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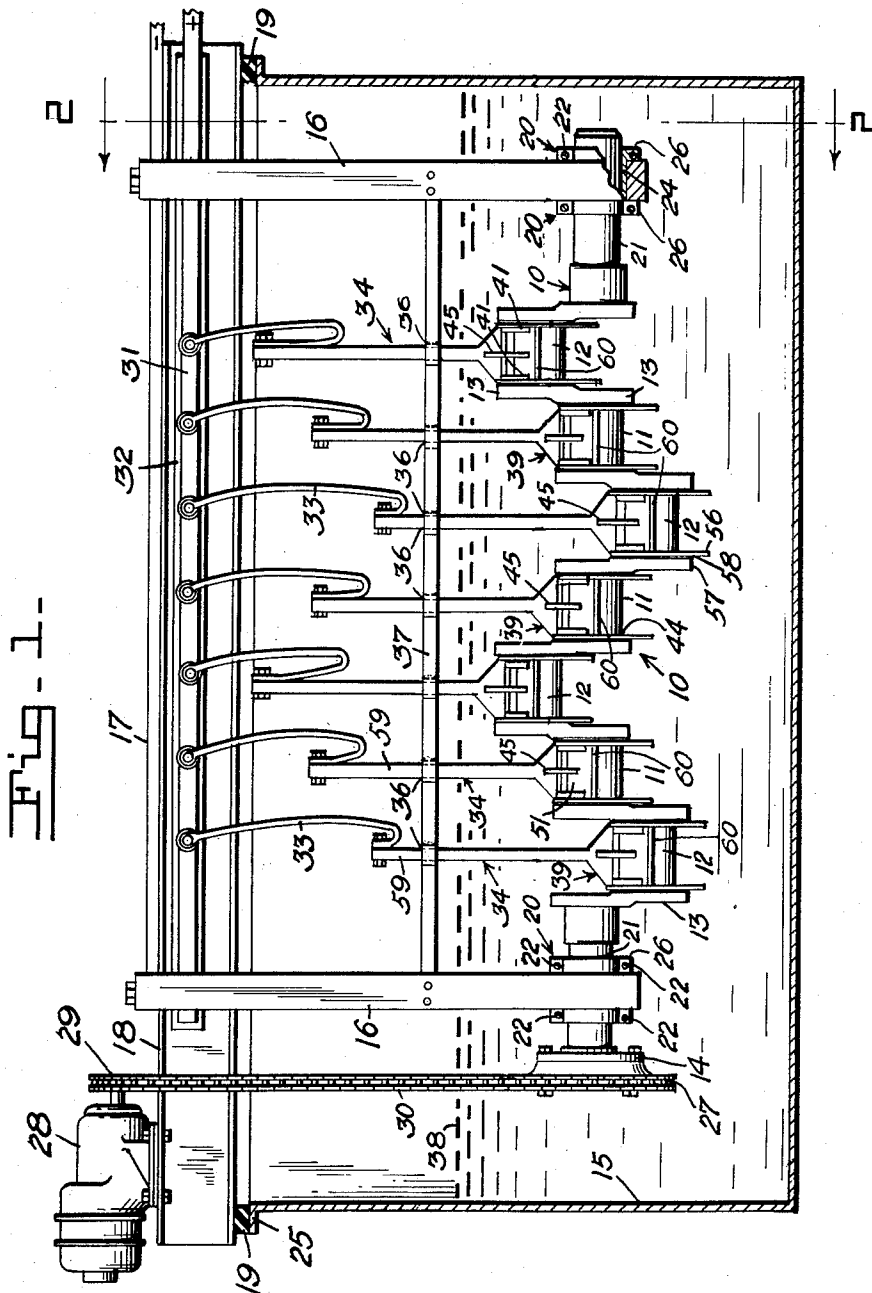
E. L. BERKENKOTTER ET AL

