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(54) **Flow drilling tools**

(57) A flow drilling tool comprising a part 1 to pierce a metal wall, a part 1*d* of increasing rounded polygonal section for opening a hole and forming a bush, a part 1*b* which generates a shape corresponding to the final shape of the lower part of the bush, a cylindrical part 1*a* of smaller diameter forming a shank, a sliding ring member 2 on the shank, and a tool holder collet 3 for gripping the shank with a face on the collet to engage the ring member.

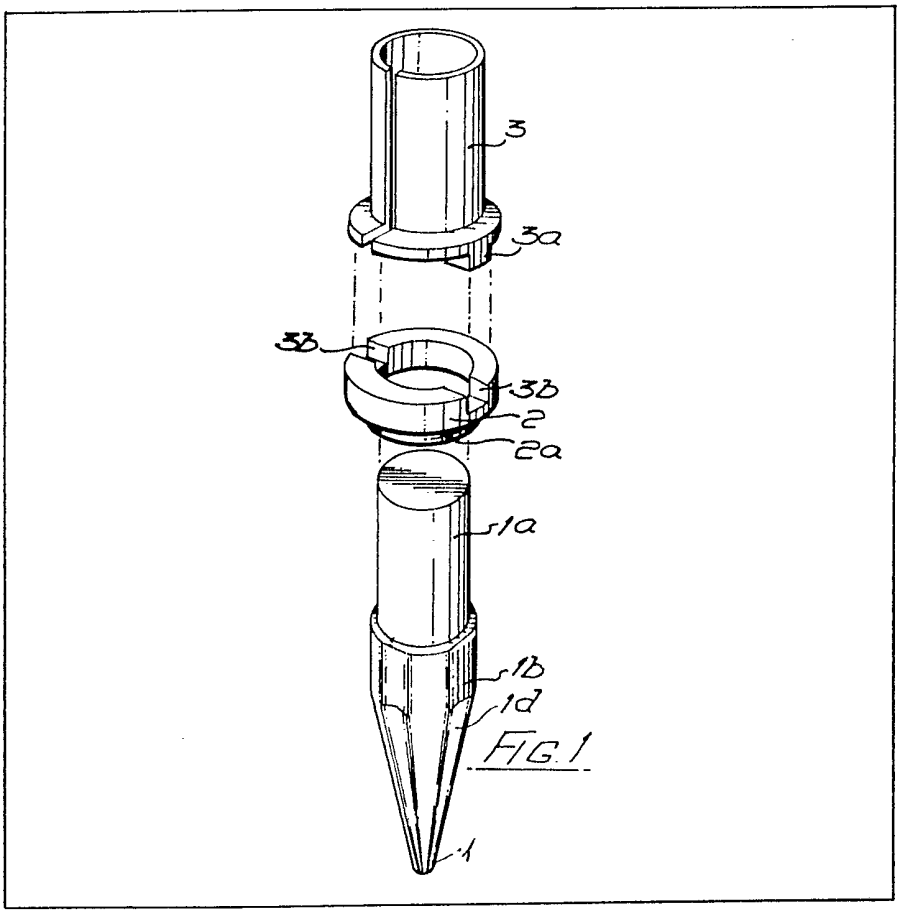

FIG. 1

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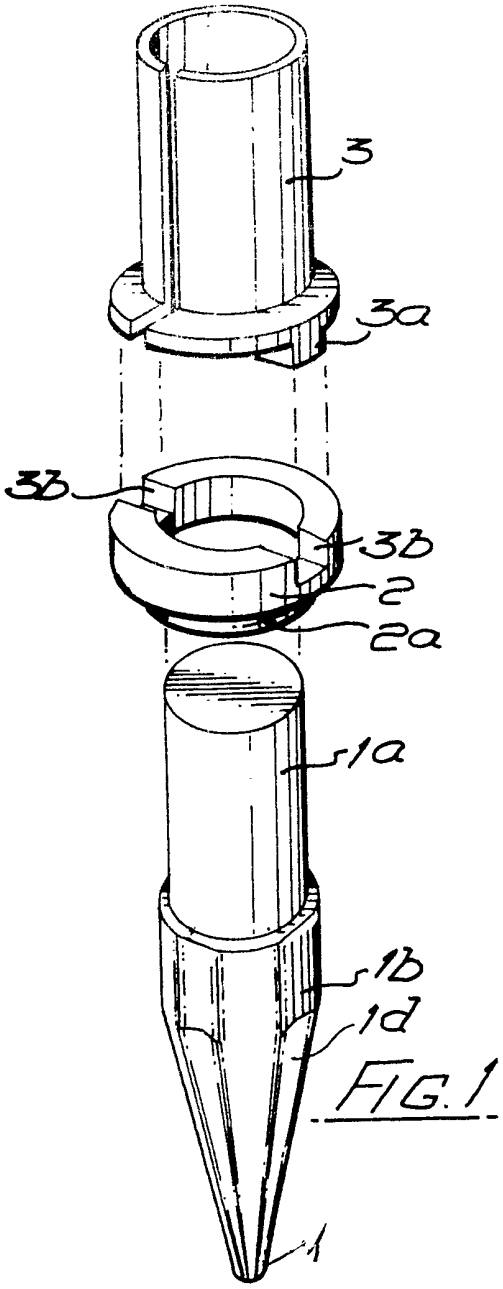

