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W. J. ROZMUS

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RATCHET AND CAM ACTUATED TOOL

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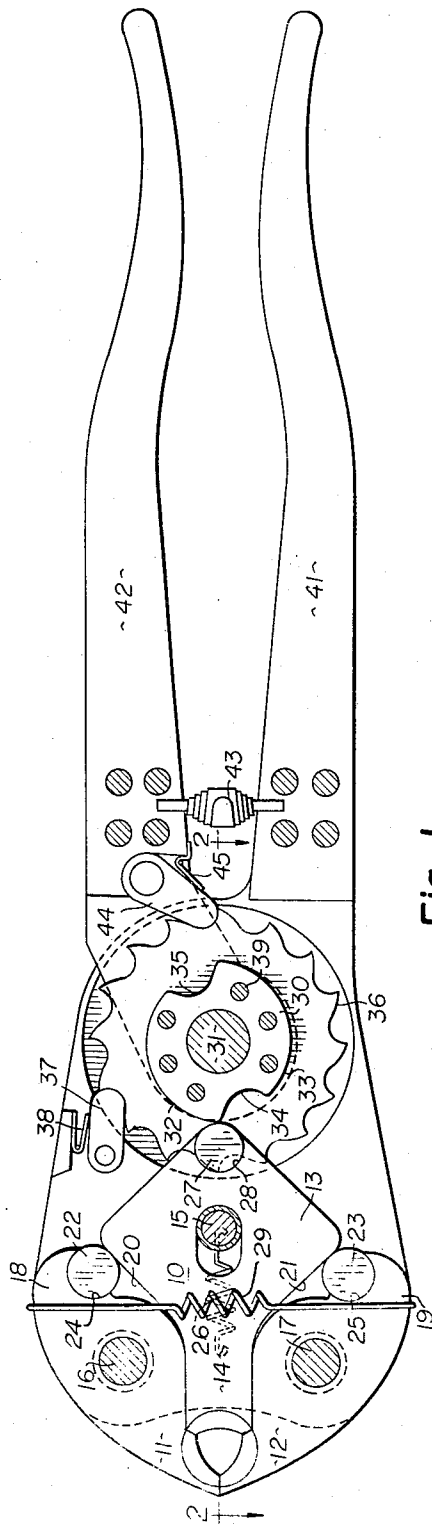


Fig. 1

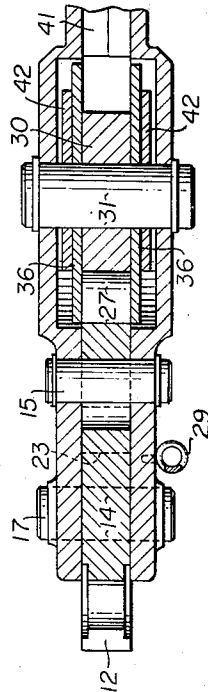


Fig. 2

INVENTOR.
WALTER J. ROZMUS
BY *Pyle and Fisker*

His Attorneys

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RATCHET AND CAM ACTUATED TOOL

Walter J. Rozmus, Whitesboro, N. Y., assignor, by mesne assignments, to Kelsey-Hayes Company, Detroit, Mich., a corporation of Delaware

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1 Claim. (Cl. 81—15)

This invention relates to cam actuated tools, and particularly to a closable jaw hand tool of light weight and rigid construction for crimping or indenting workpieces such as electrical connectors.

The primary object of this invention is to provide a movable jaw tool having a wide jaw opening, fast closure to a work position, high mechanical advantage through the work closing cycle, and assurance of completing a full work cycle whereby the jaws are required to close to a specific relative position before opening.

More specifically, an object of this invention is to provide a revolvable power cam having a peripheral surface defining a cam track, with a plurality of driven members each of which is provided with a rollable cam follower to take driving power from the cam surface, and the cam having definite recess pockets providing quick return from a maximum actuation position to the starting position.

Another object of this invention is to provide a three jaw tool having one jaw driven through a work cycle by a ratchet driven revolvable power cam and the remaining jaws driven from cam surfaces carried by the one jaw.

