Aug. 8, 1961 V. K. CHARVAT 2,994,895

BRUSHING MACHINE

Filed May 22, 1956 3 Sheets-Sheet 1

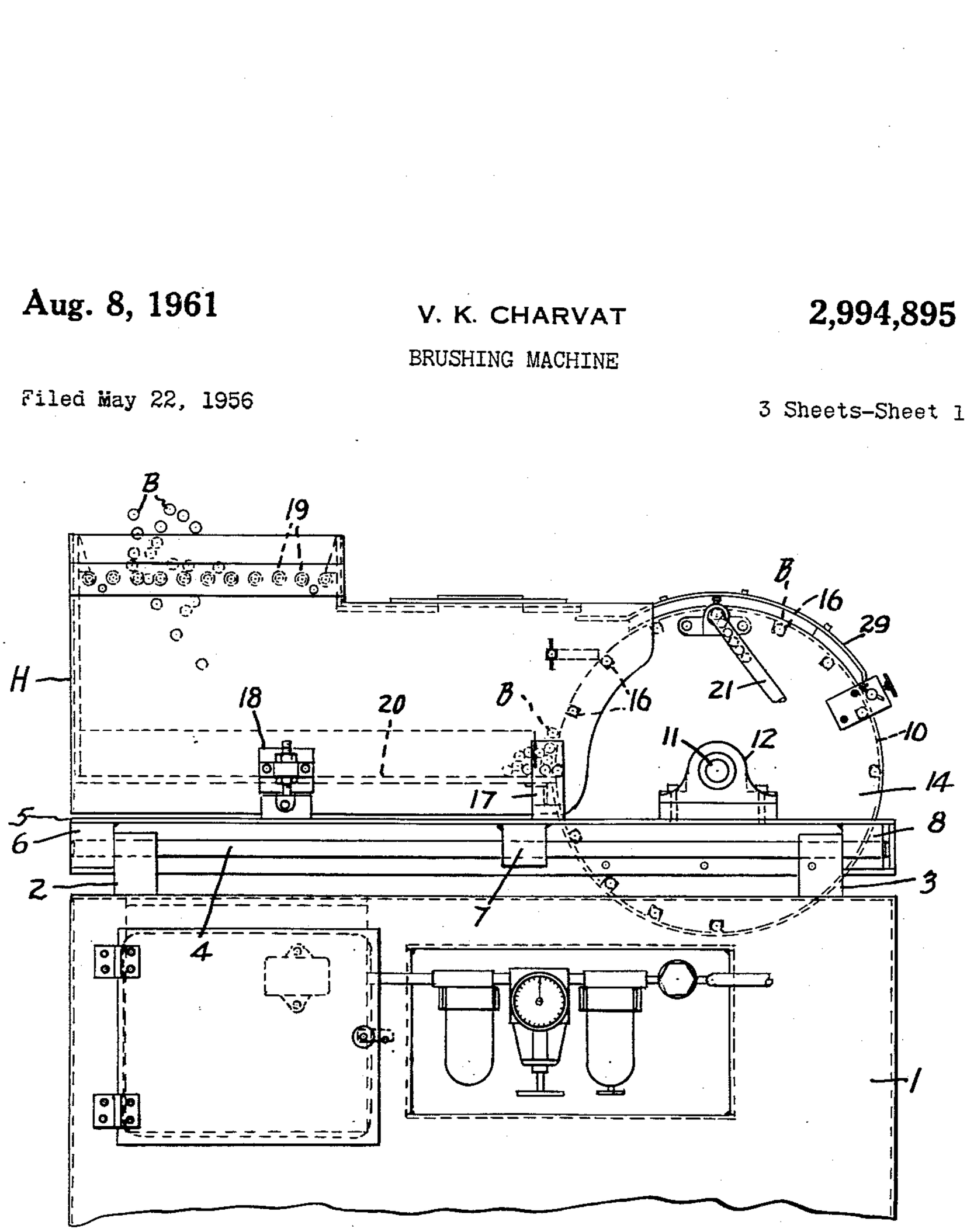

