Oct. 20, 1953 C. P. SAYLOR 2,656,225

HAND TOOL

Filed Nov. 16, 1949

FIG. 1.

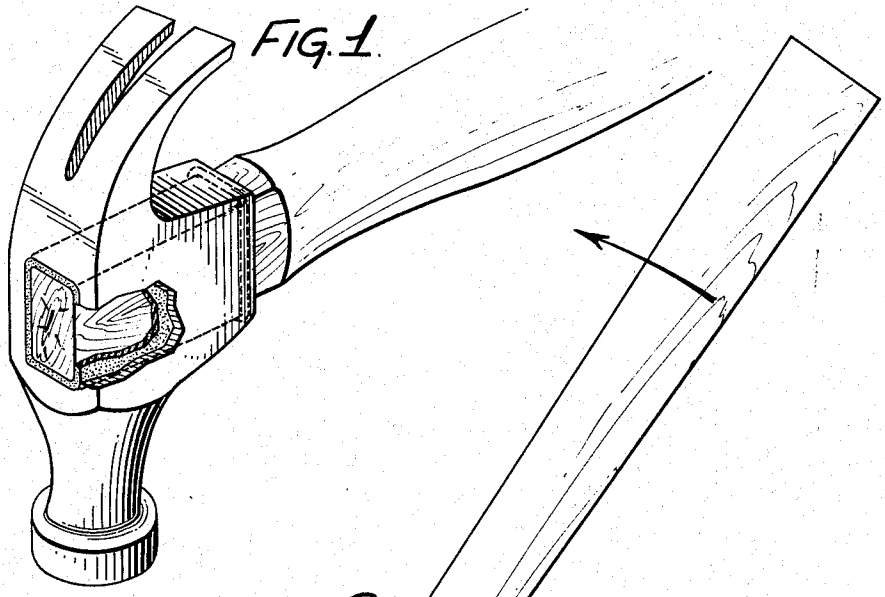


FIG. 2.

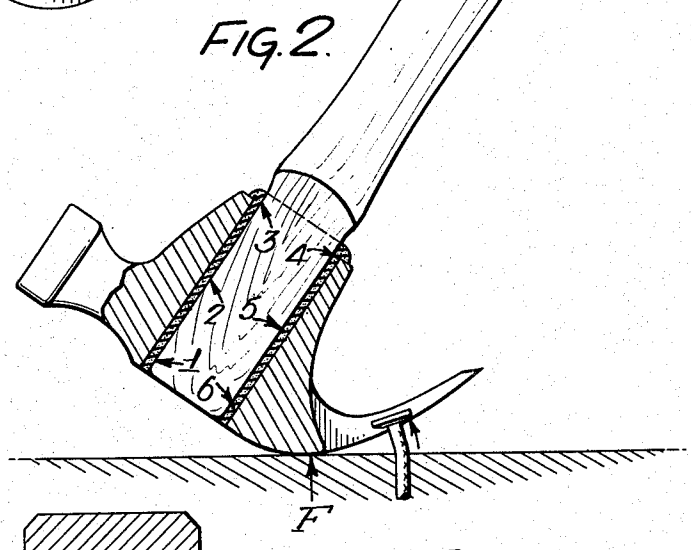
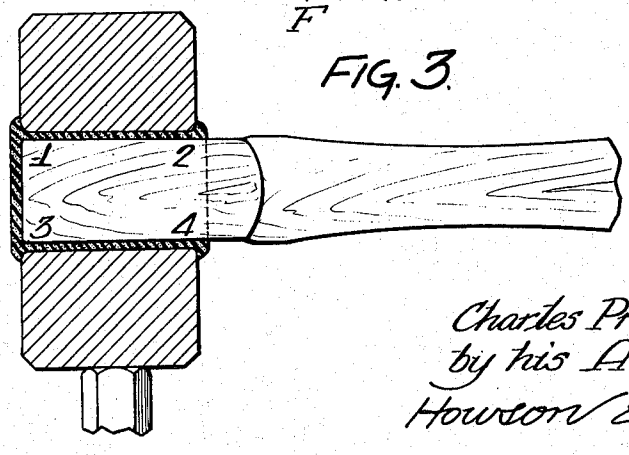


FIG. 3.



