

Nov. 17, 1959

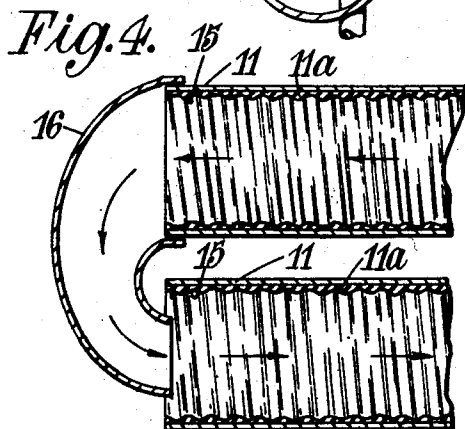
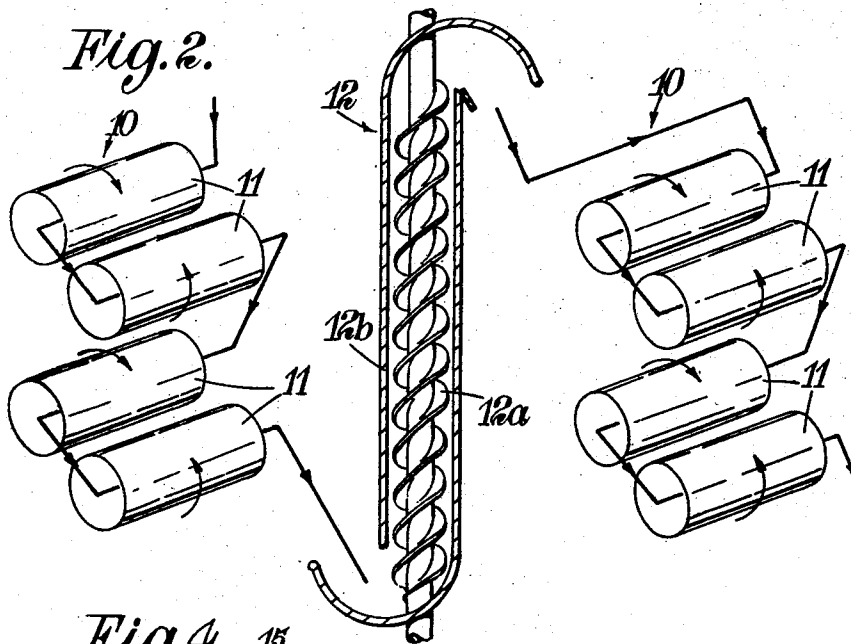
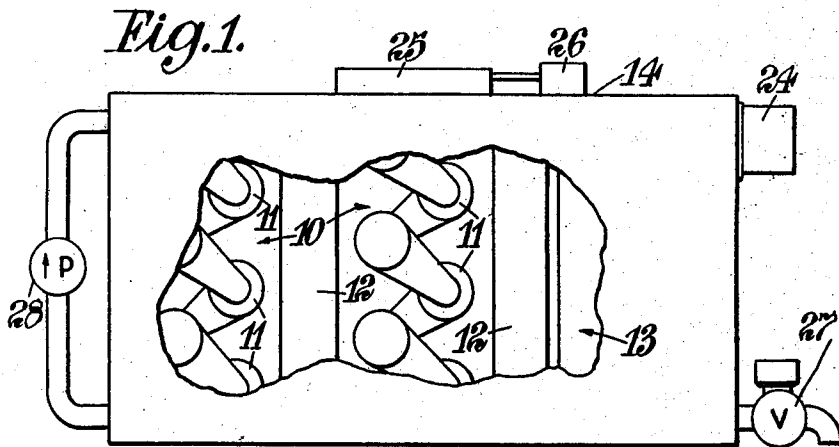
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BARRELLING AND TUMBLING APPARATUS

Filed June 10, 1957

4 Sheets-Sheet 1



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Fig. 3.

