Oct. 1, 1963 A. M. WIRTANEN 3,105,299

KNOCK-OUT PUNCH

Filed Dec. 28, 1961

Fig. 1

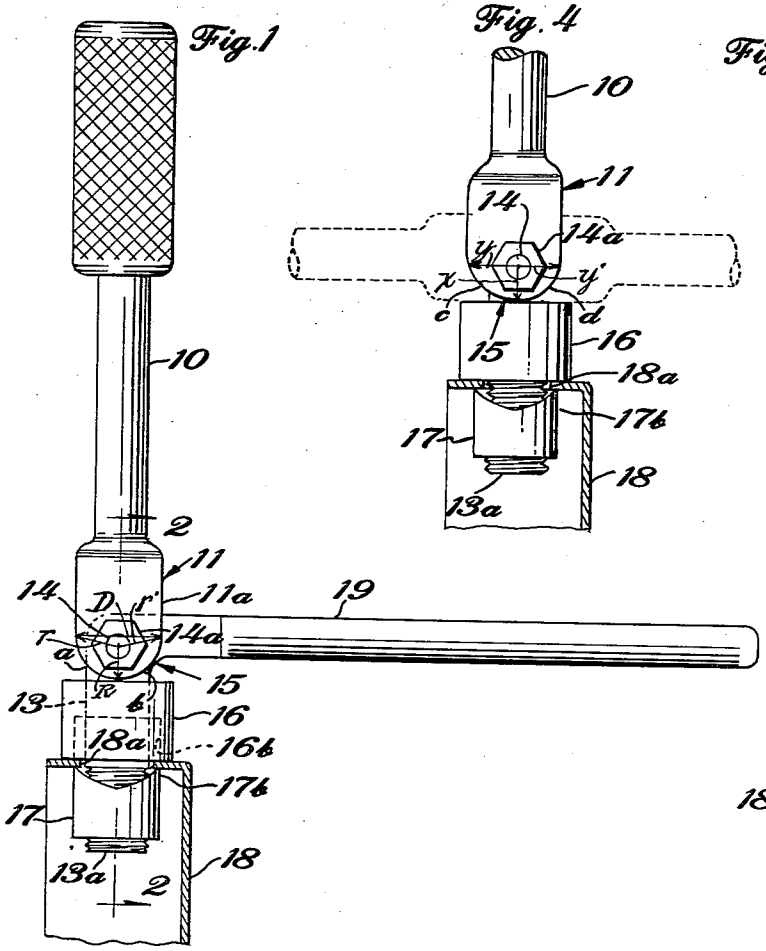


Fig. 4

Fig. 2

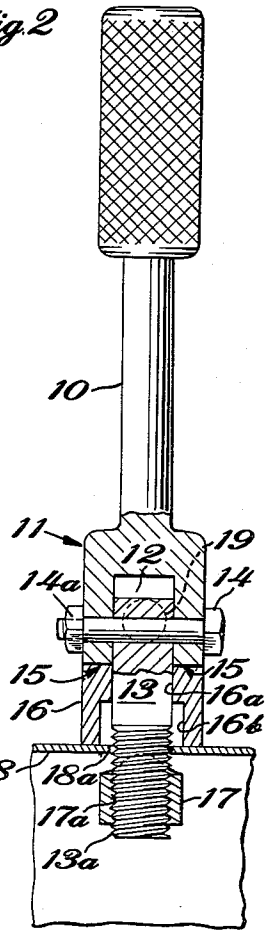
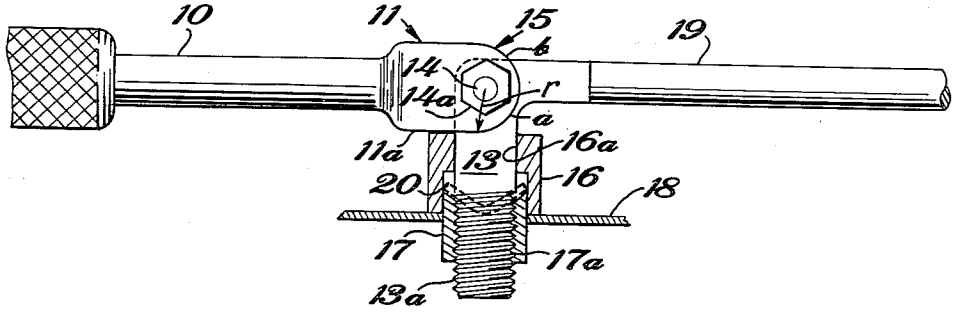


Fig. 3



Inventor

Axel M. Wirtanen

By His Attorneys

Williamson & Palmatier

United States Patent Office

3,105,299
Patented Oct. 1, 1963

3,105,299

KNOCK-OUT PUNCH

Axel M. Wirtanen, Rte. 1, Box 41, Sparta Location, Eveleth, Minn.

