W. H. KELLER & S. D. SIBLEY.

RECIPROCATING MOTOR.

APPLICATION FILED JUNE 17, 1908.

1,043,320.

Patented Nov. 5, 1912.

2 SHEETS—SHEET 1.

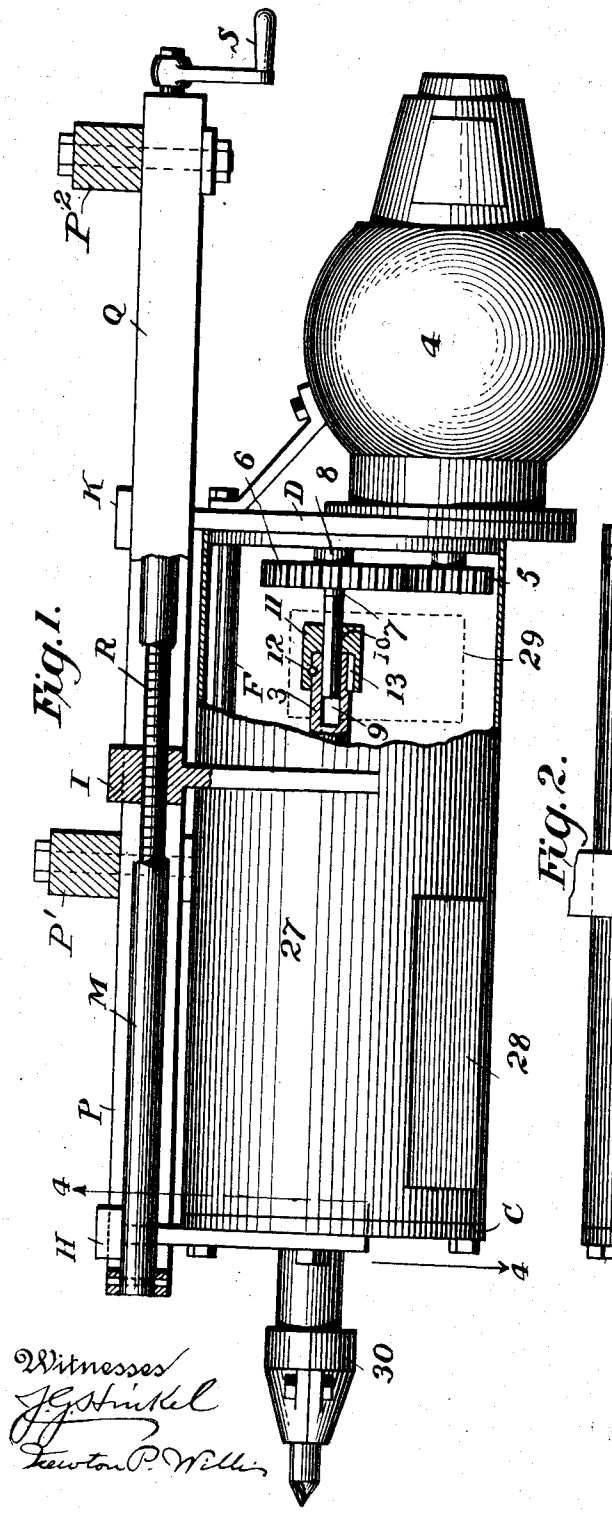


Fig. 1.

