April 24, 1962 E. UMBRICHT ET AL 3,030,896

TRANSFER APPARATUS

Original Filed Dec. 20, 1954 4 Sheets-Sheet 1

FIG. 1.

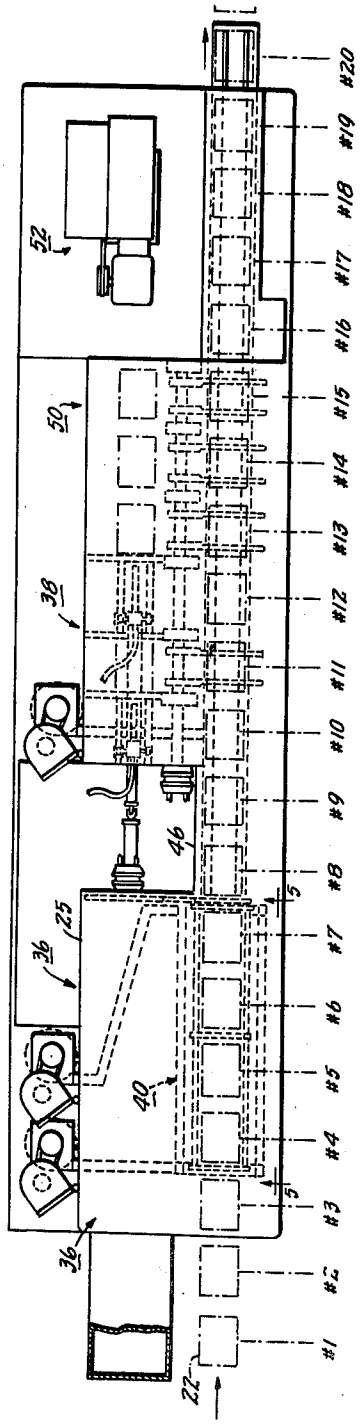
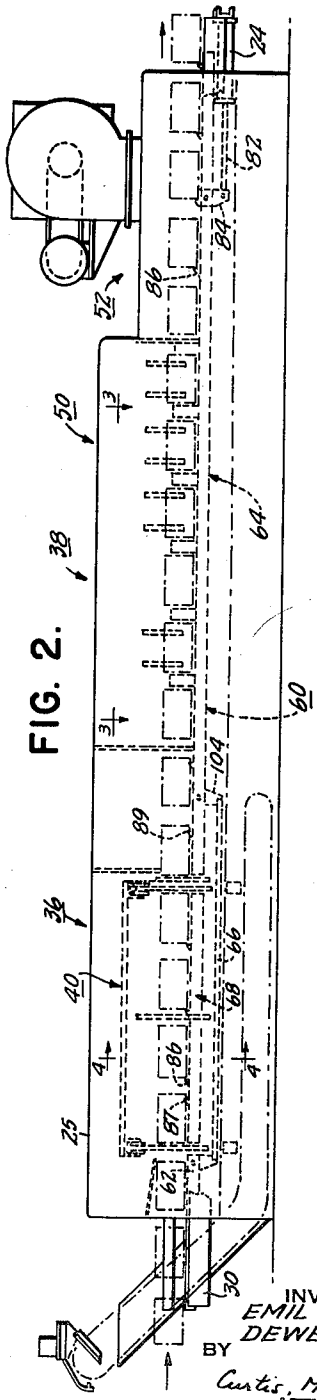


FIG. 2.



INVENTORS
EMIL UMBRICHT
DEWEY EVANS
BY
Curtis, Morris & Safford
ATTORNEYS

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FIG. 3.

