March 17, 1970 T. F. HAMMER 3,500,979

SEMI-AUTOMATIC GALVANIZING PROCESS APPARATUS

Filed Jan. 22, 1968 3 Sheets-Sheet 1

Fig. 1.

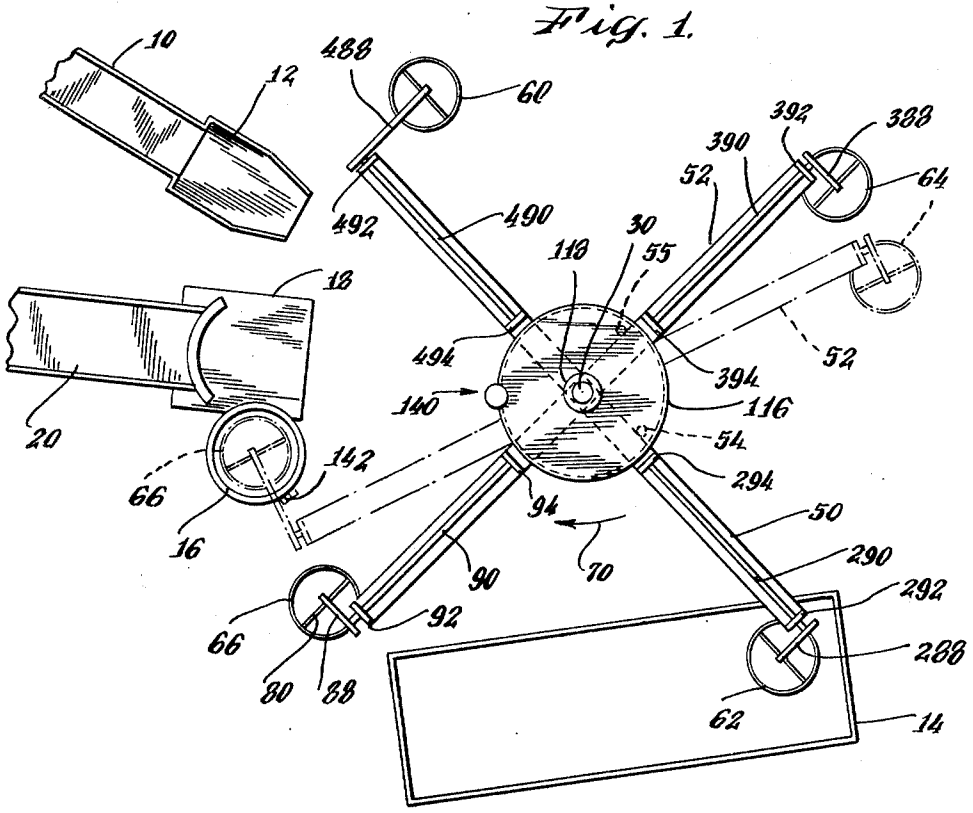
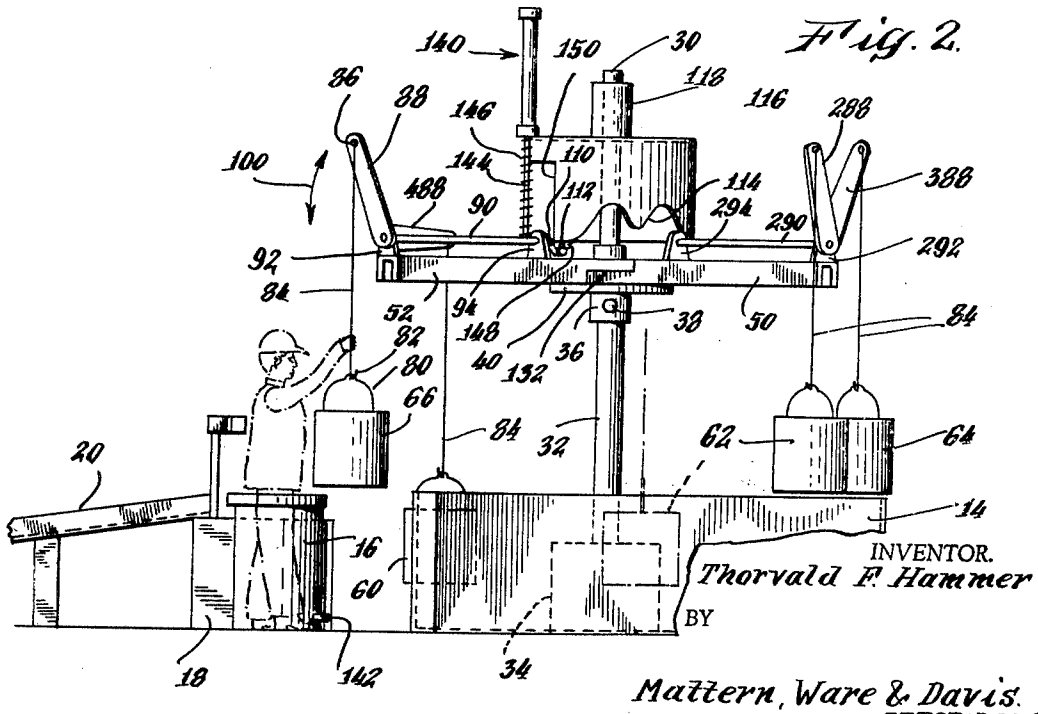


Fig. 2.



