Nov. 25, 1947. I. O. WALLBERG 2,431,354

CLEANING APPARATUS

Filed July 1, 1946 2 Sheets-Sheet 1

Fig. 1

Fig. 2

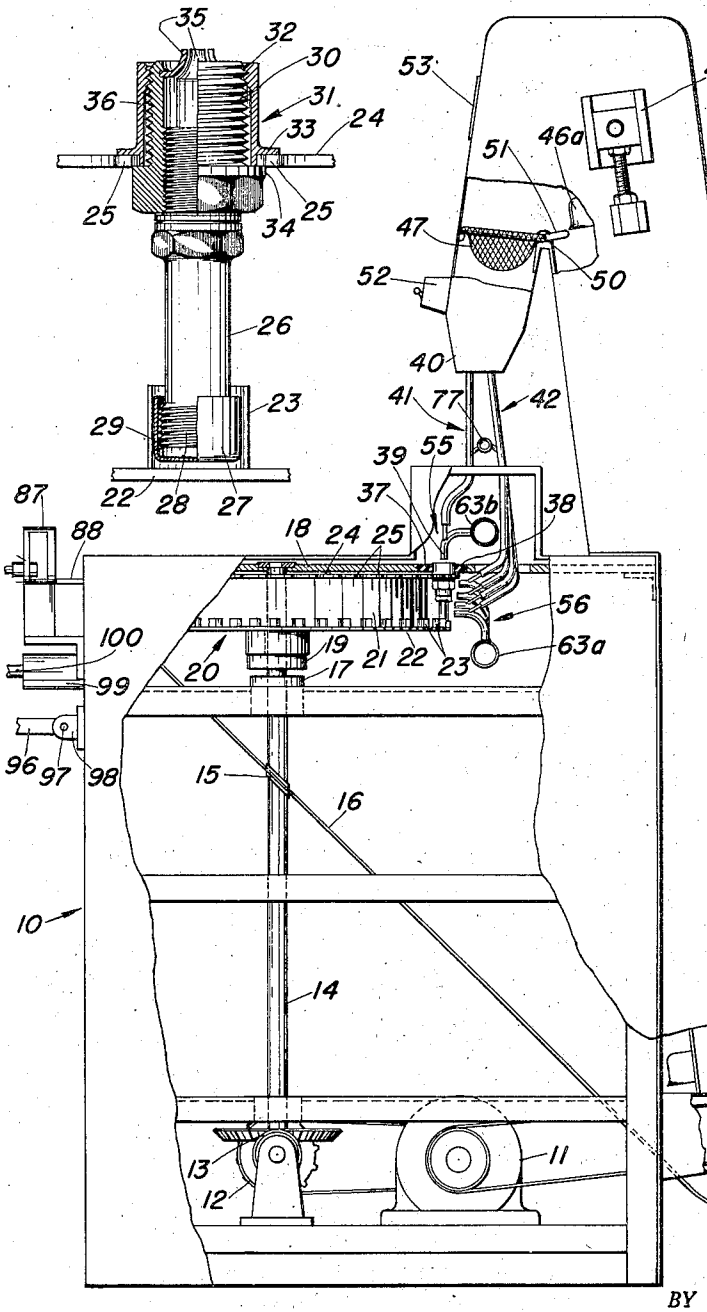
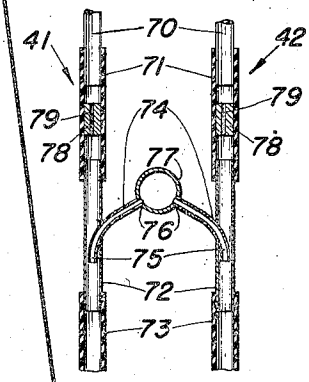


