United States Patent [19]

Dillinger

[11] **3,758,994**

[45] **Sept. 18, 1973**

[54] **PORTABLE POWER DRIVEN SURFACE FINISHING DEVICE**

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[21] Appl. No.: **229,055**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 80,690, Oct. 14, 1970, abandoned.

[52] **U.S. Cl.** ..... **51/241 S**

[51] **Int. Cl.** **B24b 19/00**

[58] **Field of Search** ..... 51/241 R, 241 S, 51/241 B, 241; 90/12 R

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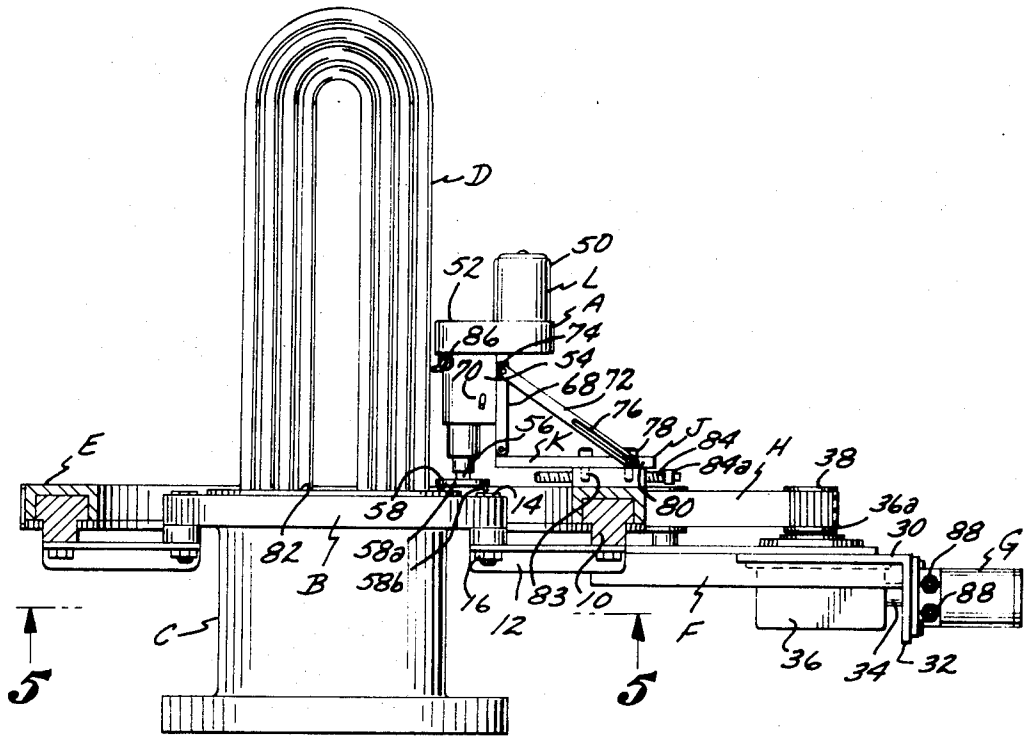
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[57] **ABSTRACT**

A portable power driven surface finishing device that is removably mountable on a vessel that occupies a fixed position in such a manner that a gasket engaging portion of a flange on said vessel may be machined even though the vessel has tubes or other obstructions projecting outwardly from the flange. The machining of the gasket-engaging surface or other surface portions of the flange adjacent thereto may include polishing, grinding, milling, routing and the like, as well as the drilling of circumferentially spaced bores in the flange at any desired angle relative thereto.

