

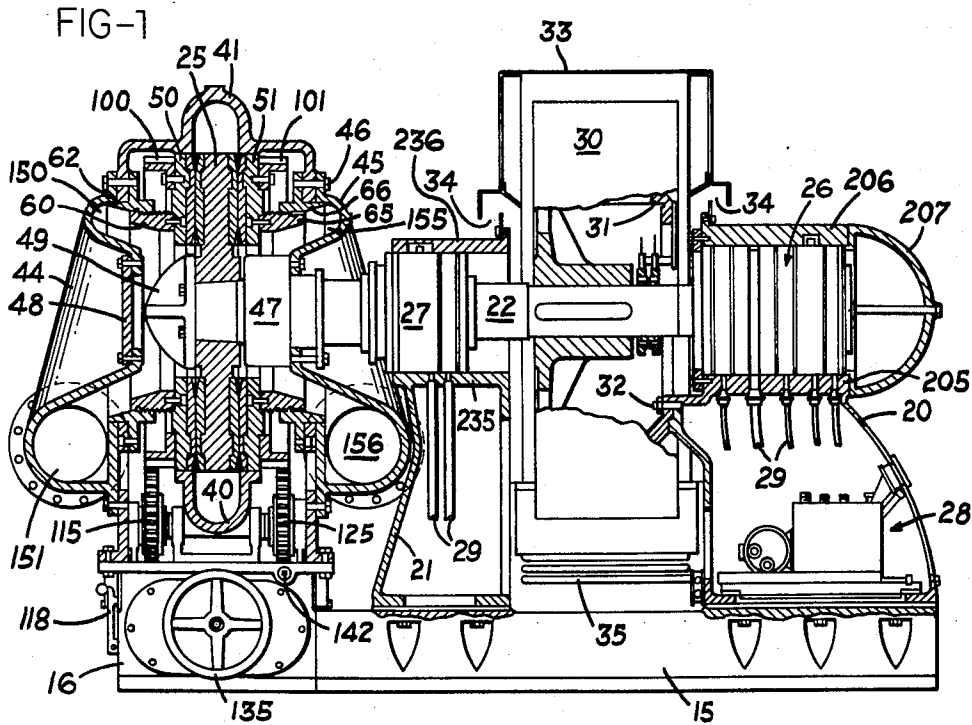
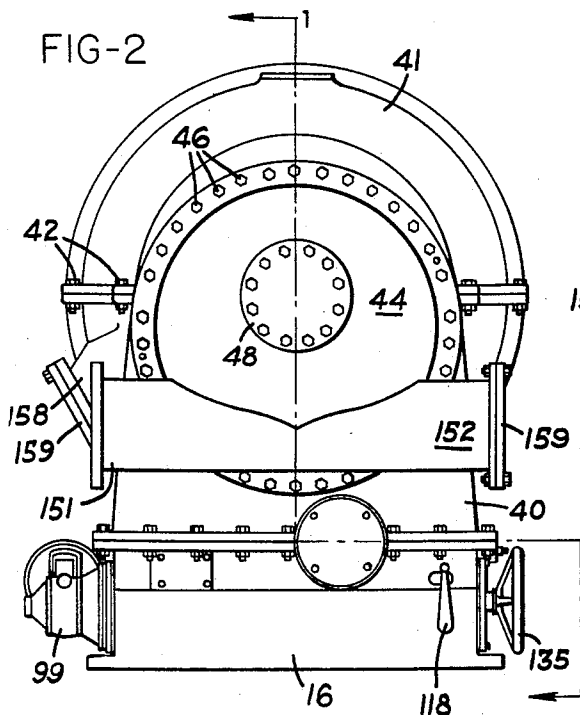
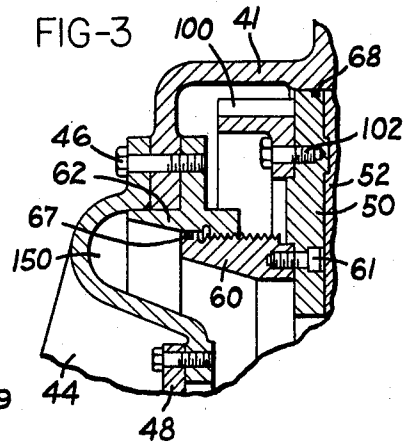
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PAPER MACHINERY

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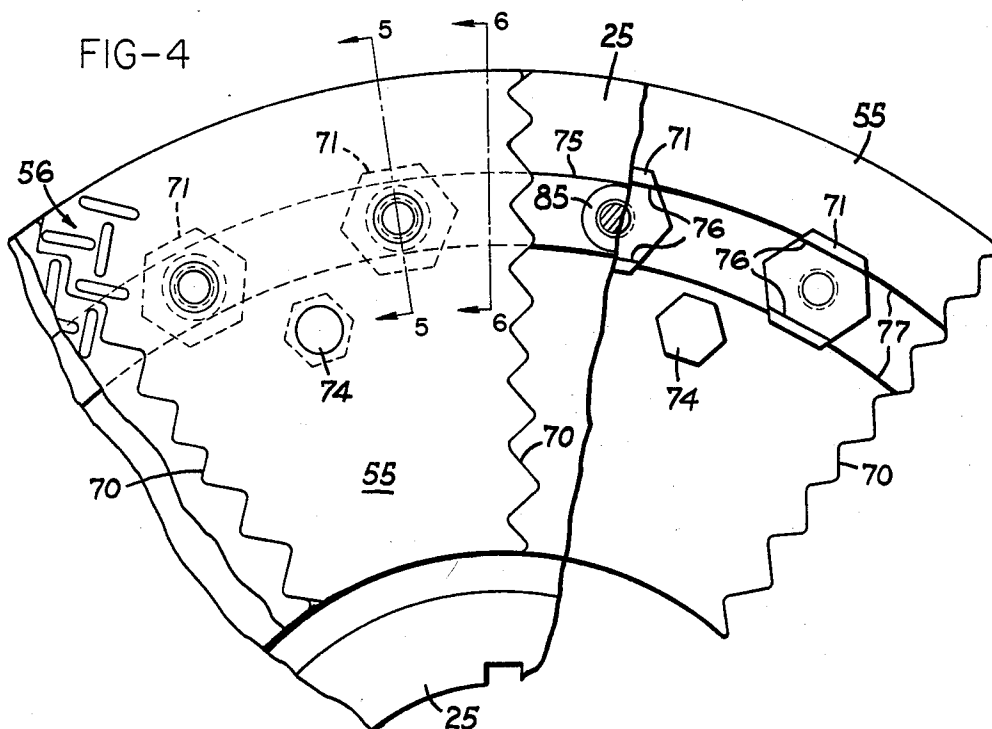
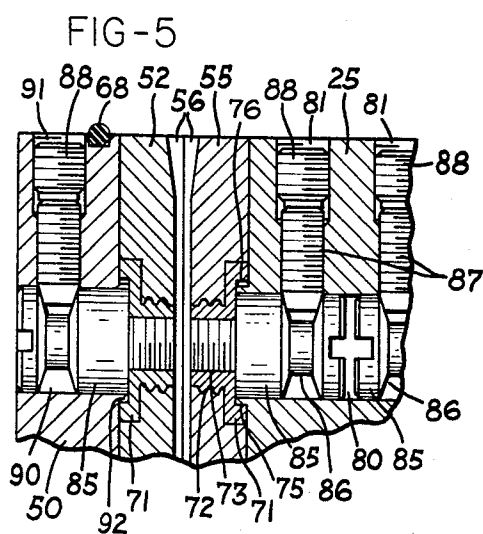
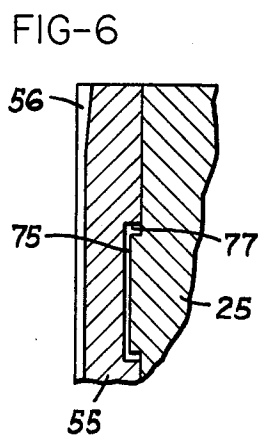
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5 Sheets-Sheet 2