2,530,677

APPARATUS FOR PLATING CRANKSHAFTS

Filed Jan. 17, 1946

3 Sheets-Sheet 1



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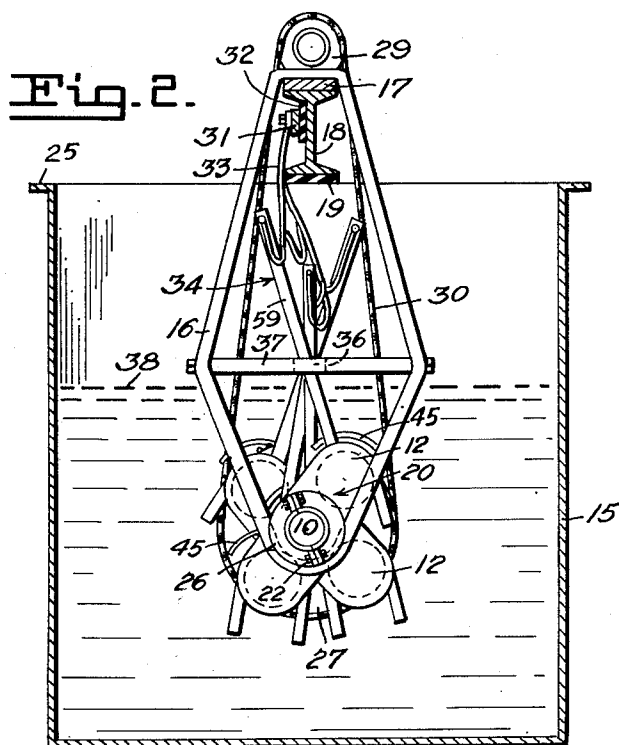
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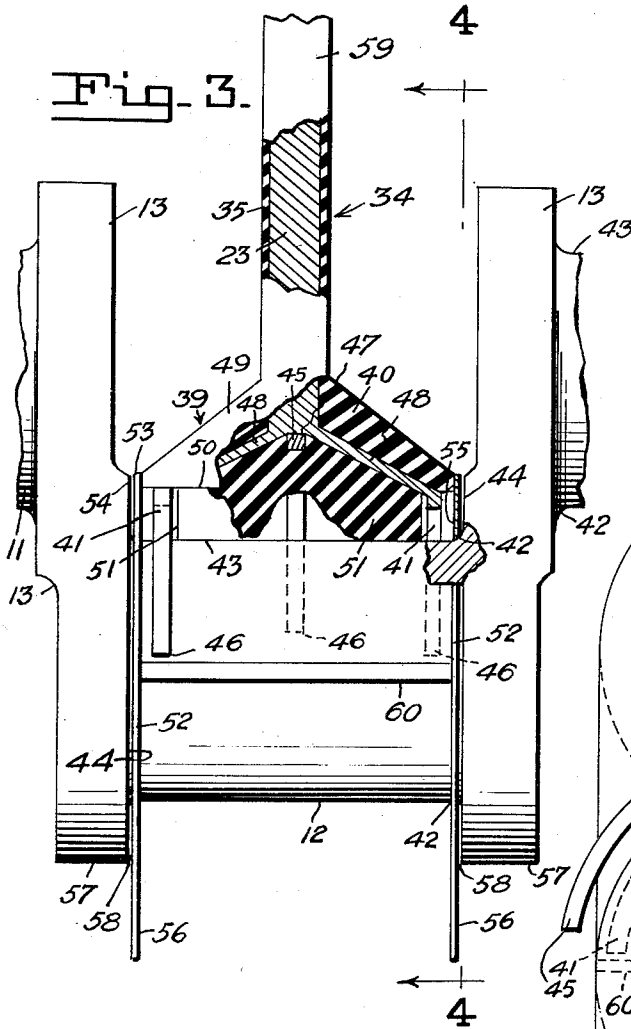
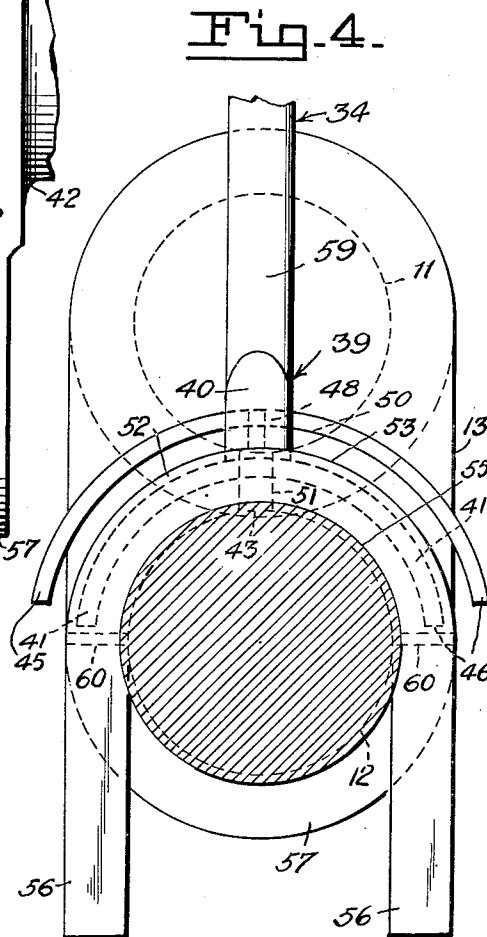
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UNITED STATES PATENT OFFICE

