

Dec. 14, 1965

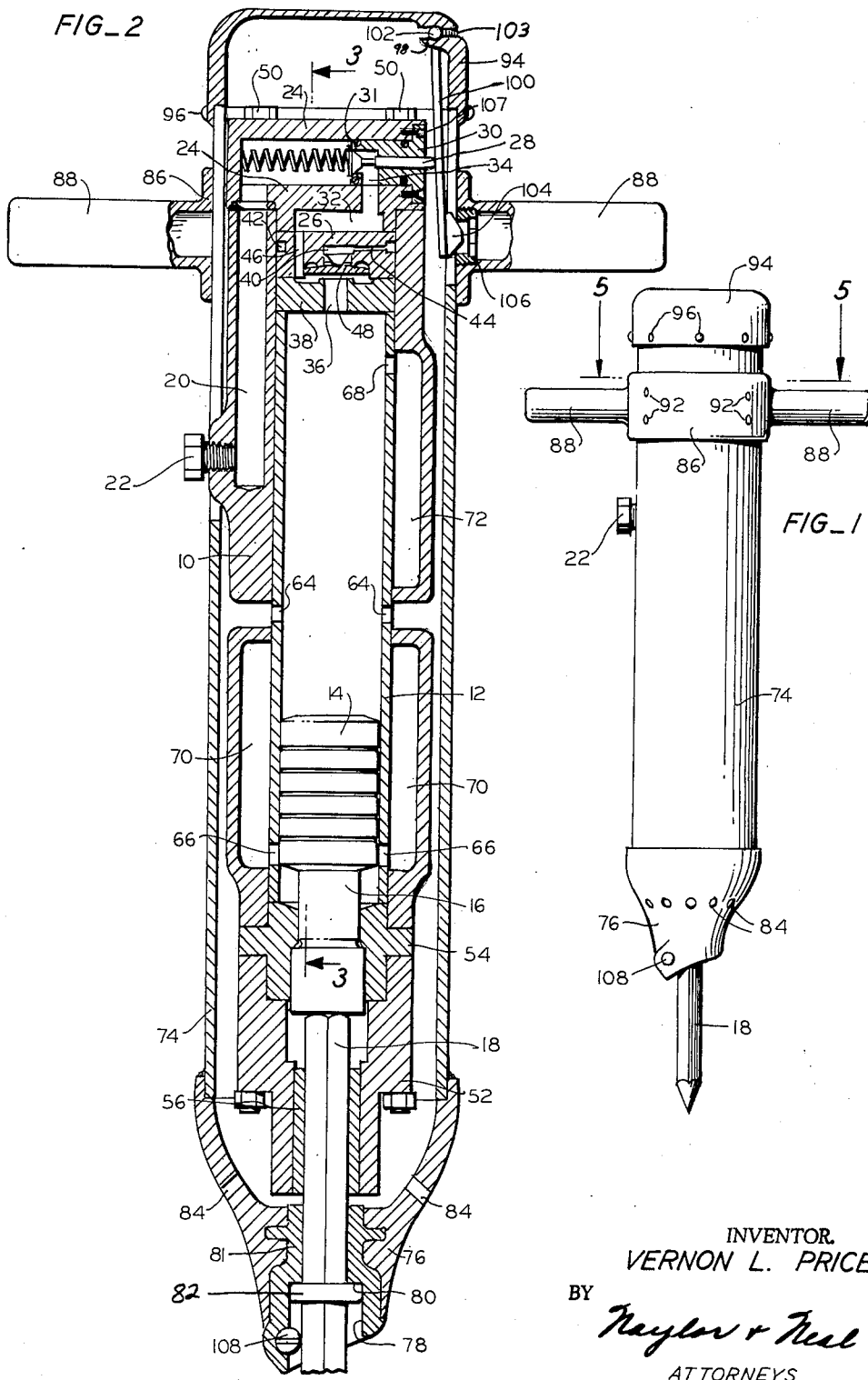
V. L. PRICE

3,223,181

VIBRATIONLESS AIR HAMMER ASSEMBLY

Filed March 27, 1962

2 Sheets-Sheet 1



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FIG_3

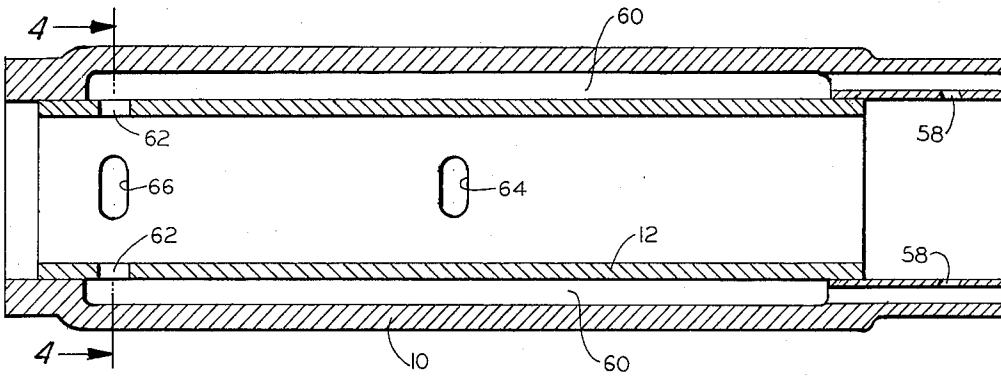


FIG_4

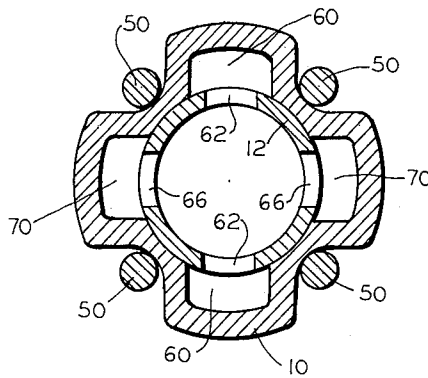
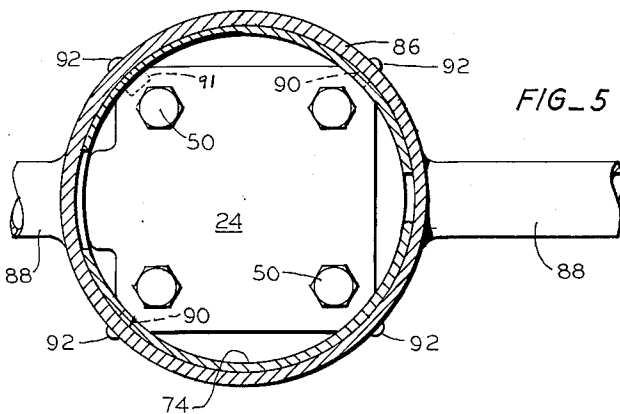


FIG_5



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VIBRATIONLESS AIR HAMMER ASSEMBLY
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11 Claims. (Cl. 173-18)

This invention relates to pneumatic tools and more particularly to pavement breakers.

In my earlier patent No. Re. 23,104, I have disclosed a pavement breaker structure in which recoil transmitted to the operator of the breaker is substantially reduced. In that structure, the manipulating handles of the breaker are connected to the percussion tool bit, or gad, with the air motor portion of the breaker mounted for free floating movement on the tool. This structure permits the operator to merely hold the tool in place while the air motor delivers downwardly directed blows to the tool bit; the operator does not feel the recoil of the air motor because there is no positive connection between the air motor and tool bit by which upward thrust from the air motor can be transmitted to the tool bit.

The present invention relates to improvements in pavement breakers which are of primary importance in breakers constructed in accordance with my above-mentioned reissue patent but which have substantial utility in power tools of other designs.

Thus, for instance, the present improvements include a generally rigid muffler which substantially reduces the noise normally inherent in the operation of pavement breakers, but this muffler has the additional functions in breakers of my prior invention of providing the rigid connection between the handle assembly and tool bit while permitting a worker to support the breaker against his leg with his leg shielded from the free floating air motor.

