

July 31, 1934.

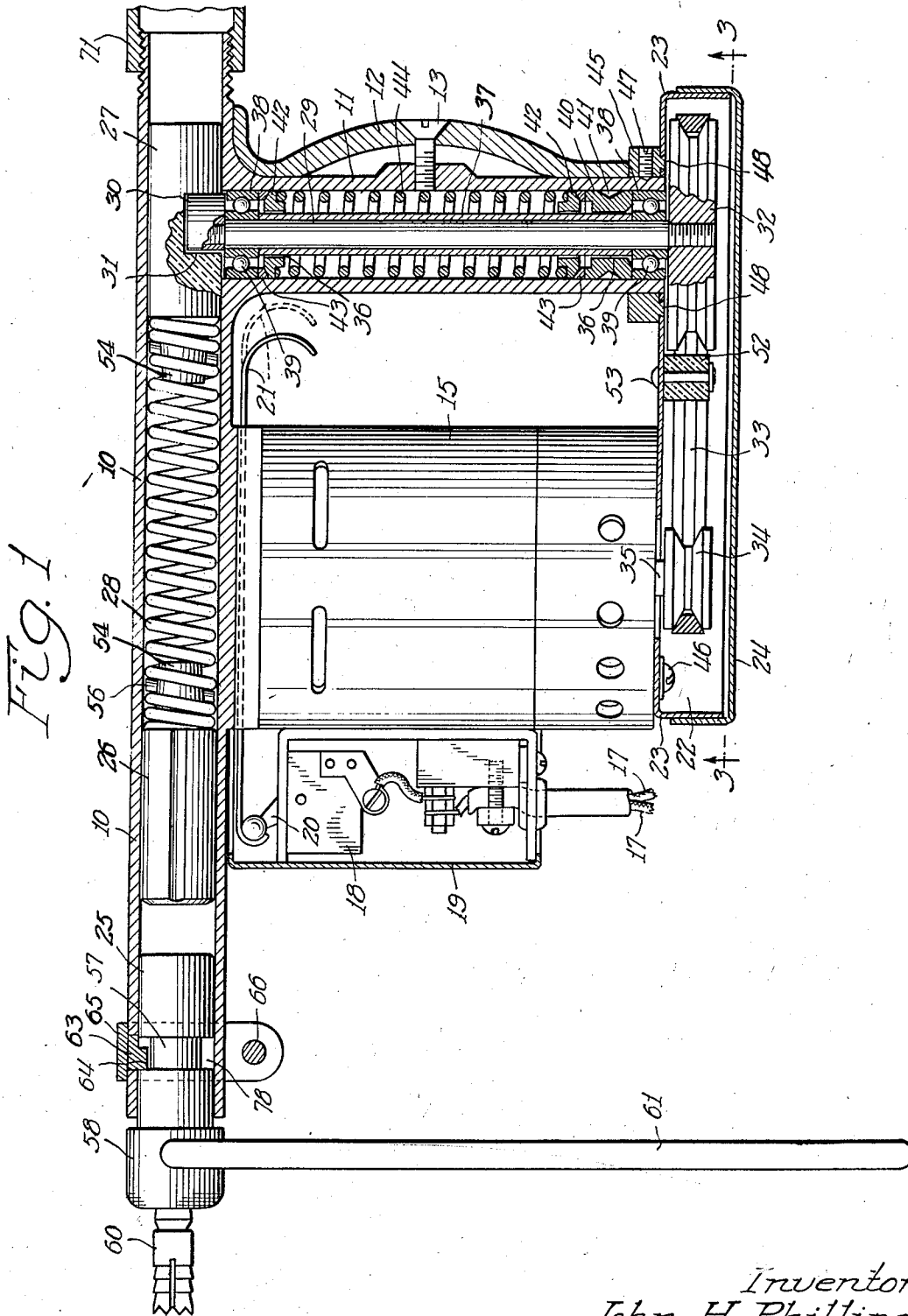
J. H. PHILLIPS

1,968,055

DRILL

Filed Feb. 20, 1933

3 Sheets-Sheet 1



Witness:
V. Silander

Inventor
John H. Phillips
By: Still + Still
Attys

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1,968,055