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APPARATUS FOR PLATING CRANKSHAFTS

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3 Claims. (Cl. 204—224)

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This invention relates to apparatus for plating crankshafts; and it comprises a plating tank containing a plating bath, means for rotatably suspending in said plating bath a crank shaft having a plurality of bearing surfaces and intermediate cheek plates, a series of anode supporting structures comprising arcuate anodes, depending spacing elements and means for masking said cheek plates, means for suspending said anode structures in said bath above said bearing surfaces with said spacing elements resting on said bearing surfaces with the arcuate anodes concentric with said bearing surfaces and with the masking means screening said cheek plates, means for rotating said crank shaft axially, means for moving said anode structures with a planetary motion through said bath in paths corresponding to the paths described by said bearing surfaces but without rotation with said bearings, whereby the bearings revolve relative to the anodes, and means for passing an electric current from said anodes to said bearing surfaces serving as cathodes; all as more fully hereinafter set forth and as claimed.

The principal objects of our invention are to provide a method of and apparatus for plating the bearing surfaces of crank shafts with a metal, such as chromium, for example; to provide a method which will ensure an even and uniform deposit of metal on said bearing surfaces; to provide a method in which the crankshaft is rotated in a plating bath thereby ensuring agitation of the bath in proximity to the surfaces to be plated and eliminating gas bubbles on said surfaces as well as stagnant pockets of electrolyte between the anodes and said surfaces; to provide a method of holding the anodes in accurate spaced relationship with the surfaces to be plated during their passage through said plating bath; to provide protection for the surfaces other than those to be plated whereby no metal deposit is formed on said surfaces, and to provide an apparatus which is suitable for rotatably supporting a crankshaft in a plating bath and for conducting the process as described.

The crankshafts for internal combustion engines, such as automobile engines, are manufactured from steel and are provided with main bearing surfaces, which serve to support the shaft in bearings in the crank case of the engine, and with off-set crank bearing surfaces serving as journals for the connecting rods of the engine. These bearing surfaces are obviously subjected to severe wear and it has been found desirable to coat them with a hard surface, such as a chro-

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mium plating. Any metal plating applied to these surfaces must, of course, be deposited with great uniformity and evenness in order to preserve the accuracy of the cylindrical surfaces. But the process of plating these bearing surfaces presents several important difficulties.

During chromium plating bubbles of gas are always produced and these tend to collect on the surfaces which are being plated and particularly on the lower portions thereof, thereby insulating these portions and preventing the deposit of metal. It has also been found difficult to maintain a uniform concentration of electrolyte between the anodes and cathodes in chromium plating. These difficulties are aggravated by the peculiar shape of crank shafts and the low throwing power of chromium plating baths.

In the prior art several attempts have been made to overcome the described difficulties. For example it has been proposed to rotate the crankshaft in a plating bath and to cover with a stop-off varnish the cheek plates and other portions of the shaft on which no plating is desired. But when a stationary anode is employed with such an equipment it is obvious that, as the connecting rod bearings revolve, they will be more heavily plated on one side than on the other. In another proposal the crankshaft is oscillated in a plating bath and annular anodes, which are concentric with the bearing surfaces, are secured to the shaft and move therewith. But for best results it is necessary that any cylindrical surfaces to be plated be rotated rather than merely oscillated. Moreover, it is difficult to mount anodes exactly concentric with the surface to be plated, and this difficulty is increased as the point of support is moved further from the cathode surface. The difficulty is compounded if the anode must be disassembled and reassembled for each plating operation, which is the case where, because the surface is oscillated rather than rotated, the anode must completely encircle the cathode surface.

