

May 27, 1969

S. F. JUDD ET AL

3,446,291

CRUST BREAKER WITH AUTOMATIC AIR CONTROL VALVE

Filed March 13, 1967

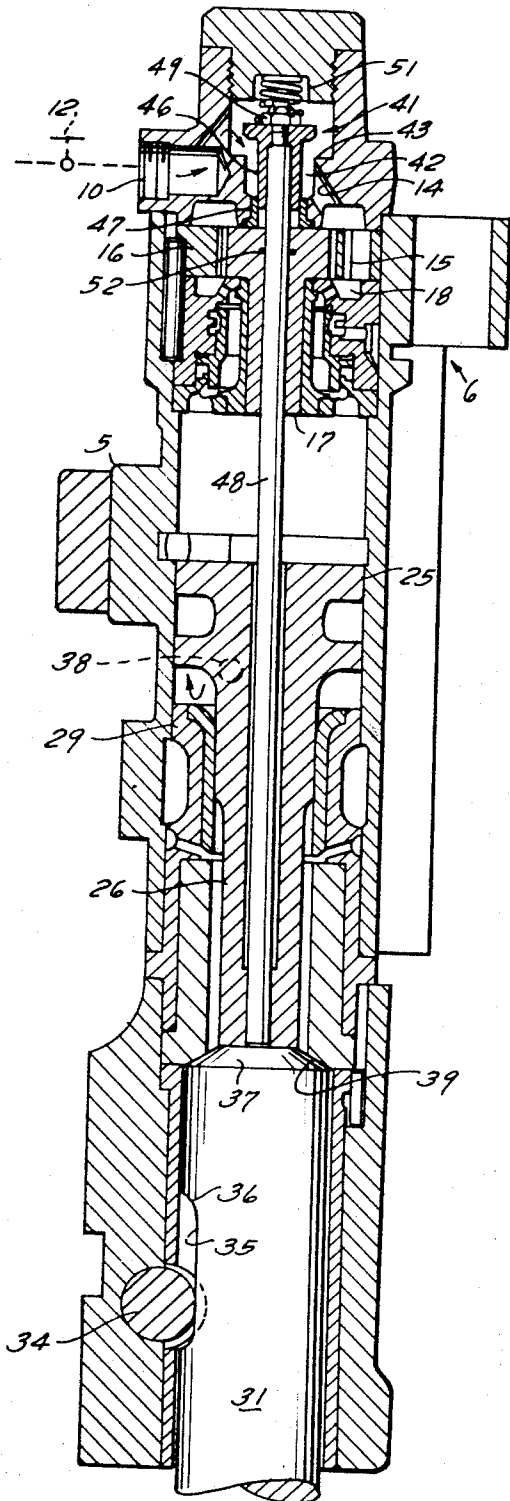


FIG. 2

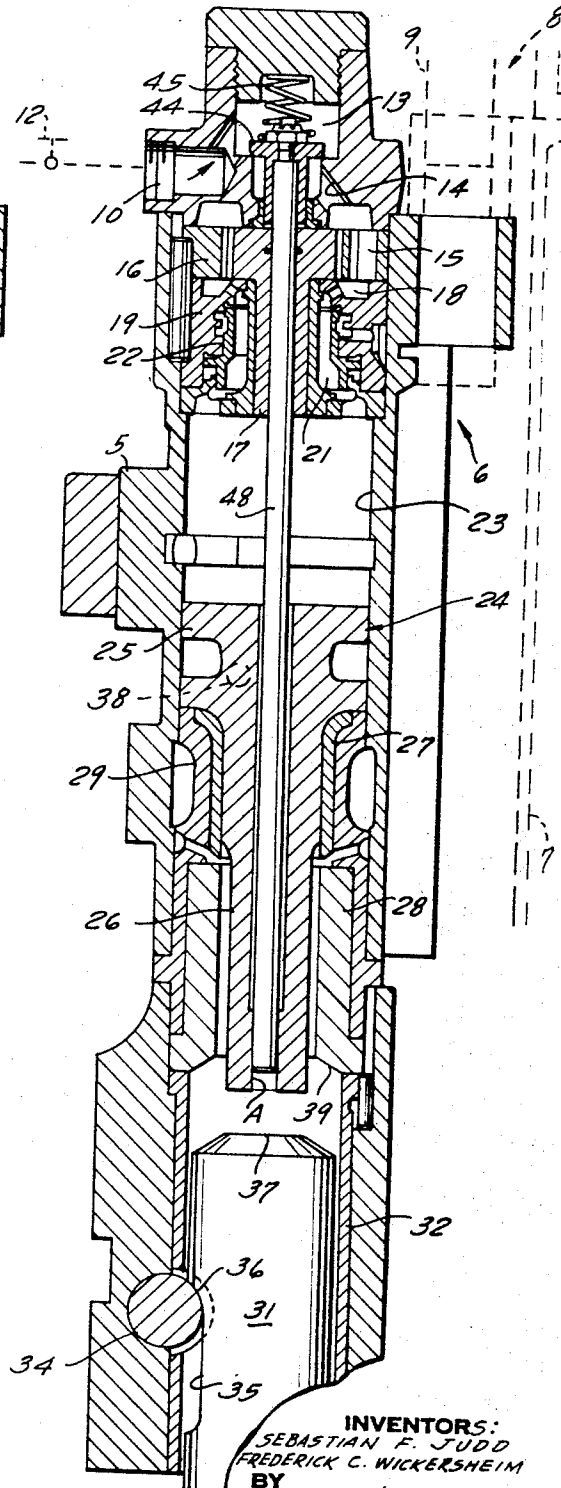


FIG. 1

INVENTORS:
SEBASTIAN F. JUDD
FREDERICK C. WICKERSHEIM
BY
Stephen J. Rudy
ATTORNEY

1

3,446,291

CRUST BREAKER WITH AUTOMATIC AIR CONTROL VALVE

Sebastian F. Judd, Whitesboro, and Frederick C. Wickersheim, Utica, N.Y., assignors to Chicago Pneumatic Tool Company, New York, N.Y., a corporation of New Jersey

Filed Mar. 13, 1967, Ser. No. 622,655

Int. Cl. E21c 3/20; B23q 5/00

U.S. Cl. 173-17

1 Claim

ABSTRACT OF THE DISCLOSURE

An improved pneumatic percussive crust breaker tool including an air-blown distributing valve for directing operating air alternately to opposite ends of a piston chamber to forcefully reciprocate a piston hammer against a work steel, and equipped with an automatic air control valve mechanism feature normally blocking flow of operating air through the distributing valve to the piston chamber adapted to be opened upon pressed engagement of the steel with the work and to be automatically returned to closed condition upon removal of the steel from the work. The valve mechanism having an association with the hammer and steel so as to be movable to open condition only after the head of the hammer has first been raised clear of the piston block upon pressed engagement of the steel with the work.

It is necessary, in order to avoid piston hammer damage to the housing in conventional crust breaker tools not equipped with the air control valve mechanism feature, to manually open the air supply valve after the tool has been pressed into engagement with the work to clear the head of the hammer from the piston liner. It is also necessary, so as to avoid piston hammer damage to the housing in conventional tools, for the operator to manually close the usual air supply valve before the tool is withdrawn from the work, or to timely close it when the steel has broken through the hard crust into a soft area. The control valve mechanism feature of the crust breaker tool of the present invention avoids the foregoing faults. It remains closed until the tool is properly positioned for operation relative to the work so as to open the valve; and it automatically returns to closed condition as the hammer becomes unsupported by the steel.

Control mechanism is known from Patent No. 1,102,271 for avoiding damage to a pneumatic percussive tool when the tool is not in working position; but this mechanism is a latch for restraining piston movement. Other mechanism is known from Patent 1,590,269 for automatically stopping inlet air to the hammer of a percussive tool when the bit is removed from the work. This known mechanism is a complex arrangement having a mode of operation which, unlike that of the mechanism of the present invention, does not solve the foregoing mentioned problems of crust breaker tools.

