This invention relates to tools commonly called "nut breakers" for breaking or splitting nuts from threaded bolts or shafts to which such nuts have become rusted or frozen.

It is an object of the present invention to provide tools capable of rapidly and efficiently splitting nuts or like objects on threaded bolts or shafts for the purpose of removing such nuts from the bolts or shafts.

It is another object of the present invention to provide tools of this type which are constructed so as to be usable both where the nut and bolt to be separated must remain in situ and where the nut and bolt can be placed and manipulated on a work bench.

A more specific object of the present invention is the provision of tools of the aforesaid type each comprising a frame having a first portion shaped in the manner of a C-clamp for accommodating the nut-breaking elements, and a second portion offset at a predetermined compound angle, i.e., in two directions, relative to the plane of the first portion and to a plane perpendicular to the same and serving as the tool handle as well as to accommodate the actuating or drive means for the nut-breaking elements.

A related object of the invention, therefore, is the provision of torque-receiving drive means accessible from the outermost end of the handle portion of such a tool and the provision of means accommodated within said handle portion for transmitting the axial thrust of the drive means through the handle portion and around the bend therein to the nut-splitting elements.

A still further object of the present invention is the provision of nut-splitting tools of the character described which are easily and economically manufactured and are sufficiently sturdy and durable to withstand the rigors of daily use over long periods of time.

The foregoing and other objects, characteristics and advantages of the present invention will be more clearly understood from the following detailed description hereof when read in conjunction with the accompanying drawings, in which:

Fig. 1 is a partly elevational longitudinal sectional view, taken along the line —— in Fig. 2, of a nut-splitting tool constructed in accordance with one embodiment of the present invention;

Fig. 2 is an elevational view of the tool shown in Fig. 1, the view being taken in the direction of the arrow A in Fig. 1; and

Figs. 3 to 6 are partly elevational sectional views, similar to Fig. 1, of nut-splitting tools constructed in accordance with other embodiments of the present invention.

Referring first to Figs. 1 and 2 of the drawings, it will be seen that the tool according to the first embodiment of the present invention comprises a frame 10 having a first portion 11 shaped essentially in the form of a C-clamp and a second portion 12 shaped essentially in the form of a straight tube. The curved frame portion 11 has a pair of ends 13 and 14 and an arculate center section 15 interconnecting the same, whereby an operating space 16, the function of which will be more fully explained hereinafter, is defined within the confines of the frame portion 11. The straight frame portion 12 is integral with the end 14 of the curved portion 11, and in its preferred form the frame 10 is a unitary casting made of hardened steel, wrought iron or any other suitable high strength metal or metal alloy.

The handle-constituting portion 12 of the frame 10 is provided with an internally threaded, longitudinally extending bore 17 which is narrowed at its innermost end, as shown at 18, and communicates with a centrally aligned section 19' of a relatively narrower bore 19. The bore 19 has another section 19'' which is oriented at an angle to the section 19' and extends through the end 14 of the curved portion 11 of the frame. As clearly shown in Figs. 1 and 2, the frame 10 is so constructed that the side face 11' of the portion 11 is flat and that the front faces 13' and 14' of the spaced ends 13 and 14 of the portion 11 are flat, substantially coplanar with one another and perpendicular to the plane of the side face 11'. The frame 10 is, consequently, provided with two plane surfaces on which it is adapted to rest under certain conditions of use still to be described. The portion 12 of the frame 10, however, is so constructed that no part thereof is coplanar with either the front faces 13' and 14' or the side face 11'. Specifically, the frame portion 12 is offset at a predetermined small angle a relative to the plane of the faces 13' and 14' and at a small angle b relative to the plane of the side face 11'. Both these angles may be about 12°. The purpose of this arrangement too will be more fully explained presently.

Referring again to Fig. 1, it will be seen that whereas the section 19' of the bore 19 is coaxial with the bore 17 and the frame portion 11, the section 19'' of the bore 19 is arranged with its axis substantially parallel to the plane of the faces 13' and 14'. Thus, a bend is formed in the bore 19 at the junction of the sections 19' and 19'', the angularity of the bend being substantially determined by the angles a and b.