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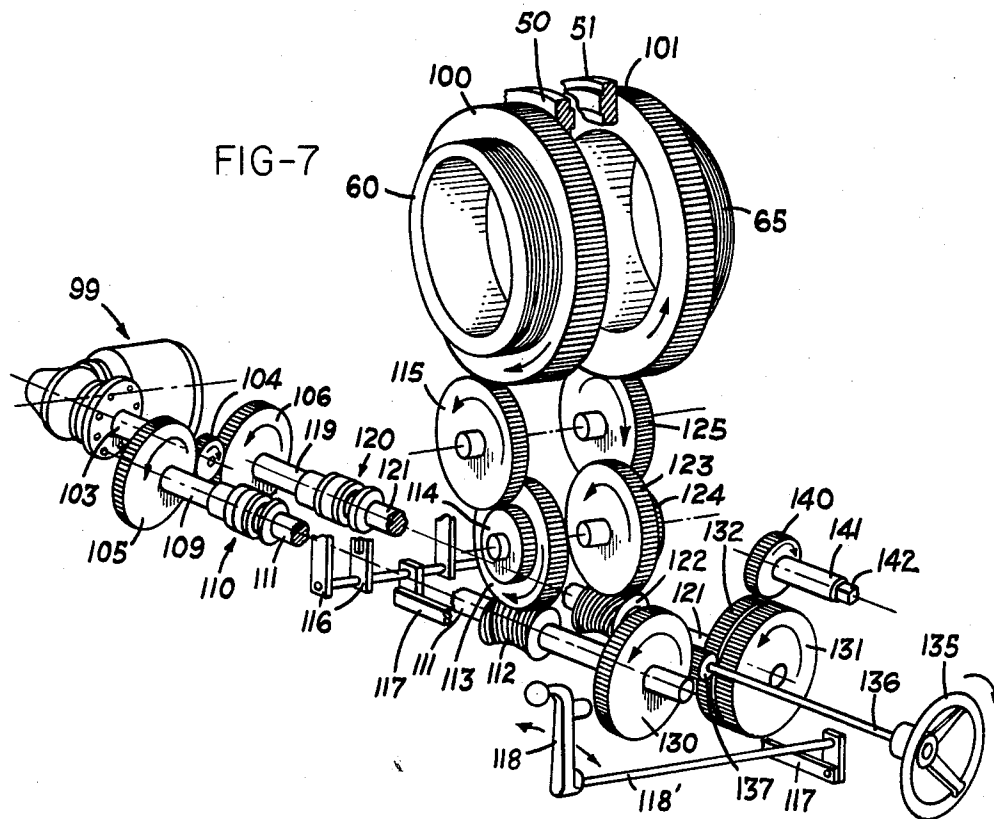
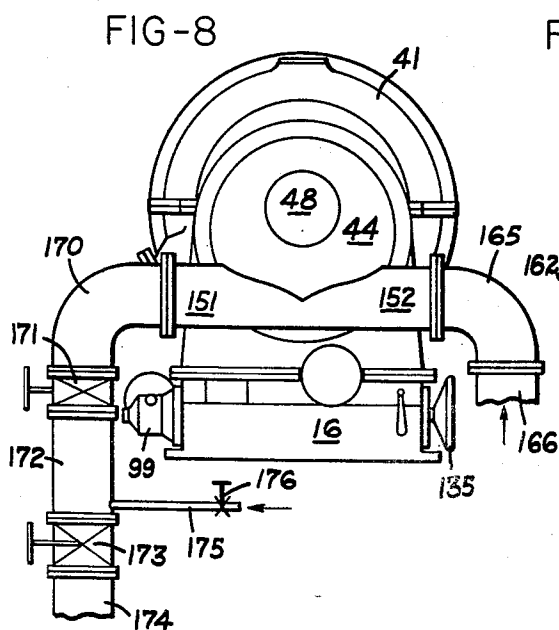
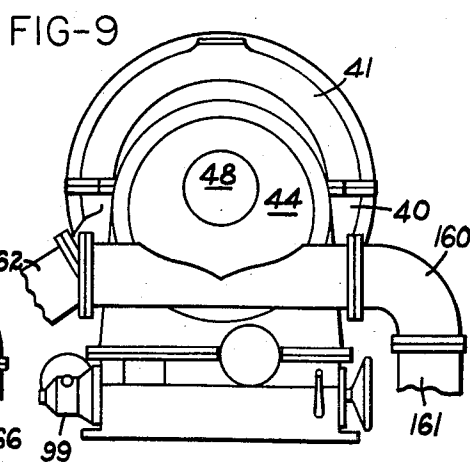
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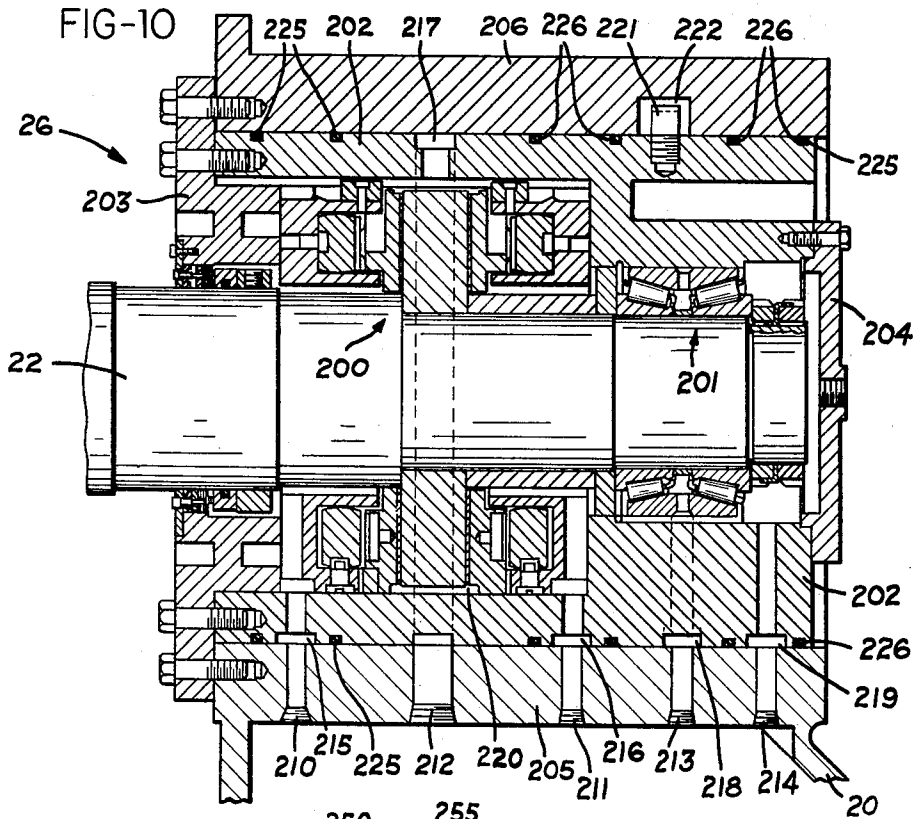
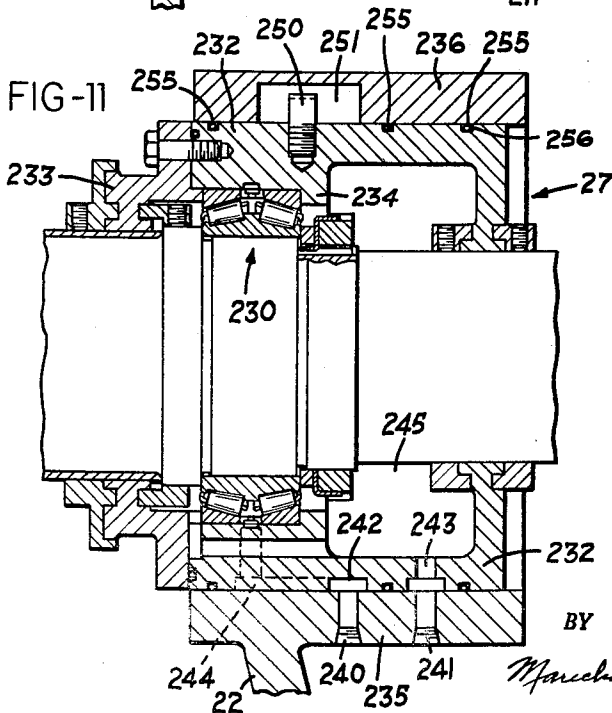
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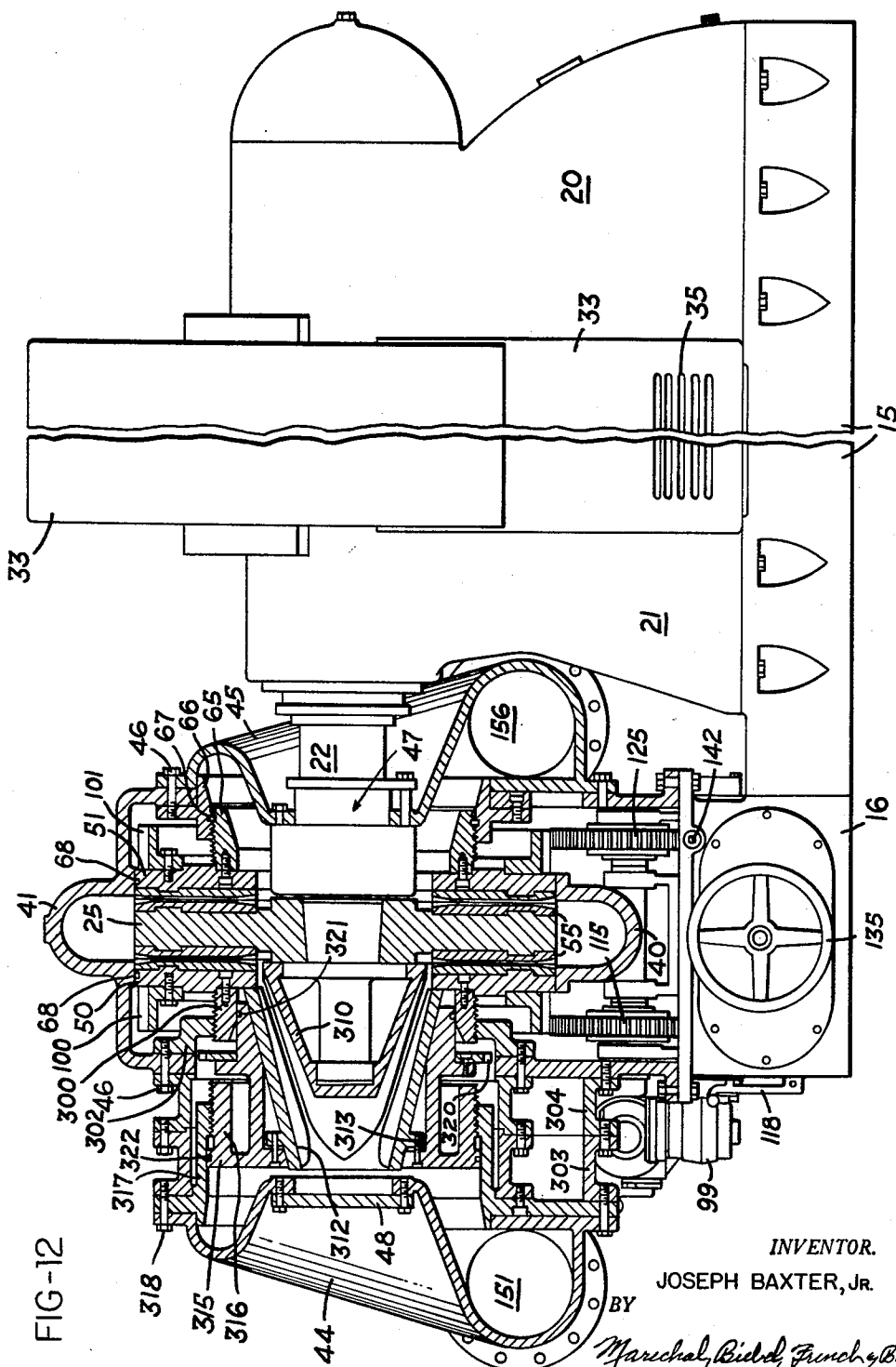


