To all whom it may concern:

Be it known that I, ARTHUR HENRY GIBSON, a subject of the King of Great Britain, residing on the property of the Lancaster Gold Mining Company, Limited, near Krugersdorp, Transvaal, have invented certain new and useful Improvements in Electrical Rock-Drills or Rock-Drilling Machines, for which I have applied for Letters Patent in the Transvaal, No. 293, filed January 31, 1903, of which the following is a specification.

This invention has reference to certain improvements in or applicable to electrically driven or operated rock-drilling machines.

Although it is designed more particularly to be applied in the construction of a drill chiefly intended for "stoping" work, it may with advantage be utilized in the construction of other kinds or classes of rock-drills or rock-drilling machines or other like machines adapted for general mining, quarrying, or similar work to which the improvements may be found applicable.

As hitherto constructed electrically-operated percussive rock-drills have not been adapted for continuous use in ordinary mining-work on account of many and various imperfections in their construction, and as a consequence they have not come into general use.

The present improvements are designed with the object of providing a practical drill or machine of comparatively simple construction, capable of being easily understood, handled, and worked by miners.

A drill embodying my improvements possesses, among others, the following additional important features and advantages: In it the motor is removed from the direct line of shock, the parts are so arranged that holes can be drilled in foot or hanging walls, an absence of protruding parts or pieces, a firm support of all working parts, the continuity of the case and water-tightness thereof, the small number of parts and the simplicity of their assembly, the reasonably small weight, and the small consumption of current or energy.

As will be understood from the preceding statements, my invention relates more especially to the general construction and arrangement of the drill and its appurtenances, and certain of the more important improvements, stated shortly, may be said to consist in the construction of the slide-carriage and in the arrangement of the same so as to be detachable or separable from the drill to facilitate transportation, particularly underground, although it need not of necessity be made in two parts; in a worm-gear or mechanism for imparting the rotary motion to the drilling-bit and in the arrangement thereof in such a way that should there be great resistance to the rotation of the bit that the consequent great end pressure of the camshaft introduces pressure upon some moving portions of the driving mechanism, so as to act as a powerful brake—as, for example, by binding or pinching the sides of the motor pinion-wheel between the stationary partition and the more slowly rotating disk; in a driving-disk attached to a cam, the case or frame forming a bearing for the periphery or rim of the disk in which it rotates; in a cam operating in conjunction with a disk tappet, the latter while free to revolve upon the drill-bar being so constructed that it will carry the drill-bar with it when it is moved longitudinally of the drill-casing; in a revolving tappet and bearing-sleeve, and abutting spiral spring, and a ball-bearing collar disposed between the spring and the drill-case; in a concentric gear for reducing the high speed of the electric motor; in the arrangement of the driving mechanism; in an extension of the frame entirely to one side of the drill-bar and capable of being fixed in any radial direction from the drill-casing, and in alternately-reversing or forward-and-backward rotation of the drill-bit with predominating movement in the forward or in one direction.

In working my improved drill the ordinary arrangements for supporting the machine may be used, such as the stope or column-bar. The cross-arm and eradle or other suitable and convenient devices may be employed in substitution therefor.

The invention will be fully described by aid of the accompanying drawings, in which a rock-drill is illustrated constructed in accordance therewith, and in which—

Figure 1 represents a longitudinal section taken through the drill-case. Fig. 2 is a section on line X X, Fig. 1, through the motor-case and gear-compartment. Fig. 3 is a sec-
tion on line y y, Fig. 2, showing the concentric reduction-gear. Fig. 4 is a plan of the drill. Fig. 5 is an end elevation of Fig. 4, and Fig. 6 a side elevation of the drill or elevation at right angles to Fig. 4. Fig. 7 shows a longitudinal section of the slide-carr
riage with the drill mounted therein. Fig. 8 is a plan of the slide-carrige with the drill removed; Fig. 9, an end elevation of Fig. 8.

Fig. 10 is an elevation of the slotted extremity of the internal sliding tube of the slide-carrige; Fig. 11, a front elevation of the strap or clamp for clamping the sliding tube around the drill-case, and Fig. 12 a side elevation of the strap or clamp.

