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Gottlieb et al.

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[54] **METHOD FOR PRODUCING METALLIC FILAMENTS**

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[73] Assignee: **Wilbur B. Driver Company**, Newark, N.J.

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[21] Appl. No.: **162,989**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 820,556, April 30, 1969, abandoned.

[52] **U.S. Cl.** **29/419**, 29/423, 29/599, 29/DIG. 32

[51] **Int. Cl.** **B23p 17/00**

[58] **Field of Search** ..... 29/187, 187.5, 191, 29/193, 194, 419, 423, 424, 599, DIG. 11, DIG. 32, 470.9

[56] **References Cited**

UNITED STATES PATENTS

2,050,298	8/1936	Everett	29/423 X
2,077,682	4/1937	Everett	29/423 UX
2,711,966	6/1955	Watson et al.	29/470.9 UX
3,277,564	10/1966	Webber et al.	29/419
3,394,213	7/1968	Roberts et al.	29/419 X

FOREIGN PATENTS OR APPLICATIONS

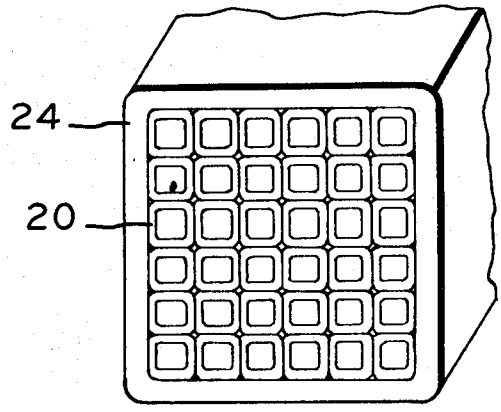
631,584	11/1949	Great Britain	29/187.5

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[57] **ABSTRACT**

A process for producing long continuous lengths of metallic filaments is disclosed which process comprises securing four flat plates of a first metal to each of the elongated sides of a billet of a second metal and having a cross section in shape of a rectangle, by edge welding each of the plates. The resulting assembly is essentially void free. The rectangular cross section of the billet is reduced while being elongated by hot rolling. The resulting elongated rectangular structure, having a core of the second metal and a cladding of the first metal over the elongated sides, is divided into a plurality of elements of the same lengths. The elements are inserted into a hollow metal tube open at both ends having a rectangular cross section in a manner to essentially eliminate the voids and with their longitudinal axes and the longitudinal axis of the tube essentially parallel. Ends of the tube are sealed and the sealed unit is reduced in cross section and elongated by hot rolling. The other materials are removed from the resulting filaments of the first metal yielding materials suitable for weaving into metal cloth.

3 Claims, 6 Drawing Figures



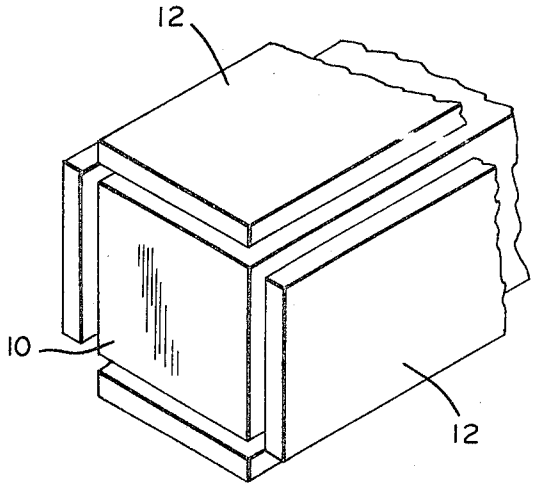


Fig. 1

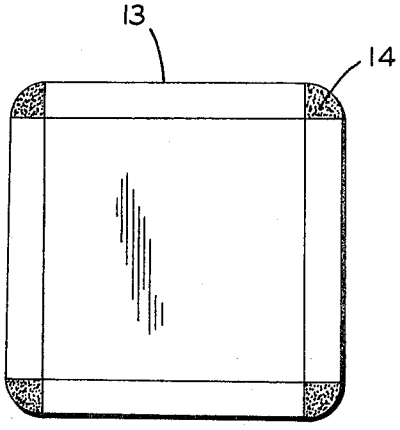
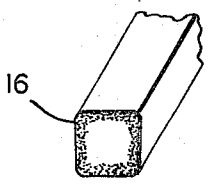


