Dec. 17, 1946. E. G. DE CORIOLIS 2,412,802

METHOD OF CARBURIZING ONE SIDE ONLY OF RELATIVELY SHORT TUBULAR PARTS

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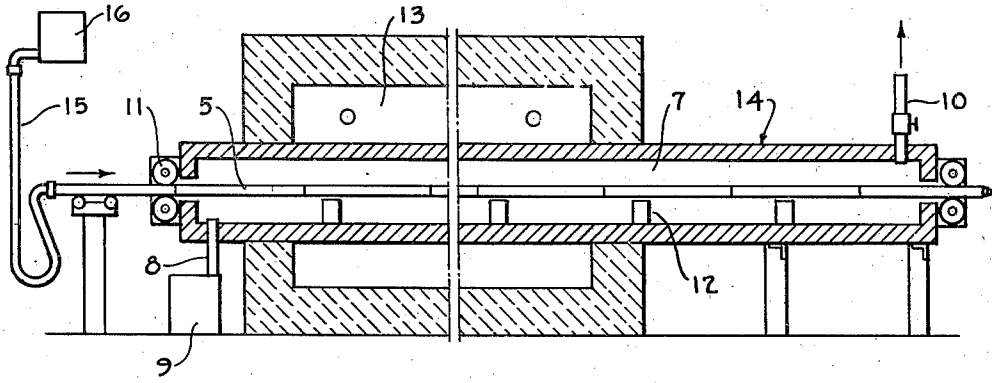



FIG-1

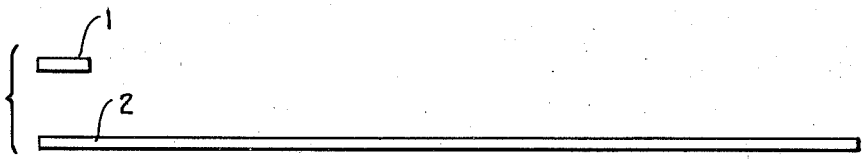



FIG-2

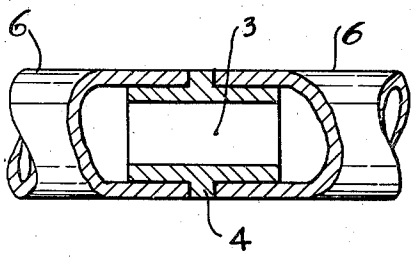



FIG-3

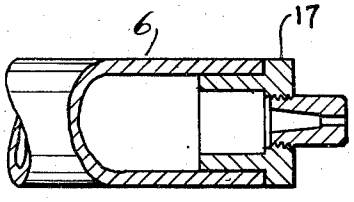



FIG-4

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## METHOD OF CARBURIZING ONE SIDE ONLY OF RELATIVELY SHORT TUBULAR PARTS

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3 Claims. (Cl. 148—17)

1

This invention relates to ways and means for heat treating tubular machine parts, such as piston pins for internal combustion engines, in a manner to produce a wear resisting surface or diffusion alloy case on one side without also producing a similar case on the opposite side so that the last mentioned side may be left relatively soft to impart toughness to the part.

Various schemes have heretofore been proposed for producing piston pins which are case hardened on the outside and soft on the inside. One scheme involves carburizing a solid rod of piston pin length and then, before quenching to harden, boring the necessary axial hole in the rod. This method is obviously wasteful of steel. Another scheme involves starting with tubular pieces of piston pin length, placing a number of these pieces on a spindle type fixture having cap means at its ends for clamping the pieces tightly together at their ends with the object in view of making the interior of the assembly gas-tight, and then exposing the assembly to the action of a carburizing gas. However, aside from the trouble involved in handling the pieces in this way it is extremely difficult in practical operation to make the joints between the pieces sufficiently gas-tight to entirely prevent carburization of the inner side of the pieces due to infiltration of carburizing gas through the joints. Another scheme involves copper plating the inside of tubular pieces, but this results in troubles not necessary to discuss.

The present invention aims to provide an improved method for the purpose stated. For a consideration of what I believe to be novel and my invention attention is directed to the following specification and claims appended thereto.

In the accompanying drawing,

Fig. 1 is a schematic vertical longitudinal section of one type of continuous case forming furnace that may be utilized in the practice of the present invention.

Fig. 2 shows the comparative lengths of a piston pin and a much longer piece of tubing from which the pin may be cut.

Fig. 3 is an axial sectional view of a tubular connector that may be employed in connection with the present invention.

Fig. 4 is an axial section of a throttling orifice plug that may be employed in connection with the present invention.

