March 17, 1942. W. A. ROSENBERGER 2,276,345

ABRADING APPARATUS

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Fig. 2

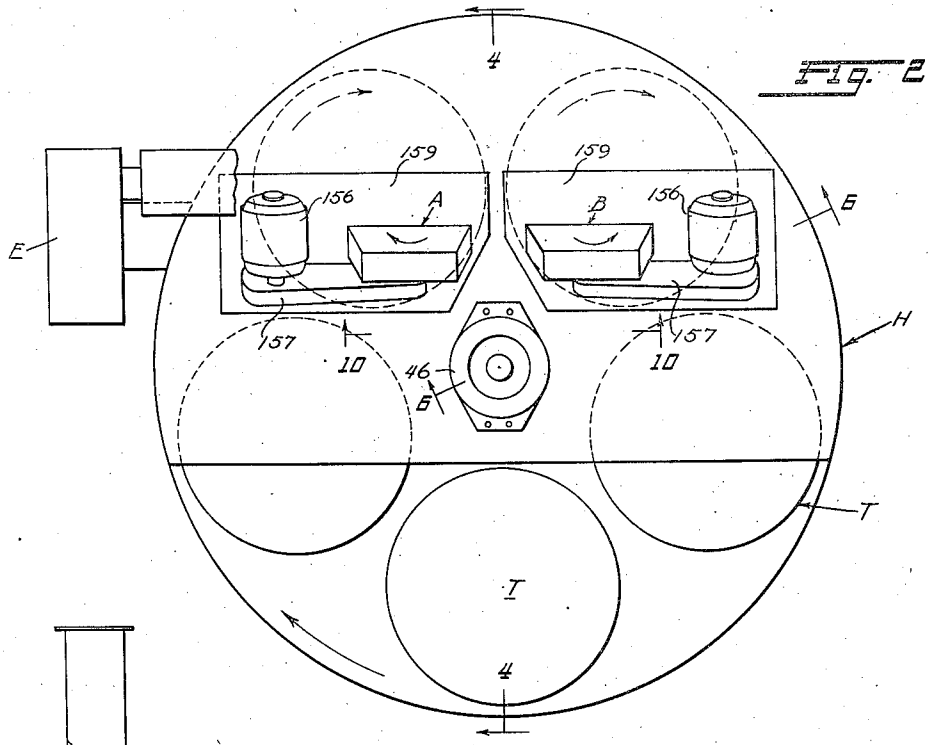
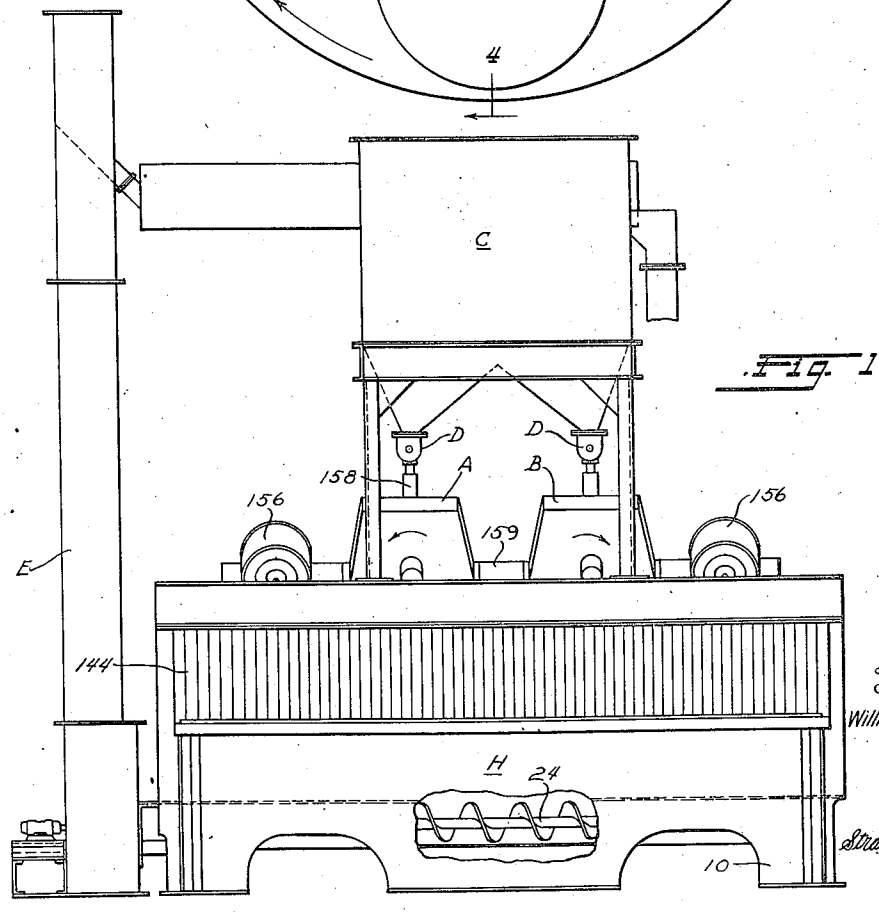


Fig. 1



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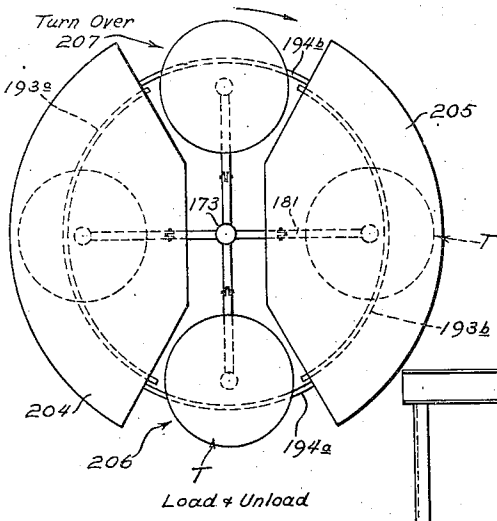


Fig. 11

Fig. 3

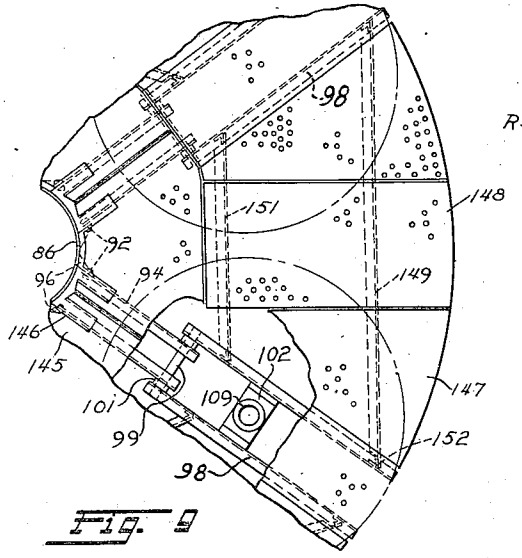


Fig. 9

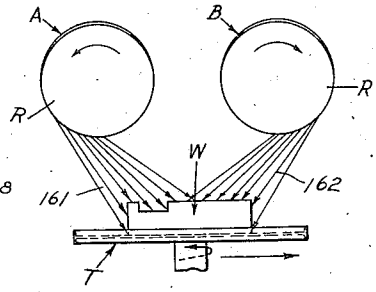


Fig. 10

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Fig. 4

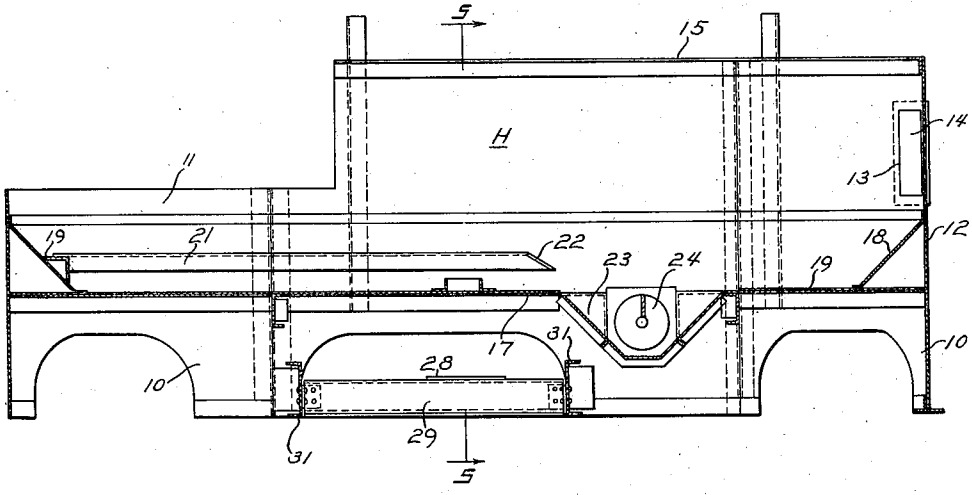
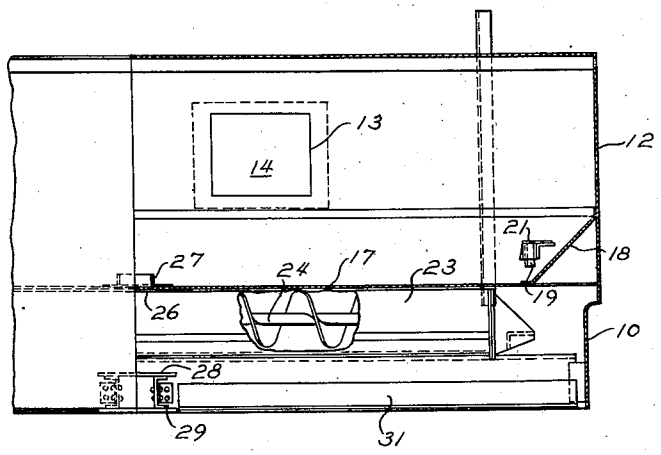


Fig. 5.



