My invention relates to anchoring means between the handle and the shank of hand tools such as screwdrivers, nut drivers or runners, chisels, files, and other hand tools such as are used by carpenters, masons, plumbers and mechanics of all kinds.

As pointed out above, the principles of my invention may be applied to a wide variety of hand tools. It will, however, be shown and described in connection with a screwdriver for which the principles of my invention are particularly adapted.

One of the problems encountered in the manufacture of screwdrivers is to prevent the shank of the driver from penetrating beyond the bottom of the bore provided in the handle for the reception of the end of the shank when the handle is subjected to impact such as might be produced by a hammer or other means of impact. The Shank of the screwdriver is usually of relatively small diameter as compared to the handle and usually to avoid expense is made of bar stock. When the handle end of the driver is subjected to impact as is frequent in the use of screwdrivers and other hand tools such as chisels, the force of repeated impacts tends to drive the shank of the screwdriver into the handle to an undesirable extent. This is particularly true when the handle is made of relatively soft plastic materials such as cellulose acetate butyrate, a commonly used material.

Numerous purchasers of large quantities of screwdrivers, particularly the Armed Forces, require the screwdrivers to meet certain impact specifications. These specifications, of course, vary with different sizes of screwdrivers but in general any size of screwdriver must be able to withstand repeated impacts of appreciable force without penetration of the shank into the handle beyond a certain amount. Heretofore, manufacturers of screwdrivers made with handles of plastic materials have had difficulty in meeting such rigid specifications as are required particularly by the Armed Forces and still employ commercial bar stock. The result is a much more expensive driver, usually one employing a forged or machined shank with an upset enlarged section or shoulder adapted to butt against the margins defined by the bore at the ferrule end of the handle.

An object of my invention is to provide a simple and inexpensive anchoring means between the handle and the shank of a hand tool.

Another object of my invention is to provide a construction for hand tools wherein the penetration of the shank into the handle when the tool is subjected to impact, is reduced to a minimum.

Another object of my invention is to provide means for locking the shank in the handle of a hand tool in such manner that a very material increase in torque may be applied to the hand tool without rotation of the shank with respect to the handle.

A further object of my invention is to eliminate the shoulder required on the shank at the ferrule end of the handle when specifications materially limit the amount of penetration of the shank into the bore of the handle which may take place when the tool is subjected to impact.

My invention further contemplates a construction for anchoring a shank in the handle of a hand tool which is easy to assemble and inexpensive to manufacture notwithstanding the substantial elimination of shank penetration when the tool is subjected to impact and notwithstanding the fact that the torque which may be applied to the tool is materially increased.

Other objects and advantages of my invention will be pointed out in the claims and will be apparent from the following description, when taken in connection with the accompanying drawings, in which:

Fig. 1 is a view of a screwdriver to which my novel anchoring means has been applied, the particular screwdriver shown being provided with screw-holding means;

Fig. 2 is a view of the shank, the insert and the handle in the position these parts occupy prior to being seated against the handle, the bit end of the driver having been turned through 90° to show the springs of the screw-holding means;

Fig. 3 is a sectional view of the handle;

Fig. 4 is a sectional view of the handle, shank and insert employed in my novel handle construction;

Fig. 5 is an external view of the insert;

Fig. 6 is a sectional view of the insert; and

Fig. 7 is a view taken substantially on the line 7—7 of Fig. 4 in the direction indicated by the arrows.

While as previously mentioned my invention is of general application, the principles thereof are particularly adapted to the manufacture of screwdrivers in connection with which the invention will be described.

The screwdriver comprises a handle, a shank and an insert generally indicated respectively by the numerals 11, 12 and 13. The handle 11 may be of any suitable material such as wood but the invention is particularly adapted for use in connection with handles of plastic materials such as cellulose acetate butyrate. The exterior of the handle may be of any suitable construction, screwdriver handles being usually provided with means such as ribs 14 for a user to obtain a firm non-rotational grip thereon. The handle is further provided with a bore 16 or opening (Fig. 3) for the reception of the shank 12.

The shank 12 may be made of any suitable metal stock, the end 17 of which is upset to provide a screwdriver bit of conventional construction. The shank may be circular in cross-section, square, octagonal, or any other polygonal shape. However, I have shown a hexagonal shank as I prefer the use of this type of material because it is more suited to the purposes of my invention and is readily available in bar stocks on a relatively inexpensive commercial basis.

