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ABRADING APPARATUS

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This invention relates to apparatus for abrasive treatment of metal articles, and more particularly to apparatus for cleaning and treating castings, forgings and similar metal articles capable of being rolled on a supporting surface or surfaces.

According to this invention, the metal article to be cleaned or treated is given a rolling or spinning movement, and is simultaneously advanced in a lineal direction through a stream of abrasive particles. The abrasive particles are projected with suitable velocity and in a suitable direction, preferably by a centrifugal abrasive projecting machine or wheel, to subject desired portions of the surface of each article to be treated to the abrasive effect of the stream of particles. The abrasive particles in the stream may be projected at various angles by the wheel, so that, as the articles are moved through the abrasive stream, any desired, or all, portions of the surface of the articles, including exterior and interior surfaces and the surfaces of projections and depressions, are struck by the abrasive particles.

In a preferred embodiment of the invention, the articles to be treated are supported on a suitable conveyor comprising a plurality of substantially parallel rolls, each of which has a helical abutment adapted to bear against the peripheral portion or portions of the article. Driving means is provided for rotating the rolls, whereby the articles supported upon the rolls are given a rotary movement, and, simultaneously, are advanced in a lineal direction along on the rolls. An abrasive projector, preferably of the rotary centrifugal type, is mounted in position to project a stream of abrasive particles against the rotating articles to treat predetermined portions of the surfaces of the articles. Two rolls are generally sufficient to properly rotate and linearly advance most rollable articles, but if the article is not sufficiently symmetrical to remain upright on the rolls, a sufficient number of rolls is provided to engage the article at three or more spaced portions of the periphery to maintain it in a suitable position to be moved in the direction of its axis of rotation.

The invention also provides a suitable mechanism whereby the articles to be treated can be automatically supplied to and placed in engagement with the conveyor in the proper position and at the proper time for initiating rotation and forward movement of the articles. Mechanism is also provided for removing the articles from the conveyor when they reach the discharge end of a conveyor.

Various other features and advantages of the invention will be apparent in the following particular description and from an inspection of the accompanying drawings.

In the accompanying drawings there is shown, for the purpose of illustration, apparatus suitable for carrying out the process according to the present invention, in which:

Fig. 1 is a view showing a vertical, longitudinal section through one form of the apparatus;

Fig. 2 is a front elevational view of the apparatus;

Fig. 3 is a rear elevational view of the apparatus;

Fig. 4 is a view showing a horizontal section taken along line 4—4 of Fig. 1;

Fig. 5 is a fragmentary view showing a transverse vertical section taken along line 5—5 of Fig. 1;

Fig. 6 is a fragmentary view showing a section taken along line 6—6 of Fig. 5;

Fig. 7 is a longitudinal cross-sectional view taken through another form of apparatus;

Fig. 8 is a transverse sectional view taken along line 8—8 of Fig. 10;

Fig. 9 is a rear elevational view;

Fig. 10 is a horizontal sectional view taken along the line 10—10 of Fig. 7;

Fig. 11 is a fragmentary view showing a modified form of roll having two different articles thereon for illustrating the operation of this type of roll;

Fig. 12 is a diagrammatic side elevational view illustrating the progress of an article through the abrasive stream and the manner in which the various surfaces are exposed to the stream; and

Fig. 13 is a diagrammatic front elevational view corresponding to Fig. 12.

Referring now particularly to Figs. 1 to 6, the apparatus shown comprises a suitable supporting framework 1, which serves to support the operating mechanism, a substantial portion of which is contained within a closed housing 2. Mounted on the top wall of the housing 2 is an abrasive projector, preferably in the form of an abrasive throwing wheel 3, rotatably mounted on a shaft 4 journalled in bearings 5 and driven from a motor 6 through a driving belt 7.

Preferably, the wheel 3 is of the rotary centrifugal type having means for controlling the direction of discharge of the thrown abrasive, and may comprise a pair of spaced parallel side plates 10 carrying radially extending blades 11

to which abrasive is supplied by a relatively stationary tubular control member and an impeller 12 rotatable with the side plates 10, of the type generally disclosed in Peik Patent No. 1,953,566. The wheel 3 is adapted to project a stream of abrasive *a* downwardly into the housing 2, which stream spreads out fan-wise throughout approximately 90°, and having a relatively elongated impingement pattern. The wheel 3, preferably, is housed in a guard housing 13 having a suitably shaped guard liner 14.

Abrasive is supplied from a supply hopper 15, through a conduit 16, having a control valve 17, to a feed spout 18 from whence the abrasive is supplied to the impeller 12. The impeller 12 throws the abrasive into the path of the blades 11 which project the abrasive at high velocity in a stream having a predetermined shape and direction. Disposed within the housing 2 is a collecting hopper 19 having a depending trough 20 in which is disposed a conveyor screw 21 extending longitudinally of the housing 2 and adapted to transport abrasive from both ends of the trough 20 toward the centre thereof. A suitable deflector 22 may be disposed above the screw 21. A transverse trough 23 extends from the centre of the trough 20 to the side of the housing 2, and is provided with a conveyor screw 24 adapted to transport abrasive to a suitable elevator 25.

The elevator 25 may have an endless belt 26 carrying a plurality of buckets 27, and may be trained over upper and lower drums 28 and 29. The elevator 25 is driven from a motor 30 driving a belt 31, which in turn rotates a pulley 32 connected to the drum 28. The drum 29 drives a shaft 33 carrying a sprocket 34 having trained thereover a chain 35 driving a sprocket 36 carried on the shaft 37 of the transverse conveyor screw 24. Thus, upon energization of the motor 30, both the elevator and the transverse conveyor screw 24 are operated.

The shaft 37 carries a bevel gear 40 meshing with a bevel gear 41 carried on a shaft 42 journaled in bearings 43. The shaft 42 drives a sprocket 44 driving a chain 45 which rotates a sprocket 46 carried on the shaft 47 of the screw 21. Thus, the screw 21 is driven from the screw 24.

Rotatably mounted within the housing 2 is a conveyor constituted by a plurality of preferably spaced, substantially parallel rolls 50, each provided with a helical abutment means, as for example the helical groove 51, the pitch of which is selected in accordance with certain dimensions of the articles to be treated, as will hereinafter be explained. Each roll 50 is carried on a shaft 52 extending longitudinally of the housing 2 and journalled in pillow blocks 53 mounted at the ends of the support 1. Each pillow block 53 has a base portion 54 provided with a flared portion 55 slidable in and forming a dove-tailed joint with a grooved way 56 of a track member 57. The track members 57 are supported on a beam 58 carried on suitable portions 59, 55 of the support 1.

Threaded oppositely through the base portions 54 of the pillow blocks 53, at each end of the conveyor, is a screw 60 which is also threaded through a stationary block 61 rigidly mounted on the support 1. The screw 60 at the forward (left-hand end as viewed in Fig. 1) end of the support 1 is provided with a hand wheel 63, and carries a bevel gear 64 meshing with a bevel gear 65, carried on a shaft 66 journalled in bearings 67. The other end of the shaft 66 at the rear end of the support 1 (right-hand end as viewed in Fig. 1) carries a similar gear 65 meshing with the gear 64 carried on the screw 60 at the rear end of the apparatus. Upon suitable rotation of the hand wheel 63, the pillow blocks 53 at the front end of the apparatus can be moved closer together or farther apart. Simultaneously, the screw 60 at the rear end of the apparatus is actuated in a similar manner to give the pillow blocks 53 at that end a similar movement to the pillow blocks at the forward end. Thus, the spacing of the rolls can be adjusted without disturbing their parallel relationship.