The improvements include a new handle assembly and valve mechanism which operates to close the air supply to the breaker when the tool bit, or gad, passes through the material being broken thereby preventing the air motor from delivering damaging blows to its lower parts or to the unrestrained tool bit. In the breakers of my prior invention, this new handle assembly and valve mechanism also permits the free floating air motor to move within a shielding without disturbing the setting of the valve mechanism as the motor moves.

The improvements also include a new structure for the air motor itself whereby the motor may be fabricated much more efficiently than could motors heretofore, and this new structure is particularly useful where the motor is to be used in accordance with my prior invention and is to be made as compact as possible for mounting within the shielding or muffler.

It will also be seen that these and other improvements disclosed herein are not only particularly useful in the pavement breakers of my prior invention, but also, they are particularly useful with each other, cooperating together as they do to provide a compact shielded tool in which a valve in the air motor is controlled remotely by the handle assembly mounted on the shield.

It is an object of this invention to provide muffler means for pneumatic pavement breakers which will substantially reduce the sound incident to the operation thereof without impairing the breaker's efficiency in operation.

It is another object of the invention to provide a pavement breaker with means for closing its air supply automatically when its tool bit passes through the material being broken so that the breaker will not damage itself by delivering blows against itself or its unrestrained tool bit.

It is another object of the invention to provide a pneumatic pavement breaker which may be constructed as efficiently and economically as possible, and in which all air

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passageways and chambers may be integrally formed in as compact a space as possible.

It is another object of the invention to provide a pneumatic pavement breaker in which the principle of my prior invention may be employed to best advantage.

Other objects and advantages of the invention will become apparent from the following description read in conjunction with the attached drawings in which:

FIG. 1 is a view in elevation of a pavement breaker constructed in accordance with the principles of this invention;

FIG. 2 is a view similar to FIG. 1, but in longitudinal sections and on a larger scale;

FIG. 3 is a longitudinal sectional view of two components of the apparatus of FIG. 2 and taken along a plane perpendicular to the view in FIG. 2;

FIG. 4 is a cross sectional view of several of the inner components of the breaker taken along the plane indicated at 4-4 in FIG. 3, and

FIG. 5 is a cross sectional view of the outer components of the breaker taken along the plane indicated at 5-5 as in FIG. 1.

Referring now in detail to the drawings and particularly to FIG. 2, the breaker is made of a cast body 10 having a cylindrical sleeve 12 shrunk fit therein with the sleeve defining a path of reciprocation for a piston 14 which strikes a tappet 16 at the lower end of the sleeve 12, and the tappet 16 transmits the blows from the piston to a pavement breaking tool bit or gad 18 on which the breaker is supported.

The body 10 has an air supply passageway 20 therein with an air hose fitting 22 firmly fastened to the body 10 in communication with the air supply passageway 20. Upper and lower valve bodies 24 and 26 respectively are mounted at the upper end of the body 10 with the valve body 24 carrying a spring loaded radially movable valve member 28 which cooperates with a valve seat member 30 to permit manual control of the air supply to the breaker. The valve seat member 30 is provided with O-ring seals 31. The lower part of valve body 24 forms a central chamber 32 therein communicating by a passageway 34 with the manually controllable valve. The lower valve body 26 is mounted just below the chamber 32, and a valve cap 38 on the top of sleeve 12 just under the valve body 26 with the cap 38 and valve body 26 defining a chamber 40 therebetween.

The valve body 26 has a peripheral passageway 42 therearound which communicates with the chamber 40 through a plurality of radial passageways 44 and a plurality of axial passageways 46 extend through the body 26 connecting the chambers 32 and 40. In this regard it should be noted that for the sake of simplicity of illustration, a passageway 44 and a passageway 46 are illustrated as being in the same plane, but in fact, four of each of these passageways are provided with each passageway 44 being positioned away from two adjacent passageways 46 by an angle of 45 degrees around the longitudinal axis of the breaker. An automatic alternator valve element is mounted in the chamber 40 and provided with a plurality of radial passageways therein, so that the automatic valve element may move between alternate positions where first the radial passageways are sealed and no air flows through the peripheral passageway 42 while air flows through the passageway 36 and secondly to a position where the automatic valve element 48 closes the passageway 36 and provides air communication between the chamber 32 and the peripheral passageway 42.