Filed Dec. 28, 1961, Ser. No. 162,873
2 Claims. (Cl. 30—360)

This invention relates to knock-out punches in general, and in particular to a portable hand operated knock-out punch having novel operating mechanism for applying power and drawing the punch and die together and which is especially suitable for use by electricians for enlarging holes in electrical metal cabinets and junction, outlet, fuse or switch boxes, although its use is not limited thereto and may be extended to other applications.

Knock-out punches of various types have been developed in the past, but these knock-out punches of the prior art including those presently available have had and do have certain disadvantages associated therewith which are avoided and overcome by the device of this invention. Many of the presently available devices are of the power operated type which are expensive to buy, large, bulky, heavy and difficult to transport and operate, especially by a single person, and are difficult and sometimes impossible to use in many situations where the piece to be punched is located in a difficultly accessible area wherein the freedom of movement is limited. Manually operated knock-out punches of the prior art are also difficult to operate in limited access locations, and require an undesirably high degree of physical effort to apply the power necessary to cut through metal.

Therefore, the primary object of this invention is to provide a portable hand-operated knock-out punch which simplifies and makes easier the punching or knocking-out of holes.

Another important object is to provide novel manual operating mechanism for conventional knock-out punch and die sets which are easier and more convenient to use than mechanism previously available.

Still another object is to provide a portable hand-operated knock-out punch which can be easily and readily manipulated in normally difficultly accessible areas and which enables the force necessary to accomplish the punching to be more easily applied than in prior hand operated punches and which enables a greater degree of force to be applied with less effort.

Still another object is to provide a portable hand operated knock-out punch which is relatively inexpensive and which can be readily carried and operated by an electrician or anyone else without help from others.

Still another object is to provide a knock-out punch which can be readily and rapidly manipulated to achieve a series of penetrating movements of the punch and die relative to each other whereby the punch gradually penetrates the material being cut until the portion to be cut out is completely removed.

Still another object is to provide operating mechanism for a knock-out punch having improved power ratios which can be varied if desired.

These and other objects and advantages of my invention will more fully appear from the following description made in connection with the accompanying drawings wherein like reference characters refer to the same or similar parts throughout the several views, and in which:

FIG. 1 is an elevational view of one preferred form of this invention as it would appear at the beginning of the knockout operation mounted on an ordinary outlet box, said box being shown in section;

FIG. 2 is a sectional view of FIG. 1 taken along the line 2—2 thereof;

FIG. 3 is a sectional view of FIG. 1 as it would appear upon completion of the knock-out operation; and

FIG. 4 is an elevational view of an alternate form of this invention with the outlet box cut away.

Reference is now made to the drawings for a better understanding and more detailed description of the invention.

Referring first to the form of the invention illustrated in FIGS. 1 through 3 inclusive, the knock-out punch illustrated therein includes a handle **10** having a slotted bifurcated cam shoe **11** mounted on one end thereof. The slot **12** of the cam shoe receives one end of an elongate threaded take-up die bolt or draw bolt **13**, which bolt is pivotally connected to the cam shoe by means of a hinge pin bolt **14** and its nut **14***a*, said hinge pin extending through the draw bolt and both sides of the cam shoe and freely journaled therein whereby the cam shoe **11** is freely rotatable about and with respect to said hinge pin for operating said draw bolt in a manner hereinafter described. The other outer or free end of the draw bolt is threaded as at **13***a*. The operating end of the cam shoe has a semi-circular cam surface **15**, the hinge pin **14** being eccentrically mounted or located with respect to this said cam surface **15** whereby the maximum radii *r* and *r'* are equal to each other and greater than the minimum radius R. Thus, each half of the cam surface **15** identified by the letters *a* and *b* provide an identical camming action whereby the handle, if moved in either direction, that is, either clockwise or counterclockwise with respect to the hinge pin **14** will achieve the same degree of camming action and pull on the draw bolt.