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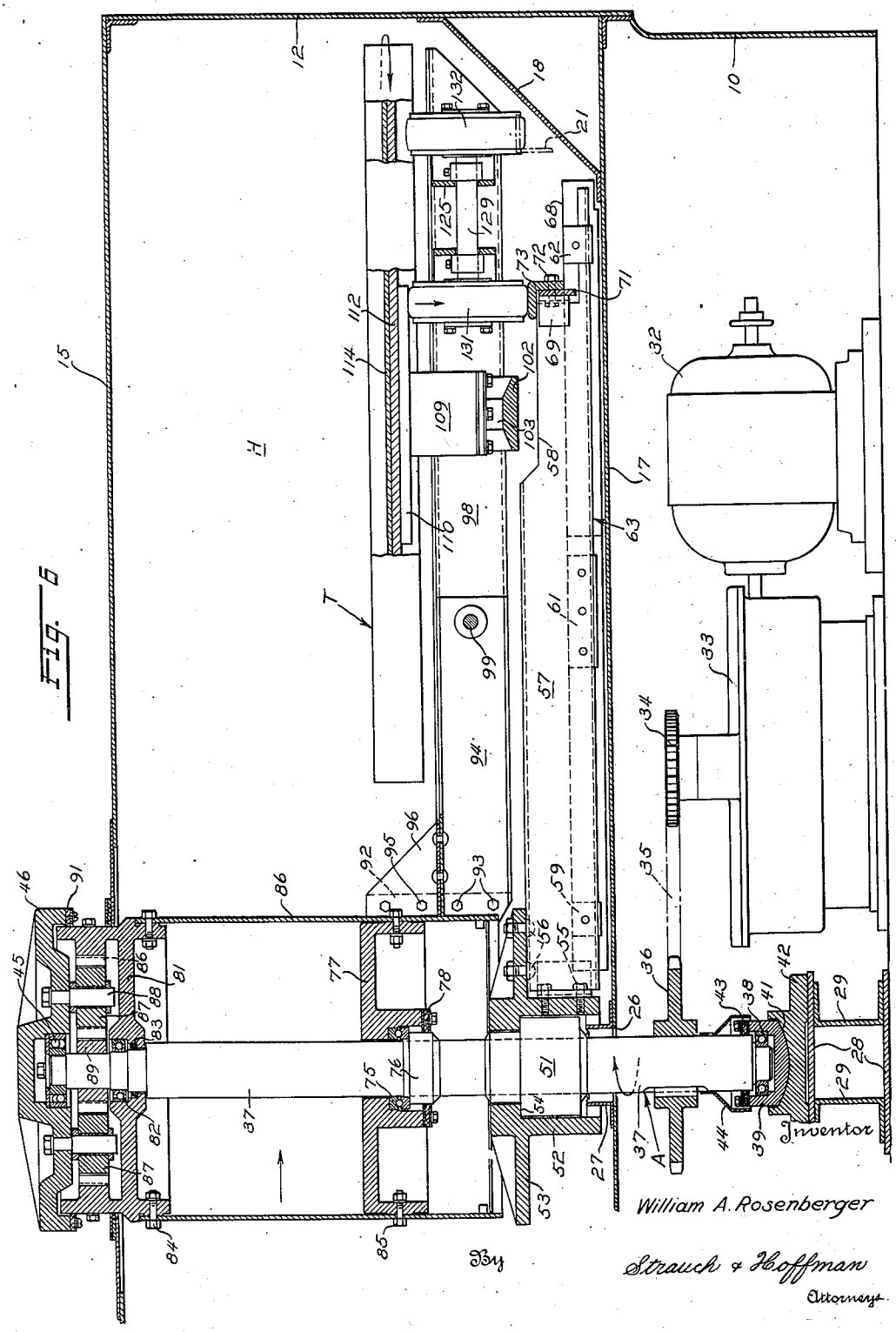


Fig. 6

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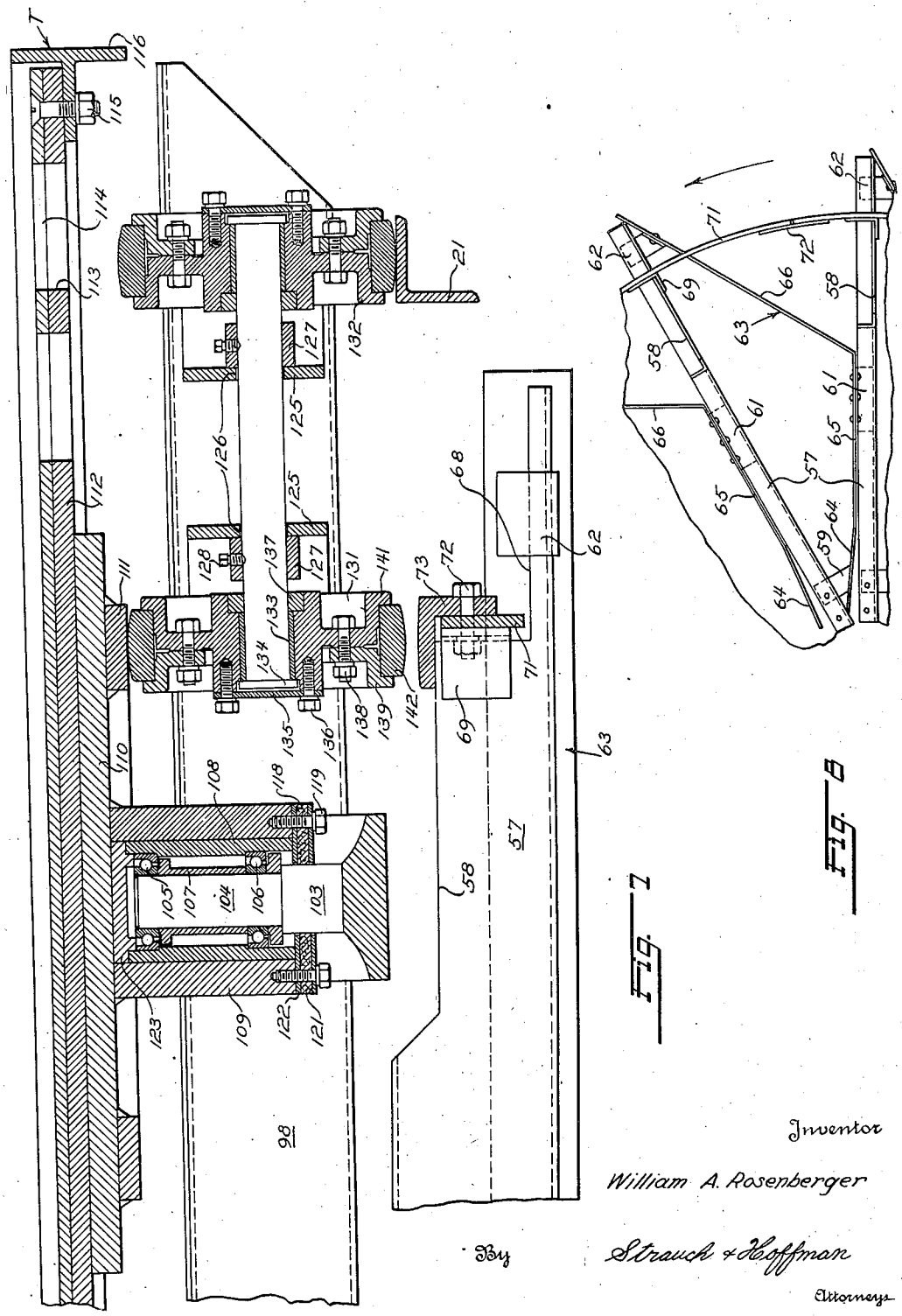


