FUNCTION SWITCHING ARRANGEMENT FOR ELECTRO-PNEUMATIC HAMMER DRILLS
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7 Claims

ABSTRACT OF THE DISCLOSURE
An electro-pneumatic hammer drill, switchable between rotary-percussion drilling and rotary drilling, includes a sleeve axially displaceable on the casing and cooperating with a tool holder and a tool mounted in the tool holder to control relative displacement thereof. The axial displacement of the sleeve continuously provides switching of the hammer drill between rotary-percussion drilling and rotary drilling by limiting the shank of the drill to a position wherein it is engageable by a percussion piston and a position in which it is out of the path of movement of the percussion piston.

Background of the invention
A known type of electro-pneumatic hammer drill, switchable between rotary-percussion drilling and rotary drilling, includes a percussion piston reciprocable in a cylinder by a pneumatic piston reciprocated in the same cylinder by a drill motor through a crank drive, the motion of the pneumatic piston being transmitted to the percussion piston through an air cushion in the cylinder. The kinetic energy of the percussion piston is transmitted abruptly to a tool holder or to a tool mounted in the tool holder, and the cylinder has air compensating openings in its jacket. The reciprocating motion of the percussion piston can be limited either by the tool shank or the tool holder.

In hammer drills of this type, it is customary to stop the action of the percussion piston by shutting down the tool, that is, when the drill is extracted from the bored hole, in order to effect purely rotary drilling in the bore. In this type of hammer drill, it is not possible to work with rotary drills, since the tool shaft is moved to the rear when the drill is pressed against the material, and this sets the percussion piston in motion again.

Another method for switching from percussion drilling to rotary drilling, with hammer drills of the above mentioned type, is to insert thereinto drills having a shorter shank or shank, so that the percussion piston is no longer operative on the drill. In this switching method, it is particularly disadvantageous that two different drills are required for one bore diameter, and these drills must be constantly interchanged for percussion drilling and for rotary drilling, with each drill being used only for a respective one of the two different drilling operations.

To facilitate application of the drill against the surface to be drilled, it is necessary that the percussion piston first strike the tool shank or shank with a relatively low force, and then strike it with increasing force. This cannot be achieved with the two types of switching mentioned above.

When tools are exchanged, the drill shaft or shank is also soiled, for example, when working on a construction site. Due to the soiling of the tool shank or shaft, foreign bodies get into the hammer drill, damaging the mechanism.

Summary of the invention
This invention relates to hammer drills used for both rotary-percussion drilling and purely rotary drilling and, more particularly, to a novel and improved hammer drill of this type including means continuously providing switching of the hammer drill between rotary-percussion drilling and rotary drilling and not requiring exchange of drills.

The objective of the present invention is to provide a hammer drill of this type which is free of disadvantages of known arrangements. Thus, in accordance with the invention, a sleeve-shaped body is guided for axial displacement on the housing or casing of the hammer drill, and this body limits axial movement of the tool, or the tool holder, with axial displacement of the sleeve-shaped body providing continuous switching from rotary-percussion drilling to rotary drilling, and vice versa. In the invention arrangement, only one tool and one tool holder is required, and the tool and the tool holder can be switched between the two operations, rotary-percussion drilling and rotary drilling, by simple displacement of the sleeve-shaped body. At the same time, penetration of foreign material into the hammer drill is prevented.

Preferably the operation switching arrangement is so designed that the axial displacement of the sleeve-shaped body is effected under the bias of a spring acting in the direction of the tool. This permits the aforementioned slow approach of the hammer drill into the work, and thus provides a continuous increase and decrease of the percussion force on the tool shaft or on the tool holder.

Preferably, the sleeve-shaped body can be locked at least in two positions, one corresponding to rotary-percussion drilling and the other to rotary drilling. The locking of the sleeve-shaped body is effected by angular displacement thereof on the casing of the hammer drill, the displacement preferably being in the direction of rotation of the drill so that locking in the desired position cannot be disengaged during operation of the hammer drill. However, one or more locking mechanisms can also be provided between the rotary-percussion drilling position and the rotary drilling position of the sleeve-shaped body.

An object of the invention is to provide an improved electro-pneumatic hammer drill switchable between rotary-percussion drilling and rotary drilling.

Another object of the invention is to provide such an electro-pneumatic hammer drill including means continuously providing switching of the hammer drill between rotary-percussion drilling and rotary drilling and without exchange of tools.