Fig. 2



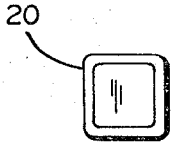


Fig. 4

Fig. 3

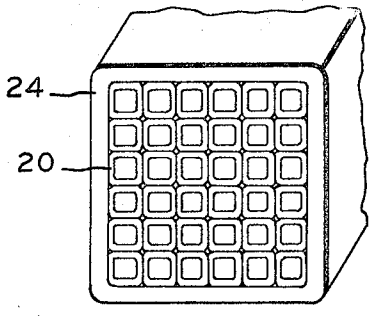


Fig. 5

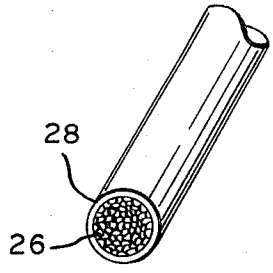


Fig. 6

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METHOD FOR PRODUCING METALLIC FILAMENTS

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of Ser. No. 820,556, filed Apr. 30, 1969, now abandoned and assigned to the assignee of the present invention.

BACKGROUND OF THE INVENTION

This invention relates to a multi-step process for producing metal filaments. More particularly it relates to a process utilizing hot rolling, in both steps.

Several processes are known for the production of metal fibers or filaments. For example, in U.S. Pat. No. 3,277,564 a process is disclosed wherein filaments are formed by forming a bundle of wires inside a sheath of a dissimilar metal, then drawing the bundle through a series of successive dies. Since round cross sectional shapes of the sheath are required in order to draw the bundle, any bundle has a relatively large portion thereof as voids. To obtain a reduction in the wire size, the total reduction in the cross-section of the bundle is relatively high.

U.S. Pat. No. 3,394,213 also discloses a process by which metal filaments are formed by construction of bundled wires or tubular elements by forming the bundled wires or elements into a billet and subjecting the billet successively to a hot forming constriction and subsequently drawing constriction. When the voids between the wires are not filled with a suitable particulate powder the billet is first compacted by axial shortening the billet, thus radially compacting the billet to reduce voids. Thereafter the billet is subject to hot extrusion.

It can be seen that the prior art methods each start with initial materials having a relatively large percentage of voids. Although the difficulties with voids are recognized, the solutions thereto either involve filling the voids with a filler material which inherently lowers the efficiency of the process or compacting the initial billet which is an additional step and adds an inherent inefficiency.

Additionally, when core materials of a first metal having a circular cross-sectional area are sheathed with a second metal and are placed in contact with each other to form a billet inside a casing, the mutual contact of the sheathed material is along a line. When the billet is subjected to compaction or constriction pressures, there is a tendency for the sheath and the casing to flow into any voids thus reducing its thickness nonuniformly and can lead to sheath rupture. If the sheath thickness is insufficient to fill the voids the cores come into contact with each other and can weld to each other. These problems are intensified with hot rolling thus hot rolling is not practical if there is substantial voids in the billets.

It is believed, therefore, that a process using void free rectangular cross section metal fibers via hot rolling without compaction or use of filler materials is an advancement in the art.

SUMMARY OF THE INVENTION

In our invention, the peripheral side surfaces of an elongated billet of uniform rectangular cross section of a second metal, for example, a billet, are each clad with a flat plate of a first metal. These plates are edge welded together to the member whereby an essentially void free assembly is formed.

The assembly is then hot rolled whereby it is reduced in cross section and is correspondingly elongated. The elongated member which has a rectangular cross section is cut into a plurality of like elements of the same length. Each element has a core of the second metal clad with the first metal.

A hollow tube of rectangular cross section with opposite open ends is formed of a metallic component which is dissimilar to the second metal and which can, but need not, be dissimilar to the first metal. This tube is filled with a plurality of said elements which have their longitudinal axes parallel with each other and with the longitudinal axis of the tube whereby the elements form an essentially void free bundle. The tube is then sealed and hot rolled. The individual elements are reduced in cross section and are elongated to form filaments of very small cross section imbedded in a metallic matrix.

Thereafter, the composite (which if necessary can be further reduced by cold drawing and annealing) can be immersed in acid media which will not attack the second metal but which will etch away all material other than the first metal, leaving only the filaments. These filaments form metallic yarn which can be used in weaving or the like.

