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2,793,552

MAGNETIC SOCKET WRENCH HAVING SPACED POLE PIECES

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Fig. 1

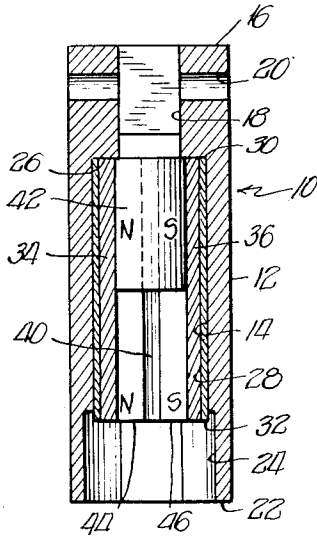


Fig. 2

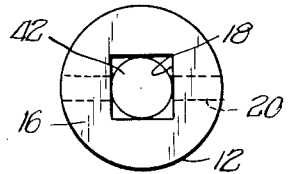


Fig. 3

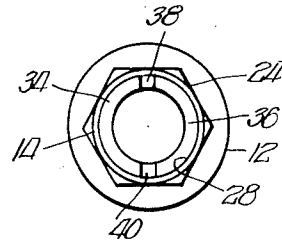


Fig. 4

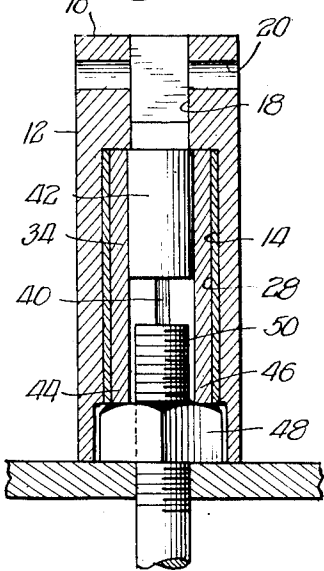


Fig. 5

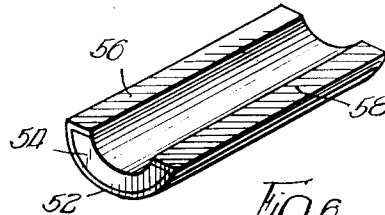
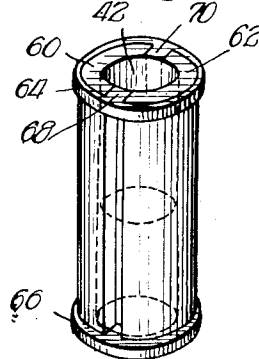


Fig. 6



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MAGNETIC SOCKET WRENCH HAVING SPACED POLE PIECES

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5 Claims. (Cl. 81-125)

This invention relates to a magnetic socket wrench and more particularly to a socket wrench in which a magnet is utilized for holding a nut in position in said wrench for threading onto a bolt or stud, or the like.

The present invention is an improvement over the prior art as represented by applicant's U. S. Patent No. 2,714,829, issued August 9, 1955, and U. S. Patent No. 2,260,055, issued October 21, 1941, to Robert T. Reardon. The first mentioned of these two prior-art patents discloses a device in which magnetic energy is transferred from an elongated magnet within the hollow shank of a tool, through a magnetic sleeve, one end of which is in abutment with the magnet. The opposite end of the sleeve is adapted to retain the workpiece within the non-circular bore of the wrench through magnetic attraction. In such an arrangement, clearance is provided for a bolt protruding above the top of a nut being driven. This construction is satisfactory where the amount of clearance for the bolt need not be more than approximately one and a half times the thickness of the nut. Where greater clearance is required, however, the length of the sleeve must be increased to such an extent that there is not enough magnetic energy remaining at the end of the sleeve to satisfactorily hold the workpiece.

The second-mentioned prior-art patent discloses a device in which a hollow magnet is provided with a transverse slot in one end, forming an air gap between the two poles of the magnet. The magnet is adapted to contact the workpiece and retain it within the noncircular socket portion of a tool. Since the material of which the magnet is made is ordinarily quite brittle, it can be easily damaged or actually broken by contact with the workpiece, which of course then renders the tool inoperative.

An object of this invention is therefore to provide a magnetic socket wrench of the character described in which the magnet is disposed inwardly from the inner limits of a nut-engaging socket so as to be relatively free from the possibility of damage through impact, and yet has its magnetic attraction effectively transmitted to the nut to be held and driven.

Another object of this invention is to provide a magnetic socket wrench of the character described which utilizes a bar magnet magnetized across its diameter and two associated pole pieces in association with said magnet, the pole pieces being of a length substantially greater than that of the magnet so as to provide a relatively large amount of clearance for the protruding portion of a bolt upon which a nut is being driven.

