

[54] ROLLING DEFORMATION OF WIRES AND SIMILAR ELONGATED ELEMENTS

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[22] Filed: **Mar. 15, 1972**

[21] Appl. No.: **234,835**

[30] Foreign Application Priority Data

Mar. 17, 1971 Germany..... 2112966

[52] U.S. Cl..... **72/236**, 29/125

[51] Int. Cl..... **B21b 27/02**

[58] Field of Search. 29/125, 148.4 D; 72/199, 236, 72/237, 476, 478

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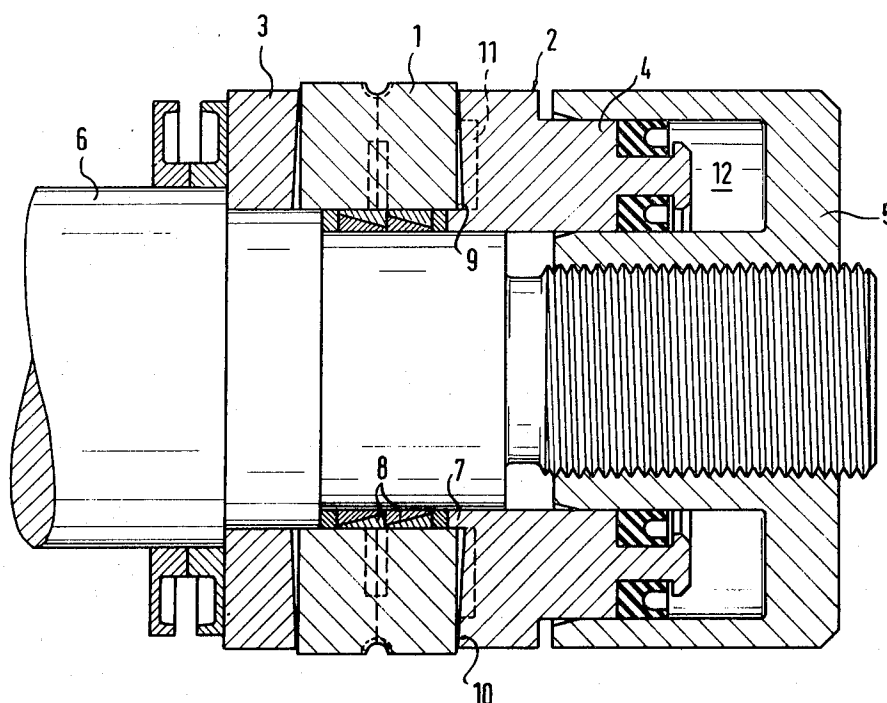
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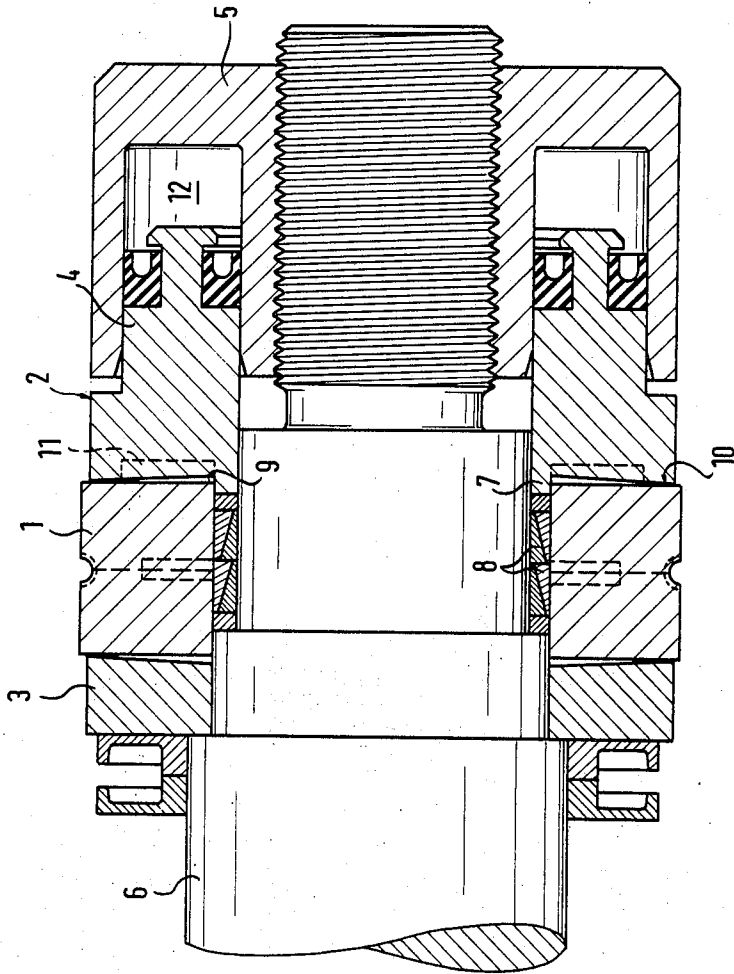
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[57] ABSTRACT