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HAND TOOL

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2 Claims. (Cl. 306—20)

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The present invention relates to hand tools, and has particular reference to an improved means for attaching the handles and heads of percussive tools—hammers, hatchets, mauls, axes, mattocks, picks, etc.—in such manner that the union shall be firm and serviceable during the normal usefulness of the implement. The means provided by the present invention may also be employed with tools which, while not primarily percussive, involve occasional large stresses at the region of contact between the handle and the metal parts of the tool. Such tools include chisels, gouges, screw drivers, shovels, hoes, rakes, post hole diggers, pruners, and others.

The traditional means of fastening the handles to percussive and like tools have long been known to be inadequate. The wedges that are driven into the end of the wooden handle to force it into contact with the metal head tend to work loose, the wood of the handle becomes bruised and loosens, changes of dampness or humidity cause alternate swelling and contraction of the wood with a gradual decrease of tightness. In attempts to overcome these faults many devices have been tried. They have included metal sleeves to protect the handle, adjustable wedges, the use of metal handles, rubber thimbles to serve as cushions between the handle and the head, wedges that are cast in position, and so forth. None of these schemes has come into general use, however, because they are based upon an incomplete understanding of the problem.

The aforementioned devices all fail because they depend solely upon resistance to pressure for withstanding the stresses to which the attachment between handle and tool is subjected, and do not effectively provide a zone for the distribution of stresses. Since only a small part of the surface of contact can at one time resist pressure, all of the forces of distortion are concentrated in small areas. The material in these areas fails because occasionally the concentrated strains become too great. One advance of this invention over the previous art lies in the provision of a strain-free shock-absorbent material between the handle and head of the tool, which is capable of resisting not only the strains of compression, but also those of extension, slide and twist. In the preferred embodiment of the present invention the three elements of handle, deformable shock absorbable material, and head are bonded together to form an integral tool in which the deformable shock absorbable material serves the two functions of providing a permanent bond and of transmitting through all of

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its area the forces that pass between the handle and the head. Ten to twenty times as much area as previously participates in transmitting the forces so that the inherent resistances to destructive strain of the handle, tool head, and bond of attachment are never exceeded.

The heads of tools are commonly made of steel which, while highly elastic, is yet hard and unyielding compared with the wood of which handles generally are made. The elasticity and permanence of wood are admirably serviceable during most stresses to which the tools are subjected but it is a universal experience that gradually, by one or both of two sequences, the handle is changed so that it no longer fits tightly in the eye of the head. Either (1) excessive stresses upon part of the wood in contact with the metal cause the wood to become bruised and distorted so that the handle gradually loosens in the head or (2), when the wood becomes damp and attemps to expand, it is confined by the metal of the head. If this confinement exceeds the capacity of the wood for elastic distortion, the wood does not retain its full size when it dries out. When both of these destructive conditions operate at the same time there is especially rapid degeneration. Attempts to repair the injury by driving wedges into the end of the handle are effective only for short times because the bruising of the wood has greatly reduced its elasticity. The wood no longer absorbs stresses of short duration, recovering elastically to its original dimensions, but yields to progressive and accelerated injury until the handle is useless and often the entire tool is cast away.

The usefulness of wood for handles and the sequences of degeneration described above are both inherent in the properties and microscopical structure of wood. Most of the plant cells in wood are long fibers, composed chiefly of a mixture of celluloses, which are bound together by lignin or lignin-cellulose combinations, wood gum, and by other fibers that run in different directions. The fibers themselves are hollow and, in the case of mature and seasoned wood, the hollow places are filled with air. There are also some pockets of air that occur at the junctions between three or more parallel fibers. This network of air pockets and elastic cellulose cell walls acts, within limits, like a resilient foam cushion and gives wood its power to be compressed and then return to its original shape after removal of the distortive force. The wood is resilient even in its surface so long as the elastic limits of the cell walls and the connective tissue are

not exceeded by momentary forces that are too great or by smaller forces when the tissues are softened by dampness. But, when the wood of a handle is bruised, the cell walls are ruptured, the air sacs are broken, the elasticity of the wood is largely destroyed, and the handle gets so that it is no longer firm in the head of the tool. The character of wood and the customary methods of attaching handles and heads of tools are such that damage to fibers and connective is inevitable when tools are given average or hard usage. The handle rarely loosens in the head of an unused tool.

