Aug. 6, 1963 M. RANDALL 3,100,105

DEGREASER

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FIG. 1

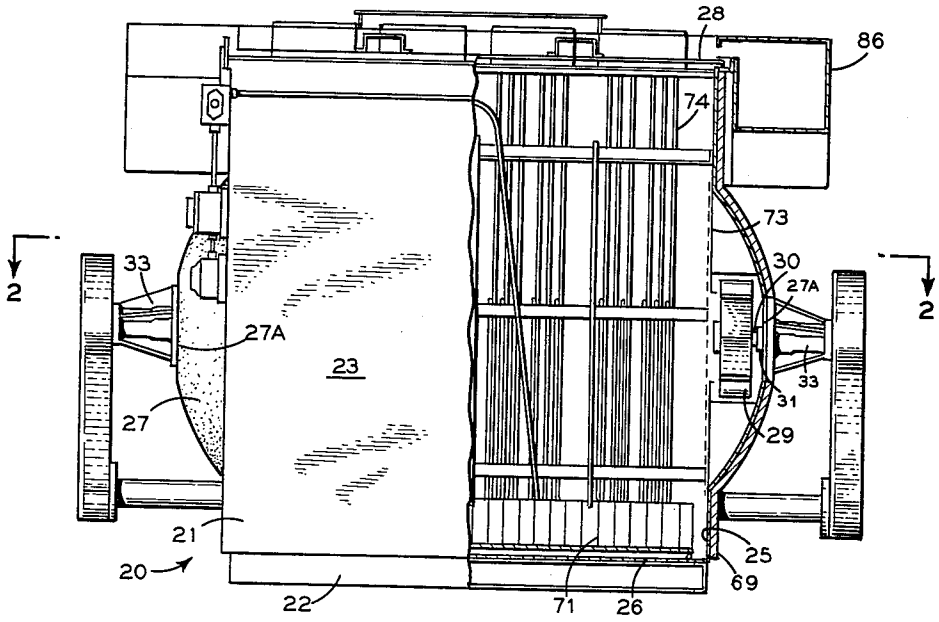
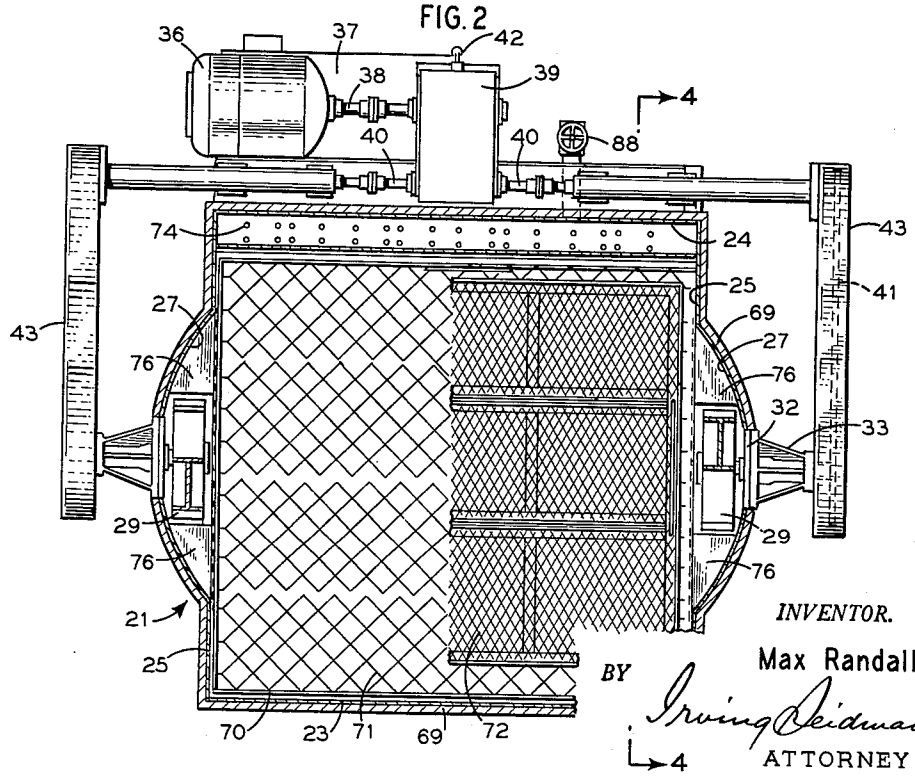