We have discovered a convenient way of plating the bearing surfaces of crank shafts wherein the shafts are rotated axially and in which arcuate anodes are mounted above in close proximity to the bearing surfaces and maintained in this position accurately as the shaft is rotated. The anodes themselves do not rotate but they describe circular paths corresponding to the paths described by the bearings, that is, they have a planetary motion. These anodes are supported above and held in accurate spaced relationship with the bearing surfaces by means of

structures including depending spacing elements, which rest on the bearing surfaces, and masking members which serve to screen the cheek plates and thrust bearings. These anode structures are provided at the top with upstanding rods which may slide in apertures provided in a longitudinal spacing plate supported above the crank shaft. In this case the anode structures describe a connecting rod motion. In another embodiment the anode structures are suspended by rods and spring clips which engage the corresponding bearing surfaces of another crank shaft rotatably supported above the shaft undergoing plating and rotating in phase with the latter. It can be seen that this method of plating crank shafts ensures a uniform and even plating on the bearing surfaces while effectively preventing the deposit of metal on the cheek plates and other surfaces on which no plating is desired.

Our invention can be described in more detail by reference to the accompanying drawing which shows, more or less diagrammatically, an apparatus within our invention and useful in conducting our process. In this showing,

Fig. 1 is a vertical section through a plating tank showing our plating apparatus in position and a crankshaft ready for plating, the apparatus and crankshaft being shown in elevation.

Fig. 2 is a vertical section taken at right angles to the showing of Fig. 1 along the line 2—2 of the latter and showing an end view of the plating apparatus and crank shaft.

Fig. 3 is a partial view of one of the crank bearing surfaces in operative relationship with an anode supporting structure, a portion of the latter being cut away to show details, while

Fig. 4 is a vertical section taken along the line 4—4 of Fig. 3 showing further details of the anode supporting structure.

In the various views like parts are designated by like reference numerals. Referring first to Fig. 1, the plating tank 15 is shown filled with a plating solution up to the level 38. On the flanged upper edge 25 of the tank an eye-beam 18 is supported by insulating blocks 19. A slow-speed driving motor 28 and sprocket 29 driven thereby are mounted on top of the eye-beam. A cathode bus bar 17 is also mounted on top of the eye-beam while an anode bus bar 31 is bolted to the side but insulated therefrom by insulator 32, these bus bars being connected to a source of current not shown. The eye-beam also supports a pair of metal stirrups 16 which are bolted thereto and electrically connected to the cathode bus bar. The crank shaft to be plated, shown generally at 10, is provided at either end with split flanged bearings shown generally at 20, which are clamped on convenient portions of the crankshaft at points where plating is not desired, as shown best in the cut away portion at the right end of Fig. 1. The mid portions 24 of the bearings are journaled in the lower ends of the stirrups, while the end flanges 26 serve to prevent endwise motion of the crankshaft. The bearings are of such size that when tightened by means of screws 22 they firmly grip the crank shaft.

The crankshaft is shown with the conventional enlarged flange 14 at one end, with a series of axially aligned main bearing surfaces 11, offset crank bearing surfaces 12 and intermediate transversely extending cheek plates 13. In order to rotate the crankshaft during the plating operation a sprocket 27 can be bolted to the flange 14 and a chain 30 is provided which con-

nects this sprocket with the sprocket 29 attached to the slow-speed motor.

Flexible anode leads 33 are secured to the anode bus bar and the lower ends of these leads are connected to the upper ends of connecting rods 59 which form part of anode structures shown generally at 34. The rods reciprocate in ports 35 provided in a longitudinal spacing plate 37, preferably of insulating material, which is supported by and serves to hold apart the sides of the stirrups. The connecting rods are provided with outer coatings of insulation 35 and inner metal rods 23; see Fig. 3. At their lower ends the anode structures terminate in hood-like members or heads shown generally at 39. These structures house the anodes 41 and 45. It will be seen that the rods 59 hold the anodes against rotation in close proximity to the bearing surfaces as the latter are rotated. The anodes are oscillated slightly in a vertical plane and held within a few degrees of the vertical as they describe a planetary motion in the plating bath.

The hoods or heads 39 are formed principally of insulating material 40 which may form a continuation of the insulation provided on the connecting rods; see Fig. 3. Depending from the lower portions 50 of the hoods are strips of insulating material forming wall-like spacing elements 51 extending substantially the length of the bearings. The lower ends 43 of the spacing elements rest on the bearing surfaces and therefore hold the hoods a predetermined distance above this surface. Anodes 41 are mounted in the hoods 39, these anodes being positioned close to the ends of the bearing surfaces. A third intermediate anode 45 is also usually provided, this being spaced at a somewhat greater distance from the bearing surface. These anodes are arcuate strips of lead, preferably of square cross section and are shaped and positioned in such manner that they are concentric with the bearing surface. The anodes are approximately semi-circular in shape, their lower ends 45 extending downwardly approximately to the level of the bearing axis. The upper surface 47 of the intermediate anode is in contact with the lower end of the rod 23 and is secured directly thereto, while the outer anodes are electrically connected to the rod by means of metal strips 48 which are embedded in the insulation.

It will be noted that the outer anodes are positioned near the fillets 42 which unite the bearing surfaces 43 with the thrust bearings 44; see Fig. 3. These anodes usually supply sufficient current to the center of the bearing surfaces to insure an even deposit thereon, hence the intermediate anodes are required only in the case of wide bearing surfaces. The hoods 39 serve to keep the anodes in proper alignment with each other and with the bearing surface.

At the ends of the hoods 39 sheets 52 of insulating material, having the shape of an inverted U, are provided for masking the thrust bearings. The upper edges 53 of these masking sheets extend upwardly at least to the upper edges 54 of the thrust bearings while their inner margins 55 at the top conform to the shape of and fit closely around the fillets 42. The depending arms 56 of the masking sheets may be extended for some distance below the lower edges 57 of the thrust bearings as shown in Fig. 3. The spaces 58 between the thrust bearings and the masking sheets are made as small as possible. A horizontal spacer 60 of insulating material maintains the proper spacing of sheets 52.

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Since the anode structures which have been described hold the anodes concentric with and at a constant distance from the bearing surface to be plated at all points of the cycle during rotation of the crankshaft, it follows that the metal deposit is highly uniform at all points of the bearing surface. Moreover, since it is possible to position the anodes within a very short distance of the surface to be plated, such as $\frac{1}{4}$ inch or less, for example, the metal lost by deposit on other surfaces is negligible. The masking sheets, of course, substantially prevent deposit of metal on the thrust bearings. These masking sheets, because of their proximity to the fillets between the bearing surface to be plated and the thrust bearings, ensure that the deposited metal will gradually decrease in thickness as the thrust bearings are approached.

In most plating methods difficulties are encountered due to excessive thickness, as well as the formation of nodules or sprouts, at the extreme edges of the metal deposit. The ideal deposit is one which decreases in thickness at its edges and this type of deposit is achieved in our method. By suitable adjustment of the distances of the anodes from the work it is possible to produce a deposit which is highly uniform at all points. This greatly reduces the amount of final grinding of the bearing surface which is required.

The use of the apparatus which has been described is very simple in actual practice. Between plating operations the entire plating apparatus, including I-beam, motor, bus bars, stirrups, anode structures and crankshaft, is lifted from the tank, usually by means of a crane. The plated shaft is then removed from the stirrups by first raising the anode structures from the bearing surfaces and placing them on one side of the shaft hanging from their flexible leads. The driving chain is detached and then it is possible to lift the crankshaft and remove it from the stirrups endwise. In order to place a new shaft to be plated in the apparatus it is then only necessary to bolt the sprocket 27 to flange 14 of this shaft and to clamp the split bearings 20 at either end in proper position. The unflanged end of the crankshaft is then slipped through the stirrups and the shaft is hung from the latter with the lower ends of the stirrups engaging the bearings. The anode structures are lifted up and fitted over their respective bearings, the masking sheets 52 serving as guides. Then, after attachment of the sprocket chain 30, it is only necessary to transfer the apparatus to the tank, to start the motor and to turn on the plating current. No individual setting and adjustment of the anodes is required. The only bolts to be tightened are those serving to hold the split bearings 20 and the sprocket 27.