The rolls 50 are driven from a motor 70 driving a pulley 71, preferably of the variable speed type, over which is trained a belt 72, also trained over a pulley 73 driving a speed reducing unit 74. The unit 74 drives a sprocket 75 which drives a sprocket 76, through a chain 77. The sprocket 76 is carried on the end of the right-hand shaft 52 (as viewed in Fig. 2), and rotates the same together with the roll 50. Each shaft 52 carries a gear 79 adapted to mesh with a gear 80 carried on a stub shaft 81, rotatably supported in the ends 82 of link members 83 which have their other ends receiving and secured to the shafts 52. The supporting arrangement for the gear 80 insures that it will be in mesh with the gears 79 throughout the entire range of adjustment of the rolls 50, whereby the rotation of the shaft 52 by the sprocket 77 is transmitted through the gear 79, and the gear 80 to the second gear 79 to rotate the second shaft 52 in the same direction as the first shaft 52. It will be seen that, upon adjusting movement of the shafts 52, the gear 80 will move vertically in a suitable manner so as to always be in engagement with both of the gears 79. This arrangement permits the spacing of the rolls to be adjusted to accommodate readily articles of various sizes.

A loading vestibule 90 is mounted on an extension 91 of the housing 2 adjacent the forward end of one side, and is closed by one or more flexible curtains 92. The floor or platform 93 of the vestibule projects into the housing 2 to a point well beyond the centre of the right-hand roll 52. Disposed opposite the end of the vestibule 90 is a swing 95 comprising a pair of parallel arm portions 96 supported from a portion 97 mounted on a pivot 98 journalled in brackets 99 secured to the housing 2. The arms 96 terminate in a seat 100 adapted to engage the periphery of an article to be treated, which, for the purposes of illustration, is shown as a drum *d*, having spaced flanges *e*, and being a preliminary casting from which brake drums are formed. Preferably, the pitch of the groove 51 of each roll is equal to the distance between the flanges *e* so that when the drum *d* is disposed on the rolls, the flanges *e* are received in adjacent turns of the grooves.

The swing 95, when in the position shown in Fig. 5, cooperates with the end of the floor 93 in holding the drum *d* out of contact with the rolls 50. The free end of the swing 95 is provided with a roll 101 rotatable on a pin 102, and adapted to be engaged by a cam 103 carried on a shaft 104 rotatable in a bracket 105. The shaft 104 is driven from the shaft 52 by a sprocket 106, a chain 107 and a sprocket 108. The cam 103 preferably is driven at one-tenth the speed as the rolls 50, and is so adjusted that it permits the swing 95 to swing to the left, as viewed in Fig. 5, away from the end of the floor 93, thus permitting the drums *d* to be lowered onto the rolls 52.

at the proper intervals and at the times when the grooves 51 are in position to engage the rims e of the drums. The swing 95 and associated mechanism may be designated as the loading mechanism.

The loading vestibule is connected to the roll spacing mechanism for movement therewith so that the end of the floor 93 has the same position relative to the subjacent roll 50 for all positions of adjustment of the rolls 50, 50. Referring to Figs. 2, 3 and 4, a member 130 is rigidly connected to the pillow block 53 nearest the vestibule 92 and is linked to a lever 131 pivoted to the support 1. The lever 131 is connected by a link 132, of adjustable length, to a frame 133 which latter is pivoted at one end to the support 1 and at the other end to the vestibule 90.

When the spacing of the rolls is varied, as will occur when the hand wheel 63 is actuated, the frame 133 is rocked about its lower pivot and slides the vestibule in the same direction as the subjacent roll 50. The vestibule 90 may be locked in position, when the adjustment is completed, by a pin 135 extending through suitably placed openings 136 in the vestibule and corresponding openings (not shown) in the portion 91.

Disposed adjacent to the rear ends of the rolls 50 is a suitable chute 115 for receiving the drums d as they pass from the ends of the rolls 50 and directing the drums d to a discharge vestibule 117 formed in the housing 2 and closed by one or more flexible curtains 118. Spaced from the ends of the rolls 50 is a deflector 119 having a soft, resilient jacket 120 for assisting in directing the brake drums 9 into the chute 15.

The operation of the apparatus is as follows: The motor 6 is energized to rotate the wheel 3, and abrasive is supplied to the wheel 3 from the hopper 18, whereby the wheel projects a stream of abrasive downwardly into the housing 2, and between the rolls 50, in a stream having a substantially elongated impingement pattern, which may be of less width than the space between the rolls 50. The motor 30 is also energized to return abrasive from the hopper 19 to the supply hopper 18.

The motor 70 is energized, and rotates the rolls 50 in a manner which will be apparent from the foregoing description. A drum d, to be treated, is disposed in the loading vestibule and impelled forwardly with sufficient force to roll it past the end of the floor 93 and into engagement with the seat 100. If desired, the floor 93 of the loading vestibule may be inclined sufficiently to cause the drum d to roll therealong, due to the gravity. As soon as the rolls 50 are in proper position to receive the drum d, the swing 95 is retracted and allows the drum d to be lowered onto the rolls 50.

The rims or flanges e of the drum d are received in a small portion of two consecutive turns of each groove 51 of each roll 50, whereby, as the rolls rotate, the drum d is caused to rotate about its [illegible] axis", and is also urged forwardly along in the housing 2.

As the drum d enters the abrasive stream a, it is struck by the abrasive particles at a predetermined angle, and as the drum d is advanced through the stream it is rotated completely, one or more times, to expose all portions to the action of the abrasive stream. As the drum is moved through the stream, it is struck by abrasive from angles varying throughout a considerable range, to thereby cause the abrasive to impinge upon the surface of the various cavities and projections.

When the drum d reaches the end of the rolls 50, it is forced therefrom and strikes the deflector 119 which directs it into the chute 115, which directs it into the discharge vestibule 117, from which it can be removed conveniently.

The apparatus so far described is capable of modification in order to render it more suitable for varying requirements. For example, where articles are to be treated which are symmetrical about their principal axis, but unsymmetrical or unbalanced about a second axis, an arrangement may be provided whereby such articles are maintained in position for a movement along the principal axis. An illustrative form of such apparatus is shown in Figs. 7 to 10, to which reference now is made.

The apparatus may comprise a suitable supporting framework 201 and a housing 202. Extending through the top wall of the housing is one or more abrasive projectors 203, generally similar to the projector 3, above described. The projectors 203 may be driven by a suitable motor 204, or motors, and may be enclosed in a housing 205 and fed from a hopper 206 through conduits 207, cooperating with each projector 203. Where a plurality of projectors 203 are employed, preferably, they will be arranged to rotate in opposite directions so that their abrasive streams a, a provide a total abrasive zone having a wide range of angularity. Various other arrangements of projectors may be made, according to the sizes and shapes of the articles to be treated, or other operating conditions.

Disposed in the housing 202 is a hopper 210 in which is disposed a conveyor screw 211 carried on a shaft 212, journalled in central bearings 218 and 213, the latter being protected by a hood 214. A transverse trough 215 extends from the central portion of the hopper 210, and has therein a conveyor screw 216 carried on a shaft 217. The conveyor screws 211 and 216 are driven from a motor 218 driving a sprocket 220 which drives a chain 221 rotating a sprocket 222 carried on the shaft 212. A sprocket 223 carried on the shaft 212 drives a chain 224 which rotates a sprocket 225 carried on a shaft 226 which drives a bevel gear 227 meshing with a bevel gear 228 carried on and driving a shaft 217. Upon energization of the motor 218, the screw 211 is actuated to force abrasive toward the trough 215, and the screw 216 forces the abrasive to an elevator 229 which elevates the abrasive to the feed hopper 206, preferably in a manner similar to that above-described.

