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Olive-Jones et al.

[11] **3,768,298**

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[54] **SWAGING APPARATUS**

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[73] Assignee: **BTR Industries Limited,** London, England

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[30] **Foreign Application Priority Data**

Nov. 19, 1970 Great Britain 55,117/70

[52] **U.S. Cl.** **72/402,** 72/465, 72/468, 29/237

[51] **Int. Cl.** **B21d 39/00**

[58] **Field of Search** 72/402, 468, 415, 72/465; 29/237, 282, 517

[56] **References Cited**

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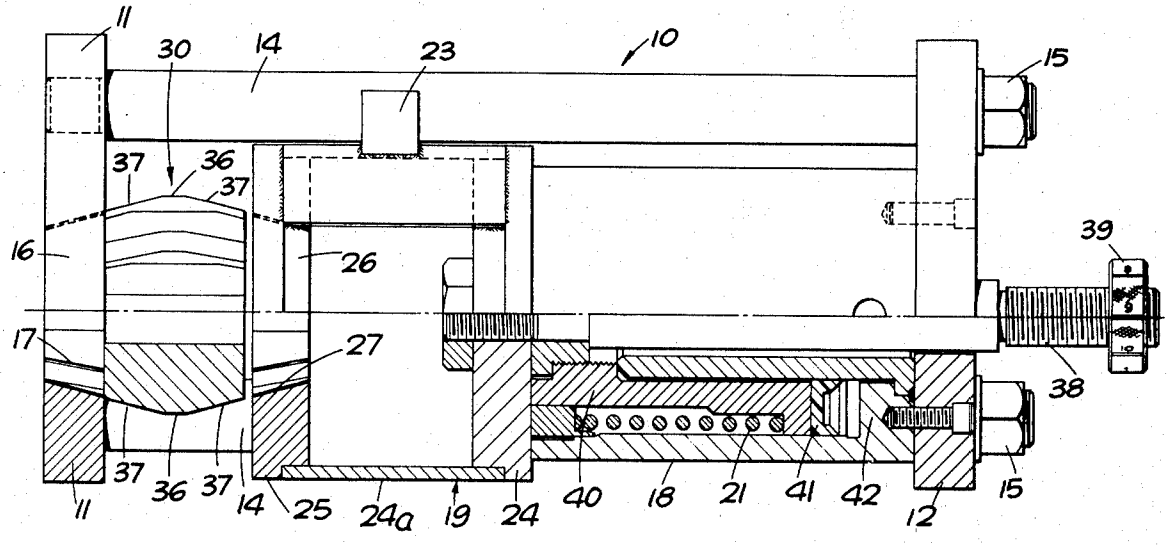
[57] **ABSTRACT**

Swaging apparatus which includes a swaging member having a plurality of radially disposed swaging fingers with resilient means located between adajacent fingers, and compresssion means to force the fingers radially inwardly so that the inner ends of the fingers may swage a workpiece located therebetween. The resilient means may comprise elastomeric blocks each bonded between adjacent fingers. The outer surface of each finger may have two portions tapered in opposite senses, and the swaging member may be located between two plates each having an aperture tapered in the same sense as the respective adjacent tapered portion, so that the fingers are compressed radially inwardly as the plates are moved towards one another.