When using plier-type tools for crimping electrical connectors and severing heavy workpieces, or other similar high pressure jobs, it is customary to provide long handles to reduce operator fatigue, or to bring the mechanical advantage to such a degree that the desired operation is possible. Long handles or levers require less input force to do the required work and provide a high mechanical advantage. Lengthening the handles, however, introduces other undesirable factors. The longer the handle, the wider is the spread between the ends of the handles, and this makes the long levered pliers unlikely for use in confined quarters, more difficult to use, and induces early operator fatigue.

Another object of this invention, therefore, comprises the provision of pliers having a large mechanical advantage with a small span at the ends of the opened levers.

Further objects are to provide a short span lever actuated tool having a long lever characteristic, the jaws of which open wider than can be expected of ordinary pliers of similar size, and to provide such tool having the foregoing characteristics which are relatively light in weight and which do not require close tolerances in manufacture that are difficult to obtain in mass production.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawing, in which:

Figure 1 is a side elevational view of a pivoted jaw tool designed principally for crimping electrical connectors, and being actuated by the improved drive device of this invention; and,

Figure 2 is a sectional view taken along line 2—2 of Figure 1.

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In the past, reliance has been principally upon fulcrum type of tools, employing single or multiple fulcrums. Sometimes these tools have been supplied with a link mechanism attached to the handles permitting a variable mechanical advantage. The well known bolt cutter is such a tool design. In this construction, handles are pivoted together and to the rearward extensions of the opposed pivoted jaws. The ratios are fixed. The jaws will not open wide to receive work. They have terrific power at completion of the closure but no variation from a uniform curve through various steps of closure and no guarantee that the operator will complete the closure. This type of tool has stresses perpendicular to the length of the tool but provides no variation at the jaw from a uniform curve of force. Such tools are heavy, rugged and the handles must be opened wide, making them one stroke, two handed tools.

Later developments brought about the use of tools having a fixed anvil and a movable anvil. The movable anvil was generally actuated by means of a pivoted cam surface or a jack step device. Such devices require rugged actuation structures because of the very large reaction stresses placed upon the pivotal mounting for any such actuation device. As a result, a large amount of the input power is consumed in overcoming frictional loads and the pivotal supporting surfaces are subject to rapid deterioration under high wear conditions.

This invention is a further development of the basic principles set forth in an application entitled "Ratchet Powered Tool" filed January 17, 1956, and bearing Serial No. 559,605 and an application entitled "Pivot Lever Retainer for Ratchet Powered Device" filed January 30, 1956, and bearing Serial No. 562,253.

For the purpose of illustrating the present invention in an operative and useful structure, an electrical terminal crimping device has been selected. As set forth in the drawing, the tool may be embodied in a multiple of jaw members and is illustrated in Figure 1 as a three jaw member. Referring to the drawing, the tool embodies a jaw 10 which is mounted to move in a longitudinal reciprocable path, and jaws 11 and 12 which are pivoted to close together with respect to one another upon the longitudinal path of the jaw 10. Each of the jaws has a portion of a surface defining a conventional crimping structure, although any work performing construction may be substituted therefor. The jaw 10 receives driving force from a rotary ratchet device which will be more fully explained hereinafter, and distributes driving force to the jaws 11 and 12. Although the application of the principles of this invention are not necessarily limited to a longitudinally reciprocable path for the jaw 10, the preferred embodiment of a three jaw tool does employ such longitudinal movement. A guide pin 15 is provided to guide the jaw in such movement. The jaw 11 is pivoted about a pivot 16 whereas the jaw 12 is pivoted about a pivot 17. Pivots 16 and 17 are laterally spaced with respect to the jaw 10, and therefore provide for pivotal closing of the work ends of jaws 11 and 12 toward the longitudinal center line of the jaw 10, which constitutes its path of movement.

