June 20, 1967 T. M. PORTER 3,326,029

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Filed Aug. 5, 1964 2 Sheets-Sheet 1

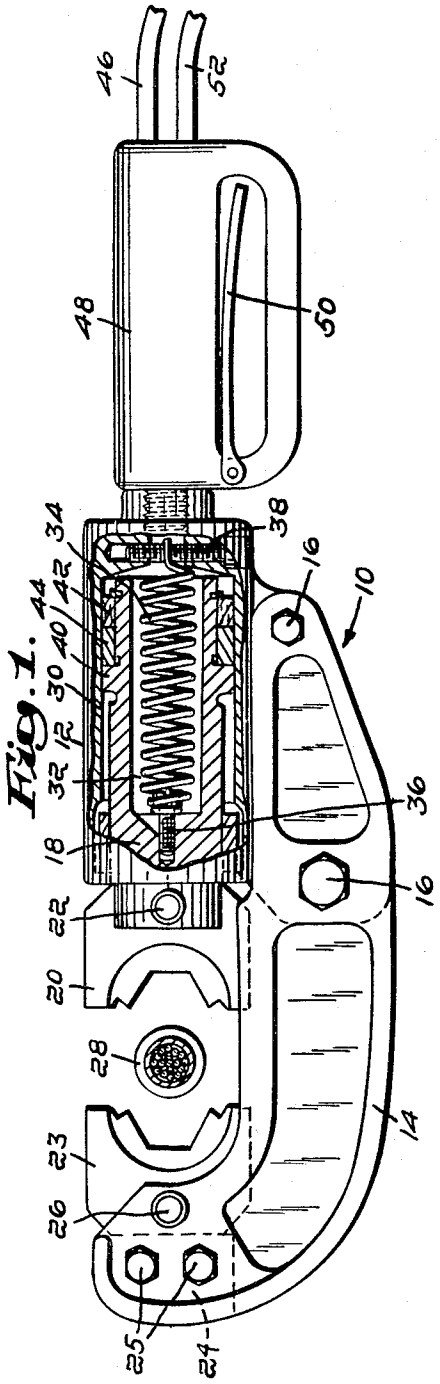


Fig. 1.

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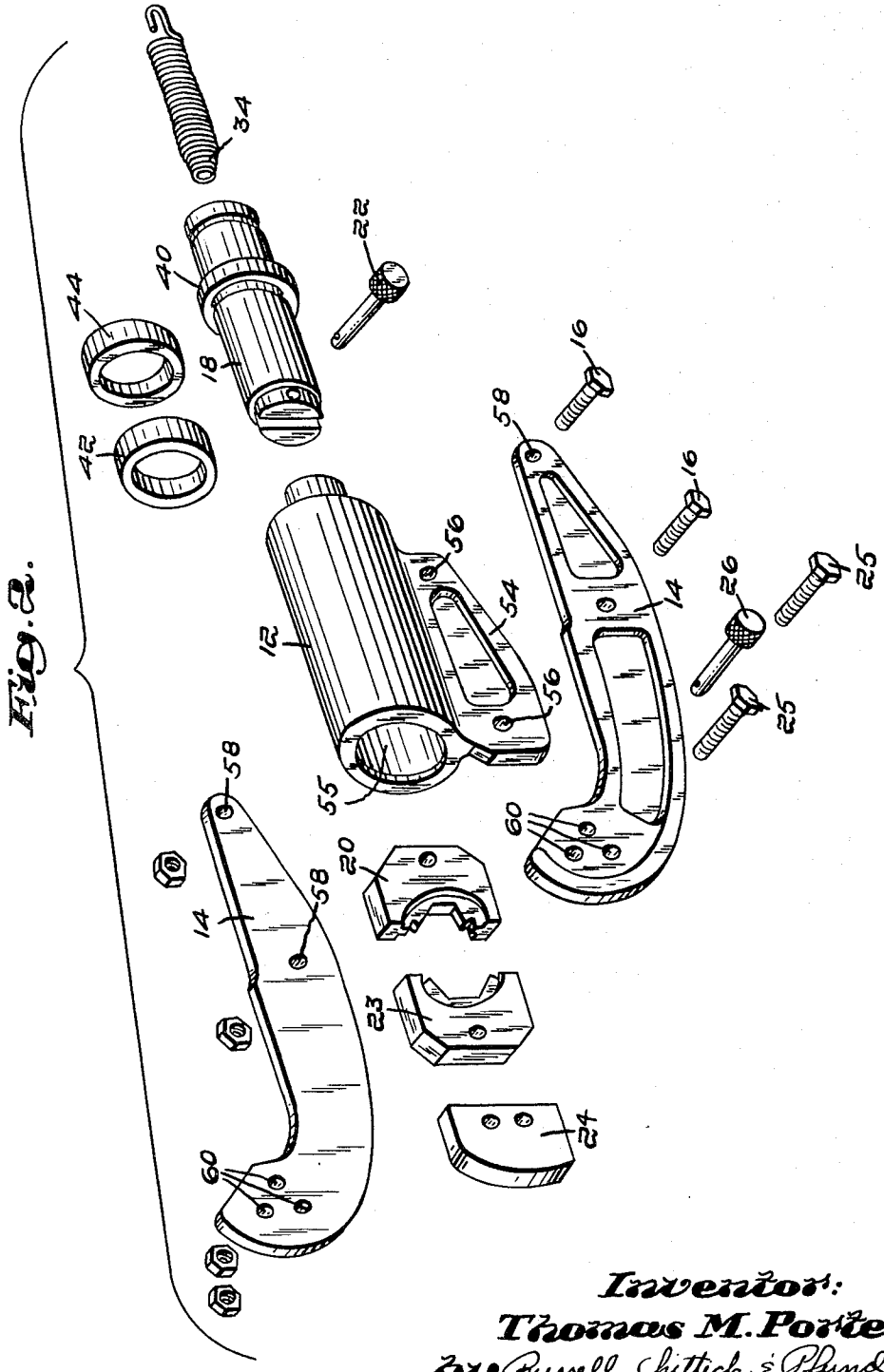


Fig. 2.

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This invention relates to portable tools and more particularly to improved piston-operated tools for cutting, crimping or performing other similar operations on various types of workpieces.

Tools of the aforementioned type are usually hydraulically or pneumatically actuated by compressed gas or liquid received from a centralized pump via flexible hoses. This arrangement enables the tools to be easily carried by operating personnel to remote locations where work is to be performed. Although generally applicable to the entire classification of portable piston-operated tools, the inventive concepts of the present invention will be hereinafter described in connection with a hydraulically-operated crimper of the type frequently utilized in crimping deformable wire connectors. It is to be understood, however, that the description of the present invention in connection with this particular type of tool is only for purposes of illustration and is not to be considered in any way as a limitation upon the scope of the inventive concepts disclosed.

When crimping wire or cable connectors, workmen must frequently climb utility poles, thereafter assuming awkward positions during actual performance of the crimping operation. Under these conditions, the weight of the crimping tool being utilized is an important factor in determining whether or not an operator can successfully perform the crimping operation. More particularly, a tool that is unnecessarily heavy becomes cumbersome to handle, thereby rendering the task to be performed increasingly difficult. Moreover, a lightweight tool is desirable since it avoids tiring the operator during long continuous periods of use. Finally, although a successful tool design should provide lightweight construction, it must also be strong enough to withstand the stresses created during the cutting or crimping operation without undergoing premature failures.

The design problems involved in producing a piston-operated tool of minimum weight and maximum strength have not heretofore been overcome to a degree satisfactory to the industry. The usual practice in fabricating tools of this type is to begin with an integrally fabricated metal blank forged to the approximate dimensions of the finished product. At this stage, because the metal has a relatively low tensile strength due to the fact that it has not yet undergone heat treatment, it is relatively soft and easy to machine. From this point, the manufacturer may adopt one of several methods in completing the fabrication of the tool. One such method is to finish machine the forging without resorting to subsequent heat treatment. However, in view of the metal's low tensile strength, the weight of a tool produced in this manner must of necessity be increased substantially if the stresses developed during subsequent operation are to be successfully withstood. As previously indicated, where portable tools are being manufactured, this increase in weight is undesirable.

In an attempt to minimize the aforementioned problem of excessive tool weight, some manufacturers perform a heat treating operation following the initial machining of the forging. This raises the tensile strength of the tool structure and permits a lighter weight tool design. However, heat treatment usually produces distortion and oxidized scaled surfaces. Consequently, the tool must be further machined following the heat treating operation in order to achieve the desired tolerances and finished surfaces. This further machining in turn results in increased manufacturing costs and an overall increase in the price of the tool being produced.

A third alternative procedure followed by some manufacturers is to heat treat the entire forging to a high hardness level prior to performing the machining operation. Although this obviates the necessity of performing two machining operations, the overall costs of producing the tool are not substantially decreased due to the fact that once heat treated, the metal becomes hard and difficult to machine. Consequently, the manufacturer must utilize special tools and in addition, slow down the speed of the machining operations in order to conserve production equipment.

The present invention obviates the aforementioned difficulties by selectively subdividing the basic tool structure into a plurality of separate forged components, usually of steel, which may be heat treated to varying degrees of hardness at various stages during the manufacturing operation. More particularly, the apparatus contemplated herein comprises either a pneumatic or hydraulic cylinder adapted to receive separable tool supporting frame members in engagement therewith. The cylinder portion is rough machined and then heat treated to a relatively low hardness level, as for example in the range of 250 Brinell, to provide a tensile strength of approximately 120,000 p.s.i. At this hardness level, the finish machining can be performed according to conventional techniques on conventional production machines. Moreover, machining operations such as cylinder boring can be done with ordinary high speed steel or carbide tools at high production rates.

The frame members are separately machined and then heat treated to a much higher hardness level of approximately 400 Brinell to provide a tensile strength of approximately 200,000 p.s.i. Further finish machining of these components is not required for the distortion resulting from heat treatment is relatively inconsequential and tolerable. The frame members and cylinder portion are then interconnected by locating pins inserted through aligned apertures in both components to complete the basic tool structure.

By separately heat treating the frame members, a high tensile strength is attained per unit of cross-sectional area. This in turn permits the weight of these tool components to be decreased markedly, thereby providing a means of producing a lightweight tool with high strength characteristics. In addition, the finishing operations may be performed by normal methods at the price of heavier construction only in the cylinder area.

It is therefore an outstanding object of the present invention to provide an improved piston-operated portable tool selectively subdivided into a plurality of components in order to facilitate manufacture.

Another object of the present invention is to provide a piston-operated portable tool having components heat treated to varying levels of hardness prior to their assembly.

A further object of the present invention is to provide a piston-operated tool having a cylinder assembly heat treated to a relatively low hardness level in order to facilitate machining, the remaining components of the tool being heat treated to a higher hardness level in order to provide the desired characteristics of high strength and lightweight.

These and other objects of the present invention will become more apparent as the description proceeds with the aid of the accompanying drawings in which:

FIG. 1 is a sectional view of a portable piston-operated tool embodying the concepts of the present invention;

FIG. 2 is an exploded view in perspective of the tool.

Referring initially to FIG. 1 wherein are best shown general features of the present invention, a piston-operated

portable tool of the type utilized in compressing wire connectors is indicated at **10**. The tool is comprised basically of a cylinder assembly **12** with spaced frame members **14** (only one of which is clearly shown in FIG. 1) commonly referred to as "cheeks" attached thereto by means of locating pins **16**. A piston **18** is extensibly mounted within cylinder assembly **12** and provided at its exposed end with a first tool member **20**. Tool member **20** is attached to the piston by means of a transverse pin **22** which may be readily removed when replacement of the tool member is necessitated.

A second tool member **23** is positioned in spaced opposed relationship to tool member **20** between frame members **14**. Tool member **23** is backed by an intermediate filler piece **24** held in place by screws **25**. Removal of tool member **23** is also possible by simply withdrawing locating pin **26** which extends laterally through both frame members **14**.

With this construction, it is apparent that when the piston **18** is extended either by pneumatic or hydraulic means, a workpiece, herein indicated in the form of a deformable wire connector **28** will be deformed or crimped by the cooperative action of first and second tool members **20** and **23**. Thus it can be seen that during the crimping operation, the forward movement of tool member **20** will be opposed by tool member **23** as the frame members **14** are tensioned and bent slightly.

A portion of cylinder assembly **12** has been broken away as at **30** to illustrate the means utilized in extending and retracting piston **18**. As indicated, the piston is internally provided with a cylinder chamber **32** within which is contained a coiled spring **34**. The spring is attached to the piston head by means of a screw **36** and is fixed at its other end to the cylinder by means of transversely extending pin **38**. The piston is further provided with a shoulder **40** having positioned adjacent thereto various sealing rings **42** and **44**.

As illustrated in the drawings, piston **18** is hydraulically actuated by means of pressurized fluid being supplied through feed line **46**. The feed line is connected to control valve **48** which may in turn be controlled by manipulation of handle **50**. Once the handle is depressed, pressurized liquid is allowed to flow from line **46** into cylinder assembly **12** in order to drive piston **18** forward. As the piston is driven forward, coiled spring **34** is extended and placed in tension. When the operating handle **50** is released, control valve **48** is reset and cylinder assembly **12** placed in communication with the return line **52**. This removes hydraulic pressure from the cylinder and allows coiled spring **34** to retract piston **18** as hydraulic fluid escapes through the return line.

The hydraulic feed and return lines **46** and **52** are connected to a conventional hydraulic pump and tank assembly (not shown). Since this remotely positioned apparatus forms no part of the present invention, it has been omitted from the drawings.

FIG. 2 is an exploded view of the tool disclosed in FIG. 1 showing the principal components prior to assembly. The cylinder assembly **12** is forged from a single blank and as clearly shown in this view, is provided with a cylindrical portion having an integral web **54** extending radially therefrom. After being rough machined, the cylinder assembly is heat treated to a relatively low hardness level of approximately 250 Brinell. Thereafter, the cylinder assembly is finish machined by being centrally bored as at **55** and drilled at **56** to accept the transversely extending pins **16** utilized in attaching the frame members **14** thereto.

Since the cylinder assembly is not subjected to subsequent heat treatment following the finish machining operation, its tensile strength will remain in the area of 120,000 p.s.i. Consequently, the bulk of the cylinder assembly must be of necessity be increased accordingly if operating stresses are to be successfully withstood. It has been found, however, that the heavier construction required in the cylinder area is not particularly undesirable since it does not produce an unwieldy tool. When considered in connection with the advantages of easier machining without subsequent distortion as a result of heat treating, which would in turn require further machining, the advantages gained through allowing the cylinder assembly to remain at a relatively low hardness level are immediately apparent.

The frame members **14** are forged to provide matching right and left hand members. In contrast to the cylinder assembly, the frame members are usually forged and immediately finish machined by having holes **58** and **60** drilled therethrough to accept locating pins **16** and the screws **25** and pin **26** which hold the filler piece **24** and tool member **23** in place. Once machined, the frame members are then heat treated to a high hardness level in the area of 400 Brinell to achieve a tensile strength of approximately 200,000 p.s.i. Although the frame members may undergo some slight distortion during heat treatment, this is not considered particularly troublesome where the cooperating tool members **20** and **23** are to be utilized in performing operations such as crimping where accuracy is not an essential requisite.

However, where accurate alignment of cooperating tool members similar to those indicated by the reference numerals **20** and **23** is essential, as for example where the tool is to be utilized in performing a piercing operation, then the aforementioned procedure can be varied slightly to achieve the desired accuracy. More particularly, the accurate positioning of each frame member on the cylinder assembly **12** is controlled by the positioning of holes **58** drilled therethrough to accept the locating pins **16**. By the same token, the position of tool member **23** and intermediate filler piece **24** is controlled by the accurate location of holes **60** adjacent the distal ends of each frame member. Since all of these holes are drilled following heat treatment, any distortion occurring prior to the drilling operation will have no detrimental effect on the ultimate location of the various tool components. This is to be contrasted, however, to the cylinder assembly where the slightest distortion following the boring operation would undoubtedly impair piston operation within the cylinder. Once all heat treatment and machining has been completed, the tool components are simply assembled in a conventional manner by use of the various connecting pins, bolts and nuts shown in FIG. 2.

In view of the above, it can be seen that the completed tool offers several important advantages. More particularly, the frame members which connect tool member **23** to cylinder assembly **12** are provided with high tensile strength without accompanying difficulties in machining. Minimum weight in this particular area is of vital importance in view of the fact that the frame members extend outwardly from the cylinder and if allowed to become bulky, would impart an unwieldy characteristic to the tool.

The cylinder assembly **12** is machined without difficulty due to its relatively low hardness. The heavier construction in this area is not considered particularly disadvantageous in view of the fact that it is located close to the control valve **48** which is usually held by the operator in one hand. Thus, it can be seen that a high strength tool is provided without sacrificing balance or lightweight through use of the present construction.

It is my intention to cover all changes and modifications of the present invention which do not depart from the spirit and scope of the inventive concepts contained herein.

I claim:

1. A piston-operated tool of the type described comprising the combination of: a first tool member adapted to be forced against one side of a workpiece, a piston reciprocally disposed within a cylinder and operatively connected to said first tool member, means for extending and retracting said piston to operate said first tool mem-

ber, means for supporting said workpiece during extension of said piston including a second tool member positioned to engage the other side of said workpiece, said second tool member supported in a fixed position relative to said cylinder by interconnecting frame means extending from said cylinder to said second tool, said frame means separable from said cylinder and heat treated to a high degree of hardness in order to provide greater strength per unit of cross-sectional area.

2. Portable apparatus for performing operations on a workpiece in response to pressure exerted by a piston, said apparatus comprising a unitized cylinder assembly having a piston extensibly contained therein, at least one frame member forged and heat treated to a relatively high degree of hardness, means for attaching said frame member to said cylinder assembly following the heat treatment thereof, said frame member when so attached forming an extension of said cylinder assembly adjacent the path of said piston, a first tool member removably mounted on the distal end of said frame member, a second tool member reovably mounted on the end of said piston for movement therewith, said first and second tool members designed to cooperate in performing an operation on a workpiece positioned therebetween during extension of said piston.

3. A piston-operated apparatus comprising the combination of a piston extensibly mounted within a cylinder assembly, means for extending and retracting said piston, a first tool member removably mounted on said piston for movement therewith, a second tool member fixed to intermediate frame means extending from said cylinder assembly, said second tool member spaced from said first tool member and adapted to operate in conjunction therewith on a workpiece positioned therebetween, said intermediate frame means separable from said cylinder assembly and heat treated to a relatively high degree of hardness to provide high strength per unit of cross-sectional area.

4. The apparatus as set forth in claim 2 wherein said frame member is comprised of a forging heat treated to a hardness of approximately 400 Brinell with a tensile strength of approximately 200,000 p.s.i., said heat treatment occurring prior to the attachment of said frame member to said cylinder assembly.

5. A multi-component construction for piston-operated tools comprising the combination of a forged cylinder heat treated to a relatively low hardness prior to being machined to the desired tolerances, an operating piston extensibly contained within said cylinder, frame means

heat treated to a high degree of hardness in order to achieve high strength per unit of cross-sectional area, means for connecting said frame means to said cylinder, a first tool member mounted on said piston for movement therewith, said first tool member opposed by a second tool member fixed to said frame means, and means for extending said piston following the positioning of a workpiece between said first and second tool members to perform an operation thereon.

6. A portable piston-operated tool providing high strength and low weight comprising the combination of: a cylinder assembly forged and heat treated to a relatively low hardness level of approximately 250 Brinell in order to facilitate subsequent machining; an operating piston reciprocally mounted within said cylinder assembly, said piston having removably attached thereto a first tool member; frame means separable from said cylinder assembly, said frame means forged and heat treated to a hardness level of approximately 400 Brinell in order to provide high tensile strength per unit of cross-sectional area; means for connecting said frame means to said cylinder assembly following heat treatment of both components; a second tool member removably attached to the distal end of said frame means at a position opposed to said first tool member, and means for extending said piston to perform an operation on a workpiece positioned between said first and second tool members.

7. The method of fabricating the basic frame structure of a lightweight piston-operated tool comprising the steps of: forging and heat treating a cylinder assembly to a relatively low hardness level of approximately 250 Brinell; machining said cylinder assembly to the desired tolerances; forging and heat treating frame members to a relatively high hardness level of approximately 400 Brinell; and connecting said frame members to said cylinder by means of locating pins extending through both said frame members and said cylinder prior to the assembly of the remaining tool components.

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