axial alignment and connected with a motor drive 12. This mechanism is all enclosed in a housing 22. Thus from the worm 18 and the worm gear 19, the large gear 20, is moved from said large gear twenty-eight, or twenty-eight gears, shown in mesh therewith, are driven together. Each of said small gears 21 has a coupling member, as 23, connected therewith, to be driven thereon. In Fig. 12 one of the complete jointed and adjustable driving members is shown in side elevation, with universal joints, 25 and 26. The body 24 thereof is composed of two telescoping members 24a and 24b, with set screws, as 24c, for slidable interlocking said members together. These driving members, of which twenty-eight are shown, constitute the driving means for twenty-eight different drill units, again referred to.

Toward the front of the general structure, that is, toward the drilling end of the machine, are two supporting and bearing heads, designated 27 and 28, of square section, and are connected by the parallel vertical bars, as 29, and the securing members 24 shown in Fig. 4, and Fig. 6a and 20 on 1, with the members extending through said supporting head 28 shown in section.

Each of these supporting heads is formed of two spaced steel sheets, as will be seen from the sectional view in Fig. 8, and the broken out view in Fig. 5, in which one of said supporting heads 19 is seen in face view through said broken out area one of the steel plates. Said bearing members 29 are bolted between the steel plates, many of them being seen in light broken lines on Figs. 4, and their arrangement and positions corresponding to the positions of similar movable bearing members seen in Fig. 20, taken line 28–20. Fig. 1. The spaced steel plates are connected by short bolts, as 30, 36, and said heads 27 and 28 are connected by long tie rods, as 31, 31, Fig. 1.

These tie rods are the same in all places, some of them are mounted wholly within the area of the square heads, as seen in Fig. 4, in light broken lines, and some similar bearing members are referred to it, as 27 and 28, and under pressure, and are carried on the outer ends of toggle members, as 29, and are supported beyond the marginal edges of said heads. On Fig. 20, and also on Fig. 1, the bearing members are designated 29. These are the movable or outer bearing members between the heads 27 and 28 and are seen in full lines in Figs. 1, 6 and 7. They are the same in all places.

It will be noted that there are thirteen of the bearing members 29 within the area of the supporting head 28, Fig. 4, distributed around, and rigidly bolted in place beneath the plates of the head.

Through each pair of bearing members, in addition to the tie rod 31, 31, Fig. 5A, extending from one head to the other, there is a feed screw, as 33, again referred to, a drill tube, as 33, and a drive shaft 34, shown of hexagonal form, and a small tube 33 for air and water, extended through each drill tube 33. By reference to Fig. 1, it will be seen that there are a total of fifteen of the outer, or movable bearing members 29, or twenty-eight, on the jointed links or toggles, designated 36, and arranged around and extending beyond the area of said heads 27 and 28. The fifteen drill tubes or units, supported in the movable bearing members 29 seen in Fig. 4, are shown in smaller heads 27 and 28. They are all held in parallel relation, the outer ones being adjustable or movable outwardly and inwardly together, as seen in light broken lines in Fig. 19. I will refer to a drill unit as including one of the drill tubes 33, with supporting and drive shaft 34, and the tie rods, all extending through one bearing member within the head 28 to the bearing member in the head 27, and out of, and therefore, as 36, shown in Fig. 4, hingely mounted on the two spaced heads 27 and 28, and all movable outwardly and inwardly together, as seen in light broken lines in Fig. 19. This adjustment of the drill is also shown in enlarged drawing in Fig. 18, being in extended view in full lines, and in withdrawn position in light dotted lines. The outer drill units are thus all moved together by their toggle supporting means. The supporting members for the drill units which are within the areas of the two heads 27 and 28 are designated 29, and are seen in light broken lines on Fig. 4. The supporting members for the drill heads or driving members which are carried by the toggle links are designated 29, as seen in Fig. 4 also, around the outer area of said head. Then there are supporting members for the ends of the drill tubes 33, as 28, which must move together forwardly as the drill units are fed into the work. These drill units are seen between the heads 27 and 28 on Fig. 1 and their supporting members are designated 29', Fig. 1, Figs. 6 and 7 and Fig. 18.

The adjustment of the supporting toggle links, 36, 36, shown in Figs. 4 and 19, is accomplished by means of a drum 37, supported by a leg 38, running on an inverted V-track 39, as seen in Figs. 19 and 19A (Sheet 7).