A further object of the invention is to provide such an electro-pneumatic hammer drill in which said switching is effected by a sleeve-shaped body axially displaceable on the casing or housing of the hammer drill.

Still another object of the invention is to provide such an electro-pneumatic hammer drill in which said sleeve-shaped body limits the axial movement of the tool or of the tool holder.

A further object of the invention is to provide such an electro-pneumatic hammer drill in which penetration of foreign material into the drill is prevented.

Still another object of the invention is to provide such an electro-pneumatic hammer drill in which said sleeve-shaped body limits the axial movement of the tool or of the tool holder.

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For an understanding of the principles of the invention, reference is made to the following description of a typical
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embodiment thereof as illustrated in the accompanying drawings.

Brief description of the drawings

In the drawings:

FIG. 1 is an elevation view, partly in section, of an electro-pneumatic hammer drill embodying the invention with the parts being in the position for rotary-percussion drilling;

FIG. 2 is a partial side elevation view looking in the direction of the arrow II of FIG. 1; and

FIG. 3 is a partial elevation and partial sectional view illustrating the parts of the hammer drill in the position for rotary drilling only.

Description of the preferred embodiment

Referring to FIG. 1, a motor casing 2 is secured on a gear housing 1. The motor has a drive or output shaft 4 which is rotatably mounted in an anticfriction bearing 3 and is provided with a pinion 5 engaging two spur gears 6 and 7. Gears 6 and 7 preferably engage pinion 5 at diametrically opposite positions.

Gear 6 is fixedly secured to a shaft 10 rotatably supported in axially spaced antifriction bearings 8 and 9, and gear 6 transmits its rotation through shaft 10 to a bevel gear 11 also fixed on shaft 10. Bevel gear 11 engages a bevel gear 13 fixedly secured on a cylinder 12, and gear 13 is rotatably mounted through the medium of an antifriction bearing 14.

Cylinder 12 is provided with an inner bore 12a, and its jacket has openings 12b and 12c which constitute air compensation openings. The front or tool facing end 15 of cylinder 12 is threaded to receive a guide bush 16 which, together with cylinder 12, is radially and axially positioned by an antifriction bearing 18 mounted in a tube 17 secured to gear housing 1. Guide bush 16 has a bore extending completely axially therethrough, and this bore has a polygonal cross section, for example, a hexagonal cross section, in order to provide for axial movement, while restraining relative rotation, of a tool holder 19. Thus, tool holder 19 is axially movable in bush 16 but fixed against rotation relative to bush 16. The tool facing end of shaft 19a of tool holder 19 terminates in a collar 19b, and a snap ring 20 is provided between the ends of the tool holder 19a and its transition from a cylindrical cross section to a polygonal cross section, tool holder shaft 19a includes a conical portion 19c.

A percussion piston 21 is axially displaceable in bore 12a of cylinder 12, and percussion piston 21 is controlled by a driving piston 23 through the medium of an air cushion in tool holder chamber 22, this air cushion being alternately under overpressure and underpressure. Driving piston 23 has arranged therein a journal or pin 24 serving as a bearing for one end of a connecting rod 26 whose other end is secured to a pin or journal 25a on a crank shaft 25. Crank shaft 25 is supported in bearings 27 and 28, and is driven by motor pinion 5 through gear 7 which is fixedly secured on shaft 25. The hammer drill, and particularly its motor, can be started or stopped by a switch 30 arranged in a grip handle 29.

In accordance with the invention, an adjusting sleeve 31 is mounted on the front portion of tube 17, and sleeve 31 has a radially inwardly directed end portion 31a which can be brought into operative engagement with collar 19b of tool holder 19. A screw 32 is threaded into tube 17, and is engaged in recesses 33, 33a and 33b of adjusting sleeve 31 so that sleeve 31 can have only a limited axial and angular displacement on tube 17, as will be apparent from FIGS. 2 and 3.

Sleeve 31 is under the bias of a spring 34 having one end bearing on the bearing 18 and its other end bearing on a disk 31b which is axially displaceable and rotatable on a portion of tool holder shaft 19a. In order to prevent penetration of sand and the escape of lubricants, gaskets 35a are provided in adjusting sleeve 31, and gaskets 35b and 35c are provided in tube 17.

