Nov. 16, 1954 J. A. LARCÉN 2,694,383

PRESSURE FLUID DRIVEN HAMMER PISTONS FOR HAMMER DRILLS AND OTHER PERCUSSION TOOLS

Filed March 29, 1949 3 Sheets-Sheet 1

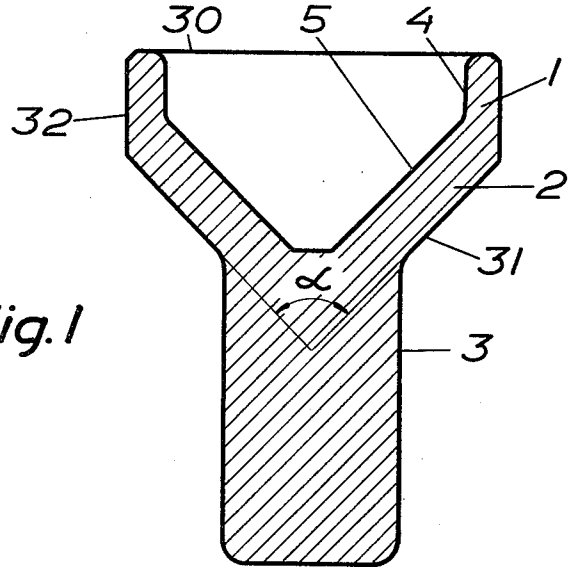


Fig. 1

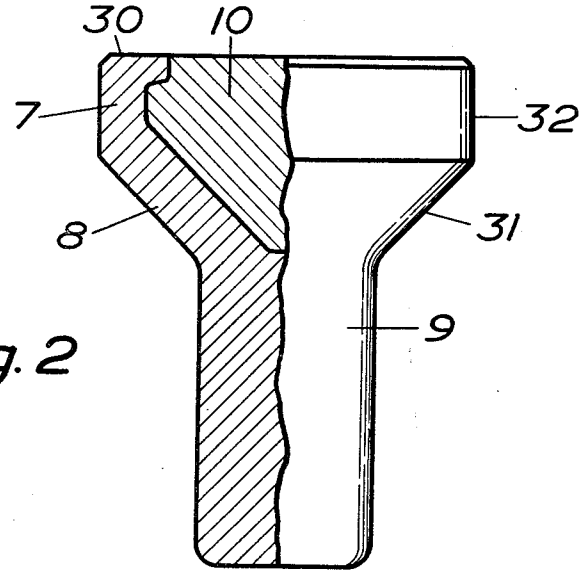


Fig. 2

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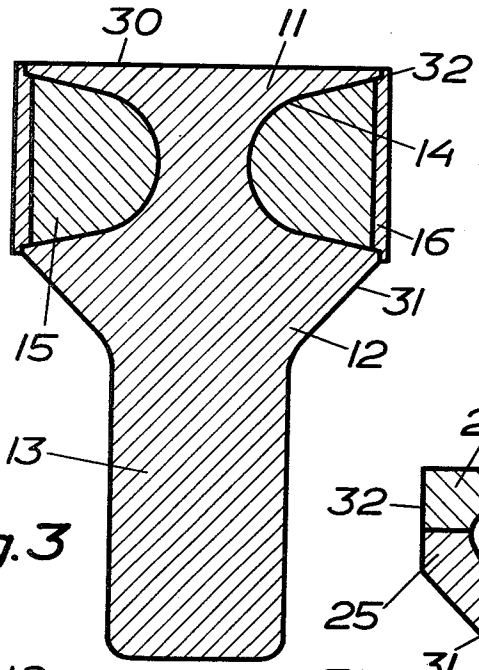