Attempts to cushion the shocks between the heads and handles of tools and to protect the wooden handles from the effects of expansion and contraction with changes in dampness have been made by many people through many years. The laborer who wraps a bit of burlap around the handle to a mattock before he drives the head in place and the inventor who described a rubber grommet for insertion between the head and handle of a tool are both trying with imperfect success to protect the wood from injury by blows or severe prying actions and from the consequences of expansion or contraction. These devices are limited in their succes because they depend entirely upon compressive resistance for the transfer of force. The important mechanical resistances to torsion or twisting, shear or slide, tension or stretching are not utilized. In consequence, as will become clear in a later paragraph, excessive forces are frequently concentrated in too small areas. Either bruising of the protective cushion or the wood of the handle occurs or the handle creeps relatively to the tool head.

According to the present invention, a tool of the type described having an annular space between the handle and the inside of the eye of the tool head, is provided with a layer of shock-absorbent material of substantially the same dimension as the said annular space, which material is molded in situ in said annular space. Due to the fact that the layer is molded in situ, the layer will, without stresses and strain, conform precisely to and will completely fill the space. As a result of this conformation of the layer to the space, a tough permanent union between the tool head and handle is provided eliminating the difficulties and affording the many advantages mentioned herein. As will appear hereinafter the term "molded" refers to the act of conforming the material to the space between the tool handle end and the tool eye, and may involve vulcanization, or other types of curing, polymerization, or other types of chemical or physical changes, depending upon the particular shock-absorbent material employed.

In preparing the improved tool of the present invention the hole or eye in the tool head is made a little larger in relation to the handle end than usual thus affording an annular space between the inside of the eye and the handle end. The tool is then prepared by providing, in said annular space, a layer of the shock absorbent material in a flowable state so that it conforms to, and is of substantially the same dimension as, the annular space between the tool head and handle, and converting the conforming layer, in situ, to a non-flowable condition. The shock absorbent material in the flowable state will contain no significant volatilizing material, and thus substantially the entire mass of

shock absorbent material will be converted, in situ, to the non-flowable condition without significant loss of any of the components thereof. This may be accomplished in a variety of ways, which will be discussed more in detail hereinafter, including filling the annular space between the handle and tool head with the shock-absorbent material in a flowable state such as by extrusion, tamping, or by pouring the material into the annular space, by placing in the eye a volume of the material in a flowable state, in excess of that required to fill the annular space and then forcing the handle end into the eye, and the like; by applying a preformed sleeve or thimble of the shock-absorbent material to the handle-end, inserting this assembly into the tool head and rendering the shock-absorbent material flowable, as by heating, so as to conform to and fill the annular space; a combination of these methods; or the like. With the layer in place and conforming to and filling the annular space, the shock-absorbent material is converted to a non-flowing condition to provide a stress- and strain-free, tough shock-absorbing cushioning union between the handle and tool head. Thus, the shock-absorbent layer is molded in situ, the surface of the handle end and the inner surface of the eye of the tool head defining the mold walls. As a result of this molding the shock-absorbent material conforms without strain to and fills the annular space between the tool head and handle.

The above discussion has dealt with the broader aspects of the present invention and is generally applicable to tools which are primarily percussive such as those set forth previously and to tools which, although they are not primarily percussive, occasionally encounter large stresses at the handle and the metal parts of the tool such as those set forth previously. In accordance with the preferred embodiment of the invention which is particularly applicable to tools primarily percussive in nature, a bond is provided on the one hand between the shock-absorbent material and the handle and, on the other hand, between the shock-absorbent material and the tool head. In some cases, the shock-absorbent material selected will exhibit high bonding properties to either the handle or the tool head or both. In other cases the handle end or the inside of the tool head eye, or both, may be treated by methods well-known in the art to improve the bonding properties of the shock-absorbent material thereto. The provision of a bond between shock-absorbent material, molded in situ in accordance with the present invention, and handle and tool head insures a tough permanent union that is capable of resisting all types of mechanical stress, for example, those of tension, pressure, torsion, and shear, and of maintaining its adhesion to both handle and tool head despite the strains of stretching, compression, twisting, or slide.

The foregoing and other objects of the invention and various features and details of the manufacture thereof are hereinafter fully set forth and described with reference to the accompanying drawing, in which:

Fig. 1 is a view in perspective of a hammer made according to the present invention, a portion of the head having been broken away to better illustrate certain structural features present in the tool;

Fig. 2 is a sectional view of a hammer showing the same engaged in drawing a nail; and

Fig. 3 is a view shown in section of a modified form of the invention as embodied in a maul.