Yet another object is to provide a magnetic socket wrench of the character described which has a relatively large amount of bolt clearance but at the same time adequate magnetic energy for holding a workpiece even though the magnet is not brought into direct contact therewith.

A further object is to provide a magnetic socket wrench of the character described which provides this substantial increase in the amount of bolt clearance but has a longi-

tudinal dimension comparable to socket wrenches of conventional construction.

A further object is to provide a magnetic socket wrench of the character described in which the protruding end of a workpiece, with its opposite end in place in the socket, is not magnetically energized to any substantial degree so that it is not repelled when an attempt is made to insert it in a tapped hole, or the like.

Still another object of this invention is to provide a magnetic socket wrench of the character described, which is simple in both construction and operation and therefore which can be readily manufactured and which has high commercial utility.

Further objects and advantages of this invention will become evident as the description proceeds and from an examination of the accompanying drawing which illustrates one embodiment of the invention and in which similar numerals refer to similar parts through the several views.

In the drawings:

Figure 1 is a vertical longitudinal section of one form of magnetic socket wrench incorporating the invention.

Figure 2 is a top view of the socket wrench shown in Figure 1.

Figure 3 is a bottom view of the socket wrench shown in Figure 1.

Figure 4 is a vertical longitudinal section of the socket wrench shown in Figure 1 disposed in operative association with a nut and bolt member.

Figure 5 is a perspective view of a pole piece of the type shown in Figure 1, the pole piece being provided with a modified form of retaining member therefor.

Figure 6 is a perspective view of a modified form of pole piece assembly utilizing keyed washers of substantially nonmagnetic material to retain the pole pieces in proper disposition.

Referring now to Figures 1, 2 and 3, a socket wrench indicated generally by the numeral 10 incorporates one embodiment of the invention. A shank 12 forms the main body of the socket wrench and is provided with a tubular bore 14 through at least a portion thereof. The upper end 16 of the shank may have a female square drive opening 18 formed therein, which opening is adapted to receive in driving engagement the square end of a suitable driving tool (not shown). A transverse opening 20 may be provided in the end portion 16 to receive a suitable spring pin adapted to keep the shank in place on the driving tool.

The opposite end 22 of the shank may be provided with a socket opening 24 which may have a hexagonal cross-sectional configuration as best shown in Figure 3, although both the openings 18 and 24 could be of any other suitable cross-sectional configuration than that shown. Likewise, the upper end 16 of the shank 12 could be provided with a fixed handle similar to that of an ordinary screw driver, if desired.

The diameter of the bore 14 is preferably such that a shoulder 26 (Figure 1) will be formed between the square drive opening 18 and the bore 14. A sleeve 28 of substantially non-magnetic material is inserted in the bore 14 so that its upper end 30 is in abutment with the shoulder 26, and the lower end 32 preferably projects a short distance into the socket opening 24, which is adapted to receive the workpiece. This sleeve encompasses a pair of pole pieces 34 and 36 of magnetic material, each pole piece preferably having a substantially semicircular cross-sectional configuration so that the two pieces, when properly assembled within the sleeve 28, form a split inner sleeve. The two pole pieces are, therefore, positioned in oppositely disposed spaced relation so that there is an air gap therebetween on each side thereof, as indicated by the numerals 38 and 40 in Figure 3.

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The two pole pieces 34 and 36 in turn encompass a magnet 42, best shown in Figure 1. This member may be in the form of a relatively short bar magnet which is magnetized across its diameter, as shown in Figure 1, with the North and South poles being indicated on opposite sides thereof by the letters "N" and "S" in Figure 1. With the magnet 42 polarized in this fashion, the lower ends 44 and 46 of the two pole pieces 34 and 36 are oppositely polarized with the North and South poles as indicated in Figure 1.

Such an arrangement, as best shown in Figure 4, permits a workpiece, such as the nut 48, to contact both ends 44 and 46 of the pole pieces within the wrench and therefore be in contact with both poles of what can be termed the "effective magnet." This arrangement provides a substantial advantage over the form of socket wrench disclosed in the Clark Patent No. 2,714,829, in that when the magnetic energy is transferred to the workpiece by direct contact or by contact through an intervening sleeve with only a single pole of the magnet (which can be termed "linear transfer"), the magnetic effect is such that the workpiece is magnetically polarized along its longitudinal axis and the ends of the workpiece will become the two opposite poles of a magnet. This is of significance when the workpiece is a bolt or screw rather than a nut, since when an attempt is made to insert the outer end of the bolt or screw into a tapped hole or the like in material in which the workpiece is to be secured, the magnetic effect will be such that the outer end of the workpiece will tend to be repelled and diverted away from the hole so that insertion therein will be difficult. On the other hand, when the lines of flux are across the face of the magnet from one pole to the other, then the workpiece contacts both poles and short circuits the magnetic field so that the flow of flux is through the workpiece from one pole to the other and substantially no magnetic energy is transferred to the opposite end of the workpiece. With the form of wrench disclosed herein, there will therefore be no problem of diversion of the outer end of the workpiece in the event that it is a bolt or screw being inserted in a tapped hole.