In accordance with the invention there is provided in a pneumatic percussive tool including a housing having a piston hammer chamber provided with an annular shoulder at the bottom of the chamber, a work steel slidable in a front head of the housing having a retracted position in the housing under pressed engagement with the work, a piston hammer reciprocable in the chamber to pound the steel when the latter is in its retracted position and adapted to pound the shoulder when the steel is not under pressed engagement with the work, and a distributing valve for directing supply air to the hammer chamber to reciprocate the hammer; the improvement comprising an automatic air control valve having a spring load biasing it to closed condition so as to block operating air

2

flow to the distributing valve when the steel is not under pressed engagement with the work, a slidable abutment engageable by the steel to raise the control valve to open condition against the load of its spring when the steel is retracted into the tool under pressed engagement with the work, and means for insuring that the hammer is clear of the shoulder before the control valve is opened.

In the accompanying drawings:

FIG. 1 is a vertical sectional view of a crust breaker tool embodying the invention showing the tool in its relaxed or non-operating condition; and

FIG. 2 is a view similar to that of FIG. 1 but showing tool in its normal operating condition.

In the drawing is disclosed a pneumatic percussive crust breaker tool having an elongated housing 5 formed by means of a plurality of sections bolted in end-to-end relation. The housing is provided with means 6 along its backside for mounting the tool in conventional manner for slidable travel along an elongated guide shell 7 for crust breaking operations. The usual operator controlled tool feed mechanism, a fragmentary portion of which is generally indicated at 8, is fixed to the shell and has a piston rod 9 connected with the housing of the tool selectively operable to feed the tool along the shell into pressed engagement with the work, or to withdraw the tool from the work.

An inlet passage 10 in a backhead section of the housing is connectable through a supply line valve 12 with a source of pressure air. Passage 10 communicates with an inlet chamber 13. The latter connects through a passage 14 and ports 15 in the circular head 16 of a stationary plug 17 with a passage 18 leading through a valve case 19 into a distributing valve chamber 21. The valve case underlies the head 16 of the plug; and it has an axial opening filled by the plug 17. A conventional air distributing slide or air-blown valve 22 operates in well known manner in the valve case to direct live air entering the valve chamber alternately to opposite ends of a piston chamber 23 to reciprocate a piston hammer 24. This reciprocating action continues automatically in well known manner as long as live air is fed to the valve.

The hammer has a piston head 25 from which axially depends an elongated stem 26. As the hammer reciprocates, its head moves in the piston chamber, and its stem moves through an upper liner 27 and a lower chuck sleeve 28 fitted in corresponding ends of an open ended piston bushing or block 29. The piston block is rigid with the housing. As the hammer reciprocates, the forward end of its stem normally pounds a work steel 31 against the work, which work in the case of a crust breaker tool would be the accumulated hard crust (not shown) in a metal producing electrolytic cell pot.

The steel is slidable axially of a bushing or liner 32 fitted in a front-head section of the housing. A retainer pin 34 extending transversely of the housing and through a longitudinal trough 35 of the steel is cooperable with a rear shoulder 36 of the trough to limit the extent of forward movement of the steel and to prevent endwise escape of the latter from the housing. The steel has a working tip, broken away, projecting externally of the front head of the housing for engagement with the work.

In a fully relaxed condition of the tool (FIG. 1), as when the steel is not pressed against the hard work, the piston hammer has a dropped or foremost position wherein its head 25 abuts the shoulder defined by the upper end of the piston block 29 and the free end of its stem 26 projects out of the piston block below the chuck sleeve 28 and axially part way into the liner 32 of the front head. And, the steel 31 has a dropped or foremost position, wherein its shoulder 36 limits upon the retainer pin 34, and a beveled head 37 at its rear end is disposed below and out of the striking range of the stem of the hammer.

In this fully relaxed condition, the piston head 25 obstructs free flow of air from the distributing valve through the side housing port 38 to the bottom end of the piston chamber so as to require the air to bleed around the piston head to get to its underside. This causes slow starting action.

