

Sept. 3, 1957

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2,804,976

METHOD AND APPARATUS FOR TREATING MATERIAL

Filed Feb. 3, 1954

5 Sheets-Sheet 1

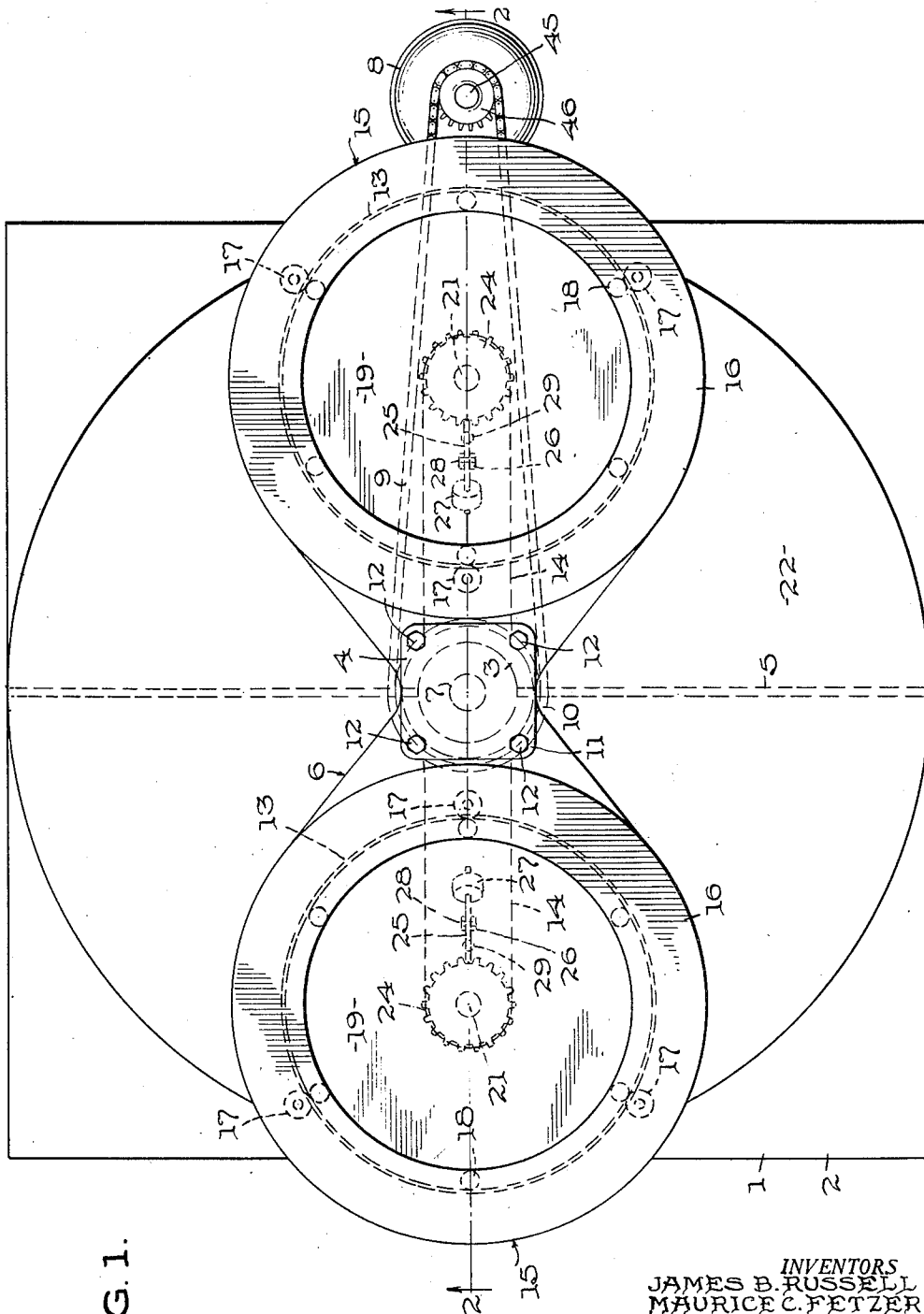


FIG. 1.