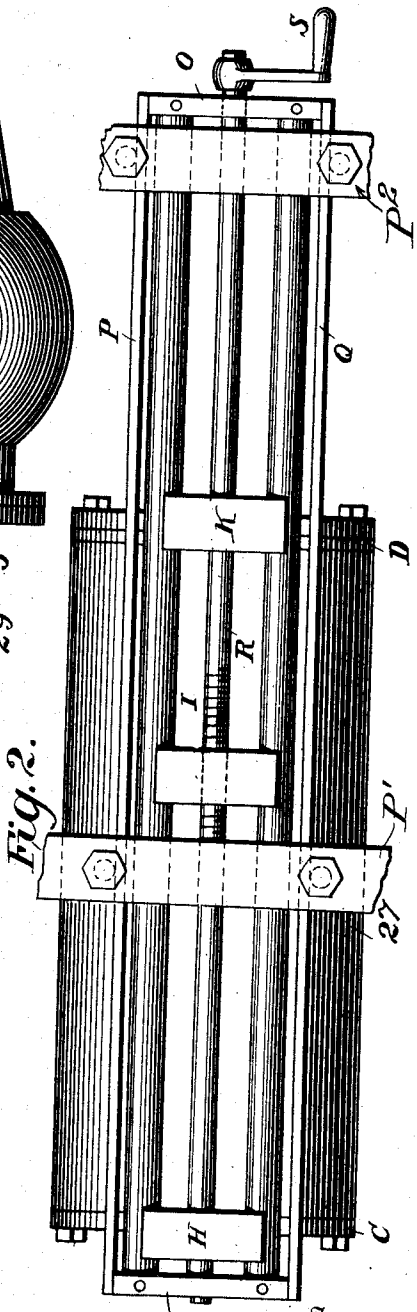


Fig. 2.

Witnesses
J. G. Hinkel
Newton P. Willis

Inventors
William H. Keller
and Samuel D. Sibley
by Thomas Howe
Attorney

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

W. H. KELLER & S. D. SIBLEY.

RECIPROCATING MOTOR.

APPLICATION FILED JUNE 17, 1908.

1,043,320.

Patented Nov. 5, 1912.

2 SHEETS—SHEET 2.

Fig. 3.

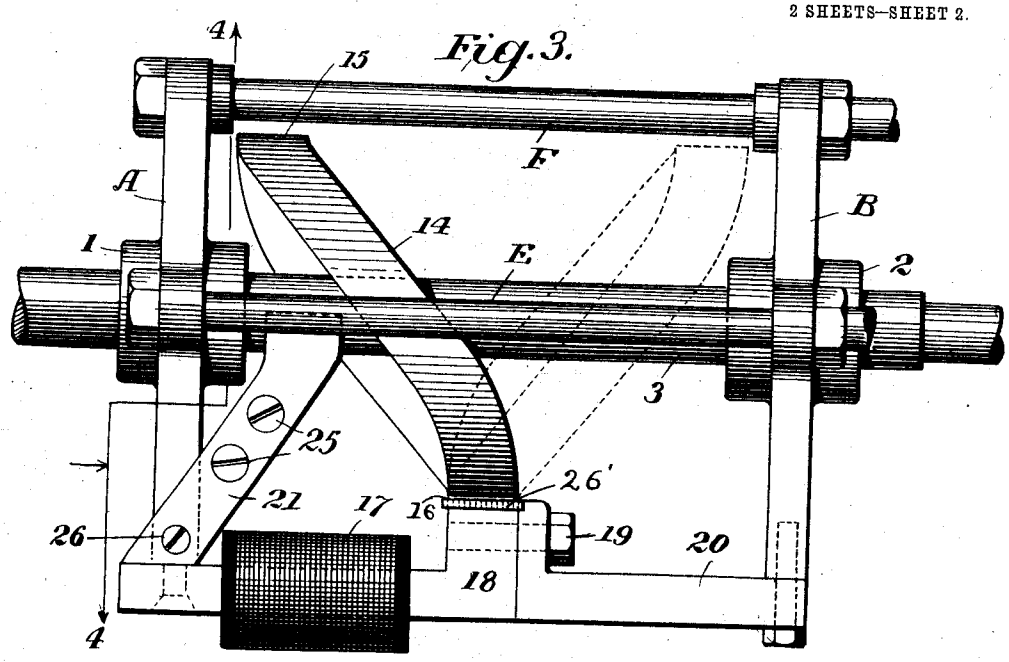
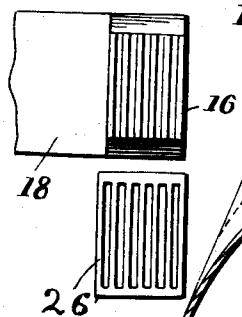


