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[54] **PNEUMATIC IMPACT TOOL**

[75] Inventors: **Vladimir Koudelka,** Roztoky u Krivoklatu; **Mirko Lada,** Prague, both of Czechoslovakia

[73] Assignee: **Naradi, Narodni podnik,** Prague, Czechoslovakia

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[30] **Foreign Application Priority Data**

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[58] **Field of Search** .... 173/139; 16/119 R; 92/85

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Primary Examiner—Werner H. Schroeder
Attorney, Agent, or Firm—Richard Low et al.

[57] **ABSTRACT**

A penumatic impact tool, in which oscillations below the frequency of 1000 cycles per second, which are detrimental to the health of the operator, are substantially reduced by the arrangement of the working cylinder as a dilation cylinder, composed of two axially aligned parts, cushioned with respect to the body of the tool.

3 Claims, 3 Drawing Figures

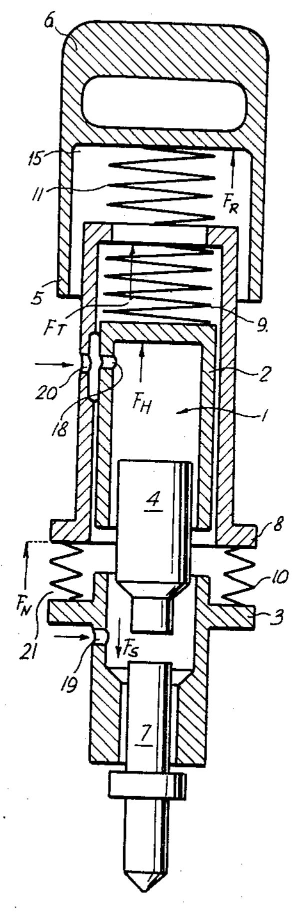


Fig.1

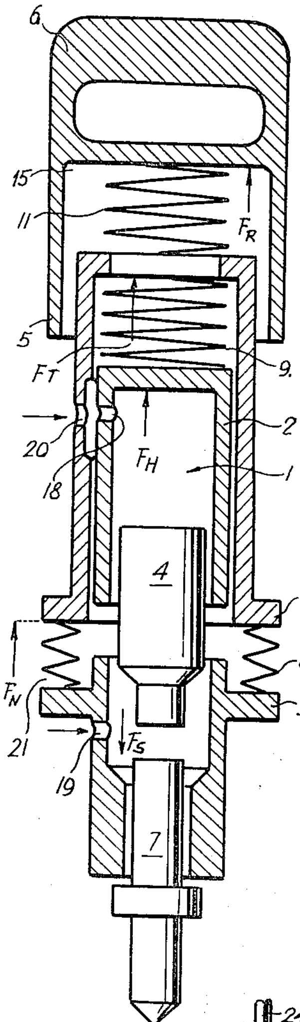


Fig.2

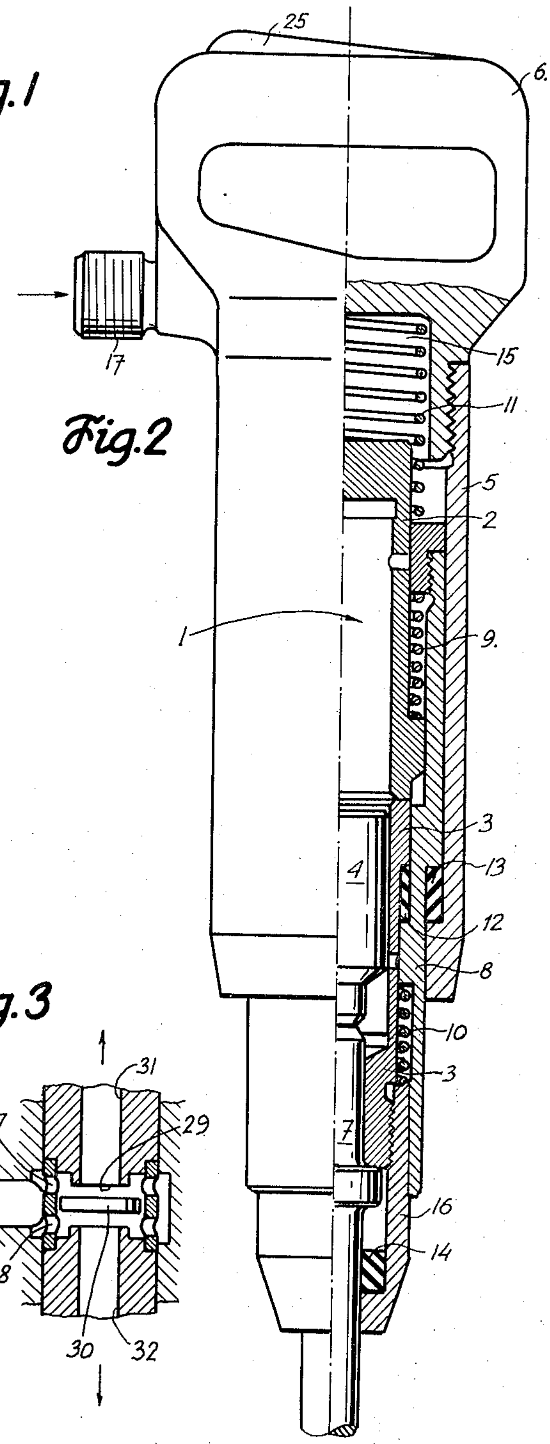
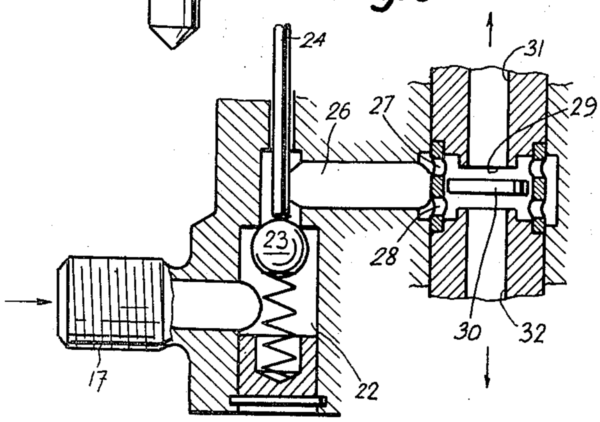


