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(54) CYLINDERS

(71) I, ULRICH REININGHAUS, a citizen of the German Federal Republic, of 5061 Kleineichen, Alte Kölner Strasse 24, German Federal Republic, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a cylinder, particularly a telescopic cylinder for an advancing shield support.

The outer sealing surfaces of a cylinder component which is arranged to move out of a cylinder, for example a hollow piston, an inner cylinder, or an extensible telescopic cylinder component, must be accurately dimensioned and have a very smooth surface. Depending upon the operating pressure and the seals used, the sealing surface must have fit properties between h 7 and h 11 according to German Industrial Standard DIN 7151. For surface smoothness Rt values according to German Industrial Standard DIN 4762 of less than 6 μm are required. It is very difficult to comply with these requirements in the long term if the sealing surfaces are subject to heavy corrosion.

Hitherto the sealing surfaces of cylinder components which are extensible have been protected by coating the surfaces such as by hard chromium plating or chemical nickel plating, or by cladding with corrosion-resistant steels by welding or spraying corrosion-resistant coatings thereon. It is not possible by hard chromium plating or cladding to achieve the required dimensional accuracy and surface smoothness without subsequent machining. During the machining process the parts are therefore brought to the required fit quality and surface quality, thereupon coated or clad, and after this operation are reground to the required values.

This method of producing corrosion-resistant outer surfaces of hollow pistons, inner cylinders, and extensible telescopic cylinder components is expensive, and the surface protection achieved complies only inadequately with practical requirements, particularly when the parts in question are used for long periods in a highly corrosive atmosphere.

According to the present invention there is provided a cylinder for use in a situation where it will be subject to wear and corrosion, wherein a metal carrier tube is provided with an outer protective sheath of a metal which is more resistance to wear and corrosion in said situation than the metal of which the carrier tube is made, the sheath having been produced by flow-forming on a mandrel, and wherein the sheath has been pushed onto the carrier tube and fixedly connected thereto by shrink-fitting it onto the carrier tube, or by expanding the carrier tube. Where the cylinder is an inner cylinder component of a telescopic cylinder, a corresponding thin-walled tube is, if necessary, inserted into the outer cylinder to serve as a running surface. If only little corrosion is to be expected or the inner contour is complicated, chemical nickel plating is preferred.

The wall thickness of the thin-walled tube is preferably from 0·2 to 1 mm. and the tube may be made from a material such as a copper alloy, including bronze and brass, a chrome-nickel steel, particularly stainless steel or titanium or a titanium alloy.

Contact corrosion between the thin-walled tube and the carrier tube can be avoided by constructional measures or by means of an insulating layer which may be an adhesive, such as one which is cured with catalysis by a different chemical potential, or a two-component adhesive, for example an epoxy resin, which cures at room temperature or at elevated temperature. In addition to the advantage of preventing contact corrosion, this adhesive bonding also improves the degree of contact between the cylinder and the tube.

The carrier tube is usually made of a low-alloy steel, aluminium, or an aluminium alloy, or of magnesium or a magnesium alloy. If the carrier tube has to be expanded in order to produce the cylinder, the metal of which the carrier tube is made must be capable of flowing under pressure.

Any thin-walled tubes for internal protection are expediently made of strip metal of suitable width, that is to say from a coil of metal and welded or soldered along a longitudinal seam.

The thin-walled tube can also be produced by helically winding accurately dimensioned strip metal directly around the carrier tube. In both cases the weld seam can be finished flush direct on a welding machine, for example by grinding. When the tube is made directly on the carrier the insulating layer may be applied previously if the connecting weld is made by means of an electron beam, ultrasound, or laser. Another particularly preferred possible method is flow forming onto a mandrel which is the method used for producing the protective sheath.

The necessary dimensional accuracy of the extensible components of the cylinder can be achieved by premachining the carrier tube in the usual manner, taking into account the thickness of the protective tube to be applied over it. No particular attention need be paid to the surface quality of the sealing surface of the carrier tube. If an adhesive or insulating layer is used, this layer is applied to the carrier tube.

