Sept. 6, 1966 L. J. PIANOWSKI 3,271,290

CATHODE AGITATOR DEVICE

Filed Dec. 13, 1962 2 Sheets-Sheet 1

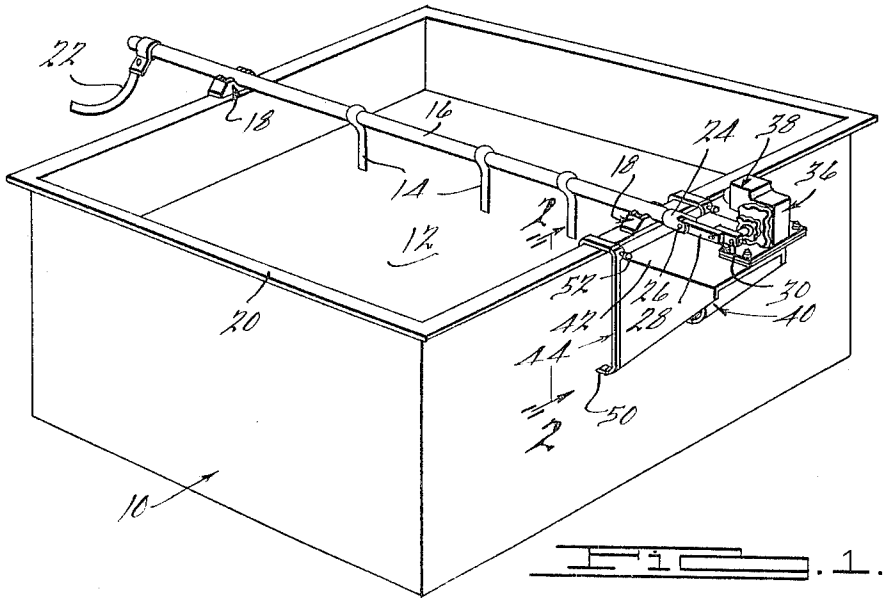


Fig. 1.

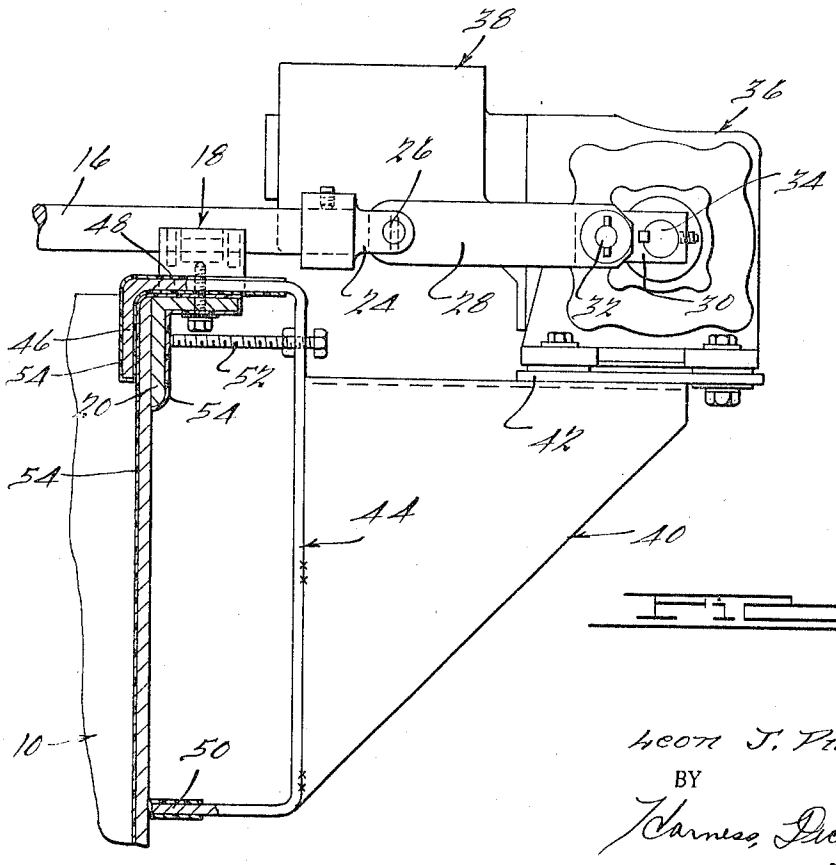


Fig. 2.