Fig.3



PNEUMATIC IMPACT TOOL

BACKGROUND OF THE DISCLOSURE

This invention relates to an arrangement in a pneumatic impact tool which solves the problem of reduction of vibrations transmitted to the handle of the tool in the course of its operation.

In pneumatic impact tools, acceleration of oscillating motion is generated over the whole range of measurable oscillations and which oscillating motion is a consequence of the fundamental operating principle and arrangement of such tools. The oscillations are caused by the movement of a piston in a working cylinder through the action of a pressure medium, generally pressurized air. The impact of the piston on the working tool, and the impact of a collar or of the front surface of the working tool against the body of the device also contribute to the creation of vibration as does the motion of the distributing means which distributes the pressure medium to the working cylinder and by a number of other factors. The individual influences react one with the other and their effects are mutually combined. They result in producing vibrations which are transmitted to the person using the tool; which from the hygienic point of view, are rather unfavourable.

By vibrations of the tool it is to be understood that there is the whole range of mechanical oscillations of the pneumatic impact tool and its parts, which oscillations are generated either as so called back strokes generated by the exciting force, or by oscillations of frequencies which although still measurable, have values of the order of ten thousands of cycles per second. Oscillations of different frequencies have different effects on an individual using the tool and their effect is determined by the capability of the individual tissues of the human body to transmit and to damp these oscillations. How far a certain frequency is detrimental to the health of individual using the tool can be determined from rules issued by health learnt from rules issued by health departments which indicate maximum acceptable levels of acceleration for each frequency or frequency range. According to these medical rules the most dangerous frequencies are the lowest, frequencies which are higher than the medium octave range at 1,000 cycles per second are not transmitted to the human body and the medical rules do not define any limitations therefor. The frequencies up to the medium octave range at 1,000 cycles per second are, therefore, decisive for consideration in determining whether the tool is suitable or harmful from the medical point of view.

There is a number of known constructions of pneumatic impact tools or of parts thereof, particularly handles, which sought to reduce vibrations of the tool and prevent their transmission to the operator. There are different arrangements which try to achieve this effect. These are primarily different arrangements for cushioning the handle with respect to the proper casing of the machine. This cushioning is achieved by different kinds of springs, by elastic material, by air cushions and by combinations of individual elements including the use of entire handle made of resilient material and the like.

All these known methods primarily reduce iscillations above the range indicated by medical rules, that is they are capable of reducing vibrations which have no substantial significance from the point of view of the health of the operator. The range of the most dangerous low frequencies is however in all cases influenced either negligibly or not at all by the prior art attempts. The contribution of these solutions is, therefore, questionable and frequently cannot be determined using common measuring means and methods of measuring and evaluating. It can be therefore summarized, that known systems for reduction of vibrations of the gripping part, that is for the handle of a pneumatic impact tool are not effective.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a pneumatic impact tool in which the oscillations of the gripping means of the tool within the low frequency range, that is within a range below 1000 cycles per second are substantially reduced.

It is another object of this invention to provide a pneumatic impact tool of reduced weight compared with similar tools, maintaining thereby the level of oscillations of the gripping means of the tool within the range below 1000 cycles per second at a suitable level.

Other objects and advantages of the invention will be apparent from the following description.