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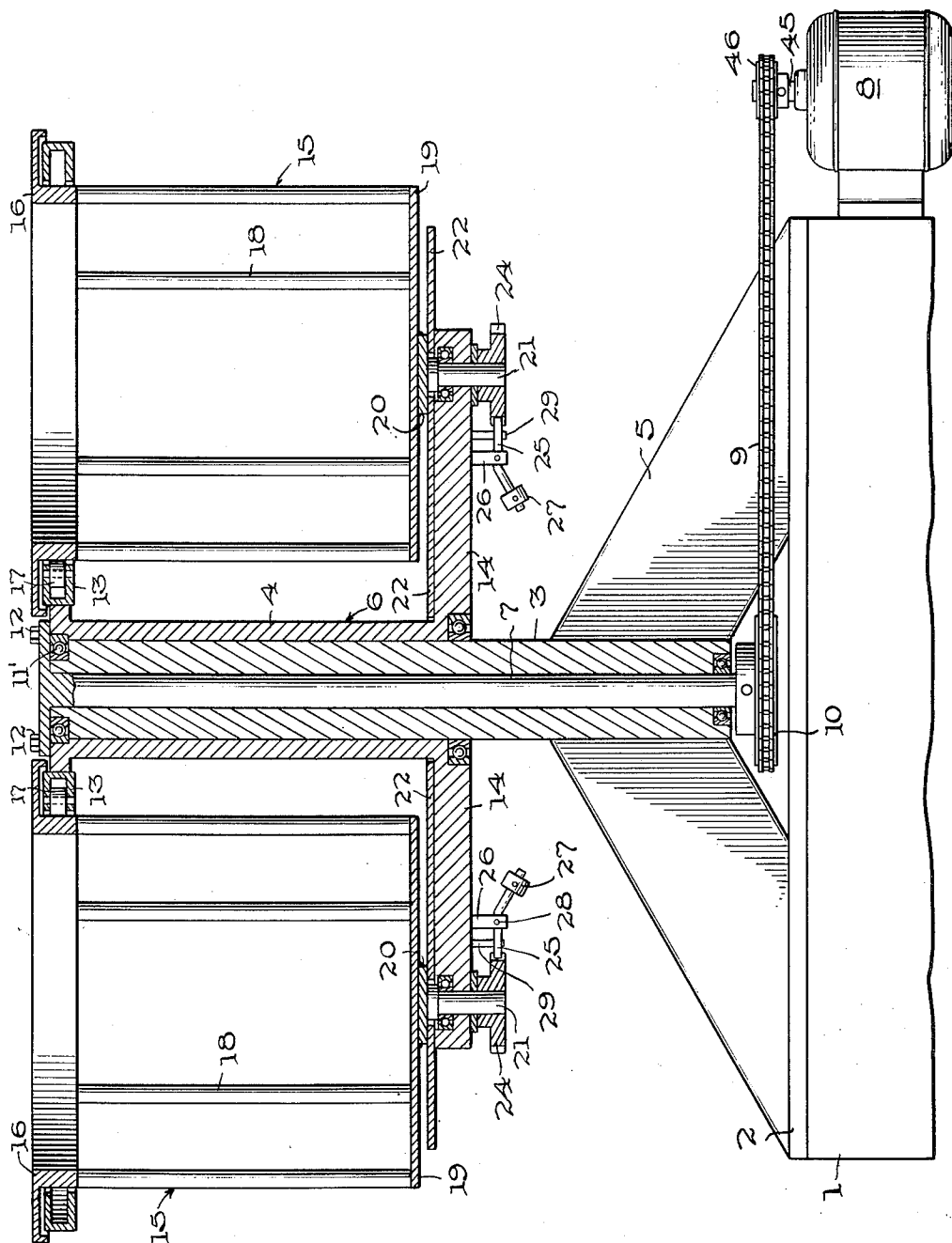
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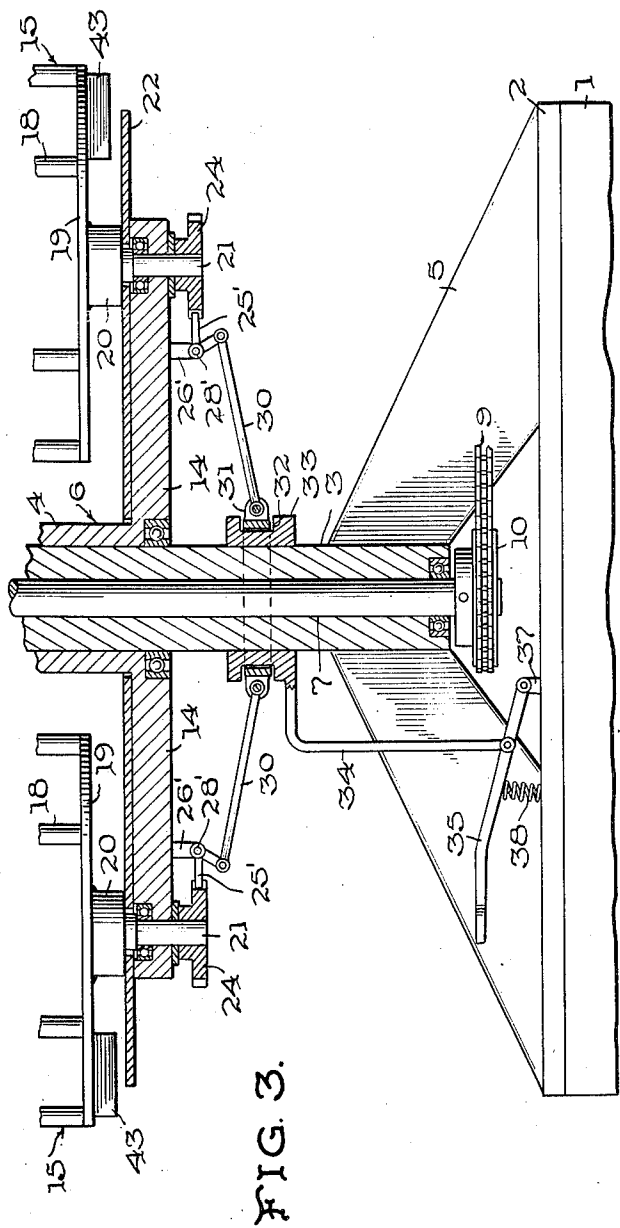


FIG. 3.

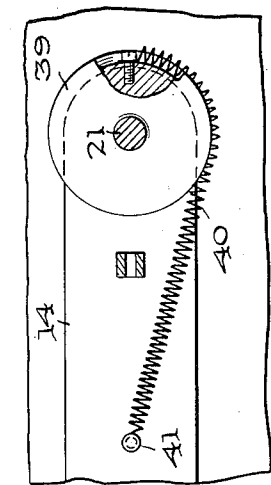


FIG. 5.

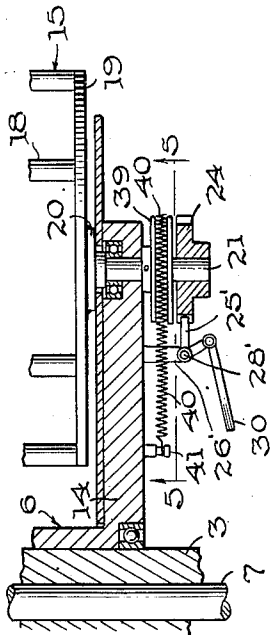


FIG. 4.

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FIG. 6.

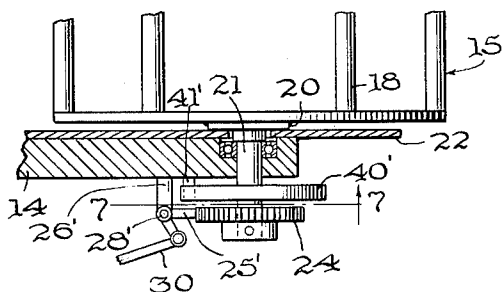
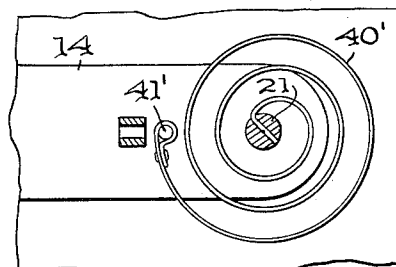


FIG. 7.



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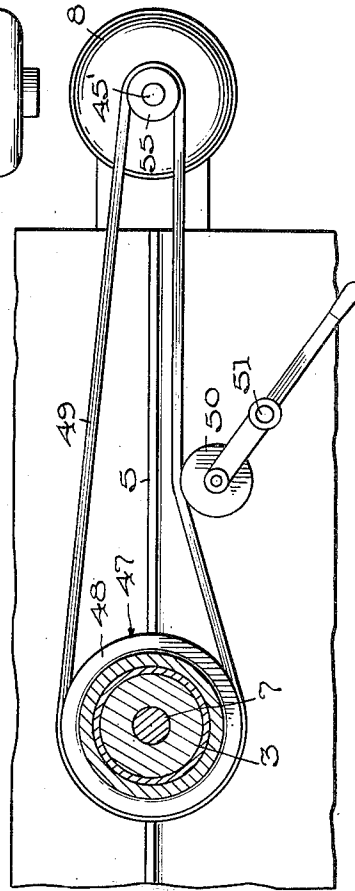
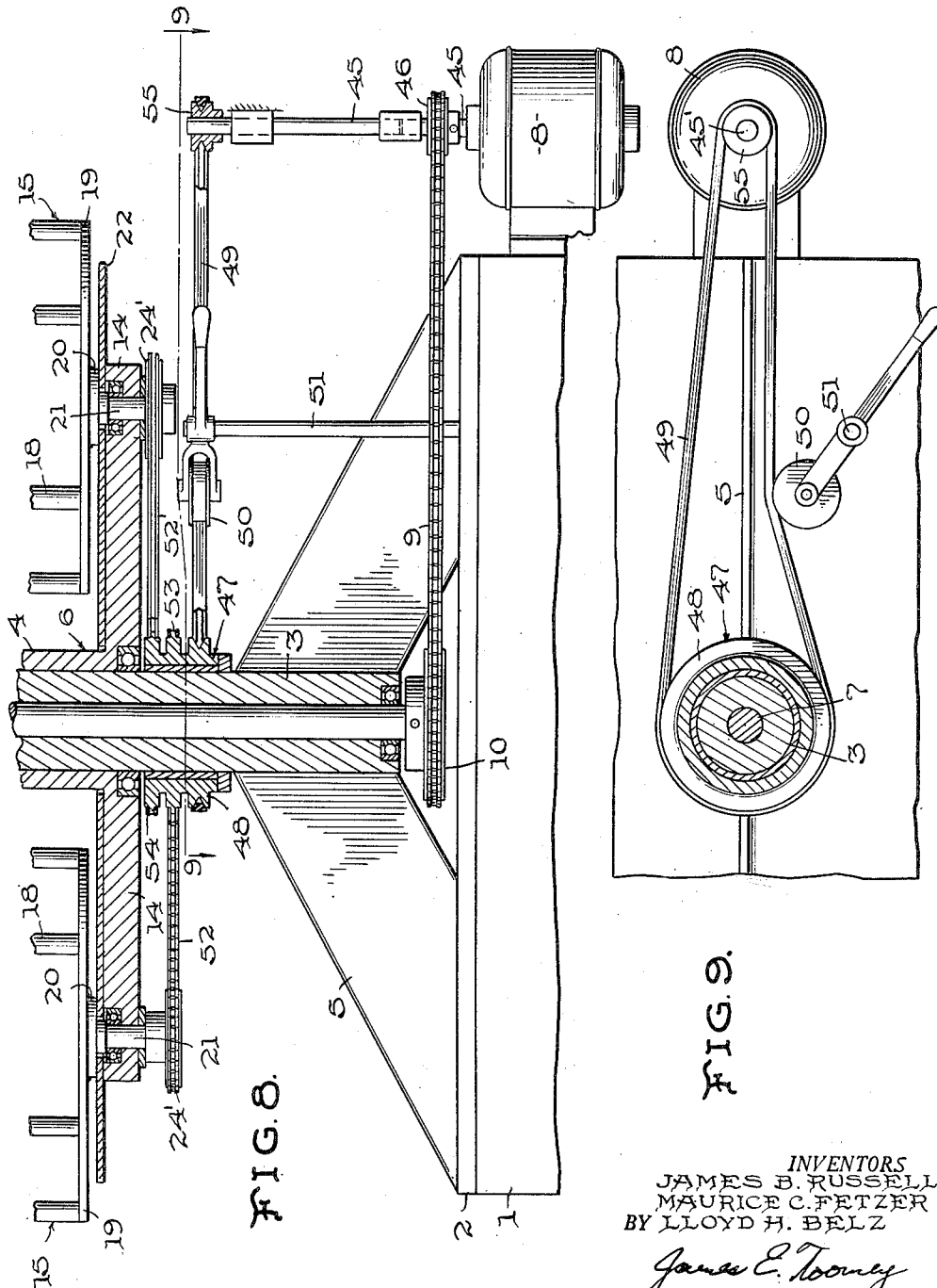
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2,804,976

METHOD AND APPARATUS FOR TREATING MATERIAL

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Application February 3, 1954, Serial No. 407,993

13 Claims. (Cl. 210—78)

This invention relates to a method of eliminating excess molten coating metal from hardware articles coated by the hot dip batch method and to apparatus employed in accomplishing this method.