4 Claims, 7 Drawing Figures



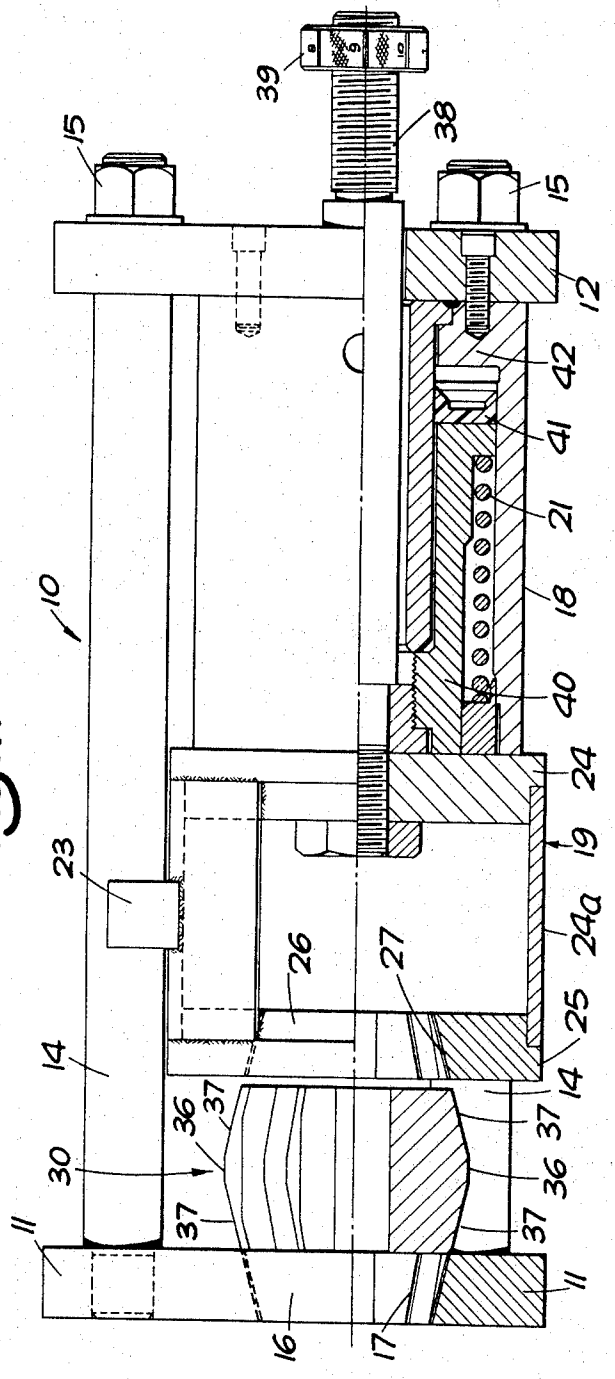

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Fig. 1.

Fig. 2.

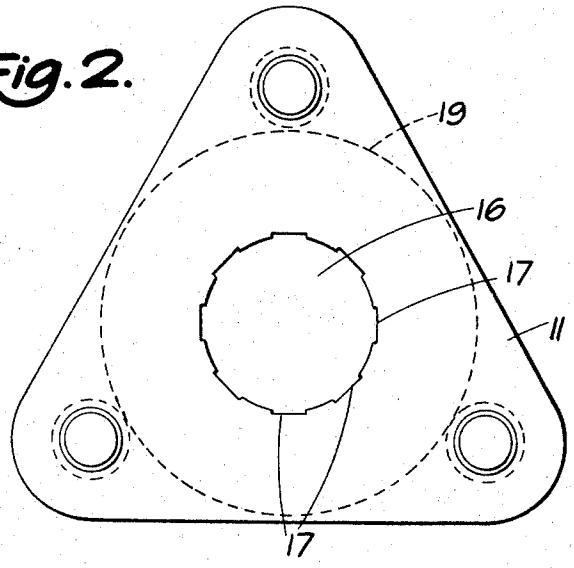


Fig. 3.

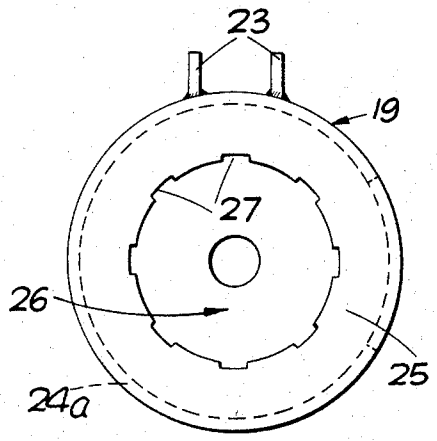


Fig. 4.