The jaw 10 receives driving power from the rotary ratchet device formerly referred to, and distributes the power to the jaws 11 and 12 as well as acting as a power jaw itself. In order to distribute such power and coordinate the movement of the jaws 11 and 12 with the forward movement of the jaw 10, the jaw 10 is provided with first and second cam drive surfaces 20 and 21 which diverge laterally from the longitudinal path of jaw movement. Thus, the jaw 10 is divided into two main portions referred to as the ram portion at the forward end, and

indicated by reference character 14, and a drive portion 13 rearwardly of the ram portion.

The jaws 11 and 12 are biased to an open position, lever end 18 and likewise the jaw 12 is provided with a rearwardly extending lever end 19. The lever ends are employed to receive driving power and thus supply control and driving power to the forward work ends of the jaws.

It has been found that a multiple cam actuated tool of the type shown is vastly improved in workability and transfer of work force into useful production by the provision of rollable members to act as bearings between the lever ends 18 and 19 and the respective cam surfaces 20 and 21 of jaw 10. As may be seen best in Figure 2, two rollers 22 and 23 are carried by sockets 24 and 25 respectively in the jaws 11 and 12. The sockets need not be confining sockets because the rollers are held between the lever ends and the cam surfaces, and ordinarily have no opportunity for displacement. The sockets do serve as large bearing surfaces to reduce pressure concentration and thereby provide long life and a minimum of frictional losses.

The jaws 11 and 12 are biased to an open position, that is, they are biased to press the roller cam followers 22 and 23 against the cam surfaces 20 and 21.

As thus far described, a three jaw construction has been set forth wherein the length of the pivoted jaws and the length of the ram jaw, together with the configuration of the cam surfaces on the ram jaw, may be varied at will to provide a coordination of the work producing surfaces and thus cause a closing to the extent and at the relative relationship desired to produce a given work function. Variation in closing rate and relationship will be readily understood by those skilled in the art.

An improved drive apparatus for the three jaw construction is also set forth in the drawing. This drive construction is a rotary ratchet device embodying a rotating cam 30 rotatable supported upon a bearing 31. Rotating cams are old and well known, but the rotating cam of this invention is believed to be entirely new and perform a significantly new and better function in the embodiment of this invention. The cam 30 is provided with two cam surfaces 32 and 33 which may more properly be referred to as portions of a peripheral cam surface. One complete cam surface operating about the major portion of the periphery of the cam 30 may be employed in some instances, whereas in other instances the two separate portions as set forth in the drawings may be employed. Choice of one or two separate cam surfaces will depend upon the amount of power to be delivered to the longitudinally reciprocable jaw 10. If a very large power ratio is required, then only one cycle of operation for each complete revolution of the cam 30 will be provided. Thus, for each rotary degree of movement of cam 30, a smaller increment of forward movement will be impressed upon the jaw 10. In the illustrated embodiment, however, it is assumed that pressure sufficient for crimping a connector to an electrical conductor is required. In this use, it has been found that two separate cam surfaces 32 and 33 are most practical, and therefore two complete work cycles may be imposed upon the jaws for each 360 degrees of revolution of the cam 30. Whether one complete cam surface or the two separate cam surface portions are employed, at least one recess surface is employed at the beginning and the end of each cam surface. Recess surfaces 34 and 35 are provided at diametrically opposite positions across the cam 30 and therefore each recess constitutes both a beginning and an end for the cam surfaces. More specifically, the recess surface 34 constitutes the end of the cam surface 32 and the beginning of the cam surface 33, whereas the recess surface 35 constitutes the beginning of the cam surface 32 and the end of the cam surface 33.

A spring 26 is provided to urge the jaw 10 to a retracted position in the direction of cam 30. A roller 27

similar in every respect to the rollers 22 and 23 is carried in a socket 28 at the end of the jaw 10. The roller 27 therefore serves as a cam follower to take power from the cam surfaces provided by the rotating cam 30 and supply that power as longitudinal force upon the jaw 10. The spring 26 urges the cam follower roller 27 against the cam surfaces presented.

