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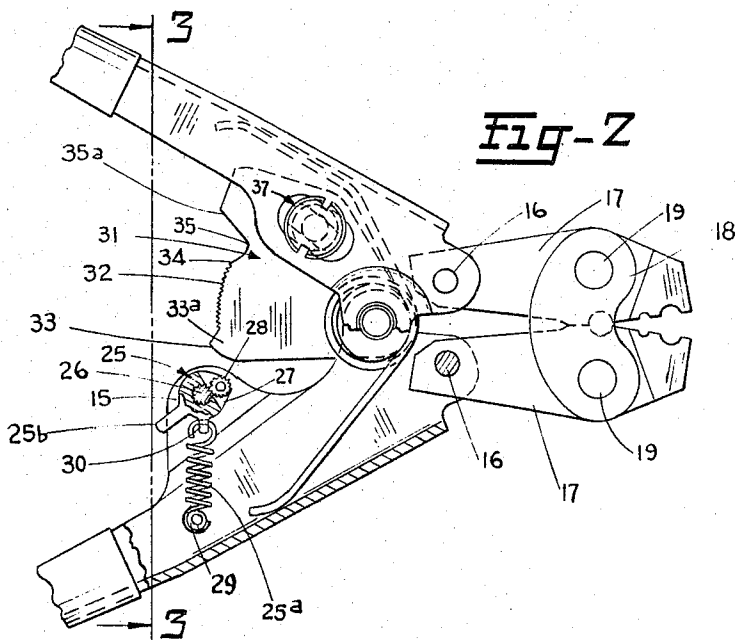
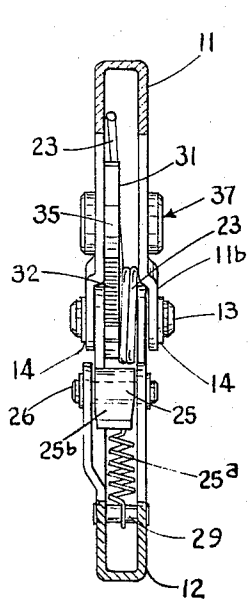
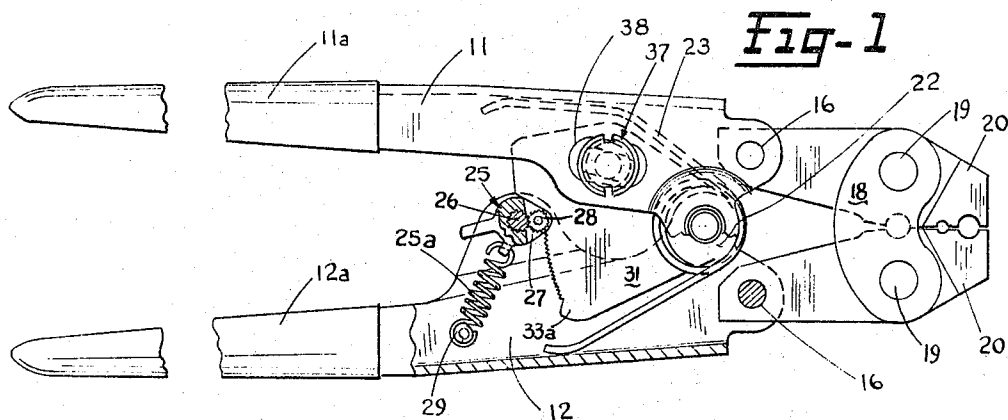
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3,277,751