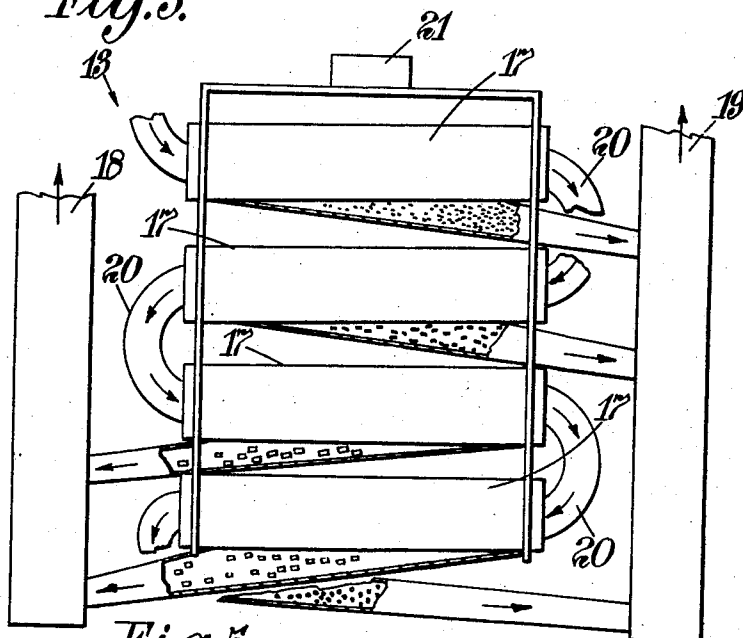


Fig. 5.

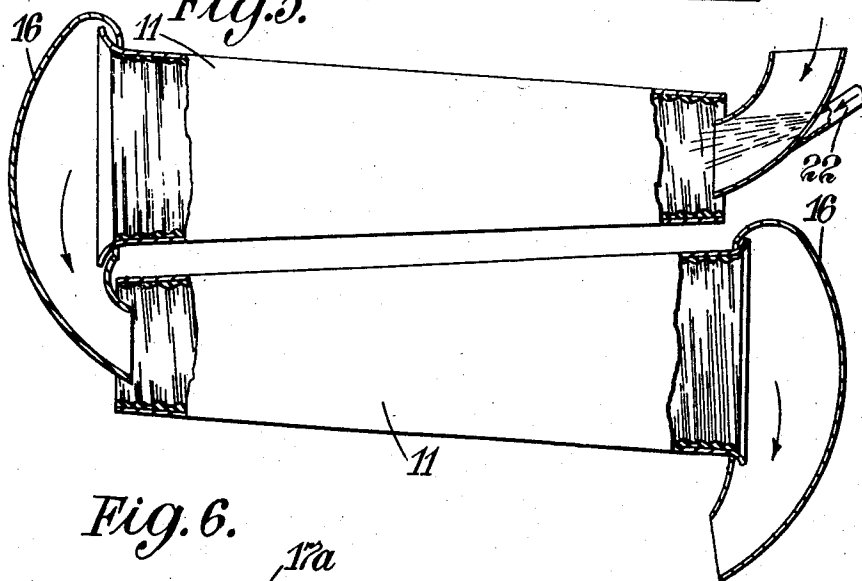
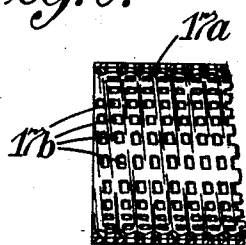


Fig. 6.



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Fig. 7.

