United States Patent [19]

Goppen et al.

[11] **3,920,086**

[45] **Nov. 18, 1975**

[54] **PNEUMATIC HAMMER**

[76] Inventors: **Albert Adolfovich Goppen,** ulitsa Narodnogo opolchenia, 22, korpus 3, kv. 95; **Igor Vladimirovich Nikolaer,** ulitsa Fadeeva, 5, kv. 37, both of Moscow; **Lidia Mikhailovna Dronova,** ulitsa Kalarash, 5, kv. 68, Ljubertsy Moskovskoi oblasti; **Anatoly Ivanovich Lednikov,** Korovinskoe shosse, 9, korpus 2, kv. 51, Moscow, all of U.S.S.R.

[22] Filed: **May 23, 1974**

[21] Appl. No.: **472,864**

[52] **U.S. Cl.** **173/134;** 173/139; 173/162; 279/169; 279/172

[51] **Int. Cl.**[2] **B25D 9/04**

[58] **Field of Search** 173/134, 139, 162; 92/169, 92/171; 279/19.5, 19.3

[56] **References Cited**

UNITED STATES PATENTS

1,632,373	6/1927	Hansen	279/19.5
1,634,623	7/1927	Miller	173/139 X
1,679,291	7/1928	Byers	173/139
1,760,276	5/1930	Nell	279/19.5
2,684,055	7/1954	Bergman	173/134 X
2,899,934	8/1959	Salengro	173/137
2,944,523	7/1960	Werstein	173/134 X
3,030,121	4/1962	Scott	279/19.5 X
3,114,423	12/1963	Naslund	279/19.3 X
3,469,504	9/1969	Neighorn	92/172
3,605,916	9/1971	Voitsekhovsky et al.	173/139
3,788,404	1/1974	Koudelka	173/139
3,792,740	2/1974	Cooley	173/139

FOREIGN PATENTS OR APPLICATIONS

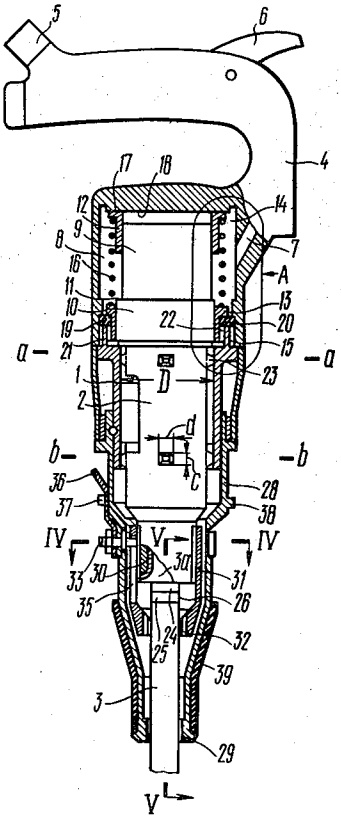
1,225,677	4/1960	France	173/134
841,893	6/1952	Germany	173/134
1,018,819	11/1975	Germany	173/139

Primary Examiner—Ernest R. Purser
Assistant Examiner—Leslie A. Braun
Attorney, Agent, or Firm—Holman & Stern

[57] **ABSTRACT**

A hammer is provided with a housing accommodating a barrel which is axially movable relative to the housing. The barrel has two portions of different diameter. One portion adjacent to the handle is of a smaller diameter, and the other portion is of a greater diameter. These portions form therebetween a shoulder having the end wall facing the handle. An annular space is provided between the outer surface of the barrel and the inner surface of the housing, and mounted in this annular space on both the first and second portions of the barrel are sealing bushings which are in sealing engagement with the housing so that annular spaces are provided between the outer periphery of the bushings and the inner surface of the housing, and a spring member is mounted between the bushings. The invention is aimed at lowering the vibration level at the hammer handle and at reducing the compressed air leakage.

