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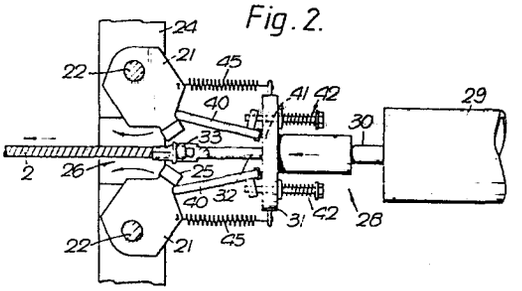
(54) **Improvements in or relating to swaging apparatus.**

(57) The specification describes apparatus by which a sleeve-like fitting 1 may be swaged on to a core 2. The apparatus includes six tools 21, each pivoted about an axis 22. By swinging the tools 21, their forming faces 25 pass through a region of minimum separation. The fitting 1 and core 2 move with the swinging of the tools 21 to be gripped between the forming faces in the region of a minimum separation and so swaged.

A plate 31, moved by a piston and cylinder 29 effects simultaneous movement of the fitting 1 and the tools 21. Springs 45 tend to restore the tools 21 after the swaging operation.

Fig. 2.



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"Improvements in or relating to Swaging Apparatus"

DESCRIPTION

This invention is concerned with apparatus by which a loose sleeve-like fitting may be swaged onto a core.

Swaging apparatus has been proposed which providesa plurality of forming dies surrouding the article to be formed and where the forming action results from impact of the dies on the article. The total energy required in moving the dies so that they hit the article with the force necessary to deform it is considerable and die wear in such a apparatus is high. Further, it may be difficult to adapt such apparatus for automatic feed of the articles where they are, for example, to be joined onto other articles, such as sleeve-like fittings being joined onto cores.

In an effort to reduce the forces acting on the dies, it has been proposed to taper the die surfaces that engage the article so that the die engages the article gradually. Even so, energy required to move the dies is considerable. An object of the invention is to provide a swaging apparatus by which swaging can be effected by the economical use of force.

According to the present invention there is provided swaging apparatus including a plurality of pivoted members which can swing simultaneously through a swaging station, in the swaging station the separation between the edges of the members remote from the axes is a minimum and when the separation is a minimum each such edge is touched by a circle of which the axis is transverse to the axes about which the pivoted members swing.

By way of example, an embodiment of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a partial sectional exploded view showing a sleeve-like fitting and a core prior to their being swaged together;

Figure 2 is a view partly in section and partly in side view with some parts removed, and shows the apparatus and the fitting prior to swaging;

Figure 3 is a view similar to that of Figure 1 showing the fitting and the apparatus after swaging;

Figure 4 is an enlarged cross-section of the fitting of Figure 1 swaged onto the core;

Figure 5 is an end view of the swaging apparatus seen from the left-hand side of the Figure 2;

Figure 6 is a view similar to that of Figure 2 illustrating a modification of the swaging apparatus shown in Figure 2; and

Figure 7 is a view similar to that of Figure 2 illustrating a further modification of the swaging apparatus shown in Figure 2.

Figure 1 shows a sleeve-like fitting 1 which is to be swaged onto a core 2.

The fitting may serve as the termination member of a conduit and the core is in the form of a flat wire metal conduit so that this conduit, together with a conduit to which the termination member may be connected,

constitutes, after swaging,a conduit assembly. The fitting has a hexagonal configuration and the swaging operation is such that each face 3 is swaged, or crimped, inwardly at point 4 so that the fitting is fixed tightly to the core 2.

The apparatus by which the swaging is effected comprises a plurality of swaging tools 21 in the form of blades, each mounted for rotation about a pin 22 carried in a roller block 23 which in turn is mounted on fixed frame member 24.

The swaging tools are arranged in a circle in three pairs,with the tools of each pair opposed to each other. Each tool 21 has a forming face 25 which in cross section and side view have the profiles that will produce the desired configurations of the fitting after swaging. In the embodiments shown in the drawings, the profile of the forming face forms, in the lengthwise direction of the fitting, an arc of a circle centred on the axis about which the tool swings and, transversely to this, as shown in Figure 5, the cross-section of the forming face forms part of a trapezoid.

The swaging tools together define a swaging station 26 having an entry side to the right of a plane containing the fixed axes of the pins 22 as shown in Figure 2 and an exit side to the left of the plane. The tools 21 may swing from the positions in which they are shown in Figure 2 to that in which they are shown in Figure 3. During that movement, they pass through the swaging station in which the separation between them is minimum and then the forming faces, or edges, 25

of each of the tools 21 touch a circle of which the arm is transverse to the axis about which the tools swing.