15 Claims, 9 Drawing Figures



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SHEET 1 OF 3

FIG.1

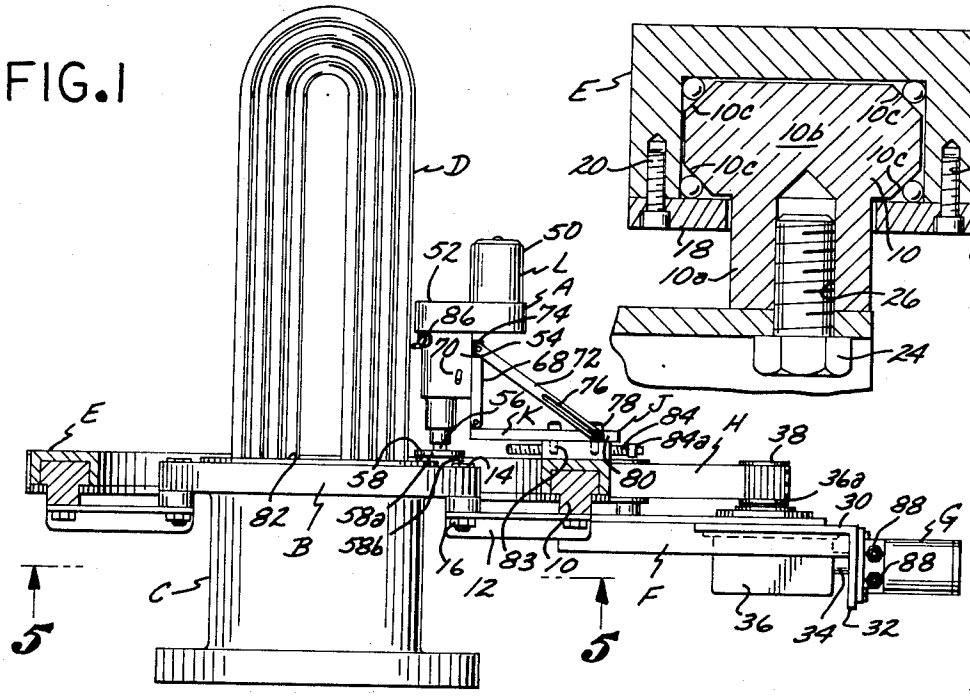
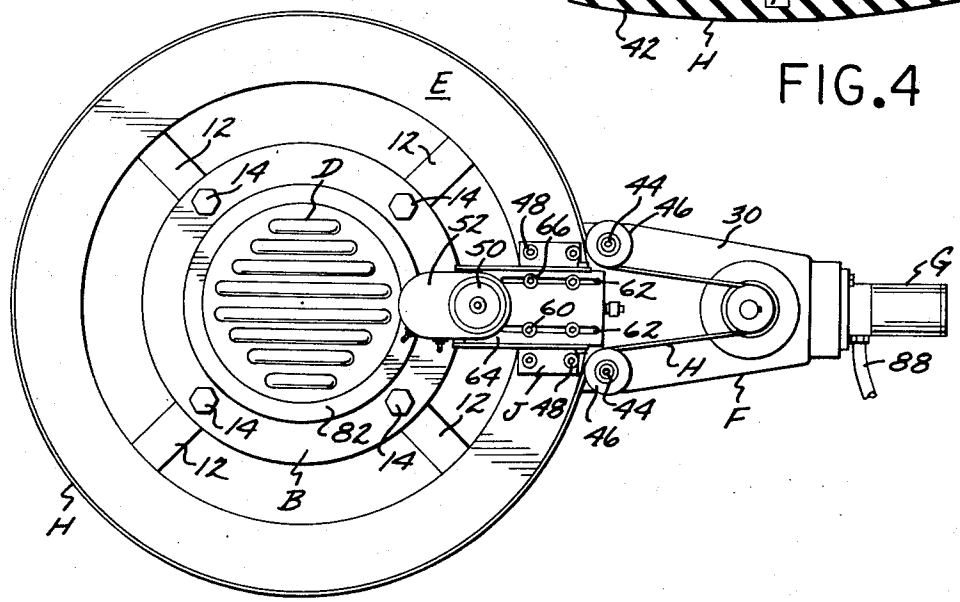


FIG.3

FIG.2



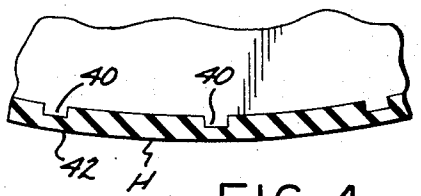


FIG.4

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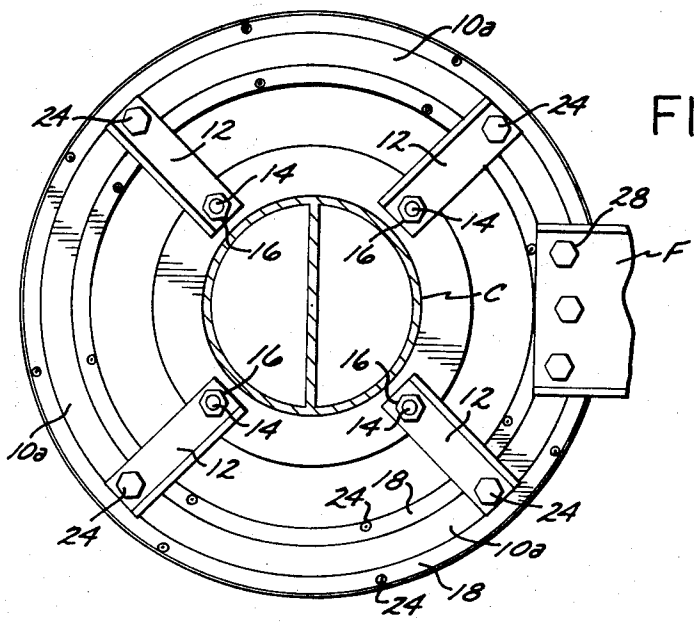