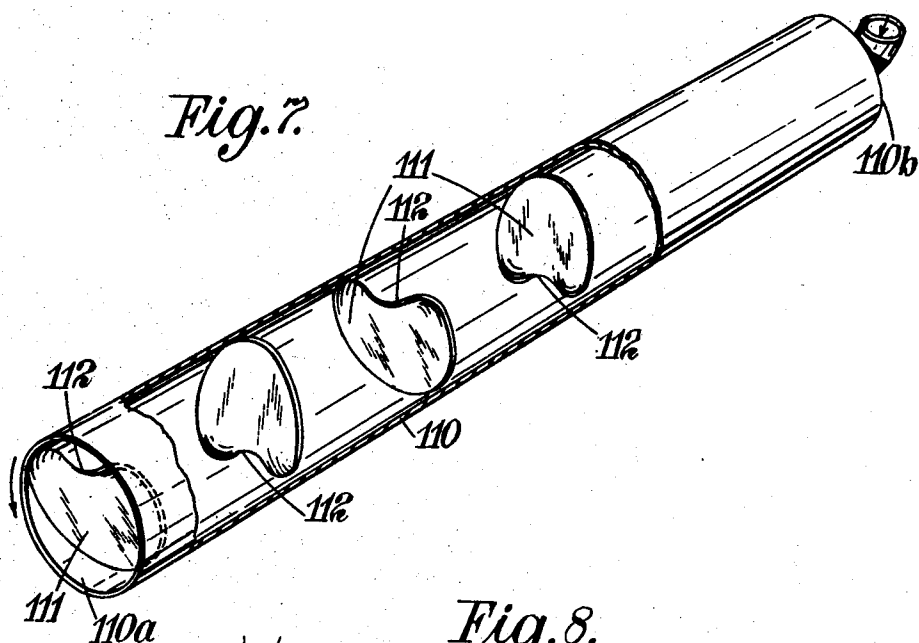


Fig. 8.

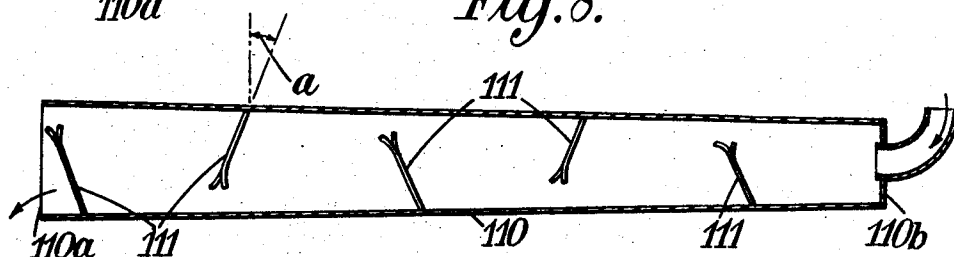
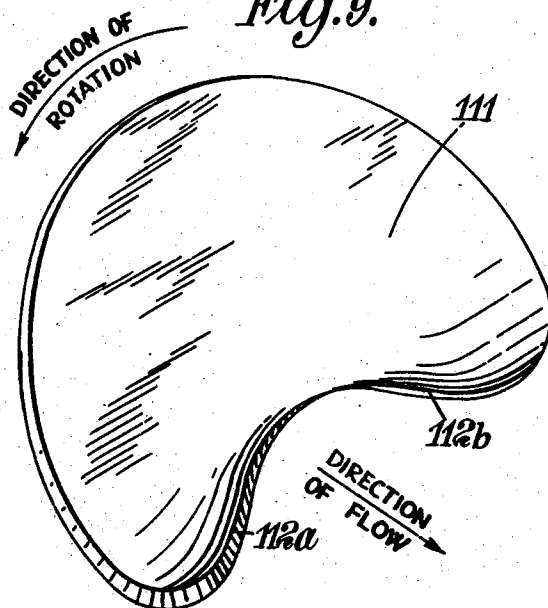


Fig. 9.



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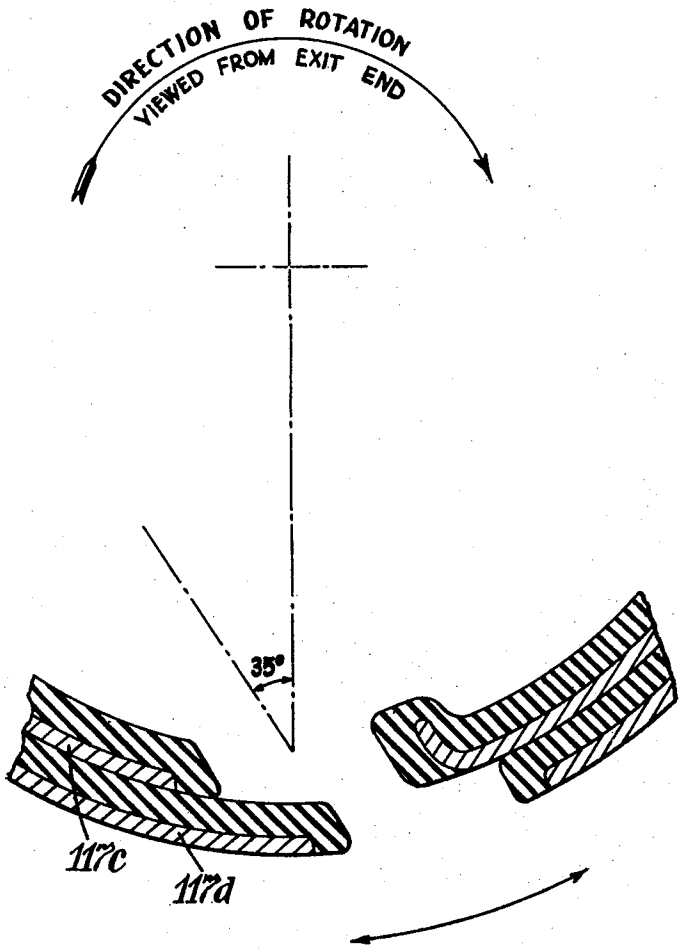
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BARRELLING AND TUMBLING APPARATUS

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Fig. 10.