Fig. 3



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Fig. 4

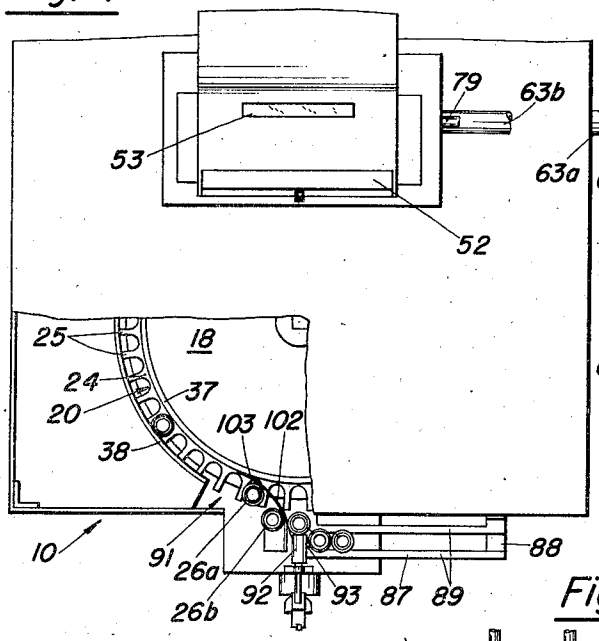


Fig. 6

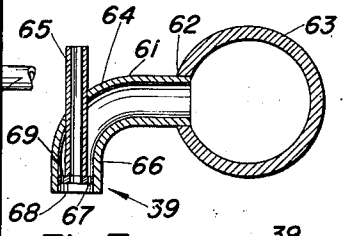


Fig. 7

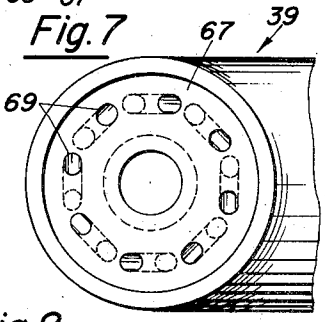


Fig. 8

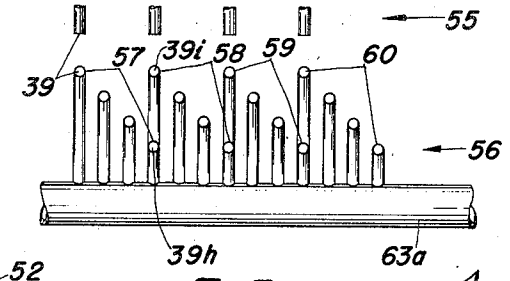


Fig. 5

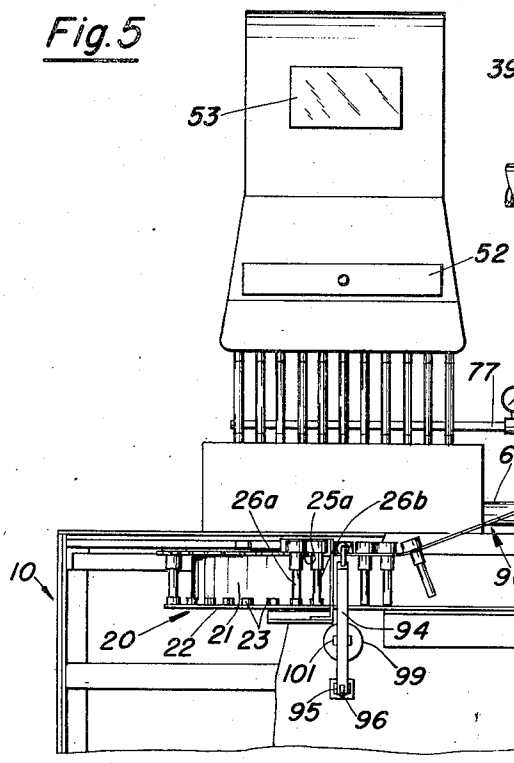
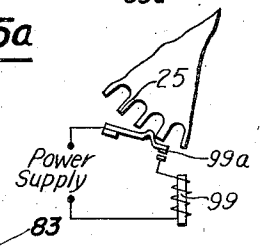


Fig 5a



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2,431,354

CLEANING APPARATUS

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Application July 1, 1946, Serial No. 680,780

7 Claims. (Cl. 51—15)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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This invention relates to a cleaning apparatus and more specifically to a cleaning apparatus having a continuous conveyor for carrying articles to be cleaned and having nozzle means for directing a cleaning substance against the articles as they are carried on the conveyor.

Objects of this invention are to provide a cleaning apparatus for continuously conveying articles to be cleaned and directing a cleaning substance against the articles; to provide for directing high velocity abrasive against articles to be cleaned; to provide for revolving and simultaneously rotating a plurality of articles such as spark plugs past a group of sandblast nozzles; and to provide an apparatus of the class described having new and improved conveyor means, loading means, and abrasive handling means.