All the parts together, that is to say the carrier tube and the protective tubes, are pushed into a die possessing high dimensional accuracy. The carrier tube or the inner tube is provided with connections and placed hydraulically under pressure from inside, so that the metal of the carrier tube, and of the inner protective tube, where applicable, beings to flow. Pressure is applied until the outer tube lies completely against the inner wall of the die and a firm bond has been obtained between the carrier tube and the protective tubes.

Dimensions are so adjusted that the outer protective tube reamins in the elastic region and, after the pressure has been removed, ensures that the entire component will shrink by an amount "x" and can be pushed out of the die. The final dimension should be accurately calculated with the aid of Hooke's law (see "Dubbels Taschenbuch für den Maschinenbau" (Dubbel's Mechanical Engineering Pocket Book), 12th Edition, Springer Verlag 1961, page 329). Any dimensional inaccuracy in respect of the outside diameter is compensated by the different expansion of the carrier tube. On its outside diameter the entire component thus has a dimensional accuracy and a surface quality which requires no further machining. The surface quality of $Rt=6$ μm can be achieved without difficulty, since commercially available sheet materials have substantially better Rt values.

The inner protective tube may also be adhesively bonded in position or rolled. If a carrier tube having an accurate outside diameter is available, the outer tube may be shrunk on or pushed on (see "Dubbels Taschenbuch für den Maschinenbau" loc. cit., pages 609 to 611).

If less heavy stressing is to be expeced and if requriements in respect of dimensional accuracy are less stringent, the carrier tube may also be pressed into the protective tube without a die, by hydraulic expansion or expansion by means of a piston. The above described expansion of the carrier tube, whether effected hydraulically or mechanically, provides the advantage that any insulating layer can be inserted and that a reliably firm bond will be achieved which will withstand thermal stresses.

With greater permissible tolerances and large differences in dimensions between the protective tube and the carrier tube, it is particularly economical to apply the protective tube by stretching longitudinally beyond the flow limit.

With insulating materials consisting of films or paper, the additional advantage is gained by allowing the insulating material to project in order to obtain a better connection and to place it around the baser metal of piston rod heads or cylinder covers, where it serves as additional protection against corrosion to prevent the formation of local elements.

In order to enable the invention to be more readily understood reference will now be made to the accompanying drawings which illustrate diagrammatically and by way of example an embodiment thereof, and in which

Figure 1 is a view, partly in section, of a cylinder, and

Figure 2 is a side view of an underground shield support.

Figure 3 is a cross-section on the line III—III of Figure 2.

Referring now to Figure 1, there is shown part of an inner cylinder consisting of a carrier tube 4 as a main component, a protective sheath 2 in the form of a thin-walled tube, and an interposed insulating layer 3 which insulates the carrier tube both against the higher grade metal of the protective tube and against a piston 1.

Cylinders such as shown in Figure 1 are required particularly as steel telescopic cylinders for supporting the roof shield or break shield in an underground shield support such as that shown in Figure 2. The shield support shown in Figure 2 comprises a floor sill 15 which is disposed on the floor and to the rear end of which a break shield 12 is articulated. The break shield 12 is connected by a joint 14 to a roof shield 13, which is supported at the joint 14 by a telescopic cylinder 5 which is pivotally connected to the floor sill 15.

The telescopic cylinder 5 consists of an outer cylinder 6 and two inner cylinders 7 and 8. As shown in the section on the line A—A in Figure 2 for the middle cylinder 7 of the telescopic cylinder 5, the cylinder 7 comprises an outer shrunk-on protective sheath 9 and an inner protective lining 10. The outer cylinder 6 is constructed in a similar manner, while the inner cylinder 8 is provided only with an outer protective sheath 9. The protective sheaths 9 expediently have a bottom 11.