Fig. 7

Fig. 8

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Fig. 11

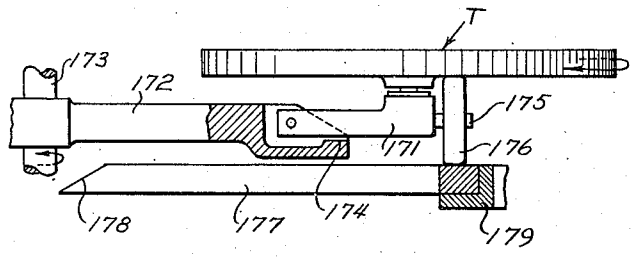


Fig. 12

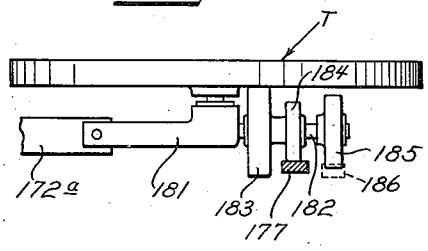


Fig. 13

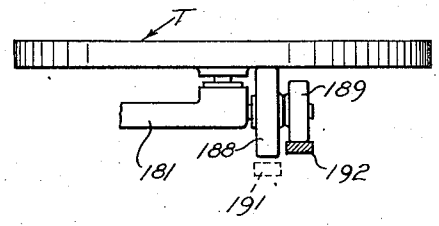


Fig. 14

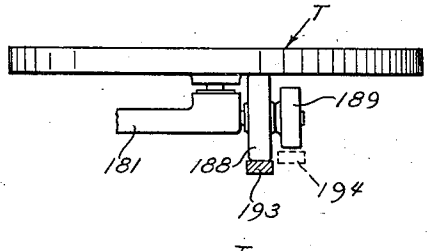
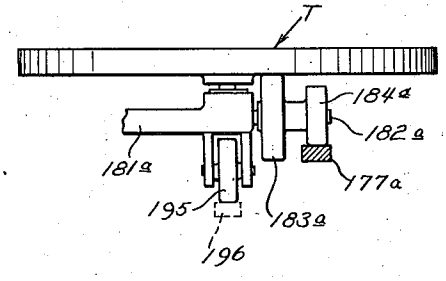


Fig. 15



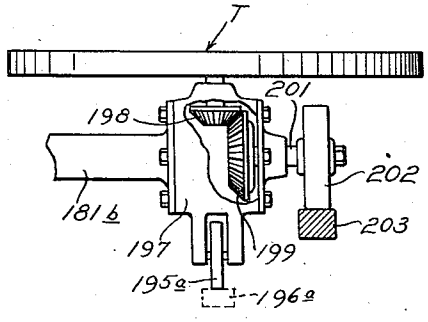


Fig. 16

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Fig. 20

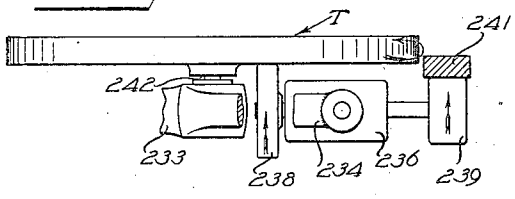


Fig. 21

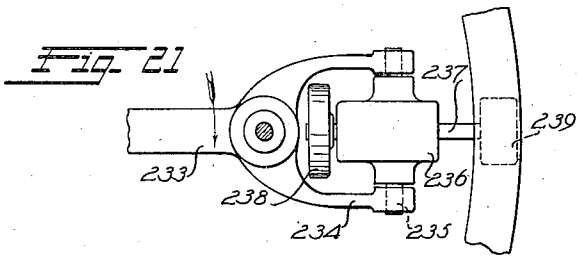


Fig. 25

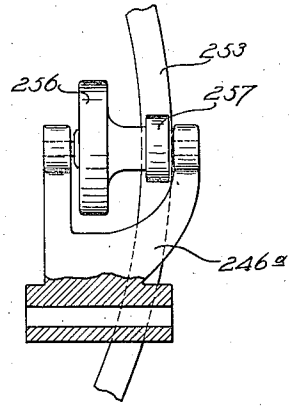


Fig. 18

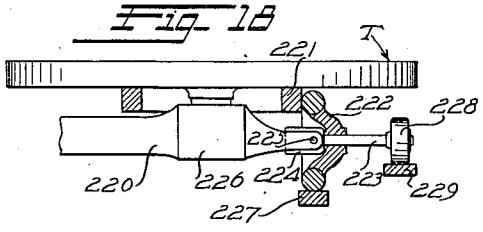


Fig. 19

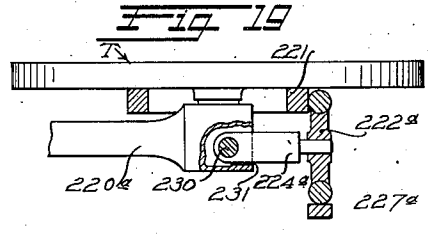


Fig. 22

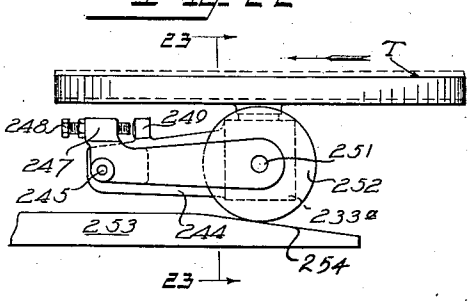


Fig. 24

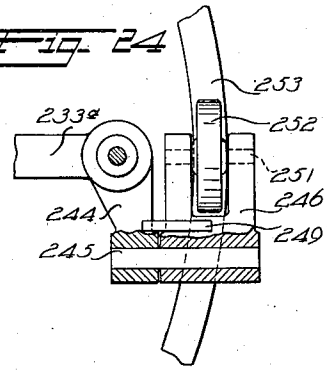
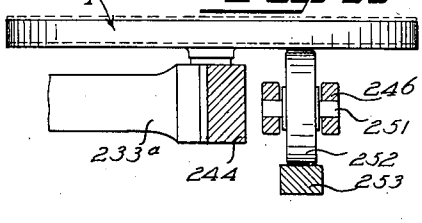


Fig. 23



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Patented Mar. 17, 1942 2,276,345

UNITED STATES PATENT OFFICE

2,276,345

ABRADING APPARATUS

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Application May 13, 1938, Serial No. 207,801

26 Claims. (Cl. 51—9)

The present invention relates to abrading apparatus and more particularly to apparatus for subjecting irregular shaped articles such as castings and the like to the action of one or more streams of abrasive propelled at sufficiently high velocity to remove scale, foundry sand and other extraneous material from the castings or other articles.

Machines of this general character are shown in the prior art. In certain forms of apparatus the work is placed on a large table which rotates at low speed and successively brings the articles under an abrasive propelling wheel. In others the work is placed upon small tables which are successively carried into a blast chamber where they are rotated about vertical axes and the articles are simultaneously cleaned by air blast abrasive nozzles. These machines of the prior art have not proved altogether successful because they fail to clean the sides as well as the upper surfaces of the work, which makes it necessary to turn the work over several times after it has been passed through the machine in order to subject all the sides thereof to the action of the abrasive streams. As this involves passing the work through the machine a number of times in order to achieve complete cleaning, it consumes time, increases cleaning costs and greatly curtails the quantity of work that may be turned out by the machine.

It is accordingly the major object of this invention to provide a novel abrading apparatus embodying a plurality of tables having means for rotating them in a blasting zone and which will efficiently clean all sides of the articles except the bottom surfaces, thereby effecting automatic cleaning of the articles with but a single turnover during the abrading operation.

A further important object is to provide a rotatable table abrading apparatus with novel table rotating mechanisms which will efficiently rotate the tables in the blasting zone and allow the tables to come to rest outside the blasting zone, and which are simple and rugged in design.

A further defect inherent in the machines of the prior art resides in the failure of their abrasive reclaiming systems to efficiently handle the spent abrasive, with the result that a sufficient quantity of spent abrasive and material removed from the articles frequently collects on the floor of the machine to subject the driving parts to high stresses and in some instances stall the machine or damage the parts.

It is accordingly a further object to devise a rotatable table abrading apparatus embodying novel means for rapidly and efficiently collecting the spent abrasive and returning it to a reclaiming system for re-use in the apparatus.

Another object is to provide rotatable table abrading machines with a novel abrasive reclaiming mechanism which embodies a scraper device driven at a greater speed than the table structure for promptly conveying the spent abrasive from the floor of the apparatus, thereby preventing a layer of abrasive of any considerable thickness from building up on the floor.

A still further object is to generally improve and refine certain other features of table machines and which will become apparent as the specification proceeds in connection with the annexed drawings, and from the appended claims.

In the drawings:

Figure 1 is a front elevational view of an abrading apparatus embodying the invention and parts have been broken away to more clearly show certain features of the construction.

Figure 2 is a top plan view of the apparatus illustrated in Figure 1 with the abrasive cleaning device removed.

Figure 3 is a side elevational view of the machine shown in Figures 1 and 2 as it appears when viewed from the right-hand side of Figure 1, and a portion of the housing has been broken away in order to illustrate the manner in which the abrasive streams are directed against the work.

Figure 4 is a vertical sectional view through the housing of the machine shown in Figures 1 to 3, inclusive, and is taken along line 4—4 of Figure 2, but the table mechanism removed therefrom in order to simplify the disclosure.