Disposed longitudinally in the housing 202 is a plurality of spaced parallel rolls 230, each having a helical abutment means such as a groove 231. In the illustrative embodiment, four such rolls are shown, but various numbers may be used, according to varying conditions of use. The two lower rolls are carried on shafts 232 extending throughout the housing 202 and journalled in pillow blocks 233 suitably mounted on brackets 238 and 239 on the ends of the housing 202; the two upper rolls 230 are carried on shafts 234 journalled in pillow blocks 235 carried on the upper bracket 235', at the rear end of the housing and in bearings 236 supported by brackets 237 spaced from the forward end of the housing 202. Guard plates 208 partially protect the driving mechanism at the rear end of the housing.

The rolls 230 are driven from a motor 240 which may be mounted on the top wall of the

housing 202 and which drives the sprocket 241 driving a chain 242 rotating a sprocket 243 fixed to a stub shaft 244 journalled in a bearing 245 centered with respect to the shafts 232 and 234. The shaft 244 carries a gear 246 which meshes with gears 247 carried on each of the shafts 232 and 234. Upon energization of the motor 240, the stub shaft 244 is rotated and drives the gear 246 which rotates the gears 247 and the rolls 230.

A loading opening 248, which may be closed by a flexible curtain 249, is provided at the forward end of the housing 202. A loading cradle 250 is provided and has depending flanges 251 receiving pivot pins 252 carried by a plurality of arms 253 rigidly carried on shafts 254 journalled in the housing 202. The arrangement of parallel arms 253 and supporting shafts 254 provides a parallel motion mechanism whereby the cradle 250 may be moved rearwardly and downwardly to a position parallel to the position shown in Fig. 7.

The cradle 250 may have an upstanding arm 256, formed by a bifurcate upper end 257, and may have also a flange 258 at its forward end. Thus, the cradle is adapted to receive and support a member having a generally circular shape and a hub-like portion. For the purpose of illustration, a brake drum casting *c*, having a rim *r* and a hub *h* is shown. The flange 258 is adapted to receive the periphery of the casting *c* and abut the rim *r*, and the bifurcate portion 257 is adapted to receive the hub *h*.

The cradle 250 is actuated from one of the shafts 232 by a sprocket 270 driving a chain 271 rotating a sprocket 272 which is carried on and drives a shaft 273 journalled in a bearing 274 and driving a speed reducer 275, mounted on a suitable bracket 276 carried by the housing 202. The speed reducer 275 drives a shaft 277 which carries a cam 278 cooperating with a follower 279. The follower 279 has a head 280 slidable in a way 281, and is connected to a link 282 pivotally connected to an arm 283 fixed on one of the shafts 254. The arm 283 is normally urged forward by a spring 284 anchored to a fixed member 285. When the shaft 232, to which the speed reducer 275 is connected, is rotated, the cam 278 is driven and causes the follower to be forced rearwardly, which rocks the arm 283 and the shaft 254, and causes the arms 253 to move the cradle 250 rearwardly and downwardly into a position whereby a casting *c* may be deposited thereon through the opening 248.

As the cam continues to rotate, it permits the cradle 250 to be moved forwardly and upwardly by the spring 284 into the position shown in Figs. 7 and 8. The shaft 232 is connected to the cradle-actuating mechanism in such a way that the casting *c* is presented to the rolls 230 at the proper time, so that corresponding portions of the grooves 231 of the rolls 230 are brought into position to receive the rim *r* of the casting *c*, whereupon the latter is caused to rotate about its axis and to be advanced along on the rolls 230. The cradle 250 and associated mechanism may be designated as the loading mechanism.

An unloading chute 290 is disposed adjacent the rear end of the rolls 230, and a rotatable arm 291 is mounted on a shaft 292 adjacent the upper end of the chute 290. The arm 291 has a flange 294 adapted to engage the forward end of a casting *c*, and has an upstanding portion 291' formed with a bifurcate end 293 adapted to receive the hub of the casting *c*. The arm 291 is continuously rotated from the speed reducer 275 through a shaft 295 journalled in a bracket 296 and driving a gear 297 which drives a suitable transfer mechanism 298 driving a gear 299 carried on shaft 292. The arm 291 is driven at such a speed that it is adapted to engage the casting *c* just as the casting reaches the ends of the rolls 230 and lifts the casting up onto the upper end of the chute from whence it slides through a discharge opening 300 closed by a flexible curtain 301. The arm 291 and associated mechanism may be designated as the unloading mechanism.

The operation of this embodiment of the invention is, in general, analogous to the operation of the first form, and is as follows: The motors 204 are energized to drive the wheels 203 and project the abrasive in streams *a*. The motor 240 is energized to drive the rolls 230, the loading mechanism and the unloading mechanism. The motor 219 is energized to drive the screws 211 and 216. A casting *c* is deposited upon the cradle 250 when it is in its rearmost position, and the cradle 250 then carries the casting *c* upwardly and forwardly, and delivers it to the rolls 230. The grooves 231 engage the rim *r*, and the casing *c* is rotated about its axis and advanced longitudinally along on the rolls 230. As the casting *c* passes through the abrasive streams *a*, *a*, the various portions of the surface are subjected to the abrasive effect of the streams and thoroughly treated. When the casting reaches the end of the rolls, it is removed by the unloading device and deposited on the chute and removed from the housing.

This invention is capable of numerous modifications and is in no way limited to the specific apparatus shown or to the treatment of articles having the specific shapes illustrated. For example, the abutment means on the rolls may be modified in various ways to accommodate articles having variously shaped perimeters, and may take the form of helical ridges or flanges rather than grooves. Also, the grooves may be of sufficient size to accommodate the entire width of the periphery of the article instead of a portion only. The apparatus also is capable of being operated in combination with suitable automatic means for supplying articles to the apparatus and removing them therefrom, whereby no manual operations are required.

Referring to Fig. 11, a roll 305 is shown having a helical upstanding flange 306 which serves as an abutment for effecting movement of the articles to be treated. The flange 306 is adapted to support an article, such as the member *k*, and cause movement thereof by engagement with a grooved or flanged portion *l* of the periphery. If the flange 306 is of suitable width, an article such as the member *m* may be supported on the roll 305 between adjacent turns of the flange 306, and is moved by abutment between the flange 306 and the end of the article *m*.

Referring now to Figs. 12 and 13, there is shown diagrammatically how the present invention effects a thorough treatment of the various surfaces of an article to be treated. There is shown an abrasive projector 3 and a series of drums *k* representing numerous of the successive positions through which an article passes as it is advanced through the stream *a* projected by the projector 3. For the purposes of illustration, a drum *k* is shown, similar to that shown in Fig. 11 and having a peripheral or web portion *w* formed with a plurality of beads or corrugations *l*, a pair of

inturned rims or flanges *f* and an internal shoe *s*.

The drum *k* is rotated and advanced into the stream (from the left, as viewed in Fig. 12), and the outer face of the right-hand flange enters the stream, then the top edge of the flange *f*, and then the inner face of the shoe *s*. As the drum *k* advances further, the inner face of the left-hand flange *f* enters the stream, and finally the top edge thereof. Since the drum *k* is rotated about its axis during its advancing movement, all circumferential portions of the various surfaces mentioned are exposed successively to the stream of abrasive during the course of one rotation.

When the drum *k* advances further into the stream, the outer face of the web *w* passes into the stream. The drum *k* continues to advance in the stream and to rotate, thereby exposing all peripheral portions to the abrasive action of the particles. As the drum *k* advances, the angle at which the particles strike it gradually change from an inclination on one side of the vertical, through the vertical, to an inclination on the opposite side of the vertical. Thus the surfaces of all projections and depressions in the web *w*, as for example the beaded portions *l*, are exposed to the stream.