The upper and lower valve bodies 24 and 26 are held in place on the top of the body 10 by four bolts 50 (see FIGS. 2 and 4) which extend the length of the breaker and embrace a base member 52 at the lower end of the air motor. A tappet bushing 54 is interposed between

the body 10 and the base member 52 and held rigidly in place by the four bolts 50. It should be noted that the base member 52 has a hexagonal bushing 56 in its lower end in axial alignment with the sleeve 12 and in which the shank of the tool bit 18 is received.

As indicated above, when the valve element 28 is opened and the valve element 48 is in its upper position, air is delivered to the top of sleeve 12 to drive the piston 14 downwardly to deliver a blow to the tool bit 18. The piston 14 is returned to the top of the sleeve 12 by movement of the valve element 48 to its lower position so that air is delivered to the peripheral passageway 42 of the valve element 26 and hence, through apertures 58 (see FIG. 3) in the body 10 and elongated lateral passageways 60 which are formed between the body 10 and the outer wall of the sleeve 12. The sleeve 12 is provided with ports 62 adjacent to its lower end to permit the air flowing through passageways 60 to enter the sleeve 12.

The sleeve is also provided with a pair of apertures 64 about midway in its length which communicate with the exterior of body 10 and provide for the discharge of air from the breaker during the working strokes. The sleeve is also provided with a pair of lower ports 66 and an upper port 68 which communicate respectively with a pair of lower bounce chambers 70 and an upper bounce chamber 72 which are formed between the body 10 and the sleeve 12.

The elements thus far described, absent the tool bit or gad 18, comprise an air motor for delivering repetitive blows to the tool bit 18. Briefly stated, the air motor functions in the following manner. A source of compressed air is connected to the air fitting 22 and the valve element 28 is moved radially inwardly of the tool to supply air to the chamber 32 and the valve body 26. With the piston 14 and valve element 48 in their lower positions, the air in the chamber 32 passes through the passageways 46 and the radial ports in the valve elements 48 and hence to the peripheral passageway 42 in the lower valve body 26. The air then passes from the peripheral passageway 42 to the lateral passageway 60 and through the ports 62 in the lower end of the sleeve 12 to supply air pressure to the lower end of the piston 14. At this time the space in the sleeve 12 above the piston 14 is in communication with atmosphere through ports 64 so that the piston 14 is driven upwardly. After the piston 14 crosses the ports 64, the air in the upper end of the sleeve 12 is compressed both in the sleeve 12 and in the bounce chamber 72 to slow down the piston's upward speed, and after the piston crosses the upper ports 68 in the bounce chamber 72, its momentum causes a sufficient increase in pressure in the upper end of the sleeve 12 that the valve element 48 is unseated and moved to its upper position. Thereafter, air is delivered from the chamber 32 to the upper end of the sleeve 12 through the passageway 36 to drive the piston 14 downwardly to deliver a working blow to the tool bit 18. At the beginning of the piston's downward movement the space in the sleeve 12 below the piston is in communication with the atmosphere through ports 64, and after the piston crosses the ports 64 the upper end of the sleeve 12 is vented while the piston compresses air in the bounce chambers 70 and lateral passages 60. It should be noted that the combined volume of the bounce chambers 70 and the lateral passages 60 is substantially greater than the volume of the bounce chamber 72 and substantially greater than the volume of the sleeve 12 below the ports 64 since it is not desirable to have the piston 14 slowed down during its downward travel by air pressure in the lower bounce chambers. As the piston reaches its lowest point of travel in the sleeve 12 the air pressure in the passages 60, aided by the movement of air from chamber 32 to atmosphere through ports 36 and 64, unseats the valve 48 and moves it to its lower position to repeat the cycle.