Alternatively, the composite need not be etched but can be used without further processing as a fiber reinforced structure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates the initial step in cladding the first component;

FIG. 2 is an end view of the billet showing location of longitudinal welds;

FIG. 3 is a perspective view of the billet showing location of the end welds;

FIG. 4 shows in cross section the shape of the clad billet after hot rolling;

FIG. 5 is a cross sectional view of the geometry employed in further step of our process; and

FIG. 6 illustrates the member obtained after still a further step in our process.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

For a better understanding of the present invention, together with other and further objects, advantages, and capabilities thereof, reference is made to the following disclosure and appended claims in connection with the above-described drawings.

Referring now to FIGS. 1–7, there is shown a first component 10 of 304 stainless steel with a cross section in the form of a square two and one half inches on a side. Flat steel side plates 12 are secured to the flat, cleaned and ground sides of the billet 13 by longitudinal corner welds 14 and end welds 16.

The steel plate covered billet was then processed in the following manner. It was first hot rolled at a temperature of 2,000° F through a succession of diamond and oval passes to reduce the cross section of the plate covered billet, for example, to a square 0.25 inch on a side as shown at 20.

A succession of segments of like length were cut from the above. After descaling, these lengths were then packed in a hollow steel tube 24 of 3 × 3 inch cross section having a one-fourth inch thick wall. The void space is essentially eliminated when segments of square cross section are used.

This tube was then sealed and again hot rolled as before whereby the individual cores of element **20** form elongated filaments **26** of small cross section, imbedded in a metallic matrix **28.** Illustratively, the composite can have a diameter of 0.25 inch at this stage.

Thereafter the composite was cold drawn and annealed to reduce the diameter of the individual filaments to a desired value as for example 0.0005 inch. The drawn composite can then be treated as for example by dipping into a dilute nitric acid bath until the steel is etched away leaving only the fine filaments of stainless steel which can be used in weaving, knitting or the like.

Alternatively, this last step can be omitted whereby the composite can be used in applications where reinforced structures are of interest.

The portions of our process relating to the steps associated with FIGS. **4–7** can be repeated as often as necessary to increase the number of filaments.

We have found that by using rectangular shaped materials throughout, the difficulties of the prior art are avoided.

As previously mentioned the prior art methods each start with initial materials having a relatively large percentage of voids. Although the difficulties with voids are recognized, the solutions thereto either involve filling the voids with a filler material which inherently lowers the efficiency of the process or compacting the initial billet which is an additional step and adds an inherent inefficiency.

Additionally, when core materials of a first metal having a circular cross-sectional area are sheathed with a second metal and are placed in contact with each other to form a billet inside a casing, the mutual contact of the sheathed material is along a line. When the billet is subjected to compaction or constriction pressures, there is a tendency for the sheath and the casing to flow into any voids thus reducing its thickness nonuniformly and can lead to sheath rupture. If the sheath thickness is insufficient to fill the voids, the core members come into contact with each other and can weld to each other. These problems are intensified with hot rolling, thus hot rolling is not practical if there is substantial voids in the billets.

By using the special geometric shapes as defined herein the foregoing problems are overcome. For example, excessive spreading during hot rolling is eliminated, the sheathing is uniform, no voids are present, therefore, no sheath rupture or core welding occurs and hot rolling is used throughout to produce the fibers.

While we have described our invention with particular reference to the drawings, our protection is to be limited only by the terms of the claims which follow.

What is claimed is:

1. A method for producing long continuous lengths of metallic filaments comprising the steps of:

securing four flat plates of a first metal to each of the elongated flat outer sides of a billet of a second metal and having a cross section in the shape of a rectangle by edge welding, the resulting assembly being essentially free of voids;

reducing said assembly in cross section while elongating same by hot rolling to an elongated structure having a rectangular cross section;

dividing said elongated structure into a plurality of elements of the same length each having a longitudinal axis;

inserting said elements into a hollow tube open at both ends and having a cross section in rectangular shape in a manner to essentially eliminate the voids and having the longitudinal axes of the element mutually parallel and parallel with the longitudinal axis of said tube, said tube being composed of a metallic component which is dissimilar to the second metal and can, but need not be dissimilar to the first metal;

sealing said element carrying tube at both ends; and

reducing said sealed tube in cross section while elongating same by hot rolling whereby filaments of small cross section composed of said second metal are imbedded in a metallic matrix.

2. A method as set forth in claim **1** further including the additional step of removing said matrix from said filaments whereby the filaments are exposed.

3. A method as set forth in claim **1** wherein said rectangle is a square.

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