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SEMI-AUTOMATIC GALVANIZING PROCESS APPARATUS

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Fig. 3.

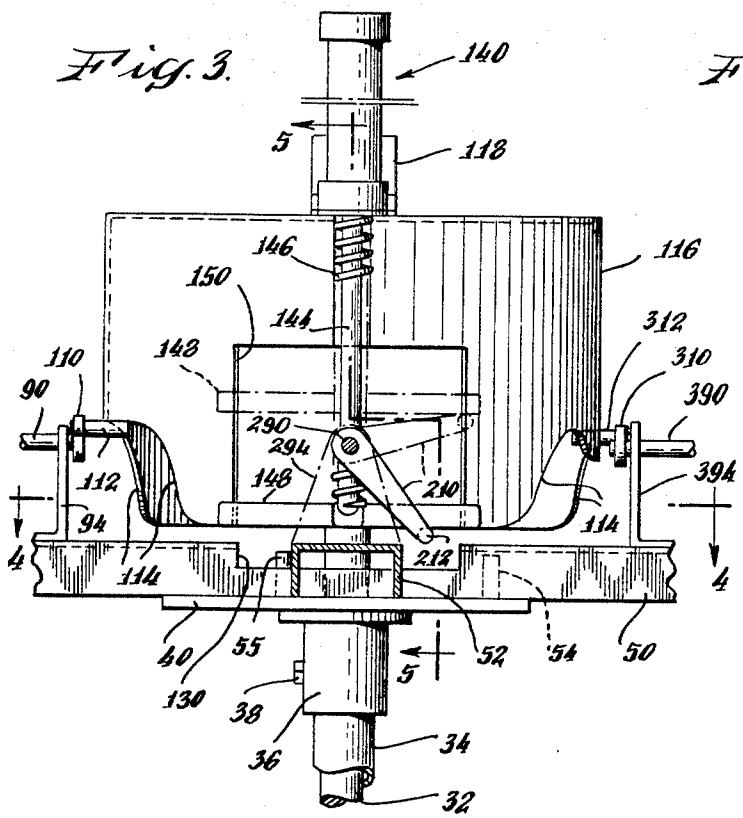


Fig. 5.

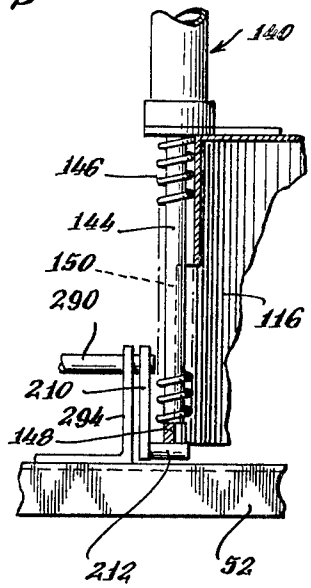
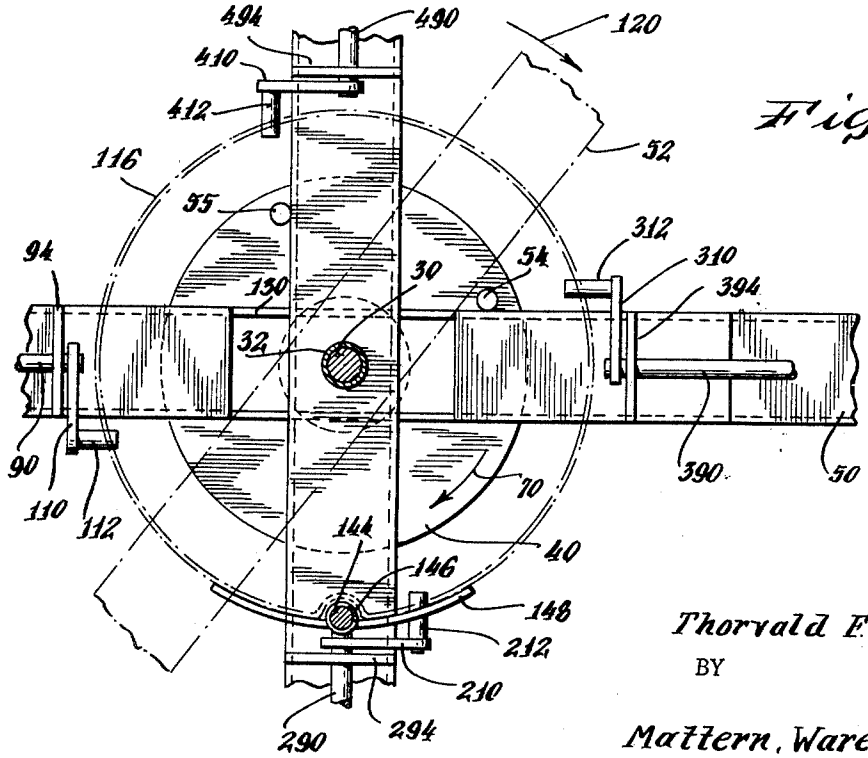


Fig. 4.