9 Claims, 5 Drawing Figures



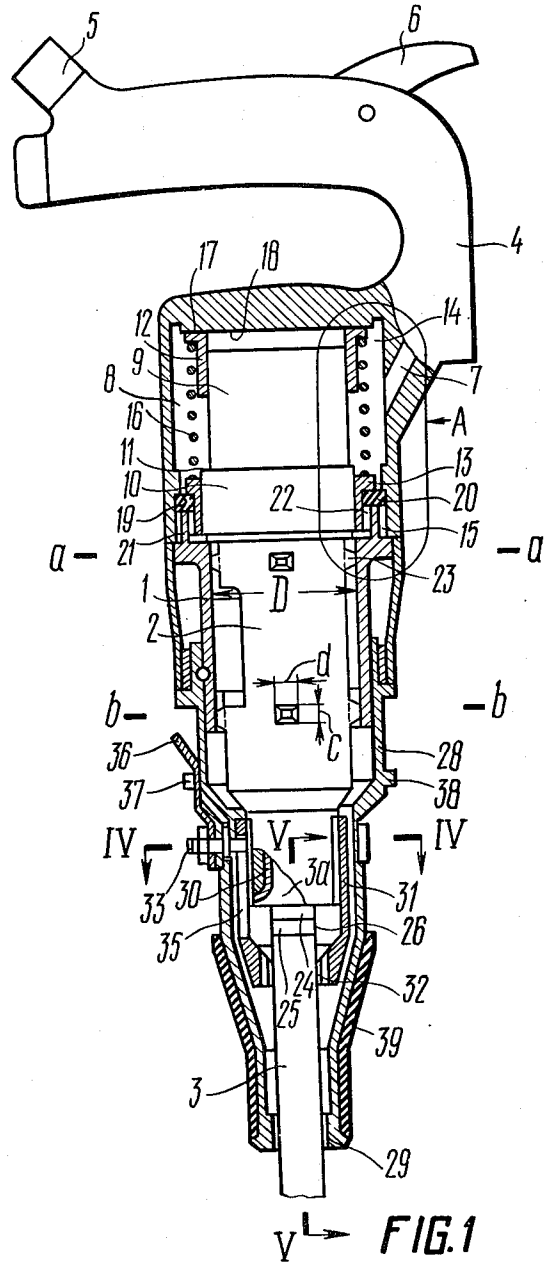

5
6
4
17
18
14
12
9
8
7
16
A
11
13
10
22
20
19
15
a
21
23
1
D
2
d
b
c
36
28
37
38
IV
V
IV
30a
33
30
31
35
26
24
32
25
39
3
29
V