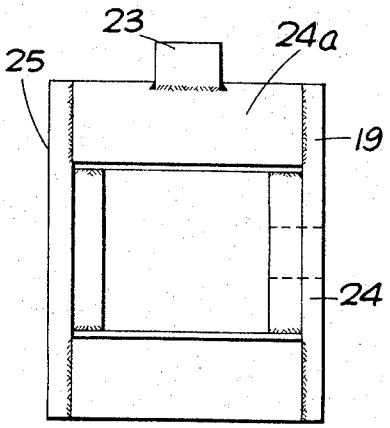


Fig.5.

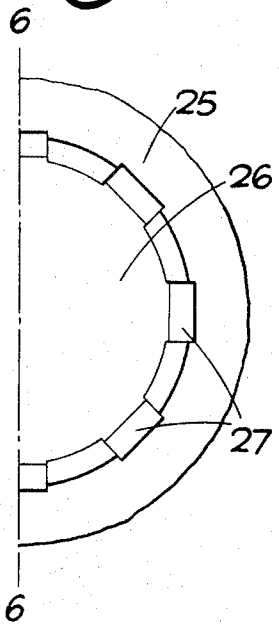


Fig.6.

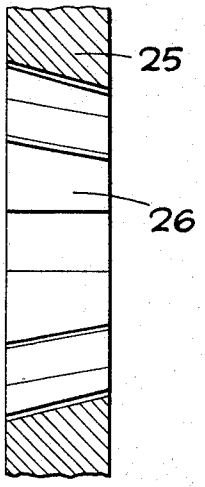
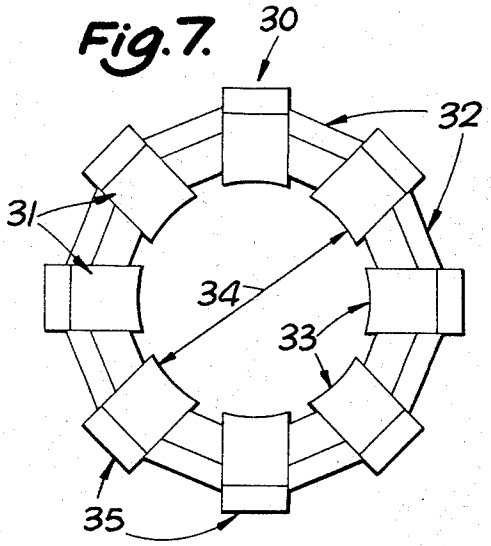


Fig.7.



SWAGING APPARATUS

The invention relates to swaging apparatus and provides swaging apparatus including a swaging member comprising a plurality of radially disposed swaging fingers the inner ends of which define a space for receiving a workpiece to be swaged and resilient means arranged between adjacent swaging fingers to urge the fingers radially outwardly which apparatus further includes compression means to force the fingers radially inwardly against the action of the resilient means, so that the inner ends of the fingers may effect swaging of the workpiece within said space.

The resilient means may comprise a plurality of blocks of elastomeric material each being bonded between adjacent swaging fingers.

Each swaging finger may have an outer surface portion which lies on a generally conical surface coaxial with the swaging member, and the compression means may comprise a structure surrounding said outer surface portions, the structure and surface portions being capable of relative axial movement whereby engagement of the structure with said surface portions during said movement forces the swaging fingers radially inwards.

In the last described arrangement, the compression structure may have a generally conical aperture formed therein and shaped so that the smaller diameter part of the surface portions may enter the larger diameter part of the aperture, there being means to cause relative axial movement between the swaging member and the compression structure to force the swaging member into the aperture thereby moving the fingers radially inwardly.

The assembly comprising said outer surface portions and said compression structure may be duplicated at axially spaced locations on the swaging member, the said conical surfaces of the two assemblies tapering in opposite directions whereby the two compression structures move in opposite axial directions to force the swaging fingers radially inwardly.