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BARRELLING AND TUMBLING APPARATUS

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Claims priority, application Great Britain June 12, 1956

26 Claims. (Cl. 51—164)

This invention relates to tumbling apparatus, that is, apparatus comprising a container in which articles are placed together with chips of granite or like material and water, kerosene, or oil, containing a suspension of an abrasive compound, the container being then rotated so that the articles tumble and are deburred and polished by the abrasive.

According to the present invention in one aspect there is provided a method of treating metal parts which comprises the steps of passing the parts from one end to the other of a rotating tube containing abrasive in a liquid, the tube rotating about a longitudinal axis which is at a substantial angle to the vertical.

According to the present invention in another aspect there is provided tumbling apparatus comprising a rotatable tube, means to feed articles to be deburred or polished into one inlet, end of the tube, said tube being constructed or arranged so that by rotation of the tube the articles are caused to travel continuously from the inlet end to the opposite outlet end, and means to receive the articles issuing from the outlet end of the tube. The tube may be horizontal and have an internal helical thread, or may be both inclined and have a helical thread, for the purpose of causing travel of the articles on rotation of the tube. In one preferred arrangement the tubes are tapered from their outlet ends to their inlet ends, so as to be, for example, of frusto-conical form, and are provided with an internal helical thread, which is deep and of coarse pitch adjacent the inlets of the tubes graduating to a finer thread of less depth adjacent the outlets of the tubes.

According to an important feature of the invention, the tube may be lined internally with abrasive-resistant material and the helical thread, where provided, is formed on the radially-inner surface of the lining.

According to another important feature of the invention the tube may be provided internally with baffle means constructed and arranged to reduce the rate of continuous flow of articles through the tube. The baffle means may comprise one or more baffle plates which block movement of the articles lengthwise of the tube except through a notch which is formed at the periphery of each plate.

According to another feature of the invention a plurality of such tubes may be provided, the tubes being arranged to be traversed by the articles in succession by the provision of transfer means between the outlet end of one tube and the inlet end of the next tube. The articles may be passed through each of the tubes, or provision may be made for the insertion of articles at an intermediate point in the train of tubes so that articles requiring different processing times can be dealt with at the same time.

According to another feature of the invention there is provided for use with tumbling apparatus a screening unit comprising a rotatable screening tube provided with

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screening apertures, said screening tube being constructed or arranged so that, on rotation of the tube articles fed into one inlet end of the screening tube are caused to travel towards its opposite outlet end.

In a preferred arrangement according to this aspect of the invention, a plurality of such screening tubes are provided through which those articles not falling through the screening apertures pass in succession, there being provided transfer means for the articles from the outlet end of one screening tube to the inlet of the next. In this preferred arrangement the screening tubes are of wire mesh coated with an abrasive-resistant material, and a helical thread or beading made of abrasive resistant material is bonded thereto internally of the tube.

Some embodiments of tumbling apparatus according to this invention will now be described by way of example. The description makes reference to the accompanying diagrammatic drawings in which:

Figure 1 shows the general arrangement of one embodiment;

Figure 2 shows one arrangement of the tumbler tubes;

Figure 3 shows the general arrangement of a suitable screening unit;

Figure 4 is a section through one form of tumbler tube;

Figure 5 is a section through a second form of tumbler tube;

Figure 6 is a sectional view of part of one form of screening tube;

Figure 7 shows a perspective view of the general arrangement of a tube fitted with baffle plates with parts of the tube broken away to show the plates;

Figure 8 shows an axial section through the tube;

Figure 9 shows a baffle plate, and

Figure 10 illustrates a modification of the arrangement of screening tubes.