MOTION-COMPELLING MECHANISM FOR A HAND TOOL

Filed May 6, 1965

2 Sheets-Sheet 1



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By

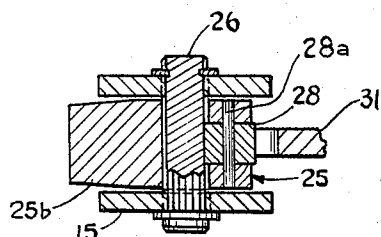
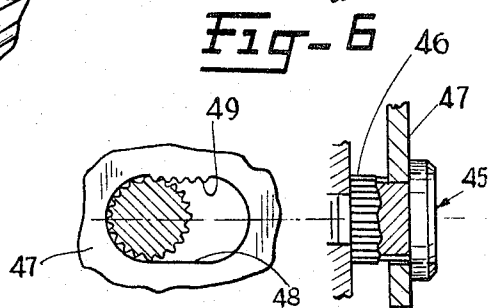
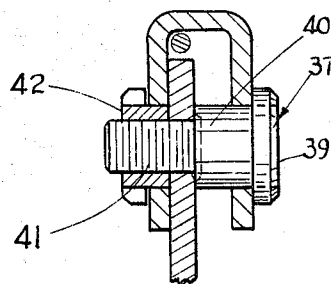
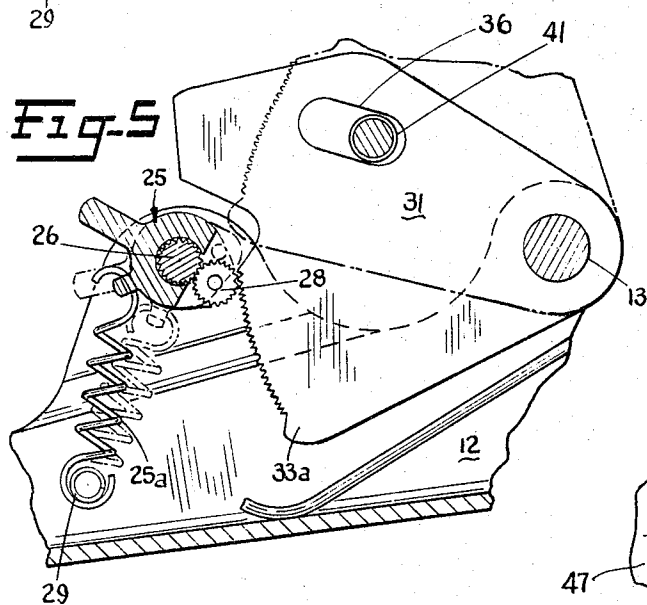
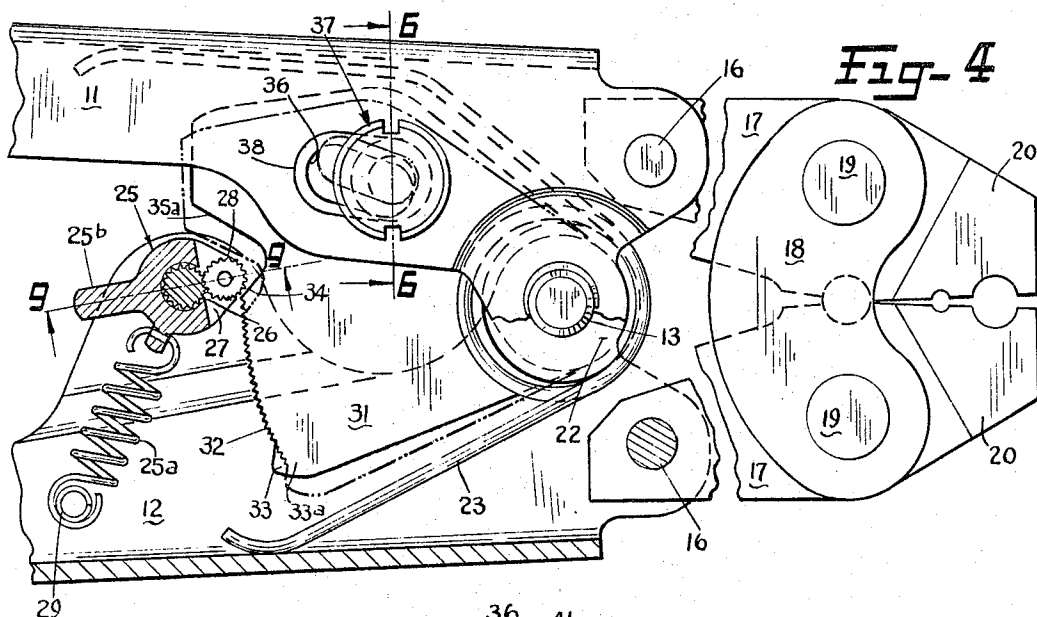
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3,277,751

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2 Sheets-Sheet 2



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3,277,751 MOTION-COMPELLING MECHANISM FOR A HAND TOOL

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This invention relates to a motion-compelling mechanism for a hand tool of the type having a pair of handles so constructed and arranged with reference to one another that the handles have a scissorlike action. Such tools are often constructed for crimping electrical terminals or connectors on electrical wires, for example.