In the last described arrangement the two conical surfaces may taper away from one another so that the swaging fingers are forced radially inwardly by axial movement of the compression structures towards one another.

In any of the above arrangements in which duplicate assemblies are provided the swaging member may be located and supported wholly by the two compression structures.

The following is a description of one specific embodiment of the swaging apparatus constructed in accordance with the invention and given by way of example, reference being made to the accompanying drawings, in which:

FIG. 1 is a part sectional, part elevation view of the swaging apparatus;

FIG. 2 is an end view of the apparatus of FIG. 1 with the swaging member removed for clarity;

FIG. 3 is an end view on a reduced scale of the ram head of the apparatus of FIG. 1;

FIG. 4 is an elevation of the ram head of FIG. 3;

FIG. 5 is an enlarged view of part of FIG. 3;

FIG. 6 is a section view on line 6—6 of FIG. 5; and

FIG. 7 is an end view on the swaging member.

The swaging apparatus shown in the drawing comprises a main frame **10** having two generally triangular

end plates **11** and **12** held in spaced apart relationship by means of three shouldered rods **14**. Screw threads are provided on both ends of each rod **14**, one end screwing directly into the left hand (in FIG. 1) end plate **11**, the right hand end of rod (**14**) passing through the right hand end plate **12**. Nuts **15** are threaded on the right hand end of each rod **14** to hold the right hand end plate against the shoulders on the rods. The left hand end plate **11** (FIG. 1) has an aperture **16** formed therein, the aperture being generally conical in shape and tapering outwardly towards the other end plate **12**. The wall of the aperture has eight equi-spaced grooves **17** formed therein, for a purpose to be described below.

An annular hydraulic ram **18** is attached to the right hand end plate **12** and extends within the frame **10** towards the left hand end plate **11**. The piston **40** of the ram is attached to a ram head **19** by means of a rod **38** which is threaded both ends, the left hand end (FIG. 1) of which attaches the ram head **19** to the piston **40**, and the right hand end incorporates a length stop **39**. The ram head **19** is urged to the left by means of hydraulic pressure introduced into he ram between an annular 'U' seal **41** on the piston **40** and the stationary end **42** of the ram **18**.

The ram head **19** is located within the frame **10** by the three rods **14**, there being sufficient clearance between the rods **14** and head **19** to permit relative sliding movement. The head **19** is held against rotation by means of two lugs **23** welded to the head and fitting with clearance one each side of the uppermost rod **14**.

The ram head **19** comprises a first circular plate **24** into which the rod **38** is threaded, welded to a part tubular member **24***a*. A second circular plate **25** is welded to the open end of the member **24**, and is provided with a generally conical aperture **26** therein, coaxial with the aperture **16**. The aperture **26** tapers outwardly towards the left hand end plate **11**, and its wall has eight equi-spaced grooves **27** formed therein so that the apertures **16** and **26** are opposed and similar.

A swaging member **30** is held between the plates **11** and **25** and is shown in greater detail in FIG. **7**. The swaging member **30** comprises eight radially extending swaging fingers **31** each bonded to and held spaced from the next adjacent swaging finger by rubber blocks **32**. The inwardly directed faces **33** of the fingers are shaped such that they form a cylindrical bore **34** in the member, the inner end of each finger being spaced from the next adjacent finger. The radially outwardly directed face **35** of each finger **31** is provided with a central portion **36** (FIG. 1) parallel to its inwardly directed face **33**, and with end portions **37** tapering inwardly to the axis of the bore **34** at an angle substantially equal to the angle of the walls of the apertures **16** and **26** in the plates **11** and **25**. The outwardly directed face **35** of each finger stands proud of the rubber blocks to which the finger is bonded.

The outer diameter of the ends of the swaging member are such that the ends of the member will just enter the apertures **16** and **26** with the outwardly directed faces **35** fitting within the grooves **17** and **27**.