Fig. 3

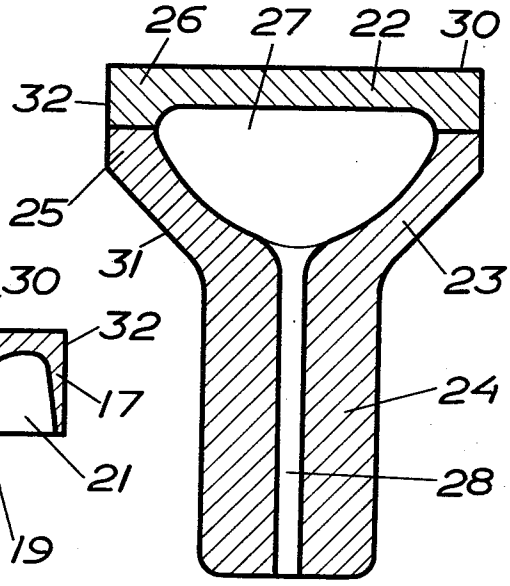


Fig. 5

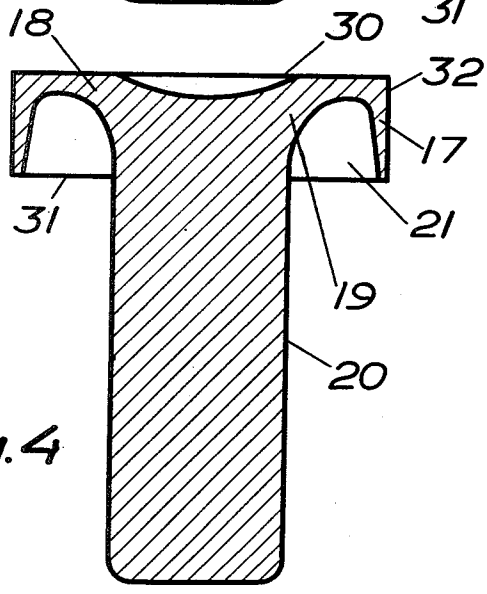


Fig. 4

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Fig. 7

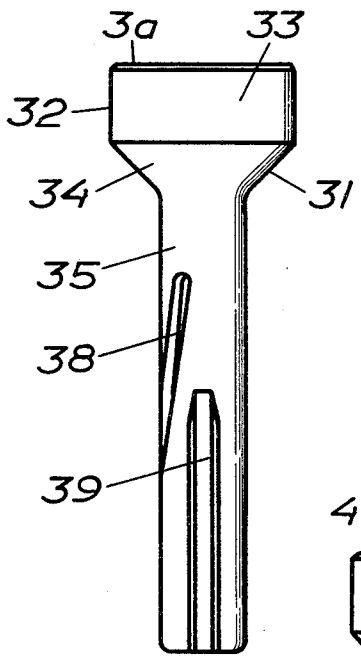


Fig. 8

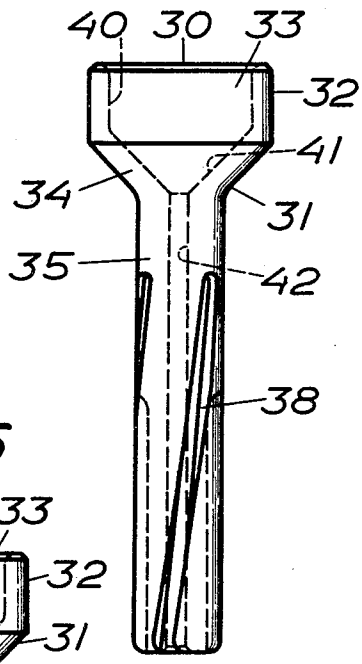
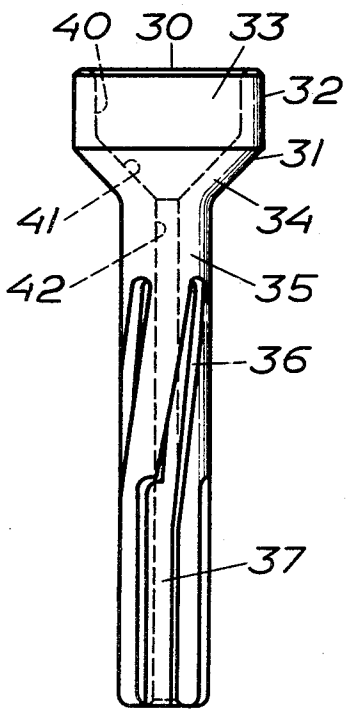