Fig. 5



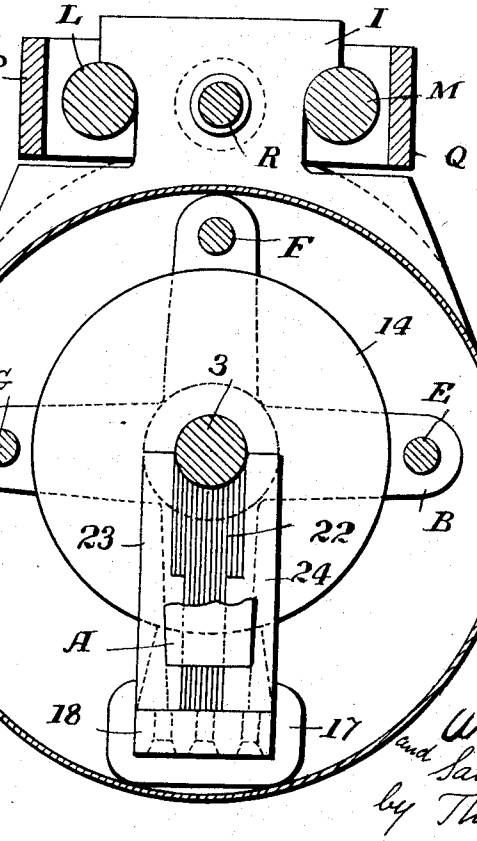


Fig. 4

Fig. 6.

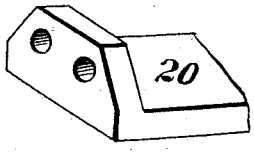
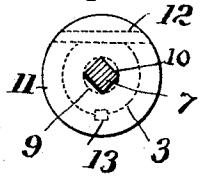


Fig. 7.



Witnesses

J. P. Tinkel

Lucian P. Wills

Inventors

William H. Keller

and Samuel D. Sibley

by Thomas Howe

Attorney

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM H. KELLER AND SAMUEL D. SIBLEY, OF CONNELLSVILLE, PENNSYLVANIA, ASSIGNORS TO KELLER-SIBLEY ELECTRIC DRILL COMPANY, A CORPORATION OF WEST VIRGINIA.

RECIPROCATING MOTOR.

1,043,320. Specification of Letters Patent. Patented Nov. 5, 1912.

Application filed June 17, 1908. Serial No. 438,992.

To all whom it may concern:

Be it known that we, WILLIAM H. KELLER and SAMUEL D. SIBLEY, citizens of the United States, residing at Connellsville, in the county of Fayette and State of Pennsylvania, have invented certain new and useful Improvements in Reciprocating Motors, of which the following is a specification.

This invention relates to reciprocating motors and is especially adapted for use in connection with drills, punches, hammers or other impact tools and particularly where such devices are used for drilling or punching in rock, coal or any similar uses.

The main object of the invention is to provide means whereby rotary motion and a magnetic pull coöperate to produce motion parallel to or axially of the axis of rotation.

Ancillary objects of the invention will appear hereinafter.

In the accompanying drawings which illustrate the invention, Figure 1 is a side elevation of apparatus embodying the invention, partly broken away and partly in section; Fig. 2 is a top plan view of the apparatus shown in Fig. 1; Fig. 3 is an enlarged side elevation, with the casing removed, of that portion of the apparatus whereby the rotary motion is combined with the magnetic pull to produce motion as before described. Fig. 4 is a section on the line 4—4 of Figs. 1 and 3 looking toward the right, this figure being on the same scale as Fig. 3. Fig. 5 is a view of a detail showing the pole face of the magnet; Fig. 6 is a perspective view of one end of a member to which the magnet is secured, and Fig. 7 is an end view of a collar as will be referred to hereinafter.

Referring to the drawings, a frame, comprising the spiders A and B and the heads C and D, which are secured and spaced by the longitudinal rods E, F and G, is sustained by means of the brackets H, I and K which are adapted to slide upon longitudinal rods L and M which are parts of a support, which support is shown as comprising the end pieces N and O and the longitudinal pieces P and Q. The frame, is thus movable with relation to the support and to effect this movement a screw R is rotatably mounted in the support and its screw threads engage with screw threads provided in the bracket I, so that as the screw is turned by any suitable means as a crank S, the frame is moved along the support. This support may be mounted in any suitable manner for the purposes in view.

