March 17, 1942. E. H. CARRUTHERS 2,276,824

COMBINED PUMP AND CENTRIFUGAL SEPARATOR

Filed Sept. 23, 1939 2 Sheets-Sheet 1

Fig. 1

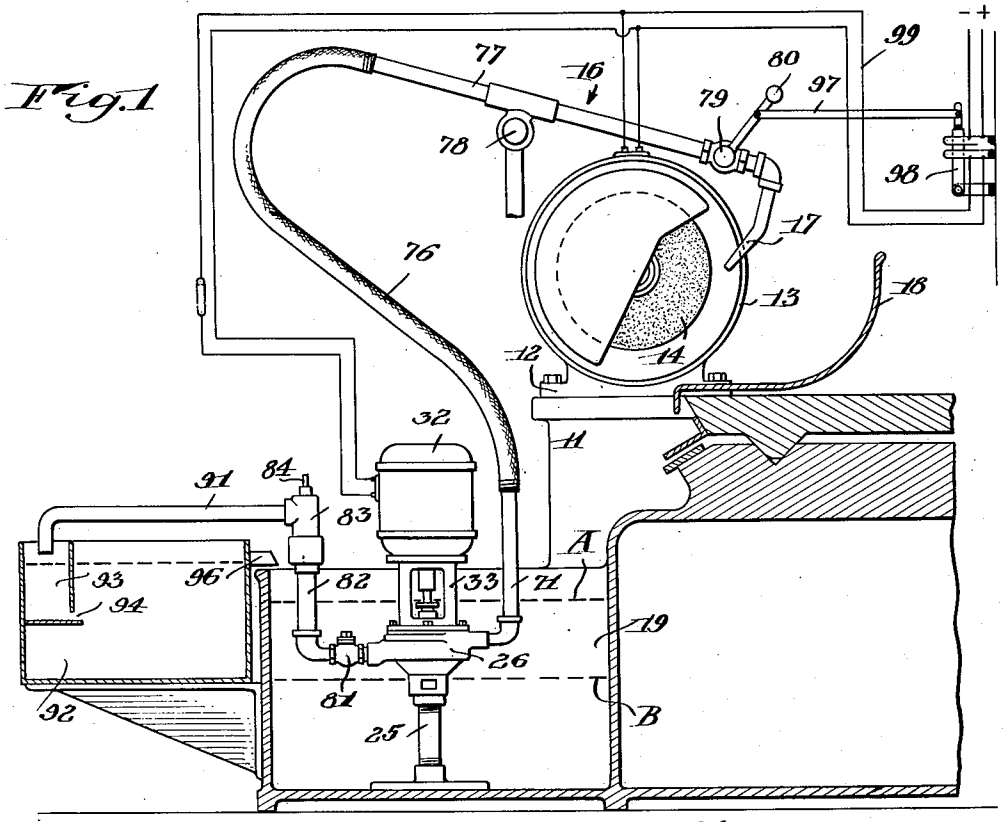
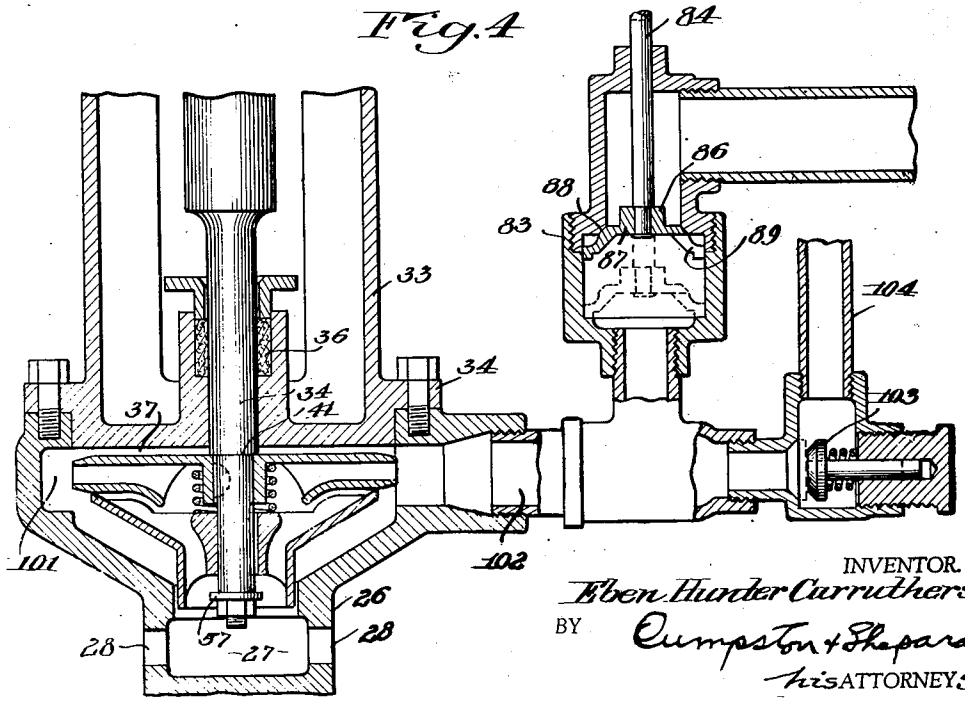