Figure 5 is a fragmental vertical sectional view of the housing shown in Figure 4, and is taken on the line 5—5 of that figure.

Figure 6 is a fragmental vertical sectional view centrally through the apparatus of Figures 1 to 3, inclusive, and is taken substantially along the line 6—6 of Figure 2; and in the position shown, the driving wheel is engaged with the active track.

Figure 7 is a vertical fragmental sectional view through the outer end of one of the table supporting arms and illustrates the table driving mechanism, the parts in the position shown cooperating with the stationary track to disengage the driving wheel from the driving track.

Figure 8 is a fragmental top plan view illustrating a position of the scraper and driving track supporting assembly, the track being omitted in this figure to more clearly show other details.

Figure 9 is a top plan view with parts in section of the structure for supporting the tables and it also illustrates the manner in which the radiating arms are pivotally connected to the rotating structure.

Figure 10 is a diagrammatic elevational view illustrating the manner in which the abrasive throwing wheels discharge the abrasive against the work, and illustrates the parts as they appear when viewed substantially along the line 10—10 of Figure 2, and when one table is midway between the two wheels.

Figure 11 is a somewhat diagrammatic view illustrating a modified form of table supporting and driving mechanism.

Figure 12 is a view somewhat similar to Figure 11 but shows a further modification of the invention.

Figure 13 illustrates a still further modified form of table and driving mechanism.

Figure 14 illustrates the table driving mechanism of Figure 13 cooperating with a different form of track assembly.

Figure 15 is a view illustrating a table driving mechanism similar to Figure 12, but it embodies a modified form of supporting roller assembly.

Figure 16 is a view showing a geared form of driving mechanism also forming part of the invention.

Figure 17 is a top plan diagrammatic view of a modified form of apparatus embodying two blasting stations.

Figure 18 is a diagrammatic view showing a modified form of table driving mechanism of the invention.

Figure 19 is a similar view showing a further modification.

Figure 20 is a diagrammatic view showing a transversely swinging roller mount for driving the tables.

Figure 21 is a top plan view of the structure of Figure 20, with parts in section.

Figure 22 is a view of a parallel swinging roller mount for the table drive.

Figure 23 is a sectional view taken on line 23—23 of Figure 22.

Figure 24 is a top plan view, with parts in section of the structure shown in Figures 22 and 23.

Figure 25 is a view similar to Figure 24 but shows a further modification of the invention.

With continued reference to the drawings, wherein like reference characters have been employed to designate like parts throughout the several views thereof, and with particular reference to Figures 1 to 3, inclusive, the apparatus embodies a housing H in which a plurality of tables T travel in a circular path. Tables T are rotated in the blasting station and the blasting operation is carried out by means of a pair of centrifugal blast wheels A and B. After the abrasive is spent it is carried to the bottom or "boot" of an elevator structure E of any desired construction, and it is elevated and discharged into an abrasive cleaning apparatus C mounted on top of the machine, and which may be of any suitable form so long as it efficiently removes nails, metallic fragments and other debris from the spent abrasive, and also removes the dust and the foundry sand before the abrasive is fed back into the wheels.

The lower portion of abrasive cleaner C is provided with a pair of storage hoppers which terminate in abrasive control valves D and which in turn supply the cleaned abrasive to the abrasive throwing wheels.

Housing construction

Referring more particularly to Figures 4 and 5, housing H is provided with a plurality of legs 10 which may rest upon the floor or be bolted thereto. The housing is provided with a low level front portion 11 which is preferably at a convenient level to allow a worker to place articles upon and remove them from the tables as they successively reach the loading and unloading station in front of the machine. The housing is provided with a cylindrical wall 12 and in top plan view the machine is of circular form. Preferably a pair of openings 13 are located in the rear wall in order to allow easy access to the blasting zone and if desired inspection of the mechanism while the blasting operation is actually being carried out. Openings 13 are provided with removable doors 14. The housing is provided with a roof 15 in which a pair of openings are provided through which the abrasive propelling wheels discharge the abrasive upon the work as it is successfully carried past them on the rotating tables, to be hereinafter described.

A flat horizontal floor 17 is provided in the housing and it is reinforced by various members not shown and is secured at its outer edge to wall 12. Supported at the outer periphery of the floor is a sloping wall 18 which is secured to wall 12 and operates to convey abrasive gravitating from the periphery of the tables inwardly onto floor 17. Rigidly secured to wall 18, by means of a plurality of brackets 19, is a circular track 21 having inclined ends 22. This track extends from a point within the blasting chamber around through front portion 11 of the housing and back into the cabinet and it operates to lift the driving mechanism of the tables clear from the driving track when the tables leave the blasting zone in order to allow them to come to rest outside the machine in a manner to be hereinafter pointed out.

Extending entirely across the floor 17, rearwardly of the axis of the mechanism, is a trough 23 for receiving the spent abrasive which accumulates on the floor, and it is propelled into the trough by a scraper or propelling mechanism to be hereinafter described. A screw conveyor 24 is located in trough 23 and is driven in any suitable manner and it conveys the abrasive accumulated in trough 23 to the boot of elevator E, by which it is carried to the cleaning mechanism as previously described.

Floor 17 is provided with a central aperture 26, and secured to the floor and aligned with aperture 26 is a flanged collar 27, which prevents abrasive from working through opening 26 from the floor. The main shaft of the apparatus projects through opening 26 and rests upon a rugged supporting structure made up of a plain pair of plates 28 and a pair of channels 29, the parts being rigidly riveted together and secured to a pair of cross members 31.

Scraper and drive mechanism

Mounted in housing H below the floor is a motor 32 (Figure 6) connected to a gear box 33 which has a driving sprocket 34. Sprocket 34 is connected by means of a sprocket chain 35 to a driven sprocket 36 keyed on a shaft 37. The lower end of shaft 37 is journaled in a bearing 38 carried by a bearing support 39 which has a spherical face 41 cooperating with a similarly shaped face

in a member 42, which is in turn supported upon plate 28. This construction permits a self-aligning action to take place, thereby avoiding severe stresses in the parts and excessive wear of bearing 38 should the parts be slightly out of alignment or should be temporarily misaligned through he loading of the tables.

A dust and abrasive seal assembly 43 is secured to member 39 and frictionally cooperating with shaft 37 to retain the lubricant in bearing 38 and to exclude abrasive and dust therefrom. Also, a depending baffle member 44 is preferably mounted on shaft 37 and encloses the seal for preventing abrasive and dust from gravitating thereto. The upper end of shaft 37 is journaled in a bearing 45 carried by a stationary cap member 46. As seen more clearly in Figure 3, cap member 46 is rigidly secured to a plate 47 and a channel 48 which extends across the top of the housing. Shaft 37 is provided with an enlarged portion 51 and provides an abutment for a hub member 52 which fits over the shaft and is provided with a flange 53. Hub member 52 is provided with a shoulder 54 which abuts enlargement 51 and the hub is keyed to the shaft by any suitable means (not shown).

Secured to hub member 52 and flange 53 thereof by a plurality of cap screws 55 and bolt and nut assemblies 56 are a plurality of channel members 57, which are each provided with a cut-away portion 58 for allowing them to clear the bearings for the tables, as will be hereinafter pointed out.

As more clearly seen in Figure 8, a plurality of angle brackets 59, 61 and 62 are rigidly secured to arms 57 and riveted thereto are scraper members 63 which are each provided with a rearwardly and outwardly inclined portion 64, which functions to prevent a concentration of accumulated abrasive adjacent the axis; a main abrasive propelling portion 65 which is substantially radial; and an outer portion 66 which inclines outwardly and forwardly with respect to the direction of rotation of the scraper assembly (shown as being counterclockwise in Figure 8) in order to gather the abrasive collecting at the periphery of the floor and propel it both forwardly and inwardly to trough 23.

It is therefore apparent that as the abrasive gravitates to floor 17 it is constantly acted upon by scrapers 63, which rapidly clear the floor of abrasive and prevent a layer of any appreciable thickness from building up thereon. Also, by reason of the forward and outward inclination of portion 66 the outer portion of the floor, which is of greater area than the portion adjacent the axis and receives more abrasive, is subjected to the action of comparatively long scraper elements and they are so inclined as to propel the abrasive inwardly as well as forwardly, thereby rapidly propelling the abrasive into trough 23.

Each arm 57 is also provided with a cut-out portion 68 at its outer end, and welded to the shoulders thus formed are a plurality of brackets 69. Also welded or otherwise suitably secured thereto is a steel band 71, which is spliced a 72 to provide a continuously smooth outer surface. Snugly fitting over band 71 and secured thereto, and to brackets 69 by bolt and nut assemblies 72 is an angular track member 73 having a rounded upper surface or other form of track for preventing spent abrasive from accumulating thereon. Track 73 will be hereinafter termed the "active" track as it drives the tables about their axes and it extends for 360 degrees at a constant level around arm structure 57 and the manner in which it cooperates with the tables will be hereinafter set forth.

Although I have shown a scraper having straight portions 64, 65 and 66 they may be replaced by a continuously curved member without departing from the spirit of the invention.