Fig. 1

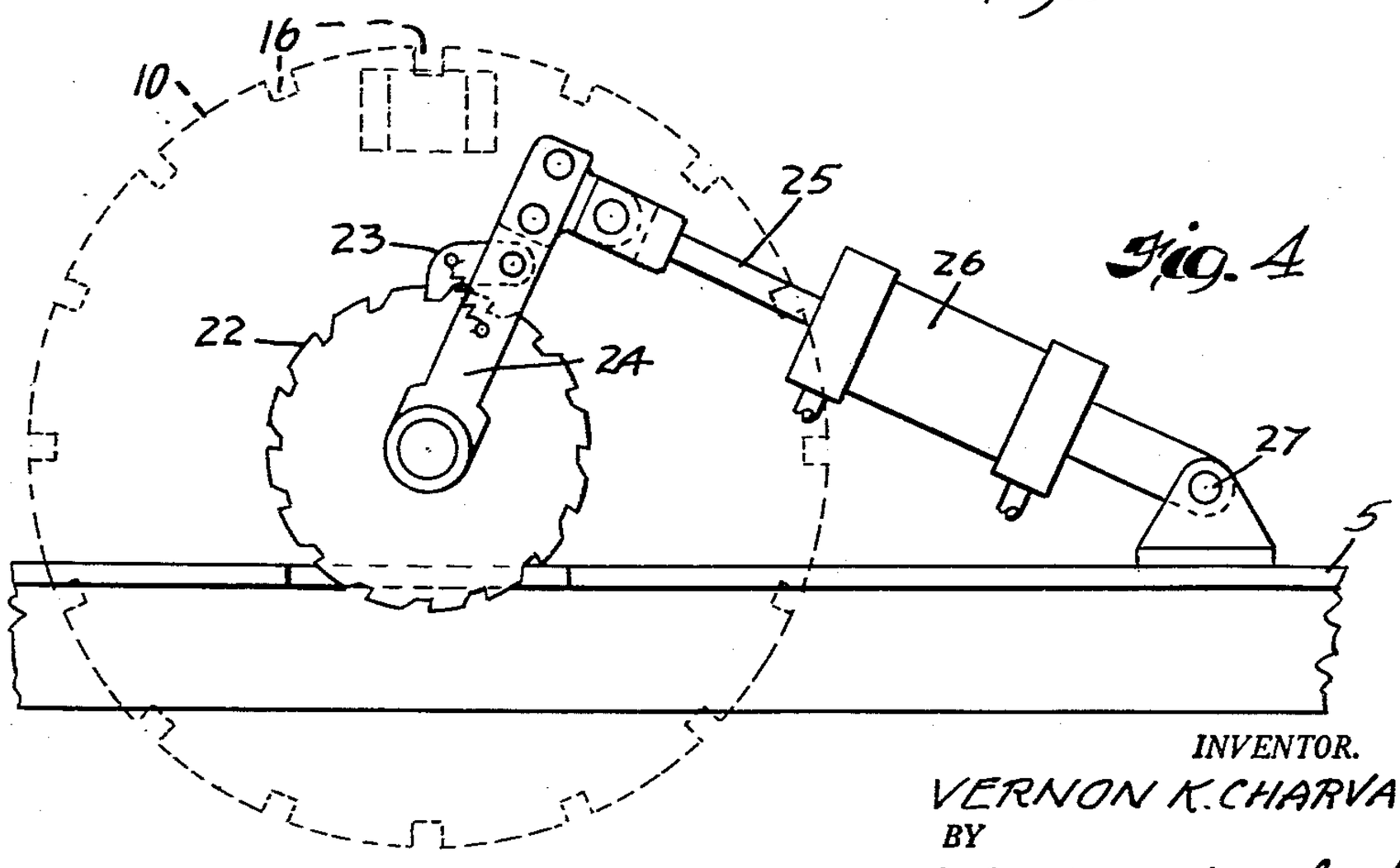

Fig. 4

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3 Sheets-Sheet 2