The shock-absorbent material referred to herein is preferably a rubber-like material, and preferably comprises an organic material which will soften, for example by heating, to a moldable condition and which may be converted to a tough, elastic mass retaining its molded shape. Such rubber-like organic materials are, for example, natural rubber, the synthetic or artificial rubbers such as butyl rubber (copolymerized butadiene and isobutylene), neoprene (polymerized chloroprene), Thiokol (condensation copolymer of ethylene dichloride and a polysulfide such as sodium tetrasulfide), Buna N (copolymer of butadiene and acrylonitrile), Buna S (copolymer of butadiene and styrene), and the like; synthetic thermosetting resins of the type which provide a tough, elastic mass when cured; the synthetic thermoplastic resins such as the plasticized vinyl resins including polyvinyl chloride, polyvinyl acetate, copolymers of vinyl chloride and vinyl acetate, polyvinylidene halides and esters, polyacrylic acid, polymethylacrylic acid, the polymerized esters thereof such as polymethylmethacrylate, and the like; nylon (polyamide resins); rubbery silicone (organosilicon oxide polymers); polyethylene; and the like. Of the various materials applicable for use, the rubbers are preferred. As is well known the rubbers, whether natural or synthetic, and the thermosetting resins, in the uncured or partially cured form will soften to a flowable condition when heated. In this state, they can be molded and converted to a non-flowing condition, i. e. cured, by further heating. The various thermoplastic resins mentioned above, on the other hand, while they soften to a flowable condition upon the application of heat, are converted to a non-flowing condition by cooling. Any of the compositions serving as the shock-absorbent material in accordance with the present invention may contain besides the materials mentioned above, certain additives normally incorporated in rubber or resin compositions such as fillers including pigments, plasticizers, catalysts, antioxidants, stabilizers, and the like, and, in the case of the rubbers, appropriate curing agents, accelerators, etc.

As stated, there is a variety of methods for preparing the improved tool of the present invention whereby the layer of shock-absorbent rubber-like material, conforming without strain to the annular space between head and handle, is molded in situ. For instance, the shock absorbent material may be heated to a point where it will flow, or at least will flow under the application of pressure, and the flowable mass filled into the annular space between the head and handle by tamping, extrusion, or, if the mass is sufficiently fluid, merely by pouring. Similarly the shock absorbent material, in a flowable state, may be placed in the eye of the tool head, in an amount slightly in excess of that required to fill the annular space. Then, using the handle end as a ram and blocking the opposite side of the eye, the handle end is pushed into the eye forcing the shock absorbent material back around the handle end and between it and the inside of the eye. The above-mentioned methods are referred to generally herein as forcing the material into the annular space. Thus, the mass will, in accordance with these methods, conform to and fill the annular space and may then be converted to a non-flowing condition, by cooling in the case of a thermoplastic resin, or by raising the temperature or continued heating to effect curing in the case of a rubber. In some cases, when using thermoplastic resins, while the shock absorbent material may be sufficiently plastic to be extruded under pressure into the annular space, it may nevertheless be desirable to heat the mass while in place to aid in its conformation to the annular space.

It will also be realized that if the shock absorbent material is in a low state of polymerization, the material may be further polymerized while in place between the head and handle and before the bonding agent is converted to a non-flowing condition.

In another method, especially applicable to thermoplastic resins, especially the polyvinyl resins, a paste, or plastisol, of the resin in finely divided particle form dispersed or suspended in a high boiling organic liquid plasticizer may be filled into the annular space to conform thereto, and thereafter the assembly heated to flux the resin and form a homogeneous resinous mass which when cooled forms a tough, shock absorbent layer of the type described. Plasticizers, as stated, are high boiling organic liquids in which the resin particles are insoluble at least at ordinary temperatures. Examples of plasticizers especially applicable for the vinyl resins are the dialkyl phthalates such as dibutyl phthalate, dioctylphthalate, dimethyl phthalate, dicaprylphthalate, and the like; butylphthalyl butyl glycolate; butoxy ethyl phthalate; tricresyl phosphate; triethylene glycol; and the like. The plastisol may contain minor proportions of other additives often incorporated in resin compositions such as fillers, stabilizers, and lubricants.

