Dec. 30, 1947. T. C. JARRETT ET AL 2,433,457

CHROME PLATED WEAR RESISTING SURFACE

Filed April 29, 1944 2 Sheets-Sheet 1

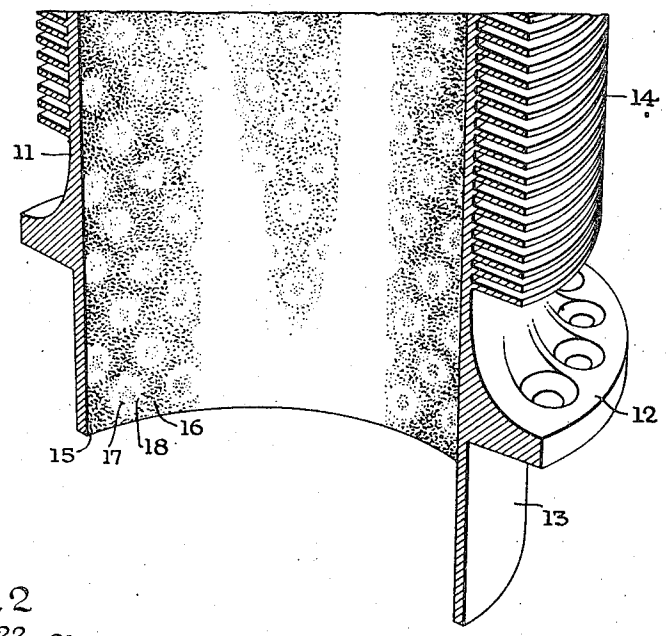
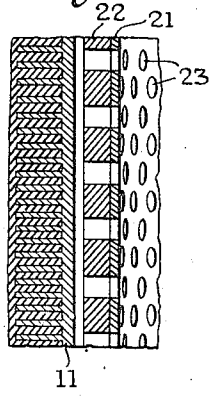