FIG-12

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Joseph Baxter, Jr., Franklin, Ohio, assignor to The Black-Clawson Company, Hamilton, Ohio, a corporation of Ohio

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13 Claims. (Cl. 241—163)

This invention relates to refining apparatus for paper making stock and the like.

The invention has particular relation to a refiner of the disk type, and it is a primary object of the invention to provide such a refiner which is of large size and capacity and which at the same time is of notably simple structural characteristics facilitating its construction, operation and maintenance while also having minimum space requirements and offering great versatility in its mode of operation.

Another object is to provide such a refiner wherein the rotor is maintained in fixed location with respect to the refiner housing, wherein the stationary work plates may be adjusted individually or jointly to predetermined spaced relation with the rotor, and particularly wherein the construction is of maximum strength and rigidity for positive support of all relatively rotating working members in desired maintained relation.

An additional object of the invention is to provide a disk type refiner as outlined above wherein the necessary piping connections are located for maximum convenience, and also wherein the refining plates on both the rotor and the stationary working plates can be changed with maximum ease and particularly without disturbing the piping connections.

It is also an object of the invention to provide a refiner having some or all of the above advantageous features which additionally offers maximum versatility from the standpoint of its inlet and outlet connections such that the incoming stock can be caused to flow with the radial component of force as in conventional attrition mills, entering from two ports on either side of the rotor to minimize end thrust, can be caused to flow against the radial component of the rotor by entering at the middle of the housing and flowing radially inwardly of the refining plates on both sides of the rotor, or can be introduced at one side of the rotor and caused to pass first radially outwardly of the rotor and then to pass radially inwardly along the opposite of the rotor for two-stage refining with the working clearances on opposite sides of the rotor being adjusted as desired in the same or different predetermined relation.

