April 20, 1937. S. J. EVERETT 2,077,682

DRAWING PROCESS

Filed May 6, 1936

Fig. 1.

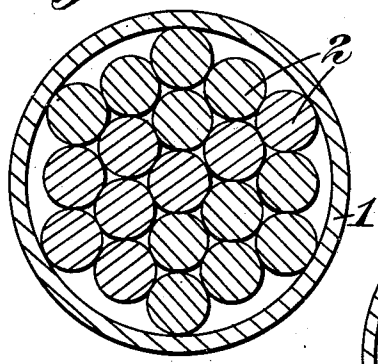


Fig. 3.

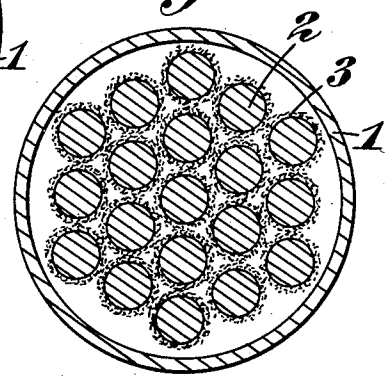


Fig. 2.

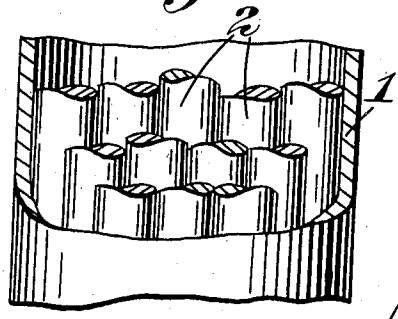
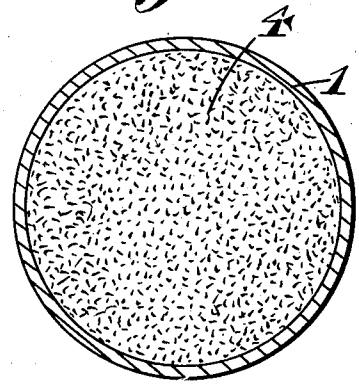


Fig. 4.



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2,077,682

DRAWING PROCESS

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Application May 6, 1936, Serial No. 78,274
In Great Britain May 17, 1935

11 Claims. (Cl. 205—21)

This invention relates to processes for reducing metal rods, wires, strips and the like by drawing, rolling and analogous operations.

The invention is concerned with a process of the type (hereinafter referred to as the type described) in which a plurality of metal elements are held together as a unit and are subjected as such to drawing, rolling or analogous operations in either the hot or cold state to reduce the cross-sectional area of each element simultaneously. It is already known, in a process of this type, as applied to elements in the form of sheets, rods, wires, strips or the like, to hold the elements together as a unit during the reduction by assembling them in side-by-side relationship in a tubular casing which is reduced with the elements and then removed, and the invention is especially, although not essentially, concerned with a form of the process in which a tubular casing is employed around the elements during the reduction.

A difficulty which arises in the carrying out of a process of the type described is that the elements after reduction tend to adhere to one another and are difficult to separate when the reducing operation has been completed. One method of overcoming this difficulty has been proposed in patent application Serial No. 17,316, now issued as United States Patent No. 2,050,298, according to which a substantial amount of packing material is provided between the elements. It has now been found, however, that if the elements are of metal containing a proportion of chromium upwards of about 10% little or no packing is necessary to avoid or largely reduce the above difficulty.

The present invention accordingly provides a process of the type described which is characterized by its application to elements of metal containing more than 10% of chromium, thereby eliminating the necessity for packing material, or reducing the amount of packing material necessary, between the elements.

Suitable materials for use in carrying out the invention include alloy steels of the type comprising up to 0.20% carbon, 6 to 14% nickel and 10 to 20% chromium, and nickel chromium alloys consisting principally of these two metals (e. g. in proportions of 80% Ni and 20% Cr. Examples of suitable alloy steels are those described in patent applications Serial Nos. 346,812 and 560,489 and British Patent Specification No. 396,809.