FIG.1

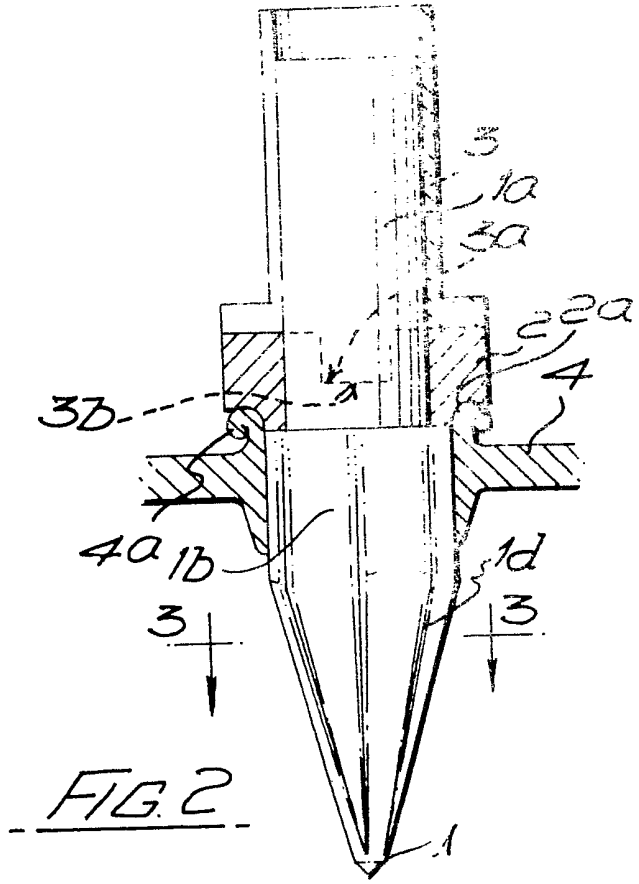

FIG.2

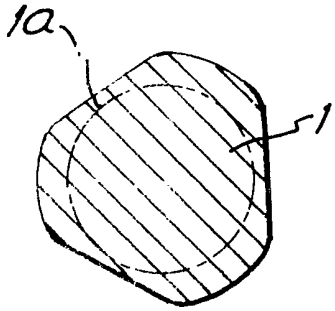

FIG.3

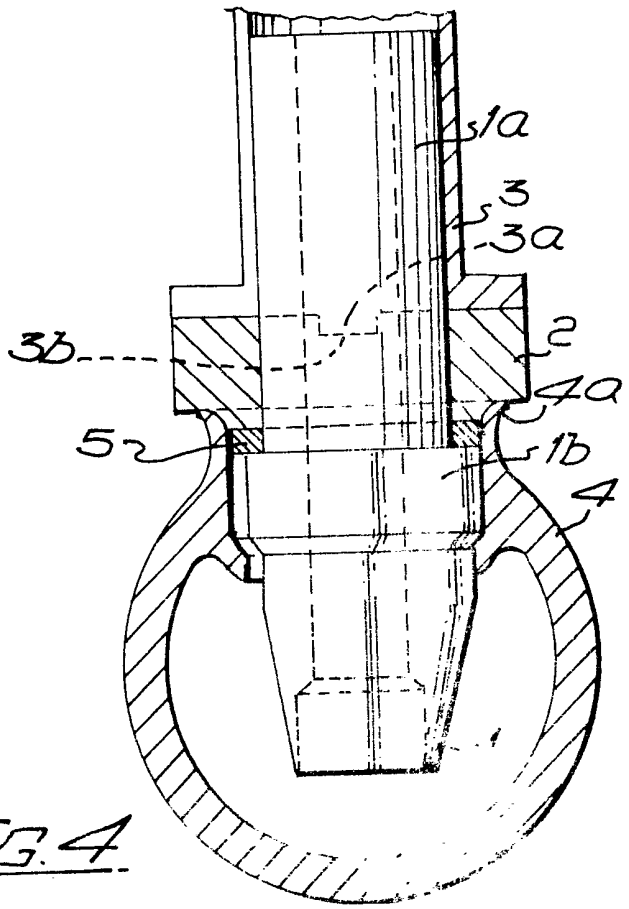

FIG.4

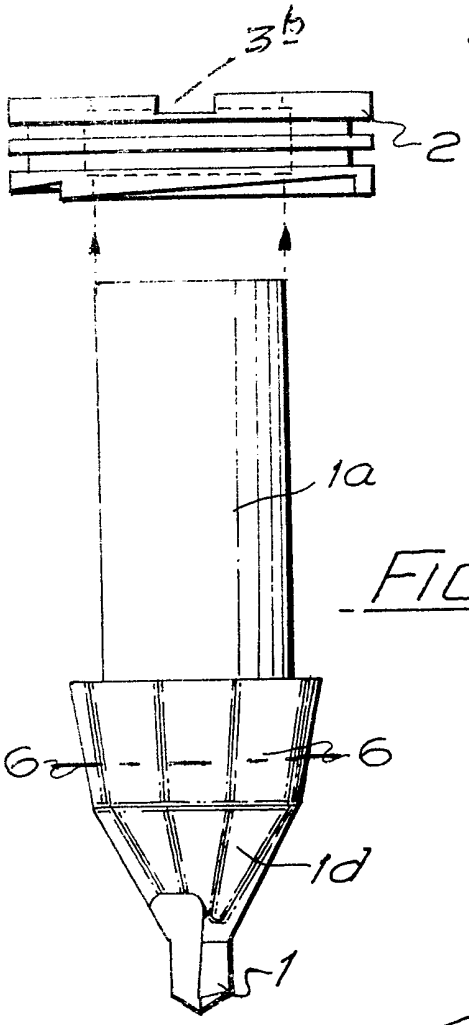

FIG 5

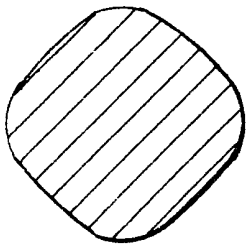

FIG 6

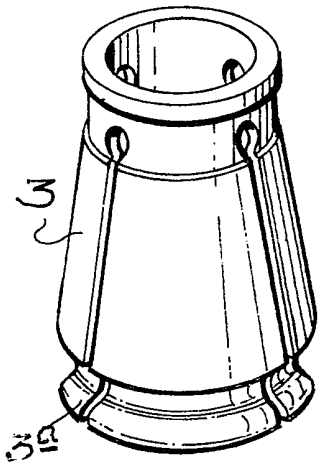

FIG. 8

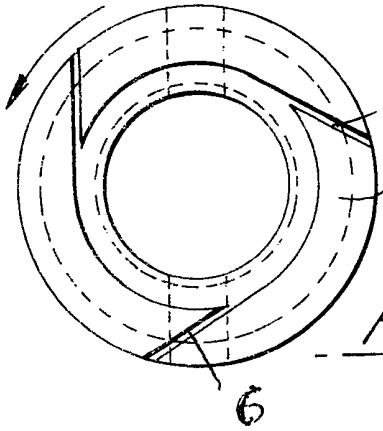

FIG. 7

SPECIFICATION

Improvements in rotary piercing tools

The invention relates to improvements in rotary piercing tools for forming a hole in a metal plate or the wall of a metal tube by friction generated heat known as flowdrilling.