In another method, the shock-absorbent rubber-like material in the form of a preformed tube or thimble-shaped arrangement can be inserted between the head and handle, and, once in place, the material is heated to cause it to flow and to conform without strain to the annular space. The resulting conforming layer is then converted to a non-flowing condition by cooling or curing as may be dictated by the nature of the bonding agent employed. Thus even when a preformed insert of rubber is employed it is in an uncured or partially cured state so that the rubber is subsequently softened and molded in the annular space. As a modification of this method, which is in effect a combination of this method with one or the other of the methods discussed above, a preformed insert, in tube or thimble shape, of the shock-absorbent material but which only fills a portion of the annular space may be inserted in the annular space. The remainder of the space may be filled with the same or different but compatible shock absorbent material by extrusion, tamping, pouring, or the like. In this way materials which bond especially well to metal and those which bond well to wood may be used in association. The resulting assembly may then be treated to cause the composite layer to flow and conform to the space, followed by conversion to a non-flowing state as discussed previously. Such methods of assembly conform to the fundamental conditions of this invention since the layer of shock-absorbent material is molded directly in the space between the tool handle and head so that it conforms to the space without strain.

It has been pointed out that the shock-absorbent material provided in the annular space between the inside of the eye and the handle of

the tool must at some stage be capable of flow so that it can conform to and fill said annular space and, in the preferred embodiment, become bonded as well to the handle and the inside of the eye. While some flow is required to obtain the necessary conformity and desired adherence, it is to be understod that the amount of movement of the shock-absorbent material in a flowable condition may be very small, it being necessary only for the shock-absorbent material to adjust itself to the annular space so that it will be present therein in the described stress and strain-free condition and, in the preferred embodiment, will flow into the desired adhesive contact.

As stated, it is preferable that the shock-absorbent material be securely bonded to the wood or other handle substance and to the steel or other material of the head. Certain of the shock-absorbent materials mentioned above possess good natural adhesion or bonding properties to steel and/or wood when incorporated in the annular space in accordance with the process of the present invention, and those that do not can have their bonding properties to the head and/or handle material improved by well-known expedients. For example, the adherence of the rubbers to steel may be improved by lightly electroplating the surface of the steel with copper, or brass, or silver, or other metals before assembling. The adherence of rubber to steel may also be improved by coating the steel surface with chemical derivatives, especially those which contain free colloidal sulfur, before curing. Similarly the attachment between neoprene and wood may often be strengthened by a preliminary treatment of the surface of the wood with oil-soluble wetting agents such as the di-alkyl esters of sulfonated di-basic acids, with baking varnishes, or with solutions of compounded neoprene that contain wetting agents. For other bonding agents and surfaces, other special procedures may be needed to foster firm adherence between the tool or handle substance and the material that forms an elastic bond between them. With most of the shock-absorbent materials and with most surfaces adhesion can be promoted by painting the surfaces with a lacquer containing partially polymerized vinyl acetate dissolved in a volatile solvent, for example a mixture of volatile esters and ketones and allowing the solvents to evaporate completely before commencing the assembly of the tool. The polyvinyl acetate adheres to the tool head and handle with great firmness and also to the shock-absorbent material and continues to polymerize in contact with the shock-absorbent material. It must be stressed that these procedures are not like and do not perform the functions of rubber cement. They are applied before the shock-absorbent material is applied to the annular space and serve so to modify the surface between the shock-absorbent material and the metal or wood so that the shock-absorbent material will adhere both to the head and handle of the tool. All volatile ingredients are evaporated before the commencement of assembly.

On the other hand, if an attempt is made to form an attachment between a tool head, handle, and a preformed cured rubber or similar grommet by means of customary cements, failure is inevitable. This is because, first of all, the grommet is not molded in situ to conform to the space without strain, and in the second place the cements are composed in greatest measure of volatile solvent and contain only a few per cent of non-volatile matter. The volatile solvent ultimately escapes by two paths—direct evaporation from the film of cement or diffusion into the rubber, which is caused to swell, and subsequent evaporation from the rubber, with an attendant contraction. At this point methodically and inexorably either the attachment to the wood, to the steel or both is broken.