From the rim of this drum 37, are pull rods 40, each extending from a telescoping member or collar 40 and a rod 41, hingely connected to the drum 37, as at 37; Fig. 14 (Sheet 4), said rod having a collar 42, suitably secured thereto by set screws, as indicated, whereby said collar serves as a stop for said rod, so that the proper adjustment can be made for moving said pivotally supported drilling units, as indicated in Fig. 19. Said drum 37 is moved outwards by hydraulic means, consisting of a plunger rod 43, secured to said drum in its center, and operating within a cylinder 44, with a tube 45 connected therewith for furnishing hydraulic fluid as indicated, as indicated in Fig. 19. A return tube from the opposite end of said cylinder 44 is seen in Fig. 19. These tubes 45 and 46 extend to and are connected with a source of supply of hydraulic fluid, again referred to.

Figs. 6 and 7 show enlarged views of one drilling unit, including a feed screw 52, a drill tube 33, with a small tube 33 for air and water, and a drive shaft 34 and the tie rods 31, 31, all of which are seen in Fig. 7, also Figs. 5, 5A and 19. The several operating or drilling units lying within the marginal areas of the heads 27 and 28, have their bearings in the members 29. For the outer drilling units, the bearing members are designated 29', as before referred to, but the supporting and bearing members to which the driving ends of the drill tubes are connected for operation, designated 29', are slidably mounted on the tie rods, and are on the feed screws, as seen in Fig. 7, so that the supporting member 29, feeds the drill tube with it as the feed screw is rotated, and as the drive shaft 34 is driven, it operates the drill tube in the drilling operation, and it moves forwardly on the small tube for air and water, on the tie rods and on the screw 33, said feed screw accomplishing the feed forwardly in the drilling operation.

By reference to Figs. 6 and 7 and 10, it will be seen that the drill tubes 33 are provided with ring gears, as 47, which mesh with drive gears, as 48, on drive shaft 34, Fig. 6. The drive shaft 34 is shown to be hexagonal in cross section, with the integral round and turning ball bearings, as at 49, in a housing 50, on the head of the supporting and bearing member 29', as carried on the toggle 36. The drive gear 48 is also in a housing, as 51, carried to move within the drill tubes 33, and the bearing member 29', as indicated in Figs. 6 and 7.

Mounted in said head 29', is a sleeve 52 through which
the water and air tube 35 passes and along which said head 29' and said sleeve 52 move in the feeding operation of the drill tube. Ball bearing sets, as 53, 53, are inserted in said sleeve 32, at opposite sides of said gear ring 47, within another sleeve member 54, substantially as illustrated in Fig. 7. In the end of said sleeve 54, is a cam sleeve or collar 55, having forming around its surface rotating cam groove 56, Fig. 10, said collar 55 being threaded at its outer end, as at 57, for connection with the inner end of a drill tube 33, as seen in Fig. 10. Said said sleeve 54, and cam studs, as 56', having their inner ends operating in said undulating cam groove 56, for causing longitudinal oscillation of said drill tube as it is revolved by the gears 47, 47, which are driven by the drive shaft 54, as shown.

Operating between sleeve 52, through which the water and air tube is located, and said cam sleeve 55 is located, are three interlocking bearing balls 59, 58, in holding pockets, as 58', 58', seen in Figs. 10 and 11. These interlocking balls form a drive from the sleeve 52 to the sleeve 55, while permitting the longitudinal oscillating movement.

I will now describe how the different parts of the drilling units are driven. By reference to Figs. 1, 2, 2A, 6, 7, 8, and 9, it is shown that each of the water and air supply tubes 35, 35 is driven from one of said cam sleeves 52, 52, and from said cam sleeves, 52, 52, by two hydraulic rams or jacks, as 76 and 77, two on each head, directed outwardly toward the opposite walls. These rams have plungers therein, designated 76' and 77' to be hydraulically forced outwardly into operating positions against the opposite walls or structures between which the machine is being used for holding the machine steady and well anchored during the drilling operation.

Referring to Figs. 22 and 23, I have shown a slightly modified mechanism for imparting an oscillating movement to the drill tube 33, as it is rotated in the drilling operation, and before described in connection with Fig. 10.

One of the operating members 29' is here shown with its gear 47' set therein, similar to the showing in Fig. 6. This gear 47 is mounted on an inner tubular member 100, provided on its end with a nut 101. Mounted on said tubular member 100, is a connecting member 102, a cam collar 102', secured in place in said member 29' by means of set screws, as 106'. Said cam collar has its end formed into an undulating cam runaway, as 103.