Table supporting structure

The work supporting tables are supported upon a structure carried by shaft 37 but they rotate in a direction opposite thereto.

Journaled on a thrust bearing 75, (Figure 6) which abuts a shoulder 76 formed on shaft 37, is a drum 77. If desired a dust and lubricant seal 78 may be secured to drum 77 and frictionally cooperate with shoulder 76 of shaft 37. A somewhat similar drum 81 is journaled on the upper end of shaft 37 by means of a bearing 82 and dust and lubricant seal 83 is preferably carried by the drum and engages the shaft. Drums 77 and 81 are provided with cylindrical outer surfaces and secured thereto, by means of a plurality of bolt and nut assemblies 84 and 85, is a cylindrical shell 86 which constitutes the main support for the tables.

The inner surface of drum 81 is formed as an internal gear 86 which meshes with a pair of pinions 87. Pinions 87 are journaled on studs 88 carried by support member 46 and they in turn mesh with a drive pinion 89 which is rigidly secured to the upper end of shaft 37. Preferably a seal 91 is secured to the lower edge of cap 46 and sealingly cooperates with the outer face of drum 81. Seals 83 and 91, accordingly, provide a closed lubricant chamber within drum 81 for reception of a quantity of lubricant to constantly bathe the gears and bearings. The lubricant may be introduced into the chamber by any suitable means (not shown).

It is accordingly seen that when shaft 37 is driven in a direction indicated in Figure 6 by motor 32 and the scraper mechanism will be driven in one direction and pinion 89 will drive pinions 87 and internal gear 86 in the opposite direction to rotate support 86 in the opposite direction from shaft 37. Tables T are therefore transported in one direction and the scraper assembly rotates in the opposite direction.

Secured in spaced relationship around the lower part of drum 86 are a plurality of members having outwardly extending portions 92. Secured to portions 92 by means of bolt and nut assemblies 93 are a plurality of pairs of channels 94. In Figure 6 the section is taken between two channels of a pair and it is seen that the flanges face toward each other. Also secured to portions 92 by bolts and nut assemblies 95 are gusset plates 96, which are riveted to channels 94. In the form of the invention illustrated, five pairs of channels 94 are employed and they constitute the primary supports for the tables. Pivoted to the outer end of each pair of channels 94 are a pair of channels 98. As seen in Figures 6 and 9, channels 98 are disposed with their flanges facing outwardly and they are pivoted to channels 94 by pins 99 and spacer collars 101 are disposed between channels 94 and 98 to maintain the parts in proper spaced relationship.

Bolted or otherwise rigidly secured to each pair of channels 98 is a U-shaped member 102 having a central upstanding pivot portion 103. Members 102 rigidly interconnect each pair of channels, and as more clearly seen in Figure 7, each pivot 103 is provided with a reduced portion 104 and mounted thereon are bearings 105

and 106 together with a spacer member 107. Bearings 105 and 106 are mounted within a sleeve 108 which in turn is carried by a cylindrical hub 109. Hub 109 is welded to a plate 110 which carries a circular track 111. Plate 110 is also welded to the table member proper 112, which has a plurality of perforations 113 therein for allowing abrasive to gravitate therethrough, and a similarly apertured removable table plate 114 is mounted over plate 112 and is secured thereto by bolt and nut assemblies 115. The latter also hold a rim member 116 in assembled relationship with plates 112. Plates 114 and rim 116 are both subjected to the action of the abrasive as they carry the work through the blast chamber, but they protect plates 112 and the other permanent parts below the tables against wear and may be readily replaced and removed, when they have become so worn as to be unfit for further service.

A combined seal and clamping assembly 118 is secured to hub member 109 and embodies a seal member 121 which sealingly cooperates with the outer surface of pivot 103 and it also embodies a plate 122 which forces sleeve 108 up into contact with a plate 123 carried in the hub.

The bearing assemblies are accordingly firmly retained in hub 109, but as they are merely slipped over pivots 104 they may allow the tables to move up and down a slight distance with respect to their pivots for a purpose that will presently appear.

Also rigidly secured between each pair of channels 98, in any suitable manner, are a pair of U-shaped members 125. Members 125 are provided with a pair of aligned openings 126 and a pair of collars 127 each having a set screw 128 threaded therein and are welded to members 125 with their openings in alignment with openings 126. A shaft 129 is secured in members 127 and a driving friction wheel or roller 131 is rotatably mounted on the inner end of shaft 129 and an idle wheel or roller 132 is rotatably mounted on the outer end. As these wheels are identical in construction only one of them will be described in detail. Taking wheel 131, it is rotatably mounted on shaft 129 by means of a bushing 133 and it is secured against endwise removal from the shaft by means of plate 134 which is secured to the shaft in any suitable manner and bears against the outer end of bushing 133. A cap member 135 is removably secured to wheel 131 by means of cap screws 136 and a lubricant seal 137 is provided in the other end of the hub to provide a lubricant and dust-tight chamber. Plate 135 also limits movement of wheel 131 to the right.

Secured to wheel 131 by means of bolt and nut assemblies 138 is a demountable rim 139 which cooperates with a flange 141 on the wheel to securely hold a tire 142 in place. Tire 142 may be made of rubber, fibre or any suitable material but I have found steel to be entirely satisfactory.

The tables are accordingly mounted for translatory movement into and out of the blast chamber, and they are also mounted for rotation about substantially vertical axes. Assuming that the table under consideration is in the loading zone outside of the cabinet, the parts will appear as illustrated in Figure 7, with idle roller 132 engaged with stationary track 21. In this condition of the parts, roller 132 maintains arm 98 at a level sufficiently high to prevent roller 131 from engaging active track 73, which is rotating in a direction opposite to the direction of translatory movement of the tables. Under these conditions, therefore, the tables undergo a slow translatory movement, but do not rotate about their vertical axes. Therefore, the operator may readily remove the cleaned work from the tables and replace them with fresh work. Also if desired the operator may manually turn the table to facilitate the loading and unloading operation because wheel 131 may freely rotate on shaft 129.

Assuming that the fresh work has been placed upon the table in question, it enters the blast chamber and in so doing pushes aside a plurality of depending flexible rubber flaps, 144 employed to prevent stray abrasive from rebounding out of the machine, and when it reaches a predetermined point, its wheel 132 will ride down inclined portion 22 of track 21 (Figure 4) and allow its arm 98 to descend and bring wheel 131 into driving engagement with track 73, as seen in Figure 6. As track 73 is rotating in a direction opposite to the direction of translatory movement of the table, roller 131 is rotated at appreciable speed in the direction indicated in Figure 6. As substantially the entire weight of the table is resting upon the upper peripheral surface of roller 131 the latter imparts rotation to the table in the direction indicated by the arrow in Figure 6.

The table is then translated through the blasting zone while it continuously rotates about its vertical axis and when it attains a point substantially diametrically opposite the inclined portion 22 of track 21 shown in Figure 4, roller 132 encounters a similarly inclined portion of the track and rides up on it thereby lifting arm 98 and disengaging its roller 131 from track 73, thereby allowing the table to come to rest outside the blasting chamber.

In view of the fact that the translatory speed of the tables is comparatively slow (clockwise one-third to one-ninth revolutions per minute) and it is desired to secure a comparatively high rotative speed of the tables in the blast zone for efficiently abrading the articles, (seven to two and one-third revolutions per minute), rollers 131 are placed as close to the vertical axes of the tables as is practicable in order to secure the proper speed ratio between the parts. However, in some installations, if it is desired to obtain a high table speed a separate roller of small diameter may be used to engage the active track and a separate roller rotated in unison with the first roller and of a larger diameter may be used to engage the tables so as to obtain a step-up in the speed. Also, if desired, gear or belt and pulley drives may be interposed between the roller that engages the active track and the roller that engages the table. Also, although I have shown a friction wheel for engaging the table, it is understood that the roller cooperating with the active track may be utilized to drive a shaft which is in turn geared to the table and drives it through other well known power transmitting mechanisms. Certain of these constructions will be described later.

Although I have illustrated the stationary track 21 as terminating inside of the blasting chambers so as to allow the tables to be translated without rotation some distance into the blasting chamber, it is to be understood that beveled ends 22 thereof may be located at various points on the circumference, depending upon the characteristics desired in the particular installation involved. For instance they may be located outside the cabinet so as to cause the

tables to start to rotate before they enter the blasting chamber if desired.

I have shown the tables as being carried by a plurality of pivoted arms in order that they may move up and down and allow the driving rollers to be successively engaged and disengaged from the active track, and I prefer to employ this construction as it is rugged and operates with a minimum of friction.

For work that is difficult to clean, I have found it desirable to rotate the main table supporting structure at approximately one-ninth revolutions per minute and which results in a speed of two and one-third revolutions per minute of the tables and a counterclockwise speed of one-third revolutions per minute of the scrapers and track. The scrapers accordingly rotate at three times the speed of the supporting structure.