It has been conventional practice for some years to incorporate in such crimpers motion-compelling means to insure that the handles of the tool may not be moved relatively to one another in such a manner as to open the crimper until the crimper has been closed sufficiently, once closing movement of the crimper has begun, so that a full crimp is assumed. It will be appreciated that otherwise the operator of the tool might inadvertently neglect to close the crimper to the extent necessary to impart a satisfactory physical and electrical connection between the workpiece and the part to which it is designed to be affixed.

Such crimpers commonly comprise a pair of cooperating jaws or dies, and it has been found helpful to employ in such a tool a motion-compelling mechanism for the foregoing reasons and which further enables the tool operator to manipulate the handles of the tool to partially close the dies on a ferrule and then insert a wire in the ferrule while the dies remain firmly gripping the ferrule. The motion-compelling mechanism prevents dislocation of the handles of the tool relatively to one another while the wire is being inserted.

Conventional motion-compelling mechanisms for tools such as described above by way of example have commonly employed cooperating pawl and ratchet elements. It has been found that in at least some applications motion-compelling mechanisms of the pawl and ratchet type have not proven entirely satisfactory in at least two aspects. Firstly, the tip of the pawl may be subject to breakage due to forces imposed on the tool. Secondly, the pawl cooperates with only one tooth of the ratchet at a time and, even while the teeth of the ratchet may be very fine, the take-up of the pawl and ratchet mechanism, tending to prevent opening of the tool, may not be sufficiently full once the crimping operation, for example, has commenced, to prevent undesirable effects on the workpiece due to even a small amount of relative movement of the tool handles in a direction to open the tool.

The invention contemplates a motion-compelling mechanism substantially free of the above-mentioned faults and yet has all the advantages of a mechanism of the aforementioned pawl and ratchet type, among other advantages, which will be apparent hereinafter.

Accordingly, it is an object of the invention to provide an improved motion-compelling mechanism for a hand tool.

Another object is to provide a motion-compelling mechanism for a hand tool which can withstand greater forces imposed on the tool in a direction opposite that in which movement is compelled.

Still another object is to provide a motion-compelling mechanism having a very full or fast take-up action which, therefore, has greater compelling tendencies than commonly found in tools incorporating conventional motion-compelling mechanisms.

A further object is to provide a motion-compelling mechanism such as described above which is adjustable to

compensate for rather large manufacturing tolerances of parts of the tool such as the jaw or crimping dies, for example, or to compensate for wear of the jaws or dies, and which motion-compelling mechanism may further incorporate a stop when assembled in a tool to limit closing movement of the jaws or the like of the tool.

For a more complete understanding of the invention, reference is made to the following description with the accompanying drawings, in which:

FIG. 1 is a broken side elevational view, partially in section, of a crimping tool having as a part thereof a motion-compelling mechanism embodying the invention, the tool being a hand tool comprising relatively movable jaws which, as illustrated here, are in relatively closed condition;

FIG. 2 is a fragmentary view similar to FIG. 1, showing the tool with the jaws thereof in relatively open condition;

FIG. 3 is a sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is an enlarged fragmentary view similar to FIG. 1 illustrating in solid lines the jaws of the tool in full crimping positions just prior to engagement of the aforementioned stop, the movement of the jaws toward relatively closed condition having been fully compelled, one element of the motion-compelling mechanism being shown in an adjusted position for one or both of the compensation purposes hereinbefore described;

FIG. 5 is a view similar to FIG. 4 illustrating in solid lines engaged positions which certain parts of the motion-compelling mechanism assume just prior to the jaws reaching the positions shown in FIG. 4, and illustrating in broken lines the positions of the aforesaid parts of the motion-compelling mechanism just prior to engagement of these parts during initial relative movement of the jaws from their open positions shown in FIG. 2 toward their closed positions;

FIG. 6 is a sectional view taken on line 6—6 of FIG. 4;

FIG. 7 is a fragmentary elevational view, partially in section, illustrating a modification of the motion-compelling mechanism;

FIG. 8 is a sectional view taken at right angles to FIG. 7; and

FIG. 9 is a sectional view taken on line 9—9 of FIG. 4.

In the form of the tool shown in FIGS. 1 through 6 and 9 there is illustrated a tool having handles 11 and 12 which may be stamped from sheet metal and covered throughout a portion of their lengths with a plastic material as at 11^a and 12^a respectively, these covered portions of the handles constituting the parts of the tool gripped by the operator. The handles 11 and 12 in the illustrated form are of channel shape in cross section, as best shown in FIG. 3, the channels being in opposing relation to one another, and the channel of the handle 11 being enlarged as at 11^b to receive a portion of the channel of handle 12, as shown in this view, where the two handles are pivotally interconnected by a pin 13 held against axial displacement by split rings 14. The pin 13 extends through the side walls of both handles 11 and 12. The channel of the handle 12 has an integrally formed raised portion 15, the purpose of which will appear hereinafter.