Referring to Figures 1 to 4 of the drawings, the apparatus comprises two stacks 10 of rotatable tubes 11 through which the articles together with chips of granite or other suitable material pass in succession, the articles being transferred from one stack 10 to the next by an elevator 12. After processing in the stacks of tubes 11, the articles and chips pass to a screening unit 13 for separation. The stacks 10 of tubes, the elevators 12 and the screening unit 13 are all immersed in a tank 14 containing a suspension of abrasive compound in corrosion-inhibited water.

Each stack 10 of tubes comprises a number of tubes 11 arranged horizontally, alternate tubes being offset laterally to one side of the vertical centre line of the stack, and the remaining tubes being offset to the other side of the centre line of the stack.

The tubes 11 are provided internally with a lining 11a of an abrasive-resistant material, such as rubber or polyvinyl chloride, and a coarse thread 15 is moulded on this lining. Conveniently the linings 11a of the tubes have all a right-hand thread or have all a left-hand thread, and each tube is driven in the opposite direction to the next adjacent tube or tubes. External flanges may be provided adjacent the ends of the tubes for mounting purposes, and a central flange on each tube may be provided for transmission of the drive.

Chips of a selected size, or selected sizes, and articles fed into the appropriate end of the top tube of the stack 10 are tumbled and moved continuously along the tube by the thread 15. A fixed chute 16 is provided at the outlet end of the first tube so that the articles are guided into the adjacent inlet end of the next lower tube, and since the latter has an identical thread but is rotated in the opposite direction to the first tube, the articles are then moved along the second tube. A similar chute 16 is provided at the outlet end of each tube 11 connecting it with

the inlet end of the next tube of the stack, so that the articles follow a sinuous path through the stack. On emerging from the bottom tube of the stack, the articles are lifted to the top of a second and similar stack 10 by a worm-type elevator 12.

The worm-type elevator 12 comprises a worm element 12a rotating in a vertical cylindrical casing 12b, and the operating surfaces of the element and the casing are coated with abrasive-resistant material.

On discharge from the bottom tube of the second stack 10 the articles are conveyed to the screening unit 13 for separation of the chips and articles. Where articles of different sizes and chips of different sizes have been passed through the tubes 11 together the screening unit 13 serves to separate them into their size groups again.

One preferred arrangement of screening unit shown diagrammatically in Figure 3 comprises four horizontal screening tubes 17 which are formed from mild steel wire mesh coated with rubber or other abrasive-resistant material. A helical beading or thread is bonded to the inside of the tubes, so that on rotation of the screening tubes about their longitudinal axes the mingled articles and chips are carried through the tubes 17 or fall through the mesh on to chutes, down which the separated articles or chips slide to a respective elevator 18 or 19, for example a worm-type elevator as previously described, for conveyance to a delivery chute. Chips which are separated out are returned to the inlet of the first stack of tubes 11 for recirculation through the machine with the incoming articles.

The articles and chips which are carried through one screening tube 17 are delivered into the next screening tube 17 down a fixed chute 20 for further separation. The first two screening tubes may be of one mesh size and the last two screening tubes may be of a second mesh size. This screening unit is intended to deal with articles of one size and chips of two sizes, or with articles of two sizes and chips of one size. Generally, all the chips will be returned to the inlet to the first stack of tubes 11 by the same conveyor, and separate delivery conveyor will be provided for each size of article.

The separation is assisted by vibrating the screening tubes, and to this end the screening unit comprises a vibrator 21, which is preferable of the electromagnetic alternating-current contactless type.

In an alternative arrangement shown in Figure 6 the screening tubes 17 are formed from cylinders lined internally with abrasive resistant material, and a coarse thread 17a is formed on the radially inner surface of the lining. The screening apertures 17b are provided in the base of the helical channel of the thread.

In the above arrangements the screening unit 13 forms a self-contained unit which is mounted to be readily interchangeable with other screening units of a potential screening range within the general capacity of the machine.

The tank 14 in which the tubes, elevators and screening unit are housed is provided with a water float valve 24 of the normal ball and valve type to control the intake from the mains water supply, and there is provided a hopper 25 containing abrasive compound which is operated by time-cycle solenoid-operated device 26 to discharge additional abrasive compound into the tank at pre-set intervals of time. A water-change valve 27 of the time-cycle solenoid-operated is also provided to drain off all the water at pre-set time intervals and to allow the water float valve 24 to refill the tank 14 with fresh water and the hopper 25 to recharge the tank with abrasive compound. A circulating pump 28, which is preferably of the self-priming diaphragm type, maintains the water in circulation and prevents settling-out of the abrasive compound.