Since the table supporting assembly and the scraper assembly are positively integeared, and since the tables are frictionally geared to the rotating track **73**, variation in the speed of one of the parts will result in a precisely proportional variation in the speed of the other parts. For instance, with work that is easy to clean, it has been found desirable to rotate the main table at approximately one-third revolutions per minute and this results in a rotation of the tables at a speed of seven revolutions per minute and a rotation of the scrapers and track assembly counterclockwise at a speed of one revolution per minute.

In each instance it is observed that the scraper assembly rotates three times faster than the table supporting structure and in the opposite direction, with the result that the abrasive is rapidly cleared from the floor and is not permitted to build up thereon to any appreciable thickness. This results in efficiently clearing the spent abrasive and in insuring that the parts will not be subjected to severe stresses or damage through abrasive accumulation.

In order to prevent the work that should fall off the tables from dropping down onto the floor **17**, a plurality of perforated plates are mounted above and are supported by channels **94** and **98** and a plurality of supporting members that will now be described. A plurality of small plates **145** are mounted (Fig. 9) on channels **94** and they are provided with cut-out portions **146** for gusset plates **96**. Abutting the outer edge of plates **45** are sector-shaped plates **147** and substantially rectangular plates **148**. The latter plates are supported on a pair of members **149** and **151** and which are in turn supported by brackets **152** which are supported on the lower flanges of channels **98**. Since the parts are not rigidly connected, the slight up and down movement of members **98** is not hindered by the various plates.

Abrasive propelling mechanism

The means employed to discharge the abrasive downwardly upon the work as it is rotated on the tables preferably assumes the form of a pair of abrasive propelling wheels, but, so far as the table and driving mechanism is concerned any desired means may be used to propel the abrasive. In the form of the invention illustrated, two wheels are preferably used and which are so related to the path of travel of the tables as to efficiently clean all surfaces of the articles except the surface upon which the article is resting. Wheels A and B may assume any desired form such, for instance, as disclosed in Keefer patents Nos. 2,108,005 and 2,108,006. They may be bladed wheels operating to discharge the abrasive solely downwardly or they may embody other means for imparting directional control to the thrown abrasive. If desired, however, the wheels may assume the form of those illustrated in Keefer patent No. 2,116,153, dated May 3, 1938. Each wheel embodies a rotor R mounted on a shaft **154** carried in a bearing **155**. A motor **156** drives each rotor through a belt drive assembly housed in a casing **157**. Abrasive is fed to each rotor through a pipe **158** which is connected to the abrasive valve D of cleaning mechanism C.

Each abrasive rotor assembly is mounted upon an auxiliary housing **159** which is supported over the openings in the roof of housing H, and as seen in Figure 3 the wheels are so supported that their axes are inclined with respect to the horizontal, so that their discharge streams **161** and **162**, which are generally fan-shaped in configuration, are disposed at an inclination to the vertical and are operable to clean the side walls as well as the top surfaces of the article of work W illustrated as being in place on table T in Figure 3.

Further cleaning of the sides of the work is effected by reason of the fact that the discharge streams **161** and **162** converge downwardly as seen in Figure 10, wherein the work has rotated 90 degrees from the position illustrated in Figure 3. As seen in that figure they clean the side walls as well as the upper surfaces of the work. The discharge streams converge downwardly because the rotors are operated in opposite directions as indicated by the arrows, and although they are shown as rotating away from each other in order to clean the exterior side walls of the articles most effectively, they may be designed to rotate towards each other if the nature of the work makes it more desirable to operate them in this manner.

The rotors accordingly each throw a discharge stream which produces a pattern of elongated configuration in top plan view at the level of the tables, and with the rotors disposed as shown in Figure 3, the major axis of each impingement pattern is substantially tangential with respect to the path of translatory movement of the tables. This has been found to be an extremely efficient relation of the parts as the articles of work are alternately carried from one side of the pattern to the other as they are rotated and translated through the blasting chamber.

Wheels A and B may be adjusted to direct their stream at greater or smaller converging angles at the tables, depending upon the nature of the work being handled by the machine.

In Figures 11 to 16, inclusive, I have illustrated modified forms of table rotating mechanisms, and the major point of difference between them and those previously described resides in the fact that a stationary "active" track is employed, so that the resulting rotation of the tables is solely due to the translatory movement thereof.

In Figure 11, I have shown table T as being journaled upon an arm **171**, the latter being pivoted to the end of an arm **172** carried by vertical rotatable shaft **173**. Shaft **173** carries other arms **171** for the other tables and is driven in a manner similar to shaft **37** and also supports the scraper mechanism (not shown). Arm **172** also embodies a stop **174** for supporting arm **171** when it is not actually supported by engagement of its roller with active-track **177**.

Arm **171** carries a shaft **175** upon which is jour-

naled a driving roller 176 disposed in driving engagement with the underside of the table. Roller 176 cooperates with an active track 177 which is supported in the housing by a plurality of brackets 179. Track 177 is provided with inclined ends 178 for causing roller 176 to be gradually picked up. Figure 11 illustrates the conditions that exist when arm 172 is translating the tables through the blasting chamber and roller 176 is riding upon track 177 and produces rotation of table T in the direction indicated in somewhat the same general manner as that described in connection with the other forms of the invention. The points of difference being that track 177 is stationary and no supporting track is used because arms 171 rest upon stops 174 when the rollers reach the end of track 177.

In view of the fact that it is necessary to translate the tables comparatively slowly in order to subject the articles to the abrasive streams for a sufficient length of time to properly clean them, the construction shown in Figure 11 may not produce sufficiently high speed of rotation of tables T for certain classes of work, and in Figure 12 I have illustrated a structure which meets this condition of operation.

In this form of the invention each table T is rotatably supported on an arm 181 which is carried by arm 172*a*. Rigidly secured to arm 181 is a shaft 182 and journaled thereon is a large roller 183 and a small roller 184, which are integrally connected, and an idle roller which is independent of the drive rollers and merely is employed to support the assembly when the drive rollers are not engaged with the active track. Roller 184 cooperates in driving frictional engagement with active track 177 and as it is of comparatively small diameter it rotates at comparatively high speed and drives roller 183, which, being of larger diameter, frictionally cooperates with table T to drive it at a faster speed than the construction shown in Figure 11. Roller 185 cooperates with a stationary track 186 indicated in phantom lines and is supported at the level indicated so that when the tables are successively brought into the loading and unloading station, rollers 185 will ride up on track 186, lift arm 181 and thereby disengage driving roller 184 from track 177 and cause the tables to come to rest.

When two stationary tracks are employed to cooperate with the driving and supporting mechanism of the tables, the supporting roller may operate to lift the driving rollers from engagement with the driving track in the loading zone or conversely, the tracks may be located at such levels that the driving roller cooperates with it and acts to lift the idle roller away from its supporting track in the blasting zone. These two constructions are illustrated in Figures 13 and 14.

In Figure 13, table T is supported by pivoted arm 181 as in Figure 12, and it carries a drive roller 188 and an idle roller 189 which cooperate respectively with an active track 191 and an inactive or supporting track 192. With this construction, active track 191 may extend all the way around the apparatus or may terminate adjacent the ends of track 192 as the latter positively lifts the driving roller out of engagement with its track 191 when the loading zone is reached.

In Figure 14, I have illustrated the structure of Figure 13 as being associated with a different track construction comprising an active track 193 and an inactive supporting track 194. In this form of the invention the tracks are arranged at such levels that upon engagement of drive roller 188 with the active track in the blasting zone, arm 181 is lifted up so as to disengage idle roller 189 from track 194. In this form of the invention track 194 may be disposed for 360 degrees of the device if desired because track 193 is at a higher effective level.

In connection with the forms of invention illustrated in Figures 12, 13, 14 and 15, it is to be distinctly understood that, if desired, the tracks may be disposed at the same effective height. In other words, the active track and the inactive track may be disposed at such a level that when the transition from the driving roller to the idle roller is made the table carrying arms will neither tip up nor down and this effected by merely overlapping the ends of the two tracks so that the idle roller will be in supporting relationship to its track for a slight distance beyond the point at which the driving roller comes into contact with its track.

In Figure 15 I have illustrated a construction wherein table T is supported upon an arm 181*a* as previously disclosed and a double drive roller assembly 183*a* and 184*a* are mounted on a shaft 182*a* carried by arm 181*a*, as in Figure 12. In this form of the invention, however, I have shown an idle roller 195 mounted for rotation in a pair of arms carried by arm 181*a*, and cooperating with a supporting track 196. The latter is shown in phantom lines, as drive roller 184 is being driven by engagement with its track 177*a* in the blasting chamber. In this form of the invention I have also illustrated tracks being disposed at the same effective level so that when the end of track 177*a* is reached, track 196 will come into play and cooperate with supporting roller 195, and by reason of this construction arm 181*a* does not tilt appreciably up or down throughout 360 degrees of operation of the apparatus.