FIG. 1

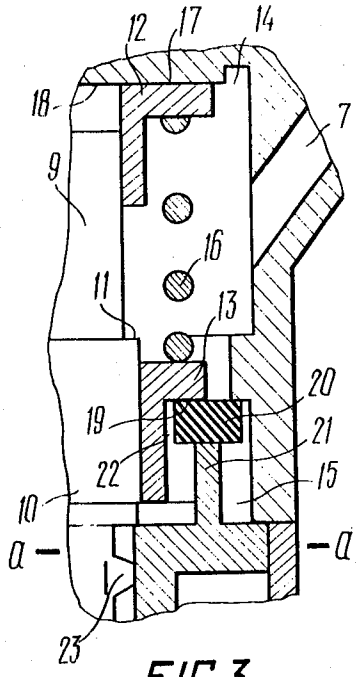


FIG. 3

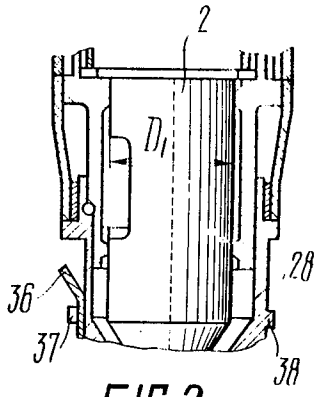


FIG. 2

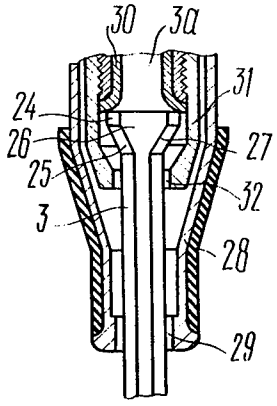


FIG. 5

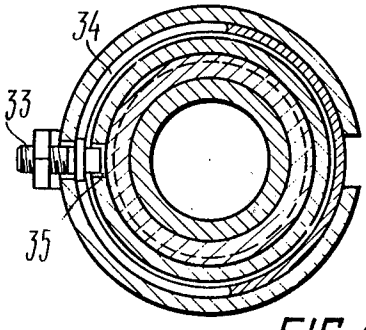


FIG. 4

PNEUMATIC HAMMER

BACKGROUND OF THE INVENTION

The invention relates to pneumatic hammers to be used in mechanical engineering, construction and in other fields.

Known in the prior art are pneumatic hammers comprising a housing having a barrel mounted therein and axially movable relative thereto so that an annular space is defined between the outer surface of the barrel and the inner surface of the housing, with an air-distribution device and an impact mechanism accommodated in the barrel to ensure reciprocation of a hammer piston, under the action of compressed air, the hammer piston imparting blows to the shank of a working tool received in the forward end of the barrel, a handle having a trigger means for controlling the supply of compressed air into the barrel, the handle being rigidly secured to the housing, sealing members mounted in the annular space between the housing and the barrel, and guide members between the housing and the barrel (cf. US Pat. No. 3456744,). In this hammer the sealing members directly contact the inner surface of the housing.

The above-described prior art pneumatic hammer has the following disadvantages:

The sealing members are in contact with both the barrel and housing so that the misalignment of the barrel relative to the housing is possible, whereby the force is transmitted to the housing by-passing a shock-absorbing member, such as spring which may be provided between the barrel and the housing.

The sealing members are prone to rapid wear due to such misalignment, thereby resulting in air leakage.

Due to the frictional engagement between the sealing members and the barrel on the one hand, and between the sealing members and the housing on the other hand, an intensive transmission of vibrations to the housing and to the handle of the hammer will take place, whereby the operator will suffer the unhealthy effect of vibration.

Widely known in the art are also pneumatic hammers, wherein the housing is mounted on the barrel so that a continuous metal-to-metal contact surface is defined therebetween. This design is deficient in that it is difficult to align the barrel relative to the housing so that there is a misalignment of the barrel relative to the housing resulting in heavy radial forces applied at the contact surface leading to rapid wear of the parts and to air leakage in the case of hammers having a shock-absorbing air cushion.

In addition, the continuous contact surface results in a more intensive transmission of vibrations to the handle.

In the known pneumatic hammers, the reactive force is absorbed by a spring mounted between the housing and the handle, and the spring should be sufficiently strong due to a great pressure force to be applied to the handle during the operation. At the same time, it is known that the weaker the spring, the better the system from the point of view of the vibration insulation of the handle.

OBJECTS AND SUMMARY OF THE INVENTION

It is the main object of the invention to provide a pneumatic hammer having a lowered vibration level on the handle.

Another object of the invention is to reduce the wear of the parts of a pneumatic hammer.

Still another object of the invention is to reduce the air consumption of the pneumatic hammer.

These and other objects are accomplished due to the fact that in a pneumatic hammer comprising a housing having a barrel mounted therein and axially movable relative thereto so that an annular space is defined between the outer surface of the barrel and the inner surface of the housing, an air-distribution device and an impact mechanism accommodated in the barrel to ensure reciprocations of a hammer piston under the action of compressed air, with the hammer piston imparting blows to the shank of a working tool received in the forward end of the barrel, a handle having trigger means for controlling the supply of compressed air into the barrel, the handle being rigidly connected to the housing, sealing members mounted in the annular space between the housing and the barrel, and guide members between the housing and the barrel, according to the invention, the barrel mounted in the guide members has two portions of different diameter, of which the first portion adjacent to the handle is of a smaller diameter, and the second portion is of a greater diameter, with the shoulder being formed between said portions having an end wall facing the handle, the sealing members comprising bushings mounted on the first and second portions of the barrel so that an annular space is formed between the outer surface of the bushings and the inner surface of the housing, and a spring member is mounted between the bushings.

