Feb. 13, 1968 E. B. LEAR 3,368,634

INDEPENDENT ROTATION ROCK DRILL

Filed Aug. 12, 1965 3 Sheets-Sheet 1

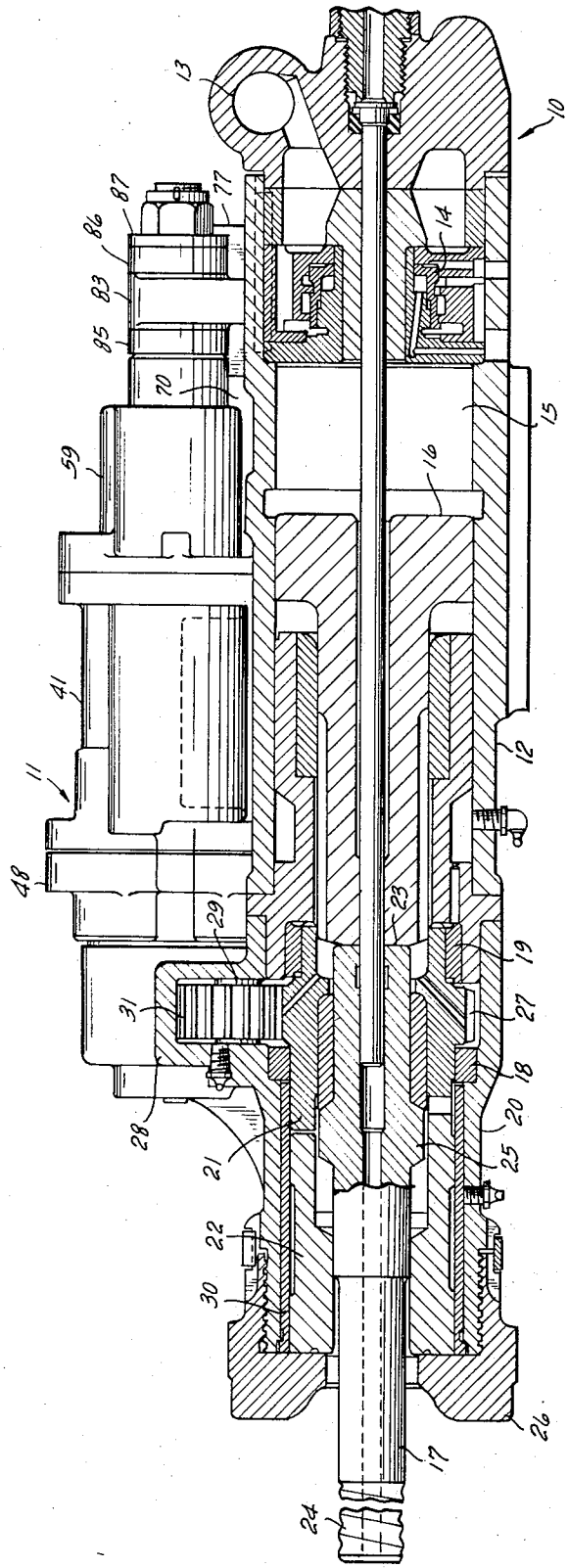

FIG. 1.

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Filed Aug. 12, 1965 3 Sheets-Sheet 2