In Figure 16 I have illustrated a construction somewhat similar to that shown in Figure 15, table T being rotatably journaled upon a pivoted arm 181*b*, which carries at its end a hollow gear casing 197. Table T is connected to a shaft that carries a gear pinion 198 at its lower end and which meshes with a bevel gear 199 rigidly secured to a shaft 201. Shaft 201 rigidly carries a drive roller 202 which cooperates with an active track 203. A supporting roller 195*a* cooperates with a supporting track 196*a* and rollers 195*a* and 202 are alternately engaged and disengaged with their tracks 196*a* and 203 in the manner described in connection with Figure 15. In this form of the invention, however, it is unnecessary to employ a double drive roller assembly as gear 199 is larger than gear 198 and provides the necessary step-up in speed of the table.

It is to be understood that various features of the several embodiments of the invention may be combined in different relationships with each other if desired. For instance, the independent supporting wheel mount shown in Figures 15 and 16 may be incorporated in all of the forms of the invention. Likewise the arm 172 having the stop 174 shown in Figure 11 may be used in all forms of the invention to obviate the need for a supporting wheel assembly. Also certain forms of the invention illustrated in Figures 11 to 16, inclusive, embodying a stationary active track, may be also incorporated in the form of the invention illustrated in Figures 1 to 10, and which embodies a movable active track.

Although I have shown a machine embodying but a single blasting station, it is to be understood that two or more blasting stations may be located in the same housing or they may be separated by a "turnover" station. In Figure 17 I have diagrammatically shown a machine of the latter form. In this figure I have shown two blasting chambers **204** and **205** spaced apart along the path of translatory movement of the tables T of the form of table mechanism shown in Figure 14. The parts are so designed that track **194***a* supports the tables in a loading and unloading station **206** so they do not rotate about their axes and work may be readily placed thereon. When shaft **173** has been rotated sufficiently to carry the loaded table into the blast chamber **204**, roller **188** engages active track **193***a* and causes the table to rotate about its axis as it travels through the chamber and is acted upon by the abrasive stream or streams.

When the tables pass out of chamber **204** and the articles are clean on their upper surfaces and sides, roller **188** rolls down out of contact with track **193***a* and supporting wheel **189** comes into contact with a second track **194***b*. The tables are accordingly translated without rotation in a "turnover" station **207** so that an operator may turn the work over before it enters blasting chamber **205** for a second cleaning operation. As the tables enter housing **205** their driving rollers **188** engage a second active track **193***b* and are rotated in the blast streams in the blasting chamber.

When the tables come out of chamber **205** their rollers **189** engage track **194***a* and are accordingly translated without rotation in station **206**, and the operator may remove the cleaned work and place fresh work on the tables. This apparatus therefore effects complete cleaning of the work with but one pass through the machine and is well suited to high quantity production and all of the previously described forms of the invention may be embodied in multi-station machines.

For simplifying the disclosure, the abrasive propelling mechanism has not been shown in Figure 17, but each chamber **204** and **205** is preferably provided with one or more wheels arranged as shown in Figures 1, 2 and 3, so as to blast the sides as well as the top surfaces of the work as it passes through the blasting chambers.

The mechanism may assume various forms in which the supporting arms for the tables are rigidly secured to the supporting structure and in Figures 18 to 25, inclusive, I have illustrated certain forms of mechanism of this character.

In Figure 18 tables T are journaled in a plurality of arms **220** which are rigidly carried by a vertical rotatable shaft or the like, (not shown). A track member **221** is secured to the underside of table T and frictionally cooperates with a wheel or roller **222** which is mounted on a shaft **223**. Shaft **223** is journaled in a bearing assembly **224** which is mounted in trunnions **225** carried by a pair of arms **226** of arm **220**. Wheel **222** is constantly engaged by an active track **227** and an idle roller **228** is rotatably mounted on shaft **223** and is operative to engage a track **229** of limited length and tilt shaft **223** and force roller **222** into frictional engagement with track **221** in the blasting chamber as shown in Figure 18.

If desired, however, shaft **223** may be spring urged in a counter-clockwise direction, so as to tend to constantly engage roller **222** with table track **221** and track **229** may be located above idle roller **228** in the loading zone to disengage roller **222** from track **221**.

The construction shown in Figure 19 is somewhat similar to that of Figure 18 except that wheel **222***a* is mounted in a bearing assembly **224***a* which is mounted in offset trunnions **230** carried by arm **220***a*, and track **227***a* is of limited length so that when the table is located in the loading zone a stop **231** supports assembly **224***a*, whereas in the blasting chamber wheel **222***a* engages track **227***a* and is rocked into engagement with track **221**.

In Figures 20 and 21 each table T is journaled in an arm **233** which is rigidly carried by vertical rotatable shaft (not shown) and is adapted to be carried in a horizontal path through the blasting chamber. Member **233** carries a pair of arms **234** which rockably support the trunnions **235** of a bearing assembly **236**, and journaled in the latter is a shaft **237** to which are rigidly secured a pair of driving rollers **238** and **239**. Roller **238** cooperates with the underside of table T and roller **239** cooperates with a track **241** of limited length, located in the blasting chamber.

Tables T may undergo vertical movement with respect to arms **233** and when they are being translated through the loading zone the hubs of the tables rest upon the upper surface of the arms **233**. When they enter the blasting chamber wheels **239** engage the underside of track **241** and cause shaft **237** to rock clockwise a slight amount into the position shown in Figure 20. This action causes wheel **238** to frictionally engage the underside of table T and lift the latter thereby developing a clearance **242** as shown in Figure 20. Therefore, when the tables are in the blasting zone the entire weight of the table is carried by roller **238**, and roller **239** engages track **241** with a substantial equal pressure, thereby establishing an efficient driving pressure between the parts.

As roller **238** is of greater diameter than roller **241**, table T will be driven at considerable speed. This construction presents the further advantage that roller **239** engages the lower side of track **241** and therefore no abrasive can become wedged between the parts.

In Figures 22, 23 and 24 there is illustrated a construction having certain features in common with that of Figures 20 and 21 as tables T are mounted for rotation on, and are capable of slight vertical movement with respect to arm **233***a*. The latter is provided with a lateral extension **244** carrying a shaft **245** on which is journaled a bifurcated lever **246**. Lever **246** carries a lug **247** in which a set screw **248** is threaded and the latter cooperates with an abutment **249** carried by arm **244**. Screw **248** supports lever **246** in the loading zone and many be adjusted to properly locate the parts. Journaled on a shaft **251** carried by lever **246** is a roller **252**, which frictionally cooperates with the underside of the table and an "active" track **253**. As shown in Figures 22, 23 and 24 roller **252** is riding up inclined portion **254** of track **253** and the table shown is accordingly in the blasting chamber. When the upper part of the track is attained, roller **252** will engage the underside of table T and lift the latter a slight amount, so that the entire weight of the table will be carried by the roll and good driving pressure will be secured. Track **253** is substantially co-extensive with the blasting chamber and tables T will be rotated while they travel through it and when the end of the track is reached roller **252** will

roll down out of contact with the table so as to allow the table to come to rest in the loading zone and throughout the travel of the tables through the loading zone levers 246 are supported by lug 249 and screw 248.

If it is desired to secure a greater rotative speed of the tables for a predetermined translation speed, the parts may be constructed as shown in Figure 25, wherein lever 246a is enlarged to provide for journaling two rollers 256 and 257 which are rigidly joined to each other. Roller 256 frictionally cooperates with the underside of table T and roller 257 cooperates with track 253. This form of the invention functions in the same manner as that just described with the exception that rollers 256 and 257 rotate the tables at a higher speed for any given translatory speed of arms 233a.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. In an abrading apparatus, means providing a blasting chamber; means for propelling at least one stream of abrasive downwardly in said blasting chamber; a plurality of upwardly facing table-like work supports; a conveyor mechanism for transporting said supports in a fixed substantially horizontal path in sequence through said blasting chamber for subjecting articles thereon to the action of said stream of abrasive; means mounting said supports for rotation about substantially vertical axes; power transmitting means including a wheel having a substantially horizontal axis carried by said conveyor mechanism for transmitting rotative efforts to said supports; a track assembly disposed parallel to the path of translatory movement of said supports through said blasting chamber and adapted to engage and drive said wheel as said work supports pass through said blasting chamber, to effect rotation thereof about their axes; a second wheel having a substantially horizontal axis on said conveyor mechanism; and a second track assembly for engaging said second wheel and disengaging said power transmitting mechanism from said first track assembly for causing said work supports to cease to rotate when they pass out of said blasting chamber for permitting articles to be removed and replaced.

2. The abrading apparatus defined in claim 1, wherein said first-mentioned track assembly extends the full length of said fixed path of travel of said supports and is provided with means for cooperating in frictional driving engagement with parts of said power transmitting mechanism.

3. The abrading apparatus defined in claim 1, wherein said first-named track assembly extends parallel to the fixed path of travel of said supports throughout the full length thereof and is provided with means for driving it in a direction opposite to the translatory movement of said supports through said blasting chamber.

