

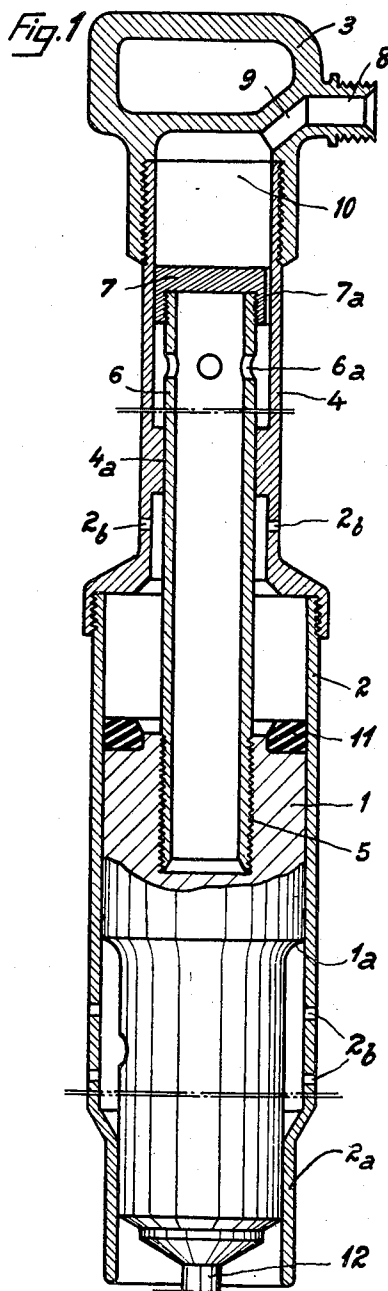
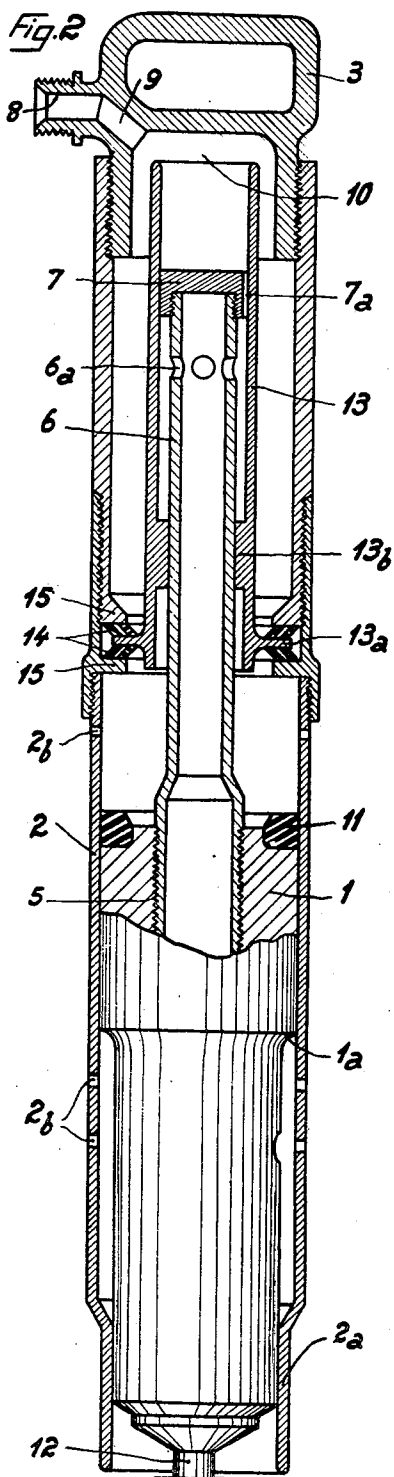
Sept. 11, 1956