A pusher means 28 comprising a piston (not shown) slidable in hydraulic cylinder 29 and connected by rod 30 to a plate 31. Plate 31 has an extension 32 thereon, the end of the extension 32 forming a cavity member 33 that serves as a socket to receive an end of the fitting 1. Movement of the piston rod 30 in the direction of the straight arrows drives the cavity member 33 to the left to force the fitting through the swaging station and, as will now be described, simultaneously operates the swaging tools 21.

Between each swaging tool 21 and plate 31 there is a pusher finger 40 to comprise a positive drive connection between the plate 31 and the tool. Each finger 40 pivotally rests at its end 41 in the plate 31. As the plate 31 moves, the fingers 40 will move the tools through the zone in which swaging is effected, the pivoting of the fingers permitting them to tilt as appropriate during this movement.

A compression spring 42 is provided for each finger 41 to ensure that the end of the finger 41 remains in contact with the plate 31.

Each tool 21 is connected to the plate 30 by a return spring 45 and urges each tool towards the position in which it is shown in Figure 2 so that it will return to that position after a swaging operation.

In using the swaging apparatus that has been described, a conduit 2 having a fitting loosely embracing the end is moved to the right, as shown in the drawings through the swaging station 26 until the fitting 1 seats within cavity member 33. At this juncture the hydraulic cylinder 29 is pressuirized to move the plate 31 and the other components that are connected to it to the left, in the direction of the straight arrows. Such movement causes the fitting to move to the left and the movement of the fingers 40 rotates the tools 21 so that the forming faces 25 swing through the swaging station 26. The faces 25 initially contact the fitting 1 at the entry side of the swaging station, but continued movement of the fitting and swaging tools 21 results in a rolling action of the forming faces 25 on the fitting 1 with a result that the faces 3 of the fitting buckle in to swage, or crimp, the fitting 1 onto the core 2. Continued movement of the cylinder 19 pushes the fitting beyond the swaging station to the position shown in Figure 3 at which point the fitting is removed from the cavity member 33. The hydraulic cylinder, and the parts that move with it, return to their starting position and return springs 45 rotate the swage tools back to their starting position where the cycle may then be repeated.

In operation of the apparatus shown in Figures 2 and 3, there may be a tendency sometimes for the fitting to be pulled away from the cavity member 33

which can thus result in concentricity problems arising in the swaged fitting. The reason for this is the effective change in radius of the swaging tools 21 between the points on the fitting 1 at which the forming faces 25 initially make contact with the outer surfaces of the fitting and the points in the swaging station at which the forming faces 25 have most deeply impressed the faces 3 of the fitting of any pair are directly opposed to each other. The effective change in radius causes a difference in the peripheral speed in the longitudinal direction of the forming faces 25 and speed in the same direction at which the fitting is moved by the pushing means so that the fitting is pulled out of the cavity member 33.

In order to compensate for this difference in speed, a yieldable drive connection may be made either between the cavity member 33 and pusher means or between the pusher fingers 40 and the plate 31. Figure 6, where parts have similar to those occurring in the earlier Figures have the same identifying numerals, illustrates a modification of the apparatus by which a compression spring 60 is included in the cavity member 33 and in operation is abutted by the fitting 1. Any variation in the relative speed at the swaging station between the forming faces and the fitting 1 is taken up by the spring 60.

The modification illustrated by Figure 7 consists in the interposition between each of the pusher Fingers 40 and the plate 31 of a compression spring 65.

Where a spring is interposed either in the cavity member 33 or at an end of the pusher fingers 40, then part of the force exerted by the pusher means is absorbed by the spring.

A swage apparatus as described above swages the fitting by a rolling action rather than either by inclined sliding engagement of a tool on the fitting or by impact of a tool on the fitting with the result that total energy required for the swaging process is less. The apparatus that has been described may be easily adapted for automatic feeding of the parts to the apparatus and automatic operation of the apparatus.

While the swaging apparatus as described is used for swaging a loose sleeve-like fitting onto a core, the device also can be used for forming ends of rods, cable, strands, flexible shafts and other articles.

1. Swaging apparatus including a plurality of pivoted members which can swing simultaneously through a swaging station about fixed axes disposed around the swaging station, in the swaging station the separation between the edges of the members remote from the axes is a minimum and when the separation is a minimum each such edge is touched by a circle of which the axis is transverse to the axes about which the pivoted members swing.