FIG. 5

FIG. 6

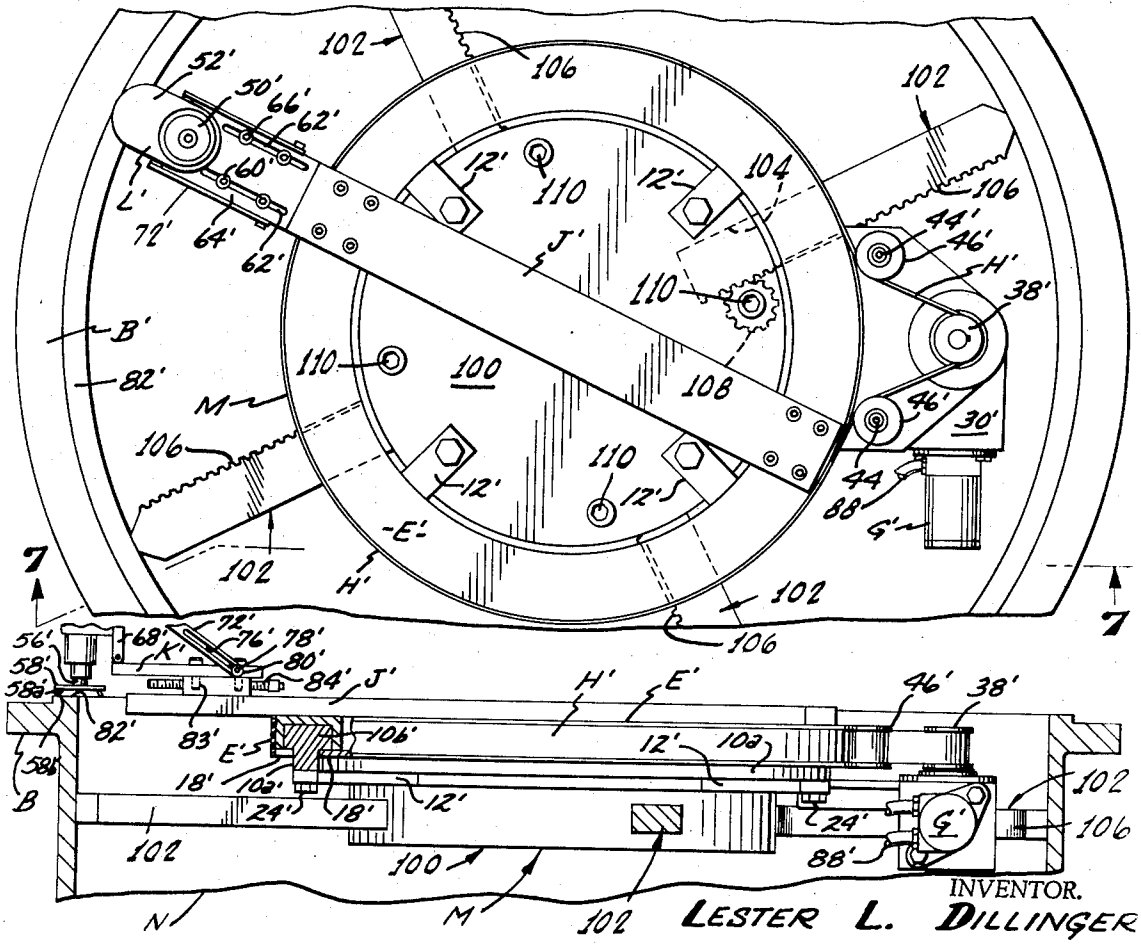


FIG. 7

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FIG.8

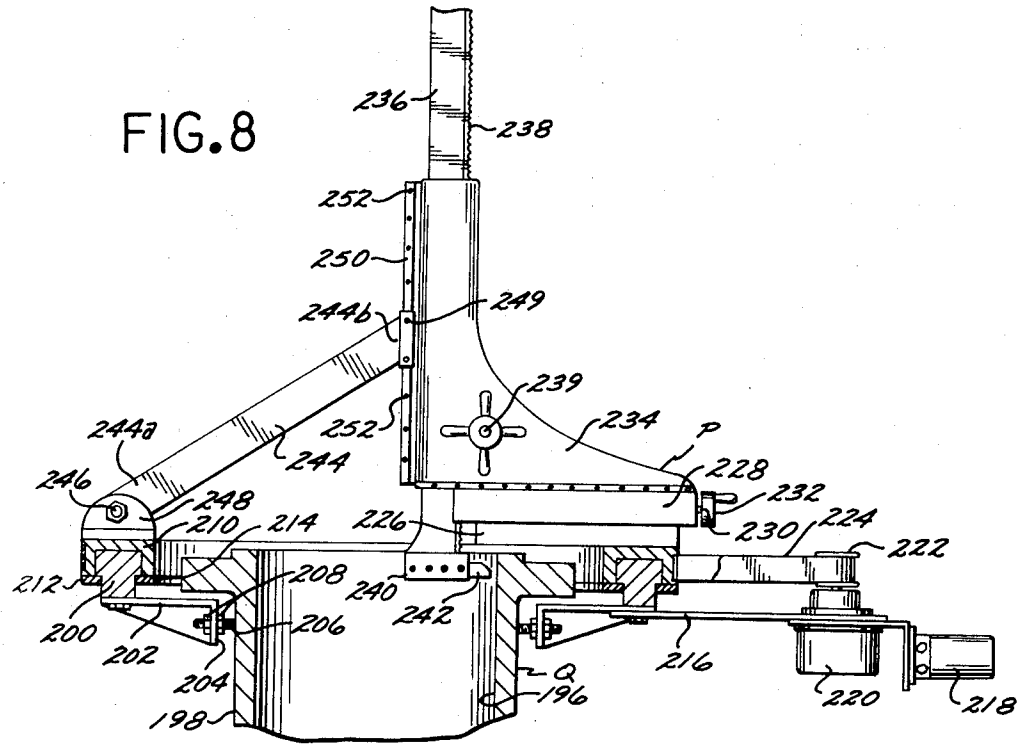
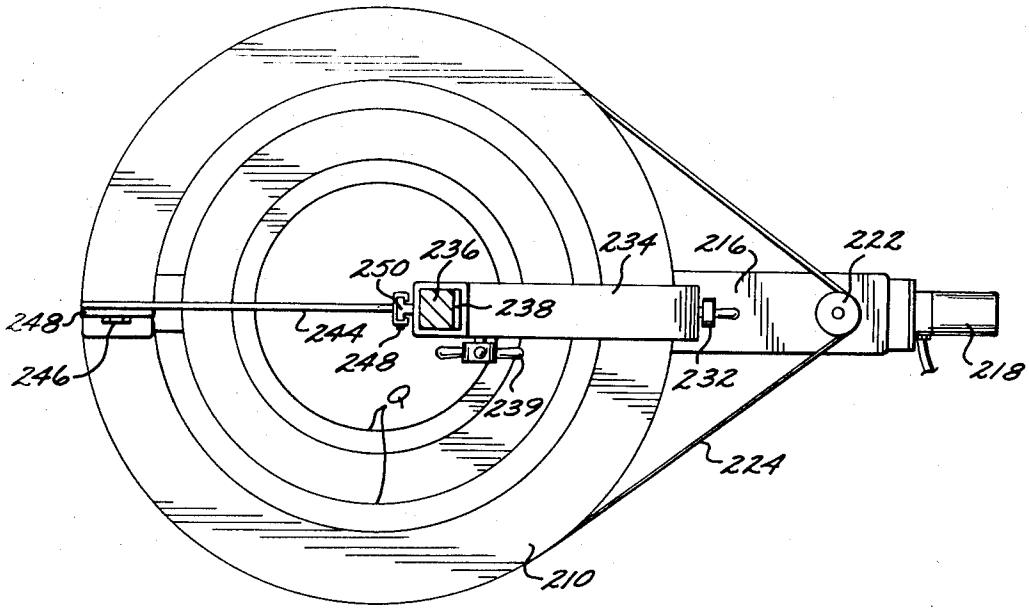

236
238
252
250
244a
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239
234
P
244a
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228
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248
232
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214
226
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224
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212
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200
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Q
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FIG.9


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224
210

PORTABLE POWER DRIVEN SURFACE FINISHING DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my co-pending application Ser. No. 80,690, filed in the United States Patent Office on Oct. 14, 1970, now abandoned entitled PORTABLE POWER DRIVEN SURFACE FINISHING DEVICE.

BACKGROUND OF THE INVENTION

1. Field of the Invention

A portable power driven device that may be removably mounted on flanges of a vessel to perform machining operations thereon.

2. Description of the Prior Art

In the chemical and refinery fields, massive vessels are employed that are impractical to move from the supports on which they are mounted. Such vessels have numerous flanged outlets, and after prolonged usage, such flanges must have machine work performed thereon, particularly as to the gasket-engaging portions thereof. In the past, such machining operations have only been performed with the greatest of difficulty, and with no degree of accuracy required to properly seal with companion flanges.