Beyond the pivot pin 13 from the raised portion 15, as shown in FIG. 2, for example, the aforementioned handles are provided with pivot pins 16 extending through the respective side walls of the handles for support thereby and each pivotally mounting one of a pair of jaws 17 through one end of which jaws the pin extends. The jaws 17 are pivotally interconnected through a pair of plates (only one being shown and indicated at 18) supporting a pair of pivots 19 therebetween, which pivots support the respective jaws by extending therethrough intermediate their ends, the jaws being pivotally mounted

in the aforesaid manner for conventional toggle-like action on swinging movement of the aforementioned handles relatively to one another. The jaws carry pin 17^a therebetween, held captive axially by the last-mentioned plates.

The jaws may carry as separate parts complementary crimping dies, for example. In the form referred to above the dies 20 are shown as being formed integrally with the respective jaws. It is to be noted, however, that the invention is not limited to a hand tool having a togglelike action, but may be employed in a tool having handles provided with a scissorslike action and, for example, imparting parallel movement of the jaws of the tool as illustrated and described in United States Patent No. 3,157,075, issued November 17, 1964. The motion-compelling mechanism embodying the invention may also be incorporated in a hand tool of the type illustrated and described in copending application, Serial No. 273,407, filed April 16, 1963, now Patent No. 3,204,445, wherein there is provided a stationary jaw, a movable jaw cooperating with the first-mentioned jaw, a swingable operating handle in pivoted relation to the fixed part and pivotally interconnected to the movable jaw.

Within the channel formed by the handle 12 there is a washerlike spacer 22 on the pivot pin 13, and a wire spring 23 is wound about the axis of the pivot pin 13 and extends over the spacer 22 for a purpose which will appear hereinafter. The ends of the spring 23 are bottomed in the respective channels of the handles 11 and 12, as shown in FIGS. 1 and 2, for example. The arrangement of the spring is such as to bias the handles toward their open positions shown in the last-mentioned view to thereby bias the jaws to their open positions as seen in this view.

The motion-compelling mechanism in which the present invention resides comprises a bracket, indicated generally at 25, pivotally supported in the raised portion 15 of the channel of handle 12 by means of a splined or toothed pin 26 held against angular dislocation in the side walls of the handle 12 through which it is extended, having complementary toothed openings, axial movement of the pin 26 being prevented (FIG. 9) by split rings. The bracket is slotted as at 27, and in this recess receives a pinion 28 revoluble on a pin 28^a suitably supported by the bracket, the pinion being in mesh with the toothed pin or gearlike element 26 so that on rotation of the bracket 25 about the axis of the gearlike part 26, rotation is imparted to the pinion 28. A coil spring 25^a disposed in the last-mentioned channel has one end secured therein as by a pin 29 (FIG. 3) extending through the side walls of the channel. The other end of the spring is secured, as at 30, to the bracket 25.

Pivotally mounted on the pivot pin 13 interconnecting the handles and disposed within the channel of the handle 11 is a platelike part, indicated generally at 31, generally of the form of a gear sector having relatively fine teeth 32 extending throughout an edge portion thereof for cooperation with the teeth of the pinion 28 which are also relatively fine.

At one end of the last-mentioned toothed portion the platelike part 31 is provided with a camming surface 33 on a cam nose 33^a extending radially outwardly of the pivot 13 a distance greater than the teeth 32, the last-mentioned surface being provided on an edge portion of the part 31. There is provided at the other end of the last-mentioned toothed portion of the plate part 31 a recess 35 in an edge portion of the platelike part forming a camming surface 34. The aforementioned plate part 31 may be likened to a gearlike part angularly movable on the pivot 13, and for the purpose of securing the gearlike part 31 with reference to the handle 11 there is provided an opening 36 (FIG. 5) in the part 31 through which fastening means designated generally at 37 (FIG. 6) extends, the last-mentioned fastening means extending through aligned openings 38 formed in the side walls of