Rotatably mounted in suitable bearings 1 and 2 in the spiders A and B, is a shaft 3. This shaft is rotated by an electric motor 4 which is mounted on the head D and is therefore carried with the frame as it is fed in one direction or the other by the turning of the screw R. Upon the motor shaft is fixed a gear 5 which meshes with a gear 6. The gear 6 is fixed upon a shaft 7 which at one end enters a bearing 8 in the frame. The other end of the shaft 7 is square in section and enters within a cavity 9, bored into the end of the shaft 3, through a square hole 10 in the collar 11 which is fixed upon the shaft 3 in any suitable manner as by a transverse key 12. A longitudinal key 13 may also be employed if thought advisable. This connection between the shafts 7 and 3 permits them to have relative axial movement but prevents them from having rotary movement with relation to each other. Of course the result as described could be secured by making the shaft 7 other than square in section. It will be seen that the gear 6 is larger than the gear 5 and that therefore the shafts 7 and 3 revolve at a slower speed than the shaft of the motor. It is desirable that a reducing gear be employed as it permits of the use of a small high speed motor without producing undue speed in the shaft 3 and where a high speed of the shaft 3 is not objectionable or a low speed motor is employed reducing gear is not necessary.

To produce axial movement of the shaft 3, an inclined iron disk 14 is fixed upon the shaft and by reason of the inclination of the disk it will be seen that the magnetic material of which it is composed is displaced longitudinally as well as circumferentially of the shaft. The periphery 15 of the disk is concentric with the shaft and facing this periphery is the pole face 16 of a magnet which is secured to the frame hereinbefore referred to. This magnet is an electromagnet comprising the coil 17 which encircles the core 18 upon which the pole face 16 is formed. This core is secured at one end to the bottom end of the lowest arm of the spider A. At the other end, the core 18 is secured by bolts or screws as 19 to one end of a member 20 which, at its other end, is

secured to the lowest arm of the spider B. When electric current is supplied to the coil 17 or, in other words, it is energized, a magnetic flux will pass through the core 18 and, emanating from the pole face 16 will pass to the periphery of the inclined disk 14 and thus through the disk to the shaft 3. If the spider A is of iron, the flux will then pass through its lowest arm to the core 18 when the magnetic circuit will be completed. In order that the magnetic flux may not be shunted off through the frame from the disk 14, the member 20 is preferably of non-magnetic material such as brass. Also, where the spider A is not of iron or is of hard cast iron, if such is the case it is desirable to employ a wiper or arm 21 of magnetic material. This wiper at one end bears against the core 18 and at the other end is in close proximity to and may even bear against the shaft 3. The wiper is inclined inwardly as shown so that its upper end approaches the disk 14 as near as possible so that the magnetic path through the shaft is shortened. Where the shaft is of steel or hard iron this will materially reduce the reluctance of the magnetic circuit. The wiper, the disk and the core 18 may be made of relatively soft iron. The wiper 21 is preferably formed of laminations 22 which are clamped between side plates 23 and 24 by means of screws 25, it being secured at its lower end by any suitable means as a screw 26, while at its upper end it may be hollowed out as shown for the reception of the shaft 3. The lamination of the wiper prevents the formation of eddy currents therein as the shaft 3 rotates. In order to fix the magnetic flux between the pole face 16 and the periphery of the disk, in position, a winding 26′ in the pole face is provided which winding is shown as consisting of a grid of copper let into slots in the pole face. This operates in a well-known manner to oppose any shifting of the field and this prevents cross pulling of the magnet, side sliding and lagging.

It will be understood that the magnet coil 17 is suitably connected with a source of electric current and that a suitable switch is provided for making or breaking its circuit so that it may be energized or deënergized at will.

The electric motor 4 may be of any suitable and well-known construction and it will be understood that it is suitably connected with a source of current and that suitable means for starting, stopping or otherwise controlling it are provided.

Upon the frame may be placed a suitable inclosing casing 27 for protecting the mechanism and in this casing may be provided suitable doors as 28 and 29 whereby hand holes are provided through which the mechanism may be reached for attending to lubrication or for other purposes; in the apparatus shown the door 28 being alongside the coil 17 while the door 29 is adjacent to the gears 5 and 6 and the sliding connection between the shafts 3 and 7.

At one end of the shaft 3 (see Fig. 1) may be mounted a chuck 30 for holding the drill or other tool.

It is clear from the foregoing that the brackets, H, I and K, the motor 4, the casing 27 and the frame therefor, which frame comprises the spiders A and B and the heads C and D, move together, in one unitary structure, with respect to the rectangular frame comprising the pieces P. O. Q. N, this rectangular frame being stationary during the operation of the apparatus in one location and supported in any suitable manner as by beams or posts P′ and P².

The parts being in the position as indicated in full lines in Fig. 3, the shaft 3 will be at the extreme left hand limit of its movement. It being understood that the magnet coil 17 is supplied with current and that therefore the magnet 18 is energized, as the shaft 3 is revolved by the motor 4 through the instrumentality of the gears, the periphery of the disk 14 will be attracted to the pole face of the magnet 18 and by reason of the fact that the successive portions of the periphery which are presented to the pole face are axially displaced along the shaft, the rotary movement of the shaft will be converted into axial movement thereof. When the shaft 3 and disk 4 have revolved through 180° the disk will occupy the position as indicated by dotted lines in Fig. 3 when the shaft 3 will have been moved axially into its farthermost right hand position. As the rotation of the shaft is continued it will be axially moved back toward the left hand until when a complete revolution has been made the disk will occupy its original position as shown in full lines and the shaft will have reciprocated axially from its extreme left hand to its extreme right hand position and back again. The rotation of the shaft 3 being continued, the cycle of operations just referred to will be repeated and it will be obvious that during the continuous rotation of the shaft a series of axial movements of the shaft will be caused and the drill or other tool will be alternately driven forward and retracted so long as the shaft 3 continues to rotate and the magnet 18 is sufficiently energized. The operation of the disk and magnet upon the shaft 3 is somewhat analogous to that of a cam.

A similar reciprocating movement to that produced by the apparatus shown might be accomplished by causing the path of one side of the disk to be fixed by causing it to enter within a groove instead of having its

path fixed by magnetic attraction as in the apparatus shown. With such a mechanical arrangement, however, if, in the case of drilling, the drill should become jammed as by coming against hard slate in drilling coal, the parts would either break or else the apparatus would be brought to a stop. A stoppage of this kind would be liable to result in the burning out of the driving motor as 4 or the blowing of a fuse or circuit-breaker. By employing a magnet interlinkage or arrangement for securing the axial movement of the shaft, this disadvantage is avoided for while the magnetism is sufficiently strong to hold the parts in operative relation during normal operation, in cases of emergency such as that just alluded to the parts can have relative movement and prevent jamming, breaking, burning out of the motor or the blowing of fuses or circuit-breakers. It will further be observed that the operation of apparatus embodying the present invention is easily controlled. By deënergizing the magnet 18 which can be done by depriving the coil 17 of its supply of current, the shaft 3 may be revolved without reciprocation.

While the invention has been shown in what is considered its best embodiment, the structure shown may be changed in numerous ways and still be within the scope of the appended claims. The invention therefore may be embodied, without departing from its spirit, in other structures than that shown in the drawing and is not, therefore, limited to the structure illustrated in the drawing.

What we claim is:

1. In a reciprocating motor, the combination with a rotatable shaft, of means for rotating said shaft, magnetic means adapted to produce a pull coöperating with the motion of rotation for moving said shaft in opposite directions along its axis as it is continuously rotated.

2. In a reciprocating motor, the combination with a rotatable shaft, of a disk thereon inclined thereto and a magnet adapted to attract said disk to move the shaft axially as it is rotated.

3. In a reciprocating motor, the combination with a rotatable shaft, of a disk thereon inclined thereto and a magnet adapted to attract said disk to axially reciprocate said shaft as it is rotated.

4. In a reciprocating motor, the combination with a rotatable shaft, of means for rotating the same, a disk upon said shaft inclined thereto and a magnet adapted to attract said disk and move the shaft axially as it is rotated.

5. In a reciprocating motor, the combination with a rotatable shaft, of a disk thereon inclined thereto, means for rotating said shaft and a magnet adapted to attract said disk and axially reciprocate the shaft as it is rotated.