The pneumatic impact tool according to this invention comprises a working cylinder arranged as a dilatation cylinder and composed of a reaction part and a guiding part, both arranged coaxially, sliding in a body, whereby both said parts, the reaction part and the guiding part are individually cushioned with respect to said body at least one prestressed elastic element, the casing with the attached handle being arranged slidingly with respect to said body and in the axial direction cushioned by at least one prestressed elastic element.

A particularly advantageous arrangement is one in which a damping space is provided between the front wall of the reaction part of the working cylinder and the part of the casing with the handle, facing this front wall.

A combined oscillating system is thus created by the pneumatic impact tool according to this invention, which system can be mathematically evaluated preferably by using an automatic calculating machine, determining the dependence between the stiffnesses of individual resilient elements and the masses of individual oscillating parts so that the resulting acceleration of the oscillating motion on the handle of the pneumatic impact tool within the whole frequency range defined by medical rules, should be a minimum. Comparing this arrangement with actually used methods for reduction of vibrations, which try to remove only the consequences of an unsuitable constructional arrangement of the tool, the arrangement according to this invention eliminates the generation of vibrations by a new construction arrangement of the impact tool. By arranging the working cylinder as a dilatation cylinder and by a suitable cushioning of its parts, both the force acting on the working cylinder by action of the pressure medium, and the back strokes of the working tool, are not transmitted to the body in their full magnitude. Damping is also achieved by cushioning of the handle with respect to the body of the impact tool. The mantle of the impact tool with the handle connected thereto are both, therefore, vibrated by a substantially reduced force, with the consequence reduction of the acceleration level within the frequency range indicated by medical rules. The reduction of the acceleration level of oscillations within this range substantially reduces the occurance of occupational diseases such as, for instance, vasoneurosis and diseases of the joints. By reduction of vibrations on the tool proper, the use of unsuitable personal safety appliances, which make working inconvenient and the effect of which is questionable is made unnecessary. In addition the reduction of vibrations of the pneumatic impact tool according to this invention has another favourable consequence. By an elastic support for individual parts and groups of parts a more perfect contact of the working tool with the work, such as rock, is accomplished. By each stroke of the piston, the whole energy is transmitted to the work or rock and transformed to useful work contrary to other solutions, where due to a high acceleration of the oscillating motion of the whole tool only a part of the impact energy is utilized for the proper useful work and a certain part of the impact energy is not utilized at all due to rebounding of the tool. The reduction of vibrations of the tool arranged according to this invention enables a reduction of the pressing force on the pneumatic impact tool while maintaining perfect contact of the working tool with the rock, achieving a higher output of the tool with substantially reduced physical fatigue of the attendant. The attendant is capable to work with full efficiency for a longer time interval than with known tools. The lifetime of parts connected with the handle is simultaneously increased and requirements for their dimensions are reduced, permitting reduction in the overall weight of the tool.

DESCRIPTION OF DRAWINGS

An examplary embodiment of a pneumatic impact tool according to this invention is shown in the accompanying drawings wherein

FIG. 1 is a general schematic outline of a pneumatic impact tool in a partial, longitudinal, cross-sectional view;

FIG. 2 is a pneumatic impact hammer shown in partial cross sectional view; and

FIG. 3 is a detailed view of the distributing means of the pressure medium in longitudinal section of the tool illustrated in FIGS. 1 and 2.

DESCRIPTION OF PREFERRED EMBODIMENT

The working cylinder **1** of the tool is arranged as a dilatation cylinder, composed of a reaction part **2** and a guiding part **3**. A piston **4** is slidingly arranged in this working cylinder **1**. Both the reaction part **2** and the guiding part **3** are slidingly supported in a body **8**. Each of these parts **2** and **3** is individually cushioned with respect to the body **8** by prestressed springs **9** and **10** respectively. The body **8** itself is slidingly supported in a casing **5** and cushioned with respect to this casing **5** by a prestressed spring **11**. The casing **5** is provided with a handle **6**. A bearing ring **12** is arranged between the guiding part **3** and the body **8** and a similar bearing ring **13** between the body **8** and the casing **5**. The guiding part **3** has on its lower external part a thread for an extension **16**, which together with a bearing ring **14** limits the hub of the working tool **7**, slidingly arranged in the guiding part **3** and in the extension **16**. The prestressed springs **9, 10, 11** create in the neutral position between the reaction part **2** and the front surface of the cavity in the casing **5** a damping space **15**. An inlet opening **18** for pressurized air is provided near the top of the reaction part **2**, as indicated schematically in FIG. **1**. A similar inlet opening **19** is near the bottom of the guiding part **3** of the working cylinder **4**. An opening **20** corresponding to opening **18** is provided in the body **8**. An air escapes from the top or bottom part of the working cylinder through the gap **21** between the reaction part **2** and the guiding part **3** in the lower or upper extreme position of piston **4**. Corresponding openings are provided in the casing **5**, in FIG. **2**. They have been omitted in order not to complicate the drawing.