In accomplishing these and other objects of the present invention, I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a side elevation view, partly in cross-section, of a cleaning apparatus embodying the features of the present invention, partially broken away to show certain details of structure;

Fig. 2 is a full size side elevational view, partly in cross-section, of a spark plug in position on the conveyor of the apparatus of Fig. 1.

Fig. 3 is a detail vertical cross-sectional view of abrasive circulating tubes of the device of Fig. 1 illustrating the flow limiting means and the auxiliary air supply; when both plugs are on the carrier 20.

Fig. 4 is a plan view, partially broken away, of the apparatus of Fig. 1;

Fig. 5 is a front elevational view, partially broken away, of the apparatus of Fig. 1;

Fig. 5*a* is a fragmentary schematic diagram of the electrical circuit for the solenoid used to load spark plugs onto the conveyor.

Fig. 6 is a detail cross-sectional view of the nozzle used in the apparatus of the present invention;

Fig. 7 is an enlarged plan view of the nozzle of Fig. 6;

Fig. 8 is an elevation view of the nozzle arrangement of this invention taken from the point of view of a spark plug in position to be cleaned.

Referring more particularly to the drawing:

Numeral 10 indicates generally a base or housing of metal in the form of a substantially closed container having a power source such as an electric motor 11 installed in the bottom thereof. Through a chain and sprocket arrangement 12

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and bevel gear train 13, the motor is adapted to rotate a drive shaft 14. The shaft 14 extends vertically through a seal 15 in an inclined partition 16 in the housing and then through a bearing 17 into the upper region of the housing 10. A roller driving wheel 18 is fixed to the shaft 14 adjacent its upper end. A bearing collar 19 on the shaft 14 supports a continuous conveyor 20 for articles to be cleaned. The conveyor 20 is freely rotatable about shaft 14.

The conveyor illustrated is designed to carry aviation spark plugs although it can be adapted within the scope of the invention to carry various articles. It comprises a cylindrical drum 21 having a lower flange 22, provided with a plurality of vertically extending U-shaped guide members 23 adapted to guide the lower ends of spark plugs, and having an upper flange 24, provided with a plurality of uniformly spaced radially extending fingers 25 for supporting spark plugs.

As shown most clearly in Fig. 2, each spark plug 26, before insertion into the cleaning machine, is provided with a cap 27 for protecting its lower opening and lower threads 28 from the action of the cleaning substance. The cap 27 is provided with a threaded portion 29 of limited extent to facilitate rapid application and removal of the cap. The lower end of the plug 26 covered by the cap 27 is received in and guided by the curved member 23 as the plug is rotated in a manner hereinafter described.

The threads 30 on the upper end of the spark plug are protected from abrasive by a generally cylindrical shield 31, Fig. 2, having a short internal thread 32 for quick coaction with the threads 30. The shield 31 also serves to facilitate the support of the spark plug on the conveyor by virtue of a flange 33 formed thereon, the undersurface of which an adjacent pair of fingers 25 engages on opposite sides of the plug. The fingers 25 fit fairly snugly between the undersurface of the flange 33 and the upper surface of a flange 34 formed on the plug 26 and are so spaced that each finger simultaneously supports one side of each of two plugs. For example, the finger 25*a* in Fig. 4 supports one side of plug 26*a* and one side of plug 26*b*.

The shield 31 is open at its upper end exposing the electrodes 35, Fig. 2, of the spark plugs to the cleaning action of the machine. A substantially cylindrical external surface 36 of the shield 31 serves as a tire or rim for the spark plug to facilitate rotation of the plug from frictional contact with friction elements hereinafter described.

Fixed on the periphery of the roller drive wheel

18 is a tire or rim 37 of rubber or similar material presenting a friction surface for engagement with the portion of the surface 36 of the plug shields 31 radially inward relative to the axis of the conveyor 20. An arcuate friction roller member 38, of rubber or similar material, is fixed to the housing in such a position as to frictionally engage the radially outward portion of the surface 36 of the plug shields 31. The cylindrical shields 31 may thus be said to be roughly externally tangent to the cylindrical roller surface 37 and internally tangent to the arcuate member 38, which latter forms a track on which the plugs rotate as they are revolved by the action of the driving wheel 18.