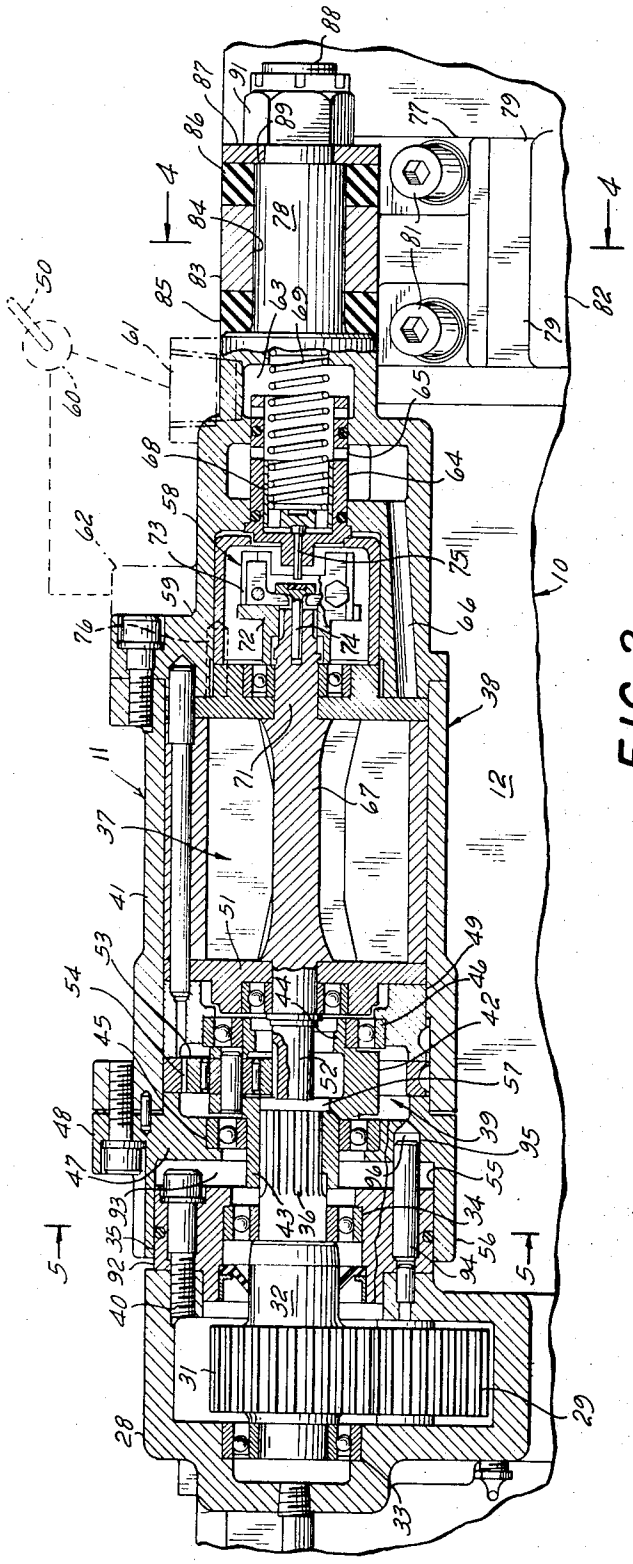

FIG. 2.

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Filed Aug. 12, 1965 3 Sheets-Sheet 3

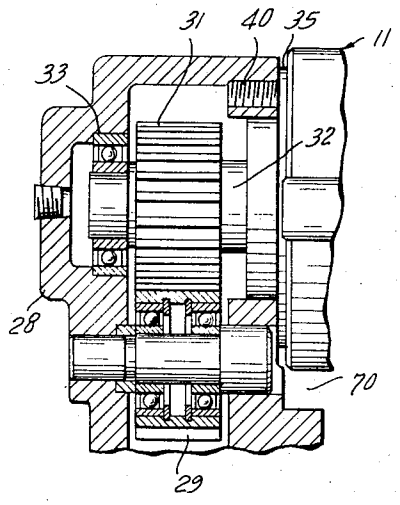

FIG. 3.

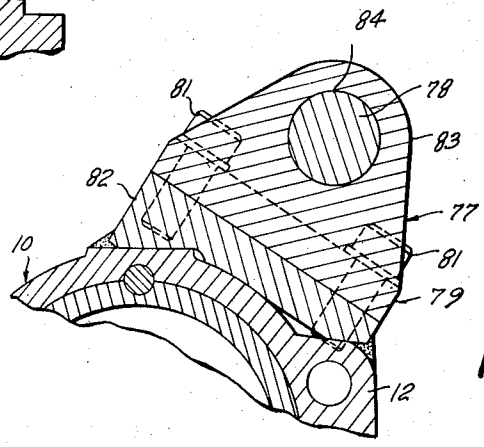

FIG. 4.

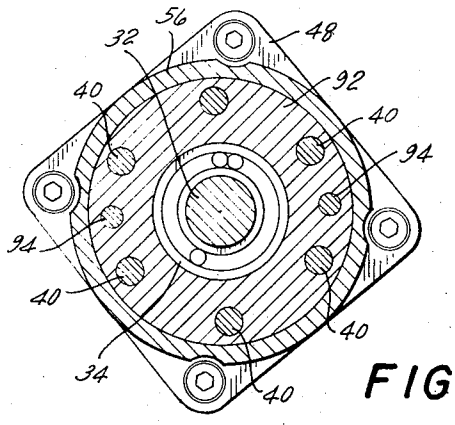

FIG. 5.