It is believed that the reduction in the tendency to adhere in the case of metal containing high proportions of chromium is due to the peculiar properties (possibly the property of non-absorption) of the thin film of chromium oxide which forms on the surface of such metals. When the elements are reduced in accordance with the present invention the surface area of each element is very considerably increased and the film of oxide which becomes extremely thin may be broken. It is therefore preferred, particularly when the elements are encased in a manner which prevents free access of air, to produce (e. g. by heating to redness in air) an initial heavy oxide coating on the metal and also, in some cases, to provide between the elements an oxidizing medium (e. g. red lead or tin oxide) in small quantities (e. g. 1 or 2% of the volume within the casing); this oxidizing medium being such as will give up its oxygen to the metal elements at the temperature reached during annealing, which is normally carried out at least once during the reducing operations. The oxidizing medium may also act as a lubricant between the elements. Alternatively, when the elements are to be reduced by a method (e. g. swaging, rolling through a guide mill, or drawing through irregular dies) which involves considerable distortion of the shape of the elements and also considerable relative movement between them, a proportion (up to about 5% of the volume within the casing) of a solid or liquid lubricating medium, which may not be an oxidizing agent, may be employed within the casing. The presence of a lubricant is found to reduce damage to the elements by abrasion against each other or the casing and also to assist in maintaining unbroken the oxide film and consequently to assist in preventing adhesion between the elements.

In certain cases where it is desired to limit any distortion of the shape of the elements during the reducing operations they may be so shaped and arranged as to fit together without interstices, for example the elements may be of square or hexagonal cross-section or they may be of different cross-section, such as rectangles of different dimensions or round sections in conjunction with sections having four concave sides.

When the elements are made up into a bundle it may be encased in a tube or other binding which may be removed, as may the encasing tube in the case of powdered elements, after the reducing operation by, for example, chemical or mechanical means.

The present invention may be applied to the production of extremely fine wires, and accord-

ing to one example of carrying the invention into effect twenty-three round section wires of 0.65 mm. diameter and of steel alloy containing 12% chromium and 12% nickel were encased in a tube 8 mm. in outside diameter and composed of a nickel-copper alloy. The encased bundle was then drawn until the outside diameter of the tube was about 0.17 mm. and the wires had a final diameter under about 0.025 mm. The tube was removed by treatment with nitric acid and it was then found that the wires could readily be separated. In order to provide an oxide film of sufficient thickness to allow of stretching the bright wires were first heated in air for about five minutes at a temperature of about 760° C. before insertion into the tube.

In another example, swarf of an iron alloy containing 18% chromium and 8% nickel was packed in a tube 13 mm. outside diameter which was drawn to an outside diameter of 0.5 mm. The filaments were easily separable after the tube had been removed.

In a still further example, stainless steel filaments were prepared from clippings from sheets of steel containing 18% chromium, 8% nickel, 0.13% carbon, 0.6% titanium and 0.6% tungsten. The clippings were packed in a hard steel tube (the steel containing 0.65% of carbon) and the whole drawn until the diameter of the tube was about 1/40th of its original diameter. The tube was then removed electrolytically leaving the clippings drawn to the form of fine easily separable wires. Alternatively, the tube can be removed by rendering it brittle, permanently or temporarily, for example by subjecting the bundle to heat treatment to harden the tube and then cracking off the tube. For this purpose an air-hardening steel may be used for the tube. Alternatively, the tube may in some cases be rendered brittle by nitriding or other gas treatment.

Three specific arrangements of tubular casings packed with elements ready for rolling or drawing are shown diagrammatically in the accompanying drawing. The first of these arrangements is shown in Figures 1 and 2, Figure 1 being a cross-section showing a tubular casing 1 packed with nineteen rods 2 of stainless steel and Figure 2 an elevation of the arrangement shown in Figure 1 with part of the casing broken away. Figure 3 shows a cross-section of a modified form of the arrangement shown in Figures 1 and 2, the rods 2 in this example each having a heavy coating of oxide 3. Figure 4 illustrates a cross-section of a tubular casing 1 packed with filings or clippings 4 of a chromium alloy.

If the elements are packed in a single tubular casing it is important that the resistance to drawing or rolling of the tube should not be very much less than that of the elements in order to ensure that the tube does not draw or roll off the elements without substantial deformation thereof. Thus, for example, copper is, in general, too easily drawn for it to be used effectively as a casing for stainless steels. Bronze or an alloy of nickel and copper or other hard copper-containing alloy may, however, be used satisfactorily and it is found that copper itself may be used if each element is encased in a separate copper tube and the encased element placed in an outer copper tube.

It is also found that when annealing an encased bundle which has been drawn to a small diameter it is necessary to carry out the annealing in a non-oxidizing atmosphere in order to avoid undue oxidation of the bundle and of the individual elements within the bundle.