The spark plugs are cleaned as they are carried on the conveyor by means of a plurality of jets of cleaning substance directed against them by a plurality of nozzles 39. The cleaning substance used is preferably an abrasive such as sand, although liquids, liquid suspensions of abrasive, etc. could be used. The abrasive is stored in a hopper 40, Fig. 1, and flows into the nozzles 39 through conduits 41 and 42. After being emitted by the nozzles 39 to clean the spark plugs, the abrasive drops down onto the inclined partition 16 and slides down it to the bottom 43 of a belt or chain conveyor housing 44 joined by fluid tight connections to the main housing 10. A belt or chain conveyor 45, driven by motor 11 and having buckets or scoops 46, picks up the used abrasive at 43 and dumps it through a sieve or strainer 47 into the hopper 40. The tension on the belt conveyor can be varied by a conventional adjustment 49. The sieve 47 is pivoted as at 50 about a horizontal axis and is held in the position illustrated in Fig. 1 by a spring (not shown). As each scoop 46 passes the sieve 47 it strikes an arm 51 formed on the strainer as apparent from the disposition of scoop 46*a* in Fig. 1. This causes the sieve 47 to pivot about axis 50 against the action of its restoring spring and thus jog the abrasive to make it fall into the hopper 40. An electric resistance heater 52 is provided to dry out the sand to prevent clogging. A transparent window 53, Fig. 5, is provided to observe the operation of the belt conveyor 45 and the sieve 47.

A duct 54 communicating with the portion of the housing 10 above the partition 16 and with the belt conveyor housing 44 leads to an exhaust fan (not shown) which removes abrasive dust, foreign particles, and the like.

The nozzles 39 are disposed in two groups generally indicated by the numerals 55 and 56, Fig. 8. The nozzles of group 55 direct jets of cleaning substance vertically downward against the electrodes of the spark plugs while the nozzles of group 56 direct jets of cleaning substance horizontally toward the lateral surface of the plugs. The nozzles of group 56 are arranged in banks, 57, 58, 59, and 60, preferably four in number. Each bank has a series of nozzles, preferably four in number disposed at an angle of preferably 45° to the horizontal, with the lowest nozzle of each series being directly beneath the highest nozzle of the series to the left of it as viewed in Fig. 8. For example, nozzle 39*i* of series 58 is directly over nozzle 39*h* of series 57. A sufficient number of nozzles 39 is provided and they are so spaced as to subject each spark plug to a substantially continuous stream of cleaning substance during at least two complete rotations thereof to insure adequate cleaning.

Although various types of nozzles 39 may be used in the cleaning apparatus of the present

invention, the type illustrated in detail in Figs. 6 and 7 has proven particularly satisfactory. The nozzle is made of an outer metal tube 61 joined by welding or other suitable means at 62 to a fluid supply manifold 63. The tube 61 is bent as at 64 substantially at right angles forming an elbow. Adjacent the bend 64 a smaller metal tube 65 extends concentrically with the outer arm 66 of the elbow and terminates in an annular separating plate 67 fixed within the tube 61 at a point spaced somewhat from the outer end of the tube 61 to form a mixing chamber 68. The plate 67 has a plurality of uniformly spaced openings 69 drilled therethrough at an acute angle to the plate to produce a swirling motion in the chamber 68 of the fluid emitted through them. Abrasive, such as sand, is fed through the tube, preferably almost entirely under the action of gravity, at a slow speed just sufficient to maintain a continuous flow. As the abrasive leaves the outer end of the tube 65 at slow speed and enters the chamber 68, it is picked up by the swirling motion of the fluid, preferably compressed air, emerging from the openings 69 and is discharged as a high velocity air-sand mixture against the spark plugs.