6. In a reciprocating motor, the combination with a rotatable shaft, of means for rotating said shaft, magnetic material mounted upon said shaft and displaced circumferentially and axially thereof and a magnet adapted to attract said magnetic material to move the shaft axially as it is rotated, said magnet acting successively upon circumferentially and axially displaced portions of said material.

7. In a reciprocating motor, the combination with a rotatable shaft, of means for rotating said shaft, magnetic material mounted upon said shaft and displaced circumferentially and axially thereof and a magnet adapted to attract said magnetic material to axially reciprocate the shaft, said magnet acting successively upon axially and circumferentially displaced portions of said material.

8. The combination with a frame, of a shaft rotatably mounted therein, means carried by said frame for rotating said shaft, magnetic means coöperating with the rotary motion of said shaft to produce axial movement of the same and means for feeding said frame parallel to the axis of said shaft.

9. The combination with a frame, of a shaft rotatably mounted therein, an electric motor carried by said frame for rotating said shaft, magnetic means coöperating with the rotary motion of said shaft to produce axial movement of the same and means for feeding said frame parallel to the axis of said shaft.

10. The combination with a frame, of a shaft rotatably mounted therein, a motor carried by said frame, a disk upon said shaft and inclined thereto, a magnet mounted upon said frame and adapted to attract said disk and means for feeding said frame parallel to the axis of said shaft.

11. The combination with a frame, of a support therefor, said frame being movable upon said support, means for moving said frame with relation to the support, a shaft rotatably mounted in said frame, a motor carried by said frame for rotating said shaft, and magnetic means coöperating with the rotary motion of said shaft to produce axial movement of the same.

12. In a reciprocating motor, the combination with a rotatable shaft, of a disk thereon and inclined thereto having its peripheral face concentric to the axis of said shaft, a magnet having a pole face facing the periphery of said disk and parallel thereto and means for rotating said shaft.

13. In a reciprocating motor, the combination with a rotatable shaft, of means for rotating the same, a disk upon said shaft and inclined thereto and a magnet having a pole face facing the periphery of said disk

and means for fixing the location of the magnetic flux between said disk and pole face.

14. In a reciprocating motor, the combination with a rotatable shaft, of means for rotating the same, a disk upon said shaft and inclined thereto, a magnet having a pole face facing the periphery of said disk and windings in said pole face.

15. In a reciprocating motor, the combination with a rotatable shaft, of an impact tool, means for continuously rotating said shaft and magnetic means adapted to produce a magnetic pull coöperating with the continuous motion of rotation of said shaft to move said tool against the work in a series of blows.

16. The combination, with a rotatable shaft, of means for rotating said shaft, a magnetic member adapted to exert a pull which coöperates with the rotary motion of said shaft to relatively move said member and shaft in opposite directions, and means for producing magnetism in said member.

17. The combination, with an impact tool of a rotatable shaft, means for rotating said shaft, magnetic material projecting laterally from said shaft and circumferentially and longitudinally displaced thereon and means for producing magnetism through said material, whereby said tool is reciprocated as said shaft rotates, said magnetism acting successively upon portions of said material which are circumferentially and axially displaced.

18. The combination with a rotatable shaft, of means for rotating said shaft, a disk upon said shaft and inclined to the axis thereof, a magnetic member adapted to exert a pull upon said disk, which pull coöperates with the rotary motion of said shaft to produce relative longitudinal movement of said shaft and said member, and means for producing magnetism in said member and said disk.

19. The combination with a rotatable shaft of means for rotating said shaft, magnetic material upon said shaft, projecting laterally therefrom, and being circumferentially and longitudinally displaced thereon, a magnetic member adapted to successively attract portions of said material which are axially and circumferentially displaced upon said shaft and thereby to coöperate with the rotary motion of said shaft to produce relative longitudinal movement of said shaft and said member and means for producing magnetism in said member and said material.

In testimony whereof we affix our signatures, in presence of two witnesses.

WILLIAM H. KELLER.
SAMUEL D. SIBLEY.

Witnesses
W. M. WEBER,
MARTIN GILLEY.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents. Washington, D. C."