2. Swaging apparatus as claimed in claim 1, in which the fixed axes all lie in a single plane and are all the same distance from the axis of the circle.

3. Swaging apparatus as claimed in either of the preceding claims in which each edge has a part, at least, that is arcuate so that the members can swing through an arc in which a constant minimum separation is maintained.

4. Swaging apparatus as claimed in any of the preceding claims and provided with means by which an annular member that is to be swaged on to a core may be pushed through swaging station in the direction of the axis of the circle.

5. Swaging apparatus as claimed in claim 4 and provided with means to swing the pivoted members through the swaging station simultaneously with movement of the annular member through the swaging station.

6. Swaging apparatus as claimed in claim 5, in which the means to push the annular member and swing the pivoted members includes a plate perpendicular to the axis of the circle and having a forwardly projecting arm on which the member may be carried to be pushed and a plurality of arms each extending between the plate and one of the pivoted members.

7. Swaging apparatus as claimed in any of claims 4 to 6 in which the means by which the annular member may be pushed includes a hollow cup in which the annular member is received with a loose fit.

8. Swaging apparatus claimed in claim 7 in which the cup includes a compression spring to permit a degree of movement of the cup, relatively to the annular member, towards the swaging station.

9. Swaging apparatus as claimed in claim 6 or either of claims 7 and 8 when appendent to claim6 in which a compression spring is provided at an end of each arm that extends between the plate and a povited member to permit a degree of movement of the plate relatively to the pivoted member towards the swaging station.

10. Swaging apparatus as claimed in any of the preceding claims in which each pivoted member is resiliently biassed towards a position from which it moves in effecting the swaging operation.

11. A method of swaging an annular member on to a core in which the core with the annular member encircling it is moved through a swaging station in which pivoted members, that swing about fixed axes, rock in such contact with the annular member as it passes through the swaging station as to effect swaging.

Fig. 1.

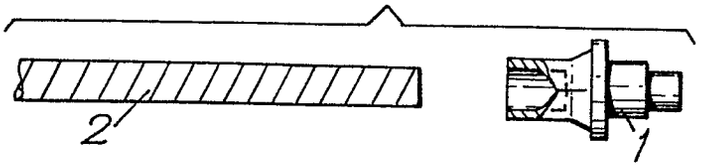

Fig. 2.

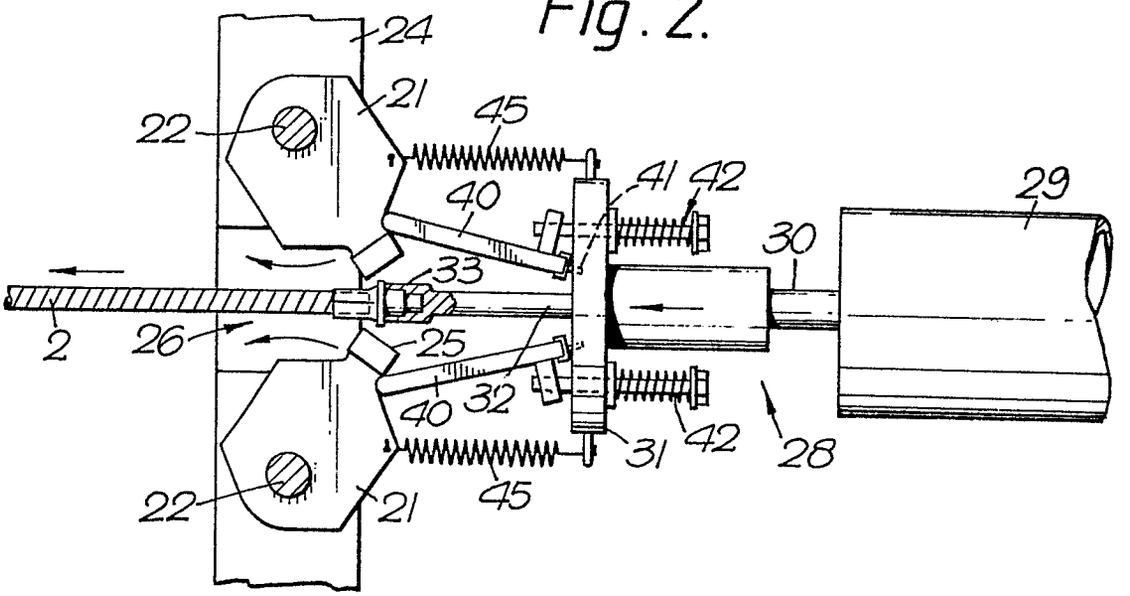

Fig. 3.