A wire or similar elongated element of metallic material is advanced between at least one pressure roller and at least one counter-roller and is engaged with the pressure roller under pressure to be rollingly deformed; the pressure roller may be profiled to form ribs, grooves or the like on the wire. The pressure acting from the wire on the roller frequently reaches such a force that it tends to destroy the pressure roller, and in accordance with the invention a counter-force is exerted upon the roller, to compensate for the force acting on the same from the wire so as to prevent its destruction.

27 Claims, 1 Drawing Figure





ROLLING DEFORMATION OF WIRES AND SIMILAR ELONGATED ELEMENTS

BACKGROUND OF THE INVENTION

The present invention relates generally to the processing of elongated elements of metallic material, such as wires, rods and the like. More particularly, the invention relates to the rolling deformation of such elongated elements, and still more particularly to a method for effecting such rolling deformation and to an apparatus for carrying the method out.

Wire, rods or the like of metallic material are processed in various ways to either reduce their cross-section, change their cross-section, or provide the elongated element with profiling. One of these ways is to engage the elongated element at one side with one or more pressure rollers, and to provide at the opposite side counter-rollers so that the elongated element is subjected to pressure in the nip between the cooperating pressure and counter-roller. As the element advances between this nip, it is subjected to requisite deformation due to the pressure exerted upon it.

Generally speaking, the prior-art devices used for this purpose utilize a plurality of pressure rollers which are spaced from one another and are mounted in suitable manner on a carrier, onto which the rollers—which are ring-shaped—are pushed and whereon they are secured with distance rings between them. At the free end of the carrier, that is the shaft or the like, a nut and/or screws are provided which prevent the roller from slipping off. In such an arrangement, the maximum pressure force which can be exerted upon the axially arrayed rollers on the shaft is at best below 1 ton of pressure.

Experience has shown that hot-rolled ribbed profiled steel elements can be hot-rolled on devices of the type above, wherein the rollers are of steel or castings of suitable metal, with a speed of only 20–25 meters/sec. Other arrangements are known in which it is possible to produce rolling deformation of wire having a circular cross-section with a speed of 50 meters/second or more, using rollers of hot metal. However, in these arrangements it is not possible in particular to profile the wire at this speed, because the deformation forces acting upon the rollers from contact with the wire are too great and tend to destroy the rollers.

In this connection it is important to understand that the elongated element, whether wire, rod or the like, is subjected by the pressure roller which cooperates with the counter-roller to strong pressure, required to either change its cross-section or/and to give it a suitable profiling. Of course, the exertion of pressure is reciprocal, because the pressure is also exerted by the wire against the contact surface of the pressure roller itself, and this force is so strong that when the roller is of a hard metal, either of solid cross-section or of annular configuration, the force tends to burst or break the roller so that the same must be discarded. Hereafter this force will be designated as the bursting force.

Inasmuch as a definition of the bursting force has just been given it is appropriate to further define that hereafter reference to an arrangement for rolling is intended to designate a unit composed of at least one pressure roller and at least one for counteracting the bursting force, although of course within the parameter

of the definition a multiplicity of pressure rollers and means is included.

SUMMARY OF THE INVENTION

It is a general object of the present invention to overcome the disadvantages of the prior art.

More particularly it is an object of the invention to provide an improved method for rolling deformation of elongated elements of metallic material, which method is not possessed of the disadvantages of the prior art.

An additional object of the invention is to provide a novel arrangement for carrying out the method.

The problem to be overcome essentially is to assure that the pressure roller (or of course rollers, if several are provided) of a hard metal or a material having the appropriate characteristics, can withstand the bursting force exerted upon it by pressure-contact with the elongated element being deformed (either for reducing or changing the cross-section of the element and/or profiling the element) so that the force does not destroy the roller (or rollers).