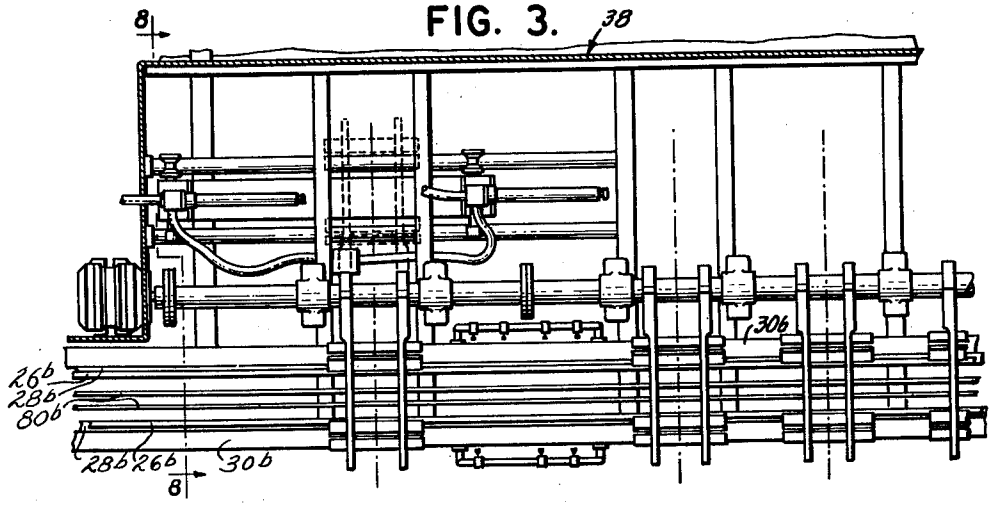
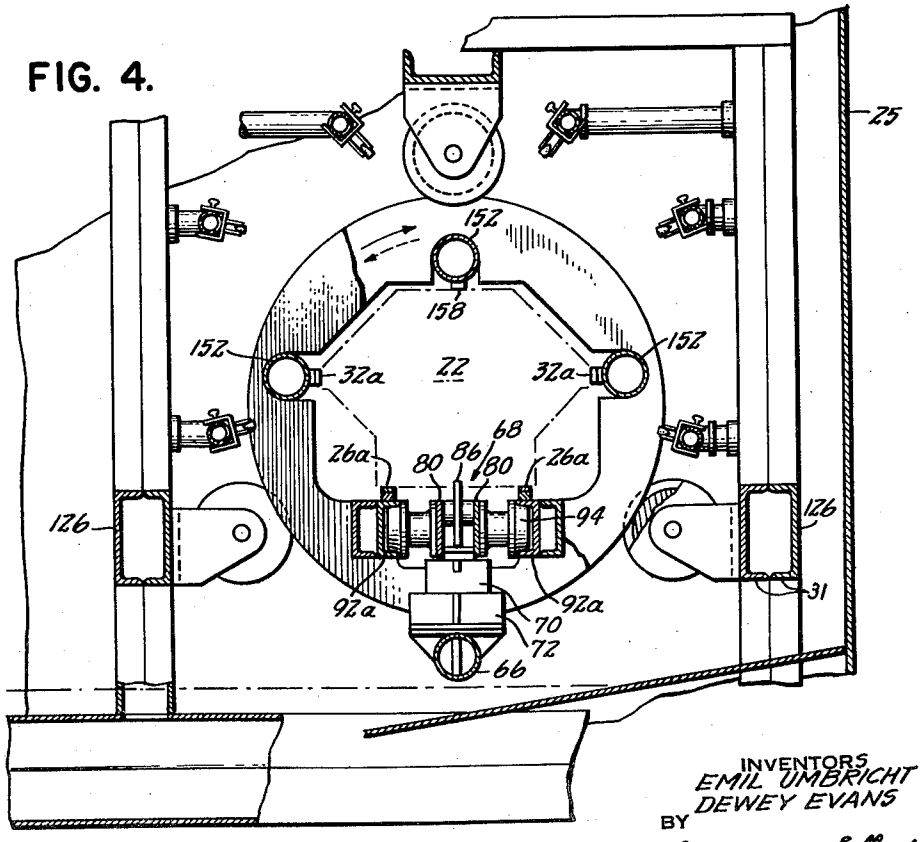


FIG. 4.