Fig. 6



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PRESSURE FLUID DRIVEN HAMMER PISTON FOR HAMMER DRILLS AND OTHER PERCUSSION TOOLS

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4 Claims. (Cl. 121—31)

The present invention relates to pressure fluid driven differential type hammer pistons for hammer drills or other percussion tools. Such pistons are well known in the art and generally comprise a piston head adapted to be reciprocated under the action of the pressure fluid in a cylinder and a piston extension adapted to deliver the blows to an intermediate member, a drill bit, or other working implement. It is also well known in the art that the number of blows delivered by such a piston during a certain time unit may be increased by reduction of the weight of the piston. For this purpose it has been proposed to partly build up the piston head by a material lighter than the steel used in the rest of the piston head and the extension such as aluminum, rubber or the like, and it has also been proposed to provide recesses or cavities in the piston. So far the proposed pistons have not been very successful. One object of the present invention is to provide a suitable distribution of the material of pressure fluid driven hammer pistons particularly of the differential type with a view to obtain a high number of blows of the piston per time unit and to obtain simultaneously a piston which produces heavy blows and stands up to the stresses set up within the piston during such operation. For these and other purposes I provide a pressure fluid driven differential type hammer piston, a non-rifled piston extension in said piston for delivering blows, a piston head in said piston axially defined by pressure surfaces of different size and merging into said piston extension, recesses in said piston head having a volume which is at least forty per centum of the volume of the piston head defined by said pressure surfaces and a cylinder encircling the piston head, and contents in said recesses having a mean specific gravity less than four, the piston head and the piston extension having together a length which is less than two and one-half times the diameter of said cylinder. As a modification I may provide a pressure fluid driven hammer piston, a substantially cylindrical piston extension of reduced diameter in said piston for delivering blows, a piston head in the piston comprising an annular cylindrical piston head portion and an annular frusto-conical piston head portion forming a junction between said cylindrical portion and said piston extension and merging into the piston extension, and recesses in said piston head having a volume which is at least forty per centum of the volume defined by the external cylindrical surface and the external frusto-conical surface of the piston head and planes perpendicular to the piston axis through the ends of said cylindrical and frusto-conical head portions.

In the accompanying drawings some embodiments of hammer pistons according to the invention are illustrated by way of example. Figs. 1–5 are axial sections of five modifications of hammer pistons according to the invention and Figs. 6, 7 and 8 are side elevations of further pistons according to the invention.

In the specification and claims the term "piston head" is used to designate the large diameter piston portion subjected to fluid pressure for producing the blows and in the illustrated embodiments generally defined by the cylindrical surface **32** and axially at one end by a plane **30** and at the opposite end by an annular surface or plane **31**, whereas the term "piston extension" designates the reduced portion of the piston designed for delivering the blows. Without departing from the scope of the invention the piston may, of course, be provided with other projections or extensions serving further purposes.

The hammer piston illustrated in Fig. 1 has a piston head comprising a cylindrical piston head portion **1** and a substantially frusto-conical piston head portion **2** which connects the cylindrical portion **1** with a cylindrical non-rifled piston extension **3** with reduced diameter and circular cross section designed to deliver blows directly or through an intermediate member to a rock drill bit or other implement. The angle α of the apex of the frusto-conical portion **2** is in this embodiment of the invention 90°. The plane **30** is the pressure surface on which the pressure fluid acts on the piston head during the positive stroke of the piston and the annular surface **31** of the frusto-conical portion **2** is the surface on which the pressure fluid usually acts during the return stroke of a piston of this type. The piston head has a cylindrical recess **4** extending into the piston head from the plane **30** at the end of the piston opposite the piston extension, said recess having a diameter being more than two-thirds of the outer diameter of the cylindrical portion **1**. The cylindrical recess **4** is continued towards the piston extension by a substantially conical recess **5**. The recesses **4** and **5** in the piston head in this case occupy about 50% of the volume of the piston head defined by the plane **30**, the surface **31** and a cylinder **32** encircling the piston head.