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INDEPENDENT ROTATION ROCK DRILL

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9 Claims. (Cl. 173—105)

ABSTRACT OF THE DISCLOSURE

Briefly, the invention comprises a pneumatic rock drill of the drifter type including an independent rotation pneumatic motor unit arranged externally of the housing and having its longitudinal axis parallel to that of the rock drill. The housing of the motor unit is mounted upon the rock drill housing by means of axially slidable connections at each end of the motor unit housing. The slide connection at one end includes buffer elements which yieldably resist axial movement of the motor unit in either direction relative to the rock drill. A speed governor in the motor unit controls speed of the motor unit in a positive direction, but not in a reverse direction.

In conventional rock drills, the drill steel is both rotated and pounded by means of the reciprocating action of a piston hammer acting through conventional ratchet-type rotation mechanism. This arrangement has its faults in that the rotation mechanism imposes a drag upon the reciprocating action of the piston, and provides only intermittent rotation of the drill steel. Further, at times it is desired, particularly in drifter drilling operations, to increase the rotational speed of the drill steel while holding the reciprocating speed of the piston hammer steady. But this cannot be done in conventional drills where the rotational speed of the drill steel is dependent upon the reciprocating speed of the piston hammer.

Accordingly, an object of this invention is to provide in a pneumatic rock drill independent rotation means for controlling rotation of the drill steel independently of the reciprocating action of the piston hammer; and to associate this independent rotation means with the rock drill in a practical and simple manner.

Another object of this invention is to associate with a rock drill an independent rotation motor unit externally of the rock drill in such manner that the one may be readily detached from the other; so that the motor unit does not interfere with the operating efficiency of the rock drill; and so that shocks imparted by the rock drill to the motor unit are absorbed without possibility of damage to either the rock drill or the motor unit.

A more particular object of the invention is to provide a cushioned slidable mounting of an independent rotation motor unit with a rock drill.

In the accompanying drawings:

FIG. 1 is a view of an independent rotation rock drill embodying the invention, wherein the rock drill is shown in longitudinal section and the independent rotation motor unit is shown in full;

FIG. 2 is a longitudinal section of the independent rotation motor unit;

FIG. 3 is a detail of the gear train at the forward end of the independent rotation motor unit;

FIG. 4 is a detail section taken on line 4—4 of FIG. 2 directed to the mounting at the rear end of the independent rotation motor unit; and

FIG. 5 is a section taken on line 5—5 of FIG. 2.

Reference is now directed to the drawings wherein the independent rotation rock drill illustrating the invention is disclosed. It includes a rock drill 10 to the outside of which is detachably mounted an independent rotation motor unit 11.

The rock drill shown is of the drifter type. It includes an elongated housing generally designated 12, comprising a plurality of sections rigidly bolted together in end-to-end relation, and adapted along its underside for mounting in conventional manner to a guide shell (not shown).

An inlet passage 13 at the rear of the housing is connectable through a suitable operator controlled supply valve (not shown) to a source of pressure air. A conventional air distributing slide or air-blown valve 14 arranged in the rear of the housing in communication with the inlet passage functions in well known manner to distribute operating air alternately to opposite ends of a piston chamber 15 of the housing to repeatedly reciprocate a hammer or piston 16 to pound a striking bar 17. This action of the valve continues automatically until the operator shuts off the air supply.

Supported in bearings 18 and 19 for rotation in a front head section 20 of the housing is a chuck driver 21. The latter drivingly engages a rotatable tool holder or chuck 22. The striking bar 17 has limited axial movement in the chuck and chuck driver. It has an anvil portion 23 projecting through the chuck driver into the piston chamber where it is subject to the pounding action of the piston. An externally projecting portion 24 of the striking bar is adapted to be coupled to a drill steel (not shown). An intermediate portion of the striking bar, defined by radially extending ears or splines 25, has a slidable splined engagement with the chuck whereky rotation of the chuck is imparted to the striking bar. A conventional cap 26 screwed over the front head of the housing bears against the chuck; and it may be removed when required to permit replacement of the chuck and striking bar. A bushing 30 is provided in which the chuck rotates.