Mounted in the end of said operating member 29' is a connecting member 104 having its inner end formed into a similar undulating cam end or runaway, as 105, to cooperate with the cam end 103 of the cam collar 102. Steel balls, as 106, are placed between the undulating cam ends or runways 103 and 105, as clearly shown in Fig. 22.

Said connecting member 104 is reduced at its end and threaded, as at 104', and a drill tube 33 is shown connected therewith.

In Fig. 23, a perspective view of said connecting member 104 is shown, with a bore therethrough and with three longitudinally extending channels 107, 107', formed or cut therein. The inner tubular member 100, within said connecting member 104, is provided in its outer surface with ball-receiving seats, as 108, to receive interlocking balls, as 109, in the channels 107 of the member 104, for interlocking the connecting member 104, and the drill tube 33, to turn together with the tubular member 100, which is driven by the gear 47, from the drive shaft 34, before described. Said connecting 104 is mounted on said tubular member 100, and bears on one end against the nut 101, and at its other end, it bears against the threaded end of the connecting member 104, as clearly shown.

Thus as said tubular member 104 is rotated with the gear 47, by reason of the interlocking steel balls 109, it drives the connecting member 104, and the drill tube 33 connected therewith, and as the spring 110 yieldingly holds the connecting member 104 inwardly, its undulating cam end 105 must operate on the steel balls 106, 106', between the adjacent and cooperating cam ends 103 and 105 and impart longitudinal vibration or oscillation to the drill tube as it is driven from the gear 47, tubular member 100 and the interlocking steel balls 109, 109.

In the other mechanism for imparting an oscillating movement to the drill tube, as shown in Fig. 10, the short cam studs 56' are not thought to be the best means for accomplishing this with. The mechanism just described is preferred, for the steel balls operating between the two cam ends, as described, with one member movable relative to the other, as shown and described, is more practicable and economical.

The use and operation of the invention herein described may be briefly described as follows:

Referring to the diagrammatic view in Fig. 21, by pressing switch 54, forum 54 is connected to motor 9, Fig. 1, which moves the entire machine on the track or J-beam 1, to and from the work. This is under control lever 80 for reversing the motor.

When the machine is thus moved to the work, it is
next necessary to set the front holding jacks 76, 76, which are controlled by valve 81. Then it is necessary to set the rear jacks 77, 77, controlled by valve 92. These jacks are operated thus set into the opposite sides of the tunnel, the machine is firmly held and is ready for operation.

The next operation is to bend the outer arms, or toggle, 33, 33, which carry the outer drilling units, as described in connection with Figs. 4 and 19, and these are operated by the cylinder 44 and its plunger 45, which moves the drum 37, as seen in Fig. 19, when it is shown moved to the outer position in full lines, and to the withdrawn or inner position in light broken lines. These are hydraulically operated and are controlled by lever 84, from the same hydraulic pressure which operates the front and rear jacks, said carrying arms for the outer drilling units being moved outwardly and inwardly, as indicated in Figs. 18 and 19.

Switch S1, starts motor M1 which operates the compressor and builds up air pressure in the tank 86.

Valve lever 90 controls the flow of air from the tank 86 to the jet mechanism 89, as shown in said diagrammatic view, Fig. 20. A movement control valve 88 controls the flow of water to said jet mechanism. Air and water are thus mixed through this jet mechanism 89 and discharged into the tunnel, as shown in a view which could also be seen in Fig. 19, 1, 4 and 19, and from which manifold small tubes, as 75, extend to the several small tubes, 35, 35, in the drill tubes 33, 33.

The small tubes 35, 35, are in the drill tubes of all the drill units, and the outer ones of which are carried by the toggle members 36, 36, and the inner or fixed ones of which are through the arms supporting heads 27 and 28, and seen in Figs. 21 and 20. The supply of air and water through the small tubes to the drill is to wash away the dust and particles from the drill bits in the drilling operation.

The small tubes 35, 35, are in the drill tubes of all the drill units, and the outer ones of which are carried by the toggle members 36, 36, and the inner or fixed ones of which are through the arms supporting heads 27 and 28, and seen in Figs. 21 and 20. The supply of air and water through the small tubes to the drill is to wash away the dust and particles from the drill bits in the drilling operation.

A cone clutch 63, operated by air under pressure from the reservoir 86, is controlled by valve lever 93, and operation of the cone clutch 63 is through the shaft 61, with a sprocket gear 62, and chain 60, for driving the series of small gears 59, 59, shown in Fig. 3, for driving the flexible shafts 59, 59, connected to and combined with said feed screws 32, as at 32', for feeding the drill tubes 33 and their drill bits 33' forwardly into the work, as will be understood from Fig. 7, and Fig. 19.