The primary purpose in devising the present invention is to provide a portable power driven device that may be removably mounted in a desired postion relative to a flange on which maintenance work is to be performed, and the flange when the device is so mounted being capable of being polished, ground, milled or routed, as well as bolt-receiving openings formed therein, all with the same degree of accuracy as though the operation were performed in a machine shop.

SUMMARY OF THE INVENTION

The present invention includes a continuous circular rail that by bracket means is secured to the flange of a vessel on which a machining operation is to be performed, with the rail rotatably supporting a ring. The rail supports a second outwardly extending bracket on which a first prime mover is mounted that rotates a driven pulley, and the pulley being engaged by an endless belt that extends to the exterior surface of the ring and causes the ring to rotate circumferentially relative to the flange. A second prime mover assembly is adjustably supported from the ring, and through a head that forms a part of the assembly drives a rotating member that is adapted to selectively support either a cutting, machining, polishing, routing or drilling device to permit desired work to be performed on the gasket-engaging portion of the flange, even though tubes or other obstructing members project from the flange.

A major object of the present invention is to provide a portable power driven device that is particularly adapted for removable mounting on the flange of a heavy vessel that is difficult to move from its normal position, with the device when so mounted capable of performing such machining operations on the flange as polishing, grinding, milling, routing, and the like, as well as the drilling of circumferentially spaced openings in the flange at any desired angle relative thereto.