P. A. SALENGRO
PNEUMATIC TOOLS

2,762,341

Filed Dec. 4, 1951

5 Sheets-Sheet 1



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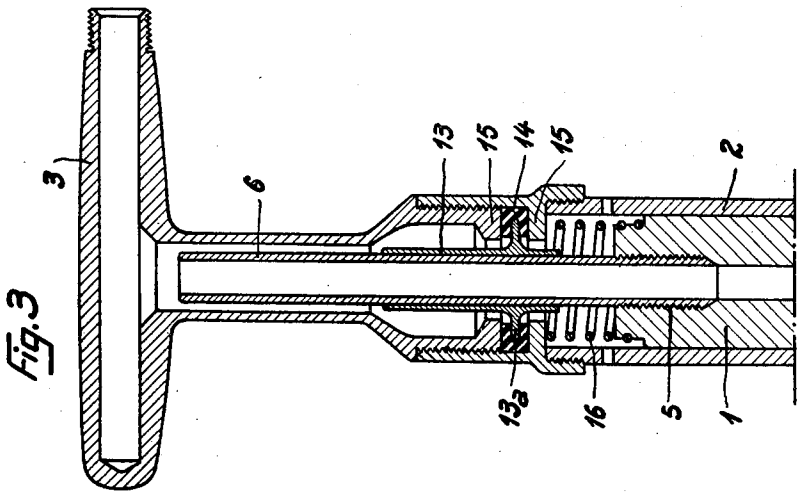
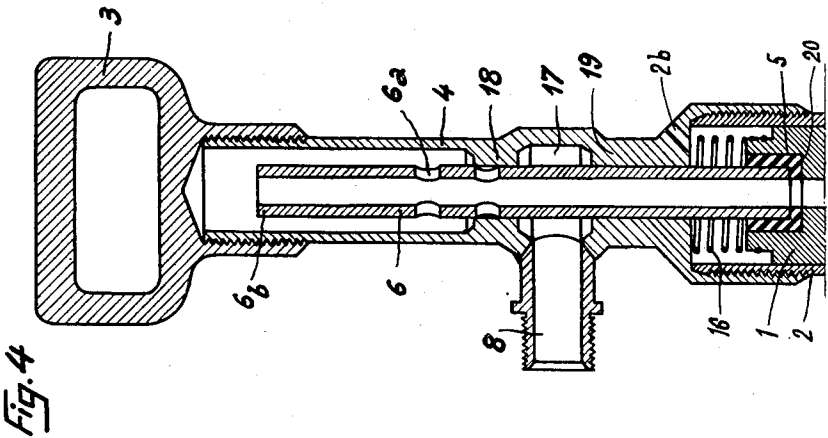
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P. A. SALENGRO
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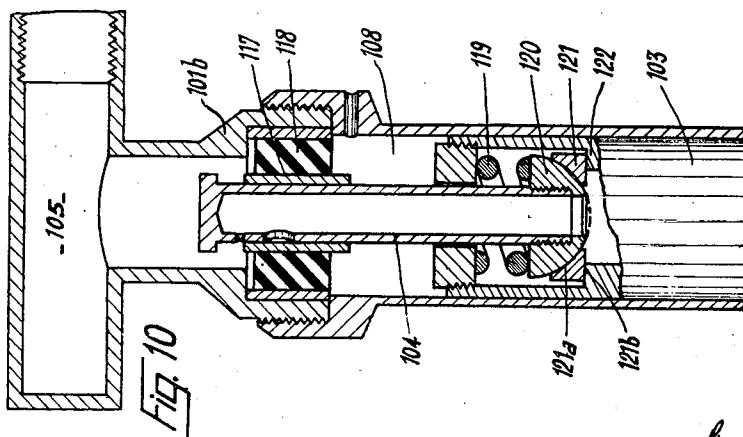
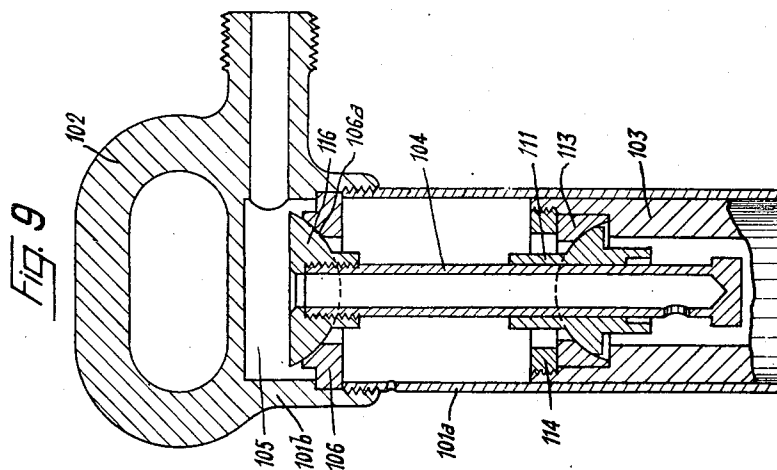
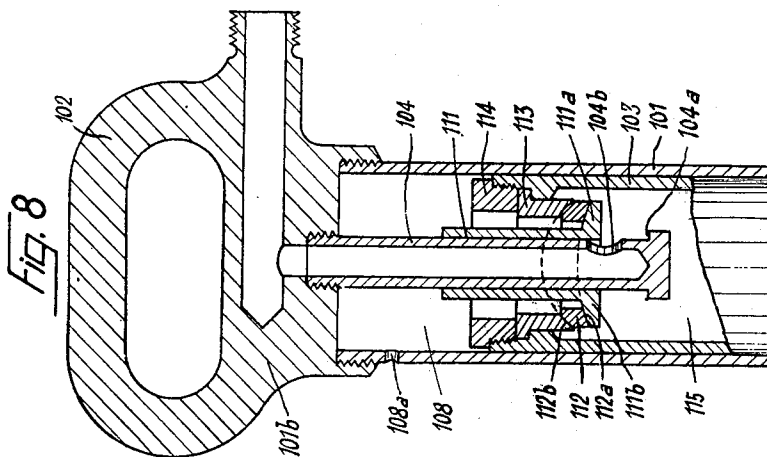
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5 Sheets-Sheet 4