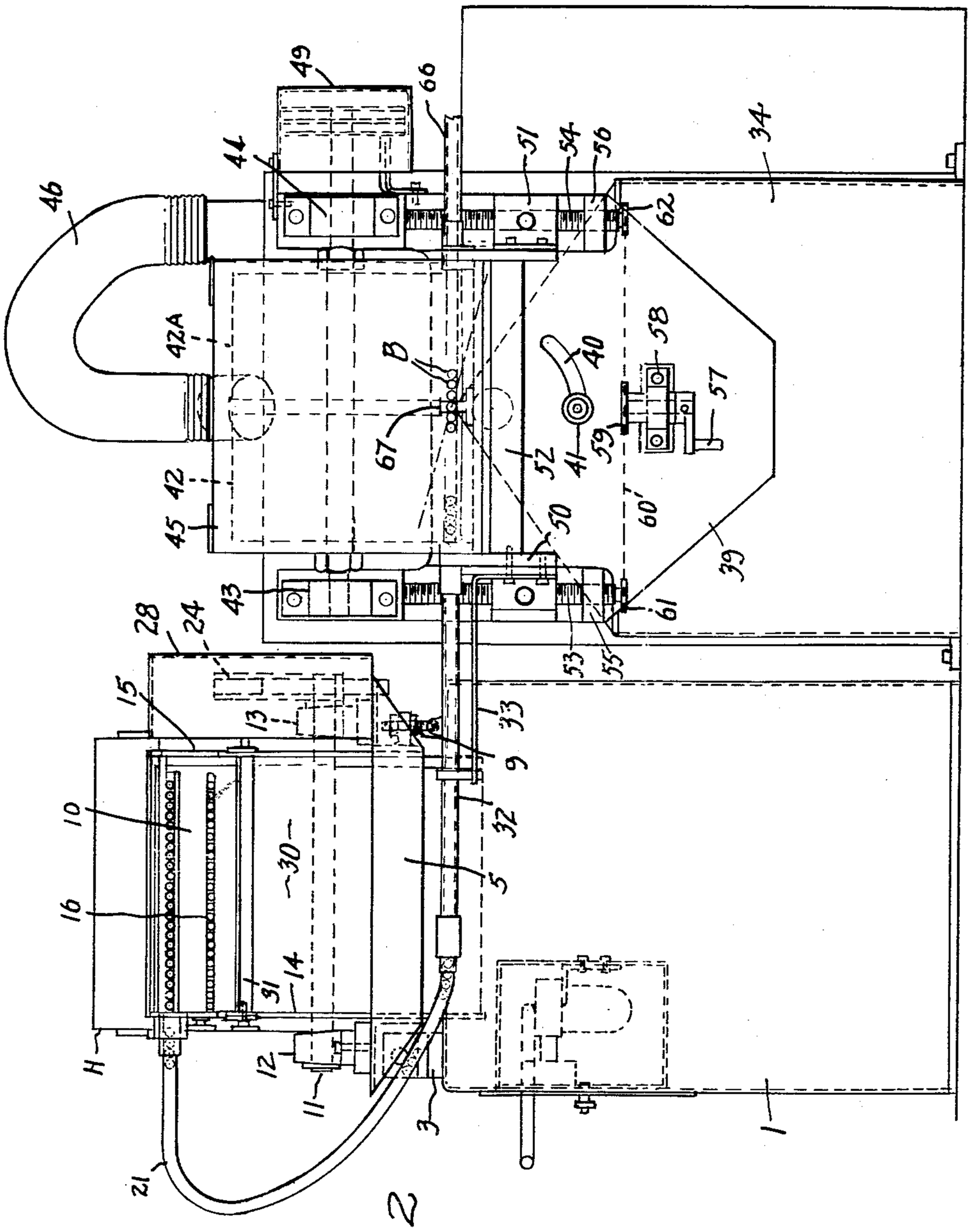

Fig. 2

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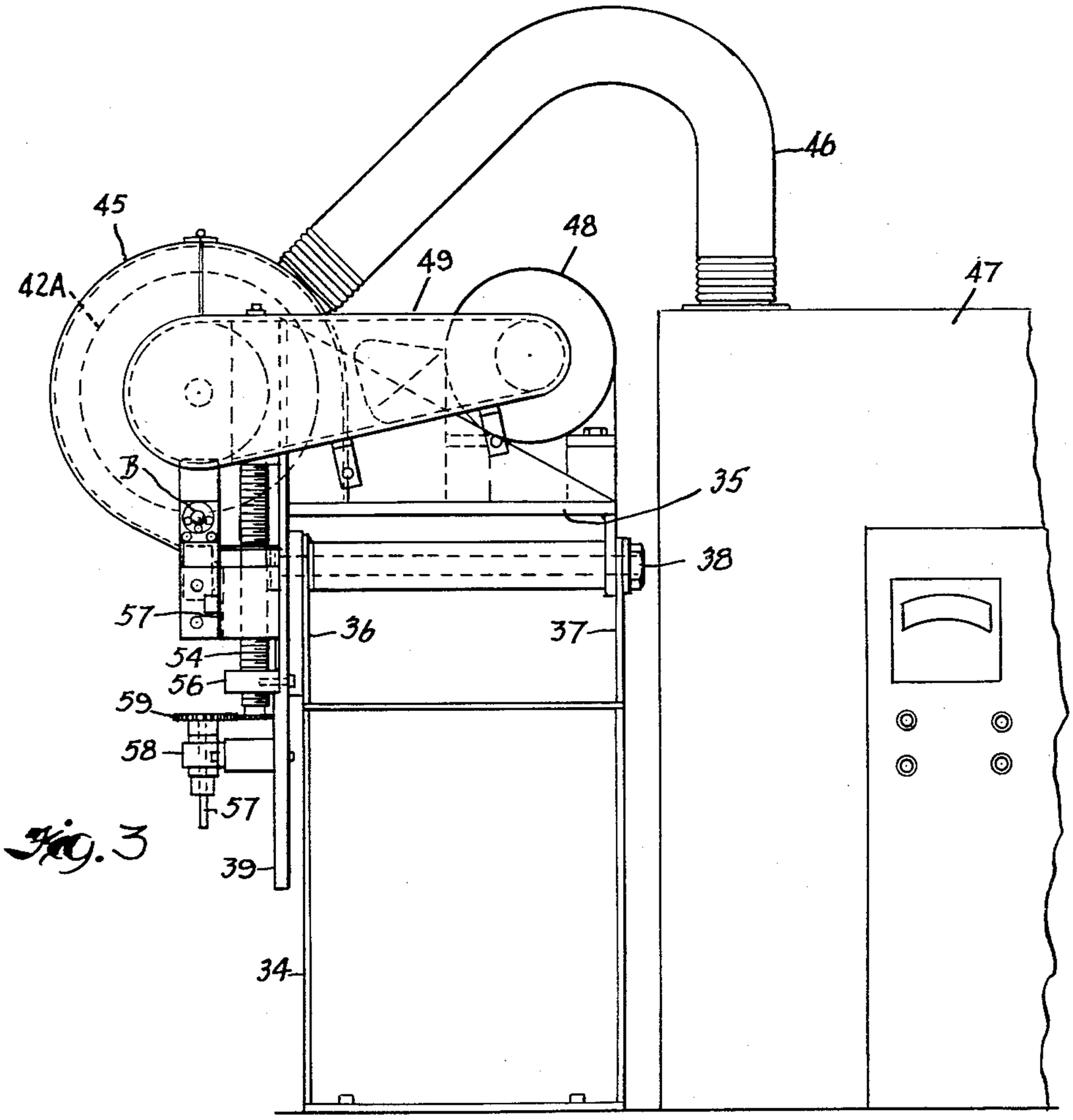