Methods for batch coating one metal on another generally consist of (1) degreasing and cleaning the metal articles to be coated by conventional methods, (2) immersing a basket containing the articles in a bath of molten coating metal, (3) inserting the basket of the articles in a centrifuge to spin or throw off excess molten metal, and (4) quenching in a suitable media. Conventional methods such as that employed in galvanizing use a conventional concentric single basket, said basket rotating about its axis to eliminate excess molten metal from the hot dipped articles. Such methods, while satisfactory in regard to galvanized iron or steel, are inadequate for coating metals such as aluminum or aluminum alloys due to the inherent difference in properties of such coating metals. This is due to the higher apparent surface tension of aluminum caused by the formation of an alumina film. As a result, when aluminum-coated hardware is rotated in a basket, a ridge of metal and alumina remains on that side of each article which is furthest removed from the center of rotation. From this, it can be seen that the magnitude and direction of the centrifugal forces are insufficient to overcome the cohesive forces acting on the surface of the molten aluminum metal to remove the last remnant of metal which forms the defect. This ridge effect also apparently results from the inability of the molten aluminum metal beneath the oxide film to distribute itself about the periphery of the article during the time interval between centrifuging and quenching or air cooling. The disadvantages of such a ridge of metal are most apparent when applied to threaded hardware articles where the ridge of metal prevents threading of nuts on bolts.

Accordingly, an object of this invention is to provide a method and apparatus for treating hardware articles provided with hot dip coatings wherein the presence of ridges is eliminated or substantially reduced.

A further object of this invention is to provide a method and apparatus for treating hardware articles provided with hot dip aluminum metal coatings wherein the presence of ridges is eliminated or substantially reduced.

A further object of this invention is to provide a method of eliminating excess molten metal from threaded hardware articles whereby there are no imperfections in the surface of the articles such as dents, uncoated areas or ridges preventing the threading of a nut upon a bolt.

A further object of this invention is to provide a method of eliminating excess molten aluminum metal from threaded iron and steel hardware articles whereby there are no imperfections in the surface of the articles such as dents, uncoated areas or ridges preventing the threading of a nut upon a bolt.

A further object of this invention is to provide a method of producing an even, continuous coating of molten

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metal upon articles of a second metal by hot dipping wherein the excess metal is removed without leaving ridges along one side of the article or having defects in the form of bare areas or dented portions of the coating or articles.

A further object of this invention is to provide an apparatus for eliminating excess molten metal from hardware articles coated by the hot dip method wherein an apparatus of the planetary centrifuge type is employed having perforate containers which move in a circular path about a fixed axis spaced from said containers and including means for rotating each of said perforate containers about its own axis and means whereby rotation of said perforate container about its own axis may be started and stopped independently of the movement of said perforate container in a circular path about said central shaft.

The present invention is directed to a method for removing the excess molten metal from coated hardware articles without having a ridge of metal coating, dents, or bare spots on the article. This method generally comprises the steps of suspending a mass of coated hardware articles within a confined zone and subjecting said mass as a whole to certain centrifugal forces. This is accomplished by rapidly moving said mass of articles as a whole in an annular path about a fixed axis spaced from the mass and making provision for rotation of the mass about an axis drawn through said mass of articles such that each of the articles will be subjected to the centrifugal force created by the mass rapidly moving as a whole in an annular path about the fixed axis and will be subjected to this force when the position of the articles has been changed relative to the fixed axis. According to one embodiment of the invention the desired result may be had by rapidly moving the mass of articles as a whole in an annular path about the fixed axis for a predetermined period of time, while simultaneously maintaining a certain portion of the mass of articles nearest the outer periphery of the annular path. Upon expiration of the predetermined period of time the mass may be rotated as a whole through an arc of less than 360° about an axis drawn through the mass of articles until a different portion of the mass from that previously mentioned is arranged closest to the outer periphery of said annular path. Upon completion of the rotation, the mass as a whole is moved in the annular path as above stated for a further predetermined period of time. The step of subjecting said mass of articles to centrifugal force may be continued during the step of rotating the mass of articles about an axis drawn through the mass as a whole, or the centrifugal force step may be interrupted during the rotation step, followed by further subjection to centrifugal force upon completion of the rotation step. According to a second embodiment of the invention the desired result may be had by continuously rotating the mass as a whole about an axis drawn through the mass of articles while the mass of articles as a whole is rapidly moved in an annular path about the fixed axis.

In the accompanying drawings is illustrated suitable apparatus for satisfactorily performing the method of this invention. However, it is to be distinctly understood that said method is not limited to any specific apparatus that may be employed.

In the drawings:

Figure 1 is a plan view of a suitable planetary-type basket centrifuge for performing the method of this invention.

Figure 2 is a cross-section of the same planetary-type centrifuge along the lines 2—2.

Figure 3 is a cross-section of the lower portion of the centrifuge showing a modification of the latch mech-

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anism employed and one means for rotating the baskets about their own axes.

Figure 4 is a similar view to Figure 3 illustrating spring loading means for rotating the baskets about their own axes.

Figure 5 is a view of the means shown in Figure 4 looking in direction 5—5.

Figure 6 is a similar view of Figure 3 showing another spring loading means for rotating the baskets about their own axes.

Figure 7 is a view along line 7—7 in Figure 6.

Figure 8 is a similar view to Figure 2 showing chain any sprocket means for rotating the baskets about their own axes.

Figure 9 is a view along line 9—9 in Figure 8.

Referring now more particularly to the drawing in which the same reference numerals are applied to like parts in the various views, a suitable apparatus for performing the invention will be described in accordance with the first embodiment hereinbefore mentioned wherein the mass of articles is rotated as a whole through an arc of less than 360° about an axis drawn through the mass of articles. This apparatus is essentially a centrifuge with a planetary basket system. Said apparatus comprises a central power driven shaft 7 and a main frame 6 having a central tubular portion 4 with oppositely disposed arms 14 integral with and at right angles to the lower extremity of said tubular portion 4. Central shaft 7 and main frame 6 are supported by hollow stationary spindle 3. Spindle 3 has an inside diameter slightly larger than the outside diameter of central shaft 7, and an outside diameter slightly smaller than the inside diameter of tubular portion 4 of main frame 6. This permits concentric assembly of central shaft 7, stationary spindle 3 and main frame 6 as shown. A base plate 2, secured to a suitable foundation 1, supports everything except the main drive motor 8. It will be seen that stationary spindle 3 is attached to base plate 2 by means of support webs 5 in such a manner as to leave a space between the bottom of spindle 3 and base plate 2 to accommodate sprocket 10 and chain 9 for the main drive. A flange 11 affixed to the upper extremity of central shaft 7 rests on a suitable bearing 11' which in turn rests on the surface of the upper end of stationary spindle 3 supporting central shaft 7 within stationary spindle 3 permitting rotation of central shaft 7 within said spindle 3. A sprocket 10 is affixed to the lower extremity of central shaft 7 to permit rotation to be transmitted to said shaft 7 from main drive motor 8 by means of chain 9, motor shaft 45, and sprocket 46, said main drive motor 8 being suitably secured to foundation 1.

The main frame 6 is carried by flange 11 of central shaft 7 by bolting the upper end of main frame 6 to flange 11 of central shaft 7 by bolts 12, such that rotation of central shaft 7 results in rotation of main frame 6. At the upper end of the tubular portion 4 of the main frame 6 rings 13 are welded. Each of these rings 13 has a U-shaped cross-section in which is mounted three roller bearings 17 to resist horizontal forces exerted on basket containers 15. Two diametrically opposed cylindrical basket containers 15 are employed for holding the hardware to be centrifuged. It will be understood, according to the invention, that one or more basket containers may be provided, it being preferred to use two or more containers which are properly positioned to give a balanced system. Where only one container is used, it may be necessary, for practical purposes, to utilize suitable counterweight means for balancing the system. These basket containers may, as shown in the drawing, comprise a top ring 16, said top ring 16 being L-shaped in cross-section, having an upper outwardly directed horizontal flange and an inner vertical downwardly directed flange adapted to fit within ring 13 and roller bearings 17. Pipe or rod framework 18 ties the upper ring 16 to a bottom plate 19 of basket container 15, said pipes or rods 18 being welded to the upper

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ring and the lower plate. Stiffener plate 20 is welded to the center of the bottom of basket container 15 and a shaft 21 is welded to said stiffener plate 20. In the free end of each arm 14 is removably journaled shaft 21 of basket container 15, said shaft extending through the bottom of arm 14 a distance sufficient to accommodate gear 24 which is affixed to the lower extremity of shaft 21. A split apron 22, which has been split for mounting, is mounted between the stiffener plate 20 of the basket containers and the lower arm 14 of the main frame 6 to prevent metal being centrifuged from getting into the drive mechanism. A latch device 25 engages the teeth of gear 24 to hold each basket container 15 in a fixed position relative to its own center line. Each latch 25 is pivotally attached to a bar 26, each bar 26 being affixed to the bottom of its respective arm 14. A weight 27 is affixed to the extremity of latch 25 farthest removed from gear 24, the pivot 28 of latch 25 being between weight 27 and gear 24. In the normal position the action of gravity upon weight 27 operates through pivot 28 to hold the portion of the latch between the pivot 28 and gear 24, against a stop 29 and in engagement with gear 24.

While apparatus other than that above described may be employed in the practice of the method of the instant invention, the use of the above apparatus for performing the method will now be described in detail.

Main drive shaft 7 is rotated by motor 8 through chain 9 and sprocket 10 imparting said rotation to the main frame 6. Initially, latches 25 are in engagement each with its respective gear 24 whereby basket containers 15, in each of which is disposed a basket containing hot dip coated ware, are held in fixed position relative to their own center line. Said containers 15 are moved in an annular path by rotation of main frame 6 about the axis of central shaft 7 at a rapid rate for a short period of time. During this period of movement in said annular path about the axis of central shaft 7 a large portion of the excess molten aluminum is thrown off from the hardware articles. Rotation of main frame 6 in this embodiment is then stopped. Each weight 27 is then raised, disengaging latch 25 from gear 24 to permit rotation of its respective basket 15 about its own center line. Each basket is then rotated for a specified number of degrees, generally less than 360°, about its own axis after which each weight 27 is allowed to return to its original position by gravity thereby engaging latch 25 with gear 24. The motor 8 is again started, main frame 6 rotating containers 15, baskets and hardware around the axis of central shaft 7. The articles in each basket are consequently shifted to a new position by centrifugal force since rotation of each basket container 15 about its own axis has placed the articles closer to the axis of central shaft 7 than the maximum distance permitted by the confines of said basket container 15. Since the ridges are formed on the side by each article farthest removed from the center of rotation, the above shifting to a new position changes the location of the ridges such that they are no longer on the side of each article farthest removed from the center of rotation and by means of the second phase of the centrifuging operation the ridges are subjected to such forces as to remove substantially all of the ridges. Shifting of the hardware articles has the further advantage that those articles which were closest to the center of rotation on the first centrifuging operation and which, therefore, had been subjected to a minimum amount of centrifugal force will now be positioned farther out from the center of rotation and be subjected to a greater amount of centrifugal force during the second phase of the centrifuging operation.

When an apparatus as above described is employed, it is necessary to stop the centrifuging operation to rotate each basket container 15 about its respective axis. Figures 3-9 disclose means for rotating each basket 15 about its own axis including means for starting and stopping

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said rotation during the centrifuging operation independently of rotation of frame 6 and central shaft 7. Means for accomplishing this independent rotation would be either by energy storing means such as eccentric loading the basket containers about their axes as shown in Figure 3, by spring loading as shown in Figures 4, 5, 6 and 7 or by a gearing mechanism and clutch means as shown in Figures 8 and 9. For either of these embodiments, a release mechanism as shown in Figure 3 may be employed, said mechanism permitting release of the latch 25' engaging gear 24 independently of the rotation of central shaft 7 and frame 6. This mechanism employs a latch 25' for each gear 24. Each latch is pivotally attached to a bar 26', said bar 26' being affixed to the bottom of its respective arm 14. Each latch 25' has one extremity of a rod 30 pivotally attached to the extremity of latch 25' farthest removed from gear 24, the pivot 28' of latch 25' being between gear 24 and the point at which rod 30 is attached. The opposite extremity of rod 30 is pivotally attached to a ring member 31 which is rotatably positioned in an annular groove 32 of a sleeve 33 which is slidably mounted on stationary spindle 3 at a point above support webs 5. Slidable sleeve 33 may be suitably keyed to spindle 3 to prevent any tendency of rotation of the sleeve during the rotation of main frame 6. A vertical bar 34 has its upper extremity affixed to sleeve 33 and its lower extremity pivotally attached to a suitable actuating device such as a lever 35. Lever 35 is pivotally attached to a bar 37 which is in turn attached to base 2. A spring 38 normally holds lever 35 in its uppermost position such that sleeve 33 is in turn held in its uppermost position whereby each latch 25' is held in engagement with gear 24 through rod 30. To disengage latches 25' from gears 24 permitting shafts 21 and basket containers 15 to rotate, lever 35 is depressed. This lowers sleeve 33 through rod 34, consequently pulling the extremity of each latch 25' farthest removed from its respective gear 24 toward central shaft 7 through rod 30, thereby moving the engaging arm of each latch 25' downwardly, disengaging said arm of latch 25' from its respective gear 24. To re-engage each latch 25' with its respective gear 24 it is merely necessary to release lever 35 permitting spring 38 to raise lever 35, thereby raising sleeve 33. This consequently moves the engaging arm of latch 25' upwardly through action of rod 30.

One means for causing angular rotation of basket containers 15 and shafts 21 is shown in Figure 3. In this embodiment a weight 43 is affixed to the bottom of each basket container 15 in an off-center or eccentric position. Said weight and distance of its center of gravity from the axis of shaft 21 should be sufficient to offset any moment produced by uneven distribution of the articles of hardware contained in the basket disposed in container 15.

Operation in the instance where an eccentric weight is affixed to each of the baskets is as follows: Each basket container 15 is rotated the desired number of degrees from the position wherein the center of gravity of the basket with eccentric weight 43 is farthest removed from the axis of central shaft 7. Latches 25' are then engaged with gears 24, as previously described, preventing angular rotation of each shaft 21 and basket container 15 about its own axis. Frame 6 carrying basket containers 15 is then rotated about the axis of central shaft 7 in the manner previously described for a desired period of time. Upon expiration of this desired period of time, the rotation of the main shaft 6 around the axis of central shaft 7 may be continued at the same speed or may be slowed down. In either case, lever 35 is pressed down, consequently releasing latches 25' from engagement with gears 24, permitting rotation of shafts 21 and baskets 15. Since baskets 15 have been angularly rotated to place the center of gravity of the containers with the eccentric weights 43 the desired number of degrees away from the angular position of said center of gravity when said center of gravity is farthest removed from the axis of central shaft

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7, the centrifugal force produced by the rotation of main frame 6 carrying baskets 15 about central shaft 7 will result in eccentric weights 43 angularly rotating basket containers 15 toward the position where the center of gravity of said weights 43 is farthest removed from the axis of central shaft 7, thereby rotating each basket container 15 the desired number of degrees about its own axis. Upon completion of said rotation, lever 35 is allowed to be moved upward by spring 38 thereby re-engaging latches 25'. The centrifuging operation may now be completed by continuing rotation of main frame 6 carrying baskets 15 for the desired period of time. In lieu of the employment of an eccentric weight 43, shafts 21 on the bottoms of basket containers 15 may be affixed in an off-center position. In such a case operation would be substantially the same as in the case where an eccentric weight is employed.

In the modified apparatus shown in Figures 4 and 5 a grooved wheel or pulley 39 is mounted on each shaft 21 between the bottom of arm 14 and gear 24. A tension spring 40 adapted to wind around pulley 39 has one extremity thereof affixed within the groove of pulley 39, the other extremity being affixed to a rod 41 which is in turn affixed to the bottom of arm 14 substantially as shown. When shaft 21 and pulley 39 are rotated counter-clockwise as shown in Figure 5 the tension on spring 40 is increased. In lieu of tension spring 40, a spiral winding spring 40' shown in Figures 6 and 7 may be employed, in which case pulley 39 is not required. The central extremity of spiral winding spring 40' is affixed to shaft 21, the external extremity being affixed to arm 14 through rod 41'. In this instance, when shaft 21 is angularly rotated counter-clockwise, a stress is set up in spring 40' which will tend to rotate shaft 21 clockwise to its original position.

In each of the above two instances, the release mechanism illustrated in Figure 3 may be employed. The method of operation will now be described. The first operative steps where spring loading is employed is to rotate each basket container 15 and consequently shaft 21 against the tension or stress set up by the spring 40 or 40' the desired number of degrees of angular rotation. While each basket container 15 is being rotated against the stress set up by the spring 40 or 40', lever 35 is held down thereby maintaining disengagement of latches 25' from gears 24 as previously described permitting said rotation. When containers 15 have been rotated the desired number of degrees lever 35 is permitted to raise by action of spring 38 thereby engaging latches 25' with gears 24 preventing the stress set up by the springs 40 or 40' from rotating containers 15 to the initial position. Frame 6 carrying containers 15 is then rapidly rotated about the axis of central shaft 7 by means previously described, for the desired period of time which is readily determined with a nominal amount of trial and error experimentation for any given size and shape of articles, coating composition and thickness, and temperature of coating bath. Upon completion of this desired period of time, rotation of frame 6 may be continued at the same speed or it may be slowed down, as desired. In either case, lever 35 is pressed down, thereby disengaging latches 25' from gears 24, as previously described. This permits the stresses in springs 40 or 40' to rotate shafts 21 and consequently basket containers 15 to their initial positions, thereby accomplishing the desired rotation. The number of degrees of angular rotation of basket containers 15 is predetermined by the number of degrees of original basket container rotation against the stress set up by the springs 40 or 40' prior to engagement of the latches 25' with gears 24.

Figures 8 and 9 illustrate a further means for accomplishing the limited rotation of basket containers 15 about their own axes during the centrifuging operation independently of the rotation of frame 6 about the axis of central shaft 7 and also illustrate one means for carrying

out the embodiment of the invention wherein the containers are continuously rotated during movement of the containers in the annular path about the fixed axis. In this embodiment, a double sprocket 47 having an integral pulley 48 rotates freely about and bears on main spindle 3. Rotation of double sprocket 47 is accomplished by rotation of integral pulley 48 by means of a V-belt 49, which V-belt 49 is in turn driven by a pulley 55 on an extension 45' of motor shaft 45. Said V-belt 49 is a loose fitting V-belt in which pulley 55 may rotate freely without transmitting its rotation to V-belt 49. An idler wheel 50 may be pivotally mounted on a suitable supporting rod 51, said supporting rod 51 being in turn mounted on base plate 2. Idler wheel 50 may be pressed against V-belt 49 to take up the slack in said V-belt whereupon rotation of motor shaft 45 is transmitted to double sprocket 47 through pulleys 55 and 48 and V-belt 49. Each of two chains 52 engaging its respective set of teeth 53 and 54 on double sprocket 48 transmits power to a sprocket 24' on each shaft 21. The application of the method of this invention where the latter apparatus is employed will now be described. Frame 6 carrying baskets 15 is rotated rapidly about central shaft 7 for the desired period of time, in a specific embodiment. Upon expiration of this period of time, idler wheel 50, which has not been in contact with V-belt 49, is now forced against V-belt 49, taking up the slack, causing the rotation of motor shaft 45 to be transmitted to double sprocket 48 in the manner previously described, which rotation of double sprocket 48 is consequently applied to sprockets 24' and shafts 21 of basket containers 15, thereby rotating containers 15. When basket containers 15 have rotated the desired number of degrees, idler wheel 50 is withdrawn from contact with V-belt 49 permitting pulley 55 on shaft 45 to turn freely without transmitting its rotation to V-belt 49. Rotation of double sprocket 48 is consequently stopped, stopping rotation of sprockets 24', shafts 21 and basket containers 15. As in all other apparatus embodiments, means such as that shown in Figure 3 may be employed to hold basket containers 15 fixed relative to their own axes during the initial and final phases of the centrifuging operation, said means being releasable to permit rotation of basket containers 15 about their own axes when desired. Where continuous rotation of the basket containers is desired, the idler wheel 50 can be moved into continuous contact with the V-belt 49. Alternatively, suitable positive drive means can be provided between sprocket 47 and motor shaft 45.

It will be understood that various changes, omissions, and additions may be made to the present invention without departing from the spirit and scope thereof as set forth in the appended claims.

What is claimed is:

1. A method of eliminating excess molten metal from hot dip metal coatings on articles of hardware, comprising subjecting said articles to centrifugal force by rapid movement in a circular path around a fixed axis for a predetermined period of time and wherein said articles are moved during a portion of said predetermined period of time such that the positions thereof are altered relative to said fixed axis whereby different surfaces of the articles face the outer periphery of said circular path after movement than faced said outer periphery prior to movement, said portion of said predetermined period of time being less than the whole period of time during which the articles are moved in a circular path about said fixed axis.

2. A method of eliminating excess molten aluminum metal from hot dip aluminum metal coatings on ferrous metal hardware articles comprising the steps of subjecting the coated articles to centrifugal force by rapid movement in a circular path about a fixed axis for a predetermined period of time, and during a portion of said predetermined period of time shifting the relative positions of said articles whereby different surfaces of the articles face the outer periphery of said circular path after such shifting

than faced said outer periphery prior to shifting, said portion of said predetermined period of time being less than the whole period of time during which the articles are moved in a circular path about said fixed axis.

3. A method of eliminating excess molten metal from hot dip metal coatings on articles of hardware comprising the steps of subjecting the coated articles to centrifugal force by rapid movement in a circular path about a fixed axis for a predetermined period of time, shifting the relative positions of said articles whereby different surfaces of said articles face the outer periphery of said circular path after such shifting than faced said outer periphery prior to shifting, and upon completion of said shifting again subjecting said articles to centrifugal force by rapid movement in a circular path about said fixed axis for a further predetermined period of time, said shifting of said articles being restricted to a portion of the period of time during which the articles are moved in said circular path about said fixed axis which is less than the entire period of time during which the articles are moved in a circular path about said fixed axis.

4. A method of eliminating excess molten metal from hot dip metal coatings on articles of hardware, comprising the steps of subjecting the coated articles to centrifugal force by rapid movement through a circular path about a fixed axis for a predetermined period of time, shifting the relative positions of said articles upon expiration of a portion of said period of time, subsection of said articles to centrifugal force being continued during said shifting operation, said shifting operation in period of time being restricted to a portion of the entire period of time during which the articles are moved in a circular path about a fixed axis.

5. A method of eliminating excess molten metal from hot dip metal coatings on articles of hardware, comprising the steps of suspending a mass of coated articles within a confined zone, and thereafter rapidly moving said mass of articles in an annular path about a fixed axis spaced from said mass for a predetermined period of time while simultaneously maintaining a certain portion of the mass of articles nearest the outer periphery of said annular path, then rotating said mass as a whole through an arc of less than 360° about an axis drawn through said mass of articles until a different portion of the mass from that mentioned above is arranged nearest to the said outer periphery of said annular path, thereafter moving the said mass of articles as a whole in said annular path.

6. A method of eliminating excess molten aluminum metal from hot dip aluminum metal coatings on articles of ferrous metal hardware, comprising the steps of suspending a mass of coated articles within a confined zone, rapidly moving said mass of articles as a whole in an annular path about a fixed axis spaced from said mass for a predetermined period of time while simultaneously maintaining a certain portion of the mass of articles nearest the outer periphery of said annular path, then rotating said mass as a whole through an arc of less than 360° and about an axis drawn through said mass of articles until a different portion of the mass from that mentioned above is arranged closest to the outer periphery of said path, and thereafter moving said mass of articles as a whole in said annular path.

7. The method of claim 6 wherein the hardware articles are threaded articles.

8. A method of eliminating excess molten metal from hot dip metal coatings on articles of hardware, comprising the steps of suspending a mass of coated articles within a confined zone, thereafter rapidly moving said mass of articles as a whole in an annular path about a fixed axis spaced from said mass for a predetermined period of time while simultaneously maintaining a certain portion of the mass of articles nearest the outer periphery of said zone, stopping said movement of said mass of articles as a whole through said annular path and rotating said mass as a whole through an arc less than 360° about an axis

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drawn through said confined zone until a different portion of the mass from that mentioned above is arranged closest to the outer periphery of said annular zone, and thereafter rapidly moving said mass of articles in said annular path a second predetermined period of time.

9. A method of eliminating excess molten metal from hot dip metal coatings on articles of hardware, comprising the steps of suspending a mass of coated articles within a confined zone, and thereafter rapidly moving said mass of articles as a whole in an annular path about a fixed axis spaced from said mass for a predetermined period of time while simultaneously maintaining a certain portion of the mass of articles nearest the outer periphery of said annular zone for a portion of said predetermined period of time, then simultaneously rotating said mass as a whole through an arc of less than 360° about an axis drawn through said mass of articles until a different portion of the mass from that mentioned above is arranged closest to the outer periphery of said annular zone while continuing the movement of said mass of articles as a whole through said annular path during rotation of said mass as a whole about said arc less than 360° and continuing said movement in said annular path after completion of said rotation for the remainder of the predetermined period of time.

10. In the art of eliminating excess molten metal from hot dip metal coatings on articles of hardware, the method for eliminating ridges of excess metal without producing contact defects such as bare spots or deformations where said articles have been previously subjected to centrifugal force by the steps of suspending a mass of coated articles within a confined zone, and thereafter rapidly moving said mass of articles as a whole in an annular path about a fixed axis spaced from said mass for a predetermined period of time, the improvement comprising the steps of simultaneously maintaining a certain portion of the mass of articles nearest the outer periphery of said path during said period of time, then rotating said mass as a whole through an arc of less than 360° and about an axis drawn through said mass of articles until a different portion of the mass from that mentioned above is arranged closest to the outer periphery of said annular path and thereafter moving said mass of articles as a whole in an annular path similar to that mentioned above.

11. A centrifuge comprising in combination a central power driven rotatable shaft, frame means carried by said rotatable shaft, at least one perforate container rotatably

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mounted on said frame and spaced from said central shaft, holding means for locking said perforate container in a fixed position relative to its own axis during rotation of said frame means about said central shaft, means for alternately releasing said locking means for said container during continued rotation of said frame about said central shaft and for causing re-engagement of said locking means for holding said perforate container fixed relative to its own axis whereby different sections of the container can be arranged adjacent the outer peripheral path of travel of said frame means, and spring means operable during the actuation of said last mentioned means for rotating the perforate container about its own axis independently of rotation of said frame means and central shaft about the axis of said shaft.

12. The centrifuge of claim 11 wherein the spring means comprises a shaft affixed to the bottom of said perforate container, a pulley affixed to said shaft, a tension spring adapted to fit within the groove of said pulley, one extremity of said tension spring being affixed within said groove of said pulley, the other extremity of said tension spring being affixed to said frame.

13. The centrifuge of claim 11 wherein the spring means comprises a shaft affixed to the bottom of said perforate container, a spiral winding spring, the central extremity of which is affixed to said axial shaft, and the external extremity of which is affixed to said frame.

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