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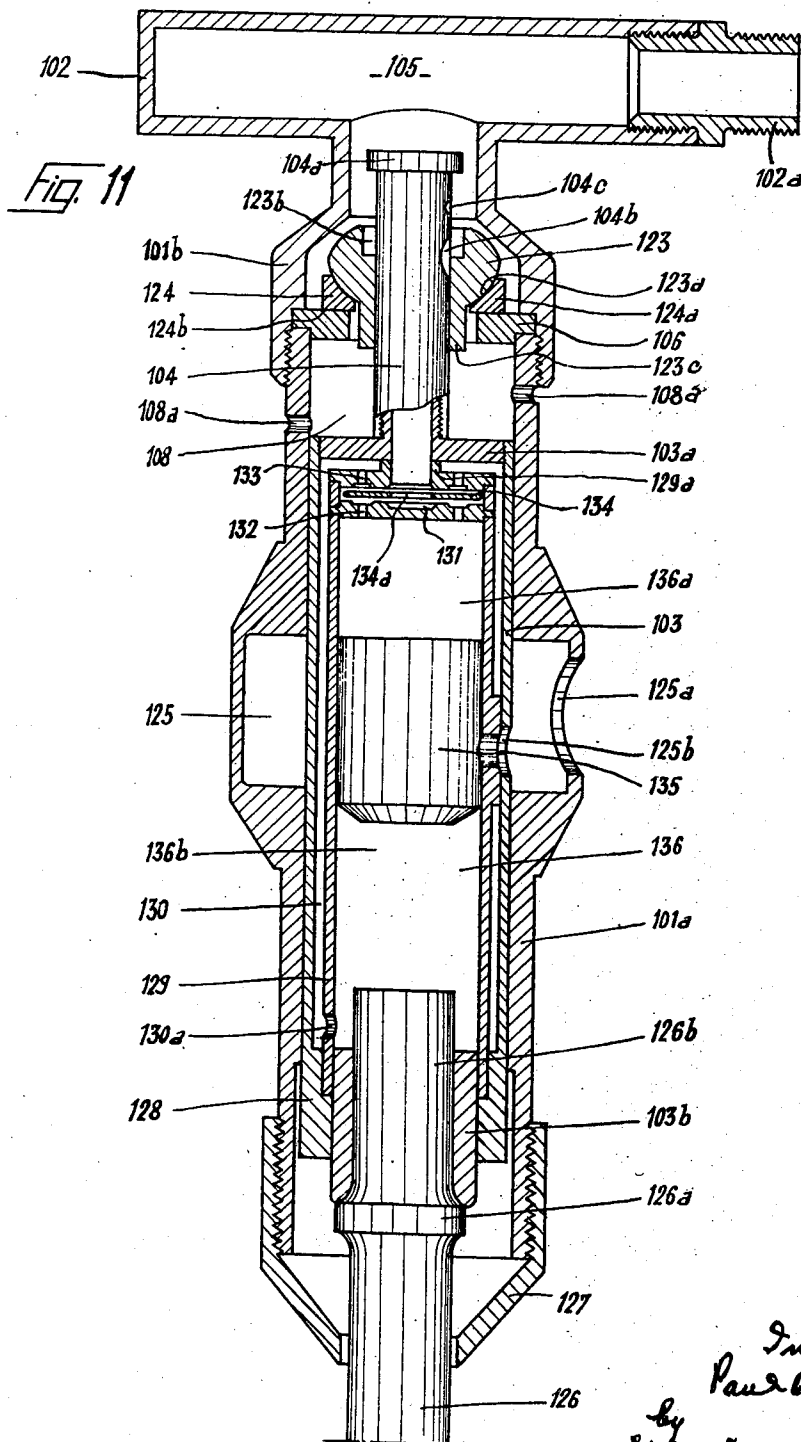
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5 Sheets-Sheet 5



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1

2,762,341

PNEUMATIC TOOLS

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Claims priority, application France December 7, 1950

8 Claims. (Cl. 121—36)

This invention relates to pneumatic tools, more especially percussion tools such as drilling hammers or picks and the like.

It is well known that in the use of air-driven percussion tools, violent and objectionable vibrations are transmitted to the operator. Various means have been proposed for attenuating this condition. The operating handle or grip and the motor of the tool are usually provided in separate elements mounted for sliding reciprocation with respect to each other, with damping means, such as springs or means providing a cushion of compressed air, interposed between said elements to absorb the shocks therebetween.

In one type of design utilizing such known damping means, a small chamber or cavity is provided between the two relatively movable elements including the grip and the motor of the tool, said chamber communicating through a restricted passage with the source of compressed air. One of said elements constitutes a cylinder and the other a piston cooperating therewith. As the two movable elements are relatively moving inwardly or towards each other, the air contained in the chamber will tend to be expelled back to its source through the said restricted passage, thus developing a throttling effect which effectively damps the vibrations. However, because of the necessarily small length of the chamber, should the amplitude of the vibrations or the force exerted by the operator exceed a definite safe range of values, parts of the relatively movable elements will strike each other and the desired shock absorbing action will be made ineffective.

As a remedy to this condition, it has been endeavored to design the device so that, regardless of the amplitude of the relative displacements between the piston and cylinder of the shock absorbing arrangement, there will always remain therebetween a certain minimum volume of compressed air, so that, in the case of large vibrations, the desired shock absorption will be produced by elastic compression of the air cushion rather than by the throttling action previously described.

Damping devices of this latter kind are not satisfactory however, for, both when the damping effect is produced by throttling of the air flow and when it is caused by compression of an air cushion, it is impossible fully to eliminate reaction forces transmitted to the grip of the tool and hence to the operator. Moreover, the amplitude of the relative motion between the movable elements is so reduced that efficient damping cannot be obtained over a sufficiently wide range.

It is an object of this invention to provide an improved pneumatic tool, and one in which vibrations are more satisfactorily damped than hitherto.

According to the invention, a pneumatically operated tool is provided wherein the requisite damping function is not performed either by throttling the air flow or by elastically compressing a restricted body of air, but rather by interposing between the percussive motor and

2

the grip elements of the tool a body of air which communicates without any appreciable loss of pressure with the source of compressed fluid, and which body of air is accordingly at a substantially constant pressure. As a result of this arrangement, the operator holding the grip of the improved tool has only to exert thereon the thrust required to balance the constant reaction force resulting from the supply air pressure, and consequently is not subjected to any vibrations.

In the improved pneumatic tool of the invention, the grip element is provided with a chamber therein communicating through comparatively wide passage means with a supply of pressure air, so that the air is subjected to no substantial loss of pressure in flowing from said supply to said chamber. The air is led to the motor of the tool through a calibrated tube the total flow section of which is so predetermined as to impart to the force acting to move the motor element of the tool away from the grip element thereof a value consistent with the mean force which the operator will have to exert on the grip in operation.

This arrangement makes it possible to impart large relative displacements to the grip and the motor elements of the tool, and makes for a highly efficient damping as well as great flexibility in operation. Means are preferably provided for mounting the calibrated tube in sealed relationship regardless of the amount of angular play which the motor element of the tool may in service assume with respect to the casing rigid with the grip in which said motor element is adapted to reciprocate. For this purpose, the calibrated tube, which may be rigidly connected either with the motor or the casing element, or alternatively may be mounted with a certain amount of freedom with respect to both said elements, has means associated with it which may be in the form of resilient seals, or rigid means provided with flat and/or part-spherical cooperating sliding surfaces arranged to remain in mutual engagement regardless of the angling which the tube may assume in service. Desirably the calibrated tube may be arranged to further control the flow of compressed air into the drive mechanism of the tool, said flow being cut off whenever the operator is not exerting a predetermined minimum pressure on the grip of the tool, and also, if desired, whenever the operator applies on the grip a pressure in excess of a predetermined maximum.