Referring to Figs. 1 to 6, illustrative of the drill, A indicates the drill-bar, the forward extremity of which the detachable drilling-bit a may be attached by means of the ordinary cod-piece a' and U-bolt a" or in other suitable manner. The drill-bar A is mounted centrally in the drill-case B, in which it is free to be reciprocated, the front portion b of the case B forming a bearing for it at one end and the end or cover b' of the case at the other. The cylindrical rear portion b" of the drill-case is screwed at b" into the central casting or front portion b of the case. The drill-bar is, as shown, preferably of hollow or tubular construction for the greater portion of its length. On that portion of the drill-bar contained within the case B is formed a collar O or annular projection C, and around the drill-bar is arranged a loose concentric disk or circular tappet D, fitting over the collar C and bearing against one side thereof. The tappet D is provided with a boss or cylindrical projection d, into which is screwed a bearing-sleeve d', concentric with the drill-bar. The sleeve d' is screwed into the boss d up to the other or opposite side of the collar C and provides a convenient means for taking up any wear or looseness between the tappet and the collar. This construction of these parts, which constitutes an extremely important feature of the invention, prevents any movement of the tappet longitudinally of the drill-bar, insures a positive reciprocation of the bar with the tappet, and at the same time permits the tappet to rotate or roll freely around the drill-bar while the tappet is in engagement or in contact with the cam. Any appreciable canting or tilting of the tappet is prevented by means of the long bearing-sleeve d' and the friction engendered distributed over a large area, thereby avoiding excessive wear. Between the tappet D and the end or cover b' of the case B and arranged concentrically around the drill-bar is a spiral spring E. The spring E at the forward end abuts against the rear face of the tappet D, and between the other end of the spring and the cover b' are arranged two loose rings or collars d", d'" grooved to form a race between them for friction-balls d'. This enables the spring E to rotate with the tappet during compression. As the tappet D, and with it the drill-bar A, is depressed the spring is placed in compression, so that when the tappet is released or disengaged the spring acts to propel the drill-bar on its outward and percussive stroke. In place of the ball-bearing shown interposed between the spring and the end of the case any other suitable and convenient construction may be adopted to eliminate the friction, or the spring could bear directly against the cover b.

The motor-case F comprises a cylindrical part f and a cover f', bolted to a flange f" of the central casting b. The motor-case is, as shown, located at one side of the drill-case B. In the motor-case F is fitted and supported the stator G of the electric motor, and arranged in position within it is the rotor G'. The motor-spindle G" at the one side is supported in a closed bearing bush or socket g', fitted in the cover f', and at the other side in a bearing formed for it in an internal disk or diaphragm H, which disk separates the motor-compartment from the gear-compartment and forms an oil-tight partition between them. The motor-spindle G" projects through the diaphragm H into the gear-compartment and has keyed or otherwise fixed to its extremity a pinion I. In a recess formed in the gear-compartment concentric with the pinion I is fixed an internally-toothed ring J, and in the annular space formed between the pinion and the teeth of the ring are arranged two counter-wheels K K', in which space they are free to travel around on motion being imparted to them through the motor-pinion L. One, two, or more such counter-wheels may be employed; but I at present prefer to employ two arranged diametrically opposite one another, as shown more particularly in Fig. 3. In the gear-case, arranged alongside the wheels K K' and located in an annular recess formed in the case, is a disk L. The recess provided in the case for the disk L forms a bearing for the rim or peripheral thereof, in which it is free to rotate. In the side of the disk L next the wheels K K' two pins or studs UL are fixed, which enter the centers of the counter-wheels, so that as the counter-wheels are propelled in their annular path on the rotation of the motor-pinion L a rotary motion is transmitted to the disk L through the medium of the said pins. Attached to the disk L and rotated by it is a short cam-shaft M, whose axis is at right angles to the axis of the drill-bar, the extremity of which shaft works in a bearing formed by a recess in the casing. On the shaft M, between the disk L and the bearing, is fixed the cam N, arranged so as to project through into the drill-case B as it rotates and to engage and precess the tappet D at the instant of revolution, as will be readily understood on reference to Figs. 1 and 2 of the drawings.

To effect the rotation of the drill-bit a portion of a revolution during each stroke, a worm or worm-thread n is formed on that part of the cam-shaft M adjacent to the drill-bar A, (see Fig. 2,) and teeth n' are formed
longitudinally of the drill-bar A, (see Figs. 1 and 2,) with which the worm a bears or engages, thereby imparting a rotary motion to the drill-bit A. The teeth n' are of spiral form in order to obtain a predominating rotatory movement of the drilling-bit in the forward or in one direction. Instead of this arrangement, the ordinary ratchet-gear employed in air-drills for the same purpose may be used.

In order to prevent the tappet D or other of the reciprocating parts from striking violently against the drill-bar A, a buffer O, of leather, rubber, or other suitable material, is fixed on the outside of the cover b' of the case B. The buffer is retained in this position by the metal cap or ring o, fixed to the cover b' by the bolts or screws o' and the nuts o". The cap or ring o is formed with an outward cylindrical projection o' and the end of the drill-bar with a shoulder or projection o", so arranged that they will come in contact and absorb the shock in the event of the drill-bar being reciprocated and the drilling-bit from any cause not striking the face of the rock. The buffer may, if preferred, be fitted between the inner end of the drill-case B and the tappet D instead of on the cover b' or in any other convenient position.

Referring to Figs. 7 to 12, in which the slide-carriage of the drill is illustrated, P and P' represent two concentric tubes, the inner and sliding tube P' telescoping into the outer and fixed tube P. The external stationary tube P is fixed at the forward extremity within the support or bracket p, which is formed with a saucer or conical projection p', by which means it may be clamped to the ordinary or other suitable support for the drill. The inner tube P' is free to slide in the tube P and has affixed to it a block p", which slides in a longitudinal slot p'" provided therefor in the outer tube P, to prevent the rotation of the tube P' during the feeding of the drill. The feeding-screw Q is disposed centrally of the tubes P P' and projects through into the hollow center of the drill-bar A. The screw passes through the end of the external tube P and gears the feeding-nut q, located in the end of the internal sliding tube P', so that as the screw is rotated by the handle q', affixed to its outer extremity, the inner tube P' slides forward or backward in the outer tube P, according to the direction of rotation of the screw. On the feeding-screw, inside the tube P, is formed a collar or shoulder q', bearing against the end of the tube, and on the outside thereof, between the handle q' and the tube end, is arranged a strong spiral spring R. This arrangement prevents any appreciable movement of the feeding-screw Q longitudinally of the tube P and allows it to rotate freely. The spiral spring R, while acting to prevent any longitudinal movement of the screw, as before described, is employed to allow the drill-case B, sliding-tube P', and feeding-screw Q to yield and move toward the rock face under abnormally heavy pulls, such as may be occasionally exerted by the motor upon the column-bar or other supporting device for the drill when the bit jams fast in the hole being drilled. In this event instead of the drill-bar A yielding to the action of the cam N the whole of the percussive apparatus is carried bodily forward against the spring R.

In Fig. 7 the drill is shown mounted in position in the slide-carriage. The drill-case B is inscribed into the closely-fitting sliding tube P'. The extremity of the inner tube P', in which the drill-case fits, is slotted in several places, as shown at c', (see Figs. 10 and 11,) to enable the tube to be firmly clamped around the drill-case. The strap or clamp S embraces the slotted end of the tube and is operated by the screw s to draw the two ends of the strap together to tighten or clamp the tube around the drill-case. This construction of slide-carriage allows the motor-case to be turned in any radial direction out of the way as may be required, according to the nearness and shape of the rock face.

What I claim as my invention, and desire to protect by Letters Patent, is—

1. In a rock-drill or rock-drilling machine, in combination, the drill-bar A, the collar or annular projection C formed thereon, the circular tappet or disk D mounted concentrically on the bar A and free to rotate thereon and bearing against one side of the collar C, the boss d of the tappet and the bearing-sleeve d' screwed into the boss d so as to reciprocate the drill-bar as the tappet is moved in a path parallel to the longitudinal axis of the bar while permitting it to revolve freely, the spiral spring E arranged concentrically around the drill-bar and bearing against the tappet at one end, and the ball-bearing collar interposed between the other end of the spring and the drill-case, substantially as described.

2. In combination the drill-bar A, the collar C, the rotating tappet D fitting over the collar and engaging one side thereof, the boss d of the tappet, the long concentric bearing-sleeve d', screwed into the boss d up to the opposite side of the collar C, the spiral spring E bearing against the tappet, and the loose collars d" d' and friction-balls d" located between them, to permit the spring E to rotate with the tappet during compression of the spring, and means for forcing the drill-bar backward to compress the spring and to release it to enable the drill-bar to be propelled on its outward and percussive stroke, substantially as described.

3. In a rock-drill the combination with the drill-bar and the concentrically-disposed rotating tappet and its operating-spring, of a cam fixed to a cam-shaft arranged transversely of the drill-bar so that as the cam is rotated it engages the tappet to force it backward to compress the spring and then releases it to permit it to be propelled on its outward and percussive stroke, the recess in the gear-
case forming a bearing for the cam-shaft, the disk fixed to the cam-shaft free to rotate in a recess formed in the gear-case which constitutes a bearing for the rim or periphery thereof, an electric motor and means for transmitting the motion from the electric motor to the disk attached to the cam-shaft, said means comprising a gear on the motor-shaft, a stationary concentric rack, and an interposed idler-gear carried by the said disk, substantially as described.

4. In a rock-drill the combination with the electric motor and its spindle G, of the pinion I, the concentric internally-toothed ring J, the counter-wheels K K' gearing-pinion I with ring J, the disk L and cam-shaft M connected therewith, the pins l l' affixed to the disk L, project into the centers of the wheels K K', to transmit the motion of the motor to the cam N, the cam N, revoluble tappet D and drill-bar A, substantially as described.

5. In combination, the electric motor G G' and its spindle G, the disk or diaphragm II, forming a bearing for the motor-spindle and a division-plate between the motor and gear compartments, the pinion I, fixed internally-toothed ring J, and counter-wheels K K', the disk L and the recess in the gear-case forming a bearing therefor, the pins l l' fixed to the disk L and projecting into the centers of the counter-wheels K K', the cam-shaft M attached to the disk L, the recess in the gear-case forming a bearing for the cam-shaft M, the cam N, the revoluble tappet D, the drill-bar A and the collar C formed thereon, the bearing-sleeve d' screwed into the tappet against the collar, the concentric spiral spring E and ball-bearing collars d d', substantially as and for the purposes described.

6. In a rock-drill, the combination with the drill-case B and its cover b', of the buffer O, the cap or cover o fixing the buffer to the cover b', the outward cylindrical projection o' and the shoulder or projection o'' formed on the extremity of the drill-bar A, substantially as and for the purposes described.

7. The combination in a rock-drill of the drill-case the hollow drill-bar A, the two concentric tubes P P' the slots r formed in the extremity of the sliding inner tube, the strap or clamp S for clamping the extremity of the tube around the drill-case, the centrally-arranged feeding-screw Q, the feeding-nut q fitted in the inner end of the inner tube P', the block p and the longitudinal slot p' to prevent the rotation of the inner tube, the collar q', the strong spiral spring R, the handle q' and the support p for the outer tube, substantially as and for the purposes described.

8. In a rock-drill, in combination, the drill-bar A, the drill-case B and its cover b', forming a bearing for the rear end of the drill-bar, the center portion b of the case forming a bearing for the forward end of the bar, the collar C formed on the drill-bar and the concentric revoluble tappet D mounted thereon, the bearing-sleeve d' fitted into the tappet, the spring E and ball-bearing collar located between the end of the spring E and the cover b', the motor-case F radially disposed relative to the drill-case B, the electric motor G G' and spindle G the bearing-socket for the spindle G' in the cover of the motor-case, the division-plate H forming a bearing for the spindle G', the pinion I fixed on the end of spindle G', the concentric internally-toothed ring J and the counter-wheels K K', the rotatable disk L and cam-shaft M and cam N attached thereto, the pins l l' of the disk L entering the centers of the counter-wheels, the worm n and spiral teeth n' on the drill-bar, the buffer O, cap o and projection o' thereof and the shoulder o'' of the drill-bar A, substantially as described.

9. In a rock-drill the combination of the hollow drill-bar A, the collar C, the revoluble tappet D and bearing-sleeve d', the spring E and ball-bearing collars d d', substantially as and for the purposes described.

10. The stationary tube P of the slide-carriage, the sliding tube P' telescoping into the tube P, slotted at the end to be clamped around the drill-case, the clamp S the block p of the inner tube P' and the longitudinal slot p' in the outer tube, in which it slides, the feeding-nut q fixed in the end of the inner tube, the feeding-screw Q, the collar q' and spring R and the handle q' for rotating the feeding-screw to feed the drill forward, substantially as described and illustrated in the drawings.

In witness whereof I have hereunto set my hand in the presence of two subscribing witnesses.

ARTHUR HENRY GIBSON.
Witnesses:
A. W. MACGREGOR,
CHAS. OVENDALE.