April 8, 1969 W. A. BIEBEL 3,436,873

VIBRATORY FINISHING METHOD

Filed Sept. 10, 1965 Sheet 1 of 2

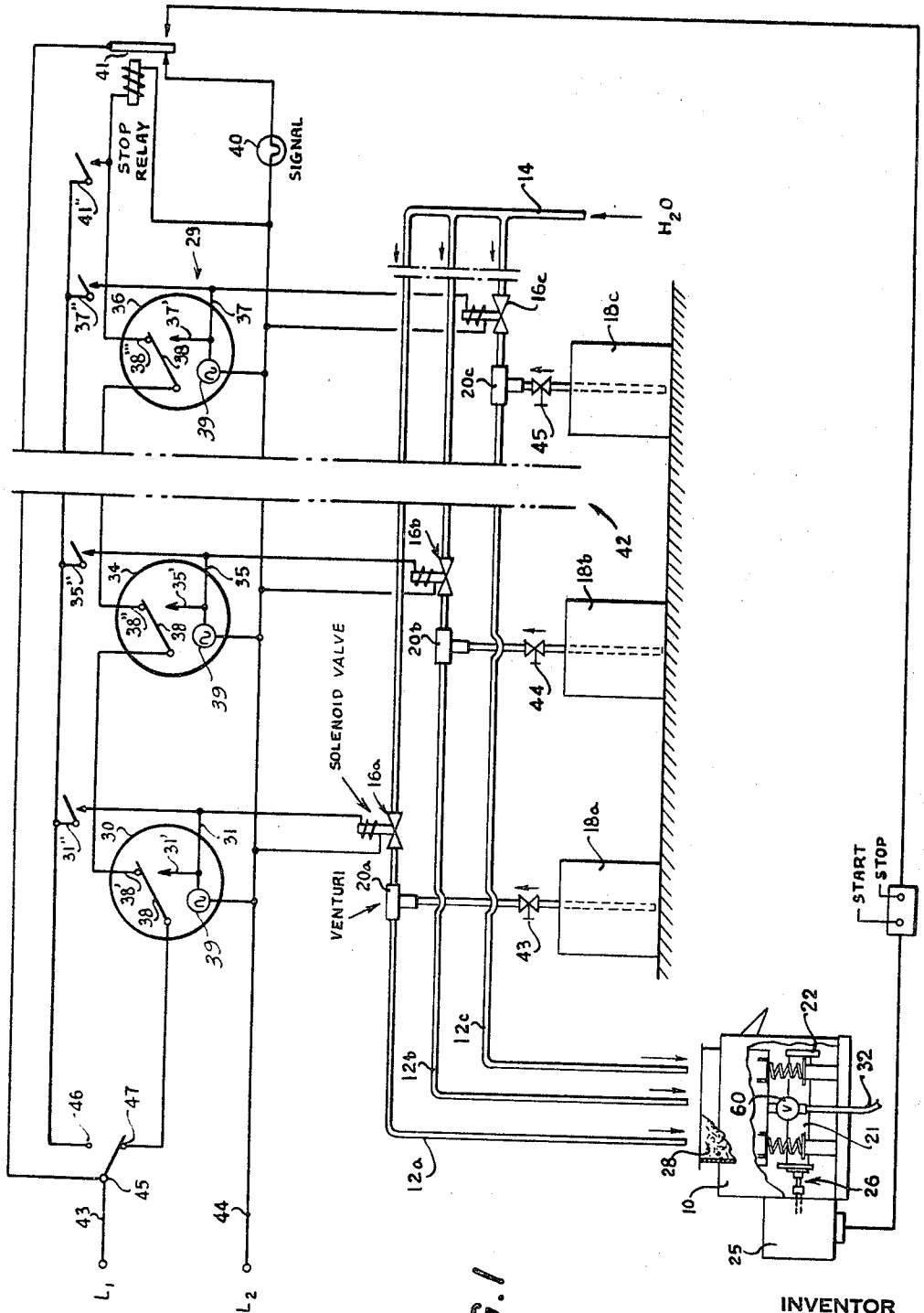


FIG. 1

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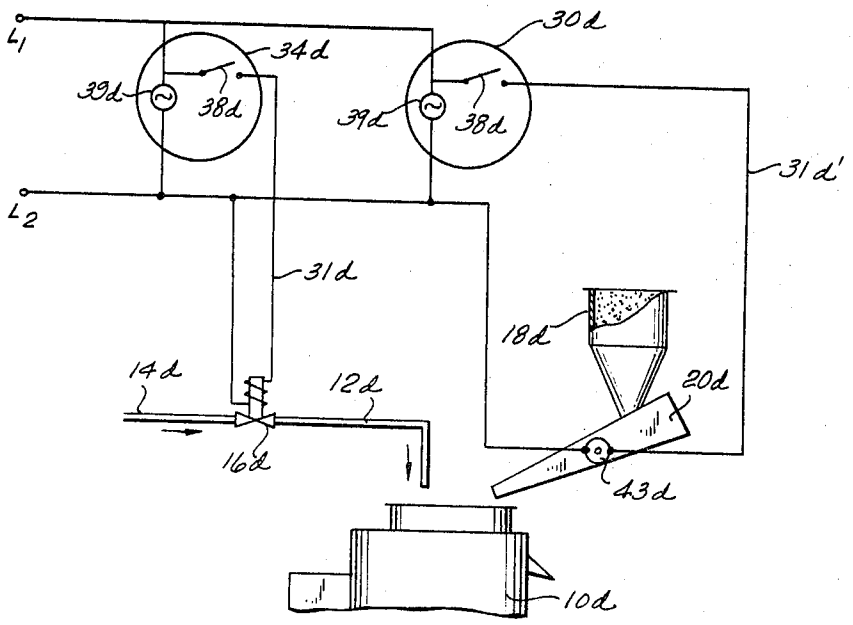


FIG. 2

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3,436,873

VIBRATORY FINISHING METHOD

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Int. Cl. B24b 1/00
U.S. Cl. 51—316 1 Claim

ABSTRACT OF THE DISCLOSURE

Method for improving the surface of articles systematically by a predetermined program including mixing a carrier liquid with chemicals to form treating liquids which are flowed over the articles and are subsequently discharged. The treatment is monitored by an automatic timing device such that the duration of the flow of each treating liquid and its supply to a treating tub is terminated after a predetermined time period and the device initiates and terminates the flow of each successive treating liquid whereby the surface of the articles are treated automatically according to a predetermined program.

This invention relates to grinding, polishing and other treatment of metal and/or plastic parts for improvement of surface, removal of excess metal, e.g., "flash," burrs, etc., and more particularly to apparatus and methods for automatically carrying out a succcession of treating steps according to a predetermined program. The invention also relates to abrading and the like in the presence of flowing material for carrying off heat and debris of the treatment.