With such embodiments of the hammer, the transmission of vibrations to the handle is reduced due to the floating arrangement of the sealing members (bushings) relative to the housing, and the air leakage is also reduced due to the fact that very small radial forces are applied to the bushings so that the wear of the sealing surfaces is minimized. As a result, the transmission of vibrations from the barrel to the handle is reduced, and the air leakage lowered, whereby the air consumption during the operation of the hammer is reduced.

In accordance with the invention, the guide members preferably comprise at least one annular row of guide projections provided on the outer surface of the barrel, with each said row including at least three projections. Alternatively, said projections may be provided on the inner surface of the housing.

Such embodiment of the guide members contributes to the reduction of the wear of the contact surfaces since a couple arising from an application of the pressure force to the hammer, by the operator, will have a greater arm as compared to that in the hammers a continuous contact surface between the barrel and the housing.

The dimensions of the projections in the axial and circumferential directions are preferably substantially smaller than the diameter of the contact surface between the projection and the inner surface of the housing, or between the projection and the outer surface of the barrel.

With such embodiment of the guide members, the transmission of unhealthy vibrations from the barrel to the hammer handle is reduced, and the cooperating surfaces are cleaned from dust and extraneous matter which may penetrate into the hammer, whereby the wear of the hammer parts is reduced.

The invention will now be described in detail with reference to the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a longitudinal section of a pneumatic hammer according to the invention with the guide projections provided on the outer surface of the barrel;

FIG. 2 shows a longitudinal section of a part of the hammer having the guide projections provided on the inner surface of the housing.

FIG. 3 is an enlarged view of detail A in FIG. 1;

FIG. 4 is a sectional view taken along the line IV — IV in FIG. 1; and

FIG. 5 is a sectional view taken along the line V—V in FIG. 1.

DETAILED DESCRIPTION OF THE DRAWINGS

A pneumatic hammer comprises a housing 1 (FIG. 1) having a barrel 2 mounted therein and axially movable relative thereto. The barrel 2 accommodates an air-distribution device and an impact mechanism (not shown) which ensure reciprocations of a hammer piston under the action of compressed air, with the hammer piston imparting blows to a shank 3*a* of a working tool 3 received in the forward end of the barrel 2.

The pneumatic hammer has a handle 4 provided with trigger means (not shown) for controlling the supply of compressed air, and the handle is rigidly secured to the housing 1. The handle 4 is provided with a pipe connection 5 for connection of an air hose (not shown), a trigger lever 6 and a passage 7 for feeding compressed air into the barrel 2.

The air-distribution device, impact mechanism and trigger means of the hammer may be of any known design, as they do not represent the subject of the invention and are well known to those skilled in the art. Therefore, these devices will not be described herein.

The barrel 2 is mounted in the housing 1 in such a manner that an annular space 8 is defined therebetween. The barrel 2 has two portions of different diameter of which a first portion 9 adjacent to the handle 4 is of a smaller diameter, and a second portion 10 is of a greater diameter. A shoulder 11 is formed between the first portion 9 and the second portion 10 of the barrel, with the end wall of the shoulder facing the handle 4.