Inlets to the train of tubes contained in a stack may be provided at different points in the train so that the machine can deal with articles requiring different processing

times, say by reason of the finish required, at one and the same time.

Figure 5 illustrates diagrammatically another preferred arrangement, in which the tumbler tubes 11 are of tapering form from their outlets to their inlets, and are rotated about a horizontal axis. The tubes are provided internally with an abrasive resistant liner as in the previously described construction, so that the articles are passed along the tube by the thread assisted by a measure of gravitation, but the helical thread, instead of being uniform, is coarse and deep adjacent the inlet (smaller diameter) end graduating to a finer, shallower thread adjacent the outlet (larger diameter) end. In one construction, for example, the tubes have a taper of 1 in 40, and the thread has a pitch of 1 inch and a depth of $\frac{1}{4}$ inch at the inlet end, and has a pitch of $\frac{1}{2}$ inch and a depth of $\frac{1}{8}$ inch at the outlet end of the tube. This arrangement ensures that the entrance to each tube is cleared quickly, and that in the event of overloading of the tubes the articles can ride over the thread.

Instead of being immersed in a bath containing a suspension of abrasive material in water, kerosene, or oil, the tubes may be fed with the suspension through a spray 22 located in the inlet to the top tube of each stack, and in this case seals are provided between each tube 11 and the co-operating chute or chutes 16.

The tubes may be made of aluminum sheet and driving and mounting flanges for the tubes may be in the form of aluminium castings. The tubes may be lined with neoprene, polyvinyl chloride, rubber or other suitable abrasive-resistant material.

Alternatively the tubes may be made, complete with mounting and driving flanges, from wire-reinforced polyester plastic material. The helical thread is in this case formed integrally with the tubes, no lining being required.

Referring now to the modified arrangement shown in Figures 7, 8 and 9 of the drawings, the tube of the tumbling apparatus, as before, consists of a frusto-conical tube 110 which tapers in diameter from its outlet 110a to its inlet 110b and is supported in bearings (not shown) for rotation about a horizontal axis. The tubes 110 is lined internally with rubber or other abrasive-resistant material.

To prevent the mass from traversing the length of the tube 110 too quickly and thus making necessary a considerable length of tube in order to provide an adequate processing time, a series of baffle plates 111 are fixed in the tube 110 at regular intervals along its length, designed and arranged to impede the longitudinal movement of the traversing mass, but to ensure a consistent flow devoid of the possibilities of lodgment with its associated risk of over-processing. The spacing of the baffle plates 111 from each other is sufficient to allow the articles to take up any position, at a point where successive baffle plates 111 are nearest each other, with a clearance from each of the baffle plates.

Each baffle plate 111 in this arrangement consists of a disc made from aluminium or mild steel coated with rubber or other abrasive-resistant material, and the plane of each disc makes an angle α with an imaginary plane perpendicular to the axis of the tube, the value of α being in the range 10° – 20° , dependent on the size of the articles and on other factors. The action obtained with this sloping arrangement is that the plates 111 tend to throw back the mass in the upstream direction so that a longer processing time is obtained in each tube. In the case of articles weighing less than about 1 oz. each, it is found that the maximum effective value of α is about 10° , since, if the angle is higher, articles trapped in the corner between the baffle and tube remain lodged despite the rotation of the tube because the gravitational effect is insufficient in comparison with the centrifugal force to dislodge them. For parts weighing more than 1 oz. the maximum effective value of α is 20° , any increase beyond this value tends to diminish the throwing-back action.

A notch 112 is formed in the periphery of each plate 111, the notch being sufficiently large to allow the articles to pass through it. The sloping arrangement of each baffle plate 111 is such that the notch 112 is nearest the outlet end of the tube and the parts of the plate diametrically opposite the notch are nearest the inlet end of the tube. The notches of successive baffle plates are displaced from each other by 180° of rotation of the tube.

Referring now particularly to Figure 9 it can be seen that the leading edge 112a of each baffle plate, that is, the edge of the baffle plate which parts the flow of articles, is bent over towards the downstream end of the tube to form a lip, the action of which is to tend to deflect back in the upstream direction articles which impinge on or near this edge, and that the trailing edge 112b is bent over towards the upstream end of the tube to form a lip so that articles contacting the upstream face of the baffle plate are deflected upstream away from the notch 112.