INVENTORS
EMIL UMBRICHT
DEWEY EVANS
BY
Curtis Morris & Safford
ATTORNEYS

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TRANSFER APPARATUS

Original Filed Dec. 20, 1954 4 Sheets-Sheet 3

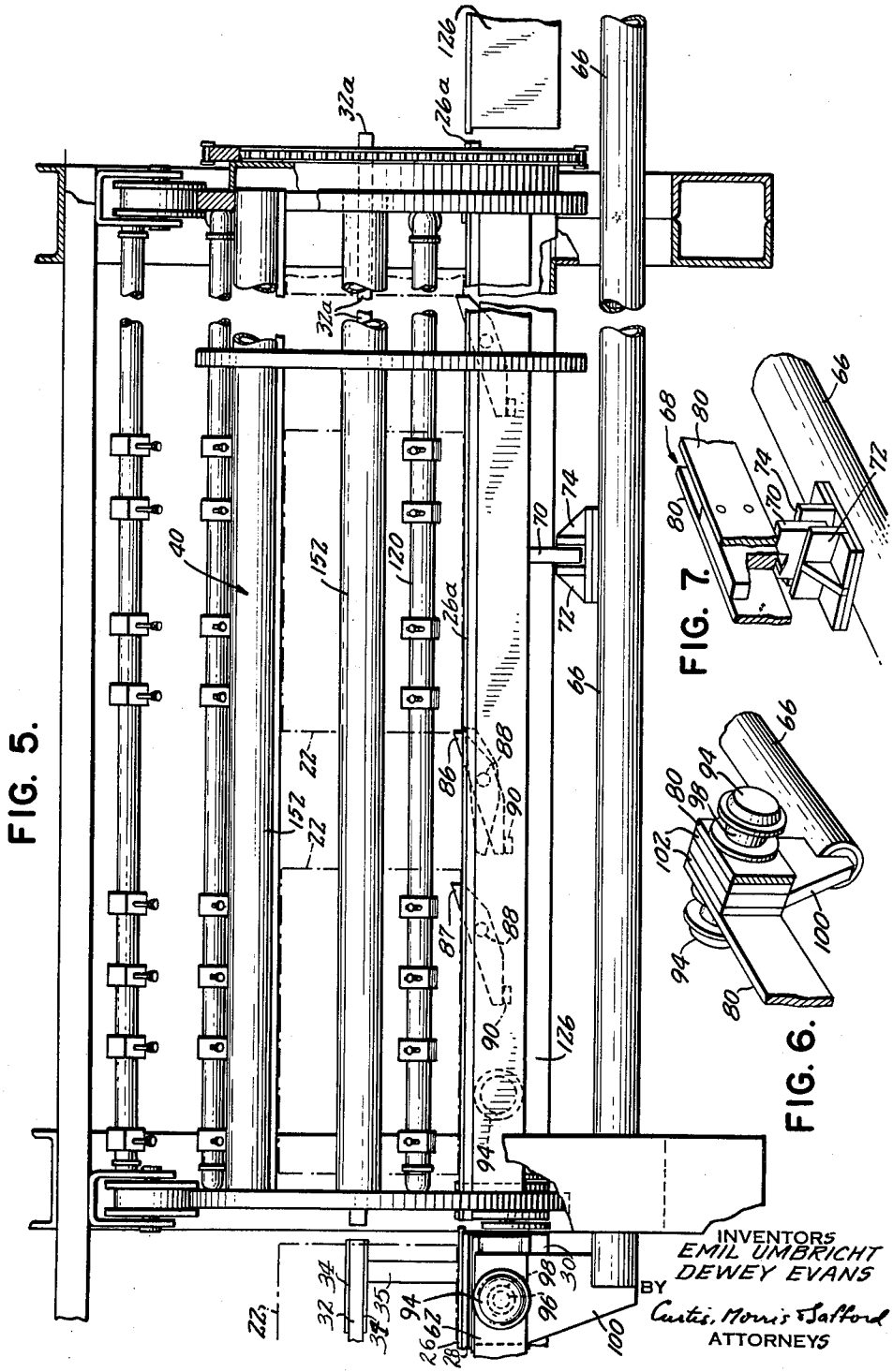


FIG. 5.

FIG. 7.

FIG. 6.