Sealing members comprise a bushing 12 slidably mounted on the first portion 9 of the barrel 2 and a bushing 13 which is mounted in the same manner on the second portion 10 of the barrel 2, and annular spaces 14 and 15 are formed between the outer periphery of the bushings 12 and 13 and the inner surface of the housing 2, (FIGS. 1, 3). In order to provide for a tight sealing, a spacing spring member, such as a spring 16 is mounted between the bushings 12 and 13. Under the action of the spring 16, end face 17 of the bushing 12 is urged against an end wall 18 of the housing 1, and end face 19 of the bushing 13 is urged against an elastic sealing ring 20 which rests against a projection 21 of the housing 1. It should be noted that the end face 17 may engage the housing 1 through the interposition of an elastic member (not shown). Therefore, a closed chamber is provided in the annular space 8 to supply the impact mechanism of the hammer with compressed air.

It should also be noted that the sealing ring 20 is mounted with a radial play 22 with respect to the bushing 13 so as not to hamper its radial displacement when the barrel 2 comes out of alignment with the housing 1.

The bushings 12 and 13 may be sealed relative to the housing 1 by other appropriate methods.

The floating arrangement of the sealing bushings 12 and 13 relative to the housing 1 permits the relieving of the bushings from radial loads, whereby their wear is substantially reduced, and hence air leakage is lowered. The air consumption is thereby reduced by 15 – 30%.

In order to guide the barrel 2 in the housing 1, there are provided on the outer surface of the barrel 2 two annular rows *a—a* and *b—b* (FIG. 1) of guide projections 23 cooperating with the inner surface of the housing 1. The dimensions *c* and *d* of the projections in the axial and circumferential directions, respectively, are substantially smaller than the diameter D of the contact surface between the projections 23 and the inner surface of the housing 1. The expression "substantially smaller" means herein that the circumferential spacing of the projections 23 is substantially greater than their dimension *d* in the circumferential direction, while the dimension *c* is substantially equal to the dimension *d*. As an example, it might be indicated that the dimension *d* is within the range of from 0.05 to 0.5 D, while the dimension "c" may be equal to the dimension *d*.

The guide projections 23 may be provided on the inner surface of the housing 1 as shown in FIG. 2. In this case, the dimensions *c* and *d* of the projections in the axial and circumferential directions, respectively, are substantially smaller than the diameter D_1 of the contact surface between the projections 23 and the outer surface of the barrel 2.

This embodiment of the guide members permits the reduction of the transmission of vibrations to the housing (handle) of the hammer. In addition, this results in an increase in the arm of a couple arising from application of the pressure force to the hammer by the operator, whereby the radial load applied at the contact between the guide projections and the housing is reduced, thereby minimizing the wear of these parts. Small dimensions of the guide projections also ensure the cleaning of the contact surface from dust and extraneous matters which may penetrate inside the hammer.

In order to improve the efficiency of the vibration insulation, as well as to ensure the safety and convenience of the control of the working tool, the pneumatic hammer is provided with means for fixing the working tool which is described in greater details in our co-pending application Ser. No. 472,858.

The working tool 3 has the shank 3*a*, and provided between the working portion of the tool 3 and the shank 3a, there is a shoulder 24 (FIGS. 1, 5) defined by a cone 25 having flats 26 and inclined bearing surfaces 27. The working tool 3 is mounted in a cup member 28 and extends through a non-circular opening 29 in the end wall thereof, with the shape of the opening corresponding to the cross-sectional shape of the working portion of the tool 3, and the shank 3*a* of the working tool 3 is received in a guide sleeve 30 fixed in the barrel 2.

In order to prevent the working tool 3 from being shot off where there is no contact between the tool and a workpiece, or in the case of an incidental starting of the hammer, there is provided, on the forward end of the barrel 2, a lock 31 comprising a nut screwed on the barrel 2. The forward end of the lock 31 is tapered and has an opening 32 whose shape corresponds to the cross-sectional shape of the tool 3 so that the two may pass through the opening 32 with a predetermined relative angular position of the openings 29 and 32. For

that purpose, the cup member **28** is provided with a pin **33** (FIGS. **1, 4**) which is rotatably mounted in a circular slot **34** of the cup **28.** One end of the pin **33** is received in a longitudinally extending groove **35** of the lock **31** so that upon rotating the pin **33** the lock **31** will be rotated, whereby the operator can bring the openings **29** and **32** in register to withdrawn the working tool **3** from the hammer, or arranged them at relatively different angles after the tool had been inserted into the hammer. In order to lock the pin **33,** the latter is provided with a leaf spring **36** (FIG. **1**) having an end engageable in a recess **37** of an annular projection **38** provided on the outer surface of the cup member **28.**

The above-described means for fixing the working tool **3** in the pneumatic hammer enables the control of the tool during operation by rotating the cup member **28,** prevents the tool from being "shot off" during idle blows of the hammer piston, and provides for an additional vibration insulation since the cup member **28,** which is held by the operator during the operation with the hammer, does not directly contact the barrel **2** and is mounted on the vibration insulated housing **1** of the hammer. Furthermore, the cup member **28** may be provided with a rubber coat or covering **39** (FIGS. **1,5**) for additional protection of the operator against high frequency vibration components.

The above-described hammer functions as follows:

Upon pressing the lever **6** compressed air is fed, into the chamber **8** formed between the housing **1** and the barrel **2** and sealed by means of the bushings **12, 13,** from which the air is fed through the air-distribution device to the impact mechanism of the hammer (not shown). By that time, the tool **3** is pressed against a workpiece, while the hammer is held by the operator gripping the handle **4.** During operation, the operator controls the working tool with the other hand by means of the cup member **28** having the rubber coat **39.**

The compressed air, which is permanently present in the annular space **8** between the housing **1** and the barrel **3,** exerts a pressure upon the shoulder **11** of the barrel **2** between the portion **9** of a smaller diameter and the portion **10** of a greater diameter, whereby a permanent shock-absorbing air cushion is formed.

During operation of the impact mechanism the barrel **2** performs a reciprocatory motion relative to the housing **1** with a small amplitude and at a frequency which is substantially equal to the frequency of the reciprocations of the hammer piston (not shown) in the barrel **2.** The vibrations arising therefrom acts upon the operator through the spring **16** and the air cushion action on the shoulder **11.**

Due to the fact that the spring **16** exerts a comparatively low compressive force, as well as due to the presence of the shock-absorbing air cushion acting on the shoulder **11,** the handle **4** is very efficiently insulated against vibration. This effect becomes more pronounced due to the fact that the sealing bushings "float" relative to the housing **1,** whereby the transmission of vibrations to the handle **4** is additionally reduced.

Vibrations generated due to the cooperation between the working tool **3** and the barrel **2** is transmitted to the housing **1** through the guide projections **23** having small dimensions, which also contributes to the reduction of the unhealthy effect of vibrations on the operator.

In addition, it should be noted that since the cup member **28** does not contact the barrel **2** and the tool **3;** the vibrations arising in this zone of the hammer will not be transmitted to the hand of the operator gripping the cup member **28** to control the tool.

Dust and extraneous material penetrating inside the hammer during operation will pass between the guide projections **23** so that they will not result in excessive wear of the latter.

It will be apparent from the above description that the pneumatic hammer according to the invention has lowered the vibration level at the handle, reduced wear of the parts and small air consumption.

While the specific embodiment of the pneumatic hammer according to the invention was given hereinabove as an illustrative example, it will be apparent that those skilled in the art can introduce various modifications without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A pneumatic hammer comprising: a housing having an inner surface; a barrel mounted in said housing and axially movable relative thereto; said barrel having a forward end and an outer surface; an air-distribution device and an impact mechanism accommodated in said barrel to ensure reciprocations of a hammer piston under the action of compressed air, with the hammer piston imparting blows to a shank of a working tool received in the forward end of said barrel; the outer surface of said barrel and the inner surface of said housing defining an annular space therebetween; a handle having trigger means for controlling the supply of compressed air into said barrel, the handle being rigidly secured to said housing; a first portion of said barrel having a smaller diameter adjacent to said handle; a second portion of said barrel having a greater diameter; a shoulder formed between said first and second portions of the barrel, an end wall of said shoulder facing said handle; sealing members comprising bushings mounted on said first and second portions of said barrel; said bushings having outer peripheries and end faces, the end faces being in sealing engagement with the housing, annular spaces provided between the outer periphery of said bushings and the inner surface of said housing; a spring member mounted between said bushings; and guide members between said housing and said barrel, whereby said sealing members are relieved from the radial load, so that their wear is reduced, as well as compressed air leakage.

2. The pneumatic hammer according to claim **1,** wherein said guide members comprise at least one annular row of guide projections provided on the outer surface of said barrel, with said row including at least three projections.

3. The pneumatic hammer accoording to claim **2,** wherein the dimensions of said projections in the axial and circumferential directions are substantially smaller than the diameter of the contact surface between the projection and said housing.

4. The pneumatic hammer according to claim **1,** wherein said guide members comprise at least one annular row of guide projections provided on the inner surface of said housing, with said row including at least three projections.

5. The pneumatic hammer according to claim **4,** wherein the dimensions of said projections in the axial and circumferential directions are substantially smaller than the diameter of the contact surface between the projection and said barrel.

6. A pneumatic hammer comprising: a housing having an inner surface; a barrel mounted in said housing and axially movable relative thereto; said barrel having a forward end and an outer surface; an air-distribution device and an impact mechanism accommodated in said barrel to ensure reciprocations of a hammer piston under the action of compressed air, the hammer piston imparting blows to a shank of a working tool received in the forward end of said barrel; the outer surface of said barrel and the inner surface of said housing forming an annular space therebetween; a handle having a trigger means for controlling the supply of compressed air into said barrel, said handle being rigidly secured to said housing; a first portion of said barrel having a smaller diameter adjacent to said handle; a second portion of said barrel having a greater diameter; a shoulder formed between said first and second portions of the barrel, an end wall of said shoulder facing said handle; sealing members comprising bushings mounted on said first and second portions of said barrel; said bushings having outer peripheries and end faces, the end faces being in sealing engagement with the housing, annular spaces formed between the outer periphery of said bushings and the inner surface of said housing; a spring member mounted between said bushings; at least one annular row of guide projections provided on the outer surface of said barrel, with said row including at least three projections, whereby the sealing members are relieved from the radial load so that their wear is reduced, as well as compressed air leakage.

7. The pneumatic hammer according to claim **6**, wherein the dimensions of said projections in the axial and circumferential directions are substantially smaller than the diameter of the contact surface between the projection and said housing.

8. A pneumatic hammer comprising: a housing having an inner surface; a barrel mounted in said housing and axially movable relative thereto; said barrel having a forward end and an outer surface; an air-distribution means and an impact mechanism accommodated in said barrel to ensure reciprocations of a hammer piston under the action of compressed air, the hammer piston imparting blows to a shank of a working tool received in the forward end of said barrel; the outer surface of said barrel and the inner surface of said housing forming an annular space therebetween; a handle having trigger means for controlling the supply of compressed air into said barrel, said handle being rigidly secured to said housing; a first portion of said barrel having a smaller diameter adjacent to said handle; a second portion of said barrel having a greater diameter; a shoulder formed between said first and second portions of said barrel, an end wall of said shoulder facing said handle; sealing members comprising bushings mounted on said first and second portions of said barrel; said bushings having outer peripheries and end faces, the end faces being in sealing engagement with said housing, annular spaces provided between the outer periphery of said bushings and the inner surface of said housing; a spring member mounted between said bushings; and at least one annular row of guide projections provided on the inner surface of said housing, with said row including at least three projections, whereby the sealing members are relieved from the radial load so that their wear is reduced, as well as compressed air leakage.

9. The pneumatic hammer according to claim **8**, wherein the dimensions of said projections in the axial and circumferential directions are substantially smaller than the diameter of the contact surface between the projection and said barrel.

* * * * *