The described arrangement may be said to possess a two fold advantage. It enables the operator correctly to adjust the operation of the device and practically eliminates no-load operation, thus substantially increasing the efficiency of the tool at the same time as it allows the weight of the tool to be substantially reduced through elimination of the means conventionally designed to take up the momentum of the piston of the tool under idle or no-load operating conditions, which means may herein be replaced simply by limit stop means whose sole function will be to prevent the bit or similar tool member from falling out of the casing during handling.

In the accompanying diagrammatic drawings, which illustrate by way of example some embodiments of the invention:

Fig. 1 is a longitudinal section of a particularly simple form of pneumatic pick constructed in accordance with the invention,

Figs. 2 and 3 are longitudinal sectional views of pneumatic picks wherein the seal around the calibrated tube is provided by resiliently mounted means,

Fig. 4 is a partial axial section of a pick wherein the calibrating tube controls the impact at the end of the stroke.

Fig. 5 is a partial axial section of a pick wherein the seal between the calibrated tube and the liner in which

3

the motor of the pick reciprocates is provided by a plurality of elements slidable relatively to and applied against one another by air pressure,

Fig. 6 is a similar view of a pick wherein the sealing means comprises a deformable seal,

Fig. 7 is a view partly in elevation and part in section of a pick wherein the sealing means includes a part-spherical surface cooperating with a complementary surface of the liner,

Fig. 8 is a partial axial section of a pick wherein the pressure-reducing tube is supported from the grip element rather than from the motor element of the pick, the seal being provided by seal elements contacting one another through part-spherical surfaces,

Fig. 9 is a partial axial section of a pick wherein the pressure reducing tube is rigidly supported neither by the grip nor by the pick motor, but is applied against the handle by means including a spherical joint, similar means being provided for the seal with respect to the pick motor,

Fig. 10 is a similar view of a pick wherein the pressure reducing tube is resiliently slidable within the tubular casing extending from the grip and is connected to the pick motor by means of sliding seal elements resiliently applied against said motor, and

Fig. 11 is a general axial section of a pick according to the invention.

In each of the several embodiments of the invention illustrated, the percussive motor 1 of the pneumatic pick, which may comprise a pneumatically actuated reciprocating piston mechanism of conventional construction of the kind shown in Figure 11, is mounted within a cylindrical sheath or casing 2 rigidly secured to a grip 3. The motor 1 is freely slidable in the casing 2 and means are provided for preventing the motor from sliding out of the casing. As shown in Figs. 1 and 2, there may be provided for this purpose a restricted diameter section 2a beyond the lower end of the casing 2, adapted to serve as an abutment for a complementary shoulder 1a of the pick motor. The casing is formed with holes 2b providing a permanent communication to atmosphere from the cylinder space in which the motor is reciprocable. The casing 2 may of course be made from a plurality of separate parts for readily assembling and disassembling the unit.

As already stated, the present invention is primarily concerned with damping the violent vibrations which occur in the operation of a pneumatic tool of the class described. For this purpose, the pick motor 1 which is freely slidable in the casing 2 is arranged to be repelled outwardly of the casing by the compressed air supplied thereto by appropriate means for driving its operating mechanism. Since the pressure of this operating air is practically constant (e. g. in the approximate range of from 70 to 100 p. s. i.); the operator will only have to exert upon the grip a constant pressure as required to balance the said constant pressure exerted by the operating air, so that he will practically not be subjected to any vibrations.

If this idea is to be successfully carried out, it is essential that the motor 1 be provided with a sufficiently wide latitude of displacement to allow the damping effect of the body of air to be fully exerted over a wide operating range. Moreover, in order to reduce to a suitable reasonable value the substantially constant pressure which the operator will have to develop, it is necessary to limit the effective area on which the compressed air acts to propel the pick motor. For example, in the case of 100 p. s. i. air, said area may be in the order of from 0.3 to 0.8 square inch for tools of usual size.

The above conditions are satisfied in each of the exemplary embodiments illustrated.

In Fig. 1, the casing 2 in which the motor 1 operates is extended upwardly by a neck section 4, to the top of which the grip 3 is secured. Mounted in a central bore 5 of the motor 1 for instance by the connection shown, is a calibrated tube 6 which is adapted to slide in the neck

4

section 4 on displacement of the motor 1. Tube 6 is guided by means of a flange 4a which inwardly projects from the wall of neck portion 4 and sealingly engages the periphery of the tube, as well as by means of a cap 7 secured over the top of the tube. As may be seen from the drawing, the range of displacements of the unit comprising the motor 1 and tube 6 is comparatively large, providing for a correspondingly wide range of vibrations throughout which damping will remain effective.

The chief purpose of tube 6 is to restrict the sectional area subjected to the action of the compressed air tending to expel the motor out of the casing. In the construction illustrated the compressed air flows through an inlet connection 8 and ducts 9 into the top of a chamber 10 defined by neck section 4, grip 3 and flange 4a. The cap 7 is formed with a number of ducts 7a through which air passes to enter tube 6 through ports 6a formed in the tube adjacent the top end thereof. The total flow section of ducts 7a and ports 6a is so predetermined as to be large enough to reduce pressure losses to a minimum. In this way substantially the full pressure of the compressed air acts on a sectional area substantially equal to the external cross-section of tube 6 to operate motor 1.

In the operation of the pick, the motor 1 is subjected to varying reactions and remains at all times subjected to the action of the body of compressed air located behind (over) it, and which not only includes the air enclosed within the tool itself but also the air contained in the pressure source as well as the connecting piping.

This body of air is large enough, and the amplitude of displacements of which the relatively movable parts are capable is sufficient so that, under normal operating conditions, no moving part will strike the casing 2 or the grip 3, and ideal conditions prevail for damping the vibrations; the casing 2 serves merely as a guiding means for the motor of the pick.