A example of a typical process to obtain a successful elastic adhesive bond and cushion between a tool head and handle is as follows: The tool head is prepared so that the "eye" or hole for attachment of the handle is larger than the handle by approximately one-sixteenth inch all around. The inside of the eye is thoroughly cleaned by sand-blasting so as to expose a fresh surface of bare metal which is immediately wet with a dilute solution (0.3%) of gum rubber, colloidal sulfur, and antioxidant in naphtha. The clean end of the hickory or other strong wood handle is dipped in a solution as follows:

	Per cent
Dichlorostyrene	40
Styrene	59.8
Benzoyl peroxide	0.2

A group of handles after dipping are subjected to an air pressure of 100 pounds per square inch for 5–10 minutes after which the pressure is gradually released. The duration of pressure and the rate of release depend upon the porosity of the wood and the age of the impregnating solution. When these conditions are correct, the liquid will all be just driven into the wood and no bubbles will form and persist after release of the pressure. In the final assembly of the tool, the tool handle serves as its own ram, being pushed into the eye of the tool head against a charge of rubber compound which is extruded back between the metal of the head and the handle. A satisfactory rubber compound which will cure to a tough bond between tool head and handle is as follows:

	Per cent
Smoked sheet	60
Zinc oxide	10
Carbon black	25
Sulfur	2
Phenyl-beta-naphthylamine	1
Polymerized trimethyldihydroquinoline	1.1
Benzothiazyl di-sulfide	0.4
Tetramethylthiuram disulfide	0.1
Mercaptobenzothiazole	0.4

The temperature may be raised to 100° C. where it is held for 10 minutes to secure temperature equilibrium. The handle is then forced into the head of the tool while the temperature is raised to 125° C. where it is held for 25 more minutes. The attachment of tool handle and head is now completed. It should be noted that it is good practice though not necessary to keep the handle at a temperature of about 50° C. for 5–6 hours before beginning assembly and that it is important that equipment used in the assembly that will come in contact with the compound be so treated as to prevent adhesion as by plating with chromium or by the use of aluminum foil separators.

The methods described in the foregoing paragraphs serve to provide a very strong bond between the wooden end portion of the handle and the metallic head of a tool that will react to all forces, those of pressure, tension, shear, and tor-

sion, so as to assure permanent attachment. Excessive distortive forces or the effects of expansion or contraction are absorbed and distributed in the bonding agent by elastic deformation and thus transmitted to the handle at values always below the limits above which injury to the handle results. The protection of the material of the handle from preliminary and progressive injury makes it possible for handles to withstand severe strains, excessive blows, and other heavy duties that would cause rapid degeneration, loosening, or breaking of handles in which the elastic adhesive bond was not employed.

The following descriptions, in which the forces exerted in some uses of tools are analyzed, should not be construed as indicating that these are new forces created by the new methods of attachment which are illustrated or that they are the only possible forces. The descriptions are employed rather to show how forces of resistance that potentially exist in all attachments through the attainment of a firm and enduring bond are utilized here to equalize stresses over the entire surface of contact.

The particular advantages of this method of attachment with a deformable shock absorbent material adhering to all surfaces of contact are illustrated in Fig. 2 which shows a section of a hammer engaged in drawing a nail. The line of contact at F between the hammer head and a board serves as a fulcrum. If circles are drawn with this fulcrum as center, stresses at any given point within the assembly of hammer head, handle, and shock absorbing layer are parallel to tangents to the circles. Thus at 1 and 6 the stresses of shear tend to cause slide between the hammer head and the handle, at 2 the stresses are chiefly shear but with some component of pressure, at 3 they are largely shear but with an important element of pressure. On the other hand at 4 and 5 the stresses are largely tension but with important components of shear. On the sides of the handle, on surfaces approximately parallel to the surface of the paper, the stresses are almost entirely those of shear and torsion.

Thus the forces of disruption between the handle and the head are of many kinds while the methods heretofore employed or described for the assembly of tools have been capable of resisting only the stress of pressure and to a lesser extent that of shear. For this reason it has been necessary for small portions of the area of contact to withstand all the thrusts between the tool handle and its head. On the other hand, in the preferred embodiment of the invention here described, resistances to distortion are shared by all parts of the area of contact. This is because the shock absorbing material which connects the handle to the metallic tool head is in firm adherence to both materials and because it is itself capable of being harmlessly distorted while distributing the stresses.