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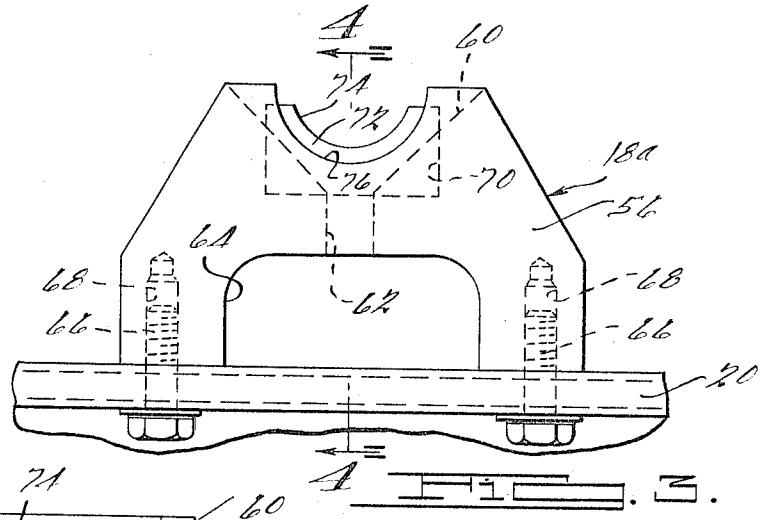


FIG. 3.

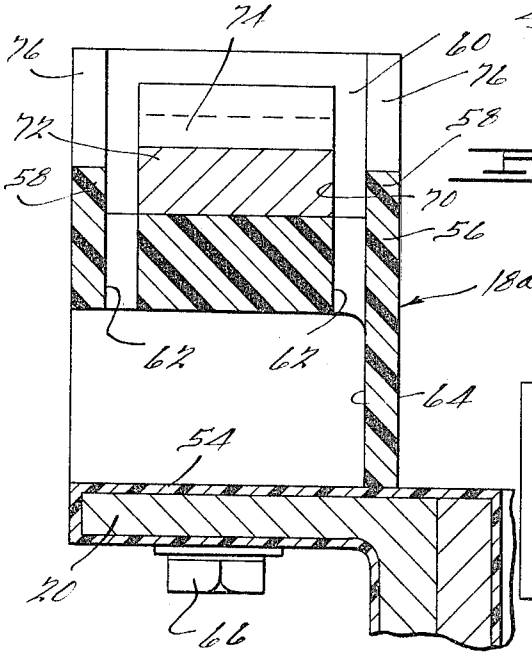


FIG. 4.

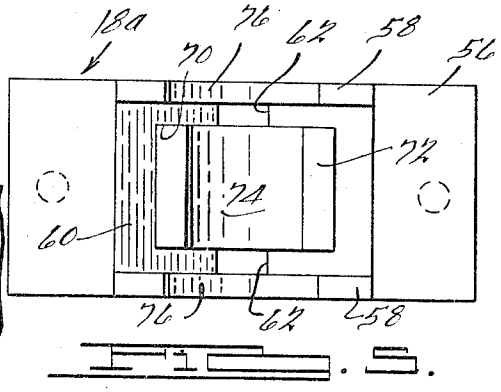


FIG. 5.

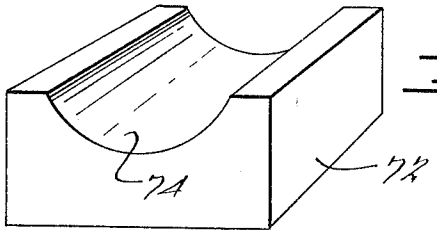


FIG. 6.

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CATHODE AGITATOR DEVICE

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8 Claims. (Cl. 204—222)

The present invention broadly relates to electrotreating apparatus and more particularly to an improved cathode agitator device for suspending and electrifying workpieces in a treating solution and gently reciprocating the workpieces during their treatment. More specifically, the present invention is directed to an improved bearing design for slidably supporting and insulating an electrified cathode rod over a treating station.

In electroplating apparatuses of the general type to which the present invention is applicable, the workpieces to be treated are conventionally supported on suitable work racks which are suspended from an electrified rod that is positioned above a treating station. Electric current is transmitted from the rod through racks to the workpieces immersed in the solution and the workpieces are reciprocated by the rod during the course of their treatment. In an electroplating operation, for example, it is necessary to impart such a reciprocatory movement to the workpieces while they are immersed in a plating solution to avoid the accumulation of gaseous bubbles on the surfaces of the workpieces which would otherwise interfere with the deposition of a uniform coating thereon.

Numerous problems have heretofore been encountered in connection with supporting the longitudinally reciprocable cathode bar over the treating station because of the corrosive conditions to which such supporting means are subjected. These problems are further aggravated by the necessity of effectively insulating the cathode rod from the attendant equipment which has occasioned the use of insulating materials which are susceptible to progressive break-down when being subjected to the corrosive fumes and liquids employed in the treating receptacle.

Various mechanical type bearing devices have been employed for supporting a cathode rod above a treating receptacle but have been found to become progressively corroded to the extent that the bearings sieze resulting in a substantial drag and abrasion between the components this abrasion has frequently resulted in the creation of friction-abrasion products which enter the treating solution effecting contamination thereof. In addition, various liquid lubricants and greases have been employed to protect and lubricate the mechanical bearings which also have caused some contamination of the treating solutions impairing the quality of the resultant coating formed on the workpieces.

It is accordingly a principal object of the present invention to provide an improved cathode agitator mechanism which overcomes the disadvantages and problems encountered in similar type apparatus heretofore known.

Another object of the present invention is to provide an improved cathode agitator device including bearings which are of an electrically insulating composition and which are devoid of any moving parts.

Still another object of ahe present invention is to provide an improved cathode agitator device including a slide bearing therein which incorporates a solid lubricant pad having a low coefficient of friction which obviates the need for employing extraneous lubricants which may contaminate the treating solution.

A further object of the present invention is to provide an improved cathode agitator device incorporating

a novel slide bearing construction including a solid self-lubricating insert which can be readily removed and replaced from time to time when the wear thereof becomes excessive.

A still further object of the present invention is to provide a cathode agitator device incorporating therein an improved bearing construction which incorporates drain means therein for draining any accumulation of treating solution and abrasion products from the bearing outwardly of the treating receptable so as to avoid any contamination of the solution therein.

Yet still another object of the present invention is to provide an improved cathode agitator device incorporating a novel bearing design which is resistant to the corrosive conditions to which it may be subjected, is of durable operation, is of simple service and maintenance, and is of economical and simple manufacture.

The foregoing and other objects and the advantages of the present invention are achieved by employing a pair of longitudinally spaced aligned bearings for reciprocably supporting an electrified cathode rod from which workpieces are suspended. Each of the bearings comprise a housing of an electrically nonconductive material provided with an elongated cavity in the bearing face thereof in which a bearing pad composed of a solid bonded lubricating material is removably disposed and which bearing pad is formed with an elongated groove for slidably receiving and reciprocably supporting the electrified cathode rod adapted to be disposed in sliding bearing contact therewith.

Other objects and advantages of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a perspective view of a treating receptacle provided with a longitudinally reciprocable cathode agitator device constructed in accordance with the preferred embodiments of the present invention;

FIGURE 2 is a fragmentary enlarged vertical sectional view of the mounting means and drive means of the agitator device shown in FIGURE 1 and taken along line 2—2 thereof;

FIGURE 3 is an enlarged side elevation view of a bearing mounted on the upper edge of the tank;

FIGURE 4 is a transverse vertical sectional view through the bearing shown in FIGURE 3 and taken along the line 4—4 thereof;

FIGURE 5 is a plan view of the bearing shown in FIGURE 3, and

FIGURE 6 is an enlarged perspective view of the bearing pad employed in the bearing construction shown in FIGURES 3–5.

Referring now in detail to the drawings and as may be best seen in FIGURES 1 and 2, a single station electrotreating or electroplating apparatus is illustrated comprising a tank **10** containing a plating solution **12** in which a plurality of workpieces are immersed while suspended from work rack **14** removably mounted on a cathode agitator rod **16**. The cathode rod **16** extends transversely above the tank **10** and is slidably supported in a pair of longitudinally spaced aligned bearings **18** secured to a frame or flange **20** affixed to the upper edges of the tank **10**.