A further object of the invention is to provide a disk type refiner having an end cover member which serves as the inlet to the refining chamber and which is so constructed that it inherently directs tramp metal and like heavy reject material to a receiving trap before it can enter the working zones of the refiner and thus cause possible damage thereto.

A still further object of the invention is to provide a disk type refiner as outlined above which is constructed to include, as optional equipment, a conical plug on the rotor shaft and a cooperating shell located in side by side relation with the rotor and its associated work plates to afford an additional refining stage within the same unit.

Still another object of the invention is to provide a drive assembly having desirable advantages for a refiner

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of the type outlined above which is characterized by the simplicity and efficiency of the lubricating system for its main bearings, and particularly which is so constructed that the entire drive shaft assembly can be lifted out of its supporting structure for maintenance and replacement without the necessity for disconnection of any lubricant lines or fittings.

Among other objects of the invention is the provision of a disk type refiner in which the complementary refining members may be adjusted to desired working clearance while the machine is under full load, and particularly wherein such adjustment may be effected automatically in response to variation in the work load thereon.

Still other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings—

Fig. 1 is a view partly in side elevation and partly broken away in vertical section, as indicated by the line 1—1 of Fig. 2, showing a refiner constructed in accordance with the invention;

Fig. 2 is an end elevational view looking from left to right in Fig. 1;

Fig. 3 is an enlarged fragment of Fig. 1 illustrating details of the adjustable mounting of one of the stationary work plates in the housing;

Fig. 4 is an enlarged fragmentary view of one side of the rotor in the apparatus of Fig. 1 to show the construction and mounting arrangement of the refining plates;

Figs. 5 and 6 are fragmentary sectional views on the lines 5—5 and 6—6 respectively of Fig. 4;

Fig. 7 is a diagrammatic view in the nature of a perspective illustrating the drive for effecting adjusting movement of the stationary work plates with respect to the rotor in the apparatus of Fig. 1;

Fig. 8 is an end elevational view illustrating piping connections to one end of the apparatus of Figs. 1 and 2 in cooperation with a junk trapping mechanism;

Fig. 9 is a view similar to Fig. 8 showing alternative piping connections;

Fig. 10 is an enlarged fragmentary view in vertical section through the thrust bearing assembly and supporting structure for the drive shaft of the refiner of Fig. 1;

Fig. 11 is a view similar to Fig. 10 of the radial bearing assembly and supporting structure for the drive shaft of the refiner of Fig. 1; and

Fig. 12 is a view similar to Fig. 1 but on a larger scale illustrating a disk type refiner in accordance with the invention which also includes a refining plug and shell therein to provide a third refining stage.

Referring to the drawings, which illustrate preferred embodiments of the present invention, the main base of the apparatus is indicated at 15, and a gear box 16 is bolted rigidly to one end of base 15, to form in effect a part thereof. Two pedestals 20 and 21 are rigidly mounted on the base 15 and support the main drive shaft 22, which projects beyond the pedestal in overhanging relation with the base and carries the rotor 25 of the refining unit. The support for the shaft 22 in the pedestals is provided by a large thrust bearing assembly 26 in pedestal 20 and a large radial bearing assembly 27 in pedestal 21 of sufficient capacity to withstand all the load imposed on the shaft during operation of the refiner. The pedestal 20 also houses a lubricating system for both bearings which includes a pump unit 28 and lubricant lines shown fragmentarily at 29, as described in detail hereinafter in connection with Figs. 10 and 11.

The main drive motor for the refiner is also supported entirely by the pedestals 20 and 21 and is shown as of the inside-out type including a rotor 30 keyed on shaft 22 and a stator 31 bolted at 32 to the pedestal 20. The cover 33 for the motor includes provisions at 34 for the

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intake of cooling air, and air outlet openings 35 through the cover are provided below the motor. This motor construction and arrangement as shown provides a powerful and closely coupled drive to the rotor 25 as well as the advantageous flywheel effect of the motor rotor 30 for improved efficiency.

The refiner rotor 25 operates in a housing comprising a lower section 40 bolted on the gear box 16 and an upper section 41 bolted on housing section 40 at 42. End covers 44 and 45 which may be of identical construction are in turn secured by bolts 46 to the housing sections 40-41 and cooperate therewith to define the refining chamber which encloses the rotor 25. The drive shaft 22 extends through the cover 45 and is provided with a suitable packing box and gland assembly 47, and the corresponding opening at the end cover 44 is closed by a cover plate 48. A propeller 49 is shown on the end of shaft 22 for assuring adequate agitation of the stock adjacent the cover plate 48.

The refining chamber also houses a pair of annular stationary work plates 50 and 51 of identical construction which carry refining plates 52 for cooperation with similar refining plates 55 on the two sides of the rotor 25. The pattern of the working surfaces of the refining plates 52 and 55 is indicated at 56 and may take a variety of suitable conventional forms. The work plates 50 and 51 are mounted for adjustment within the housing axially of shaft 22 to vary the working clearances between the opposed two sets of work plates 52 and 55. Referring particularly to Fig. 3, a ring 60 is secured as by bolts 61 to the plate 50, and the outer surface of ring 60 is threaded for engagement with the complementary internally threaded surface of an annular supporting member 62 which is secured to the housing sections 40-41 and the end cover 44 by the bolts 46. The work plate 51 is provided with a similar pair of complementary adjusting and supporting members 65 and 66.

With this construction, threaded movement of the member 60 on supporting member 62 will cause the work plate 50 to move axially of shaft 22 and thus produce the desired variation of the clearance between the refining plates 52 thereon and the opposed set of refining plates 55 on the rotor 25. Simple and effective seals are provided between these relatively adjustable parts, and are shown in Fig. 3 as including an O-ring 67 between unthreaded portions of the parts 60 and 62 and a similar O-ring 68 mounted in a slot in the outer periphery of the work plate 50 for sealing engagement against an opposed smooth surface portion of the housing sections 40 and 41. Similar seals are provided for the work plate 51 which are not readily shown in the scale of Fig. 1.

Figs. 4-6 illustrate the means in accordance with the invention for mounting the plates 55 on the rotor 25, and similar means are also used for mounting the refining plates 52 on the stationary work plates 50 and 51. Each refining plate 55 is of generally sector shape and is provided with serrated edges 70 interfitting with the complementary edges of the adjacent refining plates. Each refining plate 55 has cast therein a pair of inserts 71 each having a hexagonal head and a ribbed shank portion 72 for positive interlocking with the body of the plate. The heads of inserts 71 lie flush with the inner surface of the plates 55, and each insert is also provided with a tapped through bore 73. The parts 74 in Fig. 4 are balancing inserts which may be filled with lead to varying extents required for proper balancing.

The rotor 25 has an annular rib or land 75 near the outer periphery of each side thereof, and the head 72 of each insert 71 is provided with a complementary groove 76 for interfitting with this rib. The remaining inner surface of each plate 55 is provided with a similar groove 77 having a lesser inner diameter and greater outer diameter than the rib 75 to prevent interference with the proper engagement of rib 75 in the grooves 76 which locates the refining plates radially on the rotor. The

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grooves 76 are preferably of slightly greater radial dimensions than the rib 75 to facilitate assembly of the part, and during operation of the unit, centrifugal force will tend to hold the inner rim of each groove 76 against the inner rim of the rib 75.