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SEMI-AUTOMATIC GALVANIZING PROCESS APPARATUS

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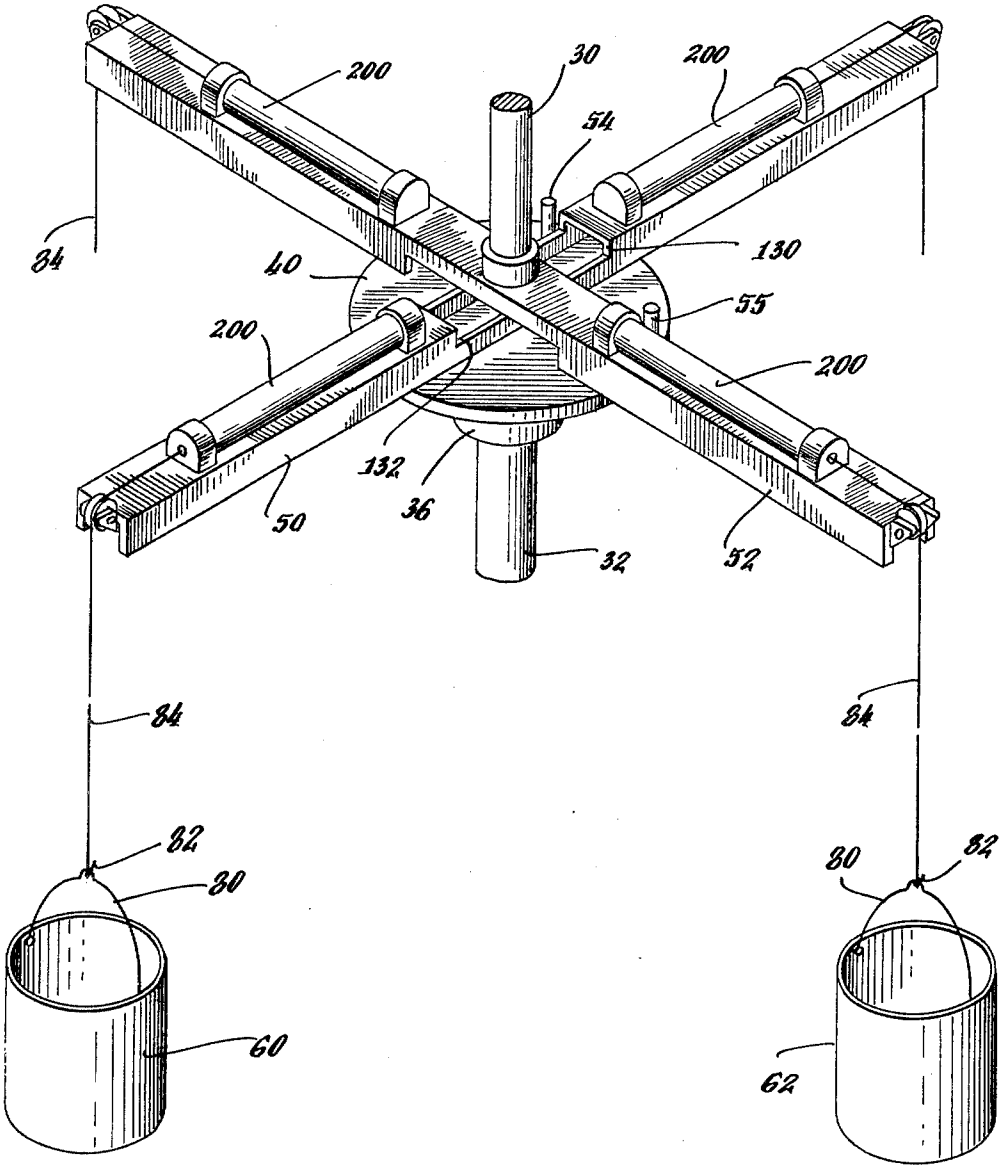
Fig. 6.



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3,500,979

SEMIAUTOMATIC GALVANIZING PROCESS APPARATUS

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Int. Cl. B65g 29/00
U.S. Cl. 198—19 9 Claims

ABSTRACT OF THE DISCLOSURE

Machinery for the semiautomatic galvanizing of small parts. A number of processing stations, including a loading station, a galvanizing dip, a centrifuge, and a dumping station, are located at spaced points around a circular processing path. A central upstanding post has a number of arms radiating outwardly to the processing stations, and the arms are driven rotationally about the post. The parts to be galvanized are suspended from the radial arms and thus transported automatically to each processing station in turn. Means are provided for raising and lowering the parts according to the requirements of each processing station. The operator is able to pull the arms manually forward of their driven positions to accelerate certain processing steps, and also has manual control over additional power-assisted means for raising and lowering the parts at the centrifuge station.

BACKGROUND OF THE INVENTION

Field of the invention

The invention relates generally to processing machinery, and in particular to apparatus for a semiautomatic galvanizing process.

The prior art

Galvanizing is a well known process for coating small iron parts with zinc, so as to protect them from corrosion. The small parts are immersed in a molten zinc bath, and then may be centrifuged to spin off the excess zinc. If the production volume is low, one may put a few parts in a bucket and manually move the bucket through the galvanizating bath and the centrifuging process. On the other hand, for high volume production, large and expensive machines have been developed to perform the galvanizing process in a highly automated and continuous fashion.

SUMMARY OF THE INVENTION

The present invention stands somewhere between these two extremes. It provides novel apparatus of the type summarized in the Abstract above, for production runs which are not so large as to justify the expense of very large, very rapid, and highly automatic machinery. On the other hand, it permits an operator who remains in manual attendance to greatly increase his rate of production, by performing many of the steps in the galvanizing process automatically. Other steps require operator intervention, but the machine greatly assists the operator in performing these steps, and enables him to galvanize more parts with greater ease. For this reason, the apparatus of this invention has been characterized as semiautomatic.

One object of the invention is to provide semiautomatic processing equipment. It is also an object to maximize the ease and rapidity of operation of processing machinery, without incurring all the expense usually associated with

the very high volume machinery. Another object is to maximize the ease and rapidity of operation of those production processes which require human intervention. It is also an object to minimize the labors of the human operator. In particular, this invention seeks to give the operator sufficient time to complete one step of the process before the machinery requires that the next step be performed. It attempts to allow the operator to work at his own pace, although in cooperation with the machine. Another object is to provide a manually controlled power assist for raising and lowering heavy materials when required. Still another object is to minimize the amount of human intervention required in processes.

The invention can take various forms, rather than being limited to any particular apparatus. However, in order to facilitate a detailed description of the invention, it will be described by reference to particular embodiments illustrated in the following drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a top plan view of a particular embodiment of a semiautomatic galvanizing machine built in accordance with the principals of this invention.

FIG. 2 is a side elevational view of the same apparatus, and an operator in the process of using such apparatus.

FIG. 3 is a fragmentary side elevational view of that portion of the apparatus of the previous figures which controls the raising and lowering of the parts to be galvanized as required by the processing steps.

FIG. 4 is a sectional view of the portion of the apparatus of FIG. 3 taken along the lines **4—4**.

FIG. 5 is a sectional view of the same apparatus, taken along the lines **5—5**.

FIG. 6 is a fragmentary perspective view of an alternative embodiment of a semiautomatic galvanizing machine built in accordance with the principles of this invention, employing another specific mechanism for controlling the raising and lowering of the parts to be galvanized.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows the overall arrangement of the particular galvanizing apparatus depicted in the drawings. This arrangement is best appreciated in terms of the sequence of steps for galvanizing small iron parts. The parts are delivered along a channel **10**, which may be either a mechanized conveyor belt or a gravity chute. The parts arriving along channel **10** are delivered to a hopper **12** where they are accumulated until the operator of the galvanizing machine is ready to begin galvanizing them.

They next are transported, in a manner which will be fully described below, to a series of processing stations. The first of these stations consists of a tank **14** which contains the usual galvanizing bath of molten zinc. The next station is a centrifuge **16** at which the excess molten zinc is spun off the iron parts. Then the parts are brought to a dumping station which includes machinery **18** for unloading the parts onto a channel **20**, either a mechanized conveyer belt or a gravity chute, which carries the finished galvanized parts away.

FIG. 1 best illustrates the fact that the processing stations represented by the hopper **12**, the tank **14**, the centrifuge **16**, and the unloader **18**, are all arranged generally along the arc of a circle, so that rotating equipment can be used to transport the iron parts to each succeeding processing station in a turn. This rotating equip-

nent is mounted upon a fixed upstanding central post **30**. As best seen in FIG. 2, the lower portion of post **30** is urrounded by a hollow shaft **32**. This shaft is rotationlly driven about the fixed central post **30** by a conventional motor and gear mechanism enclosed within the ousing **34**. The rotation of hollow shaft **32** drives the ransporting machinery which carries the iron parts on heir circular trip through the succession of processing tations described.

The rotary motion of shaft **32** is transmitted to a heavy ollar **36** secured to the shaft **32**, as for example by a et screw **38**. The collar **36** has secured thereto a circular able **40** which supports the mechanism for transporting he iron parts, and is rotationally driven by the shaft **32** nd collar **36** so as to effect the necessary circular motion hrough a succession of processing station.

A pair of carrier arms **50** and **52** are supported upon he rotating table **40**, and are rotationally driven by the able **40** by means of drive pins **54** and **55** secured to the op surface of the table **40** and bearing against the sides f carrier arms **50** and **52** respectively as the table **40** otates.

The upstanding central post **30** passes loosely through he centers of the carrier arms **50** and **52** so as to center hem properly without impeding their rotational motion bout the post **30**. The opposite ends of carrier arms **50** nd **52** extend radially outward from the center of rotaion defined by post **30**, and each radially remote end of carrier arm has means for suspending therefrom a ucket of small iron parts to be galvanized. For example, uckets **60** and **62** are suspended from opposite ends of arrier arm **50**, while buckets **64** and **66** are suspended rom the opposite ends of carrier arms **52**. As the carrier rms **50** and **52** are rotated in the direction of arrow **0**, the buckets **60**, **66**, **62** and **64** in that order, are rought around to the successive processing stations.

As a particular bucket proceeds from station to staions, it becomes necessary to raise and lower the bucket n accordance with the requirements of succeeding proccssing steps. For example, as any one of the buckets **60** hrough **66** passes the hopper **12**, it must be at the right eight to permit the parts in the hopper to be dropped ravitationally into the bucket. Then the bucket must be aised high enough to clear the wall of the tank **14** at he entrance end thereof. Immediately after that, the ucket must be lowered into the galvanizing bath conained in the tank **14**. Next the bucket is pulled slowly hrough the galvanizing bath, and is then raised out of he bath near the exit end of the tank **14** so that it can lear the tank wall once again. Then, as best seen in IG. 2 the bucket must be lowered into the centrifuge **6** and subsequently raised out of it at the end of the entrifuging operation. Finally, the bucket must be at the ight height to be deposited upon the unloading device **8** at the end of the entire process, so that the device **18** an tip the bucket over and dump its contents onto the xit channel **20**. Accordingly, the buckets are suspended rom the carrier arms **50** and **52** by a mechanism which aises and lowers them according to requirements.

As best seen in FIG. 2, each of the buckets, e.g., **66**, s provided with the usual carrying handle **80**, by means f which it is suspended from a hook **82** and cable **84**. he cable in turn is pivotely secured to a pin **86** at one nd of a rocker arm **88**. The rocker arm is affixed to a rankshaft **90** for rotation therewith. The crankshaft in rn is journaled in a pair of brackets **92** and **94** rising rom the upper surface of the left half of carrier arm **2** as seen in FIG. 2. Rotation of the crank shaft **90** erves to rock the arm **88** up or down as indicated by rrow **100** so as to raise or lower the bucket **66** accordng to the requirements of the galvanizing process at each tage.

A similar mechanism for suspending and for raising nd lowering the diametrically opposite bucket **64** is ounted on the opposite end of the carrier arm **52**, as best seen in FIG. 1. The remaining buckets **60** and **62** are also suspended from similar raising and lowering mechanisms located at the opposite ends of carrier arm **50**. In FIG. 2 it is seen that buckets **62** (solid lines) and **64** are suspended from rocker arms **288** and **388** respectively, which are both in a raised position, as is rocker arm **88**. Bucket **60** is suspended from rocker arm **488** which is in the lower position. The height of buckets **62** (solid lines), **64**, and **66** compared to the lower height of bucket **60** and the broken line representation of bucket **62**, illustrates the manner in which the rocker arms raise and lower the buckets during the course of a galvanizing process cycle. The dotted line representation of bucket **62** shows the latter while it is lowered into the galvanized dip of tank **14**.

In order to achieve semiautomatic operation, the raising and lowering mechanisms described are automatically controlled to alter the height of the respective buckets **60** through **66** in accordance with the differing requirements of each succeeding processing station. Since each such processing station is located at a different angular position about the arc of circular travel of carrier arms **50** and **52**, this is accomplished by controlling the bucket height as a function of its angular position at different stages of the circular travel.

