

(51) International Patent Classification 5 : B21D 51/40	A1	(11) International Publication Number: WO 91/01188 (43) International Publication Date: 7 February 1991 (07.02.91)
(21) International Application Number: PCT/GB90/01123 (22) International Filing Date: 20 July 1990 (20.07.90) (30) Priority data: 8916630.0 20 July 1989 (20.07.89) GB 8921901.8 28 September 1989 (28.09.89) GB (71) Applicant (for all designated States except US): EAGLE PRECISION TECHNOLOGIES LIMITED [GB/GB]; Beaufort Road, Birkenhead, Merseyside L41 1HE (GB). (72) Inventor; and (75) Inventor/Applicant (for US only) : SCRIMSHAW, Sydney, Ivan [GB/GB]; Eagle Precision Technologies Limited, Beaufort Road, Birkenhead, Merseyside L41 1HE (GB).	(74) Agent: MOCK, Hans; Marks & Clerk, Suite 301, Sunlight House, Quay Street, Manchester M3 3JY (GB). (81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CM (OAPI patent), DE*, DE (European patent)*, DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, RO, SD, SE, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US. Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	
(54) Title: IMPROVEMENTS IN OR RELATING TO METAL DEFORMATION		
(57) Abstract A method of forming a cylindrical opening in a metal sheet, for example the end wall of a container drum, involves piercing, pressing and drawing the metal sheet to provide a raised cylindrical section partly closed at one end by an annular flange. The annular flange is then bent into the cylindrical section while rolling the flange so as to permit its enlargement as necessary. The flange is provided with an internal screw thread by rolling a peripherally screw-threaded cylindrical roller of diameter less than the flange continuously over the flange surface in orbital relationship with the flange cylinder axis until the surface is deformed into a complementary screw configuration. The thread forming method may be used for any internal cylindrical surface.		

DESIGNATIONS OF "DE"

Until further notice, any designation of "DE" in any international application whose international filing date is prior to October 3, 1990, shall have effect in the territory of the Federal Republic of Germany with the exception of the territory of the former German Democratic Republic.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MC	Monaco
AU	Australia	FI	Finland	MG	Madagascar
BB	Barbados	FR	France	ML	Mali
BE	Belgium	GA	Gabon	MR	Mauritania
BF	Burkina Fasso	GB	United Kingdom	MW	Malawi
BG	Bulgaria	GR	Greece	NL	Netherlands
BJ	Benin	HU	Hungary	NO	Norway
BR	Brazil	IT	Italy	PL	Poland
CA	Canada	JP	Japan	RO	Romania
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	LI	Liechtenstein	SN	Senegal
CM	Cameroon	LK	Sri Lanka	SU	Soviet Union
DE	Germany	LU	Luxembourg	TD	Chad
DK	Denmark			TG	Togo
				US	United States of America

IMPROVEMENTS IN OR RELATING TO METAL DEFORMATION

This invention relates to metal deformation and particularly but not exclusively to a method of forming a cylindrical, internally threaded opening in an end wall of a metal, preferably mild steel, container drum.

It is known to provide cylindrical openings in the end walls of container drums by fitting a pre-fabricated insert into the end wall. This is disadvantageous because of the additional costs involved in pre-fabricating and fitting the insert. It is therefore one object of the present invention to provide a method of forming an integral cylindrical opening in the container drum end wall and forming an internal screw-thread on said opening. More generally, it is an object of the present invention to provide a method of forming a screw thread on any internal cylindrical surface.

According to a first aspect of the present invention there is provided a method of forming a cylindrical opening in a metal sheet, for example a container drum end wall, comprising piercing, pressing and drawing the metal sheet to provide a raised cylindrical section partly closed at one end by an annular flange, and bending the flange into the cylindrical section while rolling the flange so as to permit the requisite enlargement thereof.

According to a second aspect of the present invention there is provided a method of forming a screw thread on an internal cylindrical surface, for example a cylindrical opening as produced by the method of the first aspect of the invention, comprising rolling a peripherally screw-threaded roller continuously over said surface in orbital relationship with the cylinder axis until the surface is deformed into a complementary screw configuration.