When the drum *k* passes beyond a position under the vertical portion of the stream, the particles begin to strike it from the left and thus strike the outer face of the left-hand flange *f*. As the drum advances further, the stream enters the drum from the left, and impinges on the inner face of the right-hand rim. Thus, when the drum *k* passes out of the stream, all of the various surfaces will have been subjected to the abrasive effects of the stream.

As will be seen from Fig. 13, the various circumferential portions of the drum *k* pass through the stream *a* during the course of a single rotation of the drum *k*. Hence, an article can be effectively treated, even though the stream may be of considerably less width than the diameter of the article treated. Depending upon the rate of advance through the stream with respect to the rate of rotation of the article, a very narrow stream may be used. The width and spread of the stream, preferably, will be selected suitably in accordance with the size and shape of the articles to be treated and other operating conditions.

From the foregoing it will be seen that the present invention provides a convenient and satisfactory apparatus for cleaning, hardening, finishing or otherwise treating articles abrasively, and is especially adapted for the treatment of articles having peripheries of such shape that the articles conveniently can be rolled on a supporting surface. The invention also provides satisfactory means for treating all portions of the surface of articles having projections, recesses, or other irregularities, and permits the treatment of articles of such shape and size that they cannot conveniently be treated in a tumbling mill.

While certain novel features of the invention have been disclosed and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. A machine for blast cleaning metallic articles including in combination, an abrasive throwing wheel for projecting a fan-shaped stream of abrasive having a generally elongated impingement pattern, and apparatus including spaced article supporting elements for rotating and advancing the articles in a direction generally transverse to the axis of rotation of said wheel and generally parallel to the longitudinal axis of said impingement pattern, said spaced article supporting elements being out of the range of direct fire of said abrasive stream.

2. A machine for blast cleaning hollow metallic articles including, a pair of substantially parallel rolls for supporting the articles to be treated, a helical abutment on at least one of said rolls adapted to engage the articles to be treated, means for rotating at least one of said rolls to effect combined rotation of the article and forward movement of the article in the direction of its axis of rotation, an abrasive throwing wheel having its axis of rotation extending in a direction generally transverse to the direction of forward movement of the article to be cleaned, said wheel being operative to project a fan-shaped stream of abrasive having an elongated impingement pattern against the exterior and interior portions of said article while the same is being moved forwardly whereby to effect interior and exterior cleaning of the article during its passage through said stream, the longitudinal axis of said impingement pattern extending generally parallel to and between the longitudinal axis of said rolls.

3. A machine for blast cleaning metallic articles including in combination, an article conveyor, article-engaging means associated with said conveyor for imparting a combined rotary and forward movement to the article to be cleaned, means for driving said article conveyor, loading mechanism including article supporting means and means for manipulating said article supporting means in synchronism with the movement of said conveyor for automatically placing the article in position to be engaged by said engaging means, and an abrasive throwing wheel for projecting an abrasive stream against the article on said conveyor.

4. A machine for blast cleaning rollable metallic articles including in combination, an abrasive throwing wheel operative to throw a fan-shaped stream of abrasive particles, and an apparatus for conveying the rollable articles in a direction generally transverse to the axis of rotation of said wheel, said apparatus including a rotatable member for supporting the rollable articles to be cleaned, a helical article-engaging abutment on said rotatable member, means for rotating said member to produce combined rotation of the articles in said stream and forward movement of said articles through said stream, and means for feeding said articles to said member in accordance with the predetermined position of said abutment.

5. A machine for blast cleaning rollable metallic articles including in combination, an abrasive throwing wheel operative to throw a fan-shaped stream of abrasive particles, and an apparatus for conveying rollable articles in a direction generally transverse to the axis of rotation of said wheel, said apparatus including a rotatable member for supporting the articles to be cleaned, a helical article-engaging abutment on said rotatable member, means for rotating said member to produce combined rotation of the articles in said stream and forward movement of the articles through said stream, and means for feeding said articles to said member in accordance with the

predetermined position of said abutment, said means including a pivoted lever for retaining said articles out of engagement with said rotatable member, and cam means driven in synchronism with said rotatable member for actuating said pivoted lever to cause said articles to be deposited upon said rotatable member when said abutment is in a predetermined position relative to said article.

6. A machine for blast cleaning rollable metallic castings, forgings and like metallic articles including in combination, an abrasive throwing wheel operative to throw a fan-shaped stream of abrasive particles having a generally elongated impingement pattern, and an apparatus for conveying the rollable articles through said stream in a direction generally transverse to the axis of rotation of said wheel, said apparatus including a plurality of spaced generally parallel conveying rolls, and means for rotating said rolls simultaneously, the longitudinal axis of said impingement pattern extending generally between the longitudinal axis of said rolls, said rolls being spaced generally outside of the impingement pattern defined by the thrown abrasive.

7. In a machine for cleaning rollable metallic articles including in combination, an abrasive throwing wheel operative to throw a fan-shaped stream of abrasive particles, and an apparatus for conveying the rollable articles through said stream in a direction generally transverse to the axis of rotation of said wheel, said apparatus including a plurality of parallel conveying rolls, a driving member operatively connected to each of said rolls, a transmission member engaging all of said driving members, means for varying the spacing of said rolls, and links connected at one end to said rolls and at the other end to said transmission member for retaining said transmission member in engagement with said driving members in all positions of said rolls.

8. A machine for blast cleaning rollable metallic articles including in combination, a plurality of substantially parallel rolls adapted to engage at least three spaced substantially co-planar portions of the periphery of the rollable article to be cleaned to support the article in a predetermined position relative to said rolls, means on at least one of said rolls for effecting combined rotation and forward movement of said article, and an abrasive throwing wheel for projecting a stream of abrasive having a generally elongated impingement pattern against the article supported by said rolls, the longitudinal axis of said impingement pattern extending generally between the longitudinal axis of said rolls.

9. A machine for blast cleaning hollow metallic articles including in combination, an abrasive projector of the rotary centrifugal type having means for controlling the direction of projection of the abrasive and operative to project a fan-shaped stream of abrasive particles having various portions diverging outwardly from said projector and defining a generally elongated impingement pattern, spaced means for advancing an article to be cleaned through said stream, and means for rotating said article about an axis extending in the general direction of advance movement of the article and in a direction generally transverse to the axis of rotation of said projector to expose side wall, end wall and interior wall surfaces of the article to the abrading effects of the stream the longitudinal axis of said impingement pattern extending generally between said spaced article advancing means.

10. A machine for blast cleaning metallic articles including in combination, an abrasive throwing wheel for projecting a fan-shaped stream of abrasive having a longitudinally extending impingement pattern, said stream fanning outwardly along the longitudinal axis of said impingement pattern, and spaced means for imparting a combined forward and rotary movement to the article, the forward movement of said article being in the general direction of the longitudinal axis of said impingement pattern, the longitudinal axis of said impingement pattern extending generally between said spaced means.

11. A machine for blast cleaning metallic articles including in combination, a rotary abrasive projector having means for controlling the direction of flight of the abrasive to define a fan-shaped abrasive stream having portions diverging outwardly and defining a generally elongated impingement pattern, means for advancing the article to be cleaned successively through the divergent portions of the abrasive stream, and spaced means including a member rotatable about an axis extending in the general direction of forward movement of said article for rotating the said article in the stream whereby side and end wall sections of the article are impinged by the abrasive during the passage of the article through the abrasive stream, the longitudinal axis of said impingement pattern extending generally between said spaced means.