DRILL

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3 Sheets-Sheet 2

Fig. 3

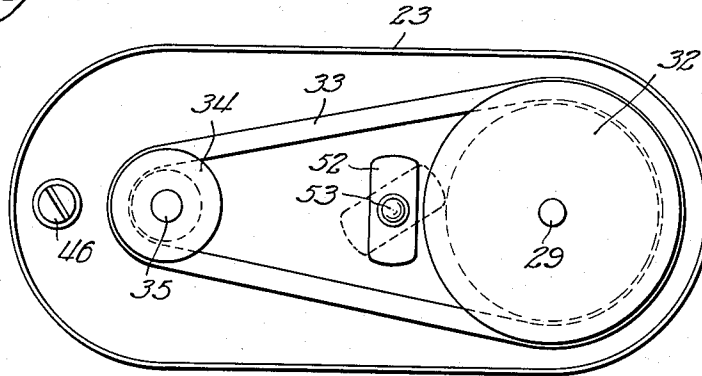


Fig. 4

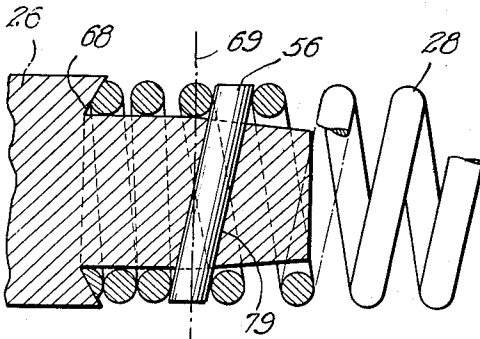


Fig. 5

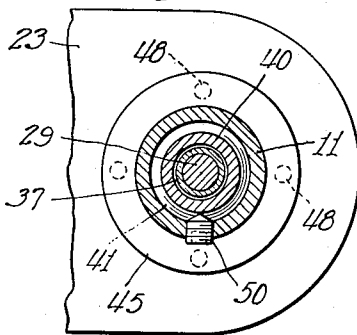
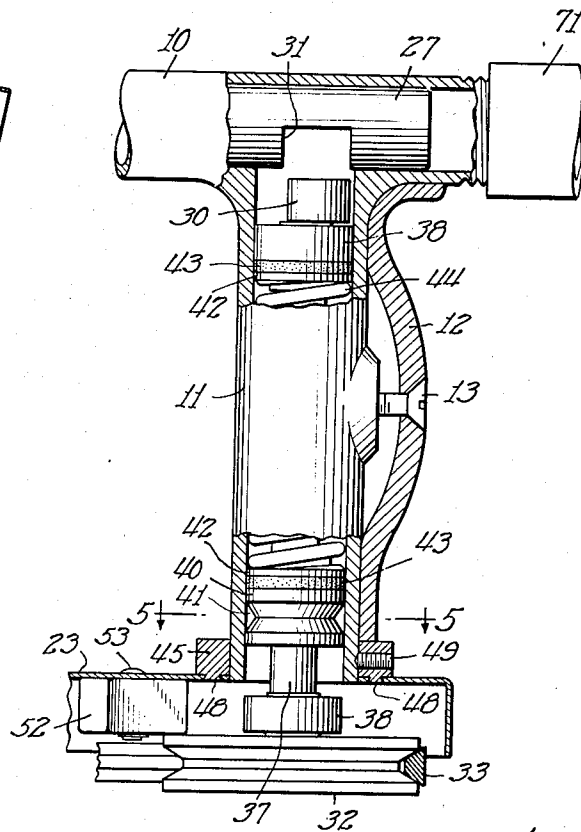