In order to obviate the objectionable consequences that would arise from the exertion of excessive forces by the operator on the pick, the upper end surface of the motor 1 is provided with damping means consisting in the exemplary embodiment described of a rubber ring 11 adapted to take up any impacts that might occur between the motor and the casing, the occurrence of such damped impacts warning the operator that he is pressing too hard on the grip of the pick and should moderate his pressure.

In addition to its guiding function and to its function of restricting the flow section offered to the pressure air, tube 6 further serves for controlling the operation of the pneumatic unit. That is, in the absence of any resistance exerted on the tool or bit 12 of the pick, the motor 1 projects a maximum amount out of the casing 2, and is retained in this projected position by abutment between the parts 2a and 1a as previously described. In this condition, the ports 6a are sealed by the flange 4a. No air can then reach the mechanism of the pick, which therefore remains inoperative. As the operator presses the bit 12 against a surface to be broken up, the motor 1 is forced upwardly into the casing, ports 6a are uncovered and the pick is caused to operate. Should for any reason the resistance exerted on the bit 12 collapse, the motor 1 will be propelled to its fully projecting condition with respect to the casing, the ports will be sealed and the mechanism will be brought to a stop. The pick is therefore unable to operate under no load conditions, or even under conditions in which it is insufficiently loaded by the operator's pressure, and operating economy is thus substantially increased.

The arrangement shown in Fig. 2 operates similarly to that described in connection with Fig. 1. In Fig. 2 however, the neck section 4 is omitted and the sealing function previously performed by flange 4a is now performed by a flange 13b projecting inwardly from a cylindrical member 13 which is resiliently supported from casing 2. For example, the support is provided by a radial flange 13a of member 13 which is clamped between two rubber

5

rings 14 retained between shoulders 15 of the sheath. As shown, the opposing annular shoulders 15 may be adjusted in their mutual spacing by a threaded connection. In this embodiment, a tight seal may be obtained regardless of the play which may be assumed by the motor 1 within the casing 2. This is due to the resilient mounting of the guide tube 13.

The construction shown in Fig. 3 shows a pneumatic tool wherein the tube, resiliently guided by a tubular member 13 as in the embodiment of Fig. 2, does not serve to control the operation of the tool. It is, accordingly, necessary to provide control means which may assume any conventional form, and which for greater simplicity, have not been illustrated. In Fig. 3, the damping of impacts due to excessive pressure on the grip is provided for by a spring 16 secured to motor 1 and which spring may be so arranged as to act throughout the full stroke of the motor, or alternatively only during an end portion of said stroke.

In the construction shown in Fig. 4, a pneumatic tool is shown wherein the tube 6 serves not only to bring the operating mechanism to a standstill in no load condition, as previously described, but further serves to stop said mechanism in case the operator should exert excessive pressure on the grip 3. For this purpose, the inlet connection 8 instead of being provided in the grip 3 to communicate with the top end of the tube 6, as previously shown, is provided at a point of the neck section 4 of the casing, adjacent an intermediate point of tube 6. The compressed air supplied through connection 8 enters an annular part 17 of chamber 10 defined by two bearing surfaces or lands 18 and 19 of the neck 4. Tube 6 is formed with a number of ports 6a. The tube is rigidly guided in sealed relationship in the bearing surfaces 18 and 19, and is mounted in the bore 5 of the motor 1 through a flexible gasket 20 made of rubber or the like. The upper face of the motor 1 is acted on by a compression spring 16, which in the construction shown is adapted to act only at the end of the stroke. This device operates as follows: Under no load, the motor 1 assumes its outermost position and the ports 6a are completely covered by the land 19. The pick mechanism is therefore inoperative. As the operator presses on the grip 3, the motor 1 is caused to slide inwardly of the sheath, the ports 6a are uncovered and air enters the motor and actuates the mechanism. Should the pressure exerted by the operator exceed a predetermined limit, the tube 6 penetrates completely into the neck 4 and the lowermost ports 6a are sealed by land 18, so that the admission of air to motor 1 is cut off and the mechanism is stopped. Upon the pressure or the impact being relieved, the motor 1 is urged by the combined effect of spring 16 and gravity outwardly of the casing and normal operation is resumed. Spring 16 may of course be arranged to act as desired throughout all or part of the stroke of the pick motor, as in the preceding example.

In the various embodiments of the invention shown in Figs. 5 to 11, the pneumatic tool such as a pick, comprises, as in the previously described embodiments a casing 101 rigidly connected to a grip 102, and having a motor 103 sliding therein. Compressed air delivered through inlet 102a provided in the grip is conveyed to the motor of the pick through the calibrated tube 104.

For proper operation of the pneumatic tool, it is essential that a tight, or at least a substantially tight seal be provided between the tube 104 and the various elements through which it slidably extends for connecting the interior of the motor with the chamber 105 into which the air is delivered. It is necessary moreover, that this seal be ensured regardless of any play that may occur in the relative motion between the motor of the tool and the casing.

In the construction shown in Fig. 5, the tube 104, rigidly mounted on the motor 103 of the pick, is shown as extending with substantial clearance through a transverse

6

partition 106 mounted across the casing and clamped between suitable shoulders on the lower part thereof in which the motor 103 is slidable and on the upper part 101b to which the grip is secured, both parts being screwed, for example, to each other. The tube 104 is snugly slidable in a cylindrical bushing 107, and the requisite seal between the previously mentioned space 105 and the space 108 defined above the pick body and communicating with atmosphere through ports 108a, is provided by an intermediate insert 109 which is formed on one side with a flat surface 109a applied against a corresponding surface 107a of bushing 107, and on the other side with a concave spherical surface 109a cooperating with a complementary part spherical protuberance 106a of the wall 106.