It will be noted that in this structure of the air motor, the air passages and chambers 20, 60, 70 and 72 are

formed integrally in the body of the tool and have substantial volume while the overall bulk of the air motor is maintained at a minimum. This character of the air motor results from the fact that it is fabricated from the separate cast outer body portion 10 with the sleeve 12 shrunk fit therein, and this arrangement of the body 10 and the sleeve 12 also provides substantial savings in labor in the fabrication of the air motor since the ports 62-68 may be made as simply as possible before the sleeve is placed in the motor 10 and since the smooth cylindrical bore in which the piston 14 travels may be provided much more easily by using a length of suitable prefabricated cylindrical pipe for the sleeve 12 than it could be provided by machining a cylindrical chamber in the body 10.

It will be noted from FIG. 2 that the air motor is supported in accordance with my above mentioned prior invention where the lower end of the air motor is not connected directly to the tool bit 18 but instead may move freely upwardly from the tool bit 18. The air motor is enclosed within a cylindrical muffler casing 74 which carries a lower cap portion 76 having a central tool bit receiving channel 78 therein with a downwardly facing shoulder 80 which embraces the customary flange 82 on the tool bit 18. The shoulder 80 is preferably defined by a hexagonal steel bushing 81 cast into the lower cap portion 76. The lower cap portion 76 is also provided with a plurality of air exhaust ports 84 from which the air discharged into the casing escapes.

A control handle assembly is mounted on the casing 74 adjacent to its upper end and includes a sleeve or collar portion 86 having lateral handles 88 thereon. The handle assembly is supported on the casing 74 by four brass bars 90 (see FIG. 5) which are attached to the sleeve 86 by screws 92 and which are received in elongated slots in the casing 74 for guiding the handle assembly for vertical movement with respect to the casing 74 between upper and lower positions, the handle assembly being illustrated in FIG. 2 in its upper position. It should be noted that four bushings 91 (see FIG. 5) made of nylon or the like are mounted in radial sockets in the upper end of the air motor and extending outwardly into contact with the casing 74 to provide upper bearing surfaces along which the air motor contacts the casing as it reciprocates within the casing 74, guidance at the lower end of the air motor being provided by receipt of the tool bit 18 in the hexagonal bushing 56.

A cap 94 is mounted on top of the casing 74 by means of screws 96, and the cap carries a pair of inner lugs 98 between which a cam member 100 is pivotally mounted by a T-shaped portion 102 thereof. An adjusting screw 103 is mounted in the cap 94 contacting the T-shaped portion 102. The cam member 100 carries a cam portion 104 (FIG. 2) adjacent to its lower end which contacts a cam actuator ring 106 in one of the handles 88 to move the cam member 100 from its position in FIG. 2 inwardly to a position parallel to the longitudinal axis of the air motor responsive to movement of the handle assembly to its lower position on the casing 74. The cam member 100 is mounted in radial alignment with the upper valve element 28 so that the valve element 28 is moved radially to its open position responsive to downward movement of the handles 88. It has been found that in some types of air motors where it may be desirable to adjust the maximum opening of the manual valve for different types of work to be done by the units, it may be desirable to mount the cam actuating member 106 for radial movement in the handle 88 as by the threaded mounting shown with the member 106 accessible from the end of the handle for adjusting the position of the cam actuating member 106 with means such as a hexagonal wrench for various types of work. In the structure shown, adjustability for the manually operable valve 28 is provided by rotating the valve seat member 30 in the valve body 24. Thus, the valve seat 30 is cylindrical in shape and is attached to

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the valve body 24 by screws 107 which pass through arcuate passages in the valve seat member 30. The screws 107 may be loosened, the valve seat member 30 rotated, and the screws 107 retightened to change the cross-sectional area of the passageway 34 at the interface between members 24 and 30. In this manner, a time balanced, hard-hitting stroke may be secured at full throttle and at different air supply pressures.