12. Apparatus for cleaning metallic castings, forgings and like metallic articles including, an abrasive throwing wheel, rotatable members for supporting the article to be cleaned, helical means associated with said rotatable members for imparting a translatory movement to the article during rotation through said stream, an article supporting element, and means synchronized with the rotating movement of said rotatable members for actuating said supporting element to place the article in gripping engagement with said helical means.

13. Apparatus for cleaning metallic castings, forgings and like metallic articles including, an abrasive throwing wheel adapted to project a fan-shaped stream of abrasive, screw means for advancing the article to be cleaned longitudinally through said fan-shaped stream and simultaneously to rotate the article in said stream, an article supporting element, and means synchronized with the rotating movement of said screw means for actuating said supporting element to place the article in operative engagement therewith.

14. Apparatus for cleaning metallic castings, forgings and like metallic articles including, an abrasive throwing wheel adapted to project a fan-shaped stream of abrasive having a generally elongated impingement pattern, and spaced conveyor means for advancing the article to be cleaned longitudinally through said fan-shaped stream in a direction transverse to the axis of rotation of said wheel while simultaneously rotating the article in said stream whereby both side and end wall portions of said article will be cleaned by the impinging effect of the abrasive during the passage of the article through the stream, the longitudinal axis of said impingement pattern extending generally parallel to and between said spaced conveyor means.

15. A machine for blast cleaning metallic articles including in combination, an abrasive throwing wheel operative to project a fan-shaped stream of abrasive particles, a conveyor for ad-

vancing the article to be cleaned through said stream, and means for removing the article from said conveyor, said means including a pivoted arm adapted to engage the article and lift the same from said conveyor, and means for actuating said arm.

16. A machine for blast cleaning hollow metallic articles including in combination, an abrasive projector operative to throw a stream of abrasive particles at blasting velocities, a conveyor for advancing the article to be cleaned through said stream, means for lifting said article from the conveyor and tilting the article to permit the abrasive deposited in the hollow article to be discharged therefrom, an abrasive hopper beneath said lifting and tilting means, and means for actuating said lifting and tilting means.

17. A machine for blast cleaning metallic articles including in combination, an abrasive projector operative to throw a stream of abrasive particles at blasting velocities, a conveyor for advancing the article to be cleaned through said stream, means associated with said conveyor for engaging the article, and means for feeding the article to said conveyor in accordance with the predetermined position of said engaging means, said article-feeding means including a pivoted lever for maintaining said article out of engagement with said article-engaging means, and a cam driven in synchronism with said conveyor for actuating said pivoted lever to cause said article to be deposited upon said conveyor when said engaging means is in a predetermined position relative to said article.