Flowdrilling is the process of forming a bushed or sleeved round hole in a thin metal sheet or the wall of a tube consisting in passing a rapidly rotating spinning drill tool under pressure through the wall for simultaneously frictionally generating heat in the metal adjacent to the tool, thus causing the metal to become plastic and displacing it in both directions along the flowdrill.

It has been proposed in U.S. Specification 1906953 (Enghauser) dated May 2nd 1933, to form a sleeve opening in a thin walled malleable iron pipe by passing a rapidly rotating spinning tool through the wall thereof for simultaneously frictionally generating red heat in the metal of the pipe adjacent the tool, thereby causing the metal to become plastic, and displacing the metal in both directions along the tool.

A tool for flowdrilling improved bushed holes in metal walls used for joining cylindrical bodies thereto by known methods such as soldering, threading or press fitting has been proposed in the French Specification No. 1189384 (Leroy) dated March 23rd 1959, having a small rounded piercing end, a part of progressively increasing polygonal cross section with rounded corners for the formation of the bush, and a part of constant polygonal cross section for calibrating its internal size.

Flowdrills are known which have, instead of the part with constant substantially polygonal cross section a part with a gradually increasing cross section or a step in the size of the cross section somewhere along the length of the part to form a bush of internal taper or with an internal step.

A flowdrilling tool has also been proposed in Specification No. 1455276 (Van Gaffen) comprising an initial tapered end portion, a second portion which when rotated generates a shape corresponding to the shape of the hole to be formed and which adjoins the base of the end portion and is coaxial with it, the cross section of the end portion and the second portion being generally in the form of polygons whose corners are bevelled along convexly curved lines, and a third portion coaxial with the second portion and adjoining it at its end remote from the end portion, the third portion having a greater diameter than the diameter of the shape generated by rotation of the second portion thereby to form a shoulder which faces the second portion so that in use the third portion co-operates with the second portion to mould the wall that surrounds the hole and one end face of the said wall.

A tool has also been proposed in Specification of Application No. 3460/78 (Van Geffen) similar to that described in Specification No. 1455276 except that the shoulder of the third portion facing the second portion is so shaped that during the formation of the hole the top of the bush is made flat and level and also rounded or chamferred or otherwise recessed at a ring zone bordering the hole.

The said shoulder may incorporate one or more cutting edges.

Where a bush is formed in the wall of a tube of relatively small diameter, the allowable working length of the flowdrill is limited and the length of the bush extending into the tube must be kept short. This is achieved by flowdrilling into a hole in the metal wall having a bore smaller than the internal diameter of the finished bush. This hole may be predrilled by a separate conventional drilling operation or by the flowdrill itself.

Such self predrilling flowdrills may take different forms. They may have cutting edges ground at their leading end or they may have the end of a centre drill or they may have a ground annular edge where the external surface of the tapered part of substantially polygonal cross section meets with the surface of an internal coaxial cylindrical or conical hollow core.

Flowdrills as described generally function satisfactorily but present a number of disadvantages which result in a high cost for a tool which, due to the high specific rate of energy to be transmitted to the workpiece by the small surface area, has a limited working life. The high cost of the tools has detracted from their common use in industry.

One disadvantage is that the majority of these tools have to be specially tailor made as not only the finished bush size may vary, but also the length, as well as the shape together with the shape of the raised portion of the bush, so that in practice any standard shape of flowdrill for a given diameter, which can be manufactured on a repetitive basis and held in stock, is out numbered by the demand for variations which may be in the shape of the piercing end, in the shape of the part which when rotated generates a shape corresponding to the shape of the hole to be formed in the length of this part when it is of constant cross section as is common, and in the shape of the generally required working face of the attached shoulder to finish the top of the bush.