The invention will now be further described by way of example only with reference to the accompanying drawings in which:-

Fig. 1 is a partly cut-away view of one end of a container drum with the end wall in section through the

closure opening;

Fig. 2 is a detail of Fig. 1 to an enlarged scale, and Figs. 3 to 6 illustrate successive stages in the manufacture of the closure opening shown in Fig. 2.

Referring now to the drawings, Fig. 1 shows part of a cylindrical container drum made of mild steel having an end wall provided with a closure opening further illustrated in Fig. 2 as comprising a raised cylindrical section 1 of double thickness with a screw thread 2 on the cylindrical inner surface of the inner metal skin. The outer end of the cylindrical section 1 is thickened to provide a sealing surface 3 which is engaged by a sealing ring 4 of a conventional externally threaded bung 5 having an internal handle 6.

The closure opening illustrated in Fig. 2 is made by first piercing, pressing and drawing the metal sheet constituted by the drum end wall (prior to fixing to the drum end in conventional manner) to form a cylindrical section 7 raised out of the plane of the end wall by a step 8 and terminating at its outer end in an annular flange 9 which partly closes the cylindrical section leaving a circular opening 10 around a central axis 11 (Fig. 3).

The raised cylindrical section 7 is then surrounded by clamping supports 12 and a tool 13 is progressively introduced into the opening 10 so as to bend the flange 9 inwardly. Such deformation of the flange 9 requires a corresponding enlargement of the opening 10 which cannot be achieved without extension of the flange 9 along its circumferential dimension. Such extension is achieved by orbiting the tool 13 about the axis 11 while simultaneously rolling the frusto-conical tool surface on the flange 9 to achieve the necessary thinning of the metal in this region. When the flange 9 has been bent inwardly to an extent conforming to the shape of the tool 13, the tool 13 is replaced by a tool 14 which has a cylindrical working surface which, using the same rolling action as the tool 13, completes the inward deformation of the flange 9 and the attendant enlargement of the hole 10. The tool 14 also

creates the shoulder 3 by pressing metal into a circular recess 15 in the clamping segments 12.

The cylindrical section 1 is then completed by using a thread forming tool 16 which has an orbiting and rolling action like tool 14 but in this case is provided with a thread formation on its outer cylindrical periphery, the action of the tool 16 serving to impress said thread formation onto the internal surface of the cylindrical section.

When internal thread forming, it is necessary to adjust for pitch error originating from the difference in peripheral length between the outer tube diameter being formed and the thread rolling tool diameter.

This difference, when the tool rolls on the component without slipping, causes a relative angular positional displacement of the two thread forms (forming and generated).

Compensation for this difference may be accomplished by axial displacement of the tool amounting to the pitch of the thread times the ratio of the two diameters.

As the depth of thread form increases during the rolling process this ratio varies with the instantaneous root diameter of the generated thread form.

The axial displacement of the forming tool may be achieved by allowing the tool to float freely or by providing an incremental movement of the tool spindle relative to tool rotation.

Alternatively, the accumulative effects may be avoided by alternating the direction of rotation of the forming tool after each full revolution of the tool spindle.

It will be appreciated that the invention has wider application than suggested by the above description. For example, a similar threaded closure may be formed with a single thickness of metal in which case the preliminary piercing, pressing and drawing operation omits the flange 9 rendering the bending stages using tools 13 and 14 unnecessary, the thread forming tool 16 being used for forming the thread in the cylindrical section 7. The invention is not confined to the formation of cylindrical closure openings for

end walls of container drums and the threading operation, for example, has wide application in relation to other cylindrical articles, e.g. conduit sections, which require an internally threaded end section.

CLAIMS

1. A method of forming a cylindrical opening in a metal sheet, comprising piercing, pressing and drawing the metal sheet to provide a raised cylindrical section partly closed at one end by an annular flange, and bending the flange into the cylindrical section while rolling the flange so as to permit the requisite enlargement thereof.

2. A method as claimed in claim 1, wherein the metal sheet is a container drum end wall.

3. A method as claimed in claim 1 or 2, wherein the raised cylindrical section is externally supported during the bending and rolling operation.

4. A method as claimed in any one of the preceding claims, wherein the outer end of the cylindrical section is deformed radially outwardly during the bending and rolling operation so as to provide a sealing surface for engagement by a sealing ring of a bung.