4. In an abrading apparatus, means providing a blasting chamber; means for propelling at least one stream of abrasive downwardly in said blasting chamber; an upright member mounted for rotation about a substantially vertical axis; a plurality of radiating arms pivoted to said member for limited rocking movement about substantially horizontal axes; a work support journaled on each of said arms for rotation about a substantially vertical axis and having an upwardly facing article supporting surface, said arms being operable to successively carry said supports through said blasting chamber when said upright member is rotated; and a track assembly for supporting said arms throughout 360 degrees of rotation of said upright member; and driving and supporting mechanism mounted on each of said arms and cooperating with said track assembly for automatically causing said supports to rotate as they pass through said blasting chamber and subject said articles to the action of said stream of abrasive, and for allowing said supports to come to rest outside of said blasting chamber for facilitating removal and replacement of articles thereon.

5. The abrading apparatus defined in claim 4, wherein said driving and supporting mechanism embodies a friction driving wheel cooperating with said track assembly and frictionally engaging the underside of said support for rotating the latter as it passes through said blasting chamber.

6. The abrading apparatus defined in claim 4, wherein said track assembly comprises an active track for causing said driving and supporting mechanism to rotate said supports as they pass through said blasting chamber, and a supporting track cooperating with said driving and supporting mechanism for causing said arms to lift said driving and supporting mechanism clear of said active track when said supports have passed out of said blasting chamber, to allow them to come to rest.

7. The abrading apparatus defined in claim 4, wherein said track assembly comprises a primary track mounted for movement in a direction opposite to the direction of translatory movement of said supports through said blast zone and a stationarily supported secondary track cooperating with said arms outside of said blasting chamber for lifting said driving and supporting mechanism clear of said primary track to allow said supports to come to rest outside said blasting chamber.

8. In an abrading apparatus, mechanism for conveying articles into and out of an abrading zone, comprising a structure rotatable about a substantially vertical axis; a plurality of arms radiating from said structure and having carriers adjacent the outer ends; means mounting said carriers for vertical movement with respect to said structure; a work support journaled in each carrier and operable to rotate about a substantially vertical axis thereon; a stationarily supported track of limited effective length; a supporting wheel mounted for rotation about a substantially horizontal axis in each of said carriers and operable to ride upon said supporting track without rotating said supports while said structure is rotating through a predetermined arc; a driving track of limited effective length; and a driving wheel journaled in each of said carriers and operable to ride upon said driving track and support said carriers and also transmit rotative efforts to said supports while said supporting structure is rotated through another predetermined arc.

9. The apparatus defined in claim 8, wherein said tracks are located at such levels and said

wheels are of such diameter as to cause said driving wheels to successively lift said carriers when they engage said driving track.

10. The apparatus defined in claim 8, wherein said tracks are located at such levels and said wheels are of such a diameter as to cause said supporting wheels to successively lift said carriers when they engage said supporting track, for disengaging said driving wheels for said driving track.

11. In an abrading apparatus, a generally upright cylindrical housing having a substantially horizontal floor; a trough provided in said floor and having means for conveying abrasive away therefrom; an article carrying mechanism disposed in said housing and movable in a horizontal circuitous path above said floor; means for propelling abrasive against said articles, said abrasive being deposited upon said floor after it has spent its energy against said work; a scraper mechanism for sweeping the abrasive accumulated upon said floor into said trough comprising a blade member mounted for rotation about a vertical axis with its lower edge in close proximity to said floor; and power operated means for simultaneously rotating said article carrying mechanism and said blade member, said power operated means rotating said blade member at a greater speed than said article carrying mechanism.

12. The abrading apparatus defined in claim 11, wherein said power operated means is operable to rotate said article carrying means and said blade member in opposite directions.

13. In an abrading apparatus, a generally upright cylindrical housing having a horizontal floor; a trough provided in said floor and having means for conveying abrasive away therefrom; a work carrying mechanism mounted in said housing and operable to carry articles in a substantially horizontal path above said floor; means for propelling abrasive downwardly upon said articles of work, the abrasive gravitating to said floor after it has been spent against said work; a peripheral conical wall extending upwardly from a region spaced inwardly from the outer edge of said floor to a region outwardly of the path of movement of said articles, for receiving abrasive gravitating from said work and conveying it to said floor at a point inwardly of the periphery of said floor, and a rotatable scraper mechanism having blades of substantially smaller radius than the radius of said horizontal floor disposed in said housing inwardly of the inner periphery of said conical wall and operable to propel the abrasive accumulated on said floor to said trough.

14. In an abrading apparatus, an upright shaft mounted for rotation in a generally cylindrical housing having a horizontal floor; means for rotating said shaft in one direction, a plurality of arms connected to the lower end of said shaft, a hollow structure telescoped over the upper end of said shaft and journaled for rotation with respect thereto; a power transmitting mechanism drivingly connected to said shaft and said hollow structure for causing the latter to rotate in a direction opposite to said shaft; a plurality of work supports carried by said hollow structure, said supports being rotatable about substantially vertical axes; and means mounted on said arms for causing said work supports to rotate about their vertical axes when said shaft is rotated.

15. The apparatus defined in claim 14, together with a scraper assembly carried by said arms and cooperating with said floor.

16. In an abrading apparatus, an upright shaft mounted for rotation in a generally cylindrical housing having a horizontal floor; a cap member in which the upper end of said shaft is journaled; means for rotating said shaft in one direction; a plurality of arms connected to the lower end of said shaft; a scraper mechanism carried by said arms; a hollow structure telescoped over the upper end of said shaft and journaled for rotation with respect thereto comprising a drum member, said drum member having an upwardly facing lubricant chamber therein and having an internal gear provided on the inner wall thereof; a drive pinion mounted on the upper end of said shaft and at least one gear carried by said cap member and intermeshing with said drive pinion and said internal gear member; for causing rotation of said shaft in one direction to produce rotation of said hollow structure in the opposite direction, said hollow structure having a plurality of work supporting table-like members mounted thereon for movement over said floor.

17. The apparatus defined in claim 16, wherein said cap member is telescopingly related to said drum and is provided with means for preventing lubricant from escaping therebetween, to provide a hollow lubricant housing for continually bathing said gears with lubricant.

18. In an abrading apparatus, a conveyor mechanism mounted for travelling movement in a substantially horizontal path into and out of a blasting zone; a plurality of tables carried by said conveyor mechanism and mounted for rotation about substantially vertical axes thereon; a member pivoted on said conveyor mechanism adjacent each of said tables; a roller mounted for rotation on each of said members and adapted to frictionally cooperate with said tables; means for automatically rocking said members so as to engage said rollers with tables and for rotating said rollers when said tables are traversing said blasting zone, and for automatically allowing said rollers to be disengaged from said tables when the latter are travelling outside of said blasting zone.

19. The apparatus defined in claim 18, wherein said member is pivoted on said conveyor mechanism for rocking movement in a vertical plane disposed substantially parallel to the path of translatory movement of said tables.

20. The apparatus defined in claim 18, wherein said member is pivoted on said mechanism for rocking movement in a vertical plane disposed transverse to the path of translatory movement of said tables.

21. In an abrading apparatus, a plurality of tables mounted for movement in a substantially horizontal circuitous path from a loading station to a blasting station, said tables each being rotatable about a substantially vertical axis, means for supporting and rotating said tables about their axes when they are travelling through said blasting station, and a second means in addition to said first means for supporting said tables without rotating them when they are travelling through said loading station.

22. In an abrading apparatus, a conveyor mechanism mounted for travelling movement in a substantially horizontal circuitous path into and out of a blasting zone; a plurality of tables carried by said conveyor mechanism and mounted for rotation about substantially vertical axes,

said tables being adapted for limited up and down movement; supporting means for carrying the weight of said tables and maintaining them at a predetermined level when they are travelling over one portion of said path; and driving means for supporting said tables and affecting rotation thereof about their axes when they are travelling over another portion of their path.

23. In an abrading apparatus, a generally upright cylindrical housing having a substantially horizontal floor; abrasive removing means; an article carrying mechanism disposed in said housing and movable in a horizontal circuitous path above said floor; means for propelling abrasive against said articles, said abrasive being deposited upon said floor after it has spent its energy against said work; a scraper mechanism for sweeping the abrasive accumulated upon said floor to said abrasive removing means comprising a blade member mounted for rotation about a vertical axis with its lower edge in close proximity to said floor; means for rotating said article carrying mechanism; and means for rotating said blade member at a different speed than that of said article carrying mechanism.

24. The abrading apparatus defined in claim 23 wherein said article carrying means and said blade member rotate in opposite directions.

25. In an abrading apparatus, means to project abrasive at abrading velocity, and means to convey work through said projected abrasive comprising a substantially vertical shaft, an annulus supported on said shaft, a second annulus supported on said shaft and vertically spaced from said first annulus, a cylindrical shell supported by said annuli, and work supporting means supported by and extending radially from the bottom of the cylinder thus formed.

26. In an abrading apparatus, means to project abrasive at abrading velocity, means to convey work through said projected abrasive comprising a substantially vertical shaft, an annulus supported on said shaft, a second annulus supported on said shaft and vertically spaced from said first annulus, said annuli being connected at their outer peripheries for mutual support, and work supporting means supported by and extending radially from the bottom of the assembly thus formed.

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