Another object of the invention is to supply a device for the machining of flanges in the field that is of relatively simple mechanical structure, is simple and easy to use, can be fabricated from standard commercially available materials, and one which when used reduces the cost and the time consumed in effecting a machining operation on flanges that form part of a stationary vessel assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a first form of the device removably supported from a flange that forms a part of a stationary vessel;

FIG. 2 is a top plan view of the device shown in FIG. 1;

FIG. 3 is a fragmentary transverse cross-sectional view of the circular rail and the ring that is movably supported for circumferential movement thereon;

FIG. 4 is a fragmentary transverse cross-sectional view of a section of the ring and endless belt that is in postive engagement therewith;

FIG. 5 is a bottom plan view of the device shown in FIG. 1;

FIG. 6 is a top plan view of a first alternate form of the device;

FIG. 7 is a transverse cross-sectional view of the first alternate form of the device shown in FIG. 6 taken on the line 7-7 thereof;

FIG. 8 is a side elevational view of a device to form the interior of a fixed, vertical, large diameter pipe or vessel of cylindrical shape to be concentric relative to the exterior surface thereof; and

FIG. 9 is a top plan view of the device shown in FIG. 8.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The first form A of the device is shown in FIG. 1 as removably mounted on a flange B that forms a part of a heat exchanger C, which exchanger has a number of tubes D projecting upwardly from the flange B.

The first form A includes a continuous circular rail 10, as shown in FIGS. 1 and 3, which rail is, by a number of circumferentially spaced, horizontal, rigid members 12, secured to the flange B by bolts 14 that extend downwardly through bolt openings (not shown) in the flange. The members 12 are held in outwardly extending positions on the bolts 14 by nuts 16 that engage the bolts, as shown in FIG. 1. The members 12 are conveniently formed from angle iron.

The rail 10 is of T-shaped transverse cross section and includes a vertically extending portion 10*a* and horizontal portion 10*b*. The rail portion 10*b* is of rectangular cross section and has truncated corners 10*c*. A rigid ring E is provided as shown in FIGS. 1 to 3 inclusive that is of channel shape transverse cross section and is slidably and rotatably mounted on the rail portion 10*b*. The ring E has two circular rigid strips 18 secured to the lower extremities thereof by set screws 20. The strips 18 extend inwardly toward one another, with the inner surfaces of the strips being adjacently disposed to the vertical portion 10*a* of rail 10. The channel shape member E and strips 18 removably lock the ring E to the rail. Ball bearings 22 are disposed within the confines of the ring E, and are in rolling contact with the truncated portions 10*c* and internal corners defined within the interior of the channel shape ring E as shown in FIG. 3. The members 12 have vertically disposed openings (not shown) on the outer extremities

thereof through which bolts 24 extend upwardly to engage tapped bores 26 formed in the rail portion 10*a*.

A first bracket F, as best seen in FIGS. 1 and 5, extends outwardly from the rail 10, and is secured to the underside thereof by bolts 28. The bracket F includes a horizontal portion 30 and a downturned outer portion 32, as shown in FIG. 1. The vertical downturned bracket portion 32, as shown in FIG. 1, supports a first prime mover G that has a driven shaft 34 projecting inwardly therefrom through an opening (not shown) formed in the portion 32, and the driving shaft being connected to a gear reduction unit 36 that is secured to the underside of the horizontal bracket portion 30.

Gear reduction unit 36 has a driven shaft 36a projecting upwardly therefrom that has a cylindrical driving pulley 38 secured to the upper end thereof. The pulley 38 and the external surface of the ring E both have circumferentially spaced, vertically extending teeth 40 formed thereon, which teeth positively engage recesses 42 formed in an endless resilient belt H formed from rubber or the like that engages the exterior surface of the ring E and the driving pulley 38. The horizontal first bracket portion 30 supports two laterally spaced stub shafts 44, as may best be seen in FIG. 2, on which idling rollers 46 are mounted that rotatably engage the belt H to maintain a maximum interior surface of the belt in driving contact with the ring E.

A second bracket assembly J is secured by bolts 48 to the upper surface of the ring E, as may be seen in FIG. 2. Radially movement-adjustable means K are supported from the bracket J as sown in FIG. 1 and support a vertically and transversely adjustable second prime mover assembly L. The second prime mover assembly L includes a motor 50 that may be electrically or fluid actuated and has a driving shaft (not shown) that engages a gear reduction unit 52, which unit through a head 54 actuates and rotates a driving shaft 56 to which a fly cutter 58 or other rotatable machining tool (not shown) is secured. The second bracket J has two pairs of laterally spaced, radially aligned stud bolts 60 projecting upwardly therefrom, as may be seen in FIG. 2, that slidably engage two elongate slots 62 formed in plate 64 that forms a part of the adjustable support K. Nuts 66 are provided that threadedly engage the upwardly projecting portions of the bolt 60, with these nuts when tightened holding the plate 64 at a desired position relative to the bracket J. The plate 64 pivotally supports two parallel, laterally spaced first links 68 that have a plate (not shown) extending therebetween.