Shown on said diagrammatic view, Fig. 21, in connection with the circuits shown are switches S1, S1', S2, S3 and S4, to control corresponding motors designated M1, M1', M2, M3 and M4, and also, in said circuits are magnetic control boxes, designated 1', 2', 3', and 4'. These control switches, levers, valves and gauges to be described are all included on the instrument board, B, in Fig. 1, and are within easy reach.

A variable speed control lever is also shown for controlling the speed of the drills and is designated 87.

Thus I have provided a gang drilling machine having a series of drilling tubes held in fixed, parallel relationship, and a series of drilling tubes carried at the free ends of toggle arms and movable outwardly and inwardly in parallel relationship with each other and with the first series of drilling tubes, with power means connected for rotating said drilling tubes in the drilling function, and with the longitudinal oscillation of said drilling tubes to increase the effectiveness of the drilling function, with means for removing the dust and drillings from the drill bits during the operation of said machine. I have also provided such a machine, supported from an overhead track, with power means for moving it to and from the work, with an instrument board carried thereby with control mechanisms for controlling all of the functions of said machine.

I am aware that many changes can and probably will be made in the details of construction and arrangement so as to affect the details described hereinafter, without departing from the real invention, and I do not, therefore, limit the invention to the details shown and described, except as may now be limited by the hereto appended claims forming a part of this specification.

The present application discloses subject matter disclosed and claimed in my copending application Serial No. 233,312, filed June 25, 1921.

1. In a rock drilling machine, a supporting and carrying structure, a plurality of drill tubes having their bearings in said structure and having drill bits in their work ends, small tubes in said drill tubes for conveying air and water under pressure through said drill tubes to said drill bits during the drilling operation, power means on said structure with driving connections to said drill tubes for rotating them in a drilling function, means connected with said drill tubes, and operated by the rotating movement thereof, to cool the drill tubes and to rotate said drill tubes during their rotation to increase the drilling function, a source of air under pressure, and a source of water under pressure, a jet mixer in which these are mixed and which are connected for mixing them, and a manifold to receive said mixed air and water, said manifold being connected with said small tubes for supplying the same to said drill tubes, said feed means connected with each drill tube for feeding it to the work, power means connected with said feed means for simultaneously operating the same for feeding said drill tubes to the work, and control means thereof.

2. In a gang drill machine for drilling rock and the like, a body structure supported for movement as a unit to and from the work, power means for moving said body structure including a plurality of spaced bearing heads connected and held in fixed spaced relationship with each other, a series of parallel drill tubes having their drill bits in their work ends, small tubes in said drill tubes for conveying air and water under pressure through said drill tubes to said drill bits during the drilling operation, power means on said drill tubes for rotating them in a drilling function, means connected with said drill tubes, and operated by the rotating movement thereof, to cool the drill tubes and to rotate said drill tubes during their rotation to increase the drilling function, a source of air under pressure, and a source of water under pressure, a jet mixer in which these are mixed and which are connected for mixing them, and a manifold to receive said mixed air and water, said manifold being connected with said small tubes for supplying the same to said drill tubes, said feed means connected with each drill tube for feeding it to the work, power means connected with said feed means for simultaneously operating the same for feeding said drill tubes to the work, and control means thereof.

3. In a gang drilling machine, a supporting and carrying structure thereof which includes as a part thereof a plurality of spaced bearing heads held in fixed relation to each other as a part of said structure, a plurality of parallel drill tubes having their bearings in said structure and having drill bits in their work ends, power means on said structure and connected with said drill tubes for rotating them in a drilling function, control with said power means, a plurality of toggle arms pivotally connected with said bearing heads, and having their outer arms connected with bearings for receiving drill tubes, drill tubes rotateably supported in said toggle arms and movable outwardly and inwardly as said toggle arms are bent and straightened, power means for simultaneously bending said toggle arms, and having said drill tubes inwardly rotateably supported in said drill tubes, said drill tubes having drill bits in their work ends, all of said drill tubes being connected with power means and a screw feed for each for feeding them while the work is being operated, and means for moving said drill tubes into the work, power means for conveying air and water under pressure through said drill tubes to said drill bits during the drilling operation, power means for moving said drill tubes to the work, and control means thereof.
original edges of said bearing heads, and power-operated means on said drill tubes for causing longitudinal oscillation of each tube during rotation in the drilling function to increase the efficiency thereof.