Fig. 2



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3 Sheets-Sheet 3

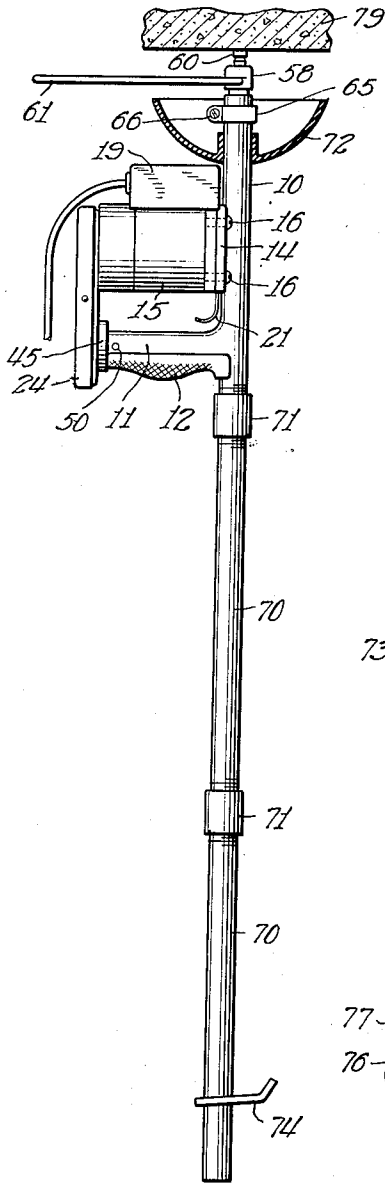


Fig. 8

Fig. 9

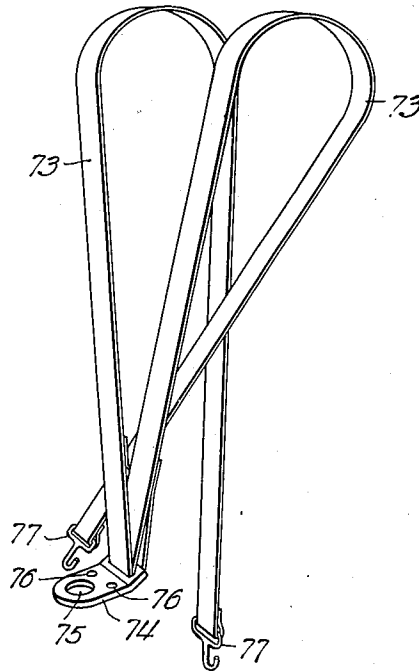
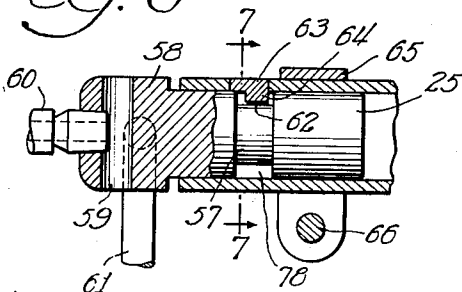
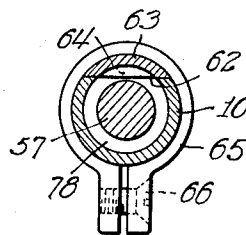


Fig. 6



Witness:
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Fig. 7



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UNITED STATES PATENT OFFICE

1,968,055

DRILL

John H. Phillips, Chicago, Ill.

Application February 20, 1933, Serial No. 657,601

14 Claims. (Cl. 125—33)

My invention relates to improvements in electrically actuated tools and has particular reference to a portable tool adapted for drilling vertical and upwardly inclined holes in concrete walls, ceilings, roofs, and the like.

The invention contemplates the use of a belt drive rather than gears to connect the motor with the plunger actuating mechanism, thereby minimizing the vibratory shocks upon the windings of the motor which shorten its useful life when gears are utilized as a part of the actuating mechanism. The use of a belt drive also minimizes the noises usually incident to the operation of a motor actuated tool having gears as a part of the power transmission mechanism.

A general object of the invention is the provision of a tool of the kind described which is compact, light in weight, economical to manufacture and has its essential movable parts such as plungers and connecting spring so arranged as to be quickly and easily removed for inspection, cleaning or repair without the use of tools or the necessity of dismantling the housing in which such parts are mounted.

The vibratory shocks detrimental to the motor windings are still further diminished by connecting the plungers with a spring and also by making the plunger, with which the actuating mechanism is directly connected, as light as possible. For this purpose, the invention further contemplates the use of relatively light fibrous material, providing a cushioning effect in the plunger with which the motor driven actuating mechanism is directly connected and the use of metal or other relatively hard heavy material in the chuck contacting plunger. This arrangement provides greater efficiency for a given motor drive inasmuch as the weight of the uncushioned plunger and its hammering effect on the actuating mechanism is minimized. The weight and driving force of the chuck contacting plunger may be correspondingly increased as a result of the diminished weight of the uncushioned plunger and another object of the invention is the provision of a pair of plungers constructed of materials of different weights in a manner to increase their efficiency and lessen the recoil and vibration of the tool when in operation.

Still another object of the invention is the provision of a novel actuating mechanism which is capable of complete assembly before mounting on the device and the provision of a novel mounting therefor adapted to permit such mechanism to be moved as a unit into and out of operative engagement with the plungers driven thereby.

A further object of the invention is the provision of novel means for connecting a spring to the adjacent ends of a pair of reciprocating plungers forming part of the device.

A still further object of the invention is the provision of novel means for supporting the tool upon the body of the operator, thereby enabling the tool to be held in alignment with the hole being drilled and also to exert the necessary feed pressure on the drill which leaves the operator with both hands free to manipulate the tool.

Still another object of the invention is the provision of a novel adjusting means for positioning a chuck whereby the effective length of the stroke of a plunger actuating the chuck may be increased or diminished within predetermined limits.

Still another object of the invention is the provision of a dust pan mounted on the device and positioned to catch the dust from the hole when drilling upward to prevent its falling on the operator, device furniture or machinery over which the holes are drilled.

The invention has among its other objects the provision of a tool in which all working parts are easily accessible for inspection, cleaning or repair by the operator on the job and which is convenient, durable and satisfactory for use wherever found applicable.

Many other objects and advantages of the construction herein shown and described will be obvious to those skilled in the art from the disclosure herein given.

To this end, my invention consists in the novel construction, arrangement and combination of parts herein shown and described, and more particularly pointed out in the claims.