In one example a rubber-lined frusto-conical tube 5 ft. long has an inlet diameter of 6.00" and an outlet diameter of 7.00", and is connected to be rotated at a peripheral speed of 80 ft. per minute about a horizontal axis. Thus the "fall" along the tube is .100" per foot length of tube. In this case a loose mass is found to move one foot along the tube in 12 seconds.

The inclusion of a series of specially designed baffles was found to increase the traverse time considerably. Thus, employing 3 baffles in each foot length of tube, the time taken for the mass to traverse a foot length was increased to 6 minutes 12 seconds. The number of baffles employed per foot length of tube depends on the size of the articles. For example, if parts 2" long are to be processed, the baffles must be 2" plus a clearance allowance apart at their nearest point, and should thus be, say, 3" apart.

One or more baffle plates similar to those described above may, according to a feature of the present invention, be fixed in the screening tubes to reduce the rate of flow through these tubes.

In a modification of the screening arrangement previously described, the screening apertures may take the form of longitudinal slots which run substantially the full length of the screening tubes so that an increased screening area is obtainable. In the arrangement illustrated in Figure 10 of the drawings the width of the slots is adjustable by using two slotted tubes 117c, 117d one fitting fairly closely inside the other, and is adjusted by rotating the tubes relative to one another, suitable turning and locking devices being provided. Both of the tubes are lined internally with rubber, and the radial clearance between the outer surface of the inner tube 117c and the inner surface of the outer tube 117d is .010 in one arrangement in which the inner diameter of the inner tube is 7.5".

Six equally-spaced parallel slots are formed in both tubes, and one edge 116 of the inner tube 117c is turned inwardly to guide the mass to the slot. The rubber covering of the edges of the slots may be such as to provide slots having their axes at an angle, for example 35°, to the radial direction. The inturnd edge 116 also serves to improve the agitation of the mass.

The outer tube is provided with three peripheral mounting and driving flanges which impart rigidity to the composite tube.

Where the screening tube is provided with baffles as hereinbefore described, the parts of the inner tube 117c may be held together and stiffened by the baffles.

Thus, the tumbling apparatus described provides a completely automatic machine for deburring and polishing articles, which is suitable for remote quality control by closed-circuit television.

I claim:

1. Tumbling apparatus comprising a plurality of tubes disposed one above the other in a bank with their longitudinal axes horizontally extending, each said tube having

an inlet end and an outlet end and each tube having its outlet end adjacent the inlet end of the tube next below it, each said tube being rotatable about its longitudinal axis and being adapted to cause travel of articles, which are to be polished or de-burred, from its inlet end towards its outlet end, feed means positioned adjacent the inlet end of the upper tube of the bank and delivering said articles into the inlet end of the upper tube, transfer means adjacent the outlet end of each tube except the lowermost tube of the bank, said transfer means receiving the articles from the outlet end of the tube and delivering them to the inlet end of the next lower tube, and receiver means positioned at the outlet of the lowermost tube and collecting said articles on leaving the tube.

2. Tumbling apparatus according to claim 1, wherein the tubes are disposed alternately on each side of the central vertical plane of the bank.

3. Tumbling apparatus according to claim 1, comprising a plurality of such banks of tubes, the receiving means of one bank of tubes comprising an elevating conveyor carrying the articles from the lower tube of said one bank to the inlet of the upper tube of a second of the banks of tubes.

4. Tumbling apparatus as claimed in claim 1, wherein each tube having on its internal surface a helical thread extending as from adjacent the inlet of the tube to adjacent the outlet circumferentially of the tube in a direction opposite to the direction of rotation of the tube to assist travel of said articles from the inlet end to the outlet end of the tube, said thread being deep and of coarse pitch adjacent the inlet end of the tube and the thread depth and pitch both decreasing towards the outlet of the tube.

5. Tumbling apparatus as claimed in claim 4, comprising a lining of abrasive resistant material, within the tube, the helical thread being formed on the radially-inner surface of the lining.

6. Tumbling apparatus as claimed in claim 4, wherein the tube is made from wire-reinforced polyester plastic material.

7. Tumbling apparatus as claimed in claim 1, comprising baffle means internally of each tube, said baffle means reducing the rate of continuous flow of articles through the tube without impeding the continuous tumbling action.