Fig. 1

Fig. 2



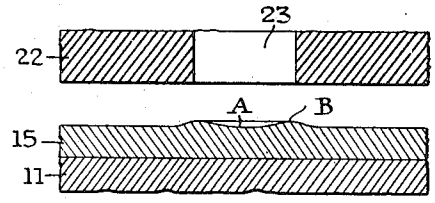


Fig. 3
PLATED

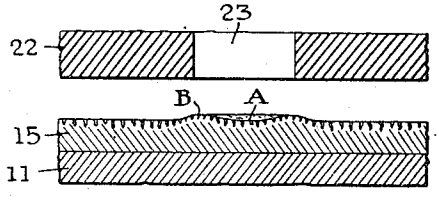


Fig. 4
PLATED AND ETCHED

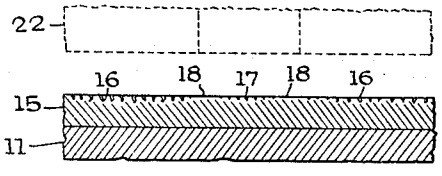


Fig. 5
AFTER HONING

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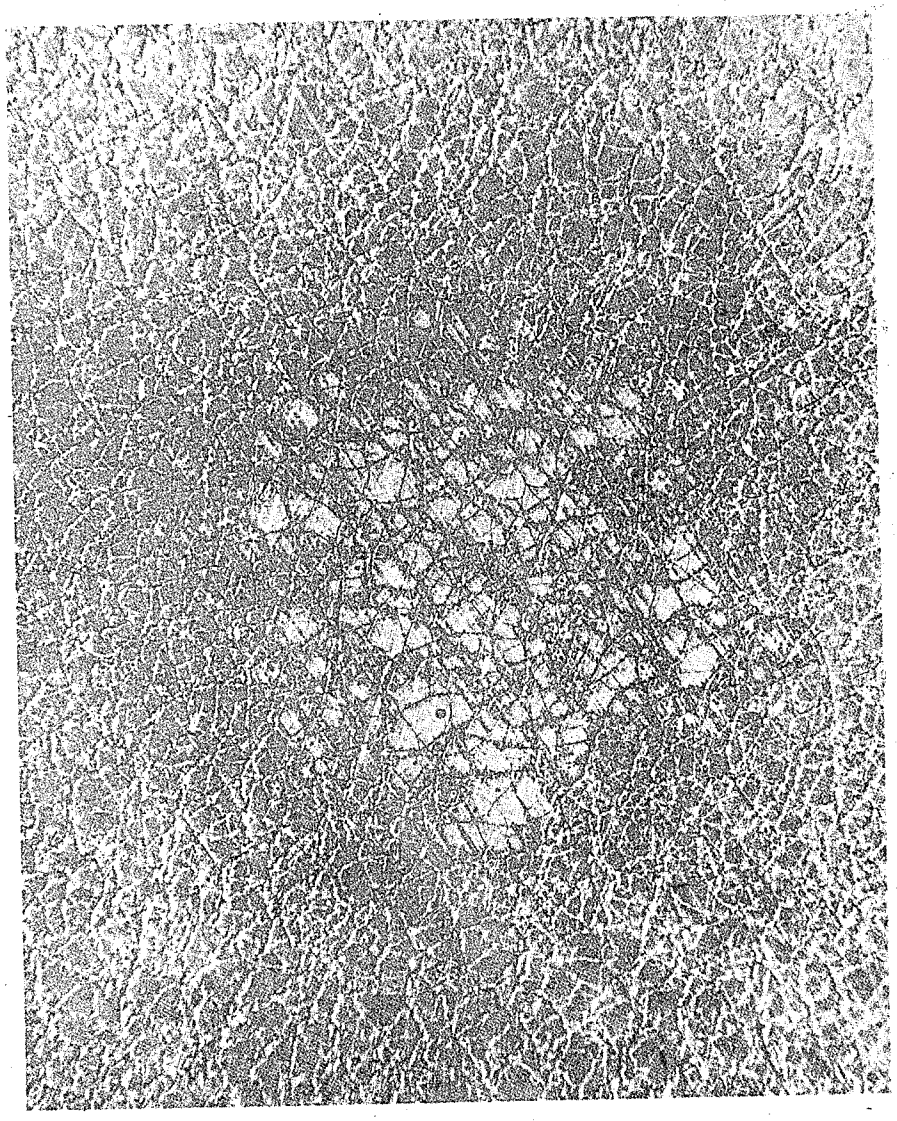
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Filed April 29, 1944 2 Sheets-Sheet 2

Fig. 6



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2,433,457

CHROME PLATED WEAR RESISTING SURFACE

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Application April 29, 1944, Serial No. 533,373

2 Claims. (Cl. 308—241)

1

This invention relates to wear-resisting surfaces for guides, bearings, journals and like parts, and is considered particularly desirable for cylinders and pistons especially in internal combustion engines.

Since the invention has been used chiefly in connection with the cylinders of large aircraft engines it will be described as so applied, but by way of example merely.

Because of its hardness, and the uniformity with which it can be electroplated, it has been proposed to plate the bores of engine cylinders with chromium. Difficulty was encountered with smooth hard chrome as it scores, possibly because the chromium does not retain a protective film of lubricating oil.

To meet this condition van der Horst proposed in Patent 2,314,604 March 23, 1943, a special plating procedure involving a final electrolytic etching treatment of the surface of the plated chromium. If the etching is carried out under properly controlled conditions, the plated surface is given a channeled or porous texture which effectively retains lubricating oil. On a plate layer say 0.0075" thick the porous surface may have a depth of 0.0022" so that the integrity of the plate is not unduly affected and the improved lubricating effect has made practical the use of chrome plated cylinders.

After plating and etching, the cylinder is honed to final form.

The present invention is based on the concept that it is desirable to diversify the bearing area as to the degree of porosity. According to the preferred practice areas differing in the degree of porosity are interspersed according to an approximately uniform pattern.

Such a patterned surface might be developed in several ways, the simplest of which is to plate by using a perforated cylindrical hollow anode, as described and claimed in our application Ser. No. 533,374 filed April 29, 1944, now abandoned.

The invention will now be described as applied to engine cylinders, reference being made to the accompanying drawings, in which:

Figure 1 is a perspective view of a longitudinally split airplane engine cylinder indicating the size and arrangement of porous spots on the finished cylinder bore, as successfully used according to the invention.

Figure 2 is a fragmentary section showing the relationship of the perforated anode and the cylinder wall when plating and etching according to the method of our related application.

Figures 3, 4 and 5 are exaggerated diagram-

2

matic sections for use in explaining the invention. These figures are not drawn to scale. Figure 3 shows the plate produced by use of the perforated anode, before etching. Figure 4 shows the same plate after etching, and Figure 5 shows the final condition after honing. In each case the position of the perforation in the anode, with reference to the plated surface is indicated.

Figure 6 is a half-tone reproduction of a photomicrograph of one spot and a portion of the surrounding area magnified 25 diameters. The original of the photomicrograph from which the half-tone was made and a small section of the cylinder wall are filed with the application as specimens.

Referring to Figure 1, a portion of an airplane engine cylinder appears at 11. This has a base flange 12, shirt 13 and heat radiating fins 14 which are shown as integral with the cylinder but commonly are applied as a separate unit.

The surface of the cylinder bore has a layer of electroplated chromium 15. In the example illustrated the surface of the layer 15 is porous as indicated at 16 and is characterized by the presence of spots 17 which are somewhat less porous, each spot being surrounded by a ring shaped area 18 in which the chromium may be denser or harder, and in any event is decidedly less porous. These ring-like areas 18 afford good guiding characteristics while the porous areas 16 and 17 afford excellent oil retention characteristics.

The operating performance of cylinders so surfaced is uniformly excellent.

This and other patterns can be produced by electroplating and etching methods of various specifically different types, but the illustrated surface was produced by the method of our copending application in which a perforated anode is used.

This is suggested in Figure 2 which shows a portion of the cylinder 11 and a cylindrical anode supposedly immersed in a suitable electrolyte. The anode is made up of a sustaining tube 21 with a sheath 22 of lead or lead alloy. This is formed with radial perforations 23 which are, say $\frac{1}{16}$" in diameter and spaced $\frac{5}{8}$" on centers in a staggered or equilateral triangle arrangement. The anode is coaxial with the cylinder, both are vertical, and the interval between anode and cylinder surface is commonly about 0.3" for a six inch cylinder but is subject to variation.

After electroplating using appropriate electrolyte and current density it will be found that the cylinder wall will be plated to a substantially

uniform thickness from end to end and completely around its circumference, but will present slight local irregularities which are exaggerated in Figure 3. In Figure 3 is indicated a sort of crater A which becomes the spot 17, surrounded by an annular rim B which becomes the ring 18. The cause for this is believed to be differences of current density which are significant because of the poor throwing power of chromium electrolytes.

The rim B is formed, probably because the ratio of anode area to coacting cathode area is increased by activity of a portion of the surface of the bore of the opposed hole 23. This implies a locally increased current density, not effective in the crater A nor in the area surrounding B. This rim may be harder or denser but this is not established as a fact.

Conditions after electrolytic etching are indicated in Fig. 4. Here portions of the plate opposite solid portions of the anode 22 are deeply etched and the crater A is somewhat less deeply etched, probably because the hole 23 in the anode reduces the efficiency of the etching operation. The rim B is still less effectively etched possibly because it is harder and denser, and hence resists etching. The fact is clear but the suggested reason is based on inference and not proved.

Conditions after honing are indicated in Fig. 5. The surface is leveled off, the rim B having been removed, so that the finished form is attained comprising a moderately porous spot 17, surrounded by ring 18 of less porous, and indeed nearly smooth chromium. Outside the ring is the area of porous chromium 16 characteristic of the Van der Horst process.

As above suggested Figs. 3–5 are not to scale, the thickness of the plate and the depths of surface configurations being greatly exaggerated as compared to the size of the hole 23 and the anode-cathode interval.

Figure 6, subject to the limitations of views of this type, gives an idea of the finished surface, but suggests a much rougher surface texture than is actually present.

The description given by reference to Figures 3 to 5 is probably an over simplification of the actual

effects, some of which are uncertain and all of which are subject to unavoidable irregularity.

In any event the ringed spots are visible and well defined after the honing operation. The porous areas do retain oil. Cylinders so treated have shown, under severe operating conditions, long life and consistent performance. They proved to be a decided improvement upon chrome plated cylinders uniformly etched all-over, and an even greater advance over chrome plated cylinders not etched at all.

While one embodiment has been described in considerable detail this is exemplary merely. The invention can be used for various bearing surfaces, convex as well as concave and may be practiced by the use of processes other than the one briefly described. A cylinder which must withstand the wear of piston rings is believed to present the most difficult problem likely to be encountered.

What is claimed is:

1. A wear resistant bearing member having a surface layer of electroplated chromium, said surface layer presenting a recurrent pattern in which areas of dense, substantially smooth chromium are interspaced in areas of porous chromium.

2. A wear resistant bearing member having a surface layer of electroplated chromium, said surface presenting a recurrent pattern in which spaced ring-like areas of dense, substantially smooth chromium surround and are surrounded by other areas of porous chromium.

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ROBERT D. GUERKE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
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2,187,626	Merriman	Jan. 16, 1940
2,268,869	Given	Jan. 6, 1942

FOREIGN PATENTS

Number	Country	Date
524,036	Great Britain	July 29, 1940