My invention is directed to surface abrasion of the parts in a bath of coolant liquid, especially by repeatedly moving them relative to a finishing media around them and more especially by vibratory treatment of such parts, e.g., castings, machined metal parts, plastics, etc., with abrasive, burnishing or polishing media, such as are already used in tumbling barrels, vibratory tubs, etc. Such media may be pebbles or chips of stone, ceramic, plastic, or other abrasive in various shapes, e.g., balls, bars, discs, circular, polygonal, star-shaped, irregular, etc. These are to be used in various grades (fine, medium, coarse, etc.) and various sizes (e.g., from ⅛" or less to ¾" or more in thickness and from ¼" or less to 3" or more on the greatest dimension). The media are filled into suitable tubs or barrels (which may be standard equipment as heretofore used for surface treating operations) together with the parts to be treated and a liquid, powder or granular coolant of a type adapted to be used with the particular media and parts. Vibration is most advantageous, but to some extent the invention can be used with other equipment for rubbing the media on the parts. I have found electric controls most suitable for automation of the process, but the controls may be hydraulic or pneumatic or mechanical.

In some cases my invention is used with wheel grinding, e.g., on abrasive machine tools with flooding by the flowing coolant.

As heretofore practiced, a mass of abrasive media, with a liquid, e.g., aqueous detergent solution, and with the parts distributed in it, has been moved and tumbled or vibrated so that the chips or pebbles rub and tap the parts between them, while the liquid flows over the surfaces of both and carries off any debris resulting from the treatment.