Arranged in the bore 17 is an externally threaded bolt 20 having a hexagonal or otherwise shaped head 20' adapted to be gripped manually or by a wrench, pliers or the like (not shown) so as to enable the bolt 20 to be rotated and axially displaced in the bore 17. A thrust pin 21 is fixed to the innermost end of the bolt 20 by means of a knurled end 21' which extends into a recess 20'' in the bolt. The other end of the thrust pin 21 extends into the section 19'' of the bore 19. At that end, the pin 21 is provided with a con cave recess 22 adapted to engage a steel ball 23 slidably disposed in the bore 19. The ball 23 is in contact with another steel ball 24 which has a portion thereof received in a con cave recess 25 formed in one end of a pressure pin 26 slidably disposed in the section 19'' of the bore 19. The other end of the pressure pin projects into the operating space 16 of the frame portion 11 and carries a flat, enlarged, nut-engaging head 27. Intermediate its ends the pressure pin is provided with a radial bore or recess 28 in which is seated a small spring 29 on which, in turn, is seated a ball 30. The spring 29 biases the ball outwardly of the pressure pin and against the surface of the bore 19 so as to frictionally retain the pressure pin in the bore section 19'', but it will be understood that for purposes of assembly and disassembly or replacement of worn parts, the pressure pin 26 can be easily extracted from the bore 19. To this end, the width of the operating space 16, i.e., the gap between the inside faces of the ends 13 and 14 of the frame portion 11, is slightly larger than the length of the pressure pin 26 — 27.

The arrangement, thus, is such that the balls 23 and 24 are in point contact with one another and in surface contact with the adjacent ends of the thrust pin 21 and the pressure pin 26. In this manner, the balls serve to
transmit the axial inward movement of the bolt 20 around the compound angle between the portions 11 and 12 of the tool frame 10 so as to bring about a linear outward movement of the pressure pin 26.

The end 13 of the frame portion 11 is provided with a bore 31 preferably axially aligned with the section 19° of the bore 19 but not necessarily so. Received within the bore 31 is a short rod or pin 32 which is provided at one end with a knurled head 33 considerably larger in diameter than the bore 31 and carrying at its outer face a chisel or similar cutting element 34. The chisel is arranged with its cutting edge 34 disposed substantially transversely to the plane of the side face 11° of the frame portion 11 and substantially diametrically of the head 27 of the pressure pin 26. The rod 32 is provided intermediate its ends with a radial bore 35 in which is seated a small spring 36 on which, in turn, is seated a ball 37, the latter being biased by the spring 36 into engagement with the surface of the bore 31 so as to frictionally retain the chisel-carrying rod 32 within the bore 31. The length of the chisel element 32-34 is, of course, also less than the width of the gap between the ends 13 and 14 of the frame portion 11 to facilitate removal and/or replacement of the chisel.

In operation, assuming it is desired to separate from a threaded bolt or shaft 38, without removing the same from its normal position of use, a nut 39 which has become rusted or frozen to the shaft, the frame 10 is manipulated so as to dispose the nut within the confines of the operating space or gap 16, with the head 27 of the pressure pin 26 at one face of the nut and the chisel 34 at the opposite face of the nut. A wrench or similar torque-applying tool (not shown) is now connected with the head 20° of the drive bolt 20 and the latter is rotated to move inwardly through the bore 17. This inward motion causes an axial thrust to be exerted by the pin 21 on the ball 23, and this thrust, which is directed at an angle to the axis of the bore section 19°, is transmitted through the intermediary of the force transmission means constituted by the balls 23 and 24 to the pressure pin 26 to advance the latter against the resistance of the nut 39 and chisel 34.

Due to the confinement of the nut 39 between the pressure pin head 27 and the chisel 34, the rotation of the drive bolt 20 and consequent advancement of the pressure pin 26 causes the cutting edge 34° of the chisel 34 to penetrate into the face of the nut 39 contacted thereby, so as to ultimately split that nut face 39 so that further advancement of the cutting edge 34° or cutting action is, of course, accompanied by a spreading or deformation of the nut 39 from its normal configuration, as a result of which the internal threads of the nut become separated from the external threads of the bolt or shaft 38.

The drive bolt 20 is now rotated in the opposite direction and the pressure pin 26 pushed into the bore section 19° by finger pressure, whereupon the tool can be moved away from the nut to permit the latter to be easily removed from the shaft 38.

It is also possible to employ the tool according to the present invention on a work bench or table for the purpose of removing a nut 39 from a shaft 38 when the latter can be removed from its normal position of use. In such a case, the frame 10 can be laid flat on the work bench as desired, i.e. either on its front face 13°-14° or on its side face 11°, whereby the tool will be positioned either as shown in Fig. 5 or as shown in Fig. 2, for this purpose that the portion 12 of the frame 10 is, in accordance with the principles of the present invention, offset at an angle a relative to the plane of the front face 13°-14° and at an angle b relative to the plane of the side face 11°. The arrangement is such that no matter which way the tool is positioned on the work bench, the frame portion 12 is slanted upwardly and away from the working surface of the work bench, whereby a wrench or similar gripping device applied to the drive bolt head 20 can be moved through almost a full rotation of the drive bolt due to the fact that there is always sufficient space beneath the drive bolt head to permit a part of the wrench or pliers to pass therebelow. It will be readily seen that this result could not be obtained if the frame portion 12 were not offset as shown but merely a straight, coplanar continuation of the frame portion 11.

When so used, of course, the operator will hold the curved portion 11 down with one hand and will manipulate the wrench with the other.

A slightly modified form of the tool according to the present invention is shown in Fig. 3 and comprises a frame 10a having a curved portion 11 and an integral straight portion 12 offset in two directions at a small angle of about 12° relative to the planes of the front face 13°-14° and the side face of the portion 11. The end 13 of the frame portion 11 supports the chisel element 32-34, and rotatably arranged in the threaded bore 17 of the frame portion 12 is the externally threaded drive bolt 20 having a head 20°. To this extent, therefore, this tool is identical with the tool shown in Figs. 1 and 2. The difference between these tools lies in the means for transmitting the thrust of the drive bolt 20 to the pressure pin 26 around the compound angle between the frame portions 12 and 11.

More specifically, in the embodiment of the invention shown in Fig. 3, the threaded bore 17 communicates at its innermost end with a section 40° of a bore 40 of substantially the same diameter. The bore 40 has a second section 40° extending through the end 14 of the frame portion 12 and parallel to the plane of the end face 14°. The angular relationship between the bore sections 40° and 40° is the same as that between the sections 19° and 19° of the bore 19 shown in Fig. 1. The pressure pin 26 is slidably arranged in the bore section 40° and is in engagement, at its innermost end, with a first element 41 of a universal joint 42. The latter includes a second element 43, shaped in the form of a bushing or sleeve, in which is received one end of a thrust pin 44 the other end of which, knurled as shown at 45, is fixedly connected to the drive bolt 20.

The tool according to the embodiment of the invention shown in Fig. 4 comprises a frame 10b with a curved portion 11 carrying the chisel element 32-34 and with a straight, handle-constituting portion 12. The end 14 of the frame portion 11 defines a bore 46 the axis of which is parallel to the plane of the front face 13°-14° of the front portion 11. The inner end of the bore 46 communicates with the innermost end of a relatively wide bore 47 formed in the frame portion 12, the other end of the bore 47 merging with the internally threaded bore 17. The bore 17, as before, accommodates the drive bolt 20 which is connected at its innermost end to a thrust pin 48. The latter is connected at its other end by means of a pin and slot joint 49 to a sleeve or like member 50 provided in its outer face with a concave recess 50° which receives the convex end 51 of the pressure pin 26 which is slidably disposed in the bore 46. Again, the axis of the bore 17-47 is inclined at a compound angle to the axis of the bore 46.

The tool according to still another embodiment of the invention (see Fig. 5) resembles the tool shown in Fig. 1 in substantially all respects, having a frame 10c with curved and straight portions 11 and 12, chisel element 32-34, bores 17 and 19, drive bolt 20 and pressure pin 26, and, except as shown in Fig. 2, the pressure pin 26 is eliminated. The pressure pin 26, and the other convexly shaped end of the thrust pin 52 is received in the concave recess 25 of the pressure pin 26, and the other convexly shaped end of the thrust pin 52 is similar to that received in a concave recess 20° of the drive bolt 20.

The tool according to yet another embodiment of the invention (see Fig. 6) is substantially identical with the
tool shown in Fig. 5 as far as the frame 10d and its associated parts and elements are concerned, and differs therefrom only in that the thrust pin is constituted by a spring or coiled wire 53. The latter carries at one end a head 54 provided with a convex surface received in the concave recess 25 of the pressure pin 26. At its other end the spring 53 is provided with a disc 55 from which extends a relatively narrow pin 56 and a relatively wider head 57 which is received in a recess 58 formed in the drive bolt 20. The head 57 is retained in the recess 58 by means of a small ball bearing 59 surrounding the pin 56 intermediate the head 57 and disc 55.

It will be readily seen that the operation of each of the tools shown in Figs. 3 to 6 is substantially the same as the operation of the tool shown in Figs. 1 and 2. Thus, upon rotation of any of the drive bolts 20 under the action of a wrench or like implement grippingly engaging the associated bolt head 20, the inward axial movement and thrust of the drive bolt is transmitted around the compound angle between the straight portion 12 of the respective tool frame and the associated curved portion 11 thereof to the corresponding pressure pin 26 through the intermediary of the transmission means constituted, respectively, by the thrust pin 44 and universal joint 42 (Fig. 2), the threaded member 32 (Fig. 5) nut 27 engaged with the angled thrust pin 52 (Fig. 5), and the spring-like thrust pin 53 having heads 54 and 55—57 (Fig. 6). Moreover, in any of these embodiments of the invention, the offsetting of the elongated portion 12 of the tool frame relative to the C-shaped portion thereof permits the tool to be used while resting on any suitable work surface, a result which has heretofore not been attainable with known nut-breaking or splitting devices.

The tools according to the present invention are characterized by a great simplicity of construction which substantially facilitates their manufacture as well as the assembly and disassembly thereof. As can be seen from the drawings, for the purpose of complete disassembly it is merely necessary to extract the chisel element 32—34 from the bore 31 and the drive bolt 20 from the threaded bore 17. Once this has been done, the pressure pin 26 can be removed from the tool frame by being pulled out of the bore in which it is normally retained, while the elements of the transmission means which are not connected with the drive bolt, such as the balls 23 and 24, or the universal joint 42 etc., can then be permitted to roll out of their respective bores merely by a suitable tilting of the tool frame. The procedure for assembly of the tools is exactly the reverse of the disassembly procedure just described, and it is evident that the construction of the tools according to the present invention will admit of no misalignment or improper positioning of any of the movable elements of the tools relative to one another.

It will be understood that, although a number of embodiments of the present invention have been disclosed herein, the foregoing description is for purposes of illustration only and that a number of changes and variations may be made in the present invention without any departure from the spirit and scope thereof as defined by the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A nut-splitting tool, comprising a frame having a first portion and a second portion, said first portion being provided with two substantially perpendicular plane faces, said second portion being offset at a first small angle relative to the plane of one of said faces and at a second small angle relative to the plane of the other of said faces, first means supported by said first portion of said frame for engaging a nut to be split, second means supported by said first portion of said frame opposite said first means and provided with a flat head, whereby a nut to be split may be positioned between said cutting edge of said first means and said head of said second means, and transmission means interposed between said drive means and one of said first and second means for transmitting the thrust exerted by said drive means to said one of said first and second means and around the bend between said first and second portions of said frame.

2. A nut-splitting tool, comprising a rigid unitary frame having a C-shaped portion open at the front and at both sides and a straight portion, said C-shaped portion having two spaced ends defining a pair of coplanar front faces the plane of which is substantially perpendicular to the plane of one of the side faces of said C-shaped portion, said straight portion extending from one of said ends of said C-shaped portion and having a longitudinal axis oriented obliquely relative to and away from both said planes in the direction of the rear and the other side of said C-shaped portion, a pressure pin slidably arranged in said frame at said one of said ends of said C-shaped portion thereof extending into the gap between said ends of said C-shaped portion, a chisel stationarily supported by said frame at the other end of said C-shaped portion opposite said pressure pin and having a cutting edge facing said pressure pin, whereby said pressure pin may be positioned in said gap between said ends of said C-shaped portion for engagement at opposite sides by said pressure pin and said chisel, a drive bolt threadedly arranged in said straight portion and projecting from the latter at that end thereof remote from the end connected to said C-shaped portion, said drive bolt being provided with a head engageable by a wrench or like implement for rotating said drive bolt and axially displacing the same along said straight portion, and transmission means interposed between said drive bolt and said pressure pin for transmitting to the latter and around the bend the compound thrust between said straight and C-shaped portions an axial thrust corresponding to the axial thrust exerted by said drive bolt upon rotation thereof.

3. A nut-splitting tool according to claim 2, said straight portion of said frame being provided with a longitudinally extending threaded bore receiving said drive bolt and with a relatively narrower first smooth-surfaced bore arranged coaxially with said threaded bore, said one end of said C-shaped portion being provided with a second smooth-surfaced bore one end of which communicates with said first bore and the other end of which communicates with said gap between said ends of said C-shaped portion, the axis of said second bore being oriented substantially parallel to said planes of said front faces and of said one side face of said C-shaped portion, whereby the common axis of said threaded bore and said first bore is oriented at a first angle relative to said axis of said second bore as measured from one of said planes and at a second angle relative to said axis of said second bore as measured from the other of said planes, said pressure pin being disposed in said second bore, and said transmission means comprising a thrust pin fixedly connected at one end to said drive bolt and extending from the latter through said threaded bore into said first bore, a first ball disposed in said first bore and engaging the other end of said thrust pin, and a second ball disposed in said second bore and engaging the innermost end of said pressure pin, said balls being in engagement with one another at the juncture of said first and second bores.

4. A nut-splitting tool according to claim 3, said compound angle of said bend between said straight and C-shaped portions of said frame being 12° relative to each of said planes.

5. A nut-splitting tool according to claim 2, said transmission means comprising a thrust pin extending substantially axially through said straight portion, and a universal joint operatively connecting the innermost end of said thrust pin with the innermost end of said pres-
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7 sure pin substantially at the bend between said straight and C-shaped portions.

6. A nut-splitting tool according to claim 2, said transmission means comprising a thrust pin connected at one end to said drive bolt and extending axially through said straight portion, a sleeve member in sliding engagement with the innermost end of said pressure pin adjacent the bend between said straight and C-shaped portions, and a pin and slot connection between said thrust pin and said sleeve member.

7. A nut-splitting tool according to claim 2, said transmission means comprising a thrust pin having a bend intermediate its ends corresponding approximately to the bend between said straight and C-shaped portions, said thrust pin bearing at one end against said drive bolt and at the other end against said pressure pin.

8. A nut-splitting tool according to claim 2, said transmission means comprising a spring-like member extending substantially axially through said straight portion, said spring-like member having a first head rotatably connected to said drive bolt and a second head in sliding engagement with said pressure pin.

9. In a nut-splitting tool equipped with means for engaging a nut at opposite faces thereof for applying pressure to and splitting said nut; a frame for accommodating said nut-engaging means, said frame comprising a rigid unitary body having a C-shaped portion open at the front and at both sides and a straight portion, said C-shaped portion having two spaced ends defining a pair of coplanar front faces the plane of which is substantially perpendicular to the plane of one of the side faces of said C-shaped portion, said straight portion extending from one of said ends of said C-shaped portion and having a longitudinal axis oriented obliquely relative to and away from both said planes in the direction of both the rear and the other side face of said C-shaped portion.

10. In a nut-splitting tool equipped with means for engaging a nut at opposite faces thereof for applying pressure to and splitting said nut; a frame for accommodating said nut-engaging means, said frame comprising a rigid unitary body having a C-shaped portion open at the front and at both sides and a straight portion, said C-shaped portion having two spaced ends defining a pair of coplanar front faces the plane of which is substantially perpendicular to the plane of one of the side faces of said C-shaped portion, said straight portion extending from one of said ends of said C-shaped portion and having a longitudinal axis oriented obliquely relative to and away from both said planes in the direction of both the rear and the other side face of said C-shaped portion.

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