In the practice of the present invention it is preferred for reasons presently appearing that the tubing to be treated shall be of the usual stock length rather than of the much shorter

2

length of the rough finished machine part. In Fig. 2, reference numeral 1 may be said to represent a piece of tubing of piston pin length and 2 a piece of tubing of stock length, it being noted that the latter is many times longer than the former.

In accordance with the present invention the tubing is passed through a furnace chamber wherein it will be heated to case forming temperature in the presence of a carburizing gas. The formation of the desired case is a matter of hours, say, about six hours, and the furnace will therefore be a relatively long affair, say, about 40 feet. The tubing is passed through the furnace in end to end relation as a string of greater length than the furnace so that the ends of the string will extend beyond both ends of the furnace whereby to permit a protective gas to be passed through the string to prevent infiltration of carburizing gas through the joints of the string from having any objectional effect on the inside of the tubing. It is, of course, desirable that the joints of the string shall be relatively gas-tight for the double purpose of preventing objectional leakage of gas either into or out of the string. The tubes are held in end to end relation in any preferred way as by means of tubular fittings 3 insertable into the ends of the tubes, the fitting preferably having an exterior circumferential shoulder 4 against which the ends of the tubes abut.

In the drawing, 5 indicates a string of tubes 6 which are being passed through a case forming furnace from the left towards the right as viewed in Fig. 1. The furnace comprises a gas-tight tunnel 7 wherethrough the tubing is passed for heating to reaction temperature in the presence of a carburizing gas maintained in the tunnel as by means of a supply pipe 8 leading from a source of supply 9 of such gas. Spent gas flows from the tunnel by way of a vent pipe 10 at the far end of the tunnel. At the front end of the tunnel is a pair of tube gripping rollers 11 for forcing the tubes through the tunnel. Inside of the tunnel there are suitable supports 12 for preventing objectional sagging of the tubes. The major portion of the tunnel from its tube entering end is surrounded by a combustion chamber 13 for maintaining a zone in the tunnel at case forming temperature. The remainder 14 of the tunnel at the right of the combustion chamber constitutes a slow cooling zone for the tubing emerging from the heating zone.

A protective atmosphere is maintained in the string of tubes by introducing it thereinto under

suitable head into the last tube of the string by any preferred means as by a flexible conduit or hose 15 leading from a source of supply 16. At the leading end of the string is an orifice plug 17 to insure that the pressure of the atmosphere inside of the string shall be slightly greater than that of the ambient case forming atmosphere which surrounds the string. It will be understood that before the tail end of the string passes into the furnace a new tube will be added and the gas supply hose 15 shifted to the tail end of the new tube and that after the leading tube of the string has emerged from the furnace it is uncoupled from the string and the orifice plug shifted to the new leading end of the string.

It will be understood that after the tubing has been heat treated as described, it is ready to be cut up into appropriate lengths depending on the length of the machine part desired, as piston pins, and that reheating and quenching are required to harden the case produced as said.

If the machine part is such as to require a hardened wear surface on its inside rather than on its outside, the case forming atmosphere will be passed through the string of tubes and the neutral atmosphere will be maintained in the furnace chamber as will now be readily understood.

Although the invention has special utility in connection with the carburizing, it is believed to be obvious that the case forming gas may be something other than a carburizing gas as, for example, a nitriding gas.

From the foregoing it will be readily appreciated that the present invention solves in a relatively simple way the problems heretofore encountered in limiting the production of a diffused alloy case to one side only of a tubular machine part such as piston pins and the like.



What is claimed as new is:

1. The method of producing a diffusion alloy case on one side only of lengths of steel tubing which comprises passing the same through a furnace chamber as a substantially continuous string which extends beyond the ends of said chamber and which is substantially relatively gas-tight at the joints, maintaining a case forming atmosphere in said chamber and a substantially neutral atmosphere in said string, and heating said lengths of tubing to case forming temperature as they pass through said chamber.

2. The method of producing a diffusion alloy case on one side only of lengths of steel tubing which comprises passing the same through a furnace chamber as a substantially continuous string which extends beyond the ends of said chamber and which is substantially relatively gas-tight at the joints, maintaining one kind of an atmosphere in said chamber and another kind of an atmosphere in said string, one of said atmospheres being a substantially neutral atmosphere and the other a case forming atmosphere, and heating said lengths of tubing to case forming temperature as they pass through said chamber.

3. The method of producing a carburized case on the outside only of lengths of steel tubing which comprises passing the same through a furnace chamber as a substantially continuous string which extends beyond the ends of said chamber and which is substantially relatively gas-tight at the joints, maintaining a carburizing atmosphere in said chamber and a substantially neutral atmosphere in said string, and heating said lengths of tubing to carburizing temperature as they pass through said chamber.

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