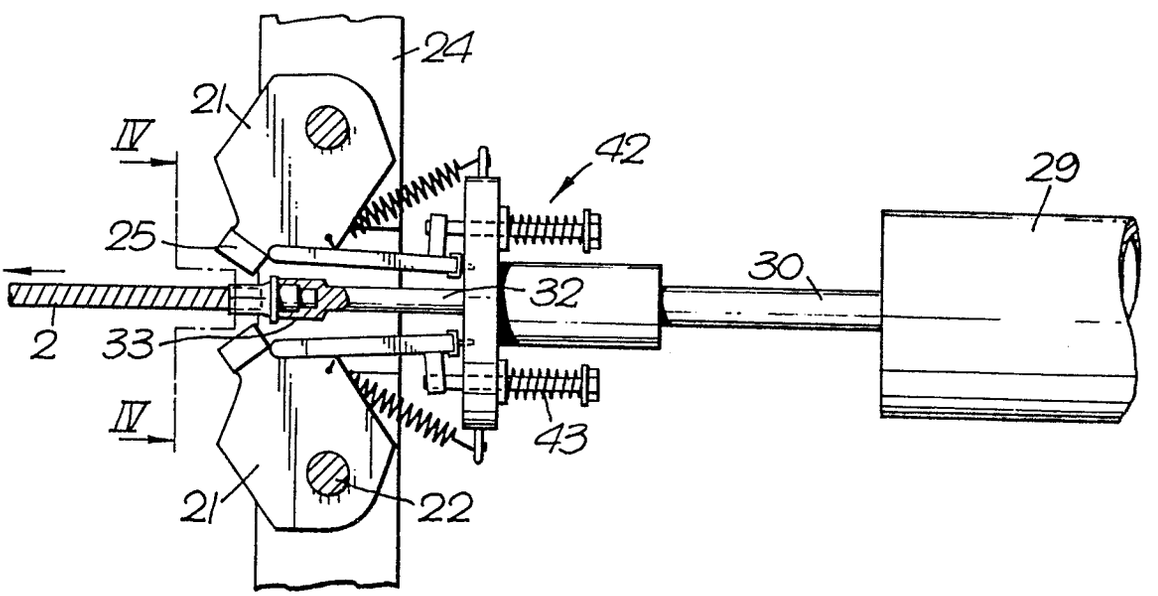

Fig. 4.

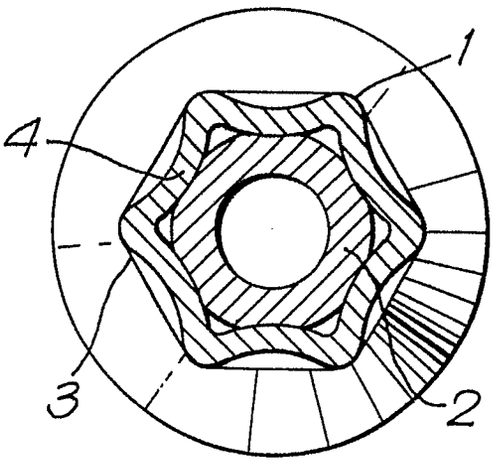

Fig. 5.