Another disadvantage is that all the parts of the tool have been made integral of one end the same material which is not necessarily the most suitable for performing the different operations by those parts. Moreover the part of increasing rounded polygonal cross section, which mainly performs the flowdrilling operation as it heats the metal to a plastic state and makes it flow along its surface while progressively enlarging the hole size, must be made from a material which maintains great hardness and wear resistance at high temperature. Such materials are very expensive and can only be given the required accurate finish by a costly grinding operation.

Another disadvantage is the difficulty of finishing the surface of the part of usually constant cross section and the required face of the shoulder for forming the raised bush caused by the relative

inaccessibility for a grinding tool due to the adjoining shoulder of greater diameter.

According to the invention a flowdrilling tool comprises an end section to pierce or cut through a metal wall and form a hole therein an adjoining section of increasing rounded polygonal section for opening the hole and forming a bush, a further adjoining section which when rotated generates a shape corresponding to the final shape of the lower part of the bush to be formed, a cylindrical section of smaller diameter forming a shank for a tool, a sliding ring member on the shank for forming the final shape of the top of the bush, a tool holder collet or chuck adapter for gripping the shank with a face to engage and drive the ring member on one or both direction of rotation.

This invention will be described with reference to the accompanying drawings:—

Fig. 1 is a perspective exploded view of a flowdrill,

Fig. 2 is a section through the wall of a tube showing a bush formed therein by the flowdrill of Fig. 1,

Fig. 3 is a section on line 3—3 Fig. 2,

Fig. 4 is a section through a tube having a modified bush formed therein by a self predrilling flowdrill,

Fig. 5 is an exploded view of a further flowdrill,

Fig. 6 is a section on line 6—6 Fig. 5,

Fig. 7 is a view from behind showing cutting edges 6,

Fig. 8 is a perspective view of a collet.

A tool for making a flowdrill bush in metal walls consists of a flowdrill member comprising an end section 1 to pierce or cut through the metal wall 4 and form a hole therein adjoining a section of increasing rounded polygonal section 1*d* for opening the hole and forming the raised bush 4*a* as well as the opposing portion of the bush adjoining either a section of constant similar cross section 1*b* for forming the bush having a cylindrical inner face, or a conical or stepped inner face of substantially known shape adjoining a long cylindrical part of smaller diameter which forms the shank 1*a* of the tool assembly. The shank 1*a* is gripped in chuck adapter of a tool holder or in the collet similar to a collet used for holding the cylindrical shank of a conventional twist drill but with a specially shaped front face.

A spacer 5 (Fig. 4) may be slid onto the shank 1*a* before the ring member is placed on the shank to determine the distance between upper and lower part of the bush. The spacer 5 is cylindrical with a bore dimensioned as a sliding fit over the shank 1*a* and an external diameter to match the bore of the bush. During the formation of the bush the spacer 5 is not driven and may slip upon the shank acting purely as a guide.

The ring member 2 is formed with recesses 3*b* engaged by lugs 3*a* on the collet 3 and may be formed with cooling ribs on its outer circumference and its bore may be machined to minimise the area of contact with the shank to reduce the transfer of heat.

Materials for various parts of the tool assembly depend on the material to be flowdrilled.

Some grades of sintered tungsten carbide have been proved to stand up best to the rigors of repetitive operations performed by the flowdrilling section 1*d* whereas the ring member 2 and the spacer may perform better when made in a different material such as a hardened tool steel.

CLAIMS

1. A flowdrilling tool comprising an end section to pierce or cut through a metal wall and form a hole therein an adjoining section of increasing rounded polygonal section for opening the hole and forming a bush a further adjoining section which when rotated generates a shape corresponding to the final shape of the lower part of the bush to be formed, a cylindrical section of smaller diameter forming a shank for a tool, a sliding ring member on the shank for forming the final shape of the top of the bush, a tool holder collet or chuck adapter for gripping the shank with a face to engage and drive the ring member on one or both direction of rotation.

2. A flowdrilling tool as in claim 1, in which a spacer is interposed between a shoulder on the shank and the ring member.

3. A flowdrilling tool substantially as described with reference to the accompanying drawings.

4. Flowdrilling bushes in tubes or metal plates when produced by flowdrill as claimed in claim 1.

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