FIG. 2



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FIG. 3

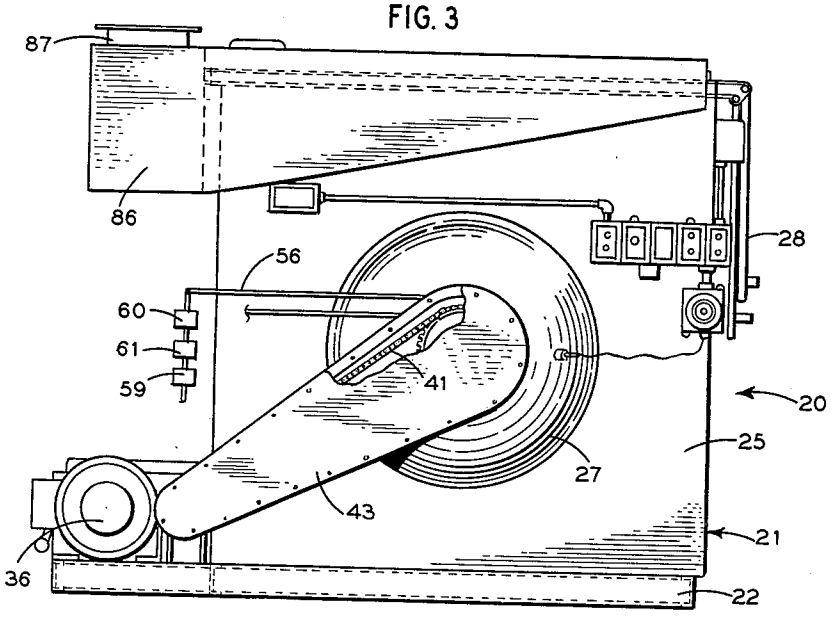
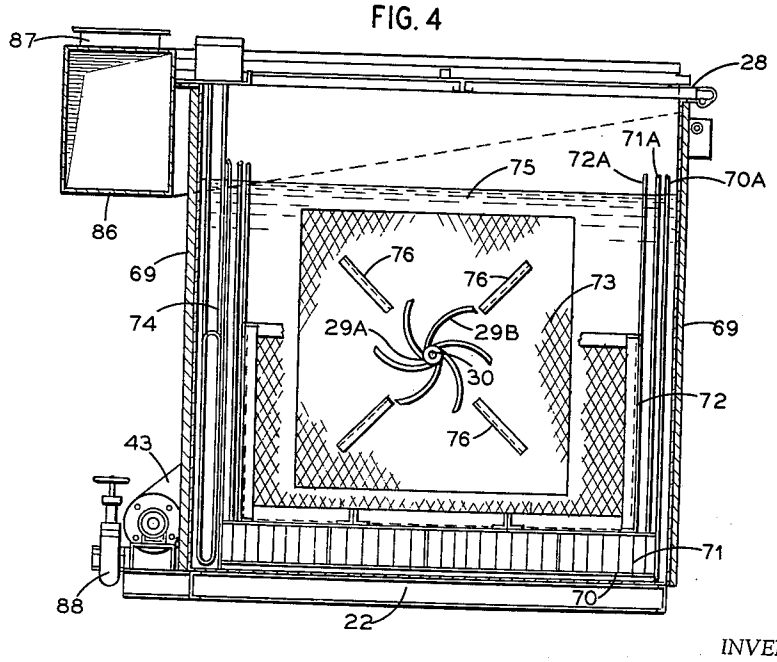


FIG. 4



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FIG. 5

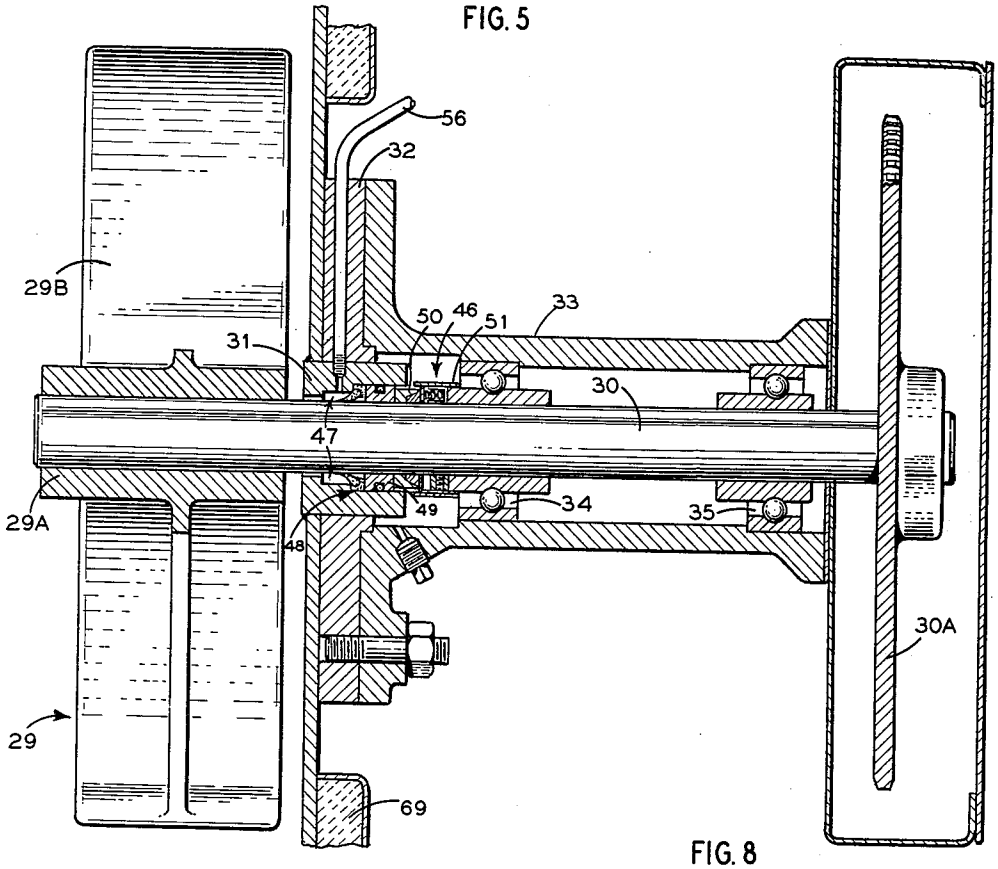


FIG. 8

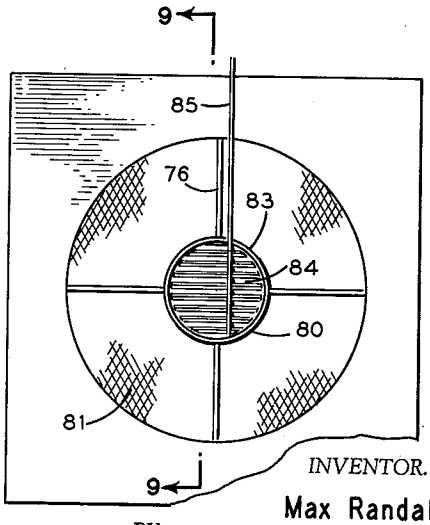


FIG. 9

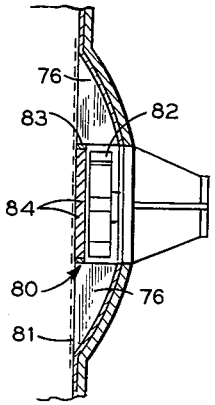
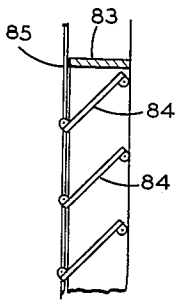