In Fig. 3, the head and part of the handle of a maul are shown as it somewhat eccentrically strikes the end of a star drill. Here the forces at positions 1, 2, 3 and 4 are different and more complex than those that were involved in drawing a nail. By being abruptly stopped, the head has tended to rotate about the point of contact and also to bound back against the handle. The forces in the shock absorbent layer which is illustrated are not only complex but they are of short duration, rapidly changing their nature, and are probably never quite the same in any two impacts. By the invention here described, in which a bonding layer of elastic shock-absorbent material is molded directly in contact and in accordance with the preferred embodiment, in adhesion with the handle and head of the tool, all these forces are resisted, distributed, and dissipated over all surfaces of attachment. The bond when properly prepared will permanently stick despite all stresses to which such tools are ordinarily subjected—even those in which the metal parts of the head are injured or the handle is broken. When once formed the bond never needs to be "tightened" or "adjusted" or otherwise repaired or renewed. Actually it is even true that handles are less likely to be broken when so joined to the head.

There are certain tools in which the handles especially are subject to breaking or other injury—for example axes and chisels. In these cases although the bond between the handle and head of the tool may be in perfect condition it is sometimes desirable to be able to replace an injured handle. To accomplish this the handle and shock absorbent material may be removed by several procedures before insertion and securing of a new handle. These methods of removing the remnants of handles may be mechanical, physical or chemical, as by heating, in the case of thermoplastic bonding agents, to soften or melt the shock-absorbent layer; the employment of solvents for dissolving plastics; penetrating compounds which creep between the shock absorbent material and the metal; or by the actual chemical destruction of the shock-absorbent material.

Details of shape of the hole through the tool head—the "eye"—or of the handle have relatively little importance. It is in general desirable, however, for the interior surface of the hole and the attachment surface of the handle to be roughened, but only in order that the area of the surfaces of contact between the bonding agent and the handle and head may be increased for the attainment of the most secure adhesion.

I have sometimes found it advantageous so to shape the shock absorbent layer that it will cover the wooden end of the handle. It has been so illustrated in Fig. 3. This simple modification prevents water and dampness from penetrating the end grain of the handle and limits shrinking and swelling of the wood. For the same purpose the end grain of the wood may by pressure treatments or by sequences of pressure and evacuation be impregnated with plastics or similar substances to such depths that entry of water will be stopped. But while these modifications are sometimes helpful they are not essential since the capacity of the shock absorbent material for distortion may be made sufficient to neutralize all cycles of swelling and contraction that occur within the wood.

In most parts of the foregoing discussion it has been assumed that the handles of tools or at least one end portion of such handles would be made of wood and the heads or working parts of steel. While such is most commonly the case, neither condition is necessary. In important exceptions either the handle or the head is made of other materials. The use of a deformable shock-absorbable substance providing a bond of adhesion between the handle and the head or other working part and transmitting and distributing forces, as more explicitly described elsewhere, must be construed as lying within the field of invention. Examples of such uses are

chisels or screw drivers in which plastic handles are attached through a deformable layer to metal blades; mauls or mallets with wooden heads secured through a shock absorbent layer to their handles; hatchets in which handles of rubber or similar elastomer with reinforcing rods are directly bonded to the heads, lead-headed mallets with deformable adhesive bonds. Although these few exceptions are enumerated, it is clear that many related and equivalent examples could have been cited.

While certain embodiments of the invention have been shown and described herein, it is not intended to limit the invention to such disclosures, and changes and modifications may be made therein and thereto within the scope of the following claims.

I claim:

1. A tool comprising a metallic head member having an opening therein, a handle member having a non-metallic end portion positioned in said opening and conforming approximately in shape thereto and having its surface spaced slightly from the adjacent surface of the head member opening to provide an annular space defined between the wall of the head opening and the inwardly adjacent surface of the handle member therein, and a continuous layer of deformable, shock-absorbent, rubber-like material in and of substantially the same dimension as said annular space and directly bonded to said surfaces of the metallic head and of the non-metallic end portion of said handle so as to transmit forces of tension, compression, torsion and shear between all adjacent surfaces during use and to distribute stresses generally over said adjacent surfaces.

2. A tool comprising a metallic head member having an opening therein, a handle member having an end portion of wood positioned in said opening and conforming approximately in shape thereto and having its surface spaced slightly from the adjacent surface of the head member opening to provide an annular space defined between the wall of the head opening and the inwardly adjacent surface of the handle member therein, and a continuous layer of deformable shock-absorbent rubber-like material in and of substantially the same dimension as said annular space and directly bonded to said surfaces of the metallic head and of the wooden end portion of said handle so as to transmit forces of tension, compression, torsion, and shear between all adjacent surfaces during use and to distribute stresses generally over said adjacent surfaces.

CHARLES PROFFER SAYLOR.

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