In the hammer piston according to Fig. 2 the piston head comprising the cylindrical piston head portion **7**, and the frusto-conical piston head portion **8** merging into the cylindrical non-rifled piston extension **9** has a recess extending into the piston head from the end opposite the piston extension. Said recess is in this case filled with a material with a specific gravity less than four, for instance rubber, as indicated at **10**, which material is vulcanized to the inner walls of the piston head. The volume in the piston head filled by the material **10** is more than 40% of the volume of the piston head defined by the plane **30**, the surface **31** and the cylindrical surface **32**.

In the embodiment according to the invention illustrated in Fig. 3 the piston head consists of a cylindrical piston head portion **11** and a frusto-conical piston head portion **12** merging into a cylindrical non-rifled piston extension **13** of less diameter than the piston head. The piston head portion **11** is provided with an annular recess **14** extending from the cylindrical surface of the piston head radially inwardly. Said recess may be filled with rubber, light metal, artificial resin or other suitable material with a specific gravity less than 4. The recess or its contents **15** may be enclosed by a cylindrical cover **16** of a metal forming the sliding surface of the piston head. The recess **14** in this case has a volume which is more than 40% of the volume defined within the cylindrical surface **32**, the plane **30** and the surface **31**.

Fig. 4 illustrates a hammer piston according to the invention, in which the piston head consists of a cylindrical flange **17**, a disc shaped portion **18** from the peripheral edge of which the flange extends, and a central head portion **19** which merges into a cylindrical non-rifled piston extension **20**. The piston according to Fig. 4 consequently has an annular recess **21** in the piston head formed within the volume defined by the planes **30** and **31** and the cylindrical piston head surface **32**. The cylinder of the pressure fluid motor in which a hammer piston of this design is intended to operate should preferably be provided with a front end head having an annular portion conforming with the annular recess **21** so that the clearance space at the front end of the piston is as small as possible.

Fig. 5 illustrates a hammer piston according to the invention in which the piston head consists of a cylindrical piston head portion **22** and a frusto-conical piston head portion **23** merging into a cylindrical piston extension **24**. The cylindrical piston head portion **22** consists of two parts **25** and **26** enclosing an internal recess **27** in the piston head filled with air. The recess **27** which constitutes somewhat more than 40% of the volume of the piston head defined by the plane **30**, the surface **31** and the cylindrical encircling surface **32** is continued into the piston extension **24** by a duct **28**. The parts **25** and **26** may be welded together or connected or formed in other suitable ways.

According to the invention hammer pistons of the types illustrated in Figs. 1–5 and intended for rock drills may preferably be carried out with a piston head diameter of 70 millimetres or more, the length of the piston head and the piston extension taken together being less than two and one-half times the diameter of the piston head. It is preferred in rock drills provided with hammer pistons according to the invention to keep the weight of the piston below 2 kilogrammes. Preferably the piston head diameter may be more than one and one-half times the stroke of the piston of such a drill.

The piston modifications according to the invention illustrated in Figs. 6, 7 and 8 consist of a piston head having a cylindrical piston head portion 33 and a frusto-conical piston head portion 34 merging into a rifled piston extension 35, which in the case of Fig. 6 is provided with helical grooves 36 continued towards the blowing end of the extension by axial grooves 37 and adapted to cooperate in a manner well known in the art with a drill turning device and a drill chuck, respectively. In the case of Figs. 7 and 8 the piston extension 35 is provided with a set of helical grooves 38 and a set of straight axially extending grooves 39 for cooperation with a drill turning device and a chuck, respectively, in well known manner. The piston head in the pistons according to Figs. 6–8 is provided with a cylindrical recess 40 merging into a substantially conical recess 41 and extending into the piston head from the end of the piston opposite the piston extension 35. The recesses 40, 41 have a volume which is about fifty per centum of the volume of the piston head defined within the cylindrical surface 32, the plane 30, and the surface 31 of the piston head. The pistons according to Figs. 6–8 are furthermore provided with a central duct 42 for accommodating a not illustrated water flushing tube, as is common practice in a great number of rock drills.