In the drawings, wherein like reference characters indicate like or corresponding parts:

Fig. 1 is a longitudinal section through the main body of the device;

Fig. 2 is a fragmentary view of the device drawn to a larger scale, including a handle member and an assembled driving mechanism mounted thereon;

Fig. 3 is a view along the line 3—3 of Fig. 1 drawn to a larger scale;

Fig. 4 is a view to a still larger scale showing one end of one of the spring connected plungers and novel means for fastening the spring therewith;

Fig. 5 is a view along the line 5—5 of Fig. 2;

Fig. 6 is a view of novel means for adjusting the position of the chuck in its mounting to vary

the effective length of the plunger between predetermined limits;

Fig. 7 is a view along the line 7—7 of Fig. 6;

Fig. 8 is a view of the assembled device drawn to a smaller scale and in position for drilling vertical or upwardly inclined holes in a ceiling or roof; and

Fig. 9 is a perspective view of a harness adapted to be worn by the operator and fastened to the device in a manner whereby its weight and feed pressure is carried by the shoulders of the operator when the device is operated in the position shown in Fig. 8.

Referring now more particularly to the drawings, the main body portion of the device comprises a casing consisting of a sectional longitudinally extending tubular member 10 and a transversely extending tubular member 11 having a grip 12 fastened thereto by a screw bolt 13. A pair of oppositely positioned lateral extensions 14 project from the underside of the member 10 and provide a mounting for a motor 15. The motor 15 is positioned in spaced apart relation to the tubular member 11 and is fastened to the extensions 14 by bolts 16. The tubular member 11 provides a housing for a portion of the drill actuating mechanism in addition to being used as a handle member for manually manipulating the device.

A pair of conductors 17 connect the motor 15 with a source of electrical energy (not shown) through switch mechanism generally designated by the numeral 18, the details of which are omitted as the invention does not reside therein and any suitable switch mechanism may be utilized for the purpose. The switch mechanism 18 is mounted in a housing 19 attached to the front side of the motor 15 and the circuit through the conductors 17 is open and closed by means of an arm 20 which is manually actuated by a member 21 slidably mounted in the upper end of the motor, the circuit being broken when the arm 20 and the member 21 are in their full line position and closed when the arm and member are in their respective dotted line positions. The arm is normally in the full line position corresponding to the closed circuit and the operator while grasping the handle 12 is enabled to actuate the arm 20 to dotted line position to close the circuit by pulling on the curved end of the member 21 with a finger or thumb.

A chuck 25, reciprocally movable in and projecting from the front end of the tubular member 10, is actuated by a pair of spaced apart plungers 26 and 27 connected by a spring 28. The plunger 27 is actuated by an eccentric 30, positioned in a recess 31 formed in the plunger, and mounted on the inner end of a shaft 29 extending through the tubular member 11. The forward plunger 26 is constructed of hard metal, preferably cast steel, and the rear plunger 27 is constructed of relatively light fibrous material, such for example, as compressed paper pulp or the like.

The outer end of the shaft 29 projects through the member 11 and provides a mounting for a sheave 32, connected by means of a V-belt 33 with a sheave 34 mounted on the motor shaft 35. A race 38 containing ball bearings 39 is mounted on each end of the shaft 29. The inner member of each race 38 bears against the adjacent end of a sleeve 37 which closely fits and is rotatable with the shaft 29.

A locating collar 40 having a groove 41 is positioned in the outer end of the member 11 and

held in place by a set screw 50 as best shown in Figs. 2 and 5. The collar 40 provides an abutment for means yieldingly holding the shaft 29 in the position wherein the eccentric 30 is inserted in the recess 31 of the plunger 27. The means for holding the shaft 29 in plunger operating position consists of a gasket 43 in contact with the collar 40, and a shouldered washer 42 superimposed thereon. A similar washer 42 is mounted on the inner end of the shaft 29 adjacent the other race 38 and is separated from the race by a gasket 43. The gaskets 43 are provided to prevent escape of waste of lubricant from the respective end bearing portions. A compression spring 44 having its ends bearing on washers 42 yieldingly holds the washers in spaced apart relation.

The sheaves 32 and 34 and the V-belt 33 are positioned in a housing 22, provided by a casing 23 which is fastened to the outer end of the motor 15 by a screw-bolt 46. A collar 45, fastened to the outer end of the tubular member 11 by means of a set screw 47, provides countersunk rivets 48 on its outer face by means of which the casing 23 is fastened to the collar. The housing 22 also includes an easily removable flange cover 24 fitting over the casing 23.

The eccentric 30, sheave 32, races 38, collar 40, races 42, gaskets 43, and sleeve 37 are first assembled on the shaft 29 and maintained in assembled position by threading the sheave onto the outer end of the shaft. The assembled device is then inserted into the tubular member 11 in the position shown in Fig. 1 with the eccentric 30 in the plunger aperture 31. The assembled actuating mechanism is then fastened in operative position in the member 11 by threading the set screw 50 into contact with the grooved portion 41 of the locating collar as shown in Fig. 5. The races 37, gaskets 43, washers 42 and spring 44 are held by the fixed collar 40 against rotation leaving the shaft 29 and sleeve and races 37 free to rotate.