Another important advantage of the present form of construction is that the length of the bar magnet can be greatly reduced and the magnetic attraction for the workpiece will remain substantially the same as in the conventional construction. In the laterally polarized form of magnet the magnetic energy is transferred across its diameter to opposite and separate pole pieces, which pole pieces will retain a high proportion of transferred energy over a greater length beyond the point of contact with the magnet than can be obtained by "linear transfer" of the magnetic flux. This is a particular disadvantage where a substantial amount of clearance is required for the end of the bolt to which a nut is being applied, since the separation of the actual magnet from the workpiece must be increased, and the amount of magnetic attraction transferred through the sleeve to the workpiece is greatly reduced. With the present construction, however, the efficiency of the transfer of magnetic energy is so improved that the length of a bar magnet may be reduced. Likewise the length of the pole pieces, which replace the previously used sleeve, can be increased. A socket is thus provided which not only gives more clearance for a bolt or the like, but likewise gives increased energy for holding the workpiece, both results being accomplished without increasing the over-all length of the socket.

The shank 12 is preferably made of a good grade of steel which is hardenable and magnetic. The sleeve 28, as previously stated, is of substantially nonmagnetic material which term is herein used in the practical sense to designate materials of very low magnetic permeability. The magnet 42 is preferably of the bar type being circular in cross-section and polarized across its diameter, as previously mentioned. It is preferably formed of Alnico

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alloy or some similar material with very high magnetic properties.

In actual operation the size of the tool selected should be such that it is adapted to receive the workpiece, such as a nut, within the socket 24. If the nut is to be driven on a bolt a distance such that the bolt will protrude above the nut, the internal diameter of the pole pieces should obviously be such that the bolt or threaded stud upon which the nut is to be threaded is capable of being received therebetween. The workpiece to be driven, such as the nut 48 shown in Figure 4, is first placed within the socket 24 in abutment with the ends 44 and 46 of the pole pieces and is maintained in that position because of the magnetic properties imparted to the pole pieces by the magnet 42.

With the nut 48 so disposed within the socket, it may then be driven on to the bolt 50 as shown in Figure 4. If the end of the bolt 50 protrudes above the bolt 48, it will be received between the two pole pieces 34 and 36. This arrangement provides a substantial amount of clearance for the bolt. It is clear that without the provision for such clearance the end of the bolt 48 would come into abutment with a portion of the socket wrench and the latter would very likely be displaced from its initial driving position with respect to the nut 46.

In assembling the construction just described, one method which may be followed is to dispose the sleeve 28, the pole pieces 34 and 36 and the magnet 42 in their proper relation to each other and then to secure them in such position by the use of silver solder, for example. This subassembly can then be press-fitted into the shank 12, or secured therein in any other suitable fashion.

Another possible form of construction and assembly is to provide an insulating layer 52 of substantially non-magnetic material for each pole piece as illustrated in Figure 5. As shown therein, a pole piece 54 is provided with a shell member 52 which may be formed of brass, for example. This shell is formed so that not only is the outer periphery of the pole piece 54 covered but the two longitudinal edges thereof are also covered by inwardly projecting shoulders 56 and 58 of the shell member 52. With this form of construction when two pole pieces are disposed so as to form a cylindrical member, the shoulders 56 and 58 of the shell will be brought into abutment with like shoulders of the shell of the oppositely disposed pole piece. The air gaps 38 and 40 present in the construction shown in Figure 3 will therefore be filled with the shoulders 56 and 58 in this embodiment of the invention. Here again the device can be assembled substantially in the manner previously described, except that the two pole pieces and their associated shells will first be secured together so that they encompass the magnet which is likewise secured there-within. This sub-assembly can then be force fitted in the shank.

As shown in Figure 6 in place of the shells for the pole pieces, the construction can be substantially as that disclosed in Figure 1 except that at opposite ends of pole pieces 60 and 62 keyed washers 64 and 66 are provided. Keys 68 and 70 are formed on each washer so as to extend inwardly at diametrically opposite points thereon and are adapted to be received within the air gaps between the longitudinal edges of the pole pieces 60 and 62, such air gaps corresponding to the air gaps 38 and 40 shown in Figure 3. In such a form the two pole pieces are thus held in spaced relation and the air gaps between the pole pieces are closed at each end, which of course will normally be desirable in order to prevent foreign matter from accumulating between the poles and actually short-circuiting the magnetic field. A sleeve member (not shown) will normally be provided in this form also, extending between the two keyed washers. It is also of course possible that a sleeve member could be provided with integrally formed keys such as the keys 68 and 70, thus eliminating the need for the washers 64 and 66.

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As previously mentioned, the path for the magnetic lines of flux in each of the described embodiments will extend outwardly from both sides of the bar magnet 42 down through the pole pieces and across the air gap at the lower ends of the pole pieces. When a workpiece is in place in the wrench, the lines of flux at this latter point will of course pass through the workpiece itself from one pole to the other. The magnetic energy which is available is thus utilized very efficiently and, at the same time, the disadvantage of having the workpiece directly in abutment with the magnet is avoided. The maximum amount of magnetic attraction is therefore effectively transmitted to the workpiece and at the same time both protection for the magnet and an unusually large amount of clearance for a bolt or the like upon which the workpiece is provided.

In the drawing and specification, there has been set forth several preferred embodiments of the invention, and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation. Changes in form and in the proportion of parts, as well as the substitution of equivalents are contemplated, as circumstances may suggest or render expedient, without departing from the function or scope of this invention as further defined in the following claims.

What is claimed is:

1. A socket wrench particularly adapted for driving nuts on bolts, comprising, a hollow shank provided at the outer end thereof with an internal noncircular bore for receiving a nut to be rotated by the socket wrench, a layer of substantially nonmagnetic material secured within said hollow shank, two pole pieces of magnetic material secured within said layer in oppositely disposed spaced relation and a magnet secured within said pole pieces, said magnet being polarized transversely of said shank and adapted to oppositely polarize said pole pieces so that the latter will retain a workpiece within said bore through magnetic attraction.

2. A socket wrench particularly adapted for driving nuts on bolts, comprising, a hollow shank provided at the outer end thereof with an internal noncircular bore for receiving a workpiece to be rotated by the socket wrench, a sleeve of substantially nonmagnetic material secured within said hollow shank, two pole pieces of magnetic material secured within said sleeve in oppositely disposed spaced relation, and a magnet secured within said pole pieces, said magnet being polarized transversely of said shank and adapted to oppositely polarize said pole pieces so that the latter will retain a workpiece within said bore through magnetic attraction.

3. A socket wrench particularly adapted for driving nuts on bolts, comprising, a hollow shank provided at

the outer end thereof with an internal noncircular bore for receiving a workpiece to be rotated by the socket wrench, a sleeve of substantially nonmagnetic material secured within said hollow shank with one end adjacent said noncircular bore, a pair of pole pieces of magnetic material and substantially semicircular cross section oppositely disposed and secured within said sleeve with the longitudinal edges thereof in juxtaposed, spaced relation and a magnet secured within said pole pieces, said magnet being polarized transversely of said shank and adapted to oppositely polarize said pole pieces so that the latter will retain a workpiece within said bore through magnetic attraction.

4. A socket wrench particularly adapted for driving nuts on bolts, comprising, a hollow shank provided at the outer end thereof with an internal noncircular bore for receiving a nut to be rotated by the socket wrench, an insert of substantially nonmagnetic material secured within said hollow shank, a pair of pole pieces of magnetic material and substantially semicircular cross section oppositely disposed and secured within said insert with the longitudinal edges of said pole pieces held in juxtaposed spaced relation thereby and a magnet secured within said pole pieces, said magnet being polarized transversely of said shank and adapted to oppositely polarize said pole pieces so that the latter will retain a workpiece within said bore through magnetic attraction.

5. A socket wrench particularly adapted for driving nuts on bolts, comprising, a hollow shank provided at the outer end thereof with an internal noncircular bore for receiving a nut to be rotated by the socket wrench, a pair of pole pieces of magnetic material and substantially semicircular cross section, nonmagnetic means secured within said hollow shank adapted to receive said pole pieces in oppositely disposed, secured relation and to maintain the longitudinal edges thereof in juxtaposed, spaced relation and a magnet secured within said pole pieces, said magnet being polarized transversely of said shank and adapted to oppositely polarize said pole pieces so that the latter will retain a workpiece within said bore through magnetic attraction.

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