When the pavement breaker described above is to be used for a particular pavement breaking operation, the desired percussive tool bit is inserted up through the hexagonal channel 78 in the lower cap portion 76, a suitable tool retaining device such as the rotary latch 108 being provided for this purpose, and the operator of the breaker may support the weight of the breaker with the handles 88 while guiding the tool into the proper position with his knee placed against the side of the casing 74. He then presses the handles 88 downwardly which causes the cam member 100 to open the valve 28 and start operation of the air motor. The air motor will then deliver a series of blows to the upper end of the tool bit 18 while the operator applies a downward force to the tool bit 18 by pressure from his hands transmitted from handles 88 to the casing 74 and hence to the flange 82 on the tool bit through the shoulder 80. This action of the operator in holding the tool against the work not only gives the operator a feel for the progress of the tool in the work, but also greatly reduces the metal to metal noise as well as the metal to concrete noise so distressing in other types of tools. Upon each downward stroke of the piston 14, a reactive upward force is imparted to the body of the air motor, but this recoil is not felt by the operator of the tool because the air motor is permitted to reciprocate upwardly within the casing 74 during this portion of the stroke. While the air motor is in operation, air is discharged into the casing 74 from the ports 64 and flows through the casing 74 to be discharged downwardly through the ports 84; it has been found that the provision of the casing around the air motor also reduces the noise incident to the discharge of air from the port 64 to a substantial extent. In this regard, substantial reduction of the noise has been obtained without the use of any baffles of sound deadening insulation in the casing 74 though, of course, such insulation could be used.

When the pavement breaker is being employed to drive the tool bit 18 through hard pavement, or as is more common practice, for breaking a segment of pavement away from the edge of a hole, the tool bit 18 when it passes through the final portion of the pavement will fall into soft dirt under the pavement or into the hole which is being enlarged so that the casing 74 falls downwardly through the sleeve 86 of the handle assembly permitting the cam portion 104 of the cam member 100 to enter the aperture in the cam actuating member 106 and thereby automatically close the air supply to the air motor. This automatic closure of the air supply to the air motor will prevent subsequent blows of the piston from striking the tappet bushing 54 and possibly damaging the same or delivering blows to the unrestrained tool bit 18 which might cause the flange 82 on the tool bit 18 to damage the tool retainer 108. It has been found that this automatic shut-off action of the breaker is sufficiently rapid, but it may be made even more rapid by providing suitable spring means interconnecting the casing 74 and handle assembly for resiliently urging the handle assembly upwardly.

A pavement breaker constructed substantially as described above has been tested by a potential customer and compared to the standard model pavement breaker of substantially the same weight which they use extensively in their normal operations. In these tests the two breakers were used to drive the same broken squared-off tool bit into a lead pan while the breakers were connected to the same source of compressed air and while the volume of air used by each breaker was measured. The two

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breakers were used alternately for five-second tests with the broken-off tool bit being switched from one breaker to the other between tests and with each breaker used to make separate holes. After three tests of each breaker, the standard breaker had a total of 5.750 inches of work done and was rated as using air at the rate of 68 cubic feet per minute, while the breaker described above had a total of 6.156 inches of work done and was rated as using air at the rate of 42 cubic feet per minute.

While one specific embodiment of this invention has been illustrated and described in detail herein, it is obvious that many modifications thereof may be made without departing from the spirit and scope of the invention.

I claim:

1. A pavement breaker comprising a cast body portion having upper and lower ends and a central elongated passageway extending vertically therein, an elongated cylindrical sleeve mounted in said central passageway and having cylindrical interior and exterior surfaces with said exterior surface embraced within said central passageway, a lateral passageway defined between said sleeve and said body and extending substantially the full length of said sleeve, an air port in said sleeve adjacent the lower end thereof communicating with said lateral passageway, an air exhaust port in said sleeve substantially midway between the ends of said sleeve and communicating with the exterior of said body, a percussion tool bit mounted in the lower end of said body in axial alignment with said sleeve, a piston reciprocally mounted in said sleeve and adapted to deliver a blow to said tool bit when said piston approaches the lower end of said sleeve, an air supply passageway in the upper end of said body portion and having a selectively operable valve therein, an alternator valve for connecting said air supply passageway alternately to the upper ends of said sleeve and said lateral passageway, upper and lower air chambers defined between said body and said sleeve and upper and lower ports extending from said upper and lower air chambers respectively to the interior of said sleeve adjacent to the upper and lower ends of said sleeve respectively, the combined volume of said lower chamber and said lateral passageway being substantially greater than the volume of said upper chamber.