The described preassembled unitary actuating mechanism mounted as described in the tubular member 11, provides an outstanding advantageous feature of the invention in that it permits the plungers 26 and 27 and their connecting spring 28 to be quickly and easily removed from the tubular member 10 for inspection or repairs without dismantling the device or requiring the use of tools for that purpose. This is accomplished by removing the cover 24 from the housing 22 and exerting a pull on the sheave 32 sufficient to move the shaft 29 against the resistance of the spring 44 to the position shown in Fig. 2 wherein the eccentric 30 is disengaged from the plunger 27. The shaft 29 is held in this partially removed position by revolving a stop block 52 on its pivotal mounting 53 to a position wherein one end projects between the sheave 32 and the casing 23. Upon removal of the eccentric 30 from the aperture 31, the plungers 26 and 27 will be free to drop out of their mounting and this will be accomplished by turning the rear end of the member 10 to a downwardly inclined position. Upon again inserting the spring connected plungers 26 and 27 into the tubular member 10 and removal of the block 52 from its wedging position, the spring 44 will retract the shaft and the mechanism assembled thereon to their original position with the eccentric 30 in operative position in the aperture 31 in the plunger 27.

The chuck 25 has an annular projecting end portion 58 in which a shell is mounted. The

shell 60 provides a hollow drill wedged in a tapering longitudinal aperture formed for that purpose in the outer end of the chuck. The shell 60 discharges loose material, resulting from the drill operation, through an aperture 59 in the projecting end 58 of the chuck. A handle 61 is mounted on the projecting end 58 of the chuck by means of which the operator is enabled to revolve or oscillate the chuck and drill as the drilling operation proceeds.

The chuck 25 has an intermediate portion 57 of reduced diameter positioned underneath a segmental aperture in the member 10 and which is closed by a locking member 63. The member 63 has an inwardly projecting flange 64 at one end, the lower edge of the flange being bounded by a circle 62. The flange projects into an annular space 78 surrounding the reduced chuck portion 57 as shown in Figs. 1 and 6 and provides a stop permitting a limited longitudinal movement of the chuck. Longitudinal movement of the chuck 25 and the drill 60 is caused by the impact of the heavy plunger 26 with the chuck which results from each revolution of the eccentric 30. The flange 64 has a width somewhat less than the length of the reduced chuck portion 57 and the maximum longitudinal movement of the chuck is determined by said difference between the width of the flange and the length of the chuck portion 70. It is desirable in some instances to change the position of the chuck in the tubular member 10 to vary the maximum outward travel of the plunger 26 which results in its contact with the chuck and this is accomplished by turning the locking member 63 end for end. In Fig. 1, the member 63 is positioned with the flange 64 adjacent the projecting end 58 of the chuck and in Fig. 6, the member is in reverse position with the flange positioned adjacent the inner end of the chuck. Obviously, the plunger 26 must move nearer to the front end of the member 10 before contacting with the chuck 25 when the member 63 is in the position shown in Fig. 1 than when the member is in the position shown in Fig. 6. The member 63 is held in the position shown in Fig. 1 by a band 65. The band 65 is clamped about the tubular member 10 by means of a bolt 66 extending through the projecting ends of the band. In Fig. 6, the band 65 is shown as having been moved to a position where it uncovers and permits access to the member 63.

Novel means is illustrated in Figs. 1 and 4 for fastening the spring 28 to lugs 54 provided on the adjacent ends of the plungers 26 and 27 whereby all of the end portions of the spring in contact with the lugs and plungers are fixedly held against movement relative thereto and as a result, wear of the springs is minimized. The means so provided for holding all contacting portions of the spring 28 rigid with the lugs 54 and the plungers 26 and 27 consists in making the lugs cylindrical adjacent the plungers with their outer ends frusto-conical or tapering and the cylindrical and frusto-conical surfaces intersecting on a line 69. The diameters of the cylindrical portions of the lugs 54 are made slightly larger than the normal interior diameter of the spring 28, thereby requiring the exertion of some force by way of pressure and twisting to mount the spring on the lugs. Grooves 68, formed in the adjacent ends of the plungers 26 and 27, provide guides adapted to receive the end coils of the spring 28 and to hold the free end of the spring in alignment with the main body thereof.

Pins 56, inclined as shown, are provided in the tapering portion of each lug 54 adjacent the cylindrical portion. The diameter of the projecting ends of the pins 56 is greater than the normal spacing of the coils of the spring 28 and the projecting ends are so positioned that in threading the spring 28 onto the lug 55, the end coils of the spring which encircle the cylindrical portions of the lugs 54 are pressed together with the extreme end coil closely fitting the groove as shown in Fig. 4.