The head 54 by conventional means is secured to the plate (not shown) and may be moved upwardly and downwardly relative thereto by rotation of a handle 70, as best seen in FIG. 1. Two pairs of second links 72 are pivotally secured by pins 74 to the upper ends of first links 68. The second links 72 have elongate slots 76 formed therein that are slidably engaged by stud bolts 78 that project outwardly from the adjustable support K and are threadedly engaged by nuts 80. By loosening and tightening the nuts 80 the first links 68 may be disposed normal to the gasket-engaging portion 82 of the flange B that is to be machined.

The adjustable support K, as can best be seen in FIG. 1, has a tapped portion 83 in engagement with a threaded rod 84. The threaded rod 84 is rotatably supported by conventional means on the bracket J, and engages the tapped portion 83. Rod 84 includes a wrench-engageable portion 84a. Rotation of rod 84 results in transverse adjustment of machining member 58 relative to flange B.

The head 54 has a rotatable crank 86 mounted thereon, which crank when rotated permits the head 54, driving shaft 56 and rotatable tool 58 to be shifted transversely relative to the gasket-engaging portion 82 of the flange B. Details of the means by which the head 54 is shifted vertically by rotation of the handle 70 are not shown as such a mechanism is conventional, and that is also true of the mechanism actuated by rotation of the handle 86 that results in lateral adjustment of the head 54 relative to the support K.

The first prime mover G may be a motor that is actuated by fluid discharged through conduits 88 as shown in FIG. 1, with the fluid preferably being compressed air, although hydraulic fluid may be used if desired. Likewise, the prime mover G may be an electric motor.

The use and operation of the first form A of the invention is extremely simple. The first form A is removably mounted on the flange B by the means previously described in detail. The circular rail 10 has an internal diameter that is sufficiently large that the rail is disposed outwardly from the flange B and concentrically positioned relative thereto. The first form A of the device when so mounted has the fly cutting member 58 disposed to contact the gasket-engaging portion 82 of flange B. The prime mover G is now actuated, with the belt H being driven to rotate the ring E relative to the flange B, and as the ring is rotated the fly cutting member 58 is caused to move circumferentially relative thereto. However, prior to the first prime mover G being actuated, the second prime mover L is energized to cause rotation of the fly cutting member 58, and this member, as it moves circumferentially relative to the gasket-engaging portion 82, applying a desired surface finish thereto. The fly cutting member 58 includes a disc 58a that has one or more teeth 58b projecting downwardly therefrom. It will be particularly noted in FIG. 1 that the machining of the gasket-engaging ring-shaped surface 82, which is at an elevated position relative to the balance of the flange B, may be performed by use of the first form of the invention A, even though a bundle of tubes D extends upwardly above the flange.

A first alternate form M of the device is shown in FIGS. 6 and 7 that is particularly adapted for use in refacing the gasket-engaging portion 82′ of a flange B′ of large diameter, such as provided on vessels N having open ends, as shown in FIG. 7. Certain of the elements of the first alternate form M of the device as shown in FIGS. 6 and 7 are common to the first form A thereof. The elements in the first alternate form M that are common to the first form A are identified by the letters and numerals previously used, but with primes being added thereto as shown in FIGS. 6 and 7.

The first alternate form M of the device, as may best be seen in FIGS. 6 and 7, includes a cylindrical body 100 that has a number of circumferentially spaced legs 102 projecting from radially extending passages 104 formed therein. Each leg 102 is slidably movable in the passage 104 in which it is disposed. The legs 102 have teeth 106 formed on at least one longitudinal edge thereof, which teeth are in engagement with gears 108 located within the confines of the body. By manually rotating shafts 110 that non-rotatably engage the gears 108, the legs may be independently moved to friction-

ally engage the interior surface of vessel N, and hold the body **100** in a centered position relative thereto.

Second bracket J' is of elongate shape and extends diametrically across ring E' to which the second bracket J' is secured by conventional means. A portion of bracket J' extends beyond ring E' and has adjustable support K' mounted thereon. The second prime mover assembly L' is supported in a position where the fly cutter **58** can machine the gasket-engaging surface as ring E' is rotated relative to rail **10.**

The use and operation of the first alternate form M of the device is substantially the same as the first form A and accordingly need not be repeated.

A second alternate form P of the device is shown in FIGS. **8** and **9** that is used in forming an end portion of an interior cylindrical surface **196** of a large diameter pipe or vessel Q to be concentric with the external surface **198** thereof.

The device P, like the inventions previously described, includes a circular rail **200** that has a greater internal diameter that the external diameter of the pipe or vessel Q. Rail **200** is preferably of T-shape transverse cross section. A number of first L-shaped brackets **202** extend inwardly from the lower portion of rail **200** and are circumferentially spaced from each other. Each first bracket **202** includes an inwardly disposed, downwardly extending leg **204** that adjustably supports a stud bolt **206** that is engaged by two lock nuts **208.** The bolts **206** and nuts **208** are adjusted for the inner ends of the bolts to frictionally pressure contact external surface **198** to support rail **200** in a concentric position relative thereto.