It will be recalled from the description of FIGS 1 and 2, that each bucket, for example bucket **66**, is raised or lowered by rocking motion of the arm **88** which is associated with the rotation of its crankshaft **90**. FIGS. 3 and 4 best illustrate the manner in which rotation of the crankshaft **90**, and its counterpart crankshafts **290**, **390** and **490**, is controlled as a function of angular position of the arms **50** and **52**. At the radially inward end of the crankshaft **90**, beyond its journal bracket **94**, is affixed a crank arm **110**. The remote end of this crank bar carries a cam-follower pin **112** which is rotatably mounted thereon. This follower rolls along a cam track **114**, best seen in FIGS. 2 and 3. The cam track is formed by the vertically undulating edge of a cylindrical drum **116** secured to a sleeve **118** which in turn is affixed to the central post **30** (as best seen in FIG. 2). As the carrier arm **50** is driven through its circular travel (arrow **70**) by its drive pin **54** on the drive table **40**, the cam-follower **112** makes a complete circuit of the cam track **114**, rising and falling with all of the vertical undulations of the cam track. Vertical motion of the follower **112** raises and lowers the crank **110** to turn the crankshaft **90** for rocking the arm **88** so that the bucket **66** can be lowered or lifted automatically at each angular position about the circular orbit. As clearly indicated in FIGS. 3 and 4, the height of the remaining buckets is similarly controlled by similar mechanisms bearing corresponding reference numerals, e.g., **212**, **210**, etc. Thus, it will be appreciated that the buckets **60** through **66** proceed up and down one after the other as they circle through the successive processing stations of this apparatus in a continuous cycle.

Normally the buckets are spaced 90° apart from each other around the circle. This is determined by placement of the two driving pins, **54** and **55**, 90° apart from each other. Pin **54** determines the driven position of carrier arm **50**, and pin **55** determines the driven position of carrier arm **52**. However, in a semiautomatic process such as this one where the intervention of an operator is required at certain stages, such human intervention can be accomplished more efficiently if the operator has some means of moving a desired bucket manually ahead of its driven position so that he can have more time to perform manual operations on that bucket or its contents, before the automatic drive mechanism is ready to move the bucket on to the next processing station.

For example, in FIG. 2 a human operator is seen grasping the cable **84** of bucket **66** which has just emerged from the galvanizing bath in immersion tank **14**. The next step in the process calls for the bucket **66** to be lowered into the centrifuge **16** and detached from its

hook 82 so that the bucket can be whirled in the centrifuge to spin off excess zinc from the galvanizing bath adhering to the iron parts in the bucket. If the operator does not begin putting the bucket into the centrifuge 16 until the carrier arm 52 has been driven by the drive pin 55 far enough around the circle to put the bucket 66 directly over the centrifuge, then there will not be time for the operator to complete the centrifuging step of the process before the driver pin 55 moves the carrier arm 52 and the mechanism for suspending bucket 66 on to the next processing station, unloader 18. To avoid this difficulty, the carrier arms 50 and 52 are allowed to pivot freely on the drive table 40 so that each of the arms can be manually pulled ahead of its driven position by the operator. See, for example, the dotted line representation of carrier arm 52 and its associated mechanisms, compared with the solid line representation in FIGS. 1 and 4. The solid line representation shows the carrier arm 52 in the position to which it is driven by contact with its driving pin 55, and the dotted line representation shows the arm in a typical position to which it is pulled ahead manually by the operator. The arrow 120 in FIG. 4 shows the direction of manual advance of the carrier arm 52, which is in the same angular sense of the direction of mechanical drive indicated by the arrow 70. The latitude of manual advance allowed the carrier arm 52 is anywhere between its solid line position, engaging directly against its own driver pin 55, up to the point where it abuts against the driver pin 54 of the other carrier arm 50. The carrier arm 50 also has a similar latitude of manual advance in the space between its own driver pin 54, and pin 55 of the other carrier arm 52.

Thus, when the bucket 66 emerges from the galvanizing tank 14, the operator can grasp the cable 84 and thereby pull the bucket 66, carrier arm 52 and all its associated mechanism forwardly ahead of its driven posititon, to avoid delay in bringing the bucket 66 to the centrifuging station. Therefore the bucket can be immediately inserted into the centrifuge 16, and the centrifuging operation takes place, spinning the excess molten zinc from the galvanized parts. By the time that the driving pin 55 has caught up with the carrier arm 52, the centrifuging operation has been completed and the operator is then ready to reattach the hook 82 to the handle 80 of bucket 66, and send the bucket on its way to the next processing station, the unloader 18, by means of the carrier arm 52 driven by its pin 55. Thus, the apparatus of this invention solves the problem stated above, by allowing the human operator to steal time from the automatic phases of the process so that he can more easily perform the manual steps.

During the time that the carrier arm 50 or 52 is manually pulled ahead in the manner described, it is necessary that the bucket at the diametrically opposite end of the particular carrier arm be in between processing stages. For example, while the operator is swinging bucket 66 forwardly by rotating carrier arm 52 ahead of its driven position, the bucket 64 at the diametrically opposite end of carrier arm 52 is necessarily also swinging ahead of its driven position. Therefore it should not be in the middle of an automatically controlled processing step when this occurs. For this reason, a large angular space between the hopper 12 and the immersion tank 14 is left free of any processing stations; i.e., the clear area in the upper right hand quadrant of FIG. 1 which is substantially diametrically opposite to the processing station represented by the centrifuge 16.

Attention should also be paid to some of the details of construction of the carrier arms 50 and 52 which permit the manual advance of these carrier arms as described. Both these arms have a channel cross section, as illustrated by the sectional view of carrier arm 52 in FIG. 3. In order to avoid unnecessary increases in the dimensions of this galvanizing apparatus, the carrier arms 50 and 52 do not overlie one another to a double thickness in the vicinity of central post 30, but instead are relieved in a complementary manner so as to nest one over the other. The carrier arm 50 has its top half removed as indicated at reference numeral 130 in FIGS. 3 and 4, while arm 52 has its bottom half removed as indicated by reference numeral 132 in FIG. 2. Moreover, the length of the relieved portion of the carrier arms 50 and 52 must be great enough to permit either one of these arms to be pulled manually ahead of the position of the other arm. For example, as best seen in FIG. 4, the length of the relieved portion 130 of carrier arm 50 must be great enough to permit carrier arm 52 to be rotated forwardly relative thereto as indicated by the arrow 120 and the dotted line representation of the carrier arm 52.

Returning now to our consideration of the processing station represented by the centrifuge 16, it will be appreciated that a large bucket full of galvanized metal parts is a fairly heavy load for a human operator to lower into the centrifuge and raise from the centrifuge by muscle power. Therefore, this invention contemplates providing the operator with a power assist in the form of an air cylinder mechanism 140 which is mounted on the cylindrical drum 116. This power assist mechanism should not be operated automatically as a function of angular position, in the way that the buckets are raised and lowered at every other stage of the galvanizing process, because the centrifuging operation is intended to be done under manual control, with the human operator pulling the bucket ahead of its driven position and manually selecting the time at which the bucket is to be lowered into the centrifuge and raised therefrom. Accordingly, there is provided a foot pedal 142 by which the operator can control the air cylinder 140 at will, causing it to lower a bucket into the centrifuge 16 or raise it from the centrifuge when desired. The air cylinder 140, the foot pedal 142, and the connections therebetween can all be of conventional construction.

An opening shaft 144 extends downwardly from the air cylinder shaft 140, and is surrounded by a counterbalancing spring 146 which assists in the raising of the bucket. At the lower extremity of the operating shaft 144 is a horizontal bridge member 148. This bridge member is normally urged by operating shaft 144 to a downward position indicated by the solid line representation 148 in FIG. 3. In this position, the bridge member 148 serves to bridge a gap formed in the cam track 114 because of a large opening 150 cut into the cylindrical drum 116 at the angular position corresponding to the centrifuge 16. Note also that the bridge member 148 is circularly curved as shown in FIG. 4 to conform to the curvature of the cylindrical drum 116 and its cam track 114.

When any one of the cam-followers 112, 212, 312, or 412 runs off the cam track 114, in the direction of arrow 70, FIG. 4, into the vicinity of the gap 150, it rides onto the bridge member 148 which is then in its lower position. In FIGS. 3 and 4 the follower 212 is shown in the position just described.

Since the gap 150 and the bridge member 148 which bridges it are located at an angular position corresponding to the centrifuge 16, when the operator manually swings any one of the buckets 60 through 66 forward so that it comes into registration with the centrifuge 16, the particular cam-follower associated with that bucket will be in engagement with the bridge member 148 and in alignment with the gap 150. Assume for the purposes of description that it is the cam-follower 212, as illustrated in FIGS. 3 and 4, which occupies that position. The operator can then operate the foot pedal 142 to actuate the air cylinder 140. This draws the operating shaft 144 and bridge member 148 upwardly against the bias of counterbalancing spring 146. As the bridge member 148 rises into

he gap **150**, the cam-follower **212** is allowed to follow it ıpwardly into the gap **150** to the dotted line position ndicated in FIG. 3. This allows the crank arm **210** to ise to its dotted line position, and causes the crankshaft :90 to rotate in the direction for lowering the associated ›ucket into the centrifuge.

The operator may then unhook the bucket and perform he centrifuging operation. Subsequently, he re-engages he hook and releases the foot pedal **142** to actuate the ir cylinder **140** so that the operating shaft **144** drives the ›ridge member **148** downwardly to its original position. This drives the cam-follower **212** and crank arm **210** lownwardly to rotate the crankshaft **290** in the direction o raise the bucket from the centrifuge. The counter-›alancing spring **146** assists in this lifting operation. Subequently, as the bucket and its associated carrier arm :2 proceed in their circular orbit to the next processing tation, the cam-follower **212** rides off the bridge mem-›er **148** in the direction of arrow **70** and continues its ravel on the cam track **114** (as the cam-follower **112** is een to do in FIGS. 3 and 4).

During the remaining phases of the galvanizing proc-ss, the operator guides the bucket to the unloader **18** ınd causes that mechanism to tip the bucket and unload ts contents into the exit channel **20**. The operator next ;uides the bucket into position near the hopper **12** so hat it can be reloaded with small parts to be galvanized. From that point on the galvanizing apparatus of this in-'ention will automatically take the bucket of parts around he blank portion of the orbit between hopper **12** and ank **14**, and later immerse the bucket of parts in the ;alvanizing bath of tank **14** and remove the bucket therefrom. Finally, the bucket again reaches the point where ›perator attention is required as it approaches the centrifuge **16**.

FIG. 6 is intended to illustrate one of several possible ılternative embodiments within the general principle of his invention. In this embodiment the mechanisms illustrated in FIGS 1 through 5 for raising and lowering he buckets, are replaced by individual actuators **200**. These may be electrically actuated solenoids or they may ›e hydraulic or pneumatic cylinders of conventional contruction. In any case, the electrical, hydraulic, or pneunatic power lines to actuate the devices **200** can be arranged in a known manner, using electrical slip rings and :ommutating switches or their hydraulic or pneumatic :quivalents. These may be arranged so that the actuators :00 are energized and deenergized as a function of angular position, to raise and lower the buckets automatically n accordance with the requirements of the different proc-:ssing stations. When the buckets reach the centrifuge tation, however, their associated actuators **200** would at hat point be released from automatic control and given ›ver to operator control so that the bucket can be raised ınd lowered at will in the manner described above.

Regardless of which specific embodiment is employed, he foregoing description merely illustrates the basic prin-:iple of this invention, which concerns novel semiautonatic processing apparatus having numerous advantages ›ver the prior art in that it is less expensive than high /olume production equipment, yet more convenient to ıse and capable of greater production than prior art :quipment involving a degree of human intervention.

Therefore the following claims, the function of which s to define the scope of patent protection to which this nvention is entitled, should be given a latitude of inter-›retation which is consistent with the inventive principles :merging from the foregoing disclosure.

The invention claimed is:

1. Semiautomatic processing apparatus comprising:

(A) an upstanding central post;

(B) a plurality of radial arms mounted on said post for rotation thereabout;

(C) driving means rotatable about said post operatively engageable with said arms for imparting rotation thereto in one direction and operatively disengageable through rotational movement imparted to said arms in said one direction independently of said driving means;

(D) a plurality of vehicles suspended from said arms for holding parts to be processed by a succession of steps;

(E) and a plurality of discrete processing stations for performing said steps, located at respective angular positions around the circle of rotational travel of said vehicles.

2. The apparatus of claim **1**, in which said arms are formed with respective rearwardly facing surfaces relative to the direction of said driven rotation, and said driving means move forwardly against said rearwardly facing surfaces to effect driving engagement, but permit said rearwardly facing surfaces to disengage freely in the forward direction when said arms are pulled ahead manually.

3. The apparatus of claim **1**:

(A) wherein said processing stations include at least one immersion tank for said parts, said tank having an entrance end and an exit end;

(B) said apparatus further comprising means for raising and lowering said vehicles from said arms and for automatically controlling the raising and lowering of said vehicles as a function of the angular position of their respective arms to automatically immerse said vehicles in said tank near said entrance end and raise said vehicles from said tank near said exit end thereof.

4. The apparatus of claim **3**, further comprising power-assisted means under manual control for raising and lowering said vehicles at a processing station other than said immersion tank.

5. The apparatus of claim **3**, wherein said raising and lowering means comprises:

(A) crankshafts rotatably mounted on said respective arms;

(B) rockers affixed to the radially outer ends of said respective crankshafts, said vehicles being suspended from said respective rockers whereby said vehicles are raised and lowered as said crankshafts are rotated to raise and lower said rockers;

(C) respective cranks affixed to the radially inner ends of said respective crankshafts to control rotation thereof;

(D) means affixed to said central post, forming a circular cam track with vertical undulations located so as to correlate said raising and lowering of said vehicles with angular position;

(E) and respective followers on said cranks engaging and following said cam track circularly to raise and lower said vehicles in accordance with said undulations.

6. The apparatus of claim **5**, further comprising:

(A) a vertically relieved gap formed in said cam track at an angular location corresponding to a processing station other than said immersion tank;

(B) a bridge member extending across said gap whereby to engage said cam followers;

(C) means mounting said bridge member for vertical movement in said gap;

(D) power means for raising and lowering said bridge member whereby to raise and lower said vehicles;

(E) and means for manually controlling said power means.

7. The apparatus of claim **1**, wherein:

(A) said driving means comprises a horizontal drive table rotatably mounted on said central post, a motor and transmission connected to rotate said drive table about said post, and a pair of drive pins upstanding from said table;

(B) said radial arms overlying said drive table in position to be engaged by said drive pins to produce rotation of said arms.

8. The processing apparatus of claim 1, further comprising:

means for automatically changing the height of said vehicles at least at one of said processing stations whereby to bring said vehicles into processing position.

9. The apparatus of claim 8 further comprising power means, and means for manually controlling said power means, for changing the height of said vehicles at the will of an operator at said selected processing station.

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RICHARD E. AEGERTER, Primary Examiner

U.S. Cl. X.R.

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