Fig. 4



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Fig. 2

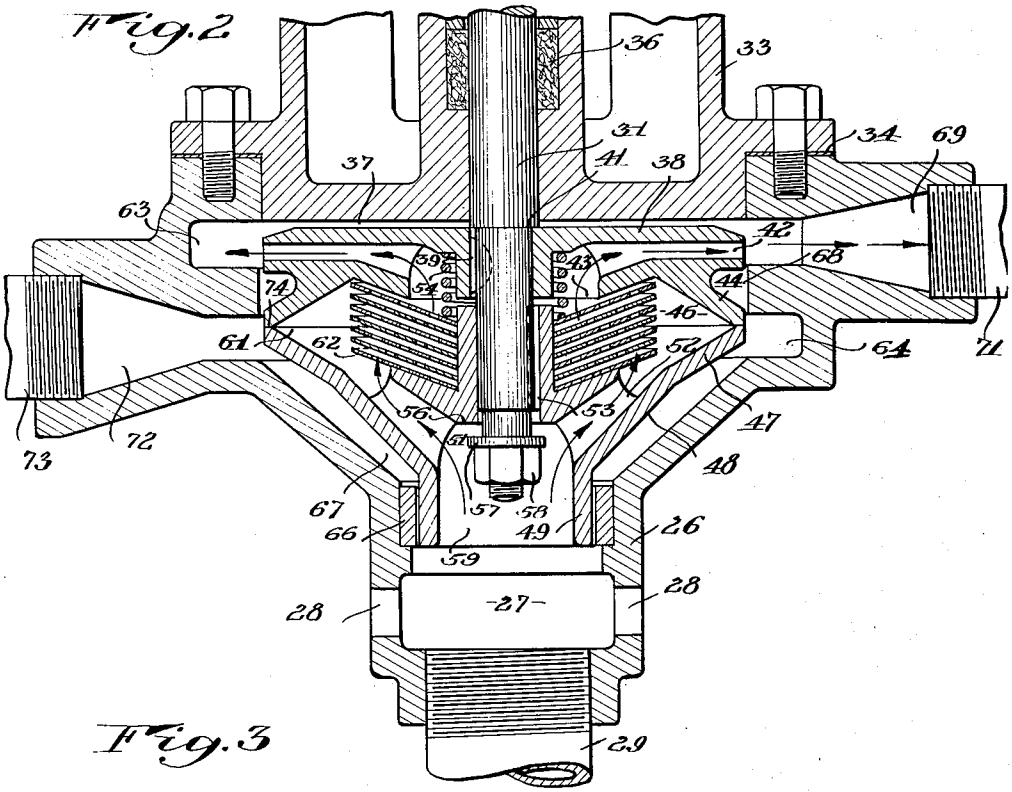
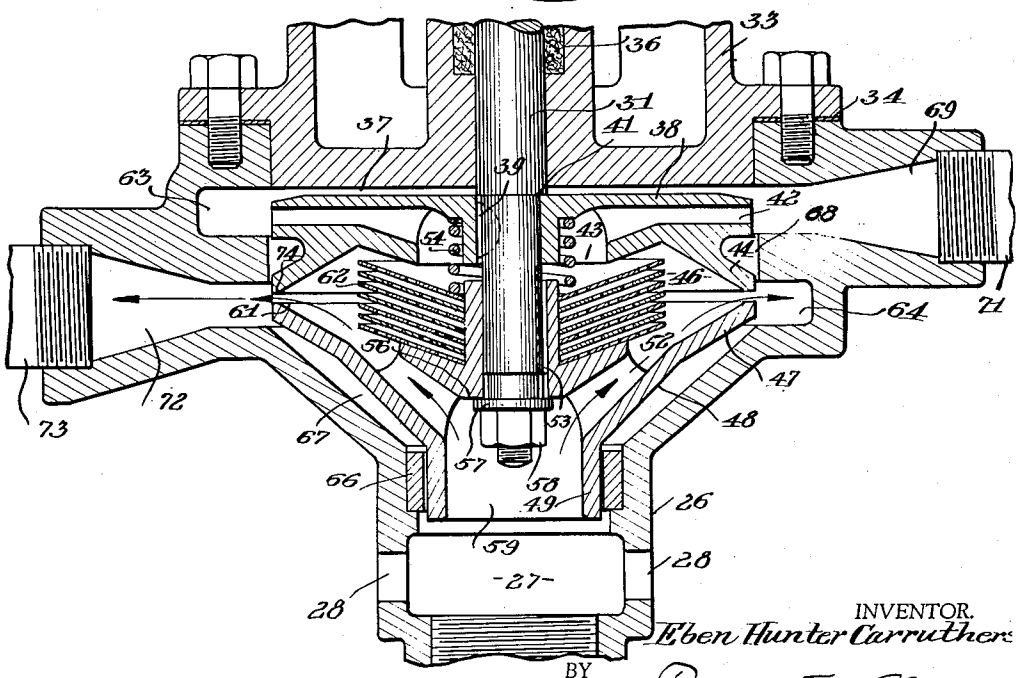