WHAT WE CLAIM IS:—

1. A cylinder for use in a situation where it will be subject to wear and corrosion, wherein a metal carrier tube is provided with an outer protective sheath of a metal which is more resistant to wear and corrosion in said situation than the metal of which the carrier tube is made, the sheath having been produced by flow-forming on a mandrel, and wherein the sheath has been pushed onto the carrier tube and fixedly connected thereto by shrink-fitting it onto the carrier tube, or by expanding the carrier tube.

2. A cylinder as claimed in Claim 1, wherein the protective sheath consists of a tube of stainless steel.

3. A cylinder as claimed in Claim 2, wherein the protective steel tube has a thickness of from 0·2 to 1 mm.

4. A cylinder as claimed in any one of Claims 1 to 3, wherein the protective sheath has been firmly bonded to the carrier tube by expanding the latter in a die.

5. A cylinder as claimed in any one of Claims 1 to 4, wherein an insulating layer is disposed between the cylinder and the protective sheath.

6. A cylinder as claimed in Claim 5, wherein the insulating layer is drawn over the end of the inner cylinder.

7. A cylinder as claimed in any one of Claims 1 to 6, wherein the cylinder is a telescopic cylinder for an advancing shield support.

8. A cylinder substantially as hereinbefore described with reference to the accompanying drawings.

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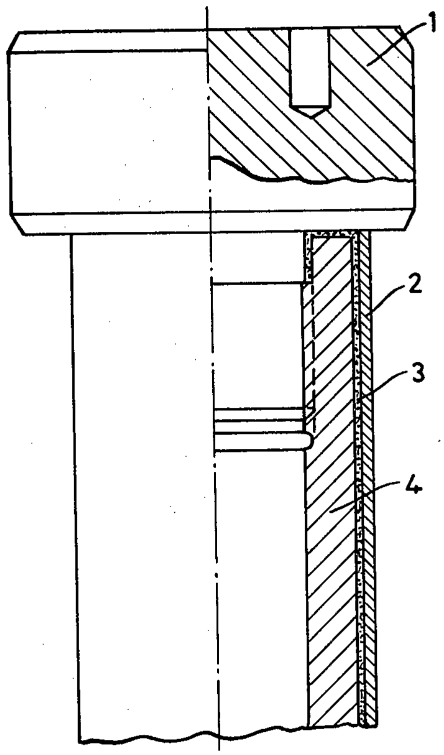
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1



1592090 COMPLETE SPECIFICATION

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Sheet 2

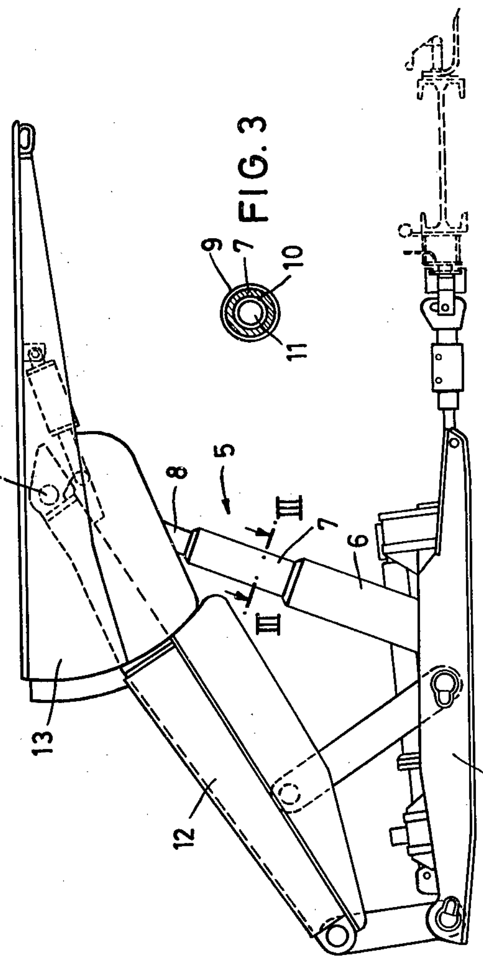

FIG. 2

FIG. 3