The pneumatic tool shown in Fig. 5 operates as follows:

In the idle condition, the motor 103 is, owing to the pressure obtaining in space 105, projected fully out of the casing and shoulder 104a of tube 104 engages the upper surface of bushing 107, ports 104b and 104c of tube 104 being sealed. The drive mechanism of the pick is thus out of communication with the pressure air and remains inoperative. When the operator presses the tool unit, by means of the grip, against a surface to be broken up or the like, the pick motor is forced into the casing and tube 104 slides through bushing 107 which latter remains applied by the pressure against the wall 106, through the medium of part 109. If desired, a spring (not shown) may be provided for assisting in maintaining bushing 107 applied in this position. To operate the tool, ports 104b and 104c are uncovered in a manner to be described in fuller detail hereinafter with reference to Fig. 11.

Regardless of any degree of play that may occur between the motor 103 of the tool and the casing 101, in other words regardless of the degree of angling between tube 104 and wall 106, a tight seal is maintained between spaces 105 and 108 owing to the mutual sliding of the surfaces 107a—109a and 109b—106a over one another. It is evident that a similar result might be obtained by forming the part-spherical complementary surfaces between the parts 107 and 109, and the flat surfaces between parts 106 and 109, or by using two pairs of part-spherical surfaces between both pairs of parts.

According to Fig. 6, tube 104 is again connected with the motor 103 of the tool. The tube is again arranged to extend freely through a partition 106 clamped as in the preceding embodiment between parts 101a and 101b of casing 101, and is slidable in a cylindrical bushing 107. In the present construction, the tight seal is not entirely provided by sliding engagement, but rather by the combination, with the part 109 which as before has a flat or spherical face 109a engaging with a complementary face 107a of bushing 7, of a resilient gasket 110 which, in the construction shown, consists of a rubber ring. A diaphragm spring member or similar resilient element may be provided instead. It will be observed that part 109 may be omitted provided the gasket 110 is so arranged that it will allow a sufficient amount of displacement of bushing 107, either by deformation or by sliding displacement. The device shown in Fig. 6 operates in a manner similar to that described in connection with the embodiment of Fig. 5.

In the modification shown in Fig. 7, which again includes a tube 104 rigidly secured to the pick motor 103, the seal between spaces 105 and 108 is not made in a strictly tight way, but only approximately, by a simple sliding engagement between the complementary surfaces 106a and 107a of wall 106 and bushing 107, which surfaces may be formed in the shape of a plane or of a sphere of very large radius. A particularly satisfactory formation is provided where the surface is that of a sphere whose center *o* is located at a point approximately corresponding to the mean oscillatory center of the pick motor. The operation of the modification of Fig. 7 is similar to that of Fig. 5.

In the forms of Figs. 8 to 10, tube 104 is not rigidly connected to pick motor 103.

According to Fig. 8, the tube 104 is rigidly connected to the part 101b of the casing which carries the grip 102. The tube extends into the pick motor 103 through a guiding and sealing arrangement including a bushing 111 through which tube 104 extends for snug sliding movement therein, a flanged head portion 111a of said bushing engaging a part-spherical surface 111b formed on an intermediate washer 112 having a complementary supporting surface 112a. The washer in turn rests through a further spherical surface 112b, upon a ring 113 held by a threaded ring 114 against the motor 103. The lower end of tube 104 is provided with a shoulder 104a and ports 104b. This arrangement operates in a manner similar to that previously described, the bushing 111 being retained in engagement against part 112 owing to the differential pressure between the space 115 within the pick motor, and space 108 communicating with atmosphere through ports 108a.

As shown in Fig. 9, the tube 104 is not rigidly connected to either of the parts of the tool, but is mounted at one end by a ball-and-socket joint 116 carried by a suitable partition 106 which is interposed and clamped between parts 101a and 101b of the sheath. At its opposite end, the tube is mounted in a guide bushing 111 formed to provide a ball-and-socket joint. The guide bushing rests on a ring 113 which is held on the motor 103 of the pick by means of a threaded ring 114. The operation is the same as previously described, the pressure within space 105 acting to apply the ball 116 against the socket portion 106a of partition 106, and the pressure in space 115 acting to apply bushing 111 against its seating.

As shown in Fig. 10, the tube 104 is guided in a bushing 117 mounted in part 101b of the casing, preferably through an annular rubber gasket 118 providing a seal between spaces 105 and 108. The tube is pressed into engagement with motor 103 by a spring 119 and engages said motor through the medium of a ball member 120 cooperating with a socket member 121 formed on one side with the part-spherical socket surface 121a and on the other side with a flat surface 121b slidably cooperating with a flat shoulder 122 of the pick body. The operation is similar to that described for the previous embodiments.

Fig. 11 illustrates a general view of a pneumatic pick embodying various other improvements according to the invention in combination with the previously-described resilient damping system. This construction comprises the casing 101 including an upper section 101b secured to the grip 102 and a lower section 101a slidably receiving therein the pick motor 103. Air is delivered to the motor 103 through the calibrated tube 104 which terminates in a shoulder 104a and is formed with ports 104b and 104c. Tube 104 is guided in a bushing 123 resting through a part spherical surface 123a in a complementary socket 124a which is formed in a slidable ring 124 which in turn engages, with its flat under face 124b, a transverse partition 106 clamped between the casing sections 101a and 101b. Formed in the upper end face of bushing 123 is an annular groove 123b corresponding in dimensions to that of the shoulder 104a of tube 104. Owing to this arrangement, it will be seen that in the idle condition of the pick, as soon as the pressure exerted by the operator on the grip 102 falls below a minimum value, a perfect seal is provided between the space 105 and 108 owing to the engagement of shoulder 104a in the groove 123b.

In addition, the annular groove 123b further cooperates with the shoulder 104a as would a dashpot cylinder with its piston, thus damping the impact that might otherwise occur between shoulder 104a and the part 123 at a time when the bit of the pick encounters no obstacle before it, this dashpot effect being had owing to the air cushion retained in groove 123b. Owing to the slight

clearance present between the walls of the groove and the shoulder, this air is gradually allowed to leak off, so that at the end of a very short period of time the perfect seal mentioned above is effectively obtained.