Heretofore, it had been almost universally considered that the liquid should be recycled through the abrading zone so as to get the advantage of flowing and circulating liquid in the mass of media with economy of liquid and

treating chemicals. From time to time, the operator examined the parts and decided whether to terminate and go on to the next step. Sometimes the operator has estimated the time required for the next step and pre-set an alarm clock or a time switch to stop the abrading action at the time of expected completion.

I have found, however, that a much better result is obtained by maintaining a flow through the abrading zone, advantageously within a media-containing vessel and discarding or renewing the fluent material after a single flow-through, and supplying fresh material continually, replacing that drawn off as effluent. This method of operating gives better surface and better color more than sufficient to justify the cost of the discarded liquids or other fluent material and chemical. Having now taken advantage of the once-through flow, I automate the entire process; I have effected economies much greater than the cost of the effluent materials.

In the accompanying drawings, I have shown an example of the practical application of my invention. It is to be understood that this is chosen for the purposes of illustrating the invention and its operation and explaining its principle so that others skilled in the art may utilize the invention in many forms and with many variations each as may be best suited to the conditions of the particular use, all without departing from the scope of my invention as set forth and defined herein.

These drawings show diagrammatically (not dimensioned to scale) a vibratory treating tub and its mounting and drive, alternative chemicals feed devices, programming timer devices and appurtenant connections.

FIGURE 1 is a wiring diagram and flow diagram representing one embodiment of the invention; and

FIGURE 2 is a similar fragmentary diagram of another embodiment.

A well known commercial type of vibratory tub finisher **10** shown in this example is representative of vibratory tub equipment available from such suppliers as Almco Queen Division of King-Seely Thermos Co., Productive Equipment Co., and Southwestern Engineering Company of Los Angeles, Calif., among others. The parts and media are loaded into the open top of the tub **10** of this finisher, and liquid is supplied from one or more of the feed pipes **12***a*, **12***b*, **12***c*, etc. Each of these pipes is supplied with water under pressure from a pipe **14** with flow controlled by an electrically operated valve **16***a*, **16***b*, **16***c*, etc., and each, when liquid is flowing therethrough, is supplied with chemical from a supply drum **18***a*, **18***b*, **18***c*, etc., sucked up by venturi **20***a*, **20***b*, **20***c*, etc.

A motor **25** drives, through a flexible connection **26**, a heavy duty vibrator on the tub **10**. This may be, for example, a vibrator drive shaft **21** carrying a fly wheel **22** balanced about an axis eccentric of the vibrator shaft on which it is carried. Such shaft is rotatably secured to the tub in bearings centered on the axis of the shaft so that the tub tends to be moved about the eccentric axis of balance by reaction to the force on the fly wheel. This shakes the tub so that the mass of parts and "pebbles" **28** flows up one side and back through the mass with appropriate rubbing against one another. Meanwhile, a treating liquid, e.g., a composition designed to facilitate abrasive cutting and wash away debris, is supplied by pipe **12***a* and fed continuously to the top of the mass of pebbles and parts **28**.

After a time sufficient to produce the desired major abrasive action or "cutting" on the parts, this operation is terminated by means of a timer **30** of the programming device **29**, indicated diagrammatically at the top of the figure on the drawing. This device comprises a series of timer switches **30**, **34**, **36**, etc., all driven by a clock motor or by separate synchronous motors. The timer **30** closes the circuit at **31**, which operates the solenoid valve **16***a*

to control the flow of the liquid through feed pipe **12***a*. The timer may be one of the standard commercial timers sold for such purposes. Ordinarily each of these consists of a synchronous motor or other clock mechanism driving a shaft which may be separate or common to all so as to extend through all of the timers **30, 34, 36**, etc. A cam in each (not shown) moves the switch arm **38** against a biasing force, from contact **31′, 35′, 37′**, etc., to contact **38′, 38″, 38‴**, etc., or vice versa.

With or without a brief interval, during which the liquid drains from the tub through the outlet **32**, the timer switch **34** next moves down away from contact **38″**; switch **30** opens its circuits at **31** and again closes at **38′**; the timer **34** closes its energizing circuit at **35** to the solenoid valve **16***b*, which operates so that water is supplied through the line **12***b* and venturi **20***b* sucks up the chemical for the burnishing operation from the supply tank **18***b*. This chemical is mixed with the water in the venturi **20***b* and in passing along the supply line **12***b* to the tub **10**, where it flows continually onto the top of the mass **28** and down through it to the outlet **32**.