the handle 11. The openings 38 are elongated and angularly disposed with reference to the pivot 13, as shown, and the opening 36 in the gearlike part 31 is also elongated and formed at a somewhat different angle with reference to the pivot 13 than the openings 38. As best shown in FIG. 6, the fastening means 37 comprises a bolt 39 having a head bearing against the outer face of one of the aforementioned walls of the handle 11 and having a cylindrical portion 40 received in the opening 38 formed in the last-mentioned wall. Beyond the cylindrical portion 40 the bolt is narrowed or of smaller diameter, and this portion of the bolt, indicated at 41, is threaded and extends through the other opening 38 in the last-mentioned handle as shown in the last-mentioned view. The cylindrical portion 40 of the bolt together with the reduced portion 41 of the latter forms a shoulder against which the gearlike part abuts, and the last-mentioned part is sandwiched between the shoulder and a headed nut 42 threaded on the portion 41 of the bolt.

It will be noted that with this construction and arrangement the gearlike part 31 may be firmly held in fixed or angularly adjusted position with reference to the handle 11 as the handles are swung relatively to one another on the pivot 13 in the operation of the tool. The head of the bolt 39 and the headed nut 42 may be suitably recessed as indicated in the drawings to receive a spanner wrench of a special size to inhibit tampering with the fastening means 37 by unauthorized persons.

Angular adjustment of the gearlike part 31 on the pivot 13 with reference to the handle 11 may be effected by loosening the nut 42 or bolt 39 with the aforementioned special tool and adjusting the bolt 39 in the slots 38. It will be noted that during movement of the last-mentioned bolt in the slots 38 for adjustment purposes, the bolt may have some limited movement with reference to the gearlike part 31 by moving in the slot 36 formed in the last-mentioned part. When the fastening and adjusting means 37 is in the desired angular position with reference to the pivot 13, the bolt 39 is tightened with reference to the headed nut 42 to firmly clamp the gearlike part 31 in adjusted position with reference to the handle 11. As will appear more fully hereinafter, the angular position of the gearlike part 31 with reference to the pivot pin 13 dictates the movement of the tool handles and, therefore, the movement of the jaws and dies carried by the jaws, which is compelled. The aforementioned spacer 22 overlaps the gearlike part 31. That is, it extends beyond it in a direction to prevent binding between the spring 23 and the gearlike part 31.

In the operation of the form of the tool described above, it will be understood with reference to the drawings that, when the tool is in the open condition shown in FIG. 2, the tool may be held by the operator in one hand and electrical terminal or connector of the ferrule type, for example, inserted between the dies 20 of the tool with the other hand of the operator. The handles of the tool may then be manipulated in a manner to swing one relatively to the other in a direction to effect partial closing movement of the dies to the extent that the ferrule is supported by the jaws in uncrimped condition.

During this initial relative movement of the handles of the tool, the surface 33 of the cam nose of the gearlike part 31 engages the pinion 28 and rotates the spring-biased bracket carrying the pinion in a clockwise direction as viewed in FIG. 2 on the axis of the gearlike element 26 with which the pinion meshes. The position which the gearlike part 31 occupies relatively to the bracket 25 and its associated parts just prior to interengagement of these parts is shown in phantom in FIG. 5.

It will be understood from the foregoing that as the bracket is moved angularly on the gearlike element 26, which is fixed to the handle 12, the pinion 28 is rotated, the pinion being rotated in a clockwise direction, as viewed in FIG. 2.

It will also be understood from the foregoing that the

spring-biased bracket 25 is moved angularly on its aforementioned pivot only to the extent necessary to permit the cam nose of the gearlike part 31 to slip past the pinion 28. During this angular movement of the bracket, the spring 25^a associated with the bracket is tensioned and, when the cam nose slips past the pinion 28, the spring 25^a functions to bias the bracket 25 in such manner that the teeth of the pinion 28 are quickly brought into engagement with the teeth 32 of the gearlike part 31.

As soon as the pinion 28 is engaged with the toothed portion of the part 31 in the aforesaid manner, relative opening movement of one handle of the tool with reference to the other handle is efficiently and very strongly inhibited by the pinion 28, which on said movement tends to wedge or jam between the gearlike element 26 and the gearlike element 31 owing to the fact that the sum of the distance between the pivotal axis of the bracket 25 and the teeth of the pinion or gear 28 engaged with the teeth 32 and the distance between the engaged teeth 32 and the axis of the pivot pin 13 is greater than the distance between the axis of the pivot 26 and the pivot 13. The wedging action of the pinion or gear 28 is a very strong one, greater than the holding action of a pawl, by reason of the fact that one or more teeth of the element 28 become meshed with teeth 32 and one or more teeth of the element 28 also become meshed with teeth of the gearlike element 26 once forces are imposed upon the handles, tending to open the jaws of the tool.