In use, the swaging member **30** is located as just described and an article to be swaged inserted within the bore **34**. The hydraulic ram is pressurised by means (not shown) to move the ram head **19** to the left (FIG. 1) so that the separation between the plates **11** and **25** is decreased. The outwardly directed faces **35** of the fingers **31** are slid along the grooves **17** and **27** pro-

vided in the walls of the apertures **16** and **26**, whereby the fingers are moved radially inwardly, thus reducing the diameter of the bore **34** and swaging the article located therein. The ram head **19** is then withdrawn to the right and the rubber blocks **32** urge the fingers **31** outwardly to release the swaged article. The ram head **19** is stopped when the swaging member is just located in the aperture in the plates **11** and **25**.

It will be appreciated that the swaging member **30** may be removed easily from the machine by fully withdrawing the head **19**, as shown in FIG. **1**, and replaced by a further member. The further member may have a bore of a different diameter, to accept articles to be swaged of a different size. The rubber blocks **32** may be replaced by blocks of a thermoplastic material.

A modified swaging member, (not shown), comprises eight swaging fingers held in a spaced apart relationship by means of spring elements arranged to permit movement of the fingers radially and to urge them outwardly. The spring elements may comprise, for example, a plurality of spring blades, each blade having one end attached to a finger and the other end to the next adjacent finger.

The end stop **39** serves to limit the movement of the ram head **19** to the left (in FIG. **1**) whereby the degree of swaging of an article in the bore **34** may be adjusted and also repeated for a succession of articles.

We claim:

1. Swaging apparatus comprising a frame, compression means comprising two plates each having a conical aperture formed therein, the plates being mounted on the frame with the apertures co-axial and tapering outwardly towards one another and mounted for relative axial sliding movement, a swaging member comprising a plurality of radially disposed swaging fingers the inner ends of which define a space for receiving a workpiece to be swaged and a plurality of blocks of elastomeric material each block being bonded between adjacent swaging fingers to urge the fingers radially outwardly, the swaging member being located between the apertures in the two plates and the other surface of each swaging finger having two tapered portions adjacent the two apertures respectively, the tapered portions being tapered in the same sense as the respective adjacent aperture, and means to effect relative sliding movement of the two plates whereby as the plates are moved towards one another the swaging fingers are forced radially inwardly against the action of the elastomeric material so that the inner ends of the swaging fingers may effect swaging of the workpiece within said space.

2. Swaging apparatus comprising a support structure, a frusto-conical aperture formed in said structure, a single swaging member comprising a plurality of radially disposed swaging fingers the inner ends of which define a space for receiving a workpiece to be swaged, a plurality of blocks of resilient material equal in number to said plurality of swaging fingers, one of said blocks being situated between and bonded to each pair of adjacent fingers to interconnect the fingers and to urge the fingers radially outwardly, one end of the member being engageable in said aperture in the support structure and the outer surface of each swaging finger having a tapered portion complementary to the frusto-conical surface of said aperture, and means to move the structure and the swaging member when engaged in said aperture relative to one another along the axis of said aperture, whereby the swaging fingers are forced radially inwardly against the action of the resilient elements so that the inner ends of the swaging fingers may effect swaging of a workpiece within said space.

3. Swaging apparatus as claimed in claim **2** wherein said means to move the structure and the member relative to one another comprise a second support structure having a frusto-conical aperture coaxial with said aperture in the first support structure, said apertures being tapered away from one another and the outer surfaces of the swaging fingers each having a further tapered portion complementary to the frusto-conical surface of the aperture in said second structure, means being provided to cause relative movement of the structures towards one another along the aligned axes of said apertures to force the swaging fingers radially inwardly.

4. Swaging apparatus as claimed in claim **2** in which the swaging fingers of the swaging element engage in grooves provided at circumferentially spaced locations in said aperture.

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