The position and inclination of the pins 56 and the length of the cylindrical portion of the lugs 54 are preferably such that a plane through the line 69 passes through the center of the coil in contact with the projecting end of the pin most remote from the plunger. The described construction and arrangement of the lugs 54 and of the pins 56 is such that all of the end portions of the spring 28 in contact with the lugs 54 and with the plungers are frictionally held against either longitudinal or rotary movement relative to the lugs and plungers and that portion of the spring between the pins 56 is free to contract and expand without possible contact with the lugs. The distortion or spread of the coils by the pins 56 is such that the coils press against both sides of the pins under all conditions of elongation of the intermediate portions of the springs.

The device as described is light in weight, those now in use and rated for $\frac{5}{8}$ " diameter hole capacity weighing approximately twelve pounds being easily manipulated for drilling upwardly inclined holes. Fig. 8 illustrates the device in position for drilling upwardly inclined holes in a ceiling or roof 79 of concrete, stone, or the like, where it is difficult to hold the drill in alignment with the hole and to exert feed pressure and manipulate the device when held only by a handle. To overcome this difficulty, I have provided a supporting means shown in Figs. 8 and 9 whereby the drill is held in alignment and the device is carried and feed pressure exerted by the body of the operator, leaving him with both hands free to manipulate the device and rotate the drill.

In providing this supporting means, I have provided the longitudinal member 10 as a plurality of sections 70 fastened together by sleeves 71 for convenience in crating and shipping. Sufficient of the sections are used to bring the member 10 to a point below the waistline of the operator. A harness comprising a pair of straps 73 extending over the shoulders and intersecting at the back of the operator enables the operator to comfortably carry the weight of the device and to exert the necessary feed pressure. One end of each of the straps 73 is fastened to a plate 74, as shown in Fig. 9, the other end of each strap is equipped with a hook 77 adapted for insertion in a pair of apertures 76 provided for that purpose in the plate. A relatively large aperture 75 is also provided through which the lower end of member 10 is projected, the diameter of the aperture being slightly larger than that of member 10 so that the plate 74 may be moved up or down for adjustment as desired. The bounding walls of aperture 75 are so inclined as to engage the member 10 and hold the plate 74 against relative movement thereon when the straps 73 are taut either under the weight of the device or by reason of the operator exerting a pull on the straps. The length of the vertical member and of the harness is such that the device may be used by either short or tall operators, the preferable position of the operator

being such that his head is approximately six inches below the ceiling in which position he can most advantageously rotate the chuck 58 by manipulation of the handle 61. The operator is enabled to raise the device by elevating his shoulders, thereby exerting the required upward feed pressure and elevation of the device sufficient to complete the drilling without readjustment of the plate 74 on member 10.

10 The downwardly extending supporting member, comprising the detachable section 70, may also be advantageously used without the harness in which case the operator while using his hands to support the device and manipulate the chuck 58 is enabled to press the supporting member against his body and thereby maintain the tool in alignment with the hole being drilled.

The arrangement of the motor 15 and the actuating mechanism and handle all on one side of the tubular member 10 enables holes to be drilled in a ceiling in closely spaced relation to a transversely extending wall or beam. A dust pan 72 is mounted on member 10 of the device above the motor 15 in a position to catch the dust and pulverized material resulting from the drilling operation and prevent its falling onto the device, operator, floors, fixtures or machinery over which holes are drilled. The pan 72 is preferably made of flexible or yielding material such as rubber to enable the sides of the pan to be pushed inwardly when drilling such holes close to walls or beams.

When desirable to use the device for drilling holes in a cramped or limited space or in walls or floors, the member 10 is shortened by disconnecting the detachable sections 10 and is then manipulated by holding the handle 11 with one hand and rotating the drill with the other.

Thus, it will be seen that I have provided a novel motor actuated tool or device of the kind described which provides a plurality of novel features cooperating to minimize the noise of operation and the vibratory shocks detrimental to the motor windings, and which is durable, light of weight, economical to manufacture, easily manipulated and so constructed that the plungers may be disconnected from the operating mechanism and removed for inspection or repairs without dismantling the device or requiring the use of tools, and also provides a number of other novel constructions and arrangements adapting the device for long service life and for use wherever found applicable.

Having thus described my invention, it is obvious that various immaterial modifications may be made in the same without departing from the spirit and scope of the invention; hence I do not wish to be understood as limiting myself to the exact form, construction and arrangement of parts herein shown and described, or uses mentioned.

What I claim as new and desire to secure by Letters Patent is:

1. In a drill of the kind described, a tubular member, a pair of longitudinally aligned spring connected plungers mounted in and reciprocally movable in said member, a chuck mounted in one end of the tubular member in the path of the adjacent plunger, said adjacent plunger being formed of relatively heavy hard material and the other plunger being formed of relatively light fibrous material and having an aperture formed therein, a motor mounted on said tubular member, a transverse tubular member projecting from said vertical tubular member and providing a

handle, a shaft rotatably mounted in said transverse member, an eccentric mounted on the inner end of the shaft and positioned in said aperture whereby rotation of the shaft reciprocally moves said plungers, and a belt drive connecting said shaft with the motor shaft.