One end of the cathode rod **16** is connected to a flexible electrical conductor **22** for electrifying the rod and the workpieces on the work racks **14** suspended therefrom. The opposite end of the cathode rod is formed with a forked fitting **24** which is pivotally connected by a pin **26** to a connecting rod **28** drivingly connected at its other end to a crank **30** by a pin **32**. The crank **30** is affixed to the output shaft **34** of a gear

reducer **36** which in turn is driven by an electric motor **38** drivingly coupled thereto. In order to insulate the electrified cathode rod **16** from the power assembly comprising the gear reducer **36** and electric motor **38**, the connecting rod **28** is preferably of a high strength nonconductive material.

The power assembly is mounted on a supporting frame **40** comprising a platform **42** which is rigidly secured to a pair of laterally spaced clamping members **44** of a general U-shaped configuration. The upper end portion of each of the clamping members **44** is provided with an L-shaped engaging member comprising a downwardly depending leg **46** which is adapted to overlie and bear against the upper inner surface of the tank **10** and a horizontal leg **48** which is adapted to overlie and bear downwardly against the flange **20** around the upper edge of the tank. The lower end portion of each of the clamping members **44** is provided with a horizontal abutting leg **50**, the end of which is disposed in bearing contact against the outer side wall of the tank.

The entire supporting frame, accordingly, can be removably mounted at the desired location along the upper edge of a treating tank and securely clamped in that position by means of a clamping screw **52** extending through the upper portion of each of the clamping members **44** and disposed with the end of the shank portion thereof in abutting relationship against the vertical leg of the flange **20** around the upper edge of the tank. As will be noted in FIGURE 2, those portions of the supporting frame **40** which are exposed to contact with the treating solution **12** contained in the tank or which are disposed in direct contact with the tank, are provided with an insulating protective coating **54** thereover such as a vinyl plastisol coating, for example. Similarly, the inner surfaces of the tank **10** as well as those portions subjected to corrosive attack by the treating solution are protected by the impervious coating **54** thereover.

In accordance with the arrangement hereinabove described, energization of the electric motor **38** effects rotation of the crank **30** and a corresponding reciprocating movement of the cathode rod **16** transversely across the tank whereby the workpieces on the work racks **14** suspended therefrom are reciprocably moved through the treating solution so as to avoid the accumulation of gaseous bubbles along the surfaces of the workpieces which would otherwise interfere with proper surface treatment thereof. The bearings **18** slidably and guidably support the cathode rod **16** during its transverse reciprocatory movement. The bearings **18** concurrently insulate the electrified cathode rod **16** from the tank **10** and other attendant structure.

A preferred construction of a bearing **18*a*** is illustrated in FIGURES 3–6 which incorporates drain means therein for draining any accumulation of abrasion products resulting from the frictional coaction between the bearing and the cathode rod **16** during its reciprocatory movement and any treating solution which may inadvertently accumulate in the bearing. In the construction of the bearing **18** illustrated in FIGURES 1 and 2, no such drainage means are provided which is satisfactory for use in those instances where the accumulation of such contaminants in the bearing is minimal and where solution contamination is not critical.

Referring now to FIGURES 3–6, the bearing **18*a*** as shown comprises a housing **56** comprised of an electrically nonconductive material which is provided in its upper or bearing face thereof with a pair of longitudinally spaced end walls **58** separated by an intervening longitudinally extending V-shaped cavity **60**. Each of the ends of the V-shaped cavity **60** adjacent to the end walls **58** is formed with a downwardly directed drainage conduit **62** having the lower end thereof disposed in communication with a chamber **64** which extends inwardly from one side of the housing disposed exteriorly of the interior of the tank to a point spaced from the opposite side thereof. In accordance with this construction any liquid treating solution or abrasion products formed during operation drain by gravity to the base of the V-shaped cavity **60** and thence through the drainage conduits **62** into the chamber **64** from which the material drains outwardly along the upper surface of a flange **20** to the exterior of the tank. The firm bearing relationship of the base of the housing against the protective coating **54** on the upper surface of the flange **20** prevents any leakage of such drained material into the interior of the tank which might otherwise effect contamination of the treating solution therein.

The housing **56** is securely mounted in appropriate aligned relationship on the flange **20** such as by means of screws **66** extending upwardly through the flange **20** and having the threaded shank end portions thereof disposed in secure threaded engagement within threaded bores **68** in the housing as may be best seen in FIGURE 3. Appropriate alignment of the cathode rod **16** and the agitator mechanism with the bearings can be achieved by adjustably positioning the supporting frame **40** along the edge of the tank and thereafter clamping the supporting frame in appropriate aligned position.

The base of the V-shaped cavity **60** in the housing is formed with a rectangular recess **70** which extends centrally thereof and longitudinally for a distance spaced from each of the end walls **58** to a point contiguous to each of the drainage conduits **62**. A bearing pad **72**, as best illustrated in FIGURE 6, is removably seated in the recess **70** as shown in FIGURES 3–5, and is provided in its upper or bearing face thereof with a longitudinally extending groove or slot **74** having a cross sectional configuration corresponding to that of the cathode rod **16**. The offset between the ends of the bearing pad **72** and the inner surfaces of the end walls **58** as shown in FIGURES 4 and 5, provides a chute into which any abrasion products resulting from the relative rubbing of the cathode rod on the bearing pad will drop and subsequently fall through the drainage conduit **62**.

In the exemplary construction shown in FIGURES 3–6, the upper edges of each of the end walls **58** are provided with a semicircular groove **76** providing radial clearance between the periphery of the cathode rod and the housing **56**. The bearing construction **18** as may be best seen in FIGURE 2 is identical in all respects to the bearing **18*a*** shown in FIGURES 3–6 with the exception that no chamber **64** is provided in the base of the housing thereof for draining the accumulation of extraneous materials from the base of the V-shaped cavity therein. Accordingly, the bearing **18** may, from time to time, require a cleaning to remove such deposits therefrom.

In either case however, the bearings serve the dual function of slidably supporting the cathode rod and insulating the electrified rod from the supporting structure. Since the bearing pad is merely seated in the recess **70** in the housing, it can be simply lifted out and replaced by a new bearing pad at such times when the wear thereof has become excessive. This feature substantially reduces the cost and time for servicing the bearings with a corresponding reduction in the length of interruption of the processing cycle.

The bearings also provide substantially increased life and are devoid of malfunction during operation by virtue of their long wearing characteristics and self-lubricating properties. The bearing pads **72** may comprise a solid integrally bonded and compacted lubricant such as graphite and preferably, molybdenum disulfide which can be readily molded to the desired shape and are formed with the desired groove **74** in the bearing face thereof. The particulated graphite or molybdenum disulfide material can be bonded together by employing any one of a number of suitable binders well known in the art and may additionally include suitable fillers and reinforcing agents such as asbestos fibers, for example, for increasing the strength of the compacted mass. A material which has

been found to be eminently satisfactory for making bearing pads 72 for use in the bearings comprising the present invention comprise a resin bonded molybdenum disulfide lubricant. This material has been found to provide exceptionally long life and relatively low friction between the cathode rod and bearing surface without the need of any extraneous lubricating substances. In addition, the material is of satisfactory strength and impact resistance maintaing its integrity in spite of relatively high loading imposed thereon by the work racks suspended from the cathode rod.

The housing of the bearing as well as the connecting rod 28 of the drive mechanism can be comprised of any suitable material which is electrically nonconductive, which is not subject to cold flow under the forces imposed thereon, which is resistant to chemical attack and degradation by the caustic and alkaline solutions which may come in contact therewith, and which are of adequate strength to support the loads imposed thereon. Materials suitable for this purpose include hard synthetic and natural rubber compositions, as well as both thermosetting and thermoplastic synthetic resins such as phenol aldehyde resins, polyurethane resins, polymethylmethacrylate resins, polyvinyl resins, polyethylene resins, polypropylene resins, polyamide resins, and the like. The foregoing and similar materials may also incorporate suitable filler materials therein to increase the physical characteristics thereof without interfering their electrically insulating properties. Of the foregoing materials, housings made of polypropylene plastic have been found particularly satisfactory due to their high impact strength and chemical resistance as well as the ease by which they can be fabricated to the desired configuration.

While it will be apparent that the embodiments of the invention herein disclosed are well calculated to fulfill the objects of the invention, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. In an electrotreating apparatus including a supporting frame positioned at a treating station and an electrified rod reciprocably mounted on the frame for electrifying and reciprocably moving workpieces suspended therefrom, the improvement comprising a pair of bearings mounted in longitudinally spaced aligned relationship on the frame for slidably supporting the end portions of the rod, each of said bearings comprising a housing composed of an electrically nonconductive material and including a bearing face formed with a pair of longitudinally spaced end walls separated by a longitudinally extending inwardly directed cavity, a bearing pad composed of a solid self-lubricating material removably seated in said cavity having its outwardly directed bearing surface formed with a longitudinally extending groove for slidably receiving the rod, the longitudinal end edges of said bearing pad terminating at a point spaced from the inner surfaces of said end walls defining therewith a pair of longitudinally spaced residue cavities for receiving the wear-abrasion products of said bearing pad and the rod, coacting means on said bearing pad and said housing for retaining said bearing pad in appropriate spaced relationship from the said end walls, and coacting means on said housing for securing each of said bearings in a fixed position on the frame.

2. In an electrotreating apparatus including a supporting frame positioned at a treating station and an electrified rod reciprocably mounted on the frame for electrifying and reciprocably moving workpieces suspended therefrom, the improvement comprising a pair of bearings mounted in longitudinally spaced aligned relationship on the frame for slidably supporting the end portions of the rod, each of said bearings comprising a housing composed of an electrically nonconductive material and including a bearing face formed with a pair of longitudinally spaced

end walls separated by a longitudinally extending inwardly directed cavity, a bearing pad composed of a solid self-lubricating material selected from the group consisting of molybdenum disulfide, graphite, and mixtures thereof removably seated in said cavity and extending therealong from a point spaced from each of said end walls defining therewith a pair of longitudinally spaced residue cavities for receiving the wear-abrasion products of said bearing pad and the rod, said bearing pad having its outwardly directed bearing surface formed with a longitudinally extending groove for slidably receiving a rod adapted to be disposed in bearing relationship thereagainst, and coacting means on said housing for securing each of said bearings in a fixed position on the frame.

3. In an electrotreating apparatus including a supporting frame positioned at a treating station and an electrified rod reciprocably mounted on the frame for electrifying and reciprocably moving workpieces suspended therefrom, the improvement comprising a pair of bearings mounted in longitudinally spaced aligned relationship on the frame for slidably supporting the end portions of the rod during the reciprocating movement thereof, each of said bearings comprising a housing composed of an electrically nonconductive material and including a bearing face formed with a pair of longitudinally spaced end walls separated by a longitudinally extending inwardly directed cavity, the center portion of said cavity formed with a recess therein extending longitudinally therealong to a point spaced from each of said end walls, a bearing pad comprised of a solid self-lubricating material removably seated in said recess having its outwardly directed bearing surface formed with a longitudinally extending groove for slidably receiving the electrified rod, the longitudinal end edges of said bearing pad terminating at a point spaced from the inner surfaces of said end walls defining therewith a pair of longitudinally spaced residue cavities for receiving the wear-abrasion products of said bearing pad and the rod, said housing formed with apertures therethrough disposed in communication with the base of said residue cavities between the ends of said pad and said end walls draining any abrasion products and liquid therefrom outwardly of the frame, and coacting means on said housing for securing each of said bearings to the frame.

4. In an electrotreating apparatus including a supporting frame positioned at a treating station and an electrified rod reciprocably mounted on the frame for electrifying and reciprocably moving workpieces suspended therefrom, the improvement comprising a pair of bearings mounted in longitudinally spaced aligned relationship on the frame for slidably supporting the end portions of the rod, each of said bearings comprising a housing composed of an electrically nonconductive material and including a bearing face formed with a pair of longitudinally spaced end walls separated by a longitudinally extending inwardly directed V-shaped cavity having a rectangular recess in the base thereof which extends centrally thereof to a point spaced from each of said end walls, a rectangular shaped bearing pad comprised of a bonded molybdenum disulfide lubricant removably disposed in said recess having its outwardly directed bearing surface formed with a longitudinally extending groove for slidably receiving the rod disposed in bearing relationship thereagainst, said housing formed with drain apertures therein disposed in communicaton wth the base of said V-shaped groove adjacent to each of said end walls for draining the accumulation of abrasion products and liquid therefrom, and coacting means on said housing for securing each of said bearings to the frame.