Fig. 3



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UNITED STATES PATENT OFFICE

2,276,824

COMBINED PUMP AND CENTRIFUGAL SEPARATOR

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Application September 23, 1939, Serial No. 296,269

16 Claims. (Cl. 233—20)

My invention relates to a combined pump and centrifugal separator.

An object of my invention is to provide a combined pump and centrifugal separator which may be economically manufactured, and which is efficient in operation.

Another object of my invention is to provide in a system wherein a liquid is continuously reused and is subject to contamination during use, improved and more effective means for removing the contamination.

A further object of my invention is to provide in a system wherein a liquid is continuously reused and is subject to contamination during use, means for automatically removing the contaminating materials from the liquid by centrifugal force and without requiring any attention on the part of the operator.

My invention further contemplates an improved coolant system for a machine tool, such as a grinder, wherein means are provided for automatically removing impurities from the system, such as metal particles, grit and dirt, which tend to accumulate in the coolant.

Other objects and advantages of my invention will be more particularly pointed out in the claims and will appear from the following description, when taken in connection with the accompanying drawings, in which:

Fig. 1 is a view partly in section and partly diagrammatic, showing the coolant system of my invention as applied to a grinder;

Fig. 2 is a vertical sectional view taken through the casing of the combined pump and centrifugal separator of my invention with the parts thereof in their normal coolant pumping position;

Fig. 3 is a view similar to Fig. 2 with the parts in the position which they occupy when impurities are discharged from the unit; and

Fig. 4 is a sectional view showing a somewhat modified form of my invention.