FIG. 10



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FIG. 7

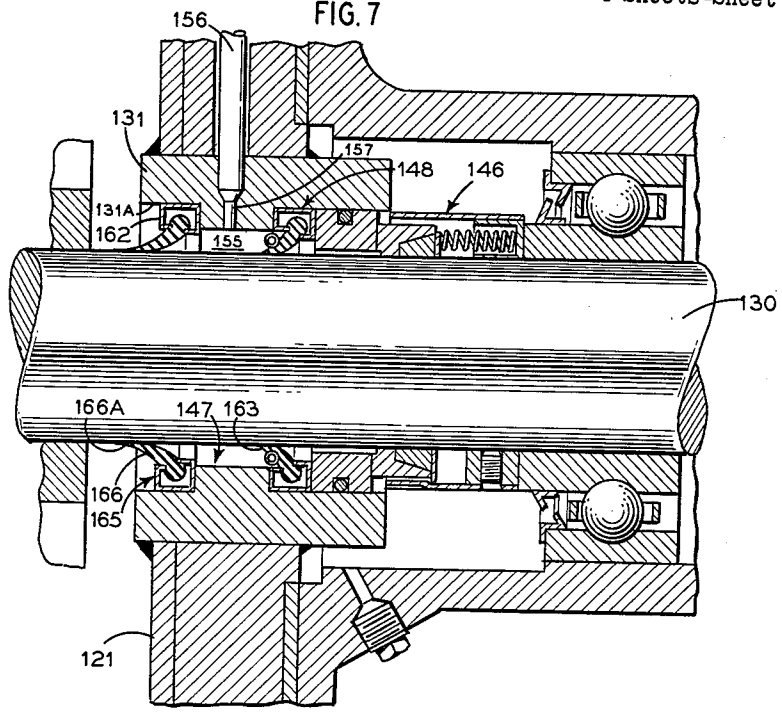
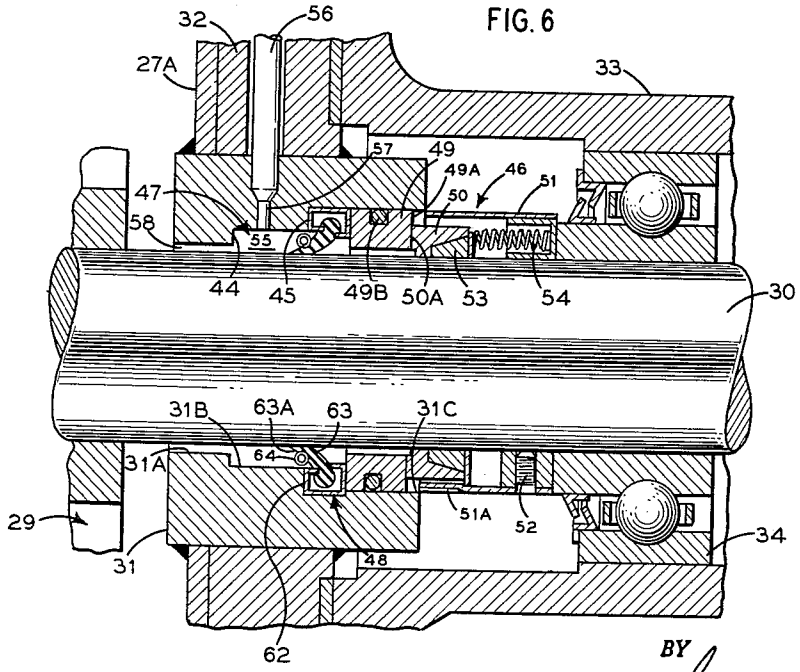


FIG. 6



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United States Patent Office 3,100,105
Patented Aug. 6, 1963

3,100,105

DEGREASER

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Filed Nov. 18, 1959, Ser. No. 853,902
4 Claims. (Cl. 259—103)

This invention relates generally to a parts cleaning machine and more specifically to an improved fluid agitating degreaser and bearing seal therefor.

Degreasers have been widely used in industry for the removal of oils, compounds, wax, grease tar, metal chip and other abrasive particles from various parts manufactured by various machining, stamping, drawing, quenching and buffing operations prior to painting, plating, pickling or phosphating the same. More recently degreasers have been employed to meet an entirely new maintenance problem wrought by the transition from piston driven to jet powered aircraft. Due to the development of less refined fuels (e.g. kerosene) and the fact that entirely new metals are required for building jet engines e.g. alloys high in nickel and cobalt like Inconel, Incoloy, Nimonic, Discoloy, etc., the conventional means for cleaning piston engine parts during overhaul and repair cannot be employed in cleaning the parts making up the "hot" section of a jet engine.

Generally the maintenance cleaning problems of a jet engine are two-fold, namely those which relate to the "cold" section of the jet engine and those relating to the "hot" section thereof. The "cold" section encompasses all of the parts and accessories ahead of the compressor, where temperatures are relatively low. Consequently the oxide, carbon deposits, and general soil on these parts are not very tenacious and can be readily cleaned by conventional means now employed for piston engine parts.

The "hot" section of the jet engine embraces the remaining parts located beyond the compressor. Because of the rapid, high temperature combustion, extreme heating and cooling gradients to which these "hot" parts are subjected, and the tremendous gas velocities encountered in this section, very tenacious oxides, scales and carbon deposits are formed thereon which are difficult to remove.

As the rotational speed of a jet engine is many more times that of a piston type engine, much greater care is needed in checking the conditions of the various components before engine reassembly. There can be no flaws or minute cracks or defects which could lead to disastrous results while in flight. For these reasons, the quality of cleaning which is required in order to insure the proper inspection in both military and commercial aircraft must be very high and the procedure exacting. The cleaning of the parts must be sufficiently complete so that special dye penetration tests can be carried out to expose any existing defect not otherwise visible to the naked eye. Such dye penetration tests can be properly performed only when the parts are absolutely clean.

In order that the parts of the "hot" sections may be properly cleaned, it is necessary that they be exposed to a series of heated baths which include very strong caustic and acid solutions in which the cleaning fluid is violently agitated by means of an impeller to properly circulate the fluid about the immersed parts. Due to the corrosive nature of the cleaning fluids, and the erosive effects of the removed carbon and scale, it is extremely important that the impeller shaft be properly sealed at all times against fluid leakage therearound. Unless this seal is properly maintained the corrosive cleaning fluids will cause serious damage to the bearings or moving parts of the degreaser thereby rendering maintenance and repair problems thereof a costly consequence.

Heretofore, sealing about an impeller shaft has been

attained by means of a mechanical seal or a stuffing box disposed about the shaft ahead of the bearing to prevent the leakage of fluid to the bearings. Of these two methods of shaft sealing the mechanical seal is by far the superior, if properly applied. Generally these mechanical seals consisted of an assembly including a stationary sealing washer and a rotating sealing washer, each having co-operating flat, precision-finished surfaces to form a running seal therebetween. Generally the sealing faces are oriented at right angles to the axis of shaft rotation with spring means transmitting forces parallel to the shaft to normally urge the sealing faces into intimate contact to effect the seal thereat.

In arrangements of this type it has also been customary to employ an air seal ahead of the mechanical seal to prohibit any abrasive particles suspended in solution, as a result of the cleaning operation, from injuring the sealing faces of the mechanical seal. Experience has shown that this arrangement had certain undesirable inherent characteristics. For example, in the event excessive build up of air pressure in the air seal due to fluctuating line pressure or to stoppage at the outlet end of the air seal about the shaft with dirt or grit, the resulting back pressure created would exert a force acting against the springs of the mechanical seal, and thereby nullify the sealing effect thereof. Also there was the inherent disadvantage that when the air seal was rendered inoperative for any reason, as on shut down or on blockage of the line due to internal scale or salt deposits, the corrosive fluids in the degreaser would tend to flow back up into the air seal parts, and thereby cause serious injury thereto.

The effect of vigorous solution agitation is extremely important in cleaning of "hot section" jet engine parts. It has been experimentally demonstrated that without agitation existing chemicals will not clean the parts properly. The degree of agitation, turbulence, solution turnover has a definite effect on consistent quality of cleaning. The most efficient means of solution movement in a restricted area, such as a 5′ x 5′ x 5′ tank required to handle a 4′ x 4′ x 3′ basket of parts, is a turbine impeller. The heretofore known degreaser constructions with bottom entry impeller are subject to much wear due to sludge accumulation. Also bottom entry fluid action is choked whenever a basket of parts is placed over the impeller. In accordance with this invention it has been discovered that side entry impellers provide the more desirable location for thoroughly agitating a solution. By utilizing opposing impellers double fluid action is attained. With opposing impellers and a substantially parabolic shaped tank housing, as will be hereinafter described, develops the maximum agitation with minimum horsepower input.

An object of this invention is to provide in a parts cleaning machine an improved sealing means for positively sealing against fluid leakage about an impeller shaft.

Another object is to provide in a fluid agitating degreaser a positive seal for a side entry impeller shaft.

Another object is to provide in a fluid agitating degreaser an improved sealing means which includes a novel seal disposed between a mechanical seal and a co-operating air seal so as to prohibit the air seal back-pressure from acting against the sealing effect of the mechanical seal.

Still another object is to provide in a fluid agitating degreaser a novel seal means disposed ahead of the air seal to effect uniform distribution of the sealing air about the entire circumference of the rotating shaft and to function as a one-way check to prevent the back flow of caustic fluid to the air seal parts in the event the air seal is rendered inoperative.

Still another object is to provide in a fluid agitating

degreaser an improved arrangement whereby the pumping action and resulting agitation is efficiently, effectively and economically attained with reasonable allowable horsepower and minimum investment.

Still another object of the invention is to effectively control and vary the rate of fluid circulation or agitation in a relatively simple and inexpensive manner.

Still a further object is to provide in a fluid agitating degreaser an improved tank configuration for enhancing the operation of the impeller.

The foregoing objects, and other features and advantages of this invention are attained by a degreaser comprising essentially a metal tank of appropriate alloy, for containing a cleaning fluid, having opposed side walls shaped into an outwardly curved portion defining a substantially paraboloidal, spheroidal, or spherical impeller housing. Horizontally extending side entry shafts, rotatably supported in suitable bearings, are extended through the center of each impeller housing for supporting an impeller within said housing. According to this invention improved sealing means are disposed about each shaft to positively prevent leakage of the fluid from the tank. Generally the sealing means comprises a mechanical seal disposed about each shaft on the fluid side of the bearing means, an air seal disposed on the tank side of the mechanical seal and a flexible, radial or lip seal disposed between the air seal and the mechanical seal to prohibit the back pressure of the air seal from nullifying the effect of the mechanical seal.

In another form of the invention a second, more flexible radial or lip seal is disposed about the shaft on the inboard or tank side of the air seal to prohibit leakage of the fluid from the tank into the air seal chamber when the latter is rendered inoperative, and to effect uniform distribution of sealing air about the entire circumference of the shaft when the air is rendered operative.

An important feature of the invention resides in the provision of improved sealing means which include an improved flexible, radial or lip seal disposed about the impeller shaft either on the bearing side of an air seal or on both sides of the air seal.

A motor driven chain or belt drive is provided to impart rotation to the impeller to effect agitation of the fluid about the parts being cleaned, and means are provided to vary the rate of fluid agitation. According to this invention the degree of fluid agitation is attained either by varying the r.p.m. of the impeller shaft through a gear ratio or through the medium of a novel fluid damper with adjustable louvers or radial vanes positioned coaxially of the impeller on the intake side thereof to control the amount of fluid induced axially into the impeller. This in a sense functions as an intake valve which can control the fluid flow through the "eye" of the impeller.

The tank internals comprise a honeycombed sludge collecting means on the bottom of the tank and a removable wire basket for containing the parts to be cleaned. Submerged heaters are also provided in the event the fluid is required to be heated to increase its cleaning action. Because the cleaning fluid may emit toxic fumes, a ventilating flue in the form of a collar duct surrounds the upper edge of the tank for directing the fumes to a suitable exhaust.

A feature of this invention resides in the provision of side entry shafts with the impeller means connected thereto disposed within an outwardly curved substantially paraboloidal impeller housing or the like integrally formed as the side walls of the tank to enhance circulation of the fluid within the tank during a cleaning operation. This paraboloidal shaped impeller housing deflects the radial centrifugal flow caused by the impeller to an axial flow with maximum conservation of the fluid energy.

Another feature resides in the provision of a novel damper disposed co-axially of the impeller to meter the amount of fluid induced axially of the impeller, and

thereby control the rate of fluid circulation or agitation, eliminating the necessity of variable speed impeller drive machinery.

The various features of novelty which characterize this invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operatnig advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there is illustrated and described a preferred embodiment of the invention.

In the drawings:

FIG. 1 is a vertical front view of the degreaser of this invention having some portions thereof shown in section with the parts basket removed.

FIG. 2 is a sectional plan view taken along line **2—2** of FIG. 1, illustrating the parts basket in position.

FIG. 3 is an outside elevation view of the degreaser.

FIG. 4 is a side sectional view taken along line **4—4** of FIG. 2.

FIG. 5 is an enlarged detail sectional view of the impeller shaft including the bearing means and improved sealing means.

FIG. 6 is an enlarged detail of the improved sealing means in accordance with this invention.

FIG. 7 is an enlarged detail of a modified form of the sealing means.

FIG. 8 is a modified side wall construction illustrating the damper means to control the axial intake of the impeller means.

FIG. 9 is a sectional view taken through line **9—9** of FIG. 8.

FIG. 10 is an enlarged detail view of the adjustable louvers of the control damper.

Referring to the drawings, the degreaser **20** comprises a stainless steel tank **21** designed to contain several hundred gallons of a highly caustic acid or acid cleaning solution, e.g. alkaline permanganate, nitric acid or the like. The tank **21** is supported in a suitable base **22** and is defined by front wall **23**, rear wall **24**, side walls **25**, and a bottom wall **26**. According to this invention the side walls **25** are provided with outwardly curved portions **27** to form an impeller housing which is substantially paraboloidal or the like in shape. The top of the tank is provided with a full end opening to facilitate access into the interior of the tank. A sliding cover **28**, preferably formed in multiple sections, is provided to close the open end during a cleaning operation. In the open position the cover sections **28** are arranged to hang in the front of the tank as shown in FIG. 3.

To enhance the cleaning action of the chemical solution, the tank **21** is provided with means to vigorously agitate the solution about the articles which are immersed in the solution for cleaning. In accordance with this invention a high efficiency pumping action for circulating the solution within the tank is obtained by opposed side entry impellers **29**. The arrangement is such that the impeller **29** agitates the solution to create an enveloping action with a continuous suction occurring through the center of the tank.

As best seen in FIG. 4, each impeller **29** consist of a hub **29A** and a plurality of radially extending blades **29B** tangentially connected thereto. Each impeller **29** is connected to a shaft **30** which extends outwardly through an end collar **31** which defines the shaft opening at the poles **27A** of the respective side wall paraboloidal section **27**. The impellers **29** are disposed adjacent their respective side walls **25** and are arranged to be housed wholly within section **27**. Preferably the impellers are located at the theoretical focal point of its respective paraboloidal housing **27**.

Connected to the outer surface of each side wall **25** is is a mounting plate **32** to which a bearing sleeve **33** is secured for supporting the shaft **30**. Each shaft **30** is rotatably mounted within its respective bearing sleeve **33**

by a pair of spaced bearing assemblies 34, 35 disposed intermediate the ends of the shaft 30.

In the illustrated embodiment the means for rotating the impeller shafts to create the pumping action includes an electric motor 36 connected to a motor mount 37 at the rear of the tank 21. The armature shaft 38 of the motor 37 is coupled through a suitable variable speed drive 39 to drive shafts 40 which in turn are connected through an endless chain drive 41 looped over sprockets connected to the ends of each drive shaft and impeller shaft 30. Control for the variable speed drive 39 is had by a suitable control lever 42. Thus in one form of the invention the degree or rate of circulation, e.g. high, medium and low, is obtained by varying the r.p.m. of the impeller shaft by appropriate control of the variable speed drive 39. Suitable guards 43 enclose the chain drive 41.

Because the cleaning fluid contained within the tank 21 is highly corrosive, it is extremely important that an absolutely fluid tight sealing means be disposed about the impeller shafts 30 adjacent their point of entry into the tank 21. Unless this is done, the leakage of the caustic fluid from the tank will cause serious damage to the bearings and bearing housing, and any other surrounding structure not otherwise immune to the corrosive effects of the cleaning fluid.