The conduits 41 and 42 for supplying abrasive to the nozzle groups 55 and 56, respectively, are shown in detail in Fig. 3. Each conduit 41 and 42 preferably includes a short metal tube 70 fixed to the bottom of the hopper 40, a short length of rubber or other flexible tubing 71, a second metal tube 72, and a second rubber tube 73. The lower end of each tube 73 fits snugly over the metal tube 65 of a nozzle 39. A small diameter metal tube 74 enters the tube 72 through its side wall and has one end bent to point downward as at 75. The tube 74 is brazed or otherwise joined to tube 72 to make a fluid-tight joint. At its other end 76 the tube 74 is connected to an auxiliary fluid or air supply manifold 77. To reduce the flow of abrasive through the conduits to the desired rate, a plug or snubber 78 of metal or other suitable material may be inserted in the tube 71. The plug 78 has a relatively small diameter opening 79 therethrough. The opening 79 is conveniently chosen to be of such a size that it will just prevent the passage of sand under the action of gravity but will permit the flow as soon as the slightest auxiliary air pressure of perhaps ½ pound per square inch is applied to the tube 74 to cause a reduction in pressure within the conduit adjacent the end 75 of the tube 74. The use of rubber tubes 71 and 73 affords flexibility of operation in that they provide for easily installing or removing a plug 79, provide for by-passing the auxiliary air supply to any particular nozzle, if desired, and provide for disconnecting any particular nozzle, if desired. Solid plugs are used to plug any openings in the conduit occasioned by disconnecting a nozzle.

The fluid supply for the apparatus preferably consists of compressed air provided by any convenient source through a supply line 80, Fig. 5. The line 80 is furnished with a combination master and reducing valve 81 which controls the pressure of the air fed to the apparatus. For adequately cleaning the lateral surface of the spark plugs a pressure of about 100 pounds per square inch is required. This pressure is supplied to the manifold 63*a* of the nozzle group 56 and is indicated by gage 82. Through a reducing valve 83 the manifold 63*b* for nozzle group 55 is supplied with lower pressure air at about

30 pounds per square inch, indicated by gage 84. This lower pressure, adequate for cleaning spark plug electrodes, is used to avoid damaging delicate mica insulation. For supplying low pressure air to the manifold 77 a reducing valve 85 is provided. This valve 85 is set to introduce whatever slight pressure, hereinbefore described as about ½ pound per square inch, is necessary to just overcome the tendency of the abrasive to pack and stick in the conduits and thus permit the flow of the abrasive substantially entirely under the action of gravity. The pressure in manifold 77 is shown on gage 86.

A loading mechanism is provided for automatically feeding spark plugs to be cleaned into the machine. This mechanism includes a track 87 fastened to the front of the machine by a bracket 88. The track 87 is provided with a pair of rails 89 partially inclined as shown at 90, Fig. 5, and turned at 90° at their lower ends terminating opposite and level with the fingers 25 as they are exposed in passing by a break 91, Fig. 4, in the arcuate friction member 38. The rails 89 support the spark plugs by engagement beneath the flange 33 on the shield 31 in the same manner as the fingers 25 support the plugs, and the rails are so disposed that as each pair of fingers 25 passes opposite them the fingers momentarily form a continuation of the rails. The plugs are inserted by hand at the upper end of the track 87 and slide down it by gravity. The plugs are periodically projected onto the conveyor by means of a shuttle 92, Fig. 4, overlying the track 87 at its turn and engaging the shields 31 on the plugs. As the shuttle 92 thrusts one plug into the machine, its side 93 prevents any additional plugs from sliding down the track 87. The shuttle 92 is operated in a known manner by a lever arm 94 pivotally connected at 95 to a link 96 pivoted at 97, Fig. 1, to a bracket 98 fixed to the base 10. The lever is actuated by a solenoid 99 having its plunger 100 pivotally connected at 101 to the lever arm 94. Current to the solenoid is controlled in a conventional manner by a switch 99*a*, shown schematically in Fig. 5*a*, periodically operated by each of the fingers 25 so as to synchronize the motion of the shuttle 92 with the motion of the conveyor 20, whereby a plug is inserted between each pair of fingers 25 at the very moment it passes opposite the track 87.

A device for unloading plugs from the machine after they have been cleaned includes a curved cam member 102, Fig. 4, fixed to the housing 10. As each plug reaches the end of its revolution on the conveyor the radially inward portion 103 of the surface of the cam member engages the radially inward surface of the plug, as shown in the case of plug 26*a* in Fig. 4. Continued motion of the conveyor 20 causes the plug to be cammed radially outward until it is completely free of the fingers 25 of the conveyor, as illustrated in Fig. 4 in the case of plug 26*b*. The plug may then drop down a chute, not shown, into any convenient receiver.