The system and the combined pump and centrifugal separator of my invention may be employed wherever impurities in a liquid of different specific gravity than the liquid are to be removed from the liquid, and the liquid is to be pumped to a source of use. The system and apparatus have been particularly designed for use in supplying clean, grit-free coolant to a machine tool. While the apparatus of my invention may be applied to a number of uses, and the system is not limited to the application herein disclosed, I have shown and described my combined pump and centrifugal separator and the system of my invention as applied to a grinder for supplying a clean grit-free coolant thereto.

The grinder, in the coolant supply system of which my invention may be employed, has been shown somewhat diagrammatically in Fig. 1 and includes a foundation or frame 11 upon which is mounted, as indicated at 12, a motor 13. The motor is adapted to drive a grinding wheel 14 which may be of any suitable type. For the purpose of supplying a coolant to the grinder a conduit system, generally indicated by the numeral 16, having a discharge spout or coolant nozzle 17, is provided. The nozzle is adapted to direct the coolant onto the work to be ground and preferably at the meeting point between the grinding wheel and the work for the purpose of preventing the work and the grinding wheel from overheating.

The coolant may be any suitable liquid, such for example as oil, or any special coolant liquid preparation such as are well known in the machine tool art. The coolant is confined by a shield 18 and by portions of the frame 11, so that it drops by gravity to a tank or coolant sump 19. If desired, a strainer or screen of any suitable type may be employed through which the coolant flows to remove large metal chips, particularly in case the invention is applied to a lathe or other types of cutting, reaming, boring, or surfacing machine tools. The coolant is naturally contaminated during the grinding process by fine particles of metal and by particles of the grinding wheel which are carried in the coolant to the sump. In the case of other machine tools the coolant may contain metal chips some of which are too fine to be removed by flowing the coolant through the screen as above mentioned.

In most of the arrangements with which I am familiar, the coolant is continually reused, without removing these particles, by pumping the coolant from the sump back through the conduit system 16. No attempt, other than settling, is made to remove the grit and metal particles and the coolant is merely replaced with fresh, clean coolant when it become too contaminated for further use. The contamination of the coolant supplied through the conduit system occurs rather rapidly, particularly when the impurities are of such character that they will be held in suspension in the coolant and will not settle out in the coolant sump 19.

In most cases, in order to replace the coolant, which has performed its function of cooling the work and the grinding wheel, as rapidly as possible with fresh coolant, it is desirable that the

coolant be supplied through the nozzle under an appreciable pressure. When the coolant is highly contaminated with grit and metal particles, the impingement of these particles on the work causes an abrasive action, which is particularly undesirable in fine machining or grinding operations. Moreover, the particles may lodge between the grinding wheel and the work and score the work.

In some installations, where the expense is justified and the character of the work requires, the coolant from a number of machines may be collected and run through a centrifuge, or other means of removing impurities, and the coolant after being cleaned may be then returned to the individual machines for reuse. Insofar as I am aware, however, with the exception of inadequate filtering systems, no one has heretofore provided apparatus of reasonable cost adapted to be applied to a single machine for automatically and continuously removing impurities such as dirt, grit and metal particles from the coolant circulated to the machine so that the machine would be at all times supplied with clean coolant.

I have provided a single unit which serves the function of not only pumping the coolant to the point of use, but also automatically removes dirt, grit, and metal particles from the coolant so that only clean coolant is supplied through the nozzle 17. In Fig. 1 I have shown the combined pump and centrifuge of my invention as supported in the sump by a pedestal 25 with the unit preferably emersed in the coolant so that it is at all times primed. However, instead of the unit being mounted with the coolant at the level indicated at A, the coolant may be at the level indicated by B so that the pump creates a sub-atmospheric pressure adapted to draw the coolant into the unit. Moreover, if desired, the unit may be mounted on the outside of the tank with a suction pipe on the inside thereof to conduct fluid to the unit.