When the steel is pressed against the hard work, because of a constant forward pressure exerted by the feed mechanism 8 upon the housing, the steel will be retracted or forced rearwardly in the front head until its beveled head 37 seats upon a complementary seat 39 formed in the bottom of the chuck sleeve. In this rearward movement, the steel will engage the stem 26 of the hammer and move it rearwardly to carry the piston head 25 clear of the piston block 29. In this condition, free air flow is provided through port 38 to the bottom end of the piston chamber. During normal operation of the tool, that is, as long as the steel is held pressed against the hard work, the head of the hammer will be held in a well known manner (FIG. 2) rearwardly of the piston block by the steel; so that as the hammer reciprocates and pounds the steel, the head of the hammer will remain clear of and will not pound the piston block. Should the steel be caused to pound the block for some reason, the rebound of the hammer will move it clear of port 38.

In conventional crust breaker tools not equipped with the automatic air control mechanism valve 41, hereinafter to be described, if live air is applied to the distributing valve 22 to cause reciprocation of the hammer before the steel has been pressed by the feed mechanism 8 against the hard work and retracted to carry the head of the hammer clear of the piston block, the hammer will be repeatedly reciprocated to pound the piston block until the supply line valve 12 is closed by the operator. This undesirable pounding will be transmitted through the piston block to the housing, and may result in cracking of the housing or other serious damage. Also, if during operation of the tool, the steel should suddenly break through the hard work crust into a soft or vacant area, the steel may move sufficiently away from the hammer to allow the latter to repeatedly pound the piston block until the operator intervenes to close the supply line valve. The general objective of the automatic control valve mechanism 41 incorporated into the tool is to avoid this destructive action; and to avoid the necessity of the operating manually opening or closing the supply line valve, as previously required, to re-start or stop the reciprocating action of the piston hammer.

The automatic control valve means 41 includes a counterbore 42 at the bottom of the inlet chamber 13, the juncture of which with the inlet chamber provides an annular valve seat 43. The opening of the valve seat communicates through the counterbore with the side passage 14. The latter leads through the side wall of the counterbore to the passages 18 leading to the distributing valve chamber. An air control slide valve 44 operating in the inlet chamber is constantly urged by an overhead spring 45 to closed condition on the valve seat 43 so as to block flow of operating air from the inlet chamber to the distributing valve. An axially depending tubular stem 46 of the control valve 44 has axial slidable movement in a guide bushing 47 fitted in a recess at the bottom of the counterbore 42. The valve stem 46 is substantially smaller in diameter than the counterbore so as to permit a free and unobstructed flow of air from the inlet chamber to the side passage 14 when the control valve is open.

The control valve is axially mounted atop an elongated slide rod 48. The upper end of the rod is sleeved by the valve stem. A nut 49 drawn tightly upon a reduced threaded end of the rod holds the valve rigidly to the rod. The overhead spring 45 is retained against being laterally displaced under pressure of air entering the inlet chamber by means of the nut which projects into one end of the spring and by means of the surrounding wall of a recess 51 at its other end. The rod depends slidably and axially

through the plug 17 and the hammer. The elongated plug 17 serves to guide the movement of the rod; and tends to avoid side to side vibration or "chattering" of the rod during operation of the tool. An O-ring seal 52 in the plug seals against leakage of pressure air around the rod to the piston hammer chamber 23. When the steel is pressed against the hard work, the head end 37 of the steel is cooperable with the bottom end of the rod 48 to slide and hold the control valve 44 raised clear of the valve seat against the resistance of spring 45.