2. A portable electrical tool of the kind described comprising a vertical tubular member, a chuck mounted in the upper end of the tubular member, a pair of spring connected plungers mounted in the tubular member reciprocally and movable to cause the upper plunger to actuate the chuck, a motor and a transverse tubular member mounted on said vertical tubular member, the transverse tubular member providing a handle, a shaft rotatably mounted in said transverse member, the lower of said plungers providing an aperture, an eccentric mounted on the shaft and positioned in said aperture whereby rotation of the shaft reciprocally moves said plungers, a belt drive operatively connecting said shaft with the motor shaft, spring means holding said shaft with the eccentric in said aperture and yielding under a pull exerted on said shaft to move said eccentric out of the tubular member to a position permitting the plungers to be dropped out of the lower end of the vertical tubular member.

3. A portable electrical tool of the kind described comprising a vertical tubular member, a chuck mounted in the upper end of the tubular member, a pair of spring connected plungers mounted in the tubular member and reciprocally movable to cause the upper plunger to actuate the chuck, a motor and a transverse tubular member mounted on said vertical tubular member, the transverse tubular member providing a handle, a shaft rotatably mounted in said transverse member, the lower of said plungers being of relatively light fibrous material and providing an aperture, an eccentric mounted on the shaft and positioned in said aperture whereby rotation of the shaft reciprocally moves said plungers, a belt drive operatively connecting said shaft with the motor shaft, spring means holding said shaft with the eccentric in said aperture and yielding under a pull exerted on said shaft to move said eccentric out of the tubular member, and stop means movable to a position to hold said shaft in said retracted position wherein the eccentric disengages the plunger.

4. In a portable electrical tool of the kind described, a vertically extending tubular member, a chuck mounted on the upper end of the tubular member, a pair of spring connected plungers reciprocally movable in the member to actuate the chuck, the lower of said plungers providing an aperture, a transverse tubular member projecting from the vertical tubular member, a motor positioned in spaced apart relation to the transverse tubular member, preassembled mechanism adapted to be inserted in said transverse member as a unit and operable to actuate said plungers, said mechanism comprising a shaft, an eccentric mounted on the shaft and positioned in said aperture, a sheave on the outer end of the shaft, a race adjacent the sheave, a race on the other end of the shaft adjacent the eccentric, a sleeve having its ends in contact with said races, a locating collar adjacent the outer race and fastened to the transverse member, a pair of washers positioned respectively adjacent said collar and inner races, a compression spring having its ends abutting said washers and yielding under a pull on the shaft to permit retraction of the shaft

sufficient to withdraw said eccentric from engagement with the plunger, stop means movable to engage said sheave and hold the shaft in said retracted position and a belt drive operatively

5 connecting said sheave with the motor shaft.

5. In a portable ceiling drill of the kind described, a vertically extending tubular member adapted to extend from the ceiling to a point adjacent the waistline of the operator, a chuck

10 mounted on the upper end of the tubular member, a pair of spring connected plungers reciprocally movable in the member to actuate the chuck, the lower of said plungers providing an

15 aperture, a transverse tubular member projecting from the vertical tubular member, a motor positioned in spaced apart relation to the transverse tubular member, preassembled mechanism adapted to be inserted in said transverse member as a unit and operable to actuate said plungers, said mechanism comprising a shaft, an eccentric mounted on and positioned in said aperture, a sheave on the outer end of the shaft, a

20 race adjacent the sheave, a race on the other end of the shaft adjacent the eccentric, a sleeve having its ends in contact with said races, a locating collar adjacent the outer race and fastened to the transverse member, a pair of washers positioned respectively adjacent said collar and inner

25 races, a compression spring having its ends abutting said washers, said spring yielding under a pull on the shaft to permit retraction of the shaft sufficient to withdraw said eccentric from engagement with the plunger, stop means movable to engage said sheave and hold the shaft in said

30 retracted position, a belt drive operatively connecting said sheave with the motor shaft, a harness adapted to be suspended from the shoulders of the operator, and means adapted to operatively engage the harness with said vertical tubular member whereby the shoulders of the operator carry the weight of the tool and provide the necessary feed pressure for one continuous drilling operation.

6. In a portable electrical tool of the kind described adapted for drilling upwardly inclined and vertical holes in ceilings or the like, a vertically extending sectional tubular member extending from the ceiling to a point adjacent the waistline of the operator, a chuck providing a

45 mounting for a drill positioned on the upper end of the member, plungers operable to actuate said chuck, motor actuated mechanism for reciprocating said plungers, a harness adapted to be suspended from the shoulders of the operator, and means adapted to operatively engage the harness with said tubular member whereby the shoulders of the operator carry the weight of the tool and provide the necessary feed pressure for one continuous drilling operation.