As shown more clearly in Fig. 2, the unit comprises a casing 26 into a chamber 27 of which coolant is drawn either through ports 28 or through a pipe connection 29. Extending into the casing 26 through its upper end is a shaft 31 adapted to be driven by a motor 32 (Fig. 1) carried on a motor support or adapter 33 mounted on the casing, as shown at 34. A packing gland provided with suitable packing 36 is employed to prevent leakage of air into the casing at this point. Mounted on the end of the shaft which projects into the casing 26 is a rotor, which is indicated as a whole by the numeral 37. The rotor has incorporated therein a combined pumping and separating unit as will presently appear. While I have shown a separate motor for driving the rotor, it would be possible to suitably gear the shaft 31 to the motor 13 of the machine tool so that the machine tool and the rotor would be driven together. This might, in some cases, be a desirable arrangement because, as will later be explained, it is preferable that the rotor be stopped when the machine tool is stopped.

The rotor 37 has an upper or pump part 38 which is rigidly keyed to the shaft, as shown at 39, and which engages a shoulder 41 provided on the shaft. The upper part 38 has vanes 42 and is somewhat similar in construction to a conventional centrifugal pump impeller. The pump part 38 has an entrance or impeller eye 43 for liquid, adjacent its central portion and encircling the shaft, from which the blades or vanes 42 extend outward and toward the periphery in any manner well known in the art of centrifugal pumps. While I have shown a pump of the conventional centrifugal type and I prefer this construction because of its relatively low cost and the ease and compactness with which it may be combined with a centrifugal separator, other types of pumps might be employed.

Preferably integrally formed with the lower side of the pump part 38 is a conical skirt 44 which forms the upper half of a separating and cleaning chamber, indicated by the numeral 46. The lower half of the separating or cleaning chamber is formed by a lower part 47 which has a substantially conically shaped wall 48 terminating in a cylindrical portion 49. The lower part 47 of the rotor is provided with a hub section 51 which is connected by webs 52 to the conically shaped wall 48. The lower part 47 of the rotor 37 is movable along the shaft with respect to the upper part or pump section 38. This is accomplished by slidably keying, as shown at 53, the hub section 51 with respect to the shaft. A spring 54 having one end confined by the pump part 38 and the other end exerting a downward pressure on the lower part 47 normally urges the lower part 47 in a downward direction, as viewed in Fig. 2. Downward movement of the lower part 47 is limited by an annular part 56 engaging a washer 57 backed by a nut 58 threaded to the end of the shaft. The cylindrical part 49 defines a suction opening 59 which communicates with the chamber 27.

It will be noted that the webs 52 are of substantial area and extend from the inner portions of the suction opening 59 outward and upward toward the separating and cleaning chamber. When the rotor is operating these webs act in a manner similar to that of the blades of a centrifugal pump and cause the coolant to be discharged into the separating chamber under pressure. The pump action of these webs is not entirely necessary when the pump part 38 is employed. By increasing the area and pump effect of these webs it might be possible to eliminate the pump part 38. However the particular arrangement shown is of decided advantage both in enabling a rather large separation space with a given size of rotor and in developing a relatively high pressure at the coolant nozzle 17.

It will now be appreciated that when the rotor is operated, the suction developed by the centrifugal pump, aided to a certain extent by the webs 52, draws liquid into the chamber 27 through the suction opening 59 through the separation chamber 46 and into the eye of the centrifugal pump impeller. During the period when the liquid is in or passing through the separation chamber 46, it is acted upon by centrifugal forces so that the grit, dirt, and metal particles which are heavier than the coolant, are thrown outward by the centrifugal forces developed in the chamber and accumulate in the space adjacent the point 61. The rotor is operated at sufficient speed to retain the heavier particles against the walls of the separation space while the centrifuged coolant passes to the eye of the centrifugal pump.

For the purpose of increasing the effectiveness of separation, caused by centrifugal force developed in the separation chamber 46, there may be provided either a vane or disc type flow distributor. Either of these constructions is well known in the art of centrifugal separators and need not be further described. As shown in the drawings, I have provided a disc type of flow distributor which comprises a plurality of discs 62, which are

perforated and mounted in spaced relation on the hub 51. It will be noted that the separating action takes place with the liquid under pressure which aids in thoroughly wetting the particles, which otherwise might float and be carried through with the coolant.