To avoid the danger of leakage of the caustic solution around the impeller shafts entry, an improved sealing means is provided to positively insure against such leakage. Referring to FIGS. 5 and 6, the end collar 31 through which each impeller shaft 30 extends is formed with an axially extending bore 31A having concentrically counter bore portions 31B and 31C defined by shoulders 44 and 45.

According to the form of the invention illustrated in FIGS. 5 and 6, the improved sealing means comprises cooperative action between a mechanical seal 46 disposed about the shaft 30 on the tank side of bearings 34, 35, an air seal 47 on the tank side of the mechanical seal 46, and a novel, radial lip seal 48 disposed between the air seal 47 and mechanical seal 46.

The mechanical seal 46 comprises essentially a stationary seat 49 and a rotating sealing washer 50 which is fixed to the impeller shaft 30 to provide a positive drive therefor, sealing being attained by contact between cooperating precision lapped faces 49A and 50A of the stationary seat and rotating washer 49 and 50, respectively. The stationary seat 49 is fitted with a sealing ring 49B, and is frictionally fitted into bore 31C of the end collar 30. The rotating washer 50 is fixed to shaft 30 through the medium of a ferrule sleeve 51 secured to the shaft 30 by a set screw 52, the ferrule sleeve 51 having depressions 51A adapted to engage corresponding detents on the sealing washer to fix the washer 50 to the ferrule sleeve 51. Positive contact between the precision lapped faces 49A, 50A to maintain the seal is insured by a Teflon wedge ring 53 which is preloaded by a plurality of circumferentially spaced springs 54. The arrangement is such that the pressure exerted by springs 54 is uniformly distributed to the sealing washer 50 in urging the latter in contact with the stationary seat 49. The spring pressure keeps the faces 49A, 50A in constant contact and also provides automatic adjustment therebetween for wear and shaft end play. The inner periphery of the Teflon ring 53 also provides a sealing function about the shaft 30.

Ahead of the mechanical seal 46 is the cooperating air seal 47. The air seal 47 comprises an annular air chamber 55 which is defined by counterbore portion 31B of the end collar. Compressed air is supplied to the air chamber through an air supply line 56 which connects to a radial bore 57 in the end collar 31 communicating with the air chamber 55. The compressed air exits from the air chamber 55 via an axial annular outlet 58 which is formed by the axial bore portion 31A of the end collar. Bore 31A has a diameter which is slightly greater than that of the shaft and it is sized so that the shaft is free to rotate without rubbing the surface of bore 31A, thereby insuring that the air discharging from the air chamber 55 is free to flow about the entire circumference of the shaft. One of the purposes of the air seal is to prevent entry of the abrasive particles or grit entrained in the cleaning solution during a cleaning operation from rubbing on the faces of the rotating and stationary seals. Included in the air system is an air filter 59, lubricator 60 and pressure regulator 61, schematically illustrated in FIG. 3.

Experience has shown that not infrequently an excessive air seal back pressure can be created due to the annular outlet 58 of the air seal 47 becoming partially or totally stopped up with dirt or grit, or to wide fluctuations in the air line pressure. When this occurs the back pressure of the air seal 47 is brought to bear against the spring action of the mechanical seal. Thus if the back pressure becomes sufficiently great or greater than the force exerted by springs 54, the effect of the mechanical seal 46 is modified or materially affected. In order to overcome this difficulty a novel radial or lip type seal 48 is disposed between the air seal 47 and the mechanical seal 46. As shown in FIGS. 5 and 6, the radial or lip seal 48 comprises an annular retainer ring 62 in which there is secured a flexible and resilient lip 63 provided with a feather edge 63A which embraces the shaft 30 in sealing relationship. The lip 63 is formed of a suitable, long wearing, non-corrosive material, able to resist the caustic effects of the cleaning solution.

As shown the retainer ring 62 of the lip seal 48 is frictionally fitted into the bore portion 31C of the end collar 31 and is positioned between shoulder 45 and the stationary seat 49 of the mechanical seal 46. The arrangement of the lip seal 48 is such that it defines an end limit of the air seal chamber 55 and positively prohibits the air seal back pressure from counteracting the spring pressure of the mechanical seal 46, even during normal operation of the air seal. Use of the intermediate lip seal 48 between the air seal 47 and mechanical seal 46 has the further advantage in that an air seal of greater pressure can be employed in a system without increasing the size or force of the mechanical seal.

Heretofore, whenever an air seal and mechanical seal were utilized in combination, it was always necessary to take into the design consideration the relative counteracting forces of the air seal back pressure and of the mechanical seal springs. With the arrangement described, an air seal having a back pressure greater than the force exerted by the mechanical seal springs 54 may be employed without creating an adverse effect on the operation of the mechanical seal. This is because the arrangement of the lip seal 48 is such that the greater the air pressure acting on the lip's edge 63A, the tighter the seal becomes about the shaft.

To insure positive sealing between the feather edge 63A of the lip seal 48 and the shaft 30 an annular garter spring 64 is provided to urge the feather edge 63A in sealing contact with the shaft as shown in FIG. 6.

FIG. 7 illustrates a slightly modified form of the bearing seal from that described herein with reference to FIGS. 5 and 6. The embodiment of FIG. 7 is identical in all respects to that of FIG. 6, with the exception that a second radial lip seal 165 is disposed about the impeller shaft 130 on the tank side or outlet end of the air seal 147. To accommodate the retainer ring 162 of the lip seal 165, the end collar 131 is provided with an enlarged counterbore portion 131*a* into which the retainer ring 162 is forcibly fitted. Secured in retainer ring 162 is a resilient and flexible sealing lip 166 which has a longer and more feathery edge 166A than that of lip 163 of lip seal 148 disposed between the air seal 147 and mechanical seal 146. Like the lip 163 of lip seal 148, the lip 166 is preferably made of a long wearing,

non-corrosive material which can satisfactorily withstand the caustic effects of the cleaning solution.