FIG. **3** shows schematically one possible arrangement of distributing means. Pressurized air is introduced into the bore of an extension **17** on the top part of the casing **5** with the handle **6** (see also FIG. **1**). This bore terminates in a space **22** containing valve means consisting of a spring loaded ball **23** actuated by a control rod **24**, which in turn is controlled through the operator by a pressure lever **25** on the handle **6** (see FIG. **1**). The valve means opens the passage into a channel **26**, which is turn leads the pressure air over upper openings **27** and lower openings **28** into a change-over space **29**, which openings **27** and **28** can be alternately opened and closed by a sliding plate **30**, admitting pressurized air either into channel **31** connected with the opening **18** in the reaction part **2** (see FIG. **1**) or into channel **32** connected with the opening **19** in the guiding part **3** of the working cylinder **1**.

Pressurized medium, for instance pressure air is introduced over the extension **17** and the valve means alternately to the upper part of the space created in the reaction part **2** and into the lower part of the space created in the guiding part **3** of the working cylinder **1**. Thus a straight line reciprocating movement of the piston **4** in the working cylinder **1** is generated. If the piston **4** is in its upper extreme position and the pressurized air starts to enter the working cylinder **1**, the air urges the piston **4** to move towards its lower extreme position. Simultaneously a force F_h of oppsoite direction is generated, acting on the reaction part **2**. The piston **4** strikes in the lower extreme position the head of the working tool **7**. The top part of the piston **4** clears the gap **21** between the reaction part **2** and the guiding part **3**, so that the air can escape from the space above the piston **4**, simultaneously reducing pressure in channel **31** so that the sliding plate **30** closes by overpressure in channel **32** and cuts off the further supply of air to the opening **18** and opens access of air by way of channel **32** via the opening **19** below the piston **4** which is thereafter urged to move in a direction towards its upper extreme position. Simultaneously a force F_S of oppsite direction is generated, acting on the guiding part **3** and on the head of the working tool **7**. In the course of operation of the pneumatic impact tool periodical changes of pressure conditions in the working cylinder **1** are created, generating periodic exciting forces F_h and F_s acting on the reaction part **2** and on the guiding part **3** of the working cylinder **1** respectively. The force F_h is however not transmitted to the body **8** in its whole magnitude due to the action of the spring **9**. A smaller force F_t acts therefore on the body **8**, the magnitude of which depends on the mutual position of the reaction part **2** and the body **8**, furthermore as well as on the rigidity and on the damping coefficient of the spring **9** and on the oscillating frequency. The force F_s acting on the head of the working tool **7** and on the guiding part **3** is transmitted to the rock. The working tool **7** is after impact of the piston **4** and after transfer of a part of the impact energy to the rock repelled back with a certain acceleration. Thus the spring

10 is compressed and a force F_n generated, part of which is transmitted to the body **8.** The body **8** thus starts to oscillate due to the action of exciting forces F_n and F_t. A force F_r is transmitted to the casing **5** and to the handle **6** connected therewith, said force F_r being proportional to the deviation of the body **8** with respect to the casing **5,** and depending on the rigidity and on the damping coefficient of the spring **11** and on the oscillating frequency. The resulting oscillating movement of the handle **6** depends therefore on the magnitude of the force F_r and on the impedance of the hand of the operator. It is possible to evaluate mathematically for what masses of the individual oscillating parts and for what rigidities of springs the force F_r acting on the handle **6** and therefore also the acceleration of the handle **6** will be a minimum.

The principle of construction of the pneumatic impact tool according to this invention can be applied for all impact tools with a straight line reciprocating movement of the piston, actuated by a suitable pressure medium.

What is claimed is:

1. Pneumatic impact tool comprising a substantially cylindrical body, a working cylinder located in said body, said working cylinder comprising an upper reaction part and a separate lower guiding part, both said parts being axially aligned in said body and being adapted to slide toward and away from each other, said upper and lower parts forming together a dilatation cylinder having a piston operating therein, said upper part and said lower part being individually cushioned with respect to said body by at least one prestressed elastic element respectively, an extension fixed to the lower end of the body, a working tool slidingly arranged in the lower part of the working cylinder and in said extension, said tool receiving the impact from the piston and from the lower part of said working cylinder, and means for alternately supplying and discharging a gaseous pressure medium into and from the spaces of the working cylinder above and below said piston.

2. The tool according to claim **1** including a casing having a handle, said casing being slidingly secured on the upper end of said body and axially cushioned with respect to said body by at least one prestressed elastic element.

3. Pneumatic impact tool as set forth in claim **1** wherein a damping space is located between the upper front wall of the reaction part and the part of the casing facing the front wall.

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