Fig. 3

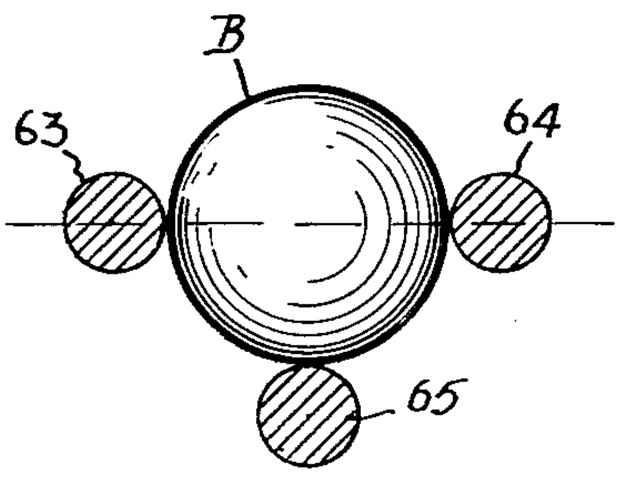

Fig. 5

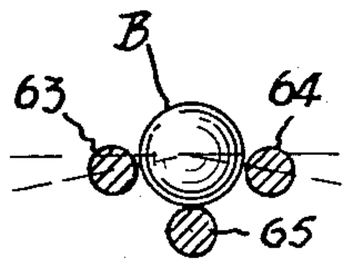

Fig. 6

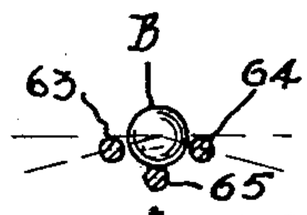

Fig. 7

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BRUSHING MACHINE

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Filed May 22, 1956, Ser. No. 586,625
17 Claims. (Cl. 15—21)

This invention relates as indicated to a novel brushing machine and method of brushing particularly adapted to the cleaning of generally spherical objects such as ball bearings and the like.

The usual final operation in the manufacture of steel ball bearings and the like is a cleaning operation designed to remove all foreign matter from the surfaces of the balls, one of the most commonly employed operations being to tumble such balls in a series of leather-lined barrels partially filled with various liquids, ground corncobs, clean cloths, etc. Such methods have not produced very uniform results and are not very well adapted to large volume production. It is accordingly a principal object of my invention to provide a brushing machine and method of brushing effective thoroughly to clean spherical objects such as steel ball bearings and the like.

Another object is to provide such machine and method which, while meticulously removing all foreign matter from the surface of such balls, will not affect their surface finish or dimensions.

A further object is to provide such machine which will be automatic in operation and easy to set up.

Still another object is to provide such machine which will fit into a continuous production line without interfering with other operations and which may continue to operate for a period even when other operations of the production line are shut down for brief periods.

Other objects of the invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, said invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

FIG. 1 is a side view of my new machine showing particularly the hopper and feed mechanism;

FIG. 2 is a vertical elevation normal to FIG. 1 showing such feed mechanism and the associated brushing mechanism;

FIG. 3 is an end elevation of the machine opposite to FIG. 1;

FIG. 4 is an enlarged detail view of the feed drum indexing mechanism; and

FIGS. 5–7 inclusive are semi-diagrammatic views illustrating the manner of supporting the work at the brushing station.

Referring now more particularly to said drawing and especially FIGS. 1–3 thereof, the embodiment of my invention there illustrated comprises a welded box frame base **1** having upstanding hinge lugs **2** and **3** adjacent one upper side edge through which passes a horizontal hinge pin **4**. A generally horizontal platform **5** is provided with three under-lugs **6**, **7** and **8** adjacent the near side edge as viewed in FIG. 1 through which such hinge pin **4** also passes. A screw jack **9** supports the other side of platform **5** in adjustably tilted position about the axis of pin **4**.

The feed mechanism

The ball bearing feed mechanism includes a wooden or synthetic plastic drum **10** mounted on shaft **11** journalled in bearings **12** and **13** on platform **5**. End plates **14** and **15** welded to platform **5** closely fit the ends of drum **10** for a purpose explained below. A series of shallow grooves such as **16** are provided in the surface of drum **10** parallel to the axis of the latter and equally spaced circumferentially of the drum. Such grooves extend to the end of the drum abutting end plate **14** and are of a depth approximately equal to the diameter of the ball bearings to be processed.

A sheet metal hopper H, preferably plastic lined, is also mounted on platform **5** adjacent drum **10**, being pivotally supported on uprights such as **17** for inclination relative to platform **5** about an axis transverse of such platform and parallel to shaft **11**. Screw jacks such as **18** are employed to hold the hopper in properly tilted position. The enclosed hopper is supplied with ball bearings B through a grid comprising a series of parallel equally spaced plastic coated bars **19** which serve to block the passage of any oversize balls. The floor **20** of the hopper will slope toward drum **10** so that such balls will roll under influence of gravity toward and against drum **10** and into any adjacent groove **16** therein.

A flexible plastic tube **21** fitted to an aperture in plate **14** in position for alignment with each of such grooves **16** when the latter reach uppermost position during rotation of drum **10**. Due to the inclination of platform **5** about the axis of pin **4**, the balls B in such uppermost groove when aligned with tube **21** will roll from such groove into such tube under the influence of gravity.

As best shown in FIG. 4, drum indexing means is provided in the form of a simple ratchet device comprising a toothed ratchet wheel **22** adapted to be engaged by detent **23** pivotally mounted on oscillating arm **24**. Such latter arm is adapted to be rocked through the reciprocation of piston rod **25** by pneumatic cylinder **26** pivotally mounted at **27** on platform **5**. This mechanism is enclosed within hood **28** (FIG. 2).

The upper portion of drum **10** may likewise desirably be covered by a hood **29** and the lower portion of the drum closely enclosed by a leather sheet or apron **30** extending from the end of hopper bottom **20** to removable roller retainer bar **31**. Such apron serves to retain the balls B within grooves **16** should any of such balls be carried beyond the entrance to tube **21** as drum **10** is indexed in a clockwise direction as viewed in FIG. 1. On occasion, tube **21** will be completely full of balls and temporarily incapable of receiving any more and on other occasions it will be capable of receiving only a portion of the balls contained in any one groove **16**. As will readily be understood, in normal operation, the rate at which drum **10** is indexed and balls fed to tube **21** will be reasonably closely correlated to the rate at which such balls pass the subsequent brushing station.

The brushing station

The balls B will flow by gravity downwardly through tube **21** into horizontal plastic tube **32** supported by outrigger bracket **33** mounted for inclination with the ball guide means at the brushing station.

Such brushing station comprises a box frame **34** adjacent base frame **1** and pivotally supporting a platform **35** on two upstanding flanges **36** and **37**. Such platform **35** is thus mounted on horizontal bolt **38** to permit it to be adjusted to a desired angle of inclination for the purpose explained below. A front plate **39** welded to platform **35** normal to pivot bolt **38** is provided with an arcuate slot **40** centered on the axis of bolt **38** through which extends a fixed bolt provided with a threaded locking knob **41** whereby platform **35** may be secured at the desired angle.

Power driven rotary brushes **42** and **42A** are journalled in bearings **43** and **44** mounted on front plate **39**, such

brushes being enclosed within a sheet metal hood **45**. Flexible hose **46** leads from such hood to dust collector **47** operative to collect dust removed from the work by the brush and withdrawn by suction through tube **46**. An electric motor **48** adjustably mounted on platform **35** is operative to drive brushes **42** and **42A** through a belt drive enclosed within housing **49**.

The work supporting means at the brushing station comprises end members **50** and **51** joined by horizontal bridge member **52** and threadedly engaging vertical screws **53** and **54** respectively. Such screws are mounted for rotation in brackets **55** and **56** welded to plate **39** so that rotation of the screws in unison will serve to raise or lower the work supporting carriage. A crank **57** journalled in bracket **58** on plate **39** is operated to drive sprocket **59** which is connected by means of endless chain **60** to sprockets **61** and **62** fixed on the lower ends of screws **53** and **54**, whereby such screws may be thus rotated in unison to raise or lower the work supporting carriage.

Supporting the ball bearings B where these are actually engaged by the brushes **42** and **42A** are three plastic rods **63**, **64** and **65** (FIGS. 5–7) journalled for rotation about their axes in end members **50** and **51**. As the balls roll out of rigid transparent plastic tube **32** through an aligned orifice in end member **50**, they rest upon the lowermost rod **65** and are maintained thereon by side rods **63** and **64**. Plate **39** and accordingly the trough defined by such rods are tilted so that the balls will roll from left to right as viewed in FIG. 2 under the effect of gravity. Such lateral support rods or rolls **63** and **64** will desirably have their longitudinal centers in a common plane passing through the centers of the balls B when such balls are of a diameter of about 1¼ inches (FIG. 5). When the diameter of the ball is approximately 7/16 inch, the longitudinal center lines of rods **63** and **64** may desirably lie about 11° below the centers of the balls (FIG. 6) and when the ball diameter is 7/32 inch, the longitudinal centers of such rods **63** and **64** may desirably lie about 15° below the centers of the balls (FIG. 7). It will thus be seen that the rod angle of contact with the balls decreases as the ball diameter increases, but the longitudinal center lines of the rods **63** and **64** should not normally be higher than the ball centers in any case. Where the balls are of a diameter less than 1 inch, the rods will desirably be of diameter approximately one-half the diameter of the balls, but this ratio need not be maintained with the larger sizes of balls (over 1 inch diameter). A slight amount of clearance between the balls and the side rods **63** and **64** is desirable.

It will be appreciated that when the ball supporting means is adjusted to present the balls to the peripheral faces of the two power driven rotary brushes, such balls will be rotated through such engagement as they simultaneously roll from left to right (FIG. 2) to the exit tube **66**. The supporting rods **63**, **64** and **65** not only hold the balls in proper engagement with the brush faces but also, by rotating about their own axes, facilitate rotation of the balls under the action of the brushes. A small enclosed chamber **67** is interposed between the two brushes **42** and **42A** to provide a very short passage through which the balls roll under the influence of gravity without being subjected to brushing action. This permits such balls to roll freely and somewhat to reorientate themselves before engaging the next brush. Two sets of the guide rods will preferably be employed, one on each side of such chamber, so that the balls rolling through the chamber are subjected only to the influence of gravity. This dual brushing operation with intermediate reorientation of the balls ensures complete and uniform brushing of the surface of each ball. It will be appreciated, of course, that while the balls and rods rotate under the action of the brushes, they do not rotate at nearly the speed of such

brushes. The amount of brushing pressure is readily adjusted by means of crank **57**.