Formed in the casing is a volute 63 for the reception of liquid discharged from the vanes of the centrifugal pump, and formed in the lower part of the casing is a second volute 64 for the reception of material discharged from the separation chamber 46, as will be presently described. A sealing ring 66 mounted in the casing is effective to maintain a differential in pressure between the suction opening 59 and the space 67 surrounding the rotor. It will be noted that the space 67 surrounding the rotor is in open communication with the volute 63 through the channel 68 so that the pressure developed in the volute 63 by the pump is effective throughout the chamber 67 surrounding the rotor 37. Also formed in the casing is a passage 69 adapted to receive a pipe connection 71 for the discharge of clean coolant free of grit, dirt and metal particles from the casing and a passage 72 adapted to receive a pipe connection 73 for the discharge of grit, dirt, and metal particles with sufficient coolant to wash out these particles as will later appear.

When the pump is operating to deliver liquid to the nozzle 17, the pressure built up by the centrifugal pump is effective throughout the chamber 67 surrounding the rotor to maintain the lower part 47 of the rotor in engagement with the pump part 38 against the action of the spring 54 and against the internal pressure within the bowl. The pressure retaining the separable portions of the rotor in engagement may be regulated as desired by throttling the pump discharge. The pressure employed is sufficient to maintain a seal at the point 74, the adjacent surfaces of the two rotor parts being preferably accurately machined at these points. Thus while the motor 32 is driving the rotor, coolant is being continuously supplied to the nozzle and the heavier impurities are collecting on the walls of the separation chamber 46.

As shown in Fig. 1, the pipe connection 71 may be connected to a flexible hose 76 which is part of the conduit 16. The other end of the hose is connected to a pipe 77 which is preferably pivoted, as shown at 78, to a support to permit adjustment of the point of application of the stream of coolant issuing from the nozzle 17. A valve 79, controlled by a handle 80, is provided in the pipe 77 for controlling the flow of coolant.

The pipe 73 is connected to a pipe 82 having a check valve 81 therein and the pipe 82 is connected to a valve body 83. The valve is preferably similar to that shown in Fig. 4 and comprises a stem 84 protruding from the valve body to permit manual actuation of the valve. Upon the lower end of the stem a valve 86 is mounted. The valve has a solid cylindrical portion 87, adapted to seat as shown at 88, on a seat portion formed in the valve body. The lower end of the value is provided with a spider or guide arm 89 serving to guide the movements of the valve from the solid line to the dotted line position shown in Fig. 4. When the valve is in the dotted line position coolant and refuse material are free to flow between the arms and out through a pipe 91, which empties into a skimming tank 92. When the pump is operating the valve is retained in a closed position by the pressure in the pipe 82. When the pump stops the valve drops by gravity to an open position. Upon starting the pump again the velocity and pressure of the liquid cause the valve to move toward its seat. However, before the valve can reach its seat, the refuse material, together with a portion of the coolant, has been discharged past the valve.

While I have shown a valve of what might be termed the impetus type, other types of valves might be employed. For example, an ordinary valve arranged to operate in synchronism with the discharge of refuse material from the rotor might be employed or a valve with its closure delayed by a dash pot action might be used. I prefer the arrangement shown since the operation of the valve and the opening and closing of the rotor are both dependent upon the pressure within the chamber 67 and the discharge passage 72 and hence the operation of these parts is synchronized.

Preferably, the skimming tank is provided with a walled compartment 93, having an opening 94. The purpose of the compartment is to avoid a direct flow of the liquid into the skimming tank so as to avoid disturbing a settled condition of the refuse material which may exist in the skimming tank. An overflow spout 96 may discharge into the coolant sump for returning skimmed coolant from the skimming tank 92 to the coolant sump 19. At intervals in accordance with the rapidity with which the grit, dirt, and metal particles accumulate in the skimming tank, the skimming tank may be cleaned.