A circular ring **210** of inverted channel shape transverse cross section is slidably mounted on rail **200,** and is removably held in position thereon by second and third rings **212** and **214** that are secured to the free edges of ring **210** by conventional fastening means (not shown). The second and third rings **212** and **214** slidably engage circular surfaces defined on the rail **200** as shown in FIG. **8.** Second and third rings **212** and **214** prevent inadvertent displacement of first ring **210** from rail **200.**

A second bracket **216** extends outwardly from first rail **200,** as shown in FIGS. **8** and **9,** and supports a prime mover **218** that drives a gear reduction unit **220.** Gear reduction unit **220** includes a driving pulley **222** that is engaged by an endless belt **224** that also engages the exterior surface of first ring **210** to rotate the latter relative to rail **200** at a relatively low speed.

A rigid, radially positioned member **226** is rigidly mounted on the upper surface of ring **210,** as shown in FIGS. **8** and **9,** and slidably supports a cross slide **228.** The member **226** and cross slide **228** removably interlock with one another to prevent inadvertent separation. A threaded rod **230** engages tapped portions (not shown) of member **226** and cross slide **228** to permit the cross slide to be moved longitudinally relative to the member when the rod **230** is rotated. Rotation of rod **230** is by a first wheel-shaped handle **232.**

Member **228** supports an upwardly extending rigid body **234** in which a heavy bar **236** is slidably mounted. Bar **236** has a toothed rack **238** extending along one longitudinal edge thereof that engages gear means (not shown) within the interior of the body. Rotation of the gear means (not shown) is accomplished by use of a second handle **239,** as illustrated in FIG. **8.** The lower end of bar **236** supports a head **240** in which a cutting tool **242** may be removably mounted by conventional means (not shown). By use of first handle **232,** tool **242** may be moved radially relative to interior surface **196.** Rotation of second handle **239** permits cutting tool **242** to be moved longitudinally relative to interior surface **196.**

A rigid reinforcing member **244** is pivotally supported on a first end **244*a*** thereof by a pin **246** from a lug **248** that extends upwardly from ring **210.** A second end **244*b*** may be adjustably secured by one or more pins **249** to a rigid strip **250** secured to body **234,** which strip has a number of longitudinally spaced openings **252** formed therein.

After the device P has been concentrically mounted on the pipe or vessel Q, as shown in FIGS. **8** and **9,** the prime mover **218** that is preferably an electric motor is energized to cause belt **224** to concurrently rotate ring **210** and the elements supported thereby relative to the pipe or vessel Q. The depth of the cut that will be taken by tool **242** is controlled by rotating handle **232.** The rate at which the cut takes place longitudinally relative to interior surface **196** is controlled by rotating handle **239.** After a desired section of the interior surface **196** has been made concentric with external surface **198,** the device P is removed from the pipe or vessel Q by reversing the procedure used in placing it in position thereon.

I claim:

1. A portable power driven device particularly adapted for surface finishing the gasket-engaging portion of a flange that forms a part of a vessel, said device comprising:

a. a continuous circular rail;

b. first means for removably supporting said rail in a fixed centered concentric position relative to said flange and parallel thereto;

c. a rigid ring of inverted transverse channel shape that extends downwardly over said rail and rotatable relative thereto;

d. a rigid first bracket supported from said first means;

e. a first prime mover mounted on said first bracket;

f. second means for rotating said ring by said first prime mover;

g. a rigid second bracket supported from said ring and parallel thereto;

h. a second prime mover disposed outwardly from said second bracket;

i. third means for adjustably supporting said second prime mover from said second bracket;

j. Rotatable surface finishing means driven by said second prime mover, said finishing means contacting said gasket-engaging portion of said flange; and

k. fourth means for actuating said first and second prime movers with said first prime mover concurrently moving said ring, second bracket, second prime mover, third means and finishing means circumferentially relative to said flange, and said finishing means as it is rotated by said second prime mover imparting a desired finish to said gasket-engaging portion as it moves circumferentially relative thereto.

2. A surface finishing device as defined in claim **1** in which said flange has an inner raised ring that defines said gasket engaging portion, and a plurality of circumferentially spaced bolt openings in said flange disposed outwardly from said raised portion, said rail having an

internal diameter greater than the external diameter of said flange, and said first means including:

l. a plurality of elongate rigid members that have first and second openings,said members having end portions thereof in abutting contact with said flange and said first openings axially aligned with said bolt openings in the end portions thereof;

m. a plurality of first bolts that extend through said bolt openings and said first openings;

n. a plurality of nuts that engage said bolts and support said members in outwardly extending positions relative to said flange; and

o. a plurality of bolts that extend through said second openings to engage tapped bores in said rail to support said rail from said members.

3. A surface finishing device as defined in claim **2** in which said rail is of T-shape transverse cross section, and said device further including:

p. first and second circular ribs that are secured to laterally spaced portions of said ring and extend towards one another, said first and second ribs cooperating with said ring to movably engage said rail to prevent said ring being inadvertently displaced therefrom.

4. A surface finishing device as defined in claim **3** in which said first prime mover is a motor and said second means includes:

q. a first pulley driven by said first prime mover, said first pulley and ring lying in a common plane; and

r. an endless belt that engages said first pulley and said ring.