Since the screwdriver is made preferably of hexagonal stock, the insert 13 is also hexagonal in cross-section and includes exterior side walls 18 and an exterior bottom wall 19. The insert 13 is provided with an opening or cavity 21 which has side walls 22 and a bottom wall 23. This cavity is relatively long and is preferably hexagonal in cross-section for the reception of the end of the hexagonal shank.

The side walls of the cavity 21 are tapered. The taper within reasonable limits may be any desired amount, but preferably is of the order of 1°. To provide a firm grip between the side walls of the shank and side walls of the cavity, the minimum cross-sectional area of the cavity 21 must be less than the cross-sectional area of the shank 12. That is, at a point removed from the bottom wall 23, let us say adjacent the numeral 24, the minimum area of the cavity 21 is less than the cross-sectional area of the shank.

While it would be possible to employ a cavity 21...
tapered, as above described, and circular in cross-section, a hexagonal cavity to correspond to the hexagonal section of the shank is very greatly preferred. With this structure the side walls of the shank extend angularly with respect to each other and engage and interfit with the hexagonal side walls 22 of the cavity 23 substantially eliminating any tendency of the shank to rotate in the insert when normal torque forces are applied between the parts.

In the practice of my invention it would be possible to employ a tapered circular bore in the handle 11. However, I prefer to employ an opening or cavity 16 which is polygonal in shape. In the particular form of the invention shown the opening 16 is hexagonal and tapered at an angle to provide in this specific limits but which is preferably approximately 1°.

The exterior of the insert 13 is also preferably hexagonal in shape and tapered, this taper also being approximately 1°. While I prefer to taper the interior and exterior walls of the insert and the walls of opening 16 by approximately the same amount, this is not essential. The tapered interior and exterior side walls of the insert and the taper of the opening 16 in the handle may have tapers which vary somewhat from each other as will be obvious.

The cross-sectional area of the base 19 is greater than the minimum cross-sectional area of the opening 16 at a point removed from the bottom 26, let us say, adjacent the point 27. While it would be possible to employ an insert 13 the exterior of which is circular and employ an opening 16 in the handle which is circular, provided that the cross-sectional area of the base 19 of the insert 13 is less than the minimum cross-sectional area of the opening 16, such a construction might be incapable of withstanding the torque forces encountered in the use of the tool without rotation of the insert in the opening 16. The hexagonal external side walls of the insert and the hexagonal side walls of the opening mate with each other so as to provide interengaging surfaces or walls extending angularly with respect to each other. Rotation of the insert 13 in the opening 16 under all normal torque forces encountered in the use of the tool is thus prevented.

It will now be understood that in the preferred form of the invention the shank, the cavity 21, and the exterior walls 18 of the insert and the walls of the opening 16 are each polygonal in shape. Possibly if each of these polygons was a triangle, the resistance to rotation of the shank in the insert and of the insert in the handle would be increased because of the greater angle between adjacent interengaging surfaces. However, I prefer hexagonal polygons because hexagonal bar stock is commercially available at reasonable prices. Moreover, it would be possible to use hexagonal walls in the cavity 21 and employ a different construction as, for example, interengaging fins and slots between the walls of the opening and the external walls of the insert. The construction shown is preferred because it is less expensive to manufacture.

It will now be understood that when the screwdriver is subjected to impact as when a hammer is applied to the head of the handle, with the bottom walls 19 and 26 in butting relation the resistance to penetration of the insert into the handle beyond the bottom wall 26 of the opening 16 is determined, at least in part, by the cross-sectional area of the bottom wall 19 of the insert. That is, instead of the impact being applied to the relatively small cross-sectional area of the end of the shank, the effective cross-sectional area to resist penetration, the area 19, is increased to an extent such that in meeting tests required by the Armed Forces substantially no penetration of the insert into the handle occurs. For example, when the shank was placed directly in the handle and a force of 15 pounds was moved through 6° and applied on the head of the handle 20 times, the shank penetrated the handle approximately 1/4 of an inch. When the same test was repeated with a screwdriver made in accordance with my invention, no measurable penetration occurred. When the same force was applied 30 times, the penetration was 3/16 of an inch and when applied 40 times, the penetration was 1/8 of an inch. These tests are far more rigid than required by the specifications of the Armed Forces and the amount of penetration was less than allowed by the specifications.