While a wide variety of rotary brushes may be employed, I prefer brushes formed of helically wound brush strip of the type disclosed in Peterson Patent 2,303,386. A variety of different brush bristle materials may be utilized depending upon the particular operation in mind, such materials including horsehair, Tampico fiber, nylon monofilaments, Fiberglas strands enclosed in nylon sheaths, etc. It will, moreover, readily be appreciated that the principles of my invention may be employed in the brushing and cleaning of a wide variety of generally spherical objects including certain fruits such as oranges, grapefruit and apples, and such brushes may be utilized to apply certain coating materials such as waxes as well as for cleaning purposes.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I therefore particularly point out and distinctly claim as my invention:

1. A machine for brushing bearing balls comprising a hopper adapted to receive a supply of such balls, said hopper having a plastic lining, a wooden drum constituting one side of said hopper mounted for rotation about a horizontal axis, means mounting said hopper for tilting about an axis parallel to such axis of said drum selectively to incline the floor of said hopper downwardly toward said drum to cause balls in said hopper to accumulate against said drum, support means for said drum adjustably mounted for tilting such axis of said drum, said drum having a plurality of grooves in its outer surface parallel to such drum axis and uniformly spaced circumferentially of said drum, said grooves being dimensioned to receive balls of the size intended to be handled by the machine and being of a width slightly greater than the ball diameter and of a depth approximately equal to the ball diameter, a guard plate abutting the lower end face of said drum to prevent balls from rolling out of said grooves, an aperture in said plate positioned for alignment with each said groove as the latter reaches uppermost position during rotation of said drum, a ratchet on said drum, fluid pressure piston-cylinder means operative to actuate said ratchet to index said drum thus to bring said grooves successively into alignment with said aperture, a flexible sheet secured against the under surface of said drum effective to retain in said grooves any balls carried past said aperture; a stand, a vertically extending flat support plate mounted on said stand for tilting about a horizontal axis normal to the plane of said support plate, a brush arbor journalled in bearings mounted on the outer face of said support plate, two axially spaced cylindrical rotary brushes mounted on said arbor for rotation therewith, drive means operative to drive said arbor and brushes, a hood substantially enclosing said brushes, suction means connected with said hood effective to withdraw material removed by said brushes from the work; ball supporting means beneath said brushes adapted to support balls in engagement therewith comprising a carriage, screw means mounting said carriage on said support plate for adjustable positioning toward and away from said brushes, two axially aligned open-ended troughs comprising plastic surfaced elongated bottom rollers and plastic surfaced side rollers mounted on said carriage for rotation about their axes parallel to said arbor, each said trough being disposed beneath a respective said brush, a short enclosed passageway between said troughs intermediate said brushes, said rollers being of a diameter not exceeding one-half the width of said troughs and the axes of said side rollers being no higher than the center of a ball resting in a said trough with slight clearance in use; a rigid plastic tube supported by said carriage and extending laterally therefrom aligned with and communicating

with said troughs, a flexible plastic tube leading from said aperture in said drum guard plate downwardly to said rigid tube and connected thereto, and means for securing said support plate in desired tilted position for movement of such balls along said troughs under influence of gravity.

2. A machine for brushing generally spherical articles comprising a hopper adapted to receive a supply of balls, a drum constituting one side of said hopper mounted for rotation about a generally horizontal axis, the floor of said hopper sloping toward said drum and abutting the latter at a level at least as high as the drum axis, whereby balls in said hopper tend to accumulate against said drum, the axis of said drum being tilted longitudinally thereof, said drum having a plurality of grooves in its outer surface parallel to such drum axis and uniformly spaced circumferentially of said drum, guard means closely adjacent the lower end of said drum to prevent balls from rolling out of said grooves, said grooves extending to such lower end of said drum, a gateway through said guard means positioned for alignment with each said groove as the latter reaches uppermost position during rotation of said drum, indexing means operative to index said drum thus to bring said grooves upwardly from said hopper successively into alignment with said gateway, retaining means closely enclosing the under surface of said drum effective to retain in said grooves any balls carried past said gateway; a frame, a brush arbor journalled in bearings on said frame for rotation about an axis inclined to the horizontal, two axially spaced cylindrical rotary brushes mounted on said arbor for rotation therewith, drive means operative to drive said arbor and brushes; ball supporting means beneath said brushes adapted rotatably to support balls in engagement therewith comprising a carriage, screw means mounting said carriage on said frame for adjustable positioning toward and away from said brushes, two axially aligned open-ended troughs comprising plastic surfaced elongated bottom rollers and plastic surfaced side rollers mounted on said carriage for rotation about their axes parallel to said arbor, each said trough being disposed beneath a respective said brush, a short enclosed passageway between said troughs intermediate said brushes, said rollers being of a diameter not exceeding one-half the internal width of said troughs and the axes of said side rollers being no higher than the center of a ball resting in said trough with slight clearance in use; and a tube leading downwardly from said gateway to the upper end of said aligned troughs adapted to conduct balls thereto under influence of gravity.

3. A machine for brushing generally spherical objects such as balls comprising a hopper, a drum mounted for rotation about a generally horizontal axis and having a substantial portion of one of its upper quadrants exposed to the interior of said hopper, the axis of said drum being longitudinally inclined, said drum having a plurality of grooves in its outer surface adapted to receive balls from said hopper in a single row extending parallel to such drum axis, said grooves being uniformly spaced circumferentially of said drum and extending to the lower end of said drum, guard means closely adjacent the lower end of said drum to prevent balls from rolling out of said grooves, a gateway through said guard means positioned for alignment with each said groove as the latter reaches uppermost position during rotation of said drum, indexing means operative to index said drum thus to bring said grooves upwardly from said hopper successively into alignment with said gateway, retaining means closely enclosing the underside of said drum effective to retain in said grooves any balls carried past said gateway; a brush arbor journalled for rotation about an axis inclined to the horizontal, two axially spaced cylindrical rotary brushes mounted on said arbor for rotation therewith, drive means operative to drive said arbor and brushes; ball supporting means beneath said brushes adapted rotatably to support balls in engagement therewith comprising a carriage, means mounting said carriage for adjustable positioning toward and away from said brushes, two axially aligned open-ended troughs comprising elongated bottom rollers and side rollers mounted on said carriage for rotation about their longitudinal axes parallel to said arbor, each said trough being disposed beneath a respective said brush, a short enclosed passageway between said troughs intermediate said brushes; and a tube leading downwardly from said gateway to the upper end of said aligned troughs adapted to conduct balls thereto under influence of gravity.

4. A machine for brushing generally spherical objects such as balls comprising a hopper, a drum mounted for rotation about a generally horizontal axis and having a substantial portion of one of its upper quadrants exposed to the interior of said hopper, said drum having a plurality of grooves in its outer surface extending generally parallel to the axis of said drum and adapted successively to receive balls from said hopper when said drum is rotated, said grooves extending to one end of said drum and said drum being disposed with its upper side sloping toward such end, guard means closely adjacent such end of said drum to prevent balls from rolling out of said grooves, a gateway through said guard means positioned for alignment with each said groove as the latter reaches a position high on said drum, indexing means operative to index said drum thus to bring said grooves upwardly from said hopper successively into alignment with said gateway; a brush arbor journalled for rotation about an axis inclined to the horizontal, a cylindrical rotary brush mounted on said arbor for rotation therewith, drive means operative to drive said arbor and brush; ball supporting means beneath said brush adapted rotatably to support balls in engagement therewith comprising a carriage, means mounting said carriage for adjustable positioning toward and away from said brush, an open-ended trough comprising an elongated bottom roller and two elongated side rollers mounted for rotation about their longitudinal axes parallel to said arbor, said trough being disposed beneath said brush; and a tube leading downwardly from said gateway to the upper end of said trough adapted to conduct balls thereto under influence of gravity.

5. The machine of claim 4 wherein said tube is flexible and said brush arbor is adjustably tiltably mounted.

6. The machine of claim 4 wherein said rollers are of diameters not exceeding one-half the internal width of said trough and the axes of said side rollers are no higher above said bottom roller than a distance equal to one-half the internal width of said trough.

7. A machine for brushing generally spherical objects such as balls comprising a hopper, a drum mounted for rotation about a generally horizontal axis and having a substantial portion of one of its upper quadrants exposed to the interior of said hopper, said drum having a groove in its outer surface extending generally parallel to the axis of said drum and adapted to receive balls from said hopper when said drum is rotated, said groove extending to one end of said drum and said drum being disposed with its upper side sloping toward such end, guard means closely adjacent such end of said drum to prevent balls from rolling out of said groove, a gateway through said guard means positioned for alignment with said groove as the latter reaches a position high on said drum, indexing means operative to index said drum thus to bring said groove upwardly from said hopper into alignment with said gateway; a cylindrical rotary brush disposed with a generally horizontal axis, drive means for said brush; ball supporting means beneath said brush adapted rotatably to support balls in engagement therewith comprising an open-ended trough formed of three parallel elongated rollers mounted for rotation about their axes parallel to said brush axis, one said roller forming the bottom of said trough and the other two rollers the re-

spective sides thereof; and a guideway leading from said gateway to one end of said trough inclined to deliver balls thereto by gravilty feed.

8. Feed mechanism for feeding balls for subsequent processing comprising a hopper adapted to receive a supply of balls, a drum constituting one side of said hopper mounted for rotation about a generally horizontal axis, the floor of said hopper sloping toward the side of said drum and abutting the latter at a level at least as high as the drum axis, whereby balls in said hopper tend to accumulate against the side of said drum in a direction generally radially thereof, the axis of said drum being titlted longitudinally thereof, said drum having a plurality of grooves in its outer surface parallel to such drum axis and uniformly spaced circumferentially of said drum, guard means closely adjacent the lower end of said drum to prevent balls from rolling out of said grooves, said grooves extending to such lower end of said drum, a gateway through said guard means positioned for alignment with each said groove as the latter reaches uppermost position during rotation of said drum, indexing means operative to index said drum thus to bring said grooves upwardly from said hopper successively into alignment with said gateway, retaining means closely enclosing the under surface of said drum effective to retain in said grooves any balls carried past said gateway, and a tube leading downwardly from said gateway adapted to receive and maintain such balls in single file.

9. Feed mechanism for feeding balls for subsequent processing comprising a hopper adapted to receive a supply of balls, a drum mounted for rotation about a generally horizontal axis and having a substantial side portion of one of its upper quadrants exposed to the interior of said hopper, said drum having a plurality of grooves in its outer surface extending generally parallel to the axis of said drum and adapted successively to receive balls in a radial direction from said hopper when said drum is rotated, said grooves extending to one end of said drum and said drum being disposed with its upper side sloping toward such end, guard means closely adjacent such end of said drum to prevent balls from rolling out of said grooves, a gateway through said guard means positioned for alignment with each said groove as the latter reaches a position high on said drum, indexing means operative to index said drum thus to bring said grooves upwardly from said hopper successively into alignment with said gateway, and a tube leading downwardly from said gateway.

10. Feed mechanism for feeding balls for subsequent processing comprising a hopper adapted to receive a supply of balls, a drum mounted for rotation about a generally horizontal axis and having a substantial side portion of one of its upper quadrants exposed to the interior of said hopper, said drum having a groove in its outer surface extending generally parallel to the axis of said drum and adapted to receive balls in a radial direction from said hopper when said drum is rotated, said groove extending to one end of said drum and said drum being disposed with its upper side sloping toward such end, guard means closely adjacent such end of said drum to prevent balls from rolling out of said groove, a gateway through said guard means positioned for alignment with said groove as the latter reaches a position high on said drum, and indexing means operative to index said drum thus to bring said groove upwardly from said hopper into alignment with said gateway.

11. Feed mechanism for feeding balls for subsequent processing comprising a hopper adapted to receive a supply of balls, a drum mounted for rotation about a generally horizontal axis, said drum having a groove in its outer surface extending generally parallel to the axis of said drum and adapted to receive balls in a direction radially of said drum from said hopper when said drum is rotated, said groove extending to one end of said drum and said drum being disposed with its upper side sloping downwardly toward such end, guard means closely adjacent such end of said drum to prevent balls from rolling out of said groove, a gateway through said guard means positioned for alignment with said groove in one position of said drum, and indexing means operative to index said drum to bring said groove from ball receiving position to position for delivering balls to said gateway.

12. Mechanism for feeding generally spherical objects comprising a hopper, endless conveying means passing through said hopper moving relative thereto having grooves therein adapted to receive such spherical objects from said hopper in a direction generally normal to said grooves, said grooves extending to a side edge of said conveying means, guard means adjacent said edge effective to prevent premature escape of such objects from said grooves, said conveying means being arranged and disposed to tilt said grooves toward said edge at a delivery station, and guide means at said delivery station adapted to receive such objects as they roll from said grooves and to maintain such objects in a single line for subsequent processing.

13. Brushing mechanism for brushing spherical objects such as bearing balls and the like, comprising a stand, a vertically extending flat support plate mounted on said stand for tilting about a horizontal axis normal to the plane of said support plate, a brush arbor journalled in bearings mounted on the outer face of said support plate, two axially spaced cylindrical rotary brushes mounted on said arbor for rotation therewith, drive means operative to drive said arbor and brushes, a hood substantially enclosing said brushes, suction means connected with said hood effective to withdraw material removed by said brushes from the work; ball supporting means beneath said brushes adapted to support balls in engagement therewith comprising a carriage, screw means mounting said carriage on said support plate for adjustable positioning of said carriage toward and away from said brushes, two axially aligned open-ended troughs comprising plastic surfaced elongated bottom rollers and plastic surfaced side rollers mounted on said carriage for rotation about their axes parallel to said arbor, each said trough being disposed beneath a respective said brush, a short enclosed passageway between said troughs intermediate said brushes, said rollers being of a diameter not exceeding one-half the width of said troughs and the axes of said side rollers being no higher than the center of a ball resting in a said trough with slight clearance in use, and means for securing said support plate in desired tilted position for movement of such balls along said troughs under influence of gravity.

14. Brushing mechanism for brushing spherical objects such as bearing balls and the like, comprising a frame, a brush arbor journalled in bearings on said frame for rotation about an axis inclined to the horizontal, two axially spaced cylindrical rotary brushes mounted on said arbor for rotation therewith, drive means operative to drive said arbor and brushes; ball supporting means beneath said brushes adapted rotatably to support balls in engagement therewith comprising a carriage, screw means mounting said carriage on said frame for adjustable positioning toward and away from said brushes, two axially aligned open-ended troughs comprising plastic surfaced elongated bottom rollers and plastic surfaced side rollers mounted on said carriage for rotation about their axes parallel to said arbor, each said trough being disposed beneath a respective brush, and a short enclosed passageway between said troughs intermediate said brushes, said rollers being of a diameter not exceeding one-half the internal width of said troughs and the axes of said side rollers being no higher than the center of a ball resting in said trough with slight clearance in use.

15. Brushing mechanism for brushing spherical objects such as bearing balls and the like, comprising a brush arbor journalled for rotation about an axis inclined to the horizontal, two axially spaced cylindrical rotary

brushes mounted on said arbor for rotation therewith, drive means operative to drive said arbor and brushes; ball supporting means beneath said brushes adapted rotatably to support balls in engagement therewith comprising a carriage, means mounting said carriage for adjustable positioning toward and away from said brushes, two axially aligned open-ended troughs comprising elongated bottom rollers and side rollers mounted on said carriage for rotation about their longitudinal axes parallel to said arbor, each said trough being disposed beneath a respective said brush, and a short enclosed passageway between said troughs intermediate said brushes.

16. Brushing mechanism for brushing generally spherical objects, comprising a brush arbor journalled for rotation about an axis inclined to the horizontal, a cylindrical rotary brush mounted on said arbor for rotation therewith, drive means operative to drive said arbor and brush; ball supporting means beneath said brush adapted rotatably to support balls in engagement therewith comprising a carriage, means mounting said carriage for adjustable positioning toward and away from said brush, and an open-ended trough comprising an elongated bottom roller and two elongated side rollers mounted on said carriage for rotation about their longitudinal axes parallel to said arbor, said trough being disposed beneath said brush.

17. Brushing mechanism for brushing generally spherical objects, comprising a brush arbor journalled for rotation about an axis inclined to the horizontal, a cylindrical rotary brush mounted on said arbor for rotation therewith, drive means operative to drive said arbor and brush; ball supporting means beneath said brush adapted rotatably to support balls in engagement therewith comprising a carriage, means mounting said carriage for adjustable positioning toward and away from said brush, and an open-ended trough comprising an elongated bottom roller and two elongated side rollers mounted on said carriage for rotation about their longitudinal axes parallel to said arbor, said trough being disposed beneath said brush, wherein said rollers are of diameters not exceeding one-half the internal width of said trough and the axes of said side rollers are no higher above said bottom roller than a distance equal to one-half the internal width of said trough.

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