2. A pavement breaker comprising a cast body portion having upper and lower ends and a central elongated passageway extending vertically therein, an elongated cylindrical sleeve mounted in said central passageway and having cylindrical interior and exterior surfaces with said exterior surface embraced within said central passageway, a lateral passageway defined between said sleeve and said body and extending substantially the full length of said sleeve, an air port in said sleeve adjacent the lower end thereof communicating with said lateral passageway, an air exhaust port in said sleeve substantially midway between the ends of said sleeve and communicating with the exterior of said body, a percussion tool bit mounted in the lower end of said body in axial alignment with said sleeve, a piston reciprocally mounted in said sleeve and adapted to deliver a blow to said tool bit when said piston approaches the lower end of said sleeve, an air supply passageway in the upper end of said body portion and having a selectively operable valve therein, an alternator valve for connecting said air supply passageway alternately to the upper ends of said sleeve and said lateral passageway, said body of said pavement breaker having a tool bit receiving channel at the lower end thereof in axial alignment with said sleeve with said tool bit received in said channel for longitudinal movement with respect to said body, a generally cylindrical and rigid casing surrounding said body and having upper and lower cap portions which define a chamber with said body mounted for longitudinal movement therein and with said exhaust port communicating with said chamber, air discharge means extending out of said chamber, tool retainer means in said lower cap

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portion including a central passageway communicating with said channel and surrounded by a downwardly facing shoulder, said tool bit extending through said passageway in said tool retainer means and having a flange thereon engaging said shoulder, and handle means mounted on said casing adjacent to said upper cap portion.

3. The pavement breaker of claim 2 characterized further in that said selectively operable valve has a valve element movable generally radially of said body for opening said valve, and said handle means includes a sleeve mounted on said casing adjacent to said upper cap portion for longitudinal movement between upper and lower positions, a handle mounted on said sleeve, and actuating means for opening said valve when said sleeve is moved to said lower position which includes a cam member mounted in said casing in engagement with said valve element for movement between an inward position extending generally parallel to the axis of said casing and an outward position and having a cam portion engaging said sleeve for moving said cam member to said inward position responsive to movement of said sleeve to said lower position.

4. The pavement breaker of claim 2 characterized further by the inclusion of valve actuating means connected to said selectively operable valve and movable radially of said casing between on and off positions where it maintains said selectively operable valve opened and closed respectively, said handles being movable axially of said casing into engagement with said actuating means to move said valve to said on position and manually operable adjusting means mounted in said handles movable radially of said casing for adjusting the distance by which said handles move said valve for adjusting the cross-sectional area which said air supply passageway has when said valve actuating means is in said on position.

5. In a pavement breaker having a tool bit receiving channel at its lower end an air motor adapted to contact a tool bit in said channel with said motor having air supply control means adjacent to its upper end, air delivery means, and a percussion member in communication with said channel for delivering blows to said tool bit responsive to the flow of air from said air supply control means to said air delivery means, the improved muffler and support means which comprises: a generally cylindrical and rigid casing surrounding said motor and having upper and lower cap portions which define a chamber with said motor mounted for longitudinal movement therein and with said air delivery means communicating with said chamber, air discharge means extending out of said chamber at a position substantially remote from said air delivery means, said lower cap portion on said casing having tool retainer means therein including a central passageway through which said bit extends and surrounded by a downwardly facing shoulder adapted to contact a flange on said bit and handle means mounted on said casing adjacent to the upper end thereof.