Reciprocation of the piston serves only to pound the striking bar. Here, it does not impart rotation to the chuck driver, nor to the chuck or the striking bar. The motor unit 11 is operable independently of the reciprocating action of the piston and independently of the operation of the rock drill to effect rotation of the striking bar. So as to drivably associate the striking bar with the motor unit, the chuck driver 21 is formed with a pinion 27 which projects into a radial enlargement 28 of the front head section of the housing. An idler gear 29 supported in the enlargement connects pinion 27 with the pinion 31 of a driving shaft 32. A bearing 33 supporting one end of shaft 32 is mounted in the enlargement; and a second bearing 34 supporting an opposite end area of the shaft is mounted in a cylindrical extension or support 35. The extension 35 is bolted fast to the enlargement by means of a plurality of bolts 40, and extends from the enlargement with its axis in parallel relation to the longitudinal axis of the rock drill. The function of the support 35, as will be later described, is to slidably support one end of the motor unit 11. The driving shaft has a straight splined end portion 36 projecting axially beyond the extension 35. A suitable motor 37 incorporated in the housing 38 of the motor unit functions to transmit rotary motion through a stage 39 of reduction gearing to the driving shaft 32 and as a consequence to the striking bar 17.

The housing 38 of the motor unit is defined by a succession of sections bolted together in end-to-end relation. It includes a central section 41 in which the motor 37 is housed. Here, the motor used is a conventional air driven motor of the radially slidable blade type. The stage of reduction gearing 39 is housed in the central section forwardly of the motor. It includes a rotatable spindle cage 42 having oppositely extending hollow shafts 43 and 44 respectively supported in bearings 45 and 46. Bearing 45 is mounted in a back wall 47 of a closure section 48 of

the housing. The closure section is rigidly bolted to the front end of the central housing section **41**. Bearing **46** is mounted in a stationary spacer **49** positioned adjacent an end plate **51** of the motor. The motor has a forward driving shaft **52** which extends freely through the rear hollow spindle shaft **44** into the spindle cage. This motor shaft **52** has a straight splined driving connection with planetary gears **53** mounted in the spindle cage. The planetary gears in turn mesh with a stationary internal gear **54**. The forwardly extending hollow spindle shaft **43** extends through its supporting bearing **45** and beyond the closure wall **47** into a recess **55** defined by a forwardly extending cylindrical skirt or sleeve **56** of the closure. In this recess the spindle shaft **43** sleeves over and has a straight splined slidable driving connection with the driving pinion shaft **32**. The latter shaft is not fully received into the spindle shaft, as indicated by the clearance **57** at its rear. This clearance permits a desired limited axial movement of the spindle shaft **43** relative to the driving pinion shaft **32** when required, as when the motor unit is jarred or shocked by the operation of the rock drill.

In this type of drilling apparatus, it is desired that the operating speed of the motor in a positive direction be automatically controlled. Here, a governor **58** is provided for this purpose. It is mounted in a governor housing section **59** bolted to the rear of the central section of the housing. The governor section is provided with a pair of inlet passages **61** and **62** each connectable by a separate hose to a common supply control valve **60**. When the control lever **50** of the latter is positioned for positive operation of the motor, operating air flows through the inlet **61** to a chamber **63**. From the latter, it enters a stationary valve cage **64** and passes through normally open radial ports **65** of the cage and a connected passage **66** to the motor chamber to rotate the rotor **67** in a positive direction. A valve **68** slidable in the valve cage is normally biased by a spring **69** to open condition relative to the radial ports **65**. A rear driving shaft **71** of the motor has a driving splined connection with the body **72** of the governor. Operation of the motor rotates the governor body **72**. As the motor speed exceeds a predetermined limit, flyweights **73** pivoted in the governor body swing centrifugally to force a pin **74** to push a pin **75** against the slide valve. This causes the latter to progressively close over the radial ports **65** against the resistance of spring **69** so as to cut off operating air from the motor and thus retard the speed of the latter.

When the control valve lever **50** is positioned for reverse operation of the motor, operating air enters the inlet **62** and flows into a port **76** connected directly to the reverse side of the motor chamber. Accordingly, the speed of the motor in a reverse direction is not controlled by the governor.

The control valve **60**, whereby the operator controls the supply of operating air to the motor unit, is separate and independent of that (not shown) whereby the operator controls the supply of operating air to the rock drill. This enables the operator to control rotation of the striking bar **17** independently of the operation of the rock drill, and at speeds which are not dependent upon the reciprocating action of the rock drill piston.