The roller 27 is pictured at a position which will be assumed by the tool at the maximum closing of the jaws and just prior to opening of the jaws for releasing of the workpiece. It may be observed that a slight further rotation in a clockwise direction of the cam 30 will permit the roller 27 to drop into the recess 34, with the result that the jaw 10 will be snapped rearwardly by the spring 26 and the jaws 11 and 12 will consequently be released and will snap open under the urge of the spring 29 provided for them.

The cam surfaces 32 and 33, as may be observed from the drawing, each present a surface which varies gradually from a true circular position measured from the center of rotation. More specifically, in the illustrated embodiment, these surfaces present regular, gradual surfaces, although they may be irregular if the work to be done so requires. The recess sockets provide the locations for complete release of the working apparatus. Accordingly, it will readily be appreciated, the location of the roller 27 in either of the recesses 34 or 35 constitutes the beginning of one work cycle and the end of another work cycle. Also, a very slight movement of the cam 30, when the roller 27 is positioned in either socket, will cause a very fast longitudinal movement of the jaw 10 as the roller is ejected from the recess. The jaw 10 is confined to a path of movement which is lateral to the cam surfaces, and consequently rotary movement of the cam necessarily results in ejection of the roller from the socket recess. Thus, the three jaws are provided with a very wide initial relationship for the easy insertion and removal of workpieces, but are quickly closed upon a new workpiece without a particularly large driving force. However, by proper coordination of the cooperating structure immediately upon closing of the jaws on a workpiece, the follower roller 27 is positioned in contact with the beginning of one of the cam surfaces 32 or 33 and therefore a very slow and high power ratio driving force commences and progresses until the opposite recess is positioned under the roller 27, whereupon a complete release of the jaws to end the cycle is accomplished.

Driving force to operate the cam 30 is provided by means of a ratchet wheel 36. The cam 30 is carried by or drivingly interconnected to the ratchet 36 by means of pins 39. Ratchet 36 is limited to one direction of movement only by means of a detent 37 urged against the surface of the ratchet by means of a spring 38, in the conventional and well understood manner.

In order to provide a source of primary driving power for the ratchet, in the particular illustrated embodiment of a hand tool, a permanent handle 41 is provided to hold the tool, and a pivot lever handle 42 is provided to transmit driving force. Handle 42 is urged to an open position by a spring 43. A pawl 44 is urged against the surface of the ratchet 36, and consequently can index from one tooth to the next upon opening of the handle 42. The handle 42 is preferably pivoted about the same center as the cam 30, but if greater power is desired without an increase in the overall length of the tool, it is possible to position the pivot for the handle 42 forward of the bearing 31 between the ratchet wheel and the jaws. Such forward position of the handle may be accompanied by a reverse drive of the ratchet wheel, and can be readily adapted by reversing the cam surfaces.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred embodiment is made only by way of example and that

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numerous changes in the details of construction and the combination of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

A three jaw work tool, comprising, a first jaw mounted for longitudinal reciprocable movement, second and third jaws pivoted laterally of said first jaw for closing movement toward the longitudinal path of said first jaw, said first jaw having first and second cam drive surfaces, said second jaw having a cam follower riding said first cam drive surface, said third jaw having a cam follower riding said second cam drive surface, said first and second cam surfaces and the cam followers being formed with respect to the three jaws to cause cooperative work-piece action of the jaws upon longitudinal reciprocation of the first jaw, and a ratchet powered drive for said first jaw, said ratchet powered drive having a rotatable cam structure presenting a cam surface revolvable about an axis, said cam surface having a drive surface of gradual

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divergence from a true circular path, said drive surface beginning and ending at a recess pocket, a drive receiving cam rider carried by said first jaw, rotation of said cam structure thereby providing a fast movement of said rider and said first jaw from a position in said recess pocket at the start of the cam surface followed by a gradual movement pattern and concluding in a fast return movement by dropping into the recess pocket at the end of the cam surface, a rotatable ratchet wheel drivingly connected to said cam structure, and a lever with pawl means to drive said ratchet wheel.

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