The programming switches may be set to feed different chemicals one after the other with time for draining and/or washing between; or several of the feed pipes may be caused to discharge into the tub at the same time, being mixed therein by the vibrating parts.

After a predetermined time suitable for the burnishing operation, the programming timer **34** breaks the circuit at **35**, thereby closing the solenoid valve **16***b* to cut off the flow through pipe **12***b*; and timer **36** then closes the circuit at **37** to open the valve **16***c* and initiate flow through the pipe **12***c*; whereupon a third and different chemical solution, e.g., an anti-corrosion, or passivating, agent from the tank **18***c* is sucked up by the venturi **20***c* into the pipe **12** where it is mixed with the flow of water from pipe **14** and is fed on through the supply line **12***c* to the tub **10**, where it passes into and through the mass **28** of parts and media.

It will be observed that each of the timer switches **30, 34, 36**, etc., is shown diagrammatically as having alternative contacts, namely, the solenoid contacts **31′, 35′, 37′** and the by-pass contacts **38′, 38″, 38‴**, respectively. Signal lights may be connected in parallel with circuits **31, 35, 37** to show the condition of the timer by lighting a signal lamp for each circuit which is energized. Illumination of the signal lamp **40** shows that the main relay **41** has opened the motor circuit to stop the operation. These signal lamps advantageously are all located at a central control panel so that the conditions of all can be taken in at a single glance.

At each of these timers may also be provided a manual switch **31″, 35″, 37″**, by which the circuits **31, 35, 37**, respectively, can be manually closed or opened.

In normal automatic operation, the switch **41** is closed to the main motor **25**; the timer motor (not shown) is started and drives a shaft extending through all the timers with a cam in each timer adapted to open and close the circuits **31, 35** and **37**, respectively, each when its intended treatment in tub **10** is to be initiated and completed. As each switch arm **38** is raised, it opens the circuit of the respective solenoid and then switches the control circuit to the next switch arm **38** in the next timer, and eventually in the last timer **36** the control circuit is switched to the relay **41**, which thereupon operates to shut off the entire operation and light the "out of operation" signal **40**.

The several feed stations **18***a, b, c*, etc., with their venturi suction and mixing devices **20***a, b, c*, etc., and control valves **16***a, b, c*, etc., each regulated by a programming timer, as indicated above, are representative of various treatments and treating materials which may be used successively or simultaneously under automatic control or manual control according to my invention. Thus, there may be an additional series of these (represented by the break in the pipe lines at **42** on the drawing); and of course there may be final and/or intermediate rinse operations with a direct connection from the pipe **14** to the tub **10**; or such rinsing can be accomplished by means of solenoid valves **43, 44, 45**, etc., in the respective suction lines which, by cutting off the chemical feed, would change the liquid supplied to the tub from a treating solution to a rinsing liquid. These can, of course, also be energized by switches operated by timers at the required times.

On FIGURE 1 of the drawing, I have shown a typical circuit diagram, the power coming from the power line connections L_1 and L_2 into the wires **43** and **44**. A manual switch **45** may be thrown either to an upper pole **46** for manual operation or to a lower pole **47** for automatic programming. The upper pole is connected to individually operable normally open switches **31″, 35″, 37″** and **41″**. Each of the first three of these, controls a circuit for one of the valve solenoids **16***a, b*, or *c*, and may also complete the circuit for the corresponding signal lamp **39**, so that a glance at the signal board will show which liquids are flowing into the tub **10**. The last manual switch **41″** closes the circuit to the main relay **41**, and thus serves to stop the motor **25** and illuminate the "idle" signal **40**.

These manual switches permit operation to be wholly under control of an operator, e.g., when a different part or different chemicals or different abrasives or burnishing or polishing materials are being tried. It also permits an operator to shorten or lengthen any part of a programmed treatment if inspection of the articles in tube **10** shows that such termination or extension is needed beyond what is automatically provided by the programmed operation. However, once the best timing has been determined for a particular article and treating conditions, it is undesirable to have operators vary from that; therelay **41**, which thereupon operates to shut off the entire narily be locked switches, the key or keys to which will be kept by a supervisor or set-up man.