5. A bearing comprising a housing composed of an electrically nonconductive material and including a bearing face formed with a pair of longitudinally spaced end walls separated by a longitudinally extending inwardly directed cavity, a bearing pad comprised of a solid self-lubricating material removably seated in said cavity and extending therealong to a point spaced from each of said

end walls defining therewith a pair of longitudinally spaced residue cavities for receiving the wear-abrasion products of said bearing pad and a member adapted to be slidably supported thereby, said bearing pad having its outwardly directed bearing surface formed with a longitudinally extending groove for slidably receiving a longitudinally extending shaft adapted to be disposed in bearing relationship thereagainst, said housing formed with apertures therethrough disposed in communication with the base of said residue cavities adjacent to each of said end walls for draining any liquid and abrasion products therefrom, and coating means on said housing for securing said bearing in a fixed position.

6. A bearing comprising a housing composed of an electrically nonconductive material and including a bearing face formed with a pair of longitudinally spaced end walls separated by a longitudinally extending inwardly directed V-shaped cavity formed with a rectangular recess in the face thereof which extends longitudinally to a point spaced from each of said end walls, a bearing pad composed of a bonded molybdenum disulfide lubricant removably seated in said recess having its outwardly directed bearing surface formed with a longitudinally extending groove for slidably receiving a longitudinally extending shaft adapted to be disposed in bearing relationship thereagainst, said housing including apertures therethrough disposed in communication with the face of said cavity adjacent to each of said end walls for draining any accumulation of abrasion products and liquid from said cavity, and coacting means on said housing for removably securing said bearing to a supporting frame.

7. An electroplating apparatus comprising a treating tank, a cathode rod extending horizontally over said tank for suspending workpieces therefrom into said tank, means for electrifying said rod and the workpieces suspended therefrom, means for longitudinally reciprocating said rod, and a pair of longitudinally spaced aligned bearings for slidably supporting the end portions of said rod, each of said bearings comprising a housing consisting of an electrically nonconductive material and including a bearing face formed with a pair of longitudinally spaced end walls separated by a longitudinally extending inwardly directed cavity, a bearing pad composed of a solid self-lubricating material removably seated in said cavity having its outwardly directed bearing surface formed with a longitudinally extending groove for slidably receiving said rod, the longitudinally end edges of said bearing pad terminating at a point spaced from the inner surfaces of said end walls defining therewith a pair of longitudinally spaced residue cavities for receiving the wear-abrasion products of said bearing pad and said rod, coating means on said bearing pad and said housing for retaining said bearing pad in appropriate spaced relationship from said end walls and coacting means on said housing for securing each of said bearings in appropriate longitudinally spaced alignment.

8. In an electroplating apparatus comprising a treating tank, a cathode rod extending horizontally over said tank for suspending workpieces therefrom into said tank, means for electrifying said rod and the workpieces thereon, means for longitudinally reciprocating said rod, and a pair of longitudinally spaced bearings for slidably supporting the end portions of said rod, each of said bearings comprising a housing composed of an electrically nonconductive material and including a bearing face formed with a pair of longitudinally spaced end walls separated by a longitudinally extending inwardly directed cavity, a bearing pad comprised of a bonded molybdenum disulfide lubricant removably seated in said cavity and extending therealong for a distance spaced from each of said end walls defining therewith a pair of longitudinally spaced residue cavities for receiving the wear-abrasion products of said bearing pad and said rod, said bearing pad having its outwardly directed bearing surface formed with a longitudinally extending groove for slidably receiving and movably supporting the end portions of said rod, said housing formed with a plurality of apertures therethrough disposed in communication with the base of said residue cavities adjacent to each of said end walls for draining any accumulation of abrasion products and liquid from said residue cavities to a point outwardly of said tank, and coacting means on said housing for securing each of said bearings in longitudinally spaced relationship adjacent to the upper edges of said tank.

References Cited by the Examiner

UNITED STATES PATENTS

2,027,788	1/1936	Ridgway et al.	308—238
2,746,732	5/1956	Guilette	204—222 XR
2,841,547	7/1958	Kotz et al.	204—223
2,901,300	8/1959	Burr	308—238
3,018,143	1/1962	Masser	308—238 XR

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