In the normal operation of the system clean coolant is continuously supplied to the nozzle 17, the grit, dirt, and metal particles being retained in the separation chamber 46. As previously mentioned, the pressure of the centrifugal pump is effective throughout the chamber 67 surrounding the rotor and is effective up to the valve 87. Thus the valve 87 is normally held on its seat, in the solid line position shown in Fig. 4 by pressure. To enable discharge of the refuse material from the separation chamber 46, the motor 32 is stopped and preferably the valve 79 is closed. The spring 54 then separates the two rotor parts due to the lowered pressure in the chamber 67 and the valve 87 drops by gravity to the dotted line position shown in Fig. 4.

When the motor is again started, before the rotor has a chance to come up to speed and pressure is built up in the chamber 67 surrounding the rotor, centrifugal force developed in the separation chamber 46 throws the refuse material out of the separation chamber. A portion of the coolant which acts as a flushing agent is thrown out with the refuse material. The refuse material and flushing coolant flow out through the discharge opening 72 and through the valve body 83 into the skimming tank. As the pressure gradually builds up in the chamber 67 the valve 87 is moved towards its seat into the solid line position, shown in Fig. 4, and the two parts of the rotor are forced together against the action of the spring 54. The dirt, grit, and metal particles are then collected in the separation chamber 46 until the next time the motor is stopped. Upon again restarting the motor, the refuse material is discharged into the skimming tank.

It would be entirely possible to discharge refuse material from the rotor without stopping and starting the unit. This may be accomplished by merely reducing the pressure within the chamber 67 (as by opening a valve) to an extent such that it is below the combined forces tending to cause separation of the rotor parts (the spring

54 and the internal pressure within the rotor). However I prefer to stop and start the rotor as this permits a reduction of the pressure in the chamber 67 to that of atmosphere and thus enables a maximum separation of the rotor parts.

Various arrangements may be employed to control the motor 32. The motor 32 may be separately actuated so that once every several hours the operator may stop and start the motor 32 so as to empty out the accumulation of refuse material from the separation chamber 46. However, it is preferable that the system be arranged so that the operator does not have to perform any conscious operation to cause the discharge of refuse material from the separation chamber.

This may be accomplished by connecting the handle 80 of the valve 79 by means of a rod 97 to a knife switch 98 which is connected by a circuit 99, as shown in the drawings, to both the grinder motor 13, and the combined pump and centrifugal separator motor 32. With this arrangement each time the operator wishes to shut down the grinder, as for the purpose of mounting a different work piece in the machine, it is merely necessary for him to close the valve 79 so as to cut off the supply of coolant to the nozzle 17, which movement of the handle of the valve 79 throws the knife switch open to automatically shut off both motors. When the machine is again started by throwing the handle 80, both motors are started and, during the starting of the motor 32, refuse material is discharged from the separation chamber 46 in the manner previously described. If a single motor is employed to drive the machine tool and the combined pump and centrifuge, of course the wiring arrangement above described need not be employed. Moreover, if desired the handle and the switch for the motors may be unconnected so that these controls are separately actuated.

It will be noted that an appreciable pressure is required in the pressure chamber 67 in order to maintain the two halves of the rotor in engagement with each other against the action of the spring 54 and against the internal pressure within the rotor. This is accomplished by throttling the discharge conduit 16, as previously mentioned, so that the pressure in the chamber 67 surrounding the rotor, and the pressure holding the valve 87 on its seat, is appreciable. The valve 79 should be closed each time the motor 32 is stopped so that upon starting the motor again, the refuse material accumulated in the separation chamber 46 will not be discharged through the conduit system 16. The check valve 81, previously mentioned, is employed to prevent the return of any refuse material in the pipe 82, lying below the valve 87, from flowing back into the chamber 67 around the rotor and intermingling with clean coolant.

In Fig. 4 I have shown a somewhat modified form of my invention, the main differences being in the omission of the discs 62, the use of only a single volute 101, and the use of a single discharge 102 for both the coolant and the refuse material. In normal operation clean coolant is discharged through the discharge 102 past a check valve 103, and into a pipe 104 which is part of the conduit system 16. The check valve is preferably backed with a relatively heavy pressure spring so that an appreciable pