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PNEUMATIC CUSHION DEVICE

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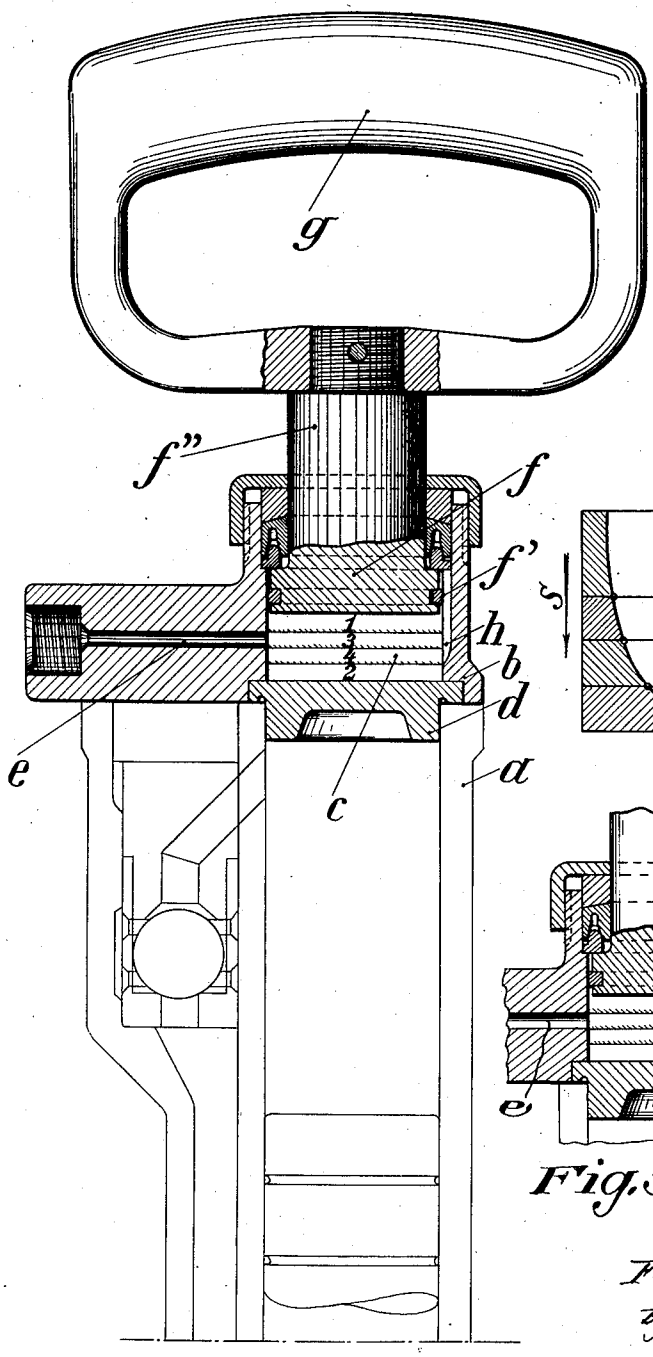


Fig. 1

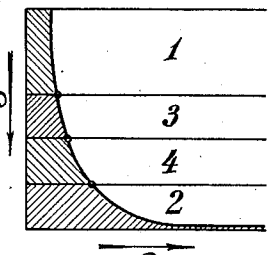


Fig. 2

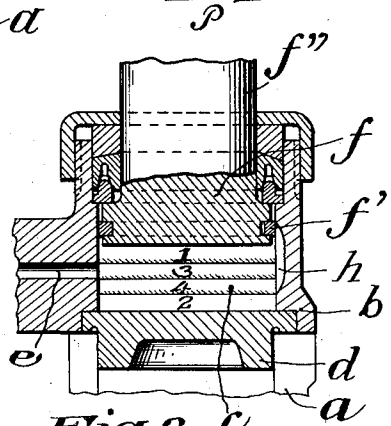


Fig. 3.

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PNEUMATIC CUSHION DEVICE

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7 Claims. (Cl. 121—36)

In order to provide a spring cushion for the handle of pneumatic hammers and other tools it is known to connect the handle with the housing containing the hammer operating means, not in a rigid manner, but to mount one part to be longitudinally movable in the other and to insert a shock damping or absorbing agent between the two. For this purpose use was made of springs made of solid material (steel) or also of compressed air from the compressor mains or from the container from which the compressed air operating the pneumatic hammer was derived.

A known arrangement making use of air as the shock absorbing agent made use of a compressed air cushion arranged between the two parts which are moved with respect to one another, said cushion being permanently connected with the compressed air container or the compressed air mains through a narrow passage at one end of the air chamber. The volume of this air cushion, which was thus not shut off, was decreased by the oppositely directed movement of the parts. The compressed air was forced back through the admission conduit into the compressed air mains or compressed air container feeding the hammer. In this manner an easy braking effect was produced, whereby the jarring effect upon the handle was to be decreased.