An important feature of the illustrated independent rotation rock drill is the manner in which the motor unit **11** is mounted to the rock drill whereby the motor unit and its mounting are protected against damage from shock imparted to the motor unit during operation of the rock drill.

The motor unit **11** is supported to the rock drill housing at its front end upon the extension **35** of the enlargement **28**; and at its rear end it is supported by means of a bracket **77**. It is supported by the extension and the bracket in such manner that its housing is clear of the housing of the rock drill, as indicated by the clearance **70**, and so that its longitudinal axis is parallel to that of the rock drill.

At the front end of the motor unit, the skirt **56** of the closure section sleeves with a slide fit over the cylindrical surface of the extension **35**. The housing of the motor unit terminates at its rear end in an axially extending cylindrical tailpiece or mounting shaft **78** which is supported by the bracket **77** (FIGS. 1, 2, 4). The bracket includes a base portion **79** rigidly secured by means of a group of bolts **81** to an external raised or bossed portion **82** of the rock drill housing. A central upright part **83** of the bracket has an axial hole **84** through which the tailpiece slidably extends. Sleeving the tailpiece between a flat inner end face of the upright and an opposed flat shoulder of the housing of the motor unit is a thick shock absorbing ring or buffer **85**. A second similar buffer ring **86** sleeves the tailpiece between opposed flat faces of the upright part of the bracket and a retaining washer **87**. The washer sleeves over a reduced end **88** of the tailpiece and is held in abutment with a shoulder **89** of the tailpiece by means of a nut **91**. The nut holds the tailpiece and buffer rings in assembled relation to the bracket in such manner that there is no axial end play between the buffer rings and the bracket or between the tailpiece and the bracket. The buffer rings are made of suitable material which is resilient and compressible, which may be rubber, or a suitable plastic such as that known as polyurethane. It is understood that one or the other of the buffer rings is compressible accordingly as axial pressure is applied to the motor unit in one direction or the other. When this occurs, the motor unit has a corresponding sliding movement relative to the extension **35** at its forward end. So that the motor unit will not be undesirably limited in this axial movement, the bracket **77** is located on the rock drill so that the extension **35** is not fully received into the recess **55** of the sleeve, as indicated by the clearance at **92**; and a clearance, as indicated at **93**, normally exists between the end of the extension and the back wall **47** of the sleeve **56**. Shock forces imparted to the motor unit during the operation of the rock drill will cause the motor unit to move axially relative to its mountings and will be absorbed by the buffer elements. The extent of this movement, however, is relatively slight, and the clearance **93** provided between the extension and the back wall of the sleeve is ample to allow for such movement.

Cylindrical keys **94** (FIGS. 2, 5) are provided to prevent rotation of the motor unit relative to its mountings. Each key is press fitted into the wall of the extension **35** and has a rear portion extending with a slide fit into an axial bore **95** in the back wall **47** of the closure **48**. The rear portions of the keys extend into the bores sufficiently to allow for relative axial movement of the motor unit, as indicated by the clearance **96**.

In summary of the nature of the apparatus: it is apparent that the rock drill **10** and the independent rotation motor unit **11** may be operated, each independently of the other, and that the striking bar **17** is rotatable at the will of the operator independently of the operation of the rock drill or the reciprocating action of the piston. Further, the speed of the motor in a positive direction is automatically controlled by the governor so as to be maintained at a desired rate during the operation of the drill; but is not governed in a reverse direction. Further, by means of the mounting arrangement of the motor unit to the rock drill, shocks imparted to the motor unit by pounding of the piston against the striking bar are absorbed by the buffer rings **85**, **86** without consequent damage to the motor unit. In this respect, the force of the shocks cause the motor unit to move back and forth along its longitudinal axis. When the force of shock imparted to the motor unit is in a rearward direction, the tailpiece **78** slides axially rearward relative to the bracket **77** compressing the inner buffer ring **85** as it does so. In this rearward movement, the front end **48** of the motor unit slides to a corresponding degree rearwardly relative to the extension **35**, the key elements **94** and the driving pinion shaft **32**. When the force imparted to the motor

unit is in the opposite direction, the tailpiece slides forwardly relative to the bracket to compress the outer buffer ring **86** between the washer **87** and the bracket portion **83**; and in this movement of the motor unit, its forward end **48** slides forwardly a corresponding degree relative to the extension **35**, the key elements **94** and the driving pinion shaft **32**.

While the back and forth movement of the motor unit is substantially absorbed or resisted by the buffer rings and is accordingly very slight, it is nevertheless such that if the front and rear ends of the motor unit were solidly mounted to the rock drill housing, the housing of either the motor unit or the rock drill would crack or otherwise become damaged. It has been found in the case of a solid mounting, relative movement of a few thousandths of an inch of the motor unit relative to the rock drill would be enough to cause failure of the mounting. Such failure would not occur here because of the manner in which the motor unit **11** is mounted to the rock drill.

It is further apparent that the motor unit **11** may be readily detached from the housing of the rock drill for replacement or repairs by removing the securing bolts **81** so as to detach the bracket **77** and then by sliding the motor unit axially rearward until it is free of the extension **35**.

What is claimed is:

1. In an independent rotation rock drill, including a rock drill member having an elongated housing and a rotatable tool holder in the housing, and a motor unit arranged externally of the housing having its longitudinal axis parallel to that of the rock drill and having a driving connection at a front end with the tool holder; means mounting the motor unit to the housing for limited relative axial movement comprising an axially slidable connection of one end of the motor unit with the housing, an axially slidable connection of the opposite end of the motor unit with the housing, and buffer means yieldably resisting the motor unit in said movement.

2. In an independent rotation rock drill including a rock drill member having an elongated housing and a rotatable tool holder in the housing, and a motor unit arranged externally of the housing having its longitudinal axis parallel to that of the rock drill and having a driving connection at a front end with the tool holder; means mounting the motor unit to the housing for limited relative axial movement comprising a front slidable connection of the motor unit with the housing, a rear slidable connection of the motor unit with the housing, and buffer means yieldably resisting the motor unit in said movement; wherein the front slidable connection includes a radial enlargement of the housing having a rearward axial extension, and a forwardly extending sleeve of the motor unit in which the extension is slidably received.

3. In an independent rotation rock drill as in claim **2**, wherein the rear slidable connection includes a bracket extending radially from the housing of the rock drill having an axial hole, and a rearwardly extending shaft of the motor unit slidably received in the hole.

4. In an independent rotation rock drill as in claim **3**,

wherein the buffer means includes resilient compressible ring elements mounted on the shaft to either side of the bracket and retainer means holding the buffer means in abutment with the bracket.

5. In an independent rotation rock drill as in claim **4**, wherein the retainer means includes a shoulder at one end of the shaft abuttable against the ring element at one side of the bracket, a second abutment slidable on the shaft abuttable against the ring element at the other side of the bracket, and an adjustable member on the shaft adjustable along the shaft relative to the second abutment to hold the resilient elements in abutting relation to the bracket.

6. In an independent rotation rock drill as in claim **3**, wherein the bracket is detachably mounted to the rock drill housing.

7. In an independent rotation rock drill as in claim **2**, wherein key elements are provided for preventing rotation of the motor unit relative to the enlargement of the rock drill housing.

8. In an independent rotation rock drill as in claim **7**, wherein the key elements are stationary with the enlargement and have axially extending portions, and the motor unit has bores in which said extending portions are slidably received.

9. In a rock drill having an elongated housing, a rotatable tool holder in the housing, a striking bar supported in the holder for rotation therewith and having limited relative axial movement, and a piston hammer reciprocable in the housing to pound the striking bar; a tool holder rotation means comprising a motor unit arranged externally of the housing having its longitudinal axis parallel to that of the rock drill, and including a motor element housed in the motor unit having a front drive shaft; gearing drivingly connecting the drive shaft with the tool holder; and shock absorbing means mounting the motor unit to the housing for absorbing the impact of shocks imparted to the motor unit by the pounding action of the piston hammer against the striking bar, wherein a first port is provided for supplying operating air to the motor in a positive direction, a second port is provided for supplying operating air to the motor in a reverse direction, valve means is provided for admitting operating air selectively to either the first or the second port, the motor element has a rear driving shaft, and a governor controlled valve is operatively connected to the rear driving shaft for controlling flow of operating air through the first port to the motor.

References Cited

UNITED STATES PATENTS

2,246,910	6/1941	Amtsberg	173—12
3,035,799	5/1962	Pierce	248—15
3,154,158	10/1964	Lincoln	173—105
3,232,176	2/1966	Henning et al.	173—105

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