The use of the second lip seal **165** has several advantages. The lip seal **165** is arranged and constructed to function as a one way check valve having a flutter or diaphragm like action permitting the air to be discharged from the air chamber **155** of the air seal to the interior of the tank **121** when the latter is rendered operative. In the event of shut down, or when the air seal is rendered inoperative for any reason, the lip seal **165** will prohibit any back up or flow of caustic solution into the air seal and chamber. Thus the lip seal **165** provides for an automatic shaft seal on shut down.

Also the diaphragm or flutter action of the feather tip edge **166A** of lip **166** insures uniform distribution of the air about the entire circumference of the shaft **130**. This construction also reduces initial cost of construction in that the machined close tolerance otherwise required between the annular outlet of the air seal and the rotating shaft are no longer required. Because the close tolerance of the air seal outlet is not required in this form, the danger of stoppage or pluggage of the air seal outlet and resulting excessive air seal back pressure is eliminated.

The tank internals consist of a sludge pan **70** which is rested on the bottom wall **26** of the tank **21**, and is sized so as to occupy almost the entire area of the bottom wall. Resting on the sludge pan **70** are honeycombed grids **71** to provide pockets for trapping any of the dirt or sludge which precipitates out of the solution. The grids **71** may be formed either as a single unit or in sections. Supported on grids **71** is a stainless steel wire basket **72** capable of supporting the parts to be cleaned. To facilitate removal of the pan **70**, grids **71** and basket **72**, each is provided with handles or hooks **70A**, **71A** and **72A**, respectively, arranged to extend above the level of the solution so that suitable hoisting apparatus may be secured thereto.

To protect the impellers **29** and to prevent any of the parts from becoming entangled with the impellers, a protective screen **73** is provided to shield the impellers. In the event the solution is required to be heated to carry out the cleaning operation, suitable submerged heaters **74** are provided. Generally the heaters are disposed in a heater well extending along the rear wall **24** of the tank. To retain the heat, the walls of the tank may be lined with suitable layer of insulating material **69**.

From the foregoing it will be noted that the tank construction is such that a maximum, unobstructed working volume is had per given unit.

With the parts to be cleaned positioned in the basket and the latter submerged in the cleaning solution **75**, operation of the impellers causes the liquid solution to be vigorously agitated about the submerged parts, the degree of agitation being controlled by the variable speed drive **39** which controls the r.p.m. of the impeller shafts **30**. The pump action of the side mounted impellers is such that the fluid is sucked axially of the impellers and discharged radially outward therefrom. According to this invention, circulation is enhanced in that the paraboloidal sections **27** in which each impeller **29** is housed will redirect the fluid laterally inward toward the center of the tank in a uniform manner to insure complete envelopment washing of the whole of the submerged parts. To prevent whirling or vortexing of the fluid within the spherical section, the latter is provided with a plurality of vanes **76** extending normal to the side wall between the outer edges of impeller blades and the circumference of the paraboloidal section.

In order to control the rate of fluid agitation without resorting to control of the r.p.m. of the impeller shafts **30** through an expensive variable speed transmission or gear ratio, one form of the invention contemplates the use of a fluid damper **80**, see FIGS. 8, 9 and 10, disposed between the protective screen **81** and the impeller **82**. Generally the damper **80** comprises a frame **83** which is secured to the vanes **76**. Pivotally connected to the frame **83** are a plurality of louvers or vanes **84** adapted to pivot between open and closed positions. A suitable operator **85** is connected to each louver so as to operate the louvers **84** simultaneously. The damper **80** is substantially equal in diameter to the impeller **82**. The operation of the damper **80** is to control the eye or suction, i.e. amount of fluid that is induced axially of the impeller, by controlling the openings of the louvers. In this manner the degree of pumping action can be mechanically controlled without affecting or varying the r.p.m. of the impeller shaft. In effect, the fluid damper affords a relatively simple, expedient and economical means of controlling the pumping action of the impellers without resorting to an expensive and complicated variable speed transmission. The motor shaft can then be connected through a direct drive to the impeller shafts.

In the event toxic fumes are emitted, a ventilating collar duct **86** is provided. As shown the collar extends around the upper side and rear walls **24** and **25**, respectively. The duct **86** is connected to a suitable blower or induction fan (not shown) to collect and exhaust the toxic fumes to the atmosphere or other suitable disposal area. An outlet **87** is provided by which the connecting duct work to exhaust (not shown) is connected. The tank is also fitted with a drain **88** by which the tank **21** may be readily emptied.

The disclosed degreaser constitutes a considerable improvement over still tank cleaning methods or cleaners having vertically disposed agitating means. By reason of the side entry impellers higher efficiency in pumping is developed for a given horsepower input and investment.

Also the side entry construction, described, circulates the solution in an enveloping action and forces the solution into all areas, even if recessed.

Also the special seals are positive insurance against harmful leakages. The inclusion of the air seal and lip seal before the mechanical seal doubles the assurance for a long maintenance-free mechanical life for the degreaser.

While in accordance with the provisions of the statutes, there is illustrated and described herein a specific form of the invention. Those skilled in the art will understand that changes may be made in the embodiment of the invention disclosed, without departing from the invention as covered by the claims, and that certain features of the invention may sometimes be used to advantage without a corresponding use of other features.