6. The improved pavement breaker of claim 5 in which said air supply control means includes a valve element movable laterally inwardly of said body for opening the supply of air to said motor; said handle means includes a sleeve mounted on said casing adjacent to said upper cap portion for longitudinal movement on said casing between upper and lower positions and a handle mounted on said sleeve; and said sleeve and valve element are interconnected by valve actuating means which include a cam member mounted in said casing in engagement with said valve element for movement between an inward position extending generally parallel to the axis of said casing and an outward position and having a cam portion engaging said sleeve for moving said cam member to said inward position responsive to movement of said sleeve to said lower position.

7. The improved pavement breaker of claim 6 characterized further by the inclusion of adjusting means

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mounted on said handle assembly for adjusting the position to which said cam member is moved responsive to movement of said sleeve to said lower position.

8. In an improved pavement breaker having a muffler casing portion with upper and lower cap ends, a percussion tool bit mounted in said lower cap end of said body, an air motor assembly mounted within said muffler casing for longitudinal movement therein and having an air supply control valve mounted in said air motor adjacent to said upper end, and a percussion piston member in said air motor in axial alignment with said tool bit for delivering blows to said tool bit when said air supply control valve is open; the improved means for supporting and controlling said breaker which comprises handle means mounted on said muffler casing portion adjacent to said upper end and movable longitudinally on said casing between upper and lower positions, and remote control actuating means interconnecting said handle means and said control valve for maintaining said control valve open when said handle means is in said lower position regardless of the position of the reciprocating air motor with respect to the casing and closing said control valve when said handle means is moved to said upper position.

9. In a pavement breaker having a longitudinal body portion with upper and lower ends, a percussion tool mounted in said lower end of said body, and an air motor assembly mounted in said body for longitudinal movement therein and having an air supply control valve adjacent to said upper end and a percussion member in said motor in axial alignment with said tool for delivering blows to said tool when said air supply control valve is open; the improved means for supporting and controlling said breaker which comprises a sleeve mounted on said body adjacent to said upper end for free longitudinal movement on said body between upper and lower positions, handle means mounted on said sleeve, and actuating means interconnecting said sleeve and said control valve for opening said control valve when said sleeve is moved to said lower position and closing said control valve when said sleeve is moved to said upper position with said actuating means providing substantially constant control of said control valve as said air motor assembly moves longitudinally of said body.

10. In a pavement breaker having a muffler body portion with upper and lower ends, a percussion tool bit mounted in said lower end of said body, and an air motor assembly mounted in said body for longitudinal movement therein and having an air supply control valve mounted in said air motor adjacent to said upper end and having a valve element movable laterally of said body for opening said valve, and a percussion piston in said air motor in axial alignment with said tool bit for delivering blows to said tool when said valve is open; the improved means for supporting and controlling said breaker which comprises a sleeve mounted on said muffler body adjacent to said upper end for longitudinal movement on said body between upper and lower positions, handle means mounted on said sleeve, and actuating means for opening said valve when said sleeve is moved to said lower position and closing said valve when said sleeve is moved to said upper position which includes a cam member mounted in said muffler body in sliding engagement with said valve element for movement between an inward position extending longitudinally of said body and an outward position and having a cam portion engaging said sleeve for moving said cam member to said inward position responsive to movement of said sleeve to said lower position.

11. A pavement breaker comprising a percussion tool bit and an air motor mounted on said bit and having an elongated bore therein, a rigid muffler casing fully enclosing said motor at the top of said motor and over substantially all of the side area of said motor with said

muffler casing and said tool bit cooperatively enclosing said air motor at the bottom of said air motor, a piston reciprocable in said bore in axial alignment with said bit for delivering blows to said bit, upper and lower ports in said bore, an air supply passageway in said motor having a selectively operable valve therein, an alternator valve in said motor for connecting said air supply passageway alternately to said upper and lower ports to reciprocate said piston when said selectively operable valve is open, valve actuating means connected to said selectively operable valve and movable between on and off positions to maintain said selectively operable valve opened and closed respectively, an air exhaust port leading from said air motor into said casing, and an air discharge port leading from said casing at a position remote from said exhaust port.

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