Moreover, the instantaneous meshing of the teeth in the manner described above provides a fast or substantially complete motion take-up, thereby providing the mechanism with a greater motion-compelling effect than would be obtained with the use of a pawl engaging a ratchet. It should be noted here that the afore-mentioned gear teeth do not tend to mesh, that is, the teeth on the gearlike part 31 and the pinion or gearlike part 28, unless or until there is a force exerted on the handles of the tool tending to move one handle relatively to another in a direction opposite that in which motion is compelled.

Once the teeth 32 have been engaged by the teeth of the element 28 in the aforesaid manner, relative motion of one handle to the other and, therefore, motion of one jaw relatively to the other, is compelled and, as relative movement of the handles is continued, the teeth of the pinion or gearlike element 28 bump or rub relatively over the teeth 32 of the gearlike element 31, the frictional contact between the teeth being dependent on the strength of the spring 25^a biasing the bracket 25 as the pinion moves to the full-line position shown in FIG. 5. In connection with the aforementioned rubbing action of the teeth of the gearlike element 28 relatively to the teeth 32 of the element 31, it should be noted that the teeth of the elements 28 and 31 are preferably rounded.

As closing movement of the handles is continued, the pinion 28 leaves the teeth 32 and the pinion is released from the gear-like part 31 when it enters the recess 35 formed in the last-mentioned part, the tension spring 25^a tending to facilitate the aforementioned release of the pinion or snap the bracket carrying the pinion to the released position in which the pinion extends into the aforementioned recess. At this point in the movement of the jaws effected through movement of the handles of the tool, the electrical terminal or connector is fully crimped and movement of one handle relatively to the other in a closing direction may be continued only until the bracket strikes the edge portion 35^a of the recess 35 in the part 31, at which point further relative closing movement of the handles is prevented to inhibit damage to the connector.

It will be understood from the foregoing that, when the pinion or gearlike part 28 disengages the gearlike part 31, the handles of the tool may move relatively to one another in a direction to open the jaws of the tool. On initial opening movement of the handles, the cam surface 34 provided by the recess 35 in the part 31 engages the pinion 28 and imparts an angular movement to the bracket

25 in a counterclockwise direction to move the pinion over center of an imaginary line between the axes of the pivot pin 13 and the pivot 26, as viewed in FIG. 4. The teeth of the pinion engage the teeth of the gearlike part 31. Once the teeth are so engaged, the handles of the tool may not be moved relatively to one another to effect closing movement of the die-carrying jaws. When the pinion 28 leaves the teeth 32 of the part 31, the aforesaid cam nose of the part 31 engages successive teeth of the pinion 28 and rubs relatively over them against the action of the tension spring influencing the pivotal bracket 25. As soon as the cam nose of the part 31 slips relatively past the pinion 28, the motion-compelling mechanism is released and here again the action of the spring associated with the bracket 25 serves to snap the bracket in an angular direction to facilitate release of the mechanism.

When the teeth are engaged as the handles move relatively to one another to open the jaws, the motion-compelling mechanism may only be released by a force such as from a finger of the operator on the tang 25^b of the bracket 25, tending to swing the bracket counterclockwise as viewed in FIG. 5. It will also be understood that, when the teeth of the gearlike part 28 are engaged with the teeth of the gearlike part 31 as the die-equipped jaws move toward their closed positions, the motion-compelling mechanism may only be released by the operator by a thrust on the tang 25^b as aforesaid but in a direction to impart a clockwise angular movement to the bracket 25.

In the modified form of the invention shown in FIGS. 7 and 8 of the drawings, the bolt indicated generally at 45, somewhat similar to the bolt 39, has a toothed portion 46 corresponding to the portion 40 of the bolt 39 and extending through one side wall 47 of a handle similar to the above-described handle 11. The toothed portion 46 extends through an opening 48 formed in the wall 47. A portion of the means defining the opening 48 defines serrations or teeth 49 extending into the opening for the purpose of meshing with the teeth of the toothed portion 46 of the bolt so that, when the bolt is loosened for adjustment in the opening 48 in a manner similar to the above-described loosening of the bolt 39 for adjustment purposes, the bolt 45 may be adjusted by turning in the opening 48 which is elongated, in desired increments. Such a construction and arrangement may be incorporated in the motion-compelling mechanism of the invention for applications in which it is desired to have the securing means for the gearlike part 31 adjustable within finer limits than is practical in the first-described form, and this construction provides a greater holding action between the handle and the bolt. The bolt 45 secures the gearlike part 31 in fixed adjusted position with reference to the corresponding handle of the tool in the same manner in which the bolt 39 secures the gearlike part 31 in place.

While only two forms of the invention have been illustrated in the drawings and described above, it will be appreciated by those versed in the art that the invention may take other forms and is susceptible of various changes in details without departing from the principles of the invention and the scope of the appended claims.

What is claimed is:

1. In a tool having first and second handles pivotally interconnected and adapted for the support of and respective association with work-performing elements of a pair, which cooperate with one another on relative swinging movement of the handles with respect to each other, the combination comprising a first toothed element having teeth arranged on a radius and secured to the first handle for relative swinging movement therewith in angularly rigid relation thereto, a second toothed element having teeth arranged on a radius and secured to the second handle for relative swinging movement therewith in angularly rigid relation thereto, and a gearlike part supported from one of said handles for swinging move-

ment therewith and for angular movement on its axis, said gearlike part also being supported from said one of the handles for swinging movement on an axis coincident with the point from which the teeth of the corresponding toothed element associated with the last-mentioned handle are generated on a radius as aforesaid, said gearlike part being spring biased toward the other toothed element, the teeth of the gearlike part being engageable with the teeth of said toothed elements simultaneously during relative swinging movement of the handles one to the other in either direction to compel relative movement of the handles in this direction while said teeth are so engaged.

2. A tool as defined in claim 1 wherein said gearlike part comprises a pinion and the support for the gearlike part from the handle which permits swinging movement on an eccentric axis and relatively to the handle with which the gearlike part is associated comprises a bracket swingably supported on the toothed element associated with the last-mentioned handle.

3. A tool as defined in claim 1 wherein the toothed element associated with said one of the handles is constituted by a splined or toothed pin, the other toothed element being generally of the form of a gear sector, and said gearlike element comprising a pinion.

4. A tool as defined in claim 1 wherein the support for the toothed element on the other handle is angularly adjustable with respect to said pivotal connection of the handles to vary the degree of motion which is compelled by said gearlike part.

5. A tool as defined in claim 2 wherein said bracket coacts with a part carried by the other handle to provide a stop for limiting relative swinging movement of the handles in one direction.

6. A tool as defined in claim 2 wherein the toothed element associated with the other handle is provided with a cam nose at one end of its teeth to engage the pinion and swing the bracket carrying the pinion in one direction against said bias, the last-named toothed part also comprising means defining a recess bounded in part by a cam surface to engage and swing the bracket in the other direction against said bias.

7. A tool as defined in claim 5 wherein said bracket is provided with a tang manipulatable by the operator of the tool to disengage said gearlike part from the other toothed element after the teeth have become engaged

in the aforesaid manner to release the motion-compelling gearlike part.

8. A tool as defined in claim 5 wherein said adjustment means comprises means defining a slot in said other handle and a bolt infinitely adjustable within the limits of said slot and extending through an aperture in the last-mentioned toothed element.

9. A tool as defined in claim 5 wherein said adjustment means comprises means defining a slot having teeth therein in said other handle and a bolt having a toothed portion cooperating with the last-mentioned teeth for adjustment in the slot and extending through an aperture in the last-mentioned toothed element.

10. In a tool having first and second handles pivotally interconnected and adapted for the support of and respective association with work-performing elements of a pair, which cooperate with one another on relative swinging movement of the handles with respect to each other, the combination comprising a pinionlike element angularly fixed to the first handle, a gearlike element secured to the second handle for relative swinging movement therewith in angularly rigid relation thereto, a bracket swingable on the pinionlike element, a pinion carried by the bracket eccentrically of its swinging axis and supported by the bracket for angular movement, the bracket being spring biased toward said gearlike element, the teeth of the pinion carried by the bracket being engageable with the teeth of said pinionlike element and the teeth of the gearlike element simultaneously during relative swinging movement of the handles one to the other in either direction to compel relative movement of the handles in this direction while said teeth are so engaged, said bracket coacting with means defined on said gearlike part to provide a stop for limiting relative swinging movement of the handles in one direction.

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