4. A gang drilling machine, as set forth in claim 3, in which the supporting and carrying structure therefor is suspended from and movable along an overhead supporting rail, with a motor drive therefor for moving said machine along said supporting rail.

5. In a gang drilling train for drilling for tunnels, a supporting and carrying structure, an overhead supporting track with means for suspending said structure therefrom, power means connected therewith for moving said structure forward from the work on said overhead track, a series of parallel drill tubes having their bearings in said track and having drill bits in their work ends, power means on said structure with operating connections with said drill tubes for simultaneously rotating them in the drilling function, means connected with each drill tube and operable by the rotation thereof for imparting a longitudinal oscillation thereto during the drilling function, power-operated jacks connected with said supporting and carrying structure at opposite sides thereof and operable to be extended into holding anchoring engagement with the opposite sides of tunnel for holding said structure firm during the drilling operation, a small tube in each drill tube for carrying water to the drill bits for removing dust and drillings therefrom, power-operating means for feeding said drill tubes for simultaneously feeding it and its drill bit into the work, control means for controlling the power operated said drill tubes, and control means for controlling the screw feed of said drill tubes into the work.

6. In a gang drilling machine, the combination with an overhead track way, a body structure with means suspending it from said track way to move thereon, motor means for moving it, said body structure including spaced bearing heads as a part thereof, a series of drill tubes extended through at least one of said bearing heads in their drill ends, each said drill tube having therein a small tube to carry water to said drill bit to remove dust and drillings therefrom, means for furnishing water under pressure to said tubes, power means carried by said body structure with driving connections therefrom to said drill tubes for revolving said drill tubes in a drilling function, control means for said power to control the speed of said drill tubes, a separate screw feed for each of said drill tubes extending through said bearing heads and connected to said drill tube intermediate said bearing heads, power means with connections for simultaneously driving said screw feeds, a member on each of said drill tubes having a circumferential undulating cam way around said drill tube, cooperating elements to work in said cam way to impart a longitudinal oscillation to said drill tubes as they are rotated in the drilling operation, control means for moving said machine toward and from the work, and control means for controlling the feed by said screw feeds, and a clutch interposed between the source of power for driving said drill tubes with means for controlling its operation.

7. A gang drilling machine as set forth in claim 6, which includes an air compressor and a jet mixing mechanism to have the water supply and the air supply mixed therein, with means for connecting it with the small tubes in said drill tubes, whereby a mixture of air and water under pressure is used to remove the dust and drillings from the drill bits in said drill tubes.

8. In a gang drilling machine, a body structure for supporting and carrying the mechanisms, said structure including spaced bearing heads connected and held in fixed relationship as a unit, a series of drill tubes having their bearings in and through said heads, within the marginal edges of said heads, said drill tubes having drill bits in their work ends, a series of toggle supporting arms pivotally connected with said bearing heads and having their free ends extending outwardly beyond the marginal edges of said bearing heads, drill tubes having their bearings in the free ends of said arms and extending from one set of toggle arms to the next set of toggle arms and being held in parallel relationship with each other and with the drill tubes within the marginal area of said heads, power means with driving connections to each of said drill tubes for rotating them in the drilling function, control means for controlling the speed thereof, power means having connection with said toggle arms for simultaneously bending them to move the drill tubes carried thereby inwardly and outwardly, a feed screw for each drill tube connected for moving said drill tube forwardly in the drilling function and power means for simultaneously operating said feed screws with control therefor for controlling the simultaneous movement of said drill tubes and for controlling the oscillation thereof as described.

9. A gang drilling machine as set forth in claim 8, including an over head track, and means for suspending said body structure and said mechanisms as a unit therefrom, to move thereon, and motor means for moving said machine as a unit to and from the work.

References Cited in the file of this patent

UNITED STATES PATENTS

307,379 Craven Oct. 28, 1884
504,179 Stanley Aug. 29, 1893
674,415 Hough May 21, 1901
698,189 Eyrson Apr. 22, 1902
883,481 Reiss Mar. 31, 1908
1,471,458 Gage Oct. 23, 1923
1,795,109 Degenhardt et al. Mar. 3, 1931
2,059,415 Thomas et al. Nov. 3, 1936
2,104,579 Bennett Jan. 4, 1938
2,128,240 Foster Aug. 30, 1938
2,302,073 Tracy Nov. 17, 1942

FOREIGN PATENTS

218,134 Great Britain July 3, 1924