What is claimed is:

1. For use in a parts cleaning machine comprising a tank adapted to contain a cleaning fluid, said tank having opposed side walls, means for agitating the fluid within said tank during a cleaning operation, said means including an impeller disposed within said tank adjacent each of said side walls, a drive shaft connected to each of the impellers, each of said shafts extending through the adjacent side wall of said tank, a bearing sleeve connected to the outer surface of said side walls, bearing means for rotatably supporting said shafts in said respective bearing sleeve, the improvement of sealing means disposed about each of said shafts between the side wall and bearing means thereof to prevent leakage of fluid from said tank to said bearing means, each of said sealing means including a mechanical seal on the tank side of said bearing means, means forming an air seal on the tank side of said mechanical seal, and a flexible lip seal disposed about said shaft between said air seal and said mechanical seal, said lip seal functioning as a one way check to prevent the back pressure of said respective air seals from acting against the sealing effect of the mechanical seals and to enhance the operation of said sealing means when the air seals are rendered inoperative, and a second more feathery lip seal disposed about said shaft between the tank and said air seals to effect uniform distribution of air about the entire circumference of said shaft and to prevent the

leakage of fluid from said tank to said air seal when the latter are rendered inoperative.

2. A parts cleaning machine comprising a tank aadpted to contain a cleaning fluid, said tank having opposed side walls, one of said side walls having an outwardly curved portion defining a substantially paraboloidal section, means for agitating the fluid within said tank during a cleaning operation, said means including an impeller disposed in said tank within said paraboloidal section, a drive shaft connected to said impeller, said shaft extending through the center of said paraboloidal section of said side wall, a bearing sleeve connected to the outer surface of said wall, bearing means for rotatably supporting said shaft in said bearing sleeve, means for rotating said shaft, sealing means disposed about said shaft between said side wall and bearing means to prevent leakage of fluid from said tank, said sealing means including a mechanical seal on the tank side of said bearing means, means forming an air seal on the tank side of said mechanical seal, and a flexible lip seal disposed about said shaft between said air seal and said mechanical seal, said lip seal functioning as a one way check to prevent the air seal back pressure from acting against the sealing effect of said mechanical seal and to prevent leakage of fluid beyond the air seal when the latter is rendered inoperative, and means for regulating the degree of fluid agitation, said latter means including a damper within said tank disposed co-axially of said impeller on the intake side thereof, said damper including a plurality of adjustable louvers, and means for adjusting said louvers to regulate the amount of fluid induced axially of said impeller.

3. A parts cleaning machine comprising a tank adapted to contain a cleaning fluid, said tank having opposed side walls, each of said side walls having an outwardly curved portion defining a substantially paraboloidal section, means for agitating the fluid within said tank during a cleaning operation, said means including an impeller disposed in said tank within each of said paraboloidal sections, a drive shaft connected to each impeller, said shafts extending through the center of their respective paraboloidal section of said side walls, a bearing sleeve connected to the outer surface of each side wall, bearing means for rotatably supporting said shafts in their respective bearing sleeve, means for rotating said shafts, sealing means disposed about each of said shafts between their respective side wall and bearing means to prevent leakage of fluid from said tank, each of said sealing means including a mechanical seal on the tank side of said bearing means, said mechanical seal including a stationary sealing washer and a co-operating rotating sealing washer fixed to the shaft and rotatable therewith, and spring means normally urging said rotating washer into sealing engagement with said stationary washer, means forming an air seal on the tank side of said mechanical seal, and a flexible lip seal disposed about said shaft between said air seal and said mechanical seal, said lip seal functioning as a one way check to prevent the air seal back pressure from acting against the sealing effect of said mechanical seal and to prevent leakage of fluid beyond the air seal when the latter is rendered inoperative, means for rotating said impellers to effect agitation of said cleaning fluid whereby said fluid is attracted axially of said impellers and discharged radially outward thereof, and said paraboloidal section directing said radially directed fluid laterally inward toward the center of said tank, and means for regulating the degree of fluid agitation, said latter means

including a damper within said tank disposed co-axially of said impeller on the intake side thereof, said damper including a plurality of adjustable louvers, and means for adjusting said louvers to regulate the amount of fluid induced axially of said impeller.

4. A parts cleaning machine comprising a tank adapted to contain a cleaning fluid, said tank having opposed side walls, each of said side walls having an outwardly curved portion defining a substantially paraboloidal section thereat, means for agitating the fluid within said tank during a cleaning operation, said means including an impeller disposed in said tank within each paraboloidal section, a drive shaft connected to each impeller, said shafts extending through the center of their respective paraboloidal section, a bearing sleeve connected to the outer surface of each side wall, bearing means for rotatably supporting said shafts in their respective bearing sleeve, means for rotating said shafts, sealing means disposed about each of said shafts between their respective side wall and bearing means to prevent leakage of fluid from said tank to said bearing means, said sealing means including a mechanical seal on the tank side of said bearing means, said mechanical means including a stationary sealing washer and a co-operating rotating sealing washer fixed to the shaft and rotatable therewith, and spring means normally urging said rotating washer into sealing engagement with said stationary washer, means forming an air seal on the tank side of said mechanical seal, a flexible lip seal disposed about said shaft between said air seal and said mechanical seal, said lip seal functioning as a one way check to prevent the air seal back pressure from acting against the sealing effect of said mechanical seal and to prevent leakage of fluid beyond the air seal when the latter is rendered inoperative, a second lip seal disposed about said shaft between said air seal and said tank to effect uniform distribution of said air about the entire circumference of said shafts and to prevent leakage of fluid to said air seal when the latter is rendered inoperative, means for rotating said impellers to effect agitation of said cleaning fluid whereby said fluid is attracted axially of said impellers and discharged radially outward thereof, and said paraboloidal sections directing said radially directed fluid laterally inward toward the center of said tank, and means for regulating the degree of fluid agitation, said latter means including a damper within said tank disposed co-axially of each impeller on the intake side thereof, said damper including a plurality of adjustable louvers, and means for adjusting said louvers to regulate the amount of fluid induced axially of said impeller.

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