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ABRADING APPARATUS

Filed March 21, 1936 7 Sheets-Sheet 1

Fig. 1

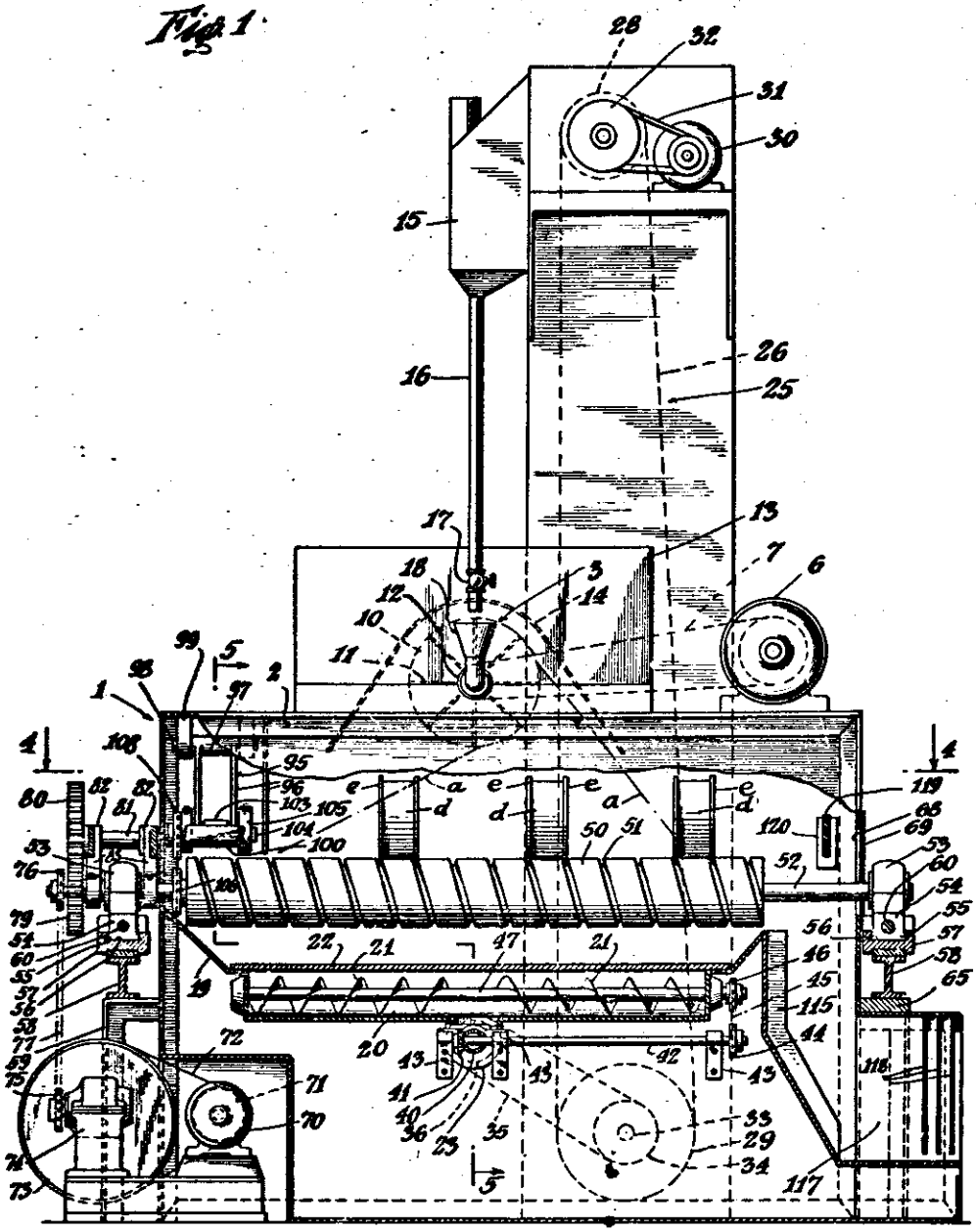

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Fig. 2

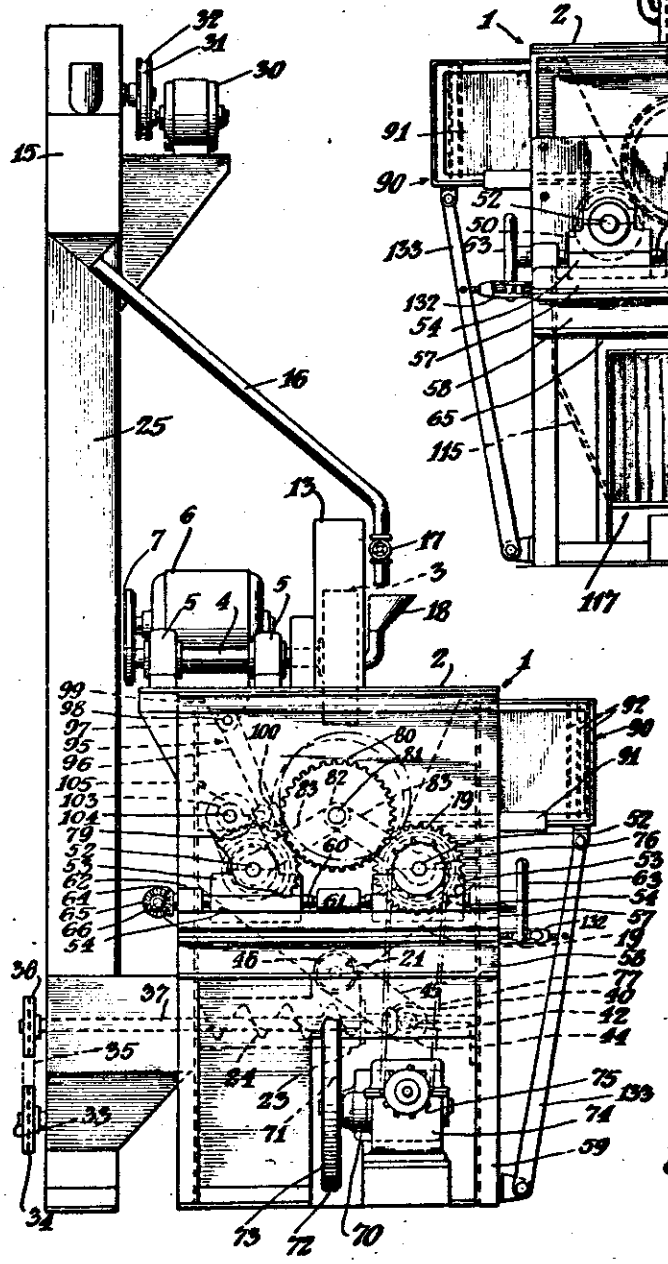

Fig. 3

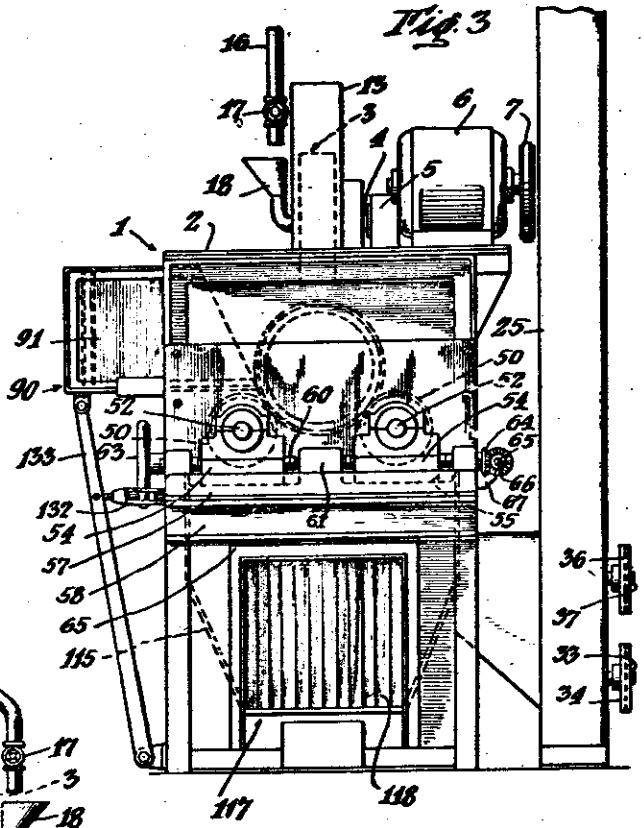

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Fig. 4

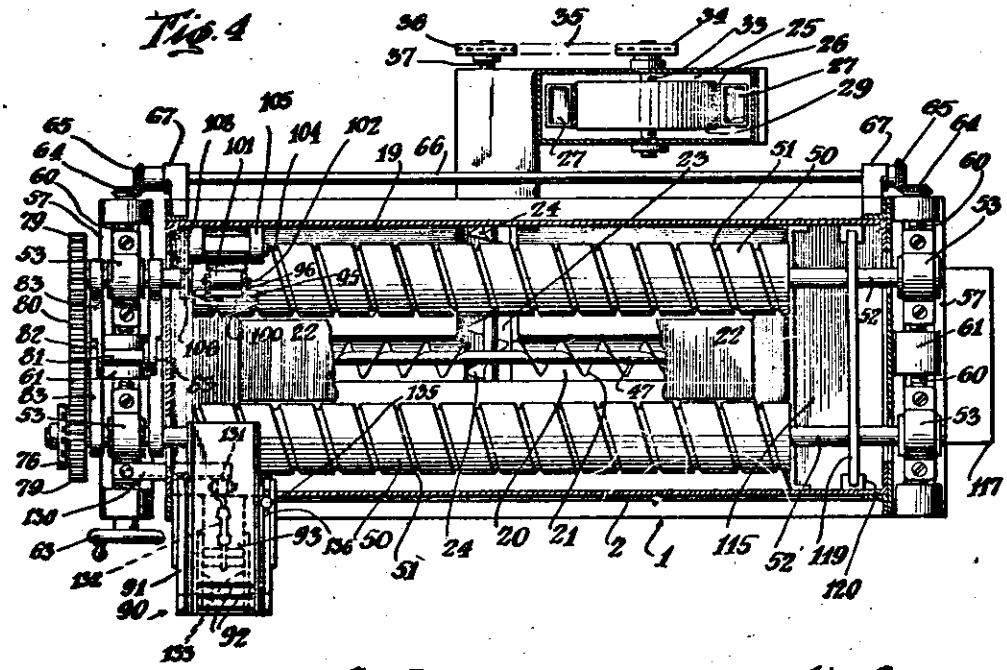
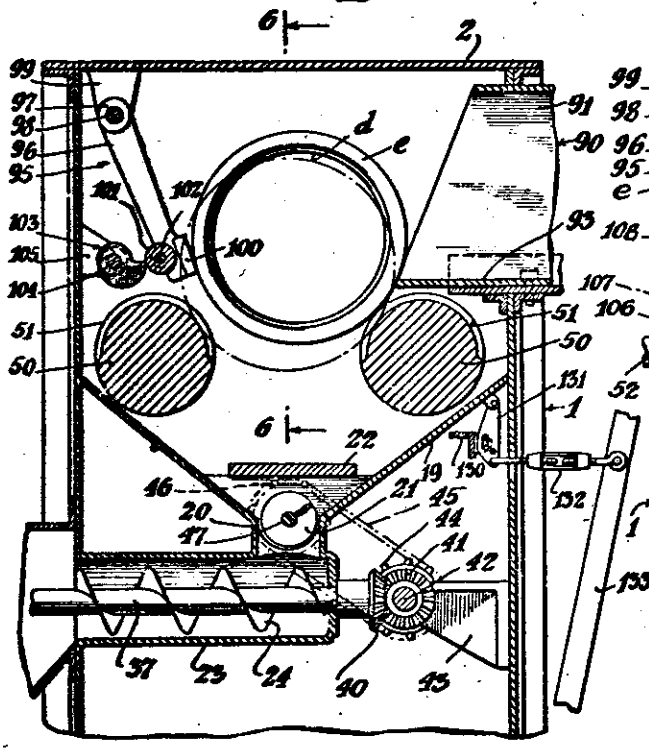


Fig. 5



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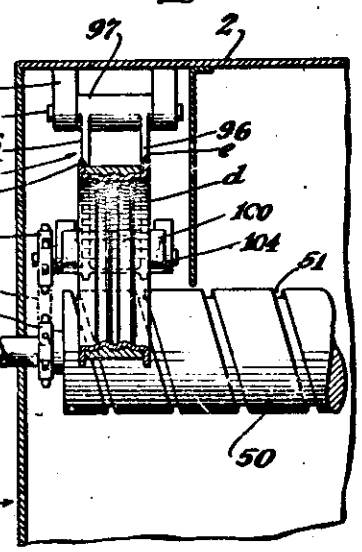

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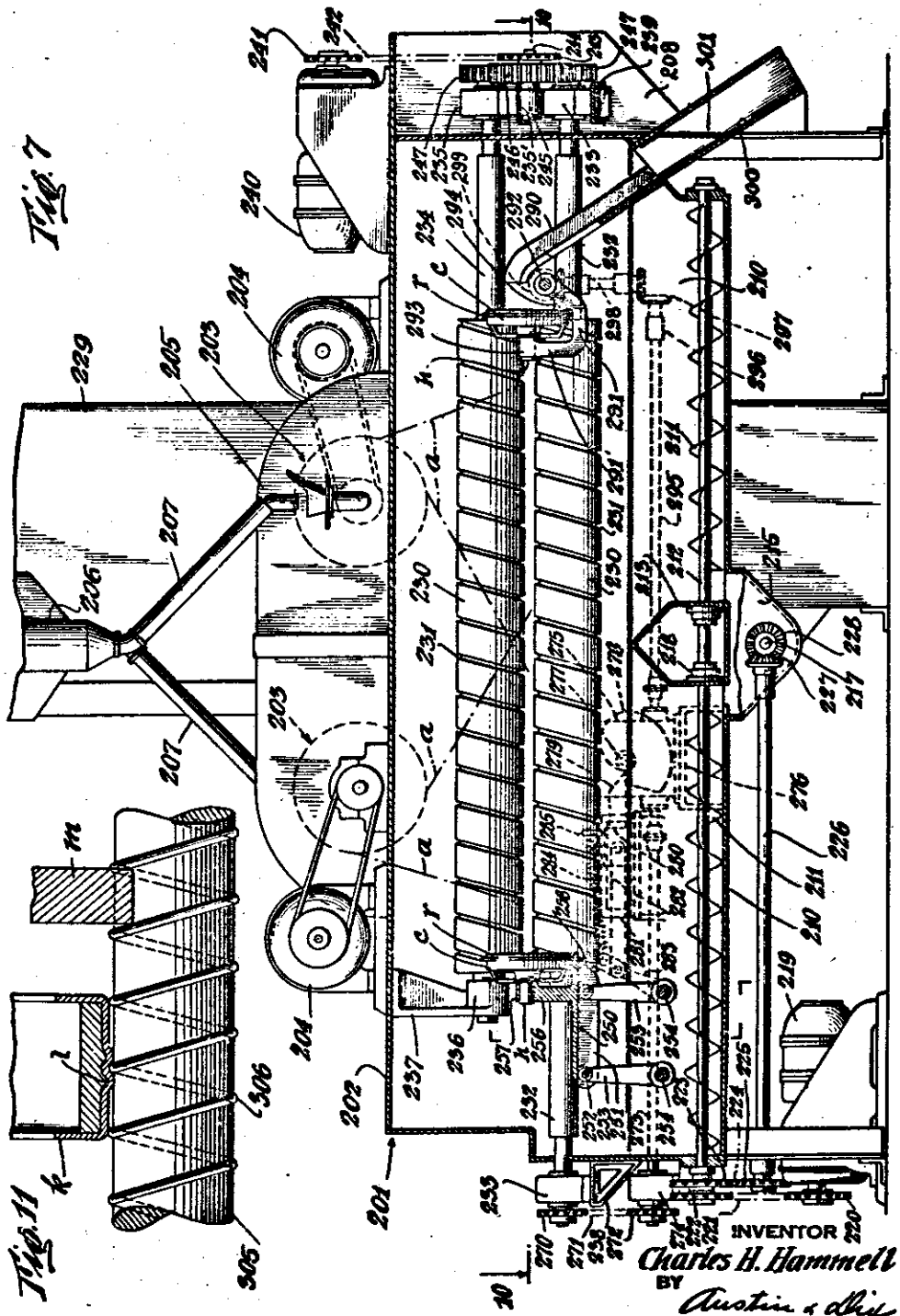

Fig. 7

Fig. 11

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Fig. 9

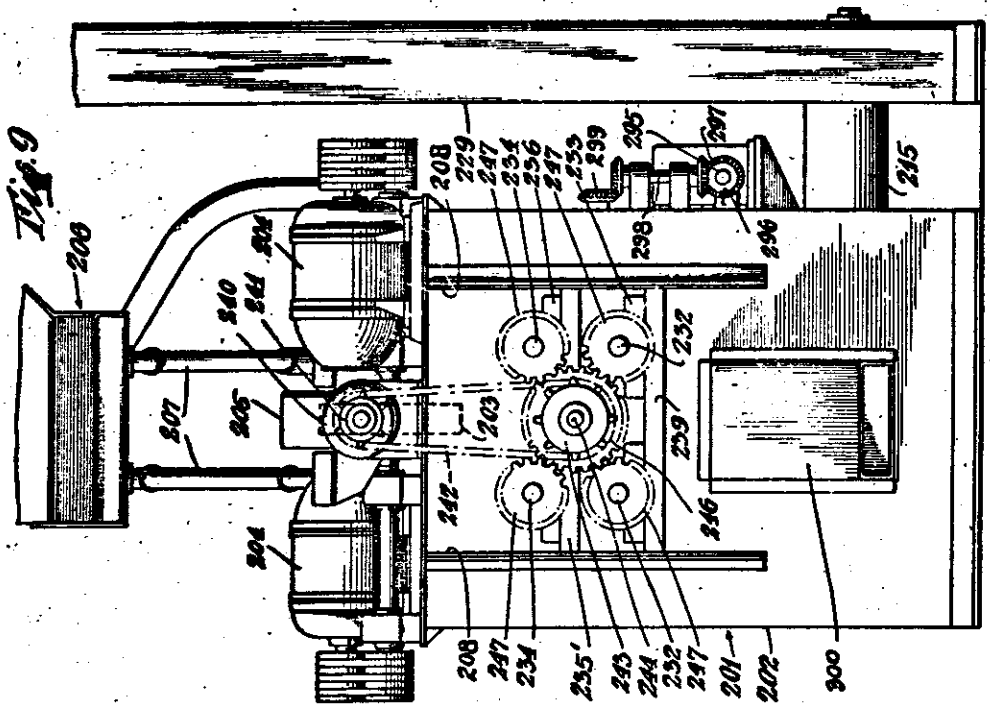
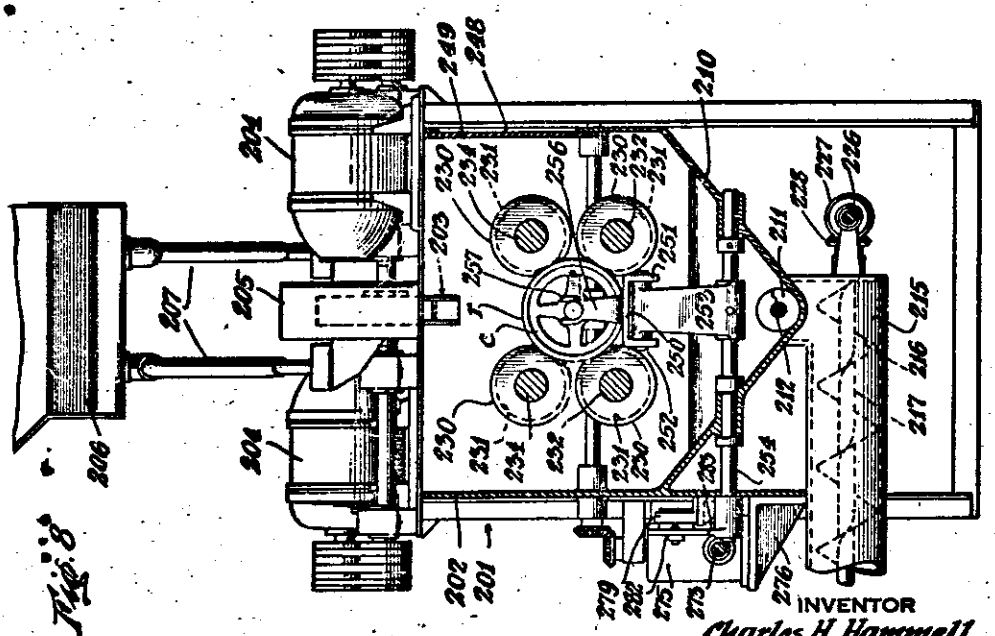


Fig. 8



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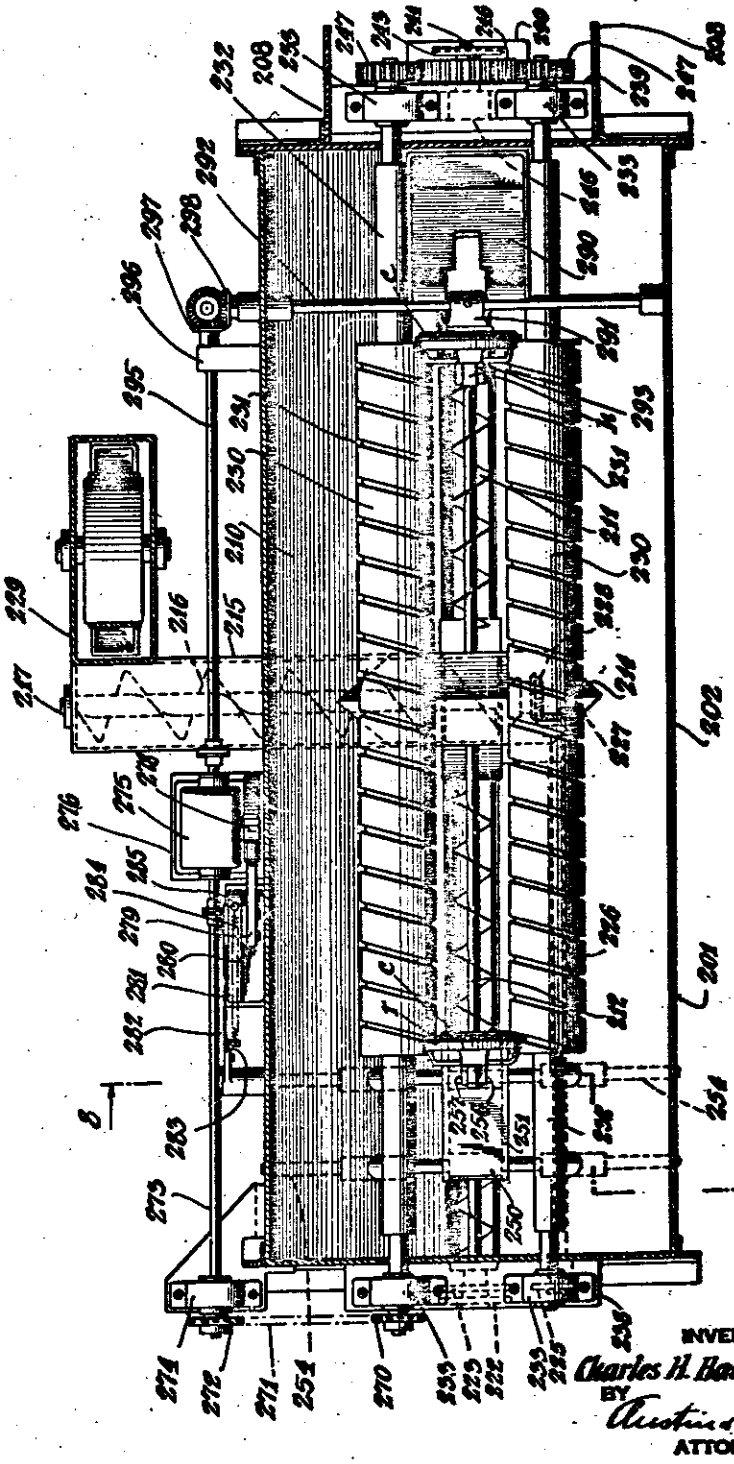

Fig. 10

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Fig. 12

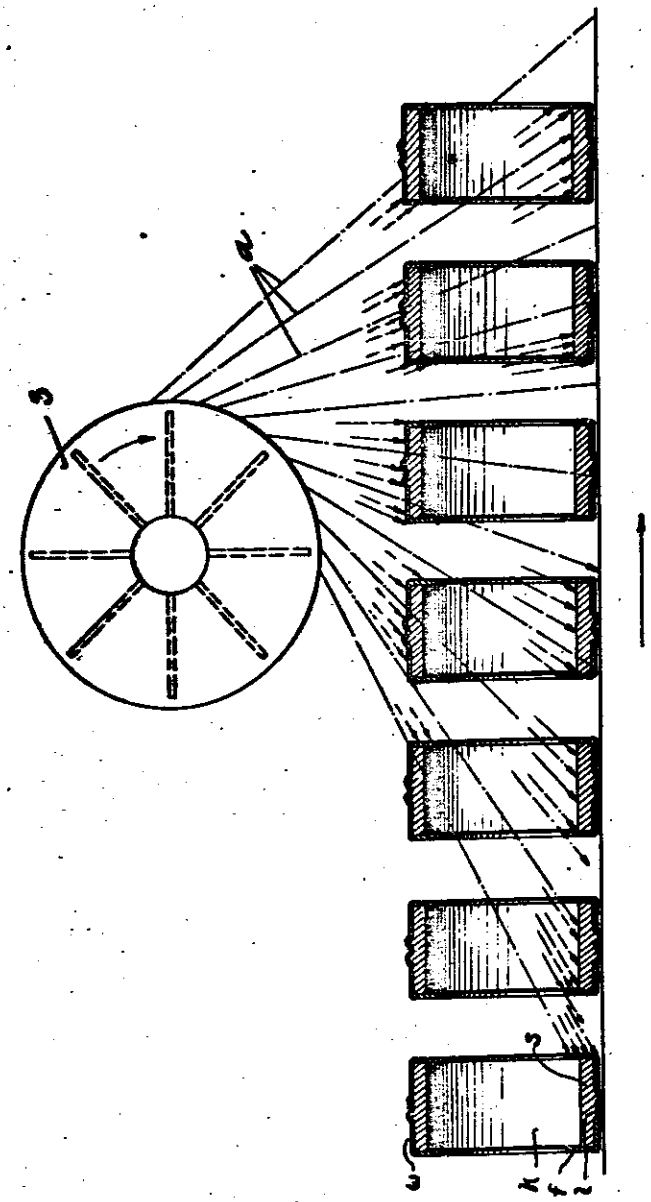
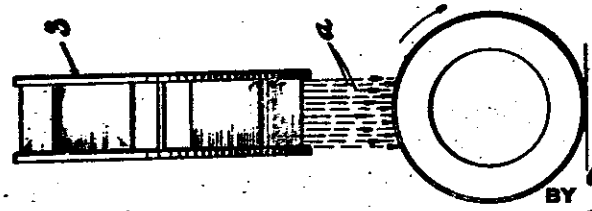


Fig. 13



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