5. A method as claimed in any one of the preceding claims, wherein the inwardly bent flange is provided with an internal screw thread by rolling a peripherally screw-threaded cylindrical roller of diameter less than the flange continuously over the flange surface in orbital relationship with the flange cylinder axis until the surface is deformed into a complementary screw configuration.

6. A method as claimed in claim 5, wherein the screw threaded roller is moved or permitted to move axially so as to compensate for the difference in pitch between the forming and the generated threads.

7. A method of forming a screw thread on an internal cylindrical surface, comprising rolling a peripherally screw-threaded cylindrical roller of diameter less than said surface continuously over said surface in orbital relationship with the cylinder axis until the surface is deformed into a complementary screw configuration.

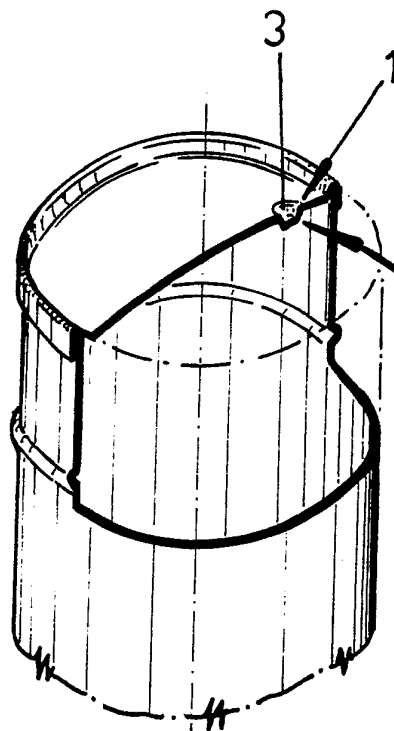


FIG. 1

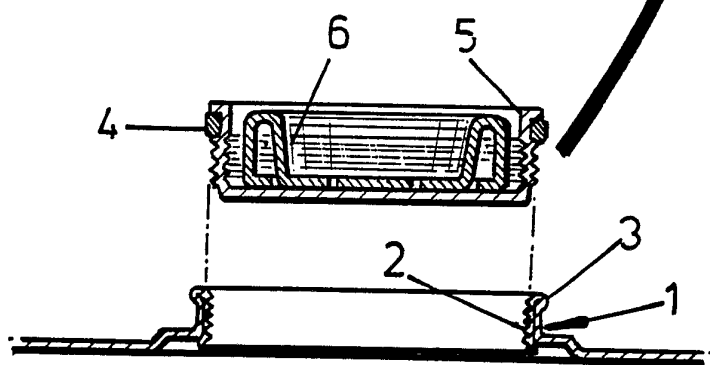


FIG. 2

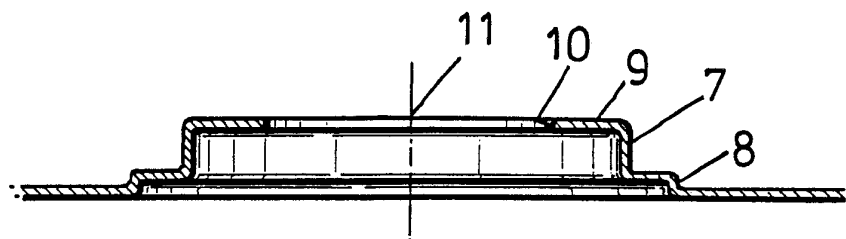


FIG. 3

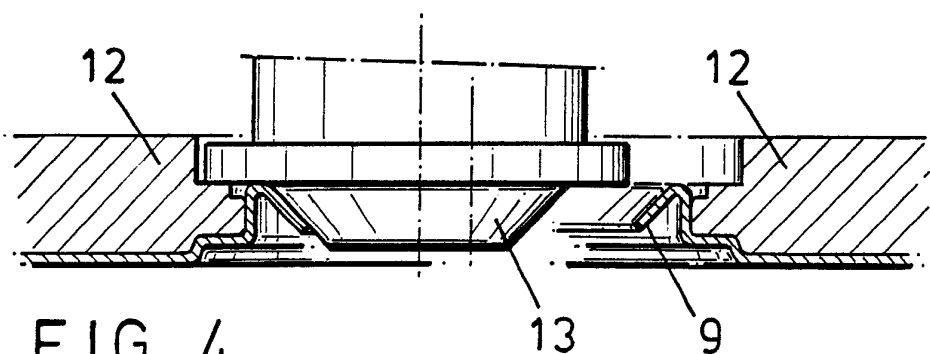


FIG. 4

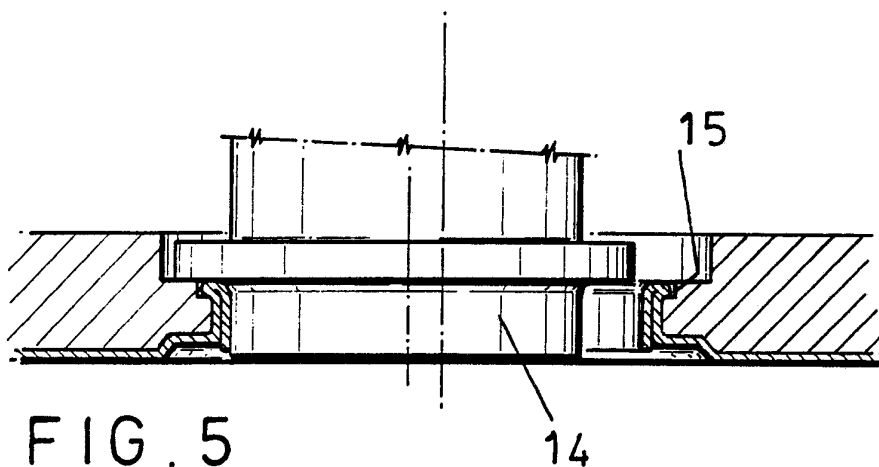


FIG. 5

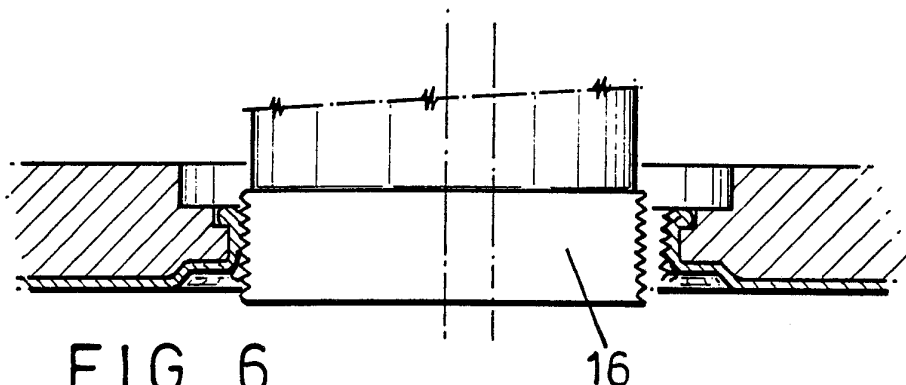


FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/01123

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC ⁵ : B 21 D 51/40		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC ⁵	B 21 D	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *		
III. DOCUMENTS CONSIDERED TO BE RELEVANT *		
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	US, A, 2493933 (THOMPSON) 10 January 1950 see column 2, line 37 - column 6, line 45; figures 9-14 --	1-6
Y	FR, A, 2490119 (KRAMATORSKY INDUSTRIALNY INSTITUT) 19 March 1982 see page 10, lines 13-33; figures 4-8 --	1-6
A	US, A, 2460721 (THOMPSON) 1 February 1949 see column 1, line 43 - column 2, line 36; figures -----	1
* Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
12th October 1990	15. 01. 91	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	miss T. MORTENSEN 	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ²

This International Searching Authority found multiple inventions in this international application as follows:

1. Claims 1-6: A method of forming a cylindrical opening in a metal sheet by piercing pressing drawing, bending and rolling.
 2. Claim 7: A method of forming a screw thread on an internal cylindrical surface by rolling.
1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
 2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

1-6

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

GB 9001123

SA 38899

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 09/01/91
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 2493933		None	
FR-A- 2490119	19-03-82	None	
US-A- 2460721		None	