8. Tumbling apparatus as claimed in claim 7, wherein the baffle means comprises a baffle plate having a notch in its periphery, the plate blocking movement of the articles lengthwise of the tube except through the notch.

9. Tumbling apparatus as claimed in claim 7, said baffle means comprising a plurality of baffle plates spaced lengthwise of the tube, each baffle plate having a notch in its periphery, the notches of successive baffle plates being displaced angularly from each other, each plate blocking movement of the articles lengthwise of the tube except through its notch.

10. Tumbling apparatus as claimed in claim 7, having the notches in successive baffle plates displaced from each other by 180°.

11. Tumbling apparatus as claimed in claim 10, having the baffle plates fixed in the tube with its plane inclined at an angle to an imaginary plane which is perpendicular to the lengthwise axis of the tube, the portion of the plate diametrically opposite its notch being nearest the inlet end of the tube than the notch and the notch being furthest away from the inlet end of the tube.

12. Tumbling apparatus as claimed in claim 11, wherein said angle is the range 10°-20°.

13. Tumbling apparatus as claimed in claim 9, wherein the notch in each plate is bounded by a leading edge facing in the direction of rotation and parting the flow of articles moving on to the edge under gravity, and a trailing edge facing oppositely to the leading edge, the leading edge being bent towards the outlet end of the tube

and affording a lip which tends to deflect the articles toward the inlet end of the tube.

14. Tumbling apparatus as claimed in claim 13, wherein the trailing edge of the notch, is bent over towards the inlet end of the tube and deflects the articles away from the notch.

15. Tumbling apparatus as claimed in claim 1, comprising also a screening unit connected to receive articles from the outlet end of the lowermost tube of the bank, said screening unit comprising at least one rotatable screening tube having an inlet and an outlet and provided with screening apertures, said screening tube on rotation causing articles fed into the inlet end to travel towards its outlet end.

16. Tumbling apparatus as claimed in claim 15, wherein the screening tube is provided internally with a helical thread to assist to cause travel of the articles and the thread is of coarse pitch, the screening apertures being provided in the base of the helical channel of the thread.

17. Tumbling apparatus as claimed in claim 15, wherein the screening apertures are slots which extend axially of the screening tube.

18. Tumbling apparatus as claimed in claim 17, the screening tube comprising two coaxial tubes fitting closely one within the other, longitudinal slots being provided in each of the tubes, the slots in the tube overlapping and the tubes being angularly adjustable relative to vary the extent of overlap of the slots, and means locking the tubes against relative angular displacement after adjustment.

19. Tumbling apparatus as claimed in claim 18, wherein the paths defined by the slots extend at an angle of the order of 35° to the radial direction.

20. Tumbling apparatus as claimed in claim 15 comprising a plurality of units, each having a plurality of screening tubes, said units being mounted to be readily interchangeable, and the tubes of each unit having a different screening range from the tubes of the other units.

21. Tumbling apparatus as claimed in claim 15, comprising also means to vibrate the screening tube.

22. Tumbling apparatus as claimed in claim 15 comprising a tank housing the tumbling tubes and screening tubes, the tank containing abrasive compound in suspension in a carrier liquid.

23. Tumbling apparatus as claimed in claim 22 comprising automatic time-controlled means charging the tank with the abrasive compound and carrier liquid at pre-set intervals of time.

24. Tumbling apparatus as claimed in claim 23, wherein said automatic means comprises means to spray a suspension of an abrasive compound in a carrier liquid into the upper tumbling tube when a fresh charge of articles to be processed is fed into the tube.

25. Tumbling apparatus as claimed in claim 1 comprising means charging a fresh supply of abrasive compound into the tumbling tubes with each charge of articles to be polished or de-burred.

26. A tumbling apparatus comprising a plurality of separate tumbling tubes in a vertically disposed bank, each tube having an inlet end and an outlet end and having its axis inclined with its outlet end lower than the inlet end, the outlet end of each tube being adjacent the inlet end of the tube next below it, chute means interconnecting adjacent ends of the tubes so that the tubes are arranged in series, means feeding articles to be tumbled into one end of the uppermost tube, means collecting the articles at the end of the series after the tumbling operation, and means for rotating the tumbling tubes.

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