While we have described what we consider to be the best embodiments of our invention it is obvious, of course, that various modifications can be made in the specific structures which have been described without departing from the purview of this invention. Thus it is possible to mount the anodes and anode structures on one side or beneath the bearings to be plated instead of on top as has been described. The hood or head 39 may be of a variety of constructions. For example, the depending spacing element 51 may be made as a separate element and fastened to the conductor 48 and to the anodes 41 and 45 by means of screws, with an extension to which the masking sheets 52 may be cemented. The

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whole may then be wrapped with tape and lacquered or coated with a mass of wax. A more satisfactory construction is obtained when the hood, wall-member and insulation 35 are molded in one piece. In an alternative construction these members can be molded in two halves which are then bolted together. The insulating material employed in the construction of these parts can be of any of a variety of materials provided that sufficient mechanical strength is provided and the material is resistant to the solution. Among the specific materials found useful are resins and lacquers of the vinyl, vinylidene, polystyrene and methacrylate types.

The weight of the anode structures is usually adequate to hold those structures in proper position with respect to the bearing surfaces to be plated. If necessary, however, weights may be attached to the anode structures or springs may be provided to ensure a firm contact between the spacing walls 51 and the bearing surfaces. With the embodiment of Figs. 5 and 6, no springs or weights are required.

While the apparatus and method of this invention are particularly adapted to the plating of crankshafts with chromium, it is obvious, of course, that they are equally adapted to the plating of crankshafts with other metals, such as nickel or cadmium, for example. In such cases the lead anodes may be replaced by anodes of carbon or graphite of similar shape which, under these conditions, would have a somewhat longer life. Other modifications of this invention which fall within the scope of the following claims will be immediately evident to those skilled in this art.

What we claim is:

1. An apparatus for electroplating the bearing surfaces of a crankshaft having off-set bearings, which comprises means for rotatably supporting such a crankshaft beneath the surface of a plating bath, means for rotating said shaft in said bath whereby said off-set bearings describe a planetary motion, a plurality of anode structures, one for each bearing to be plated, comprising at least one semi-circular anode, a depending wall-like insulating spacing element extending substantially the length of the bearing to be plated and adapted to bear against the upper surface of the bearing thereby to hold the anode in proximity to but spaced from said surface, and an electrically conducting rod rigidly connected at its lower end to said anode, a plate mounted above said bath having ports therein adapted slidably to receive the upper ends of said conducting rods, flexible electrical leads connected to the upper ends of said rods and means for passing an electric current through said leads, through said rods, through said anodes and through the plating bath to said bearings serving as cathodes while said bearings and said anode structures describe a planetary motion in said bath with the anodes being held above said bearing by said spacing elements and being prevented from rotating with said bearings by said rods sliding in said ports.

2. The apparatus of claim 1 wherein said anode structures include depending masking elements mounted at either end adapted to confine the current to the space between the anodes and the bearing surfaces.

3. An apparatus for electroplating the bearing surfaces of a crankshaft having off-set bearings and intermediate cheek plates, which comprises means for rotatably suspending such a crank-

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shaft in a plating bath, means for rotating said shaft about its axis whereby said off-set bearings describe a planetary motion in the bath, a plurality of arcuate anodes at least one for each bearing surface to be plated, means, including for each anode an insulated metal rod electrically connected at its lower end to the anode, for holding said anodes in close proximity to said bearing surfaces during the revolution of the latter and means, including a plate supported horizontally above said crank shaft and said plating bath provided with ports in which said insulated rods are adapted to reciprocate during rotation of the crank shaft, for causing said anodes to describe a planetary motion corresponding to the planetary motion of said bearings without revolving with said bearings, whereby the bearings revolve relative to the anodes, strips of insulating material interposed between said anodes and said bearing surfaces, and rigidly attached to said anodes for holding said anodes spaced a predetermined distance from said surfaces, said insulating strips being adapted to bear against and to slide along said surfaces, and means for passing an electric current through

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said bath from said anodes to said bearing surfaces.

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