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2,846,758

METHOD FOR MANUFACTURING HOLLOW METAL SECTIONS

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Fig. 1

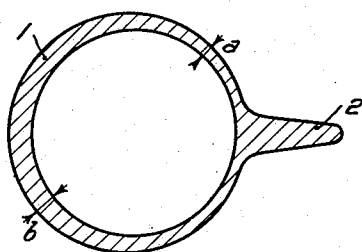


Fig. 2

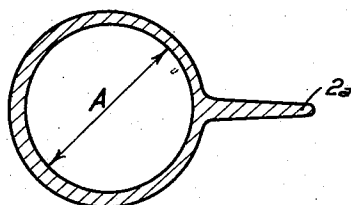


Fig. 3

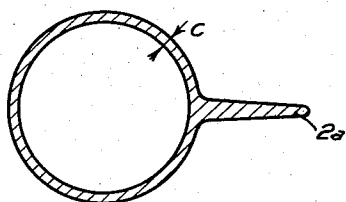


Fig. 4

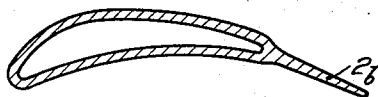
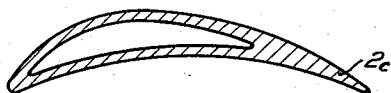


Fig. 5



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3 Claims. (Cl. 29—156.8)

The present invention concerns the manufacture of hollow metal sections, and particularly of hollow turbine blades.

During the last few years, the use of turbine blades of the conventional type has been considerably extended and the temperatures to which they are subjected have been substantially increased. The efficiency of the machines utilizing such blade seems indeed to increase substantially with the temperature of the fluid used. There is however a limitation thereto, due to the rapid wear of the paddles, which flow under the action of temperature and of the stresses to which they are subjected. In particular, for rotating machine parts, the action of centrifugal force tends to increase the speed of flow and consequently the rapidity of wear of the blades.

New steels had to be studied, the chemical compositions and the methods of preparation of which provide better characteristics at high temperature. Numerous compositions have been proposed and among these a few offer remarkable characteristics. Any improvements in this direction, however, meet with great difficulties either because the cost of such steels is too high or because they utilize rare raw materials, or finally because they offer great difficulties in converting an ingot into a hollow section.

It has also been proposed to solve the problem of turbine blades working at high temperatures by using hollow blades, which allow, on the one hand, an intense cooling of the sections by blowing air in their lower portion, and, on the other hand, an expansion of the blade under the action of sudden changes in temperature, without creating any internal stresses as is the case with solid blades.

The manufacture of such hollow blades, however, also meets with great difficulties. In a general manner such manufacturing operations are those of the so-called lost-wax casting process which has the drawback of being costly and of giving rise to numerous rejections, without actually resulting in the production of thin walls, or the method which consists in starting from a bent sheet which is welded before it is finally formed, the latter process causing heterogeneities along the welded parts resulting in short life of the blades.

The object of the present invention is a process for manufacturing hollow metal sections having walls of a constant thickness and if desired comprising several longitudinal fins placed in a symmetrical or dissymmetrical manner. This method which may be particularly applied to be manufacture of turbine blades makes it possible to obviate the above mentioned drawbacks. It comprises, fundamentally the following successive operations:

(1) A tubular section is hot extruded with a press, the section being with a press provided, if desired, with rough forms of the fin or fins which the finished section is intended to include, the thickness of the wall of this tubular section, as well as its outer peripheral development, being greater than those of the finished section to be obtained.

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(2) Said tubular section is drawn in order to provide it with an outside peripheral development substantially equal to that of the section to be obtained.

(3) This drawn section is cut into elements of a length slightly longer than that of the final product to be obtained.

(4) These elements are reamed inside to give them the desired wall thickness for the final section to be obtained.

(5) These reamed elements are brought, in one or more forming operations, by means of a press, to the final desired shape of the finished section.

(6) They are finally cut to the exact required length. Between these various operations, the intermediate products may be subjected to the conventional operations of annealing, for eliminating the hardening stresses, and to subsequent pickling operations. The final product itself, if need be, may be subjected to a final thermal treatment.

The initial extruded section is preferably obtained by using, as a lubricant for the extrusion operation, a substance such as glass, having a wide melting range as contrasted with a true melting point at the temperature of operation according to what is described in French Patent No. 966,773.

An example of embodiment of the method according to the invention is described hereinafter with reference to the appended drawing wherein:

Fig. 1 is a transverse sectional view of the extruded section constituting the initial rough form for a hollow turbine blade.

Fig. 2 is a similar view of said rough form after drawing operations.

Fig. 3 is a similar view after reaming operations.

Figs. 4 and 5 are two transverse sectional views showing two successive stages of formation of the final products.

For manufacturing, according to the invention, a turbine blade with a section as represented in Figure 5, a tubular profile 1, laterally provided with a longitudinal fin 2 of rough form, is first hot extruded by means of a press in which glass is used as a lubricant.

Due to the dissymmetry of the extruded profile, a product is generally obtained with unequal thicknesses, the thickness of *a* being, theoretically, inferior to the thickness of *b*.

The product thus extruded is then cold drawn as shown in Figure 2, so as to provide the outer portion of the section with determined dimensions which depend upon the dimensions which are required for the finished product, while the dimension of internal diameter A should remain at a value which is inferior to the dimension obtained after the subsequent reaming step.

The drawn section is then cut into elements, the length of which is slightly greater than that of the finished product, after which these elements are reamed as shown in Figure 3 in conformity with their outer diameters so as to eliminate the initial off-centering, and in order that their thickness *e* be of a constant value, equal to the thickness to be obtained in the finished product.

They are then pressed, in two successive operations, to the shapes represented in Figs. 4 and 5.

Between these various operations, the products undergo the conventional annealing operations, for eliminating the hardening stresses and then are subjected to pickling operations.

The parts which are finally of a section according to Fig. 5 are then brought to their desired length. If necessary, they then undergo a final thermal treatment.

During these various stages, the rough fin 2 is also gradually brought to its final shape 2c, through the intermediate stages 2a and 2b.

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Special shaping tools make it possible to give the blades a twist over their length according to Figs. 4 and 5 as is sometimes required for this kind of product.

What I claim is:

1. In a method for producing from a billet a plurality of hollow metal bodies having an alar shape in which the hollow portion of said bodies comprises a substantially lateral displacement away from the tip of said bodies, said bodies having a predetermined cross-section length and wall thickness, the steps comprising hot extruding the billet into a hollow tubular piece with a fin extending longitudinally thereof and being integral therewith, said hollow tubular piece having both a wall thickness and a peripheral development greater than those of the final hollow body, drawing said tubular piece into a tubular element having a peripheral development substantially equal to the peripheral development of the final hollow body and having said fin extending longitudinally thereof, cutting said tubular element into elementary portions, each of which has a fin portion integral therewith

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and extending outwardly away from the hollow portion thereof, reaming the inside of each elementary portion to provide a wall thickness substantially equal to that of the final hollow body and pressing said elementary portions to the shape of the final hollow body.

2. The method of claim 1 characterized by the step of lubricating the billet during extrusion with a substance having a wide melting range as contrasted with a true melting point.

3. The method of claim 1 characterized by the step of cutting said pressed portions to the length of the final hollow body.

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