The hammer pistons according to the invention described hereinabove and illustrated in the accompanying drawings should only be considered as examples and the details of the invention may be modified in different ways within the scope of the claims. Although the illustrated hammer pistons are intended for use in machines driven by compressed air they may naturally also be used in machines driven by steam or other pressure fluid.

The invention also includes hammer drills or other percussion tools provided with hammer pistons according to the invention. Such a hammer drill according to the invention may have an external diameter of the piston head which exceeds 70 millimetres and which exceeds the stroke of the piston at least one and one-half times. The weight of the piston of such a hammer drill may preferably be less than 2 kilogrammes.

What I claim is:

1. In a pressure fluid driven hammer piston for hammer drill or other percussion tools, a recessed piston head forming a minor portion of the total mass of said piston defined by axially spaced surfaces having the same maximum diameter, a substantially solid piston shank forming a further portion of the piston constituting the main portion of the mass of said piston, an end portion on said piston shank for delivering blows directly to a member, a cylindrical sealing surface formed on said piston shank, and a cylindrical sealing surface on said piston head connecting said axially spaced surfaces and having a diameter from two to three times the diameter of said sealing surface on the shank, said recess in the piston head having a volume from two-thirds to one and one-half times the volume of the material forming said head and said recess communicating only through an axial opening with the exterior of said piston.

2. In a pressure fluid driven hammer piston for hammer drills or other percussion tools, a recessed piston head forming a portion of said piston defined by axially spaced surfaces having the same maximum external diameter and presenting surfaces acted on by the pressure fluid to drive the piston, a substantially solid piston shank forming a further portion of the piston, an end portion on said piston shank integral with said shank for delivering blows directly to a member, a cylindrical sealing surface formed on said piston shank, a cylindrical portion of said piston head forming a cylindrical sealing surface connecting said axially spaced surfaces and having a diameter from two to three times the diameter of said sealing surface on the shank, one of said axially spaced surfaces being frusto-conical and connecting said cylindrical portion with the piston shank, said recess constituting from forty to sixty per centum of the volume defined by said cylindrical portion, said frusto-conical surface, a plane perpendicular to the axis of the piston through the small end of the frusto-conical surface and the surface perpendicular to the piston axis at the end of the cylindrical piston head portion opposite the frusto-conical surface.

3. In a pressure fluid driven hammer piston for hammer drills or other percussion tools, a relatively light, recessed piston head forming a minor portion of the total mass of said piston, a substantially solid piston shank forming a further portion of the piston and constituting the main portion of the total mass of said piston, an end portion on said piston shank integral with said shank for delivering blows directly to a member, a cylindrical portion on said piston head forming a cylindrical sealing surface having a diameter from two to three times the diameter of said shank, and a frusto-conical portion of the piston head connecting said cylindrical portion with the piston shank, said cylindrical and frusto-conical portions of the piston head forming a light shell partially enclosing a relatively large recess of substantially the same volume as the material forming said shell and extending axially into the piston head from one end thereof.

4. In a pressure fluid driven differential hammer piston for hammer drills or other percussion tools, a piston head forming a portion of said piston and shaped as a hollow shell having two axially spaced walls defining said head and having the same maximum external diameter and presenting surfaces acted on by the pressure fluid to drive the piston, a cylindrical portion connecting said walls and forming a cylindrical sealing surface, a substantially solid piston shank forming a further portion of the piston and connected to one of said walls, an end portion on said piston shank for delivering blows directly to a member, and a cylindrical sealing surface formed on said piston shank, the recess in said piston head defined by said cylindrical portion and said walls having a volume from two-thirds to one and one-half times the volume of the material forming said shell.

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