In pursuance of these objects, and of others which will become apparent hereafter, one feature of the invention resides in a method of rollingly deforming rods, wires and like elongated elements of metallic material; briefly stated, this method comprises the steps of advancing an elongated element of metallic material between at least one pressure roller and at least one counter-roller. The element is engaged under pressure with the pressure roller so as to deform the element, and simultaneously the element exerts upon the pressure roller a first force which is of a magnitude tending to destroy the pressure roller. According to the present invention, there is exerted upon the pressure roller from at least one direction a second counterforce of such magnitude as to counteract the first force and to prevent the destruction of the roller.

Advantageously, the direction from which the second force is applied should be a lateral direction and the second force should be at least identical in magnitude with the first force, and preferably greater.

The pressure roller may be axially compressed, or at least substantially axially, at least during the exertion of pressure on it by the element, and the compression may take place directly or indirectly by means of a hydraulic pressure or an analogous pressure, in such a manner that the axial components of the first force are counteracted.

The first force or bursting force is to be considered for purposes of the present disclosure as that force exerted upon the pressure roller by the element being deformed which, if the pressure roller is of one piece, can no longer be withstood by the pressure roller and will result in destruction of the roller. The bursting force is also to be considered that force which, if for instance the roller is of two parts or halves, will so act upon the roller that the two parts or halves are driven apart to such an extent that the roller can no longer act in its intended manner upon the elongated element.

The present invention represents the first realization known to us of the fact that the bursting force acting upon the pressure roller—with the latter being made of a hard metal—can be compensated in order to prevent the destruction of the roller.

It is further advantageous according to the present invention that the compensating force or second force is applied by a pre-compressed mass of synthetic plastic

material, although pneumatic or hydraulic forces can also be utilized. If the synthetic plastic material is used, then it is intended that it should be subjected to pre-compression and should exert its force resulting from its tendency to expand upon a piston or an analogous force-transmitting component which transmits the second force to the roller, and if the latter is for instance of two halves, the second force will then also serve to maintain them in abutment and in operative position relative to one another.

An apparatus for carrying out the present invention may utilize a pressure roller in conjunction with a piston which is itself subjected to a pressure sufficient to transmit to the pressure roller the second force of such magnitude as to counteract the first force to which the pressure roller will be subjected when deforming a rod or wire-shaped elongated element.

A particularly advantageous embodiment of the invention utilizes a shaft having an abutment shoulder against which one axial end of the pressure roller abuts whereas at the opposite axial end there is provided an annular piston surrounding the shaft and bearing against the pressure roller, the piston having at the end remote from the pressure roller a reduced-diameter end portion (which of course need not be provided) and which is received in a pressure cylinder also mounted on the shaft.

The pressure cylinder should surround the shaft annularly and in U-shaped configuration, and the piston may be provided with grooves or the like for receiving a sealing element. A pressure ring may be provided on the piston and may act upon one or more particularly radially acting wedges or similar mounting and holding means which cooperate with the roller to prevent the same from axially shifting on the shaft.

It is advantageous if one or both of the abutting surfaces of the piston and the pressure roller are so configured as to be inclined with respect to the axis of the shaft in such a manner that the contact takes place only in the radially outer regions of the piston and pressure roller.

One or both of these surfaces may be provided with an annular recess which surrounds the shaft, the purpose being to concentrate the specific surface pressure into certain areas of the contacting faces or engaging faces.

It is a further concept according to the present invention that the pressure roller may be made of at least two parts which contact one another in a plane of separation extending radially of, or at a different angle of inclination with reference to, the shaft, and the plane of separation should advantageously be midway or substantially midway of the axial length of the pressure roller.

The shaft itself is also of a particular configuration, having one portion of a first diameter and being stepped at an adjacent portion so as to produce an abutment; the adjacent portion is provided with a further step for receiving the wedge or wedges and on which further portion the pressure roller is also mounted, with an additional portion being also provided which is also stepped to mount the cylinder itself. The roller is advantageously provided with suitable passage means for circulation of the cooling fluid, and its circumferential surface may be inclined with respect to the axis of the shaft on which it is mounted. The circumferential surface may be cylindrical, it may be con-

cave or convex, or it may be profiled, that is, a combination configuration is possible.

In axial direction of the pressure roller the circumferential face may be subdivided into two immediately adjacent portions, that is axially adjacent, which are of different and mutually independent profiling.

The piston advantageously extends to or almost to the periphery of the pressure roller; between it and the pressure roller itself a ring of material may be positioned which should advantageously consist of a strongly vibration-damping substance, either metallic or non-metallic, although a material which is not vibration-damping can also be utilized. Such ring may be completely or partially recessed into the piston and/or into the pressure roller, that is into the respectively adjacent contact surfaces thereof. The ring may be provided with cut-outs if desired.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments when read in connection with the accompanying drawing.

DESCRIPTION OF THE DRAWING

The single FIGURE is a fragmentary axial section illustrating one exemplary embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Before entering into a detailed discussion of the drawing, it is pointed out that only those features which are germane to the present invention have been illustrated. Other features are conventional and details may be ascertained, if necessary or desired, by reference to pages 562-580 of "The Making, Shaping and Treating of Steel," Eight Edition, issued by the United States Steel Corporation.

Turning now to the drawing, it will be seen that reference numeral 6 identifies a roller shaft in a rolling mill, the shaft 6 being stepped in diameter to provide a shoulder against which a ring 3 is seated. The here annular pressure roller 1 surrounds the shaft 6 and abuts axially against the ring 3, its other axial end being contacted by the also annular piston 2.

In the illustrated embodiment a piston 2 has a reduced-diameter end portion remote from the pressure roller 1 and extending into a pressure cylinder 5 which is annular and U-shaped in configuration and which embraces the shaft 6 as illustrated. Advantageously the cylinder 5 is provided with an opening that can be pressure-tightly closed or with a one-way valve (not illustrated) which permits no outflow from the annular clearance or chamber defined in the interior of the cylinder 5 with the piston 2 which together constitute a hydraulically operated unit. This clearance can be filled in accordance with the present invention with a mass of synthetic plastic material which is introduced and pressurized whereupon the opening is closed. Of course, it is possible to utilize hydraulic fluid or even air in place of the synthetic plastic material.

In any case, after the cylinder 5 is mounted on the shaft 6, the pressure so produced (in the case of use of synthetic plastic material this will be a "pre-compressed" material which cannot relax its compres-

sion because the opening in the cylinder 5 is closed after the material is compressed) acts upon the piston 2 to transmit a force upon the roller 1 which is thus stressed and maintained in position. This force is so selected, by considerations which can be determined theoretically by calculation or empirically in a manner known to those skilled in the art, that it will counteract the bursting force exerted upon the circumferential surface of the pressure roller 1 by an elongated element or flank which the latter engages under pressure in order to deform the same. The circumferential surface may be profiled, as indicated by the groove 1a, so that an elongated element, whose width is greater than the width of the groove 1a, will be formed with a rib the cross-sectional configuration of which corresponds to that of the groove 1a, or else an elongated element may be received entirely in the groove 1a and may have its cross-section reduced to that of the groove 1a from a previously larger cross-section.

Additional means may be provided to further counteract the possibility that the roller 1 may burst under the influence of the bursting force or might be otherwise damaged thereby. A recess 11 may be provided to assure that the counterpressure or counterforce exerted by the piston 2 will be directed to a particular region, that is in the present instance, due to the location of the recess 11, the force will be directed to the peripheral region 10 of the roller 1. However, under certain circumstances it may also be possible to provide the inclined surface 9 as shown.

The piston 2 should of course extend as far as possible towards the periphery of the roller 1, and it may be advantageous in certain circumstances that it partially embraces the periphery of the roller 1 in the region of the adjacent axial end thereof, in which case the other axial end may also be partially embraced by the ring 3.

A pressure ring 7 is provided on the piston 2 to provide for additional arresting and tightening of wedges 8 or a single wedge 8 to thereby maintain the roller 1 against movement radially of the shaft.

Between the ring 3 and the roller 1, and/or between the roller 1 and the piston 2, a force-transmitting means may be provided, for instance in form of annuli of vibration-damping material, or of non-vibration-damping material. This has been mentioned above but is not specifically illustrated in the drawing.

Although hydraulic fluid can be utilized, the currently preferred medium is a mass of synthetic plastic material which is advantageously introduced into the cylinder 5 as discussed earlier, filling the space or clearance 12 mentioned before and having been introduced into this space under pressure which, because the opening (not shown) in the cylinder 5 is closed after the material is pressurized, acts upon the piston 2.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing those described above.

While the invention has been illustrated and described as embodied in the processing of elongated elements of metallic material, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

We claim:

1. In a method of rollingly deforming elongated blanks by advancing the same between a pressure roller

and a counter roller while subjecting the same to pressure, whereby the pressure roller is subjected to the action of forces having components acting in the axial direction of said pressure roller, the improvement which consists in hydraulically subjecting said pressure roller to axial compression of such magnitude as to counteract said components at least while the rollers deform the blanks.

2. In an apparatus for rollingly deforming elongated blanks, a combination comprising a shaft; a pressure roller having a circumferential surface adapted to engage and rollingly deform the blanks, whereby said roller is subjected to the action of first forces having components acting in the axial direction of said rollers; and a hydraulically actuated cylinder-and-piston unit having a cylinder member and a piston member, one of said members acting upon said pressure roller adjacent said circumferential surface so as to exert upon said pressure roller second forces counteracting said axial components of said first forces.

3. A combination as defined in claim 1, wherein said members of said unit define a chamber; and further comprising a body of pressurized medium confined in said chamber and acting on said one member.

4. A combination as defined in claim 3, wherein said body is of synthetic plastic material.

5. A combination as defined in claim 1, said roller being of a hard metal.

6. A combination as defined in claim 2, wherein said body is of high-viscosity substance.

7. A combination as defined in claim 2, said roller having two axial ends; further comprising abutment means engaging one of said axial ends for preventing axial shifting of said roller; and wherein said one member engages said other axial end for exerting said second forces upon the same.

8. A combination as defined in claim 2, wherein said piston and cylinder members are located adjacent one axial end of said roller, said cylinder annularly surrounding said shaft and said piston being guided in said cylinder.

9. A combination as defined in claim 3, said cylinder member having an opening for introduction and pressurizing of said body, and including closure means for closing said opening.

10. A combination as defined in claim 8, said piston member being annular and including at least one circumferential recess, and further comprising a sealing element received in said recess.

11. A combination as defined in claim 8; further comprising mounting elements wedgingly mounting said roller on said shaft against axial displacement; and wherein said piston member has a surface pressing upon said mounting elements for preventing displacement of the same.

12. A combination as defined in claim 8, at least one of said roller and piston member having an inclined engaging surface so configured that said roller and piston engage only in the radially outer region of said roller.

13. A combination as defined in claim 8, said roller and said piston member having respective engaging surfaces; and wherein at least one of said engaging surfaces is provided with an annular recess surrounding said shaft.

14. A combination as defined in claim 8, said roller being of at least two sections which abut in a plane of

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separation inclined to the axis of said roller; and said piston including holding means for holding said sections in abutment.

15. A combination as defined in claim 14, said plane of separation being normal to said axis.

16. A combination as defined in claim 14, said plane of separation being midway between the opposite axial ends of said roller.

17. A combination as defined in claim 8, further comprising cooling passage means on said roller for passage of a cooling medium therethrough.

18. A combination as defined in claim 8, wherein said circumferential surface is inclined with reference to the axis of said shaft.

19. A combination as defined in claim 8, wherein said circumferential surface is cylindrical.

20. A combination as defined in claim 8, wherein said circumferential surface is convex.

21. A combination as defined in claim 8, wherein said circumferential surface is concave.

22. A combination as defined in claim 8, wherein said circumferential surface is profiled.

23. A combination as defined in claim 22, wherein said circumferential surface is composed of two axially adjacent sections each of which is provided with a dif-

ferent profiling.

24. A combination as defined in claim 2; and further comprising an annulus of strongly vibration-damping material interposed between at least one of said members and the roller.

25. A combination as defined in claim 24, said one member being said piston member; and wherein said annulus is at least in part recessed into at least one of said piston member and said roller.

26. A combination as defined in claim 24, wherein said annulus is provided with cut-outs.

27. A combination as defined in claim 2, wherein said shaft has a first portion of a first diameter, a second portion of a reduced second diameter, an abutment ring on said second portion and abutting against a shoulder formed by the same with said first portion, a third portion of a further-reduced third diameter surrounded by said roller, arresting means between said roller and said third portion for arresting the former against movement relative to the latter, and a fourth portion of a further-reduced fourth diameter with said cylinder member surrounding said fourth portion adjacent one axial end of said roller.

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