According to another suggestion there was likewise a chamber filled with compressed air arranged between the two parts of the hammer which are longitudinally movable with respect to one another and which are to be cushioned with respect to one another, and a disc-piston connected with the handle by means of a rod, dividing it into two partial chambers; a compensating extension upon the piston made the total pressure equal upon one side and the other of the piston. Each of the two partial chambers separated from one another by the piston disc was individually in communication with the compressed air from the compressed air mains also during the operation of the hammer.

In these arrangements, upon relatively great strokes of the portion of the hammer which is thrown back, the pressure medium will be completely forced out of the compressed air chamber between the surfaces which approach one another, so that the limiting surfaces finally strike against one another and the shocks become uncomfortably and injuriously perceptible to the hand of the operator of the hammer. In the second-named arrangement, moreover, it is difficult to produce a motion-damping effect upon the start of the vibrations or shocks, or in certain intermediate positions, because of the equality of the loads upon opposite sides of the piston.

The present invention aims at overcoming the imperfections of cushioning means for pneumatic hammers, and it consists in providing a cushioning chamber in the head of the tool containing a piston connected by a rod of large cross section to the handle, and having a port by-passing the piston and connecting the two chamber spaces on each side thereof, the full area of the plain face of the piston being thus subject to the pressure of the compressed air, while the rod face of the piston offers a substantially smaller area to said pressure. In accordance with the position, at the time being, of the differential piston thus formed relatively to the ends of the port and the compressed air inlet of the chamber, such a mutual action occurs upon the cushioned parts and the layer of compressed air between them, that during recoil of the hammer cylinder towards the handle, which, of course, takes place in a relatively short stroke, in a first portion of this stroke a braking and damping action are produced by the compressed air in the chamber being driven back into the mains, and the pressure of the air in the chamber is increased to a small extent, because it cannot flow out as rapidly as the stroke of the piston diminishes the chamber volume, owing to the small area of the inlet.

The invention is illustrated on the accompanying drawing, in which:

Figure 1 is a longitudinal section of the handle of a pneumatic hammer,

Fig. 2 is a diagram illustrating the operation, and

Fig. 3 is a view similar to Fig. 1 with certain details omitted, showing the modified form of groove.

The working area is represented in the pressure diagram (see 1, Fig. 2) as a trapezoid slightly deviating from a rectangle.

In a succeeding portion of the moving-together of the parts of the hammer there follows a supplemental increasing throttling of the discharge of the compressed air out of the air cushion into the compressed air mains, an increased braking or damping and an increased consumption of energy.

At the end of this portion the compressed air mains are disconnected; however, by a special provision, a discharge path is still provided for the air, but, the throttling and the pressure are intensified.

Finally, the space between the walls of the housing, the piston surface and the oppositely-posi-

tioned closure wall is completely sealed off and the special means, which still provide a discharge path for the air, is disconnected. The enclosed air, which is at a pressure already higher than that of the working compressed air, is in this manner made into a true air cushion or spring. Upon continued movement of the cushioned parts toward one another, the pressure of the air increases very rapidly in accordance with known physical laws; however, a striking together of the surfaces which are separated by the air and a jarring together or battering together are made impossible, because even in the most extreme case an air cushion always remains. The compressed air curve in the diagram rises sharply and finally proceeds approximately parallel to the axis of the abscissæ (see 2, Fig. 2).

In accordance with the nature of the work which the hammer performs, the extent of the compression and the magnitude and degree of intensity of the blows, shocks and vibrations, the strokes of the housing, with respect to the handle, assume a greater or smaller magnitude. In the most favorable case the to-and-fro movements will spend themselves within the first period or phase. If the strokes of travel are greater and the shock effects thus also increase, they enter the field of the second or third portion, and in the case of individual unforeseen or even repeated shocks, of great intensity, the parts of the arrangement will assume such positions with respect to one another that the position of the last phase will be made unnecessary and eliminated.

In the present invention, the operation of which has been essentially explained above, it is of primary importance, and is characteristic, that the first portion of the action—which may be called 1—is followed by one corresponding to the last phase—which may be called 2—that is, that both are combined in a cushioning device for pneumatic hammers in such manner as to operate successively. The intermediate portions—which may be called 3 and 4—may be arranged in more or less pronounced form and may be more or less clearly separated, and in accordance with the circumstances of the hammer involved, they may also be omitted.

The invention may be embodied in practice in various forms. In the drawing an example is illustrated wherein the phases 1, 2 and also 3 and 4 all occur or are all traversed. In Fig. 1, *a* is the housing of the hammer and to the left of the same is shown the hammer operating mechanism, the details of which are of no specific importance to the present invention. *b* is the head of the hammer containing the main air chamber or cylinder *c* which is sealed off from the housing *a* of the hammer by the partition wall *d*. The compressed air supply passage or inlet *e* passes through the wall of the head, and leads from the compressed air mains or supply into the main compressed air chamber or cylinder. The cylinder *c* is provided with a disc-piston *f* containing a piston ring *f'* which provides a good seal. The edges of the piston ring and the piston ring itself are determinative of the control of the cushioning device and the occurrence of the phases of the operation which result therefrom. The piston *f* is preferably constructed as a differential piston by means of the heavy piston rod *f''* which may be made integral therewith or connected therewith, and which is sealed with respect to the outer atmosphere and carries the handle *g* of the hammer. In the condition of rest the compressed air entering into the cylinder *c* through the passage *e* exerts a force upon the active piston surface and pushes the piston into its uppermost position, as shown in Fig. 1 of the drawing. Due to the opposed movements of the piston *f* and the housing *a* produced by the shocks and vibrations of the housing, the piston will be brought into the four positions indicated in dotted lines in the drawing, corresponding to the portions 1, 3, 4 and 2. After traversing the portion 1 the piston ring *f'* commences to gradually cover the opening of the inlet *e*.

In the wall of the cylinder *c*, a by-pass port formed by a groove *h* is provided running parallel with the direction of travel of the piston *f*, and a plurality of such grooves may also be provided, if desired. This groove terminates some distance below the lowermost point of the opening of the intake passage *e*. Inasmuch as this is determinative of the beginning of the working phase 3, the lower edge of the groove *h*, that is, the by-pass from the main cushioning chamber to the auxiliary chamber on the other side of the differential piston *f* is determinative for the commencing of the cushioning period 2, that is, the last portion 2 in the possible cushioning travel. The by-pass *h* may diminish in cross section toward the opening into the main compressed air chamber *c*, and also toward the other side, or in both directions as shown in Fig. 3. It serves the purpose of decreasing the increase of pressure in the chamber *c* during the phases 2 and 3. The cushioning in these phases is indeed intended to increase in power, however, to a moderated degree.

Fig. 2 is a diagram with very much magnified paths of travel showing the cushioning occurring during the use of the hammer during the working areas which become effective in the whole and in the individual partial phases 1, 3, 4 and 2. In view of the general description and explanation of Fig. 1 already given, the diagram will be understood without any further explanation.

I claim as my invention:—

1. In a pneumatic hammer, a head containing a cushioning chamber having an inlet for compressed air, a member to be cushioned with respect to said head, a piston reciprocable in said chamber and adapted to close said inlet before reaching one end of its stroke, said piston being also by-passed by a groove in the chamber wall connecting the chamber spaces on opposite sides of the piston, and means connecting the piston with said member, said piston throttling the groove which is closed by the piston after the inlet is closed and before the piston reaches the end of the chamber.

2. A pneumatic hammer in accordance with claim 1, in which the piston rod is of large cross section relatively to the area of the disc-piston.

3. A pneumatic hammer in accordance with claim 1, wherein the by-pass groove decreases in cross-sectional area toward one of its ends.

4. A pneumatic hammer in accordance with claim 1, wherein the by-pass groove decreases in cross-sectional area toward each end.

5. In a pneumatic hammer, a head containing a cushioning chamber having an inlet for compressed air, a handle, a piston reciprocable in said chamber and adapted to close the inlet before reaching one end of its stroke, and a rod extending from said piston through an end of the chamber and connected to the handle, the head having a by-pass groove therein connect-

ing the spaces of said chamber on opposite sides of the piston and the piston throttling the groove which is closed by the piston after the inlet is closed and before it reaches the end of the chamber.

6. In a pneumatic hammer, a head containing a chamber, a cushioning piston slidable in the chamber and dividing the same into spaces on opposite sides of the piston, a handle, a piston rod connecting the handle to one face of the piston and of such diameter that the effective piston area on the rod side of the piston is substantially smaller than the effective area of the other side of the piston, and a conduit between the larger chamber space and a source of pressure adapted to be closed by the piston, said head having a groove therein by-passing the piston and connecting the two chamber spaces and the piston throttling the groove which is closed by the piston after the conduit is closed and before the piston reaches the end of the chamber.

7. A device for cushioning the handle of a pneumatic hammer, comprising a piston and rod connected to the handle, and a cylinder for the piston having an inlet for compressed air and over which the piston slides to close the inlet, said cylinder having a groove by-passing around the piston which terminates near the end of the cylinder and is closed by the piston after the piston closes the inlet and before the piston reaches the end of the cylinder.

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