5. A surface finishing machine as defined in claim **3** in which said third means includes:

q. a pair of laterally spaced first links extending outwardly from said second bracket and pivotally supported therefrom, said first links supporting said second prime mover therefrom, and said first links having axially aligned first openings in the outer ends thereof;

r. a pair of pins that extend through said first openings;

s. a pair of second links that have openings in first end portions thereof that pivotally engage said pins, said second links having longitudinal slots in second end portions thereof; and

t. screw means supported from said second bracket that adjustably engage said slots to permit said first links, second prime mover, and surface finishing means to be angularly adjusted relative to said gasket-engaging portion.

6. A surface finishing device as defined in claim **1** in which said rail has an exterior diameter that is substantially less than the interior diameter of said flange, and said first means includes:

l. a circular rigid body;

m. a plurality of rigid legs circumferentially spaced on said body and movable relative thereto, and said legs extending radially from said body; and

n. fifth means for adjustably moving said legs relative to said body for the outer ends of said legs to frictionally engage an interior surface of said vessel and support said body in a centered position relative to said flange.

7. A surface finishing device as defined in claim **6** in which said legs have teeth on at least one longitudinal side thereof and said fifth means is:

o. a plurality of gears rotatably supported on said body that engage said teeth, with said gears when selectively rotated imparting independent movement to said legs to permit said body to be centered relative to said flange.

8. A surface finishing device as defined in claim **6** in which said second bracket is of elongate shape and is diametrically positioned on said ring and of sufficient length that a first end portion thereof extends outwardly from said ring, and said third means being mounted on said outwardly extending portion.

9. A surface finishing device as defined in claim **8** in which said first prime mover is a motor and said second means includes:

q. a first pulley driven by said first prime mover, said first pulley and ring lying in a common plane; and

r. an endless belt that engages said first pulley and said ring.

10. A surface grinding device as defined in claim **8** in whcih said third means is mounted on said first end portion of said second bracket, and said third means includes:

q. a pair of laterally spaced first links extending outwardly from said second bracket and pivotally supported therefrom, said first links supporting said second prime mover therefrom, and said first links having axially aligned first openings in the outer ends thereof;

r. a pair of pins that extend through said first openings;

s. a pair of second links that have openings in first end portions thereof that pivotally engage said pins, said second links having longitudinal slots in second end portions thereof; and

t. screw means supported from said second bracket that adjustably engage said slots to permit said first links, second prime mover, and surface finishing means to be angularly adjusted relative to said gasket-engaging portion.

11. A portable power driven device particularly adapted for forming a desired longitudinal section of the interior surface of a large diameter cylindrical vessel to be concentric with the external diameter thereof, said device comprising:

a. a continuous circular rail having an internal diameter greater than the external diameter of said vessel;

b. first means for removably supporting said rail in an encircling position on said vessel and concentric relative thereto;

c. a rigid ring of inverted transverse, channel-shape cross section that extends downwardly over said rail and is rotatable relative thereto, said ring including a first upper surface;

d. a bracket that extends outwardly from said rail;

e. prime mover mounted on said bracket;

f. second means for rotating said ring by said prime mover;

g. a radially disposed rigid member supported from said first upper surface;

h. a cross slide movably mounted on said member for longitudinal movement relative thereto;

i. third means for moving said cross slide on said member;

j. a rigid body extending upwardly from said member;

k. an elongate bar movably supported from said body and normally disposed to said member;

l. fourth means for moving said bar relative to said body;

m. a head supported from one end of said bar, said head capable of being positioned within said vessel; and

n. a cutting tool supported from said head, with the depth of cut that said tool makes when said prime mover rotates said ring being controlled by said third means concurrently moving said cross slide, body, bar, head and tool towards or away from said interior surface and the rate at which said tool moves longitudinally being controlled by said fourth means that concurrently moves said bar, head and tool.

12. A portable power driven tool for finishing a surface of revolution of one end of a cylindrical work piece, comprising:

a. a continuous circular rail having a T-shaped cross-section;

b. first support means coupled to the bottom of the T of said rail and adapted to be removably attached to the work piece and adjustable relative thereto for positioning said rail in concentric alignment with the surface to be finished;

c. a ring having downwardly and inwardly depending edges which encompass the lateral T arms of said rail, and being rotatable thereon;

d. a surface finishing tool;

e. second support means coupling said tool to said ring in a fixed circumferential position thereon, and being adjustable for adjusting the position of said tool both radially and axially of said ring;

f. first power drive means coupled between said ring and said rail and selectively operable for rotating said ring; and

g. second power drive means coupled to said tool and adapted for driving said tool while said ring is rotating.

13. A portable power tool as claimed in claim **12** which further includes a plurality of sets of roller bearings confined between said ring and said rail for rotatably supporting said ring.

14. A portable power driven tool as claimed in claim **12** wherein said second support means is adapted to provide a feed drive for said tool while said tool is operating.

15. A portable power driven tool as claimed in claim **12** wherein the surface to be finished lies perpendicular to the longitudinal axis of the work piece, and said first support means is adapted to position said rail on the outside of the work piece and precisely parallel to the desired finish level of the surface.

* * * * *