7. In a ceiling drill of the kind described, a sectional vertically extending tubular member, a chuck mounted in the upper end of the tubular member, the lower end of the tubular member extending downwardly to a point adjacent the waistline of the operator, a pair of spring connected plungers in longitudinal alignment in said member operable to actuate said chuck, a motor mounted on the tubular member, a transverse tubular member adjacent said chuck, a shaft rotatable in said transverse member and having an eccentric mounted on its inner end in operative engagement with the lower plunger whereby rotation of the shaft reciprocates said plungers, a belt drive connecting said shaft with

75 the motor shaft, a flexible cup shaped member

mounted on said vertical member above the motor adapted to receive loose material resulting from the drilling operation, a harness adapted to be suspended from the shoulders of the operator, and means adapted to operatively engage the harness with said tubular member whereby the shoulders of the operator carry the weight of the tool and provide the necessary feed pressure for one continuous drilling operation.

8. In a portable electrical tool of the kind described, a chuck carried by said tool, a pair of spaced apart plungers operable to actuate the chuck, motor actuated mechanism for driving said plungers, the adjacent ends of said plungers each provided with a lug, said lugs each being bounded by a cylindrical surface adjacent the plungers and a frusto-conical surface tapering towards its outer end, a coil spring operatively connecting said plungers so arranged that a plurality of coils at each end of the spring closely fit the cylindrical surface of the lugs, and a pin mounted in each lug, the ends of said pin projecting between adjacent coils and having a diameter greater than the normal spacing of the coils.

9. In a portable electrical tool of the kind described, a chuck carried by said tool, a pair of spaced apart plungers operable to actuate the chuck, motor actuated mechanism for driving said plungers, the adjacent ends of said plungers each provided with a lug, said lugs each being bounded by a cylindrical surface adjacent the plungers and a frusto-conical surface tapering towards its outer end, a coil spring operatively connecting said plungers so arranged that a plurality of coils at each end of the spring closely fit the cylindrical surface of the lugs, means for locking the lug contacting portions of the spring against either lateral or longitudinal movement, said means comprising a pin having its ends projecting from the lug between adjacent coils of the spring, the projecting ends of the pin having a diameter sufficiently greater than the normal spacing of adjacent coils that the pressure of the spring against the outside of the pin is greater than any working strain in the intermediate section of the spring.

10. In a portable electrical tool of the kind described, a longitudinal tubular member, a chuck projecting from the forward end of said member, motor-actuated mechanism operable to drive said chuck, a downwardly extending longitudinal member detachably fastened on said tubular member adapted to provide a support when drilling vertical and upwardly inclined holes, a flexible harness suitable for suspension from the shoulders of the operator, and adjustable fastening means on said harness adapted to be selectively engaged with and providing a support for said downwardly extending member, and a flexible cup positioned under and concentric with said chuck adapted to collect the waste material resulting from the drilling operation.

11. In combination, a drill of the kind described adapted for forming vertical and upwardly inclined holes, an extensible vertical supporting member for the drill terminating adjacent the waist-line of the operator when the drill is in operative engagement with the work, a harness adapted to be worn over the shoulders of the operator, and means on the harness adjacent the waist-line of the operator adapted to frictionally engage the supporting member when said harness is taut.

12. In combination, a drill of the kind de-

scribed adapted for forming vertical and upwardly inclined holes, an extensible vertical supporting member for the drill terminating adjacent the waist-line of the operator when the drill is in operative engagement with the work, a harness adapted to be worn over the shoulders of the operator, and means on the harness adjacent the waist-line of the operator adapted to frictionally engage the supporting member when said harness is taut, said means being so positioned that the operator may, by elevating his shoulders, apply feed pressure to the drill as it ascends with the work.

13. In combination, a portable tool for drilling vertical and upwardly inclined holes comprising a drill, a vertical supporting member for the drill terminating adjacent the waist-line of the operator when the drill is in operative position, a harness adapted to be worn over the shoulders of the operator, and means mounted on said harness adjacent the waist-line of the operator adapted to frictionally engage said supporting member when said harness is taut, the

position of said means being such that the operator may by elevating his shoulders, apply the necessary feed pressure for one continuous drilling operation.

14. In combination, a drill of the kind described adapted for forming vertical and upwardly inclined holes, an extensible vertical supporting member for the drill terminating adjacent the waist-line of the operator when the drill is in operative engagement with the work, a harness adapted to be worn over the shoulders of the operator, a disc hingedly mounted on the harness adjacent the waist-line of the operator, said disc providing an aperture through which said vertical supporting member projects in closely fitting wedging engagement when the disc is inclined to the axis of the member, said harness being maintained taut by the weight of said drill and supporting member whereby the operator is enabled to provide the necessary feed pressure for one continuous operation by elevating his shoulders.

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