The operating and power applying mechanism just described is designed to be used with a cooperating punch and die set such as the die **16** and the punch **17** shown in the accompanying drawings. The die **16** is provided with a central opening **16***a* which communicates with the cylindrical bore **16***b* of the die and through which the take-up bolt **13** freely passes. The punch **17** is cylindrical and adapted to slidably fit in the bore **16***b* of the die. The punch is provided with a central threaded opening **17***a* which threadedly receives and engages the lower threaded portion **13***a* of the draw bolt. The working face of the punch shown has diametrically opposed protruding portions or teeth **17***b* which make first contact with and penetration of the material to be cut.

One typical application of use of this knock-out punch is with a standard metal outlet box, a portion of which is identified by **18** in the drawing. In these conventional outlet boxes, knock-out holes of a standard size are provided, one of which is illustrated at **18***a* in the drawings, which holes in any given outlet box are usually designed to take a certain size conduit. It frequently happens that it is necessary for the electrician to enlarge these holes such as to connect a larger sized conduit with the outlet box or switch box, as the case may be, and the tool of this invention serves to punch out slugs of different diameters as may be required for different sized conduits depending on the size necessary so as to enlarge the knock-out holes provided in the box to accommodate the larger sized conduit.

FIGS. 1 and 2 illustrate the relative positions of the various component parts of the invention, the punch and die set, and the outlet box itself at the start of the knock-out operation and FIG. 3 illustrates the relative positions of these elements upon completion of the knock-out operation.

Thus, in use and operation, the die **16** is placed against the outside of the outlet box **18** with the central opening **16***a* thereof in substantial alignment with the hole **18***a* of the outlet box. The take-up bolt **13** is then inserted through the aligned openings in the die and the box and punch **17** is threaded thereon until the punch (specifically the teeth **17***b* thereof) is in engagement with the inside wall of the box, and the low point or minimum radius

of the cam surface 15 represented by the radius R is snug or tight against the outer or working face 16c of the die with the handle 10 in axial alignment with the draw bolt as seen in FIGS. 1 and 2. The enlargement of the hole 18 and the knock-out operation is then ready to proceed. The handle is then swung either clockwise or counterclockwise with respect to the hinge pin 14 until it reaches a perpendicular position with respect to the draw bolt as seen in FIG. 3. In the course of the movement of the handle, one of the cam surfaces *a* or *b* bears against the die 16, and due to the eccentricity of the cam surface thereof relative to the hinge pin 14, the cam works against the die pulling the draw bolt outwardly and thereby pulling or drawing the punch 17 towards the die 16 and into the metal wall of the outlet box a distance equal to the amount or degree of eccentricity of the cam (the difference between the minimum eccentric radius R and the maximum eccentric radii *r* and *r'*).

In some instances, the degree of eccentricity as compared with the thickness of the wall of the box may be such as to enable the knock-out operation to be accomplished by a single movement of the handle from aligned to perpendicular position with respect to the draw bolt (vertical to horizontal position as shown in the drawings). However, it frequently happens that a single movement of the handle results in only partial penetration of the wall and incomplete cutting of the slug by the punch. In such cases the camming and drawing action previously described must be repeated until the slug has been cut out and the knockout completed. To repeat the drawing action, it is necessary to take up the slack between the die and cam.

Therefore, when the handle has reached the horizontal and one complete movement thereof has been accomplished, the handle is returned to the vertical with the minimum eccentric radius R opposite the die, and the cam is tightened, with respect to the die to repeat the punching operation hereinbefore described. To accomplish this tightening, the take-up bolt 13 is turned to draw the cam shoe towards and against the die. Because the punch 17 has already partially penetrated the metal wall of the outlet box, the punch is held against movement by its engagement with the box during the turning of the draw bolt to enable the draw bolt to turn relative thereto and enable the tightening to be accomplished as desired. This turning of the draw bolt may be accomplished either by turning of the handle 10 or may be accomplished by means of a second handle 19 which, in the form shown, is rigidly secured to the upper end portion of the take-up bolt 13 and extends outwardly therefrom at substantially right angles thereto. When the cam shoe has again been tightened against the die, the handle is again swung to the horizontal position shown, causing the cam to work against the die and pull on the draw bolt, and another partial penetration of the wall of the outlet box by the punch is accomplished as previously described. This partial punching and tightening is repeated until the knock-out has been accomplished and the slug 20 is cut from the wall of the outlet box and the punch enters the bore 16*b* of the die as seen in FIG. 3. The entire assembly is then pulled out of and away from the outlet box and the punch disengaged from the draw bolt and the slug removed therefrom.