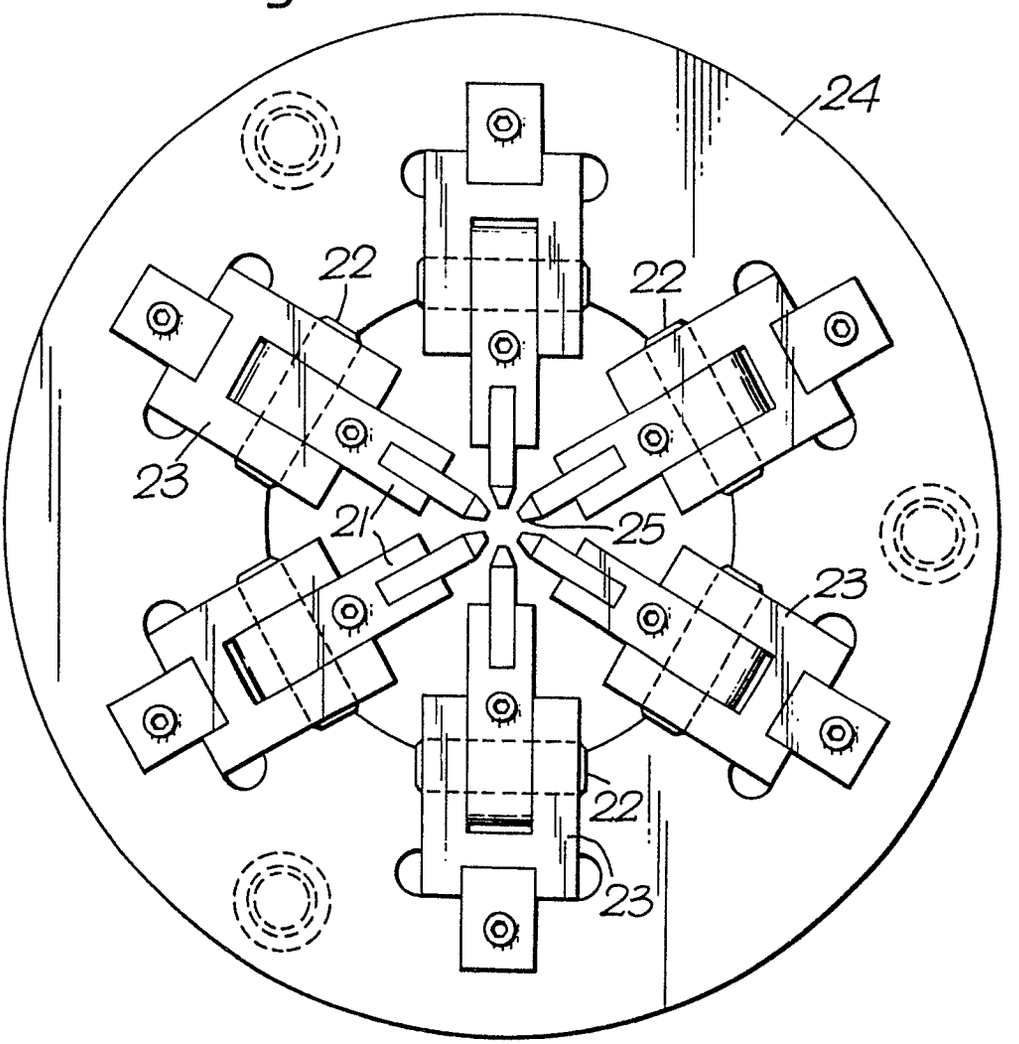

Fig. 6.

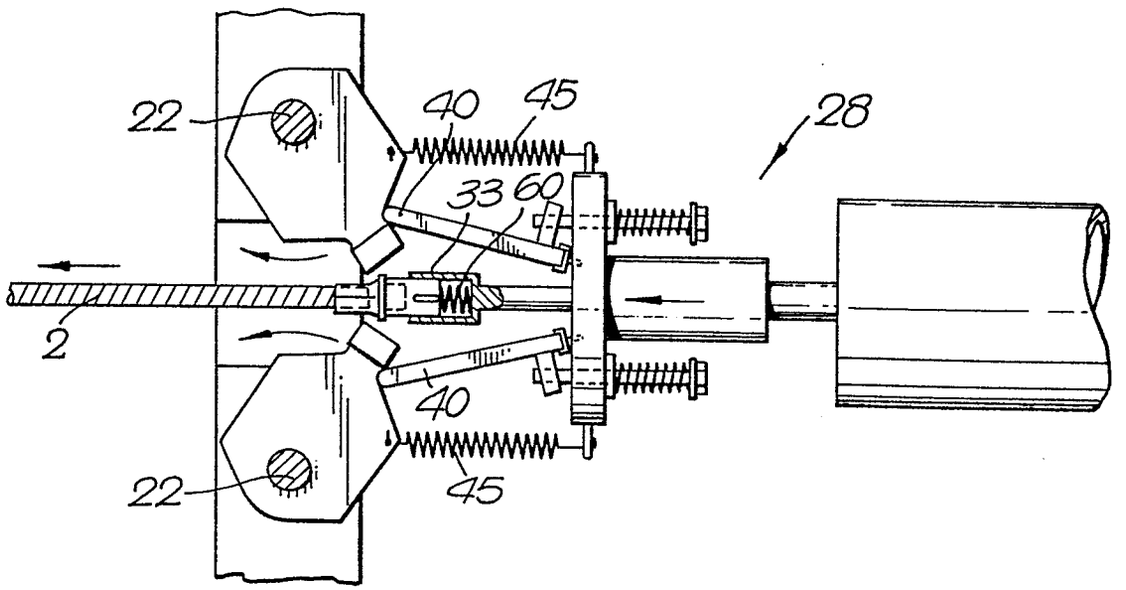

Fig. 7.