Operation

To use the machine of the present invention the hopper 40 is first filled with an abrasive such as blasting sand. The air valves 81 and 83, are adjusted to provide the desired pressure indicated on gages 82 and 84 for cleaning the lateral surface and electrodes of the spark plugs to be cleaned, and the auxiliary air valve 85 is set to the pressure, indicated on gage 86, just sufficient to produce a gravity actuated flow of sand through conduits 41 and 42. The heater 52 is energized to maintain the sand dry to facilitate easy flow. The motor 11 is started, causing the drive wheel 18 to rotate and the belt conveyor 45 to operate. Shields 31 and caps 27 are placed on the plugs 26, their quick placement being assured by the short threads 32 and 29, respectively. The prepared plug units are then placed on the inclined portion of the track 87, with the rails 89 engaging the flange 33 on each plug unit.

In order to start the motion of the conveyor 20 one or more plugs may be inserted by hand between fingers 25. The conveyor mechanism then functions as a planetary friction gear system. The surface 37, acting as a driving sun gear, rotates the plugs 26, whose shields 31 serve as planet pinions and roll along as they react against the friction surface 28, which latter constitutes a fixed orbit gear. The resultant motion involves turning of the conveyor 20 about its axis in the capacity of a planet carrier. The plugs 26 thus rotate on their own axes as they are revolved on the conveyor 20 about its axis. The motion of the conveyor 20 produces by means of fingers 25, periodic, synchronous operation of the switch (not shown) controlling solenoid 99. After the initiation of the switch operation the feeding of plugs to the machine becomes automatic through the action of the shuttle 92 actuated by the solenoid 99 through the linkage 100 and 101 at the moment when each pair of fingers 25 forms a continuation of the track 87.

The plugs 26 are carried on the conveyor 20 and perform at least two rotations on their own axes during the time they are passing the jets of air-driven sand issuing from the nozzle groups 55 and 56. This insures that all parts of the plugs are adequately exposed to cleaning action. As plugs complete their revolution on the conveyor 20, they are engaged by the fixed cam member 102 and ejected by its camming action from the conveyor into a convenient receptacle (not shown). The shield 31 and caps 27 are then removed for re-use.

The conveyor buckets 46 retrieve the used abrasive which ricochets off the spark plugs and slides down the inclined partition 16 into the trough 43. The buckets 46 dump the used sand and entrained foreign particles, such as paint cleaned from the plugs, into the screen or sieve 47. As the buckets 46 pass the arm 51 they jog the sieve 47 sifting the sand back into the hopper 40 for re-use. The mesh of the sieve 47 is just sufficient to permit sand to pass through it but to retain larger foreign particles.

The exhaust fan connected to the duct 54 withdraws, by suction, dust and light weight foreign particles from the housing 10. A large settling tank (not shown), into which the duct 54 empties, so reduces the air speed that any abrasive picked up by the suction fan will settle and fall back into the trough 43.

Although the invention has been illustrated as applied to a particular type of spark plug it is apparent that it is equally applicable to cleaning other articles, either with or without shields or caps, and may employ cleaning substances other than air-driven sand.

While I have shown but one embodiment of my invention, it is apparent that the device is susceptible to modification without departing from the spirit of the invention. I do not wish, therefore, to be limited by the disclosures set forth, but only by the scope of the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. An apparatus for cleaning a plurality of articles, each having a cylindrical surface of substantially identical diameter, comprising a housing, a generally cylindrical conveyor mounted for rotation about a substantially vertical axis within said housing and having a plurality of radially extending fingers uniformly spaced around the periphery thereof, each pair of said fingers being adapted to receive and support one of said articles, a roller wheel mounted for rotation about said vertical axis having a frictional surface on its periphery adapted to engage the portion of said cylindrical surface of said articles radially inward relative to said vertical axis when said articles are carried by said conveyor, an arcuate reaction member having a friction surface concentric with said conveyor and so positioned as to engage the portion said cylindrical surface of said articles radially outward relative to said axis, so constructed and arranged that rotation of said wheel causes revolution of said articles with said conveyor and simultaneous rotation of each said articles about the axis of its cylindrical surface, said arcuate member having an interrupted portion exposing said conveyor for loading and unloading said articles, means for directing a cleaning substance against said articles as they are carried by said conveyor, means above said directing means for storing cleaning substance and supplying said substance at least partially under the action of gravity to said directing means, and means including an inclined member beneath said conveyor for collecting and returning used cleaning substance to said storage means.