Provision is also made for positively locking the plates 55 against axial movement with respect to the rotor 25. The rotor is provided with a plurality of through bores 80 located to coincide with all of the respective bores 73 in the inserts 71. An additional pair of bores 81 extend radially into each bore 80 from the outer periphery of the rotor. A lock screw 85 is threaded into each of the bores 73, and it has an enlarged head provided with a circumferential groove 86 having tapered sides. The head of the screw 85 is of the proper dimensions for slip fitting into one of the bores 80, and a lock screw 87 is threaded into the adjacent bore 81 to provide cam action locking engagement of its tapered lower end with the groove 86. An additional lock screw 88 is threaded in the outer end of each bore 81 to lock against the outer end of the screw 87 therein.

This construction of the rotor and refining plates is duplicated on both sides of the rotor and also on the inner surface and outer periphery of each of the stationary work plates 50 and 51, as is indicated by the bores 90 and 91 and the rib or land 92 on the work plate 50 in Fig. 5. This construction and arrangement not only provides simple positive locating and maintaining of all the refining plates in proper position, but it greatly facilitates their exchange or replacement, since the locking screws 87 and 88 are accessible from the outer periphery of the rotor and stationary work plates, and after these screws have been loosened, it is necessary only to back the work plates off sufficiently from the rotor to provide clearance equal to the axial dimensions of the heads of the screws 85.

The drive for effecting adjusting movement of the work plates 50 and 51 with respect to the rotor 25 is best seen in Fig. 7, and it includes a drive unit identified generally as 99 which may effectively be of the structural and operational characteristics disclosed in Staeger et al. Reissue Patent 24,185, issued July 24, 1956, to the assignee of this application. This drive is ultimately transmitted to plates 50 and 51 through ring gears 100 and 101 secured to the back surfaces of plates 50 and 51 respectively by means of bolts 102 (Fig. 3). The drive shaft 103 of the drive unit 99 includes a spur gear 104 meshing simultaneously with a pair of gears 105 and 106 from which the drive is separately transmitted to the gears 100 and 101.

The gear 105 is on a shaft 109 connected through a clutch 110 with a shaft 111 carrying a cone gear 112. This gear 112 in turn meshes with a worm gear 113 connected with or otherwise driving a spur gear 114 meshing with an idler 115 which is also in mesh with the ring gear 100. The clutch 110 is shown as operated by clutch shoes 116 through a lever 117 and handle 118 mounted on a shaft 118' and located as shown in Figs. 1 and 2 on the end of the gear box 16 which houses this transmission.

The gear 106 is mounted on a shaft 119 which is connected through a clutch 120 with a shaft 121 carrying a cone gear 122 meshing with a worm gear 123. The worm gear 123 carries or otherwise drives a spur gear 124 which is in turn connected through an idler 125 with the gear 101. The clutch 120 is operated by clutch shoes 126 which are also actuated from the handle 118 in such manner that the clutches 110 and 120 may be engaged or disengaged simultaneously. The cone gears 112 and 122 are indicated as of opposite hands to effect driving of the gears 100 and 101 in opposite directions for simultaneous movement of the work plates 50 and 52 towards or away from the rotor 25. Furthermore, such adjusting movement can be effected automatically during operation of the unit to maintain constant refining

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conditions by connecting the drive unit 99 with the power circuits for the motor 30—31 for actuation in response to changes in the load on the refiner as disclosed in the above Patent Re. 24,185.

Provision is made for optional manual adjustment of either of the work plates 50 and 51 separately from the other, as may be desired for purposes such as to establish a greater working clearance between one pair of sets of refining plates than the other pair in order to maintain different refining conditions at the two working stages of the apparatus. As shown in Fig. 7, the shaft 111 carries a gear 130 near its forward end, and the shaft 121 carries a similar gear 131 which is axially offset from the gear 130. The shaft 121 also carries an idler gear 132 of the same size as gears 130 and 131 which is aligned with but spaced from the gear 130.

A hand wheel 135 is mounted outside the gear box 16 on a shaft 136 which in turn carries a spur gear 137 adapted to mesh with the gears 130, 131 and 132. The shaft 136 is mounted for axial movement to the extent required to establish meshing engagement of gear 137 with either of gears 130 and 131 individually, and also gear 137 is of sufficient axial extent to mesh with both of gears 130 and 131 simultaneously if it is desired to effect manual adjustment of both work plates simultaneously. During any such manual adjustment, the clutches 110 and 120 are disengaged.

As previously noted, exchange or replacement of any of the refining plates 55 requires initially that one or both of the work plates 50 and 51, depending upon the refining plates to be changed, be backed off from the rotor sufficiently to provide the necessary axial clearance for removal of the refining plates. Provision is accordingly made for rapid adjusting movement of both of the work plates by means of a gear 140 on a shaft 141 which projects through the front of the gear box 16 and is provided with means such as a squared outer end 142 for attachment to an air motor or other convenient power or manual drive (not shown). The gear 140 meshes with the idler 132, and when this drive is to be used, the hand wheel 135 is adjusted to the position wherein the gear 137 meshes with both of gears 130 and 131 to transmit thereto the drive from the idler 132.

The invention provides a selection of piping connections to and from the apparatus, depending not only on the layout of the installation but also on the refining conditions desired. Thus as previously noted, the end covers 44 and 45 are shown as of identical construction, and each is constructed to provide a pair of ports which may be used selectively as inlet or outlet ports for the refining chamber formed by the housing sections 40 and 41. In particular, and referring to Figs. 1 and 2, the end cover 44 is constructed to provide therein a pair of volute passages 150 extending in both directions from the bottom of the cover to the top thereof, and these passages in turn connect along the inner surfaces of the supporting member 62 and the ring 60 with the inner periphery of the refining plates 52 on the work plate 50 and their complementary set of refining plates 55 on the rotor 25.

Along its lower side, the end cover 44 is formed to provide a pair of ports 151 and 152 which lead generally tangentially from the passages 150 and in opposite directions toward the front and back of the machine respectively. The end cover 45 is similarly formed to provide a pair of volute passages 155 and a pair of tangentially extending ports, only the port 156 being seen in Fig. 1. In addition, the lower housing section 40 is provided with a port 158 communicating directly with the space within the housing which radially overlies the rotor 25.

This arrangement of ports as just described provides great versatility in the use of the refiner as well as maximum convenience in the piping connections therewith. For example, either of the ports 151 or 152 may be used as an inlet for stock to be passed between both sets of refining plates 52 and 55 for two-stage refining and ulti-

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mate discharge from the port 156 or its companion port at the front of the machine, or the reverse arrangement may be used. With any such arrangement, either the port 151 or 152, the port 158, and either the port 156 or its companion port will be closed as indicated at 159 in Fig. 2.

In another piping arrangement, illustrated in Fig. 9, one of the ports in each end cover 44 and 45 may be used as inlets, in which event the port 158 will form the outlet, and the stock will then be treated in only a single pass between one set of refining plates 52 and 55. This arrangement is illustrated in Fig. 9 by the elbow 160 and the pipes 161 and 162, and the converse arrangement may also be used, with the port 158 forming the inlet. In this event one of the ports in each end cover will provide the outlet as also shown in Fig. 9. With this latter piping arrangement, the stock must be forced against the radial component of the rotor, as is also the case on one side of the rotor when the stock is forced to flow from one end cover to the other as described above.