As shown in Figs. 5, 6 and 10, tube 104 may be formed with ports 104b and 104c of different sizes, and the purpose of this arrangement will now be described. The said ports, shown as being two in number but which may of course be provided in any suitable number, may increase in size from the free end of tube 104a in order to provide one or more successive idling and intermediate power output conditions of the tool before reaching the full power output condition, owing to the fact that the holes 104c and 104b are successively uncovered, and also to the fact that the pressure air supplied is, at the beginning of the stroke, throttled between shoulder 104a and part 123.

The cylinder 101a of the sheath, in which the pick body 103 operates, defines, in an intermediate part thereof, a wide annular chamber 125 communicating with the atmosphere through windows 125a, and the port or ports 125b through which the pressure air escapes from motor 103 during operation of the tool are located in the chamber. These ports 125b are provided at such a level that, when the pick is at rest, they are sealed by the corresponding part of the cylinder 101a, thereby preventing the ingress of dirt into the operating mechanism.

The lower limit stop is suitably conformed for damping the impact at the end of the operating stroke of the pick motor. In this construction, the bushing 123 is for this purpose provided with an extension 123c adapted to be engaged by the end 103a of motor 103. On occurrence of the impact, bushing 123 is raised and compressed air enters space 108 which at this time does not, or practically does not, communicate with atmosphere any longer since ports 108a are sealed by the pick motor. Under these circumstances, the force to which the motor is subjected is determined by the section area of chamber 108, and said force which is substantially higher than the normal operating force, must be overcome by the operator before he can feel the impact. This force is comparatively high in pneumatic tools of usual construction and the present provision assures efficient protection against end-of-stroke impact. Modifications of this arrangement are further shown in Figs. 8 and 9.

The bit or similar tool 126 of the pick instead of being retained, as in conventional picks, by a member connected to motor 103, is retained by a cap 127 secured to cylinder 101a of the casing and adapted to be engaged by a shoulder 126a of the bit. The shank 126b of the bit is guided in a bushing 103b of motor 103. This arrangement is advantageous in that it imparts a wide latitude of displacement for the bit in operation, while providing for the possibility of reinserting the bit fully into the motor of the pick in idle condition. Furthermore, the danger of cap 127 coming loose is minimized since this cap is not subjected to vibrations.

The motor 103 of the pick consists of an outer casing 128 and an inner liner 129 defining between them an annular passage 130 into which air is adapted to flow to act on the under surface of the piston. This annular passage is sealed from the interior of tube 104 by known means, such as by a welded collar 129a serving to hold the liner 129 against the mouth of tube 104. Alternatively such sealing may be obtained by insertion of sealing gaskets, or further by fitting the collar in the tube, or other suitable means. At the top of liner 129 there is defined an annular chamber 131 into which the operating air is delivered and which connects on one side through ports 132 with the interior of the pick motor and, on the other, through ports 133 with the annular passage 130. Passage 130 near its lower end communicates with the interior of the motor through ports 130a. Freely mounted within chamber 131 is a valve 134 con-

sisting of a disc member formed with a central aperture 134a.

The drive mechanism just described operates as follows: In the idle condition, it can be assumed that piston 135 is located at the base of chamber 136 in the pick motor. Shoulder 104a is seated within groove 123b. As the operator presses the bit of the pick against a surface to be broken up, the bit member is pushed into the pick motor until its shoulder 126a has engaged bushing 103b, at which time piston 135 uncovers ports 130a; then the motor of the pick slides in the casing and compressed air penetrates into the drive mechanism first at a moderate rate through ports 104c, then at the full normal rate of supply both through ports 104b and 104c. Valve 134 seals ports 132 and the air flowing through annular space 130 raises piston 135. Towards the end of its upward stroke, the piston acts in the first place to compress the air contained in upper chamber 136a above it, and in the second place to uncover the exhaust ports 126b, thereby placing the lower part 136b of chamber 136 into communication with atmosphere. Under the effect of the pressure which is now set up within chamber 136a, valve 134 is lifted off its seat, seals ports 133 and uncovers ports 132, through which latter ports air enters chamber 136a and actuates the piston towards the bit. The piston during its downward stroke uncovers ports 125b. The valve 134 is applied against ports 132 and air passes into annular passage 130 through ports 133, and the operating cycle is repeated. To stop the pick, it is only necessary to raise it bodily, whereupon the motor 103 slides to its fully retracted position in the casing, and first ports 104c then ports 104b are sealed, and the supply of compressed air into the mechanism is cut off.

It will be noted that the form of construction just described provides great simplicity owing to the fact that the motor 103 and casing 101 are capable of assuming any relative angular position with respect to each other about their common axis, inasmuch as the admission of pressure air is effected centrally through tube 104 and exhaust is effected peripherally through chamber 125. Hence cylindrical parts may be used and angular positioning pins or the like may be omitted. However, the provision of angular locating means between the casing connected to the grip, and the motor of the tool, in no way interferes with the provision of the damping means previously described.

As regards the operation of pneumatic tools constructed in accordance with the teachings of the invention, experience has shown that satisfactory results are obtained when the mass m_2 of the elements rigidly connected to the grip is not too low as compared to the mass m_1 of the pick motor and elements rigidly connected thereto. By way of indication, excellent damping action has been obtained in designs where the ratio from m_2 to M (where M equals $m_1 + m_2$) is in the range of from 0.3 to 0.7.

In predetermining the force that has to be exerted for depressing the grip, a mean value, with respect to time, of the forces acting on the tool (such as a bit), which forces are due to impacts and pressures, as well as the weight of the pick motor proper has to be considered. In practice, the supply tube should be so calibrated that the motor will at all times remain retracted to a sufficient amount in the casing for providing successful operation in all cases. Naturally, the effective section area of the pressure limiting tube will vary with difference characteristics of individual picks.

