Oct. 31, 1961 H. PENNINGTON 3,006,837

APPARATUS FOR ELECTROPLATING METAL CYLINDERS EQUIPPED WITH PORTS

Original Filed April 11, 1952

Fig. 1.

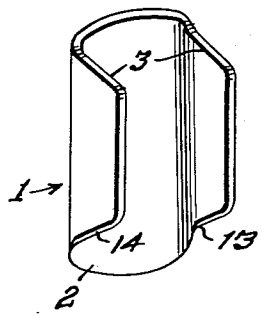


Fig. 2.

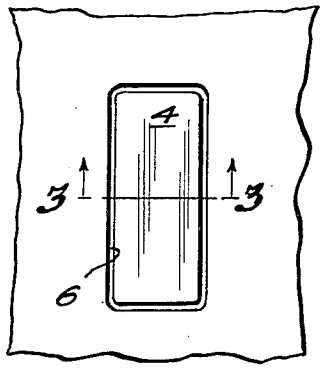


Fig. 3.

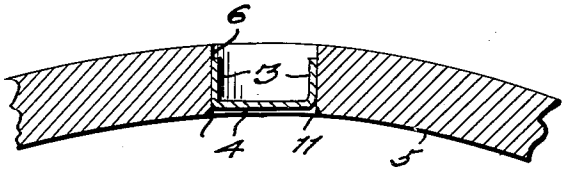


Fig. 4.

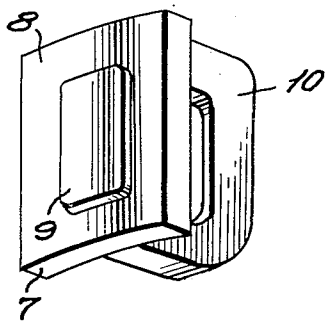


Fig. 5.

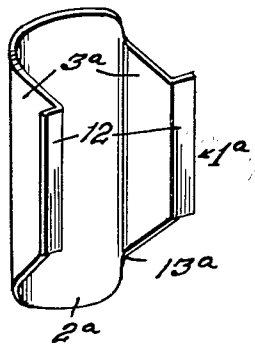


Fig. 7.

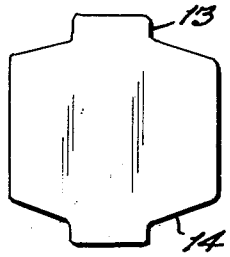
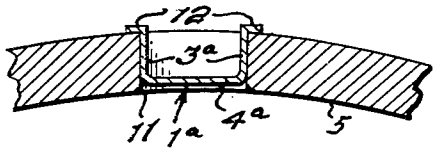


Fig. 6.



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United States Patent Office 3,006,837 Patented Oct. 31, 1961

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APPARATUS FOR ELECTROPLATING METAL CYLINDERS EQUIPPED WITH PORTS

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Original application Apr. 11, 1952, Ser. No. 281,824. Divided and this application Nov. 2, 1954, Ser. No. 466,362

1 Claim. (Cl. 204—280)

This invention relates to apparatus for electroplating metal cylinders equipped with ports; and it comprises in combination a metal cylinder, a wall of which is to be electroplated and which has ports intermediate its ends, and a plurality of port bleeders constituting channel-shaped elements of a corrosion-resistant metal, each having a substantially flat section conforming in shape to the shape of said ports, said port bleeders being removably secured in and serving to close off said ports with the flat sections depressed slightly below the wall of the cylinder which is to be plated, said port bleeders being electrically conductive, whereby when the cylinder is electroplated they receive a deposit of metal and the metal deposited on the cylinder wall is smoothly rounded over the edges of the ports; all as more fully hereinafter set forth and as claimed.

This application is a division of my copending application Serial No. 281,824, filed April 11, 1952, now abandoned and covers the port bleeders which are employed in the process of chromium plating which is described and claimed in said application. In this prior application it is explained that the liners and cylinders of several types of internal combustion engines have been chromium plated for many years with excellent results. In the plating process the liner or cylinder is immersed in a chromium plating bath and made the cathode. The anode is placed inside the bore. Ring bleeders are placed at both ends of the bore to prevent the chromium deposit from building up and "treeing" on the inside surface. It is possible to chromium plate liners and cylinders in this fashion to extremely close tolerances.

When it was attempted to extend this chromium plating process to the plating of the cylinders and liners of two-cycle engines of the diesel type, for example, various difficulties arose. These particular engines have in their cylinders a ring of ports for scavenging air substantially midway between the ends of the bores. When an attempt was made to chromium plate these bores in conventional manner it was found that the plating built up not only around the edges of the ports but also on the bridges between the ports to such an extent that it was impossible to produce chromium plated bores within the tolerances permitted. Areas of thin deposit were produced and striations were formed in the plating. The same difficulties arose in the plating of free-piston cylinders and liners which have two sets of ports located a distance from the middle of the liner, which is equal to the piston strokes plus a distance required for pistons and rings to clear the ports, these ports admitting supercharged air through one set and discharging exhaust gases through the other set. There are also diesel fuel injection nozzle holes located in the middle and lubricating oil holes through which lubricating oil is injected into the liners. While the usual tolerances for the internal diameters of such cylinders and liners are no greater than 2 to 3 thousandths of an inch, the thickness of the chromium plating produced in conventional fashion in the annular belts including the port areas frequently came to 0.01 inch or more above that outside this belt. It is not feasible to hone a belt of this character to the required tolerance, since excessive honing would reduce the depth

of lubricating oil channels in channel-type chromium and therefore interfere with perfect lubrication locally.

Experience has shown that the heavy deposits of chromium on the edges of the ports and on the bridges between the ports which are caused by the conventional chromium plating of cylinders and liners having intermediate ports, are struck by the piston rings and that this causes sufficient damage either to the deposits, to the rings and/or to the pistons to disable the engines or seriously to shorten their lives.

In the chromium plating of the bores of cylinders and liners of internal combustion engines the bores are usually held vertically in the plating bath usually with the head end up. When these bores are provided with intermediate ports, as in the case of two-cycle and free-piston engines, it has been found that the openings cause turbulence of the bath just above the ports. This turbulence results in thinner than normal chromium and it causes striations to be formed in the chromium plating. These striations are vertical and usually cannot be removed completely by honing. These striations and thin chromium areas bridge the piston rings in the high pressure areas preventing the piston rings from making a tight seal with the walls of the bore and thus causing loss of power due to gas blow-by past the rings.

As described in my acknowledged copending application I discovered a simple way of overcoming the described difficulties involved in the plating of cylinders and liners which have ports intermediate their length. This involves inserting prior to the chromium plating procedure my novel port bleeders in the ports of the cylinders or liners with their substantially flat faces slightly depressed beneath the surface to be plated. The flat metal surfaces of these bleeders receive the chromium deposit which otherwise would build up on the edges of the ports. If inserted flush with the surface to be plated and then removed after the plating operation sharp edges are left around the ports. But I discovered that, if the bleeders are inserted with their flat surfaces slightly below the surface to be plated the chromium forms a smoothly rounded deposit covering the edges of the ports. The inside edges of these ports are usually chamfered and when these are plated, using my new bleeders, the chromium follows the chamfered edges leaving no sharp edges at the liner wall. The chromium is deposited in uniform thickness throughout the bores and well within the tolerances permitted. Striations and thin areas of deposit are eliminated. This enables retention of a continuously tight operating seal between the piston rings and the wall of the bore thus sustaining engine power.

My invention can be described in greater detail by reference to the accompanying drawing which shows, more or less diagrammatically, two embodiments of my port bleeder. In this showing,

FIG. 1 is a perspective view of one of my port bleeders of simple type,

FIG. 2 is a partial view in elevation of the inside surface of a cylinder showing a scavenging port with one of my bleeders inserted therein,

FIG. 3 is a partial transverse sectional view of a liner showing a port fitted with the bleeder of FIG. 1, the section being taken along the line 3—3 of FIG. 2.

FIG. 4 is a perspective view of a tool which can be used to insert from the inside the bleeder of FIG. 1 to a predetermined distance below the inner surface of the bore of a liner or cylinder.

FIG. 5 is a perspective view of a modified form of port bleeder adapted to be inserted in the port of a liner from the outside to a predetermined depth,

FIG. 6 is a partial transverse section taken through

a liner and showing an end view of the liner of FIG. 5 in position in one of the ports of the liner, while

FIG. 7 is an elevation of a blank from which the bleeder of FIG. 1 can be made.

In the various figures like parts are designated by like reference numerals.

From FIGS. 1 and 7 it is evident that in one form my port bleeder, shown generally at **1**, can be made directly from sheet metal using a simple die punching and forming operation. FIG. 7 shows the blank cut from sheet metal. The bleeder has a substantially flat central section **2** and two wings or spaced-parallel flanges **3** at right angles to the flat section. The flanges are narrower than the flat sections of the bleeders, being cut away at points **13** where the flanges join the flat sections. The outer edges of the flanges are beveled as at **14**. This assists in inserting the bleeders into the ports. Thus, if the end of a bleeder is inserted in a port and then twisted so that its flanges enter the port, the walls of the port assist in compressing the flanges together. The beveled edges also assist in centering the bleeders in the ports. The contour of the flat section of the bleeder conforms to the shape of the port in which the bleeder is to be inserted, being usually rectangular with rounded corners, as seen clearly from FIG. 2. The operating face **4** of the bleeder receives a chromium deposit and this face is depressed slightly below the surface of the bore, as shown best in FIG. 3 where the liner is shown at **5** and a port at **6**. The bleeders are made of a resilient metal, such as steel, and the flanges are bent apart at their outer ends so they diverge slightly. The flanges press against the side walls of the port and have sufficient resilience to hold the bleeders firmly in position once they are set. I prefer to make them from stainless sheet metal having a thickness of approximately 0.025 inch.