An important advantage of the end cover construction of the invention when either end cover is used as an inlet is illustrated in Fig. 8, which shows the port 152 as the inlet port connected by elbow 165 to the inlet supply pipe 166. This advantage is that both gravity and the flow pattern of the entering stock tend to direct tramp metal or other heavy reject material toward the unused port 151, and this port may accordingly be connected to a junk trap unit comprising an elbow 170, a first valve 171, a pipe section 172, a second valve 173 and a discharge pipe 174. In normal operation, the valve 171 will be opened and the valve 173 will be closed, and the heavy reject material will therefore be thrown through the port 151 and elbow 170 into the pipe section 172. At intervals, this reject material is easily removed by shutting valve 171 and then opening valve 173, and this may be done without interference with the normal flow of stock through the refiner. Improved operation is obtained by bleeding the small flow of water into the pipe section 172 just above the valve 173 as shown by the line 175 and valve 176 in Fig. 8.

The port arrangement of the invention as described and shown makes it readily possible to maintain all piping connections in relatively low positions, which in turn makes it relatively simple to brace or otherwise dampen the piping adjacent the machine against the transmission of vibration effects. Also, the inlet and outlet connections to the end covers may be located at either the front or back of the unit as suits the convenience of the installation. A further important advantage contributed to by the port arrangement of the invention is that all changes and adjustments of the refining plates may be carried out without disturbing the piping connections. During such maintenance or servicing operations, it is necessary to remove only the upper housing section 41, which may be done without disturbing either of the end covers 44 and 45 except for removal of the upper group of bolts 46. Thereafter, complete access may be had to all of the refining plates for servicing or replacement through the exposed upper half of the machine by simply turning the rotor 25 until all of the refining plates thereon have come successively within reach. The same result is obtained for the work plates 50 and 51 by manual rotation thereof through the hand wheel 135 as already described.

The construction and arrangement of the lubricating system for the bearings for the drive shaft 22 also contribute to the ease of maintenance of the refiners of the invention, and particularly they make it possible to remove and replace the drive shaft without the necessity of changing or disconnecting any lubricating lines or fittings. Thus referring first to Figs. 1 and 10, the thrust bearing assembly 26 for the opposite end of the drive shaft from the rotor 25 includes a Kingsbury thrust bearing 200 and a cone roller thrust bearing 201, both of which are en-

closed in a housing sleeve 202 provided with an end cover 203 and an end plate 204 for retaining the bearings in position therein. The housing 202 is in turn received on a semicylindrical seat portion 205 at the upper end of the pedestal 20, and a top cover 206 and end cover 207 complete this assembly.

The seat portion 205 of the pedestal 20 is provided with a plurality of lubricant ports for the lines 29, and these ports are shown as a pair of inlet ports 210 and 211 and an outlet port 212 for the bearing 200 and an inlet port 213 and outlet port 214 for the bearing 201. The housing 202 is provided in its outer surface with a similar series of ports 215-219 and connecting passages leading to the respective bearings therewithin, and it will be noted that the outlet port 217 for bearing 200 is at the top of housing 202 and connects with the port 212 by way of a circumferential groove 220 in the periphery of the housing to assure that bearing 200 always be full of oil.

The proper positioning of the housing 202 on the seat 205 both angularly and axially for registry of the respective mating ports 210-219 is assured by a pin 221 in the upper surface of the housing which fits within a slot 222 in the cap 206. Proper sealing of the respective ports against direct communication along the outside of the housing 202 is obtained by means of a plurality of O-rings 225 received in circumferential grooves 226 in the housing 202 between each pair of adjacent ports and between the ends of the housing and the ports 215 and 219 respectively. This construction accordingly makes it possible to remove the drive shaft and its thrust bearing assembly from the pedestal 20 after simply unbolting the cover 206, and when the parts are replaced, all the lubricant ports will automatically be properly aligned and reconnected by engagement of the several O-rings 225 with the seat 205 and cap 26 without the necessity for handling any connections or other fittings.

The construction of the radial bearing assembly 27 is similar with respect to the above characteristics of the thrust bearing assembly 26. Referring to Figs. 1 and 11, the cone roller bearing 230 is mounted in a housing sleeve 232 by means of an end cover 233 and an annular shoulder 234 within this housing. The pedestal 21 includes a semi-cylindrical seat portion 235 for receiving the housing 232, and the top cover 236 is bolted to the pedestal similarly to the cover 206.

The seat portion 235 of pedestal 21 is provided with an oil inlet port 240 and an outlet port 241 for a pair of lines 29, and the housing 232 is provided in its outer surface with inlet and outlet ports 242 and 243 as shown. A passage 244 leads from the port 242 to the interior of the bearing 230, and the housing 232 includes a reservoir chamber 245 connecting with the outlet port 243.

The correct angular and axial positioning of the housing 232 on seat 235 is established by a pin 250 in the top of the housing which is received in a slot 251 within the cover 236. Sealing of the lubricant ports against direct communication exteriorly of housing 232 is established by O-rings 255 received in grooves 256 in the outer surface of the housing. This bearing assembly may therefore be removed and replaced with the drive shaft in the same manner as the assembly 26 after simply removing the cover 236 and without the necessity for handling any lubricant lines or fittings.

Fig. 12 illustrates how the refiner described in connection with Figs. 1-11 may be readily converted to add a third refining stage incorporating a conical plug and complementary shell member. The majority of the parts shown in Fig. 12 may be identical with those in Figs. 1-11 and have therefore been given the same reference characters. The only changes are in certain of the parts located between the work plate 50 and the outer end cover 44, as now described.

The supporting members for the work plate 50 are of somewhat different construction from the members 60 and 62 but operate in similar manner, and they com-

prise a ring 300 bolted to the work plate 50 and having its outer surface threaded for engagement with the complementary internally threaded portion of the annular supporting member 302 which is secured within the housing sections 40 and 41 by the bolts 46. Instead of being mounted directly on the housing sections as in Fig. 1, the end cover 44 is mounted in spaced relation therewith by means of a pair of spacer sections 303 and 304 in order to provide increased space within the housing as a whole for receiving the conical refining plug 310, which is mounted on the end of the shaft 22 in the same position as the propeller 49 in Fig. 1.

The complementary shell member 312 for the plug 310 is secured as by bolts 313 to an annular supporting member 315. This member 315 has an outer threaded portion 316 engaging with the complementary internally threaded portion of a supporting member 317 which is generally similar in construction to the part 62 and is similarly secured as by bolts 318 to the end cover 44 and the outer spacer section 303. The member 315 is thus adjustable axially in a manner similar to the work plates 50 and 51, and it is shown as carrying a gear 320 adapted to form the final member in a suitable gear train comparable to that shown in Fig. 7 and which may be actuated either manually or by power from outside of the machine. The member 315 also may readily carry appropriate means for completing the proper sealing against the escape of liquid from within the unit, and such means are shown as an O-ring 321 bearing against the inner surface of the ring 300 and an O-ring 322 bearing against the inner surface of the part 318.