INVENTORS
EMIL UMBRICHT
DEWEY EVANS
BY
Curtis, Morris & Safford
ATTORNEYS

April 24, 1962 E. UMBRICHT ET AL 3,030,896

TRANSFER APPARATUS

Original Filed Dec. 20, 1954 4 Sheets-Sheet 4

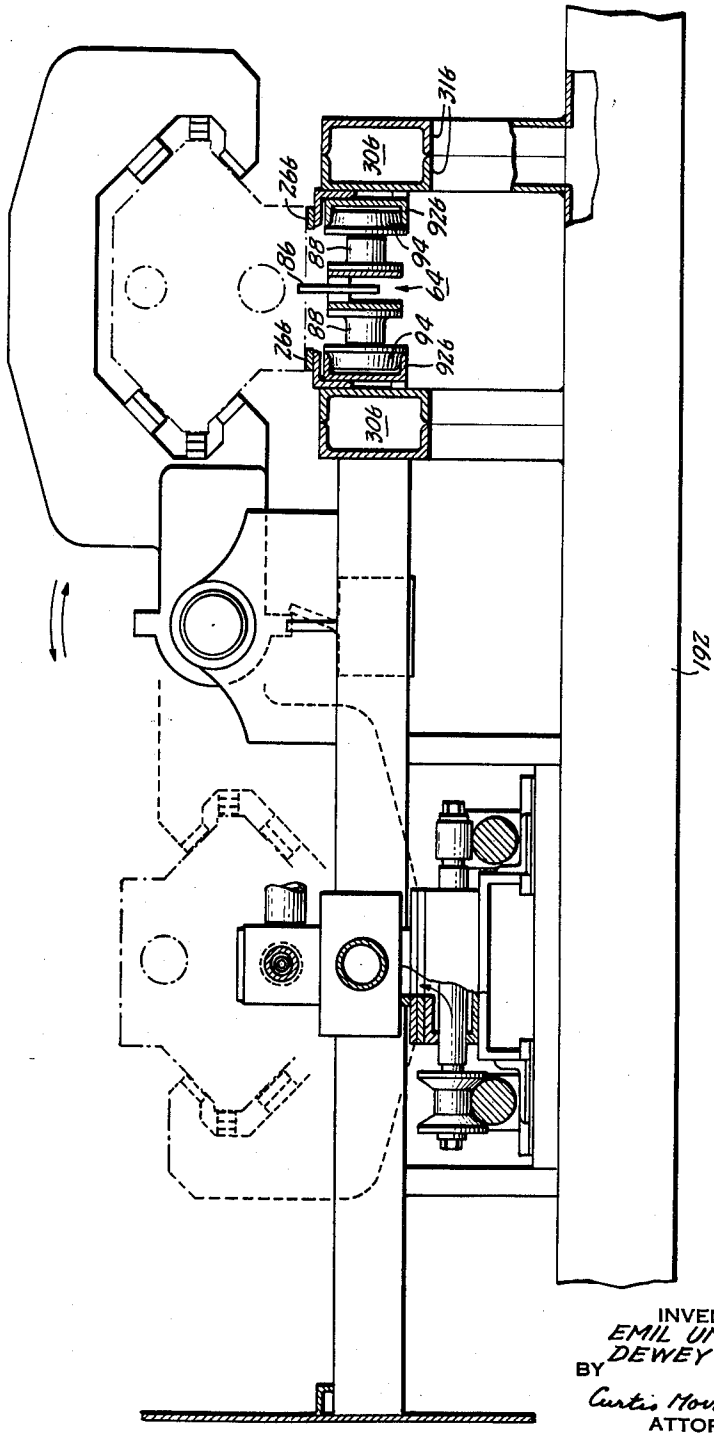


FIG. 8.

INVENTORS
EMIL UMBRICHT
DEWEY EVANS
BY Curtis Morris & Safford
ATTORNEYS

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3,030,896

TRANSFER APPARATUS

Emil Umbricht, Jackson, and Dewey Evans, Belleville, Mich., assignors to Ajem Laboratories, Detroit, Mich.

Original application Dec. 20, 1954, Ser. No. 476,138, now Patent No. 2,918,071, dated Dec. 22, 1959. Divided and this application Oct. 16, 1958, Ser. No. 773,129

4 Claims. (Cl. 104—162)

The present invention relates to transfer apparatus and more particularly to an apparatus for transferring heavy castings and the like such as are found in the automotive and other closely allied mass-production industries. This invention is described as embodied in a machine for washing under high pressure both the outside and inside of metal parts or assemblies and various other articles, and then for draining the washing liquid out of the articles and drying them.

In many mass-producing type industrial applications involving the fabrication of complicated machine parts and assemblies, it is necessary at one or more points in the production schedule to remove the various soils or other materials which adhere to both outside and inside the articles and accumulate as a result of the previous manufacturing steps, for example, such soils as moulding sand and metal particles, combined with films of the various cutting oils used during machining. The need for efficient automatic apparatus to provide the required cleaning has become increasingly important, for, in modern machinery such as automobiles, the parts are held to closer tolerances and the presence of only slight amounts of soil or contaminating material causes damage by corrosion and scouring after the parts are assembled and run.

For example, in the automobile industry it used to be true that the washing of the various parts was treated, in effect, as merely an incidental step in the assembly of the automobile. But now there have been vast increases in horsepower and engine speed. The castings are much more complex. V and Y blocks are commonly used, including many borings and oil passages, with provision for hydraulic valve lift systems, etc. With such power, speed and complexity, the tolerances are so close and the finishes are so fine that complete effective washing of the parts prior to assembly has become one of the key steps in the production line. Incomplete washing of just one portion of any one of the multitudes of passages and surfaces in any one of several parts can quickly result in failure on the test line, resulting in expensive overhauling of the engine.

The type of apparatus described herein as embodying the present invention is well adapted for inclusion in automatic power washing machines for cleaning machined castings, such as automobile engine blocks and similar articles which must be thoroughly washed on the outside and have internal passages and chambers which must be forcefully flushed out before final assembly.

In the machine described herein, the engine blocks or similar articles to be washed are supported one behind another along a path and are intermittently advanced along it. The articles pass in succession through a roll-over washing stage where high pressure sprays and streams of washing liquid are directed on them as they are revolved completely over around a horizontal axis, back and forth several times. Then the articles pass through an internal flushing stage where they are turned upside down and their various internal passages are directly and forcefully flushed out by mandrels inserted into the articles through larger openings. Jet forming orifices in the inserted mandrels are precisely aligned with the small passages to be washed, and very high pressure jets of cleaning solution from these orifices then flush

out the passages. Advantageously, intermittent high pressure air blasts mixed with the washing solution enhance the surge effects of the flushing streams. In later stages the articles are drained out and blown dry.

Among the many advantages of the embodiment presently to be described is that when it is incorporated in the automatic power washer, it helps to insure that the complete washing operation is enabled to be carried out as a precision, high speed, high efficiency step in a production line.

A further advantage of the transfer mechanism as described herebelow is its ability to accommodate the roll-over stage of the power washer and thus enable the complete exterior washing of four articles arranged end-to-end in a space not much longer than the four articles themselves.

It is an advantage of this transfer apparatus that it permits at the internal flushing and draining stages the articles to be lifted up from their path through the machine and to be swung up and over to an upside down position for most effective flushing and draining.

The present application is a division of application Serial No. 476,138, filed on December 20, 1954 and now issued as Patent No. 2,918,071.

The various aspects, features, and advantages of the present invention will be more fully understood from the following description considered in conjunction with the accompanying drawings, in which:

FIGURE 1 is a top view of an engine block washing machine which embodies within it the invention, the blocks enter the machine at the left end at station No. 1 and leave the machine at station No. 20 at the right end;

FIGURE 2 is a side view of the machine of FIGURE 1;

FIGURE 3 is a partial top view, on enlarged scale, taken along the line 3—3 in FIGURE 2, looking down, and showing the flop-over block washing fixtures and mandrel mechanism for washing interior portions of the block;

FIGURE 4 is a partial cross sectional view of the machine, on enlarged scale, taken along the line 4—4 of FIGURE 2, looking to the right and showing a cross section of the roll-over carriage and associated mechanisms;

FIGURE 5 is a partial longitudinal sectional view of the machine, on the same enlarged scale as FIGURE 4, taken along the line 5—5 of FIGURE 1 looking toward the interior of the machine, showing a side elevation of the roll-over carriage and associated washing, block transfer-ring, and carriage drive mechanisms;

FIGURE 6 is a partial perspective view, on enlarged scale, of a portion of the block transferring mechanism, seen also at the extreme left in FIGURE 5;

FIGURE 7 is a partial perspective view, on enlarged scale, of another portion of the block transferring mechanism, seen also near the bottom center in FIGURE 5;

FIGURE 8 is a partial cross sectional view, on enlarged scale, taken generally along the line 8—8 in FIGURE 3 looking to the right, showing the flop-over fixture and associated block transferring and mandrel mechanisms.

General Description of the Transfer Apparatus and the Power Washer in Which the Preferred Embodiment Is Incorporated

Referring generally to the whole machine as shown in FIGURES 1 and 2, the engine blocks 22, indicated in diagrammatic forms as dotted rectangles, enter the machine at the left at station No. 1. These blocks, for example, may be coming from a production line in which they have received all of the required machining operations and are being sent through the machine to wash off and thoroughly clean from them the accumulated soils, metal filings, sand,

etc., which have accumulated during the previous production steps. The blocks **22** are being washed in preparation for the assembly of the engine which begins along an assembly line stretching away from the right end of the machine. In going through the machine, the blocks **22** pass in sequence through twenty separate stations, indicated as 1 through 20, in FIGURE 1. These stations are uniformly spaced along the length of the machine. Each station may be considered as being equal in length to the length of one of the engine blocks being washed. A small space exists between the adjacent ends of the blocks in successive stations.

In order to move each of the blocks in the machine simultaneously to the next succeeding station, a transfer mechanism (the preferred embodiment of this invention) described in detail below, and actuated by a hydraulic cylinder **24** shown at the lower right in FIGURE 2, is used. The blocks **22** pause at each station for a brief period of time during which they are washed externally or internally, drained, or blown dry, as the case may be, and then are transferred on to the next station, and so forth on through the machine, finally leaving the machine at station 20 clean and dry, in readiness for assembly.

Stations 1 and 2 are outside of the first housing **25** of the machine. As seen in FIGURE 4, the blocks **22** have a generally V or Y configuration, indicated in phantom lines, and in stations 1 and 2 the blocks are received on supporting tracks **26** in FIGURE 5, which engage outer edges of the bottom of the block or so-called pan rail. These tracks or rails **26** are secured to longitudinally extending brackets **28** formed by angle irons welded along the length of a pair of parallel hollow longitudinal frame members **30** formed of channel irons **31** welded together flange to flange (similar to horizontal frame manifold **126** shown in FIGURE 4).

In order to guide the blocks along the tracks **26**, a pair of spaced guide rails **32** are secured along the length of the inner faces of another pair of angle iron brackets **34** supported from the main longitudinal frame members **30** by means of legs **35** secured to the outside of the main frame members. The guide rails **32** engage the blocks **22** on opposite sides at their widest points.

Stations 3 through 7 are inside of the housing **25** and comprises the roll-over washing stage, generally indicated at **36**, for washing the outside of the blocks **22**. Considerable internal washing also occurs, of course, but the high speed washing jets of fluid are directed mainly at the outside of the machine in this stage **36**. Station 3 is just inside of the machine housing **25** and, in effect, acts as a vestibule in which each block sits before it moves into stations 4, 5, 6, and 7 which include a unitary roll-over block washing carriage, generally indicated at **40**. A small entrance doorway is provided in the left end of the housing **25** between stations 2 and 3 which is just large enough to pass a block.

The roll-over carriage **40** is advantageously adapted to carry four blocks simultaneously in spaced end-to-end relationship and to slowly roll these blocks once over and back around their longitudinal axes while they are externally washed as generaly indicated in FIGURE 4. The blocks are slowly rolled over through almost a full 360° and then rolled back again, and then the transfer apparatus moves them ahead one station, with a washed block being discharged from the right of the carriage while another block comes into the left. The operation of the roll-over carriage and its interrelationship with the transfer mechanism is described in greater detail below.

In the stations 8 and 9 the blocks are passed through a connecting tunnel in a tunnel housing **46** (seen best in FIGURE 1) between the roll-over washing stage and an internal flushing stage **38** which includes stations 10 through 13. In stations 11 and 13 the blocks are picked up off the main tracks **26** through the machine and are swung up and over through an arc, as indicated in FIGURE 8, and are held for a period upside down while being internally washed and drained before being returned to the main track to be moved on by the transfer mechanism.

Following the stage **38** is a drain-off stage **50** including two other flop-over stations 14 and 15, which are used to drain off the washing solutions which tend, in modern engine blocks with their complicated internal configurations and inter-connecting passages, to be trapped in puddles internally of the block.

Next is the drying stage, indicated generally at **52**, including stations 16, 17, 18 and 19 in which the blocks **22** are thoroughly dried by means of high pressure blasts of hot air. The general arrangement of the various ducts, manifolds and nozzles in the drying stage **52** may be generally similar to that disclosed in our copending application, Serial No. 462,726, filed on October 18, 1954, now Patent No. 2,926,674, and as shown in our copending application, Serial No. 467,746, filed on November 9, 1954, now Patent No. 2,979,062.

As will be understood, controls are provided at the receiving and delivery ends of the machine for automatically gauging the transfer mechanism, and therefore the machine, to the speed of operation of the production line ahead of it and to assembly line following it so that the machine always operates efficiently at full capacity and yet does not pile up excess blocks into the assembly line. The machine as described herein incorporating the present invention is capable of thoroughly washing and drying in the neighborhood of 140 to 160 blocks per hour, both inside and out, with each block as it passes through the machine receiving a number of precisely controlled positioned washing operations and positioned drying operations.

The preferred embodiment of the present invention as mentioned above is mounted in a power washer and includes a transfer bar assembly **60** extending the full length of the machine. The bar may be considered to include three sections; a loading transfer bar **62**, which operates with the blocks in stations 1 through 3, a main transfer bar **64** which operates with the blocks in stations 8 through 20, inclusive, and is connected to bar **62** so as to move integrally with it by means of an offset connecting bar **66** (see also FIGURE 5). The third part of the transfer bar mechanism is the carriage transfer bar **68** which operates with the blocks in stations 4, 5, 6, and 7 in the carriage and is carried by and moves with the roll-over carriage **40** when it rolls around. As shown in FIGURES 5 and 7, the carriage transfer bar **68** is connected with the main transfer bar only when the carriage is in its initial upright position and a clutch dog **70** projecting from the underside of the carriage transfer bar is engaged in a V-shaped notch between a pair of clutch brackets **72** and **74** welded to the top of the offset connecting bar **66** at its center.

The three transfer bar portions **62**, **64**, and **68** are of generally identical construction, although being of different lengths. Each of these includes a pair of spaced longitudinal members **80** extending parallel and closely adjacent each other (see FIGURES 6, 7, and 4). These bars **80** are held uniformly spaced by means of blocks welded therebetween, not shown. The hydraulic transfer cylinder **24** reciprocates a piston rod **82** connected to a gusset **84** welded between members **80** of the main transfer bar **64**, so as to drive the transfer bar assembly **60** longitudinally in the machine a distance slightly greater than the spacing between the front end of one station and the front end of the next succeeding station.

In order to engage the rear of the pan rail of the blocks **22** and advance them to the right, a plurality of drive dogs **86** are supported on pivots **88** intermediate the longitudinal members **80**. These pivoted dogs are balanced so that their forward corners tend to rise up and engage the rear of the block, as shown in FIGURE 5, thus sliding all of the blocks to the right as the transfer

mechanism 60 moves to the right. As the transfer bar is returned to its initial position, the projecting corners of the drive dogs strike the underside of the respective following blocks, turning the dogs a small distance clockwise as seen in FIGURE 5 so that the dogs can slide back under following blocks and then rise up and engage the rear faces of the following blocks in preparation for the next transfer. A plurality of stops 90 extending transversely between the members 80 and engaging the rear ends of the dogs prevent them from turning out of driving relationship with the rear faces of the blocks during the transfer operation.

The members 80 are supported between a pair of tracks 92*a* and formed by spaced parallel channels having their flanges aligned and faced towards each other. Flanged tapered wheels 94 project into the open face of the channels 92*a* and engage the upper surfaces of the lower flanges of the channels. As shown in FIGURES 4, 5, and 6, these flanged wheels 94 are supported by stub shafts 96 projecting into the sleeve portions of flanged sleeves 98 having their flanges welded to the outer faces of the members 80. Among the many advantages of this arrangement is the ease with which the transfer bar 60, wheels 94 and tracks 92*a* are assembled, the stub shafts 96 being slid into sleeves 98 as the wheels 94 are fitted into the open ends of the tracks 92. Moreover, the supporting surfaces of the lower flanges of the tracks 92*a* are inclined somewhat downwardly toward each other; by cooperating with the tapered surface of the flanged wheels, produce a lateral guiding action as well as a supporting action.

As shown in FIGURE 6, the inter-connecting bar 66 is secured to the loading transfer bar 62 by means of a gusset 100 secured by blocks 102 between the members 80 of the loading transfer bar. A similar connection is made between the right end of the connecting bar 66 and the main transfer bar 64 in the vicinity of station 9, as shown in FIGURE 2. The reason the right gusset 104 is spaced back from the front (left) end of the main transfer bar is to provide clearance for the roll-over carriage when the front end of the main indexing bar projects into the roll-over carriage to engage its first dog 89 with the block being transferred out of station 7 into station 8.

Parts of the carriage 40 performing functions corresponding to those of parts in stations 1, 2, and 3 have corresponding reference numerals followed by the suffix *"a."* The four blocks 22 in the carriage are supported by tracks 26*a* fastened to the top of the inner braces 92*a* and are guided at each side by lateral guide rails 32*a* welded along the inside faces of the pipes 152 and are confined at the top by another similar guide rail 158 along the underside of the top pipe 152 which supports the blocks as the carriage rolls over so as to prevent tumbling of the blocks in the carriage.

Among the advantages of this axial roll-over washing action is the fact that the blocks 22 are enabled to be held in closely spaced end-to-end relationship while they are rolled over. Thus, the spray, in effect, has a concentrated target, resulting in a highly efficient washing operation, for only a very small percentage of the washing solution can pass through the small spaces between the four blocks. The rolling motion of the blocks is very effective in loosening the soil material and dumping it out of the blocks. Moreover, the reversal in rolling direction helps in dumping out the dirt.

When the carriage returns to its initial position, the clutch dog 70 engages between the clutch brackets 72 and 74 so that the carriage transfer bar is locked to the remainder of the transfer bar mechanism to form effectively a unitary transfer mechanism 60 extending the full length of the machine for transferring all of the blocks, including those in the carriage, one station to the right. The block in station 7 is pushed out the rear of the carriage 40 and another block comes in the front end of the carriage. In order for the carriage transfer bar 68 to engage the block coming into the front end of the carriage, an additional block drive dog 87 is used near its front end. As the block is coming into the carriage, the dog 87 catches the inside of the front end of the block pan rail, as shown in FIGURE 5, so as to pull this block the rest of the way into the carriage.

As seen in FIGURE 2, a similar block drive dog 89 is included near the front end of the main transfer bar 64 to catch the front end of the block being pushed out of the carriage 40 so as to pull it the rest of the way into station 8.

Parts of the machine in the flop-over internal washing and draining stages 38 and 50 performing functions corresponding to those of other parts earlier in the machine have the same reference numerals followed by the suffix *"b."* FIGURES 3 and 8 illustrate how the transfer mechanism is positioned in relation to the rest of the power washer in these stages 38 and 50.

In the drying stage, including stations 16 through 19, the blocks are blown dry as described above. The number of stations used to dry the block is determined by its configuration. Four stations are shown, but in many instances fewer stations may be used. In certain instances the drying stage may be omitted altogether, because the washing solution contains powerful corrosion inhibiting agents so that the amount of wetness remaining after the draining stage can dry by natural evaporation, but usually at least one station for blowing the blocks dry would be used.

Sequence of Operation

Although many aspects of the sequence of operation of the machine will be clear from the foregoing description, a summary of the operation is set forth here for convenient reference and to clarify the function of the transfer mechanism in the machine.

Upon starting an operating cycle the working parts are positioned as follows:

(1) The transfer mechanism 60 is in initial position (i.e. transfer cylinder rod 82 is extended). The internal washing mechanism is in initial position. The roll-over carriage 40 is in initial position and so are the flop-over fixtures.

(2) If blocks are in the loading station and the unloading station is empty, then the transfer mechanism 60 advances all of the blocks to the next stations.

(3) The transfer mechanism 60 then returns to initial position and dwells there while the following occurs:

(4) The roll-over carriage 40 slowly rolls over and back to initial position.

(5) At the same time, the flop-over fixtures pick up blocks and invert them, dwelling in the inverted position.

(6) The internal washing mechanism advances into the block and dwells there for a period while the flushing occurs and an air blast is turned on and off, and then it returns to initial position.

(7) The flop-over fixtures swing back to initial position.

(8) The cycle repeats if the loading station has again been filled and unloading station is empty.

These cycles of operations are advantageously produced by combined electric and hydraulic control systems of the type well known in the art; for example, being generally like the circuits disclosed in our copending application Serial No. 467,746, filed November 9, 1954. In such systems electric switches are used as the sensing elements to sense the positions of the block in the loading and unloading stations and are used to sense the positions of the transfer piston rod 82, the internal washing mechanism and the positions of the shafts of the roll-over and flop-over mechanism. These electrical switches actuate solenoid-operated hydraulic control valves in a hydraulic control system. These solenoid valves then direct the flow of the hydraulic fluid in the control system so as to move pistons which, in turn, develop sufficient force to open and close the main valves for operating

the piston rods and various other mechanisms, as will be understood.

From the foregoing description it will be understood that the transfer apparatus of the present invention is well adapted to provide the many advantages discussed above, and that this can be adapted to a wide variety of industrial operations including washing and cleansing and that various changes or modifications may be made therein, each as may be best suited to a particular application, and that the scope of the present invention as defined by the following claims, is intended to include such modifications or adaptations limited only by the prior art.

What is claimed is:

1. In power washing apparatus of the type for washing manufactured articles, means for moving and guiding the articles through the apparatus comprising a pair of spaced parallel channels extending through the apparatus, said channels each having upper and lower flanges and being positioned with their respective flanges directed inwardly towards each other, a pair of spaced parallel rails for supporting and guiding the articles, said rails being carried on the respective upper flanges of said channels, a reciprocating drive mechanism, a pair of closely adjacent parallel bars extending longitudinally between said channel, means interconnecting said bars and connecting said bars to said reciprocating drive mechanism, a plurality of pivots extending transversely between said bars and spaced uniformly therealong, a plurality of drive dogs each swingably mounted on a respective one of said pivots and each being effectively weighted more heavily about its pivot at a predetermined end, a plurality of stops extending transversely between said bars and each adjacent to a respective one of said pivots for normally supporting the weighted end of the adjacent drive dog with the opposite end of the dog projecting from between said bars for engaging and moving an article which is on said rails, a plurality of pairs of sleeves projecting laterally outwardly in opposite directions from respective ones of said bars toward the respective channels, and a plurality of pairs of flanged wheels engaging in said channels and having stub shafts rotatably fitting into respective ones of said sleeves.

2. In power washing apparatus of the type for washing manufactured articles, a transferring mechanism for transferring the articles through the apparatus comprising first, second, and third guide rails extending end-to-end through said apparatus, aligned first, second, and third transfer bars, respectively, extending parallel with said guide rails, a rigid interconnection bar joining said first and third transfer bars and having its axis offset from the line of said transfer bars and extending parallel with said second transfer bar, reciprocating drive mechanism coupled to one of said bars for reciprocating said first, second and third transfer bars longitudinally parallel with said first, second, and third guide rails, a plurality of drive dogs carried by said first, second, and third transfer bars for engaging and driving articles along said respective rails, a releasable coupling between said second transfer bar and said interconnection bar, and second drive mechanism coupled to said second guide rail and to said second transfer bar for moving said second guide rail and second transfer bar simultaneously laterally from alignment with the remainder of the transfer mechanism, thereby disengaging said releasable coupling, whereby articles on said second guide rail can be shifted laterally without disengagement from the drive dogs of the second transfer bar.

3. In power washing apparatus of the type for washing manufactured articles, a transferring mechanism for transferring the articles step-by-step through the apparatus for effectuating the washing operation comprising first, second, and third pairs of guide rails extending through said apparatus and defining first, second, and third tracks for guiding and supporting the articles, first, second, and third rigid transfer members, said transfer members extending parallel respectively with said first, second, and third tracks, first cyclic drive mechanism connected to said first and third transfer members for moving said transfer members back and forth near said first and third tracks, said first, second, and third transfer members including drive elements for engaging and moving articles on said first, second, and third tracks, respectively, a releasable coupling for releasably connecting said second transfer member with said first drive mechanism, second drive mechanism, and movable support means carrying said second track and said second transfer member and being driven by said second drive mechanism to move said second track and said second transfer member away from said first and third tracks for disengaging said releasable coupling and moving an article in said second track into an alternative position in said washing apparatus while the article remains aligned with the drive elements of the second transfer member.

4. In an automatic power washer for heavy automotive castings and similar manufactured articles used in mass production industries wherein various washing operations occur at equidistantly placed processing stations, a transferring mechanism for transferring the articles station-by-station through the washer comprising first, second, and third track means extending through the washer to support said articles, a first longitudinally reciprocating transfer bar extending through the washer parallel to said first and third track means, a second transfer bar extending parallel with said second track means, guide means for longitudinally guiding said transfer bars, reciprocating drive mechanism connected to the first transfer bar and releasably coupled to said second transfer bar, a plurality of drive dogs pivotally mounted equidistantly along said transfer bars for engaging said articles on the forward stroke for moving each article from one station to the next successive one, each dog being effectively weighted more heavily at a predetermined end, a plurality of stops mounted on said transfer bars adjacent to each of said drive dogs for maintaining the drive dogs in the proper driving attitude by limiting the extent of rotation, second drive mechanism, and movable support means carrying said second track means and said second transfer bar and being driven by said second drive mechanism to move said second track means and said second transfer bar away from said first and third track means for disengaging said second transfer bar and moving an article on said second track means into an alternative position while the article remains aligned with the drive dogs of said second transfer bar.

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