It will be understood that many modifications may be made in the structural details of the embodiments shown and described without departing from the scope of invention as defined in the ensuing claims.

What I claim is:

1. A pneumatic drilling tool comprising a hollow casing element having opposing ends, one of said ends being open and grip means provided on the casing element

adjacent the other end, a percussive motor element slidably mounted in the casing element for limited movement through the open end, a partition means extending across the casing element above the open end and defining a chamber above the open end, means connecting the chamber with a source of compressed air, a tube mounted on one of the elements for conducting air from the chamber to the motor element and a bushing slidably and air-tightly circumposed on the tube and rockably and air-tightly mounted on the other of the elements.

2. A pneumatic drilling tool comprising a hollow casing element having opposing ends, one of said ends being open and grip means provided on the casing element adjacent the other end, a percussive motor element slidably mounted in the casing element for limited movement through the open end, a partition means extending across the casing element above the open end and defining a chamber with the other end, means for conducting compressed air to the chamber, a tube for conducting compressed air from the chamber to the motor element, said tube having an open end and a closed end and being provided with ports adjacent said closed end, said tube being mounted by its open end on one of said elements, a bushing slidably and air-tightly mounted around said tube and being rockably and air-tightly mounted on the other of said elements, said tube sliding relative to the bushing and having its ports located so as to be sealed off by the bushing during a predetermined movement of the motor element in said open end of the casing element.

3. A pneumatic drilling tool comprising a hollow casing element having opposing ends, one of said ends being open and grip means provided on the casing element adjacent the other end, a percussive motor element slidably mounted in the casing element for limited movement through the open end, an annular resilient member fixed in said casing element above the open end and forming a chamber with the other end thereof, a bushing mounted in said resilient member, a tube mounted on said motor element and slidably and air-tightly disposed in said bushing to conduct compressed air from the chamber to the motor element, means for conducting compressed air to the chamber, said tube having an open end attached to the motor element and a closed end and having ports provided adjacent the closed end and said ports being so located as to be closed off by the bushing for a predetermined position of the motor element in said casing element.

4. A pneumatic drilling tool comprising a hollow casing having opposing ends, one of said ends being open and grip means provided on the casing element adjacent the other end, a percussive motor element slidably mounted in the casing element for limited movement through the open end, an annular resilient member fixed in said casing element above the open end and forming a chamber with the other end thereof, a bushing mounted in said resilient member and being of less diameter than the casing element, a tube having an open end attached to the motor element, said tube being slidably and air-tightly disposed through the bushing and extending into the chamber to conduct compressed air from the chamber to the motor element, said tube having an opposing closed end of greater diameter than the internal diameter of the bushing and being provided with ports adjacent said closed end, said closed end having an axial passage establishing communication between the chamber and the ports and said passage and ports being closed off from communication by the bushing when the motor element is in a predetermined position and means for conducting compressed air to the chamber.

5. A pneumatic drilling tool comprising a hollow casing having opposing ends, one of said ends being open and grip means provided on the casing element at the other end, a percussive motor element slidably mounted in the casing element for limited movement through the open end, an annular resilient member fixed in said cas-

11

ing element above the open end and forming a chamber with the other end thereof, a tubular guide member mounted in said resilient member and extending axially of the casing element within the chamber, said guide member having opposing open ends and having an internal bushing of less diameter than the guide member, a tube having an open end attached to the motor element, said tube being slidably and air-tightly disposed through the bushing and extending axially within the guide member and having a closed upper end of greater diameter than the internal diameter of the bushing, said tube having radial ports adjacent said end and said end being formed with an axial passage in its portion beyond the internal diameter of the bushing, said passage and parts being closed off from communication by the bushing when the motor element is in a predetermined position in the casing element.

6. A pneumatic drilling tool comprising a hollow casing element having opposing ends, one of said ends being open and grip means provided on the casing element adjacent the other end, a percussive motor element slidably mounted in the casing element for limited movement through the open end, a partition means disposed transversely of the casing element above the open end and defining a chamber above the open end, means connecting the chamber with a source of compressed air, a tube mounted on one of the elements for conducting air from the chamber to the motor element, a bushing slidably and air-tightly circumposed on the tube, at least one annular member air tightly circumposed on the bushing and carried by the other of the elements, said annular member rockably supporting the bushing while ensuring an air tight connection thereof with the other of the elements and means permanently connecting the portion of said casing element between the partition means and the open end with the atmosphere.

7. A pneumatic drilling tool comprising a hollow casing element having opposing ends, one of said ends be-

12

ing open and grip means provided on the casing element adjacent the other end, a percussive motor element slidably mounted in the casing element for limited movement through the open end, a partition means disposed transversely of the casing element above the open end and defining a chamber above the open end, means connecting the chamber with a source of compressed air, a tube mounted on one of the elements for conducting air from the chamber to the motor element, a bushing slidably and air-tightly circumposed on the tube and a ring member surrounding the tube and mounted on the other element and rockably supporting the bushing on the other element.

8. A pneumatic drilling tool comprising a hollow casing element having opposing ends, one of said ends being open and grip means provided on the casing element adjacent the other end, a percussive motor element slidably mounted in the casing element for limited movement through the open end, a partition means disposed transversely of the casing element above the open end and defining a chamber above the open end, means connecting the chamber with a source of compressed air, a tube mounted on one of the elements for conducting air from the chamber to the motor element, a bushing slidably and air-tightly circumposed on the tube and said bushing having a part spherical surface, a supporting member supported by the other of the elements and having a surface complementary to the part spherical surface and on which said part spherical surface rockably rests for movement of the bushing in all directions transverse to the longitudinal axis of the casing element.

References Cited in the file of this patent

UNITED STATES PATENTS

1,048,099	Robertson	Dec. 24, 1912
1,792,888	Benedict	Feb. 17, 1931
1,924,234	Faudi	Aug. 29, 1933
2,500,036	Horvath	Mar. 7, 1950