It will be appreciated that the second right handle 19 may be used not only to turn the draw bolt and tighten the cam shoe against the die, but also serves as a conveinent means of holding and steadying the assembly. In the form shown in FIG. 1, the maximum cam radii *r* and *r'* terminate at the opposite ends of the diameter D of the semi-circular cam surface 15 and the sides 11*a* of the cam shoe tangentially meet the cam surface at the points of termination so that the cam surface ends and the camming action terminates when the handle reaches the end of its travel and is in a substantially horizontal position with

the sides 11*a* of the cam shoe resting against the top of the die. This makes easier the knock-out task, as it maintains high pressure for a moment as the metal keeps on yielding in the act of changing handle direction. It also makes it easier to hold the handle down at the end of its travel since the camming action is terminated and the pressure is relieved and the handle is relieved of any tendency to spring back up. The provision of an additional handle such as at 19 is optional, and may be dispensed with if desired, as in the form of the invention shown in FIG. 4 and described hereinafter.

This invention also contemplates a device having a two speed action or two different camming actions as distinguished from the one speed or single cam action of the device hereinbefore illustrated and described. Thus, in the device of FIGS. 1 through 3 inclusive, the cam surfaces *a* and *b* are the same so that the same camming action takes place regardless of which direction the handle is moved. However, the form of the invention shown in FIG. 4 employs a two speed action. The form shown in FIG. 4 is the same in all respects to that shown in FIGS. 1–3, except for the elimination of the extra handle 19 and a change in the cam surfaces hereinafter described. In FIG. 4, the cam shoe has two different eccentric cam surfaces identified as *c* and *d*, said cam surfaces having a common minimum eccentric radius X and different maximum eccentric radii Y and Y', Y being greater than Y' and both Y and Y' being greater than X whereby the cam surface *c* provides a greater degree of camming action and depth of cut or penetration than the surface *d*. Such a two speed cam can be utilized on metals of varying thickness and can also be used on any given piece of metal or other material to provide a double cutting action before the tightening operation takes place. Thus, where the cutting action is not too difficult and the resistance is not too great, the greater camming action supplied by the cam surface *c* may be employed directly to quickly effect the knock-out operation by swinging the handle to the left (as shown in FIG. 4) one or more times. Where tougher material is being punched and the resistance to cutting is greater, the handle may be first swung to the right (as shown in FIG. 4) so as to utilize the less eccentric cam surface *d* in the first movement of the handle. When the cut effected by the cam surface *d* has been completed, the handle is then returned to the upright position and then swung in the opposite direction (to the left) so as to utilize the more eccentric cam surface *c* which then makes an additional cut because of the greater camming action it provides. Thus, a double action or cut can be accomplished by swinging the handle first to one side and then to the other, following which the handle is then raised to the vertical, the cam shoe is tightened against the die and the action repeated until the knock-out is completed.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the various parts without departing from the scope of my invention.

What I claim is:

1. Mechanism for operating cooperating punch and die members, both of which have center openings one of which is threaded, said mechanism comprising a threaded draw bolt adapted to pass freely through the opening of one of said members and threadedly engage the threaded opening of the other of said members, a cam for engaging the member through which the bolt freely passes, means for hingedly mounting said cam on said bolt whereby camming movement of said cam against said member forces said punch and die members towards each other, and handle means for operating said cam.

2. Mechanism for operating cooperating punch and die members, both of which have center openings one of which is threaded, said mechanism comprising a threaded draw bolt adapted to pass freely through the opening of one of said members and threadedly engage the threaded opening

of the other of said members, a bifurcated cam element, the branches thereof defining a slot for receiving the end of said bolt adjacent said one member, hinge pin means pivotally interconnecting said bolt and said branches for pivotal movement of said cam about an axis normal to said bolt, said branches having cam surfaces adapted to engage and work against said one member, and handle means for operating said cam.

References Cited in the file of this patent

UNITED STATES PATENTS

834,139	Kidder	Oct. 23, 1906
1,305,898	Hahnemann	June 3, 1919
1,817,223	Abramson et al.	Aug. 4, 1931
2,292,446	Huck	Aug. 11, 1942
2,787,324	Hartmeister et al.	Apr. 2, 1957