4. The method of operation of the electro-pneumatic hammer drill embodying the invention will now be described. With the motor running, the rotation of pinion 5 is transmitted through gears 6, 7, 12, and thus to guide bush 16 which turns tool holder 19 due to the interfitting polygonal cross section portions of these two elements. The rotation of pinion 5 is transmitted through gear 7 to the crank drive comprising crank shaft 25 and connecting rod 26, and this reciprocates driving piston 23. Percussion piston 21 is also reciprocated, by the reciprocating driving piston 23 and through the air cushion in chamber 22. To make certain that no damping cushion can be formed during rotary-percussion drilling, in cylinder chamber 12a between percussion piston 21 and guide bush 16, air compensating holes 12b are provided in the jacket of cylinder 12. These are preferably so arranged that they are covered by percussion piston 21 in a non-snorting operation, when the latter has passed and opened the air holes 12c opening into cylinder chamber 22, so that an air cushion is formed in cylinder chamber 22 to absorb the kinetic energy of percussion piston 21.

If adjusting sleeve 31 is not locked by engagement of screw or bolt 32 in one of the recesses 33a or 33b, spring 34 biases adjusting sleeve 31 in the direction of the tool, as shown in FIG. 3. Thereby, screw 32 is at the intersection of the axes or center lines of recesses 33 and 33a. Through its end face 31a of adjusting sleeve 31, in turn, presses tool holder 19 in the direction of the tool, so that tool holder shaft 19a does not extend into cylinder chamber 12a. With the machine thus connected, tool holder 19 rotates while driving piston 23 reciprocates in chamber 22.

If tool holder shaft 19a does not extend into cylinder chamber 12a, percussion piston 21, driven by driving piston 23 through the compressed air cushion, moves sufficiently far in the direction of the tool that it covers compensating holes 12b and opens bores 12c (see FIG. 3). Due to the uncovering of bores 12c, underpressure can no longer be produced in cylinder chamber 22 during the return of driving piston 23. For this reason, percussion piston 21 no longer is moved. Thus, the tool performs only a rotary movement. Due to the rotary movement, adjusting sleeve 31 is rotated by frictional forces until the end of recess 33a engages screw 32, so that tool shaft holder 19 and adjusting sleeve 31 are locked in the rotary drilling position. When the machine is pressed against the work to be drilled, the pressure is absorbed by adjusting sleeve 31.

By turning adjusting sleeve 31 opposite to the direction of rotation of tool holder 19, the sleeve is unlocked and screw 32 is thus again at the intersection of the longitudinal axes or center line of recesses 33 and 33a. If adjusting sleeve 31 subsequently is moved, against the bias of spring 34, toward gear housing 1 and to the position where screw 32 is at the intersection of the longitudinal axes or center lines of recesses 33 and 33b, and turned in the direction of rotation of the tool, adjusting sleeve 31 is locked by engagement of screw 32 in recess 33b, the sleeve thus being locked in the rotary-percussion drilling position. If the hammer drill is now started and pressed against the material, tool holder 19 is displaced until conical portion 19c engages guide bush 16. Tool holder shaft 19a thus extends so far into cylinder chamber 12a that compensating holes 12b no longer can be covered by percussion pistons 21 and bores 12c can no longer be uncovered (see FIG. 1). The overpressure or underpressure necessary for moving percussion piston 21 now can be built up so that percussion piston 21 strikes against tool holder shaft 19a. Responsive to removal of the contact pressure against the work, percussion piston 21 displaces tool holder 19 so far out of cylinder chamber 12a that the reciprocation of percussion piston 21 opens the compensating holes 12c, so that the tool holder now performs only a rotary movement, Due to
resistance, for example, during extraction of the drilling tool from the bore, tool holder 19 can move further in the direction of the tool until snap ring 20 bears against end portion 31a.

In order to facilitate drilling of brittle or fragile material, adjusting sleeve 31 is turned to the rotary drilling position but is not locked. That is, screw 32 is at the intersection of the longitudinal axes or center lines of the recesses 33 and 33a. In this position of sleeve 31, spring 34 urges the sleeve and tool holder 19 in the direction of the tool. If the hammer drill is now applied against the work with increasing force, tool holder 19, through collar 19b and end portion 31a of adjusting sleeve 31, moves this sleeve against the bias of spring 34 and in the direction of gear housing 1. At the same time, tool holder shaft 19a is projected into cylinder chamber 12a. With the hammer drill running, the shaft 19a of the tool holder is in a position in which percussion piston 21 begins to strike, with reduced force, since it no longer covers the compensating holes 12c. By applying greater pressure on the hammer drill, the striking force can be increased until the conical portion 19c of tool holder 19 engages guide bush 16, with screw 32 being again at the intersection of the longitudinal axes or center lines of recesses 33 and 33b of sleeve 31. In this position, adjusting sleeve 31 is again turned by the rotating tool holder and locked in screw 32 engaging in recess 33b, the locking being effective in the rotary-percussion drilling position.