When the steel and piston hammer are in their fully relaxed or foremost positions (FIG. 1), as when the steel is not pressed against the hard work, the control valve is closed upon its seat under the load of its spring. In this closed condition of the valve the rod 48 depends to a position in the hammer short of the end of the stem, as indicated by the distance A in FIG. 1. This structural arrangement is of decided advantage in that it enables the head of the hammer to be first lifted an initial distance clear of the piston block by a pressed rearward movement of the steel and supported in that position before the steel can engage the rod 48 and force the control valve to open condition. After the piston hammer has been initially elevated to carry its head clear of the piston block, then, as the steel is further retracted, it engages the rod to lift the control valve to open condition and simultaneously raises the head 25 of the hammer further relative to the piston block to the position shown in FIG. 2. This arrangement serves to allow a desirable smooth starting operation of the hammer. As the piston head is raised, it uncovers the side port 38 so as to allow, when the control valve is next opened, desirable air flow to the underside of the piston head. In providing an initial elevation of the piston head 25 before permitting the control valve to open, premature reciprocation of the hammer, as might otherwise occur, is avoided.

The operation of the crust breaker tool as improved by the automatic air control valve feature 41 is as follows: The operator initially opens the supply line valve 12 to allow entry of operating air to the inlet chamber 13. This is a step which normally would not be taken by the prudent operator of a conventional unimproved crust breaker tool unless the steel were first pressed into engagement with the hard work. But now this step can be taken before the steel is pressed against the work because of the automatic control valve feature which is normally closed under the load of its spring to block flow of operating air from the inlet chamber to the distributing valve. Next, the tool is pressured in conventional manner against the hard work to cause the steel to move rearwardly against its seat 39 to a retracted position for pounding by the hammer. In its rearward movement, the work steel will first engage and move the stem of the hammer rearwardly to carry its head an initial distance clear of the anvil block corresponding to the distance A. Then it will also engage the rod 48 and will move the hammer further rearward simultaneously with the rod. Movement of the rod forces the control valve open against the resistance of its spring. Operating air then flows from the inlet chamber to the distributing valve to reciprocate the hammer. As long as the steel is held pressed upon the work, it will be retracted and maintain the control valve in open condition against the resistance of the return spring, as in FIG. 2.

Now, if during operation of the tool the steel should suddenly break through the hard work crust into a soft or vacant area, the steel will project forwardly clear of both the stem 26 of the hammer and the control valve rod 48 to limit upon the retainer pin 34. The control valve return spring 45 will expand in response to this action of the steel to close the control valve. This action immediately stops further application of air to the piston chamber and stops further reciprocation of the hammer, thus avoiding the possible damage to the tool that might otherwise happen were it not for the automatic control

5

valve feature. Further, when it becomes necessary to withdraw the tool from the work, the control valve will be automatically closed by its spring as the rearward pressure of the steel upon the control valve rod is relaxed.

What is claimed is:

1. A pneumatic percussive crust breaker tool including a housing having a piston hammer chamber provided with annular shoulder means at its bottom, a work steel axially slidable in a front end of the housing having under pressed engagement with the work a retracted position in the housing, a guide shell slidably supporting the tool, power means for selectively sliding the tool along the shell to carry the steel into or away from pressed engagement with the work, a piston hammer reciprocable in the chamber to pound the steel when the latter is in its retracted position and adapted to pound the shoulder means when the steel is not under pressed engagement with the work, the hammer having a position engaging the shoulder means and extending axially into the path of movement of the steel so as to be moved by the steel away from the shoulder means when the steel is retracted, an air-blown reciprocating distributing slide valve means for directing supply air alternately to opposite ends of the chamber to reciprocate the hammer, a plug fitted axially

6

of the valve means, an automatic air control valve having a spring load biasing it to a normally closed condition so as to block supply air flow to the valve means, a slidable rod engageable by the steel to raise the control valve to open condition against the spring bias when the steel is retracted under pressed engagement with the work, the rod extending axially of the tool through the plug, and the hammer having a position extending axially into the path of movement of the steel relative to the slidable rod so that the steel has cooperation with the hammer when retracted to move it away from the shoulder means prior to the steel engaging the slidable rod.

References Cited

UNITED STATES PATENTS

1,586,865	6/1926	Wade	173—15
1,713,784	5/1929	Slater	173—17
2,559,282	7/1951	Curtis	173—11
3,305,953	2/1967	Von Mehren et al.	173—15

FOREIGN PATENTS

420,171	4/1924	Germany.
---------	--------	----------

ERNEST R. PURSER, *Primary Examiner.*