Many of the features more particularly described in patent application Serial No. 17,316 may be employed in carrying out the present invention. Thus for example, any of the methods described in that specification for removing the whole or part of the encasing tube may be employed in the present case. Further, the reduced elements according to the present invention may be formed into stranded wire or cable in the manner described in patent application Ser. No. 17,316.

I claim:

1. A process for the production of fine wires, strips, thin sheets or the like by reduction from elements of larger cross-section which comprises assembling inside a tubular casing a plurality of metal elements composed of alloy steel comprising 0.05% to 0.20% carbon, 6% to 14% nickel and 10% to 20% chromium, and subjecting the encased elements as a unit to reducing operations to reduce the cross-section area of all the elements, simultaneously, and then removing the casing.

2. A process for the production of fine wires, strips, thin sheets or the like by reduction from elements of larger cross-section which comprises assembling a plurality of elements of metal containing more than 10% of chromium in a tubular casing, together with a proportion of oxidizing material such as will give up its oxygen at annealing temperatures for the elements, subjecting the encased elements and oxidizing material as a unit to reducing operations, including annealing, to reduce the cross-sectional area of all the elements simultaneously, and then removing the casing.

3. A process for the production of fine wires, strips, thin sheets or the like by reduction from elements of larger cross-section which comprises assembling in a tubular casing a plurality of elements composed of alloy steel comprising 0.05% to 0.20% carbon, 6% to 14% nickel and 10% to 20% chromium, and with the elements a proportion of oxidizing material such as will give up its oxygen at annealing temperatures for the elements, and subjecting the encased elements and oxidizing material as a unit to reducing operations, which include intermediate annealing of the elements, to reduce the cross-sectional area of all the elements simultaneously and then removing the casing.

4. A process for the production of fine wires, strips, thin sheets or the like by reduction from elements of larger cross-section which comprises assembling a plurality of elements of alloy steel containing 0.05% to 0.20% carbon, 6% to 14% nickel and 10% to 20% chromium, in a tubular casing of material different from that of the elements but having a resistance to reduction not substantially different from that of the elements, subjecting the casing and the elements contained therein to reducing operations as a unit and then removing the casing from the reduced elements.

5. A process for the production of fine wires, strips, thin sheets or the like by reduction from elements of larger cross-section which comprises assembling a plurality of elements of alloy steel containing 0.05% to 0.20% carbon, 6% to 14% nickel and 10% to 20% chromium in a steel tube and subjecting the tube and the elements contained therein to reducing operations as a unit to reduce the cross-sectional area of all the ele-

ments simultaneously and then removing the tube.

6. A process for the production of very fine wires or strips or very thin sheets or the like which consists in assembling as a unit a plurality of elements of metal containing more than 10% of chromium and subjecting the elements as a unit to alternate reducing and annealing operations to reduce the cross-sectional area of all the elements simultaneously, the annealing at the final stages of the process being formed in a non-oxidizing atmosphere.

7. A process for the manufacture of fine wires, of stainless steel which consists in packing a plurality of elements of an austenitic chromium-nickel steel alloy containing upwards of 10% chromium in a metallic tubular casing of material having a resistance of drawing comparable with that of the elements, subjecting the elements and the casing as a unit to drawing and finally removing the casing.

8. A process for the production of fine wires, which consists in assembling in side by side relationship to form a bundle a plurality of rods of metal containing more than 10% of chromium, each rod being placed in a separate casing before assembly to form the bundle, placing the bundle in a tubular casing and subjecting the encased bundle as a unit to reducing operations, and then removing the casing.

9. For use in the production of fine wires, strips, thin sheets or the like by reduction from elements of larger cross-section an assembly comprising a tubular casing and packed therein for reduction therewith a plurality of elements of metal containing more than 10% of chromium, the casing being removable from the elements after reduction and the reduced elements being readily separable.

10. A process for the production of fine wires, strips, thin sheets or the like by reduction from elements of larger cross section, which comprises assembling inside a tubular casing a plurality of metal elements containing more than 10% of chromium, placing inside the tubular casing a proportion of lubricating material and subjecting the encased elements as a unit to reducing operations to reduce the cross sectional area of all the elements simultaneously, and then removing the casing.

11. A process for the production of fine wires, strips, thin sheets or the like by reduction from elements of larger cross section, which comprises assembling inside a tubular casing a plurality of metal elements containing more than 10% of chromium, placing inside the tubular casing a proportion of lubricating material up to about 5% of the volume within the casing and subjecting the encased elements as a unit to reducing operations to reduce the cross sectional area of all the elements simultaneously, and then removing the casing.

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