What is claimed is:

1. In an electro-pneumatic hammer drill switchable between rotary-percussion drilling and rotary drilling, and of the type including a casing, a rotary and axially reciprocable tool holder, in the casing, and a tool having a shank mounted in the holder, a cylinder, a pneumatic piston reciprocated in the cylinder by the motor through a crank drive, and a free percussion piston reciprocated in the cylinder by the pneumatic piston through an air cushion in the cylinder, the kinetic energy of the free percussion piston being transmitted abruptly to the tool holder or the tool shank, the cylinder having air compensating openings in its jacket and the reciprocation of the free percussion piston being limited by an inner impact end of the tool holder or the tool shank; the improvement comprising means, including a sleeve axially displaceable on said casing and operably connected with said tool holder and said tool to adjust the axial position thereof relative to said free percussion piston; said sleeve being continuously axially displaceable, even during tool operation, to adjust the axial position of said inner impact end, relative to said percussion piston, between a position in which the inner impact end is out of the range of action of said percussion piston and a position in which said inner impact end is wholly within the effective range of action of said percussion piston, to provide switching of said hammer drill between rotary-percussion drilling, with full percussion, and rotary drilling, with no percussion.

2. In an electro-pneumatic hammer drill switchable between rotary-percussion drilling and rotary drilling, the improvement claimed in claim 1, in which said means includes a spring biased said sleeve in the direction of the tool.

3. In an electro-pneumatic hammer drill switchable between rotary-percussion drilling and rotary drilling, the improvement claimed in claim 1, in which said means includes locking means controllable with said sleeve to lock said sleeve selectively at least in the axial position thereof corresponding to rotary-percussion drilling and the axial position thereof corresponding to rotary drilling.

4. In an electro-pneumatic hammer drill switchable between a rotary-percussion drilling and rotary drilling, the improvement claimed in claim 1, in which said sleeve has a radially inwardly extending lip at its tool facing end and closely embracing said tool holder, said lip engaging a shoulder on said tool holder.

5. In an electro-pneumatic hammer drill switchable between rotary-percussion drilling and rotary drilling, the improvement claimed in claim 2, including a spring biased said sleeve to engage said lip with said shoulder.

6. In an electro-pneumatic hammer drill switchable between rotary-percussion drilling and rotary drilling, and of the type including a casing, a rotary and axially reciprocable tool holder, in the casing, and a tool having a shank mounted in the holder, a cylinder, a pneumatic piston reciprocated in the cylinder by the motor through a crank drive, and a percussion piston reciprocated in the cylinder by the pneumatic piston through an air cushion in the cylinder, the kinetic energy of the percussion piston being transmitted abruptly to the tool holder or the tool shank, the cylinder having air compensating openings in its jacket and the reciprocation of the percussion piston being limited by the tool holder or the tool shank; the improvement comprising means, including a sleeve axially displaceable on said casing and controllable with said tool holder and said tool to control relative axial displacement thereof; the axial displacement of said sleeve continuously providing switching of said hammer drill between rotary-percussion drilling and rotary drilling; said means including locking means controllable with said sleeve to lock said sleeve selectively at least in the axial position thereof corresponding to rotary-percussion drilling and the axial position thereof corresponding to rotary drilling; said locking means locking said sleeve in either of its axial limiting positions responsive to rotation of said sleeve on said casing.

7. In an electro-pneumatic hammer drill switchable between rotary-percussion drilling and rotary drilling, the improvement claimed in claim 6, in which said locking means locks said sleeve in either of its axial limiting positions responsive to rotation of said sleeve in the direction of rotation of said tool.

References Cited

UNITED STATES PATENTS

2,988,590 1/1969 Fulp ___________ 173—48
3,114,421 12/1963 McCloud ___________ 173—14
3,161,241 12/1964 Allen et al. ___________ 173—14

ERNEST R. PURSER, Primary Examiner

U.S. Cl. X.R.

173—48, 115