The machine shown in Fig. 12 offers all of the advantages already described in connection with Figs. 1-9, especially from the standpoint of servicing and maintenance. The normal manner of use would be to utilize one of the ports in the end cover 44 as the inlet, in order to take advantage of the pumping action of the conical plug to supplement the radial component on the outer surface of the rotor 25 in forcing the stock radially inwardly towards a discharge port in the end cover 45. It would, however, be equally possible to utilize any of the other piping arrangements previously described in connection with Figs. 8 and 9, and it will also be apparent that the device of Fig. 12 is well adapted for combination with a junk trap of the type shown in Fig. 8 as previously described.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Refining apparatus of the character described comprising a main base, pedestal means fixed to said base, drive means supported by said pedestal means and including a drive shaft projecting horizontally in overlying relation with said base, a rotor mounted on said shaft in supported relation with said pedestal means, means forming a housing mounted on said base separately from said pedestal means and defining a refining chamber enclosing said rotor, end covers secured on opposite sides of said housing and closing the sides of said chamber, means on said end cover adjacent said drive means receiving said drive shaft in rotatably sealed relation therethrough, a pair of work plates located within said chamber on opposite sides axially of said rotor, refining plates on both sides of said rotor, refining plates on said work plates for cooperation with said rotor refining plates, a supporting member for each said work plate secured to said housing and including a threaded cylindrical surface of substantially larger diameter than said drive shaft and substantially coaxial therewith, a mounting member secured to each said work plate and connected in threaded relation with said threaded surface of the adjacent said supporting member for adjusting movement thereon with

respect to said rotor, means operable from outside said housing for effecting said adjusting movement of each said work plate to vary the relative spacing of respective said refining plates, and means on each said end cover forming a port for use selectively as an inlet or outlet for said chamber.

2. Refining apparatus of the character described comprising a main base, pedestal means fixed to said base, drive means supported by said pedestal means and including a drive shaft projecting horizontally in overlying relation with said base, a rotor mounted on said shaft in supported relation with said pedestal means, means forming a housing mounted on said base separately from said pedestal means and defining a refining chamber enclosing said rotor, end covers secured on opposite sides of said housing and closing the sides of said chamber, means on said end cover adjacent said drive means receiving said drive shaft in rotatably sealed relation therethrough, a pair of work plates mounted on said housing on opposite sides axially of said rotor, refining plates on both sides of said rotor, refining plates on said work plates for cooperation with said rotor refining plates, each said end cover including a portion defining a pair of generally volute passages extending outwardly from said housing in both directions from the top thereof coaxially with said rotor, and means on each said end cover defining a pair of ports adjacent the bottom of said housing and connecting substantially tangentially with said volute passages for use selectively as inlets or outlets for said chamber.

3. Refining apparatus of the character described comprising a main base, pedestal means fixed to said base, drive means supported by said pedestal means and including a drive shaft projecting horizontally in overlying relation with said base, a rotor mounted on said shaft in supported relation with said pedestal means, means forming a housing mounted on said base separately from said pedestal means and defining a refining chamber enclosing said rotor, end covers secured on opposite sides of said housing and closing the sides of said chamber, means on said end cover adjacent said drive means receiving said drive shaft in rotatably sealed relation therethrough, a pair of work plates mounted on said housing on opposite sides axially of said rotor, refining plates on both sides of said rotor, refining plates on said work plates for cooperation with said rotor refining plates, each said end cover including a portion defining a pair of generally volute passages extending outwardly from said housing in both directions from the top thereof coaxially with said rotor, means on each said end cover defining a pair of ports adjacent the bottom of said housing and connecting substantially tangentially with said volute passages for use selectively as inlets or outlets for said chamber, a supporting member for each said work plate secured to said housing in surrounding relation with the adjacent said pair of volute passages and including a threaded cylindrical surface, a mounting member on each said work plate connected in threaded relation with the adjacent said supporting member and cooperating therewith to form the outer wall of a passageway connecting the adjacent pair of volute passages with the inner periphery of said refining plates or the adjacent said work plate, and means for effecting selective threaded movement of said mounting members on said supporting members respectively to vary the axial spacing of said refining plates.

4. Refining apparatus of the character described comprising a main base, pedestal means fixed to said base, drive means supported by said pedestal means and including a drive shaft projecting horizontally in overlying relation with said base, a rotor mounted on said shaft in supported relation with said pedestal means, means forming a housing mounted on said base separately from said pedestal means and defining a refining chamber enclosing said rotor, end covers of substantially identical structure

secured on opposite sides of said housing and closing the sides of said chamber, means on said end cover adjacent said drive means receiving said drive shaft in rotatably sealed relation therethrough, a pair of work plates mounted on said housing on opposite sides axially of said rotor, refining plates on both sides of said rotor, refining plates on said work plates for cooperation with said rotor refining plates, each said end cover including a portion defining a pair of generally volute passages extending outwardly from said housing in both directions from the top thereof coaxially with said rotor, means on each said end cover defining a pair of ports adjacent the bottom of said housing and connecting substantially tangentially with said volute passages for use selectively as inlets or outlets for said chamber, and means on said housing forming an additional port for use selectively as an inlet or outlet for said chamber.

5. Refining apparatus of the character described comprising a main base, pedestal means fixed to said base, drive means supported by said pedestal means and including a drive shaft projecting horizontally in overlying relation with said base, a rotor mounted on said shaft in supported relation with said pedestal means, a plurality of sections forming a housing mounted on said base separately from said pedestal means and defining a refining chamber enclosing said rotor, end covers secured on opposite sides of said housing and closing the sides of said chamber, means on said end cover adjacent said drive means receiving said drive shaft in rotatably sealed relation therethrough, a pair of work plates mounted on said housing on opposite sides axially of said rotor, refining plates on both sides of said rotor, refining plates on said work plates for cooperation with said rotor refining plates, means on each said end cover forming a port for use selectively as an inlet or outlet for said chamber, said housing sections being proportioned to overlie radially the peripheries of said rotor and said work plates, releasable means mounted in the peripheral surfaces of said rotor and said work plates for securing said refining plates thereto respectively, and means removably securing one of said housing sections to the remainder of said housing to expose said releasable means for access for exchange of said refining plates without affecting said ports.

6. Refining apparatus of the character described comprising a main base, pedestal means fixed to said base, drive means supported by said pedestal means and including a drive shaft projecting horizontally in overlying relation with said base, a rotor mounted on said shaft in supported relation with said pedestal means, a plurality of sections forming a housing mounted on said base separately from said pedestal means and defining a refining chamber enclosing said rotor, end covers secured on opposite sides of said housing and closing the sides of said chamber, means on said end cover adjacent said drive means receiving said drive shaft in rotatably sealed relation therethrough, a pair of work plates mounted on said housing on opposite sides axially of said rotor, refining plates on both sides of said rotor, refining plates on said work plates for cooperation with said rotor refining plates, means on each said end cover forming a port for use selectively as an inlet or outlet for said chamber, said housing sections being proportioned to overlie radially the peripheries of said rotor and said work plates, releasable means mounted in the peripheral surface of said rotor and said work plates for securing said refining plates thereto respectively, means removably securing one of said housing sections to the remainder of said housing to expose said releasable means for access for exchange of said refining plates, means forming a threaded connection between said housing and each of said work plates, and means cooperating with said threaded connection for rotating said work plates selectively to bring the entire periphery thereof progressively into such exposed position.

7. Refining apparatus of the character described comprising a main base, pedestal means fixed to said base,

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drive means supported by said pedestal means and including a drive shaft projecting horizontally in overlying relation with said base, a rotor mounted on said shaft in supported relation with said pedestal means, upper and lower housing sections mounted on said base separately from said pedestal means and defining a refining chamber enclosing said rotor, end covers secured on opposite sides of said housing sections and closing the sides of said chamber, means on said end cover adjacent said drive means receiving said drive shaft in rotatably sealed relation therethrough, a pair of work plates mounted on said housing sections on opposite sides axially of said rotor, refining plates on both sides of said rotor, refining plates on said work plates for cooperation with said rotor refining plates, means on each said end cover forming a port for use selectively as an inlet or outlet for said chamber, said housing sections being proportioned to overlie radially the peripheries of said rotor and said work plates, complementary means on the faces of said rotor and said work plates and on the backs of said refining plates for indexing said refining plates radially in working positions on said faces respectively, releasable means extending radially through the outer peripheral surfaces of said rotor and said work plates for locking said refining plates axially in said working positions, and means removably securing said upper housing section to said lower section to expose said releasable means for access for exchange of said refining plates.

8. Refining apparatus of the character described comprising a main base, pedestal means fixed to said base, drive means supported by said pedestal means and including a drive shaft projecting horizontally in overlying relation with said base, a rotor mounted on said shaft in supported relation with said pedestal means, upper and lower housing sections mounted on said base separately from said pedestal means and defining a refining chamber enclosing said rotor, end covers secured on opposite sides of said housing sections and closing the sides of said chamber, means on said end cover adjacent said drive means receiving said drive shaft in rotatably sealed relation therethrough, a pair of work plates mounted on said housing sections on opposite sides axially of said rotor, refining plates on both sides of said rotor, refining plates on said work plates for cooperation with said rotor refining plates, means on each said end cover forming a port for use selectively as an inlet or outlet for said chamber, means on said lower housing section forming a third port for said chamber, said housing sections being proportioned to overlie radially the peripheries of said rotor and said work plates, releasable means extending radially through the outer peripheral surfaces of said rotor and said work plates, releasable means extending radially in working positions, and means removably securing said upper housing section to said lower section to expose said releasable means for access for exchange of said refining plates without affecting any of said ports.

9. Refining apparatus of the character described comprising a main base, a plurality of sections forming a housing mounted on said base and defining a refining chamber, end covers secured on opposite sides of said housing sections and closing the sides of said chamber, a rotor supported for rotation within said chamber in substantially parallel relation with said end covers, a pair of work plates mounted on said housing sections on opposite sides axially of said rotor, refining plates on both sides of said rotor, refining plates on said work plates for cooperation with said rotor refining plates, said housing sections being proportioned to overlie radially the peripheries of said rotor and said work plates, releasable means mounted in the peripheral surfaces of said rotor and said work plates for securing said refining plates thereto respectively, means removably securing one of said housing sections to the remainder of said housing to expose said releasable means for access for exchange of said refining

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plates, and means on each said end cover forming a port for use selectively as an inlet or outlet for said chamber.

10. Refining apparatus of the character described comprising a main base, a plurality of sections forming a housing mounted on said base and defining a refining chamber, a rotor supported for rotation within said chamber, a pair of work plates mounted on said housing sections on opposite sides axially of said rotor, refining plates on both sides of said rotor, refining plates on said work plates for cooperation with said rotor refining plates, said housing sections being proportioned to overlie radially the peripheries of said rotor and said work plates, releasable means mounted in the peripheral surfaces of said rotor and said work plates for securing said refining plates thereto respectively, means removably securing one of said housing sections to the remainder of said housing to expose said releasable means for access for exchange of said refining plates, means forming a threaded connection between said housing and each of said work plates, and means for rotating each said work plate on its said threaded connection to vary the clearance thereof with respect to said rotor and to bring the entire periphery thereof progressively into said exposed position.

11. Refining apparatus of the character described comprising a main base, a plurality of sections forming a housing mounted on said base and defining a refining chamber, a rotor supported for rotation within said chamber, a pair of work plates mounted on said housing sections on opposite sides axially of said rotor, refining plates on both sides of said rotor, refining plates on said work plates for cooperation with said rotor refining plates, said housing sections being proportioned to overlie radially the peripheries of said rotor and said work plates, complementary means on the faces of said rotor and said work plates and on the backs of said refining plates for indexing said refining plates radially in working positions on said faces respectively, releasable means mounted in the peripheral surfaces of said rotor and said work plates for locking said refining plates thereto respectively in said working positions, and means removably securing one of said housing sections to the remainder of said housing to expose said releasable means for access for exchange of said refining plates.

12. Refining apparatus of the character described comprising a main base, pedestal means fixed to said base, drive means supported by said pedestal means and including a drive shaft projecting horizontally in overlying relation with said base, a rotor mounted on said shaft in supported relation with said pedestal means, means forming a housing mounted on said base separately from said pedestal means and defining a refining chamber totally enclosing said rotor, means on said housing adjacent said drive means receiving said drive shaft in rotatably sealed relation therethrough, a pair of work plates located in said housing on opposite sides axially of said rotor, refining plates on both sides of said rotor, refining plates on said work plates for cooperation with said rotor refining plates, means forming a threaded mounting for each of said work plates in said housing, means for rotating each said work plate on said threaded mounting therefor to adjust the axial spacing thereof with respect to said rotor, a refining plug mounted on the end of said shaft and located radially inwardly of and in axially outwardly spaced relation with the adjacent said work plate, a complementary refining shell in said housing forming with said plug a frustoconical refining zone connecting at the larger end thereof with the inner periphery of said adjacent work plate, means for adjusting the axial position of said shell with respect to said plug to vary the effective working clearance therebetween across said refining zone, and means on said housing forming a port leading to the smaller end of said plug and an additional port connecting with said refining chamber on the opposite side of the said rotor from said plug.

13. Refining apparatus of the character described com-

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prising a main base, pedestal means fixed to said base, drive means supported by said pedestal means and including a drive shaft projecting horizontally in overlying relation with said base, a rotor mounted on said shaft in supported relation with said pedestal means, upper and lower housing sections mounted on said base separately from said pedestal means and defining a refining chamber enclosing said rotor, inner and outer end covers secured on opposite sides of said housing sections and closing the sides of said chamber, means on said inner end cover receiving said drive shaft in rotatably sealed relation therethrough, a pair of work plates located on opposite sides axially of said rotor, means forming a threaded mounting for each of said work plates on the adjacent said housing section, means for rotating each of said work plates on said threaded mounting therefor to adjust the axial spacing thereof with respect to said rotor, refining plates on both sides of said rotor, refining plates on said work plates for cooperation with said rotor refining plates, spacer means secured to said outer end cover and to said housing sections to support said end cover in axially spaced relation from said housing sections and to define a refining zone located between said

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end cover and said refining chamber, a refining plug mounted on the end of said shaft within said refining zone and of smaller maximum diameter than the inner diameter of the adjacent said work plate, a complementary refining shell for said plug, means forming an axially adjustable mounting for said shell on said spacer means for effecting variation of the working clearance between said shell and said plug, means defining an inlet port leading to the smaller end of said plug through said outer end cover, and means forming an outlet port in said inner end cover.

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