The foregoing example represents an operation in which the liquids supplied from the pipes **12***a, b, c*, etc. trickle or flush down over the surfaces of the abrasive pebbles **28** to an open drain **32**, from which they are run off to waste or some subsequent treatment or use. The drain in such case would, of course, be open at all times. In some cases, however, it may be desirable to perform at least a part of the treatment with the abrasive pebbles and articles submerged in a treating liquid or a rinse bath. In such case it becomes necessary, of course, to close or restrict the drain outlet **32** so that the inflowing liquid can accumulate in the tub. Most advantageously, in such case, the valve **60**, which is provided for regulating the rate of drainage, is closed first to permit filling of the tub, after which the inflow may be cut off and the trapped bath, used as such, for a period of time and then drained off, or the valve **60** may be adjusted to give a drain-off substantially equal to the inflow of one or more of the pipes **12***a, b, c*, etc. When operating in this manner with the drain **32** closed or restricted, there is, of course, the danger of overflow, which should be protected against by a suitable overflow drain (not shown).

In FIGURE 2 is shown another embodiment of my invention designed primarily for use with fluent solid chemicals, e.g., in powder or granular form. In this case, the treating chemical in fluent form is supplied to a hopper **18***d* and fed down into the tub **10***d* by a vibrator trough **20***d*, e.g., such as is offered under the trademark "Syntron." The motor **21***d* which shakes the trough **20***d* to effect feeding of the chemical is energized by a circuit which is controlled by a percentage timer **30***d*, e.g., as shown in FIGURE 2. In either case, the percentage flow timer may replace or supplement the timers **30, 34, 36**, etc., of FIGURE 1, in the same or a like circuit. Water or other coolant is fed through pipes **12***d* and **14***d* and its flow, in addition to, or instead of, the flow through solenoid valve **16***d*, can be controlled by a percentage flow timer, which allows flow through valve **16***d* for only a predetermined percentage of the time which will give

the desired dilution of the powder or granular material flowing from **20***d*. This timer may revolve several, or many times, for each revolution of the liquid flow timer switch. Such percentage timer equipment, which is readily available in the art, e.g., from Industrial Timer Corporation of Newark, N.J., rotates continuously and closes a circuit for a predetermined percentage of any given time cycle. Thus, for example with the device in the energizing circuit for a solenoid valve, or a screw type feed for a dry chemical, the amount of material fed can be controlled by adjusting the percentage up or down.

What is claimed is:

1. The method of systematically treating the surface of articles by a predetermined program comprising placing the articles to be treated in a vibrating tub, mixing a flow of carrier liquid and a first treating chemical to form a first treating liquid for facilitating abrasion, the duration of the flow of said first treating liquid being determined by an automatic timing device, supplying the first treating liquid to said vibrating tub, draining the first treating liquid from the tub; said automatic timing device terminating the flow of said first treating liquid and the supply thereof to said vibrating tub after a predetermined time period and automatically initiating the flow of carrier liquid and a second treating chemical to form a second treating liquid adapted to act as a burnishing agent, the duration of the flow of said second treating liquid being determined by said automatic timing device, supplying the second treating liquid to said vibrating tub, draining the second treating liquid from the tub; said automatic timing device terminating the flow of said second treating liquid and the supply thereof to said vibrating tub after a predetermined time period and automatically initiating and terminating the flow of carrier liquid with each successive treating liquid, whereby the surface of the articles are treated automatically according to a predetermined program.

References Cited

UNITED STATES PATENTS

3,044,227	7/1962	Charuat	51—263
3,161,997	12/1964	Balz	51—316
3,173,664	4/1965	Isaacson	51—163 X
3,210,891	10/1965	Joy	51—163
3,324,605	6/1967	Lester	51—163 X
3,353,796	11/1967	Roberts	51—163

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,436,873 April 8, 1969

William A. Biebel

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 35, "12" should read -- 12c --. Column 4, line 28, "tube" should read -- tub --; lines 34 and 35, "relay 41, which thereupon operates to shut off the entire narily" should read -- fore, the switches 31″, 35″, 37″ and 41″ etc., will ordinarily --.

Signed and sealed this 7th day of April 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents