United States Patent

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Original application Feb. 5, 1968, Ser. No. 703,021, now Patent No. 3,538,792. Divided and this application May 11, 1970, Ser. No. 36,289

[54] MAGNETIC TOOL
8 Claims, 9 Drawing Figs.

[52] U.S. Cl. 81/125, 145/50
[51] Int. Cl. B25b 13/02, B25b 15/00
[50] Field of Search 81/125; 145/50, 35

[56] References Cited
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3,392,767	7/1968	Stillwagon	81/125 X
2,671,484	3/1954	Clark	81/125 UX
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ABSTRACT: A fastener-driving magnetic tool has an annular inner pole piece and an annular outer pole piece concentrically spaced with an annular thickness-orientated elastomeric strip magnet disposed therebetween. The inner pole piece is in radially expanding comprising relation against the magnet for retaining both the magnet and the the inner pole piece, and an axially adjustable inner pole piece extension member or a nonmagnetic tube member is disposed within the inner pole piece.

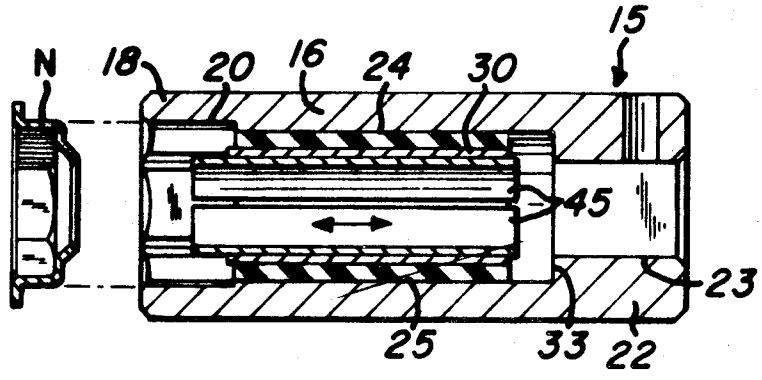


FIG-1

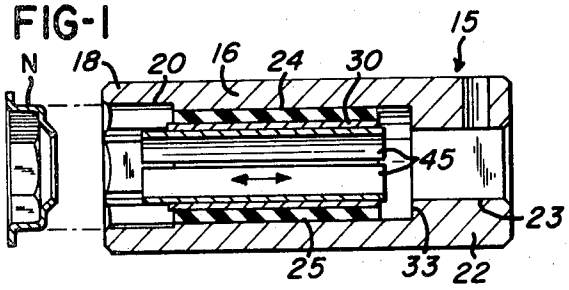


FIG-2

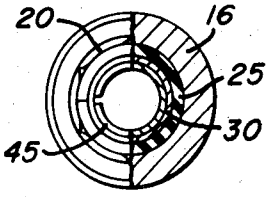


FIG-3

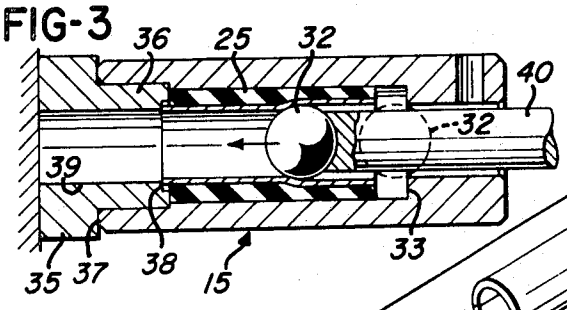


FIG-4

FIG-5

FIG-6

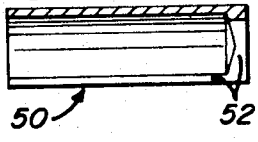


FIG-7

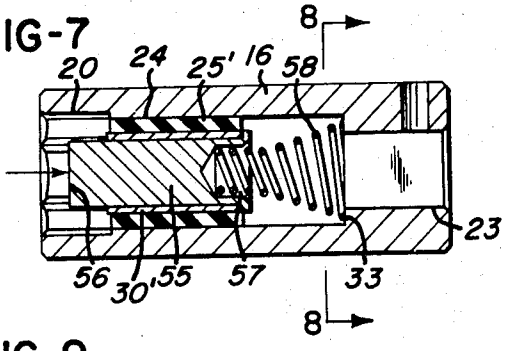


FIG-8

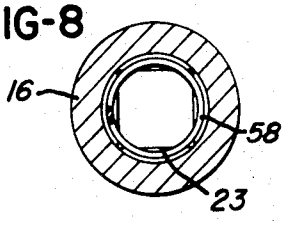
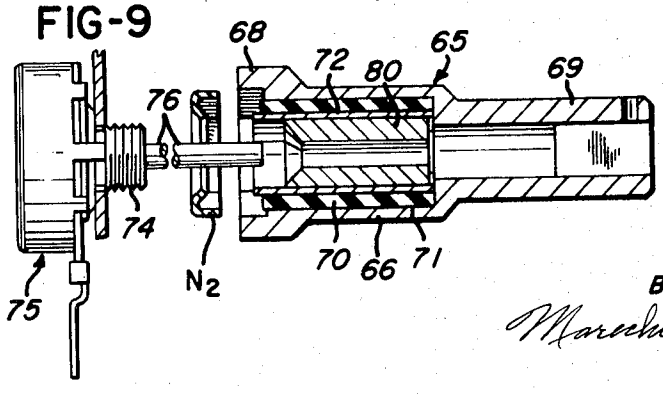


FIG-9



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MAGNETIC TOOL

RELATED APPLICATIONS

This application is a division of copending application Ser. No. 703,021, filed Feb. 5, 1968, now U.S. Pat. No. 3,538,792.

BACKGROUND OF THE INVENTION

In the assembly of a fastener driving tool as disclosed in applicant's U.S. Pat. No. 3,392,767, issued July 16, 1969, an elastomeric strip magnet is rolled into a tube or cylinder and inserted into the annular or tubular outer pole piece. A cylindrical inner pole piece is machined so that at least a portion of its outer diameter is slightly greater than the free inner diameter of the inserted strip magnet and then the inner pole piece is pressed axially into the strip magnet.

Since the flexible strip magnet is rather soft and fragile, it has been found desirable to machine the outer diameter of the inner pole piece within very close tolerances and to form a pilot portion of slightly reduced outside diameter and a smooth outer surface so that when the inner pole piece is pressed axially into the magnet, it will not strip or shear material from the magnet. It has been found, however, that the close machining of the inner pole piece significantly increases the cost of the tool and the reduced pilot portion prevents full area contact of the inner pole piece with the magnet.

Due to the various types of commonly used nut fasteners, usually a socket type driving tool, as shown in the above application, is constructed for a particular type and size of nut. That is, the inner pole piece is positioned in precise axial spaced relation to the outer pole piece according to the thickness of the type of nut which is being used. It has been found desirable to construct such a socket so that it can accommodate nuts of different thickness.

There is also a specific problem presented by a socket as shown in the above application when threading a nut onto a tubular threaded stud from which projects a concentric magnetically attractable stem or shaft, for example, when assembling a rheostat to a control panel. That is, the stem is attracted to the inner pole piece thereby moving the shaft out of alignment with the socket and resulting in producing a bad start of the nut on the stud.

SUMMARY OF THE INVENTION

The present invention is directed to an improved fastener-driving magnetic tool of the character described above and which incorporates an annular inner pole piece expanded radially into compressing relation with the elastomeric strip magnet so that both the magnet and the inner pole piece are positively retained within the outer pole piece. The expansion of the inner pole piece for retaining the magnet not only eliminates the need for machining the inner pole piece within close tolerances and for forming a pilot portion of the inner pole piece but also eliminates the need for forming a smooth inner surface on the magnet. Furthermore, the expanded inner pole piece assures full area contact between the magnet and the inner and outer pole pieces thus providing maximum magnet utilization.

The present invention also provides a magnet fastener driving tool incorporating an inner pole piece extension member which is in axially adjustable relation to the inner pole piece so that one tool can accommodate threaded fasteners of various shapes and thicknesses. In another embodiment, the inner pole piece of a drive socket is lined with a nonmagnetic tubular sleeve member so that when the socket receives a shaft projecting concentrically from a tubular threaded mounting stud, alignment of the socket and stud is maintained and the nut is properly threaded on the stud.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an axial section through a drive socket constructed in accordance with the invention;

FIG. 2 is an end view of the socket shown in FIG. 1 with a portion broken away;

FIG. 3 is an axial section similar to FIG. 1 and illustrating in exaggeration a method of assembling the socket in accordance with the invention;

FIG. 4 is an exploded perspective view of the drive socket shown in FIG. 1;

FIGS. 5 and 6 show a modification of an inner pole piece extension member;

FIG. 7 is an axial section of a drive socket constructed in accordance with another embodiment of the invention;

FIG. 8 is a section taken generally on the line 8—8 of FIG. 7; and

FIG. 9 is an axial section of a further embodiment of a drive socket constructed in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the figures of the drawing, FIG. 1 illustrates a magnetic pickup socket 15 constructed in accordance with the invention and of the type commonly referred to as a "-clearance socket" particularly suited for driving a nut N onto a threaded bolt (not shown). The socket 15 includes a tubular body 16 forming an outer pole magnetic piece, and having a forward driving end portion 18 with a socket opening 20 of hexagonal cross section for receiving the nut N. The body 16 also includes a rearward end portion 22 having a square opening 23 for receiving the square drive shank of a tool, such as a pneumatic wrench or a hand actuated socket wrench. The central portion of the body 16 has a cylindrical bore 24 in which is positioned a thickness orientated elastomeric magnet 25 formed or rolled into the shape of a cylinder from a strip magnet material as disclosed in the aforementioned application, and as shown in FIG. 4.

A cylindrical inner pole piece 30 having an outer diameter slightly less than the inner diameter of the cylindrically shaped magnet 25, is inserted within the magnet 25 and expanded radially into compressing relation with the outer pole piece or body 16. One method of expanding the inner pole piece 30 is illustrated somewhat exaggerated in FIG. 3 wherein a metal ball or spherical mandrel 32 of a diameter greater than the inside diameter of the inner pole piece 30 is first positioned within the cylindrical bore 24 of the socket 15 as shown in the dotted portion adjacent the internal shoulder 33 formed by the opening 23. The magnet 25 and inner pole piece 30 are then successively inserted into the bore 24, and the entire socket assembly is positioned on a tubular fixture 35 having a portion 36 which is received within the socket opening 20. The fixture 35 provides an external shoulder 37 which abuts the end of the body 16, and an internal shoulder 38 forms a stop for the end of the inner pole piece 30.

A cylindrical bore 39 is formed within the fixture member 35 and has a diameter slightly larger than the spherical mandrel 32 but less than the outer diameter of the inner pole piece 30. While the socket 15 is firmly held on the fixture 35, a plunger 40 is inserted within the opening 23 and is pressed against the spherical mandrel 32 causing the mandrel to move towards the opening 39 within the fixture 35 thereby progressively expanding the inner pole piece 30 into radially compressing relation with the magnet 25.

While the use of the spherical mandrel 32 illustrates one method of expanding the inner pole piece 30, it is within the scope of the invention to expand the inner pole piece by other methods, as for example, by hydraulic pressure or by using an elongated plunger type mandrel. Furthermore, it is within the scope of the invention to employ a split inner cylindrical pole piece such as an elongated C-shaped spring sleeve and to contract or collapse the inner pole piece before inserting it into the magnet 25.

Referring to FIGS. 1, 2 and 4, an auxiliary inner pole piece or sleevelike extension member 45 having a longitudinally extending slot 46 and a C-shaped cross-sectional configuration, may be disposed within the cylindrical inner pole piece 30 and frictionally retained, so that it is frictionally adjustable in an axial direction with respect to the inner pole piece 30. The adjustability of the inner pole piece extension member 45 with

respect to the socket opening **20** enables its end surface **48** (FIG. **1**) to be precisely positioned in relation to the end of the body **16** according to the thickness of the nuts being driven in order to obtain a positive engagement between both the inner and outer pole pieces and the nut and thereby obtain the most effective magnetic attraction between the socket **15** and the nut.

Referring to FIGS. **5** and **6**, a modified inner pole piece extension member **50** has a head portion **51** with a diametrically extending slot **52** which continues throughout the length of the extension member to provide a C-shaped cross-sectional configuration substantially the entire length of the extension member. The head portion **51** provides the extension member with an end surface which permits convenient adjustment of the extension member relative to the expanded inner pole piece **30**.

FIGS. **7** and **8** show another embodiment of a socket member constructed in accordance with the invention. In this embodiment, the socket body **16** retains a cylindrical shaped magnet **25'** and an expanded cylindrical inner pole piece **30'** which, in turn, slidably receives an extension member **55** having a forward end face **56** and a blind hole **57** in its rearward end portion. A spiral-helical compression spring **58** has its smaller end received within the hole **57** and its larger end seats on the internal shoulder **33**.

The inner pole piece extension member **55** has an outwardly flared rearward end flange **60** which engages the rearward end of the inner pole piece **30'** to limit the forward movement of the extension member **55** under the force exerted by the spring **58**. The minimum distance between the forward end face **56** of the extension member **55** and the forward end surface of the body **16** is preset to provide for positive engagement between the extension member and a relatively thin nut such as shown in FIG. **1**. When the socket is used with a thicker nut, however, the extension member **55** moves rearwardly compressing the spring **58** to produce full engagement between the socket opening **20** and the outer peripheral surface of the nut while also maintaining positive engagement with the nut for obtaining the maximum magnetic attraction between the socket and the nut. It is to be understood that the extension member **55** could be tubular and the spring **58** be constructed to engage the end surface of the tubular member.

In accordance with another embodiment of the invention, a magnetic clearance socket **65** (FIG. **9**) has a tubular body **66**, a fastener receiving opening **68** and a square shank receiving opening **69**. A rolled elastomeric strip magnet **70** is positioned within a counterbore **71** formed within the body **66**, and a cylindrical inner pole piece **72** is expanded radially in the manner described above for retaining the magnet **70** and inner pole piece within the body **66**. The socket **65** is ideally suited for use in threading a nut N_2 onto a threaded tubular stud **74** of a rheostat **75** having an elongated stem or shaft **76** concentric with the threaded stud **74**. When the shaft **76** is constructed from a magnetic material, the stem is prevented from being attracted to the inner pole piece **72** during starting of the nut N_2 by an inner sleeve or tube **80** of nonmagnetic material such as aluminum which is pressed fitted into the inner pole piece **72** thereby blocking the magnetic attraction between the shaft **76** and the inner pole piece **72**.

From the drawing and the above description, it can be seen that a fastener driving magnetic tool constructed in accordance with the invention has several desirable features and advantages. For example, by expanding the inner pole piece **30** into radially compressing relation with the magnet **25**, both the magnet and the inner pole piece are effectively and positively retained within the body **16** without the need for maintaining extremely close tolerances and smooth finishes on the outer surface of the inner pole piece **30** and the inner surface of the cylindrically shaped magnet **25**. Also, by the use of the mandrel **32**, the magnet strip **25** and the pole piece **30** are accurately positioned with respect to the socket opening concurrently with the sizing step.

Another important feature is provided by the axially adjustable inner pole piece extension member **45**, **50** or **55** which enables the socket to be conveniently and precisely adjusted for accommodating threaded fasteners of various thicknesses. Furthermore, the nonmagnetic tubular member **80** shown in the embodiment of FIG. **9** conveniently adapts a magnet socket for accurately starting and driving a threaded fastener over an elongated concentric shaft which would otherwise be attracted towards the inner pole piece **72** causing the socket to tilt out of alignment with the axis of the shaft.

While the method of expanding the inner pole piece within the magnet and outer pole piece is illustrated in the drawing in conjunction with the assembly of a clearance type socket, it is to be understood that the expanding technique may also be used for assembling other forms of annular magnets for fastener driving tools. For example, the magnet assembly shown in FIG. **6** of the above application for use on a screw driven bit may be accomplished by expanding the inner cylindrical pole piece within the outer cylindrical pole piece.

While the method and articles herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise method and these articles, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A fastener-driving magnetic tool adapted to pick up a magnetically attractable fastener and to retain such fastener in a driving position thereon, comprising a tool body having a fastener-driving portion and means forming a hollow outer pole piece, an annular strip magnet disposed within said outer pole piece, an annular inner pole piece disposed within said strip magnet, and said inner pole piece being in radially expanded compressing relation against said magnet for positively retaining said inner pole piece and said magnet within said outer pole piece.

2. A tool as defined in claim **1** including an axially adjustable inner pole piece extension member disposed within said inner pole piece.

3. A tool as defined in claim **2** wherein said inner pole piece extension member has a C-shaped cross-sectional configuration throughout a substantial portion thereof and is in frictionally gripping relation with said inner pole piece.

4. A tool as defined in claim **2** wherein said inner pole piece extension member is substantially solid and has a generally cylindrical configuration.

5. A tool as defined in claim **2** including means forming a stop for limiting the axial movement of said extension member, and a spring connected to said extension member for biasing said member toward said stop.

6. A fastener-driving magnetic tool adapted to pick up a magnetically attractable threaded fastener and to retain such fastener in a driving position thereon, comprising a rotatable tool body having a fastener-driving portion and means forming an annular outer pole piece, an annularly arranged thickness-orientated elastomeric strip magnet disposed within said outer pole piece, an annular inner pole piece disposed within said magnet, means for retaining said inner pole piece and said magnet within said outer pole piece, and a tubular member mounted within said inner pole piece.

7. A tool as defined in claim **6** wherein said tubular member is axially adjustable relative to said inner pole piece to form an adjustable extension thereof.

8. A tool as defined in claim **6** wherein said tubular member comprises a nonmagnetic tube adapted to prevent said inner pole piece from attracting a magnetically attractable rod or shaft concentric with said fastener.

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