The bleeders of FIG. 1 can be set a predetermined distance below the surface of the bore by the simple tool shown in FIG. 4. This consists of a block **7** of wood or the like whose face **8** is advantageously arcuate to conform in shape to the bore of the cylinder or liner. The face of the block is provided with a raised section **9** which may be rectangular plate of metal secured to the block and this raised section is also advantageously provided with a curved face to conform to the curvature of the bore. The height of the raised section of the block corresponds to the depth to which the bleeder is to be inserted in the bore of the cylinder or liner. The dimensions of the raised section are somewhat smaller than those of the port. A handle **10** can be provided at the rear of the tool. In use the bleeder is inserted part way into a port and the raised section of the tool is then pressed against the face of the bleeder until the raised section seats in the port and the face of the block becomes flush with the face of the bore. The bleeder is thus depressed beneath the surface of the bore a distance corresponding exactly to the thickness of the raised section of the tool.

When in position in the ports of a liner or cylinder my bleeders should be depressed below the surface of the bore a distance substantially corresponding to the depth i.e. the radius of the chamfer **11**. When thus positioned the chromium deposit is smoothly rounded over the edges of the bores.

In FIGS. 5 and 6 a modified port bleeder is shown generally at **1***a*. This bleeder is provided with spaced parallel flanges **3***a* whose outer ends terminate in diverging right-angle end flanges **12** which lie in a plane parallel to that of the flat section of the bleeder. This bleeder is inserted into the ports of the liner from the outside. The flanges **3***a* have a length which corresponds to the depth of the ports minus the distance to which the bleeders are depressed beneath the bore of the liner. When these bleeders are forced into the ports the diverging flanges serve as means for preventing further insertion of the bleeders when they reach their predetermined positions in the ports.

In the plating process making use of my port bleeders a free-piston or a two-cycle engine liner, for example, which has been prepared ready for plating is equipped with ring bleeders at both ends of the bore and my port bleeders are inserted in each of the ports to the correct depth. The so-equipped article is then introduced into a chromium or other plating bath below the surface of the bath. A suitable cylindrical anode is positioned axially in the bore with proper clearance and the plating operation is then conducted in conventional manner. After plating the plated liner is removed from the bath and the bleeders are removed from the ports. The plated bore is then usually honed in conventional fashion. In many tests I have found it possible to chrome liners having ports to a predetermined diameter with a tolerance of only 0.0005 inch throughout.

The port bleeders can be used twice and then stripped by inserting them in the ports of a worn liner while the chrome plate of the latter is being stripped. A double thickness of chrome plate on the bleeders is readily removed during the conventional stripping operation and then the bleeders are suitable for reuse.

While I have described what I consider to be the most advantageous embodiments of my invention it is evident of course that various modifications can be made in the specific structures of my bleeders which have been described without departing from the purview of this invention. Thus it would be possible to employ bleeders having four spring flanges instead of two although the two flanges which have been described are adequate to hold the bleeders in position during the chromium plating. When two flanges are employed it is a simple matter to press the flanges together with the fingers when the bleeders are being inserted in a port while this could not be done readily with four flanges. It is evident that my bleeders can be used in the electro plating of the surfaces of all types of metal elements of cylindrical shape which have ports of any type intermediate their ends. Thus my bleeders can be used in diesel fuel injection nozzle holes, in lubricating oil holes, in all the ports of the cylinders and liners of free piston engines etc. with the result of successfully eliminating high chromium on and adjacent the edges of all these openings, and elimination of striations and low-chromium areas in the deposits above the holes when plated vertically. They are, of course, particularly useful in plating such surfaces from plating baths which have low throwing power. Metals other than chromium, such as nickel and cadmium, can be deposited with advantage making use of my bleeders in operations requiring such use. While the particular metal used in making my bleeders is not important it is advantageous to employ a metal which is corrosion resistant as well as being resilient. Bronze can be used in some cases. It is possible, of course, to plate the bleeders with a corrosion resistant metal in order to prolong their life. The bleeders must obviously be electrically conducting in order to perform their function. In the case of plating articles having large openings it is advantageous to have the metal-receiving faces of the bleeders conform in curvature to the curvature of the surfaces which are being plated. The bleeders can be used in the plating of either the outside or the inside surfaces of cylinders or the like. Further modifications of my bleeder which fall within the scope of the following claim will be immediately evident to those skilled in this art.

What I claim is:

A combination of units especially adapted for electroplating operations which comprises:

(*a*) a metallic cylindrical wall liner structure for internal combustion engines having at least one port intermediate its ends,

(*b*) a port bleeder located in each of said ports,

(*e*) each of said port bleeders being channel-shaped,

(*d*) each of said port bleeders having a substantially flat central section conforming in shape to the shape of the ports of said cylinder,

(*e*) each of said port bleeders having spaced parallel flanges on opposite sides of said flat section whose outer ends diverge slightly and which press against the side walls of said ports so as to hold the bleeders resiliently in position during the plating operation,

(*f*) each of said port bleeders serving to close off the port it is located in,

(*g*) each of said port bleeders having its said flat section depressed slightly below the interior surface of said metallic cylindrical wall structure,

(*h*) said port bleeders being electrically conductive so that when the said wall structure is plated, the port bleeders receive a deposit of metal and the metal deposited on the cylinder is smoothly rounded over the edges of the ports.

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