It would be possible to employ an insert 13 of metal of approximately the same hardness as that of the shank. However, one of the important aspects of my invention is to provide an insert which is softer than the shank but harder than the material of the handle. Any material in the drawings and described above, can a small screwdriver the torque was increased from 40 to 90 inch pounds without any measurable rotation between the parts occurring until the 90 inch pound figure was reached. In a medium size screwdriver the torque applied was raised from 90 to 210 inch pounds without measurable rotation occurring until the 210 inch pound figure was reached.

A further fact of importance is that if in use the screwdriver is subjected to impact as by applying a hammer to the head of the handle, such force is applied between the butting faces 19 and 26 (Fig. 4) tending to spread these faces and slightly deform the adjacent parts. This action merely tends to anchor the insert more securely in the handle. It will be understood that when impact forces are applied, the force exerted between the butting end of the shank and the bottom wall 23 of the cavity, is of no importance insofar as the force is not applied so as to cause the insert to be relatively hard as compared to the handle. Such impacts, however, do appear to anchor the shank still more firmly in the handle.

A further important aspect of my invention is the fact that the parts may be assembled quickly and inexpensively. It is merely necessary to seize the insert onto the shank, place the insert and shank in the cavity of
the handle and apply a relatively small force between the head of the handle and the bit to seat the parts as shown in Fig. 4. In Fig. 2, I have shown the parts in the approximate relative position they occupy prior to being driven to a bottoming position.

A further important advantage of the structure of my invention lies in the fact that it provides an improved assembly when it is desired to use a screw-holding device in connection with the driver. It will be noted from Fig. 4 that the length of the insert can be appreciably less than the depth of the opening 16. This provides a tapered recess 31 for the reception of the sleeve 32 of the screw-holding device generally indicated by the numeral 33. Such screw-holding devices are well known in the art of screwdrivers and need not be more particularly described. However, it will be understood that the screw-holding device when not in use, may be slid upwardly along the shank so that the sleeve 32 lies in the recess 31 and is held snugly in position by the side walls of the opening 16 due to the taper.

While I have shown my invention for use in connection with a screwdriver, as mentioned above, the invention has general application to hand tools. Moreover, it will be apparent that various modifications and changes may be made from the structure shown, particularly in the form and relation of parts without departing from the spirit of my invention.

I claim:

1. A hand tool comprising, in combination, a tool having a metal shank, a handle having an opening defined by side walls and a bottom wall, said side walls extending along the entire length of said shank, said shank having a cavity for the reception of the end of said shank, said cavity being closed at its inner end to provide an exterior end wall which will butt against the bottom wall of the handle opening at least if pressure is applied on the handle end and the side walls of said cavity being tapered inward for at least a portion of their extent toward said closed end wall, the material of said insert being softer than the metal of said shank and the cross-sectional area of said shank being greater than the smallest cross-sectional area of said tapered cavity before said shank is assembled in said insert where-by when the shank is driven into said tapered cavity the walls of said cavity bulge to provide a tight fit.

2. A hand tool in accordance with claim 1 wherein the smallest external cross-sectional area of said insert is greater than the minimum cross-sectional area of said opening before said insert is assembled in said opening and the material of the insert is harder than the material of the handle whereby when the insert is driven into said opening the walls of said opening bulge to provide a tight fit.

3. A hand tool in accordance with claim 1 in which the walls of the shank are flat sided and polygonal.

4. A hand tool in accordance with claim 1 in which the walls of the shank, the interior and exterior walls of the insert and the interior walls of the handle are flat sided and polygonal to form interengaging flat faces to prevent rotation of the shank in the insert and rotation of the insert in the handle when the tool is subject to torque.

5. A hand tool in accordance with claim 1 wherein the smallest external cross-sectional area of said insert is greater than the minimum cross-sectional area of said opening before said insert is assembled in said opening and the material of the insert is harder than the material of the handle whereby when the insert is driven into said opening the walls of said opening bulge to provide a tight fit and in which the walls of the shank, the interior and exterior walls of the insert and the interior walls of the handle are flat sided and polygonal to form interengaging flat faces to prevent rotation of the shank in the insert and rotation of the insert in the handle when the tool is subject to torque.

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