2. An apparatus for cleaning articles, each having an annular shoulder, comprising a conveyor having a plurality of uniformly spaced fingers, each two adjacent fingers being adapted to support one of said articles by engaging opposite sides of said shoulder; a loading mechanism including a first track portion having rails adapted to support said articles by engaging opposite sides of the shoulders thereon, said conveyor fingers being movable past said track portion and so disposed relative thereto that said each adjacent pair of fingers periodically forms a momentary continuation of said track, a shuttle adapted to push said articles along said track, an inclined track portion entering said first track at a side thereof and adapted to load by gravity said first track with said articles, means for periodically actuating said shuttle in synchronism with the movement of said fingers past said loading mechanism to push said articles from said first track portion onto said conveyor between a pair of adjacent fingers at the moment said fingers form a continuation of said first track; means for cleaning said articles as they are carried on said conveyor; and unloading means comprising a cam surface adapted to cam said articles off said conveyor.

3. A cleaning apparatus for cleaning articles each having a cylindrical portion and provided with an annular shoulder comprising a substantially closed housing, a generally cylindrical conveyor mounted for rotation about a substantially vertical axis within said housing, article support means around the periphery of said conveyor including uniformly spaced radial fingers adapted to receive said articles and support them by engagement with the shoulders thereon and spaced guides to receive portions of said articles remote from said shoulders coacting with said fingers to retain said articles in desired position, an arcuate roller surface surrounding a portion of said conveyor and adapted to frictionally engage the outward area of said cylindrical portions of said articles when said articles are carried by said conveyor, a roller wheel concentric with said conveyor adapted to have its periphery frictionally engage the inward area of said cylindrical portions of said articles when said articles are carried by said conveyor whereby said articles are rotated as they are revolved on said conveyor between said roller wheel and said roller surface by rotation of said roller wheel, and means for applying a cleaning substance against said articles as they are carried on said conveyor.

4. An apparatus for cleaning an article having a threaded portion to be protected from cleaning action comprising a shield having a substantially cylindrical external surface stepped to present a supporting shoulder and having an internal surface provided with a relatively short thread for rapid positioning of said shield by engagement with said threaded portion of said article and provided with a portion of a diameter substantially larger than the outside diameter of said threaded portion adapted to surround and shield said threaded portion; a first friction member; a second friction member movable relative to said first friction member; a plurality of jets of cleaning material; and a carrier having means for engaging said supporting shoulder of said shield for carrying said article with the external surface of said shield in frictional engagement with both said friction members, whereby through relative motion of said members, said article is rotated as it is moved by relative motion of said members past said jets.

5. An apparatus for cleaning articles, said articles being adapted to receive generally cylindrical shields which constitute therewith units on which said shields form annular shoulders, comprising a conveyor having a substantially horizontal disc mounted for rotation about a substantially vertical concentric axis, support means around the periphery of said conveyor including uniformly spaced radial fingers for suspending said units from said shoulders, an arcuate friction roller surface surrounding a portion of said conveyor and adapted to be contiguous to the outward surface of said shields when said units are carried by said conveyor, a friction roller wheel concentric with said conveyor adapted to have its periphery contiguous to the inward surface of said shields when said units are carried by said conveyor, whereby said articles may be rotated as they are revolved by said conveyor, and means for directing a cleaning substance against said articles as they are rotatingly conveyed.

6. An apparatus for cleaning an article having an area to be protected from cleaning action comprising a shield adapted for engagement with the article to surround the area to be protected, said shield having a generally cylindrical external surface, a first friction member, a second friction member moveable relative to said first friction member, a carrier for said article disposed so as to maintain said external surface of said shield in frictional contact with said friction members whereby said article may be rotated by relative motion between said members.

7. A cleaning apparatus comprising a conveyor for articles to be cleaned, nozzle means adapted to direct a fluid and abrasive mixture against said articles as they are conveyed, abrasive storage means disposed above said nozzle means, abrasive carrying tube means connecting said abrasive storage means with said nozzle means, flow limiting means within said tube means, fluid supply means entering said tube means between said flow limiting means and said nozzle means for assisting the flow of abrasive, means for drying said abrasive to limit clogging thereof, and compressed fluid supply means for said nozzle means.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
865,261	King et al.	June 21, 1887
1,875,994	Davis	Sept. 6, 1932
1,918,653	Martin	July 18, 1933
2,365,152	Stearman	Dec. 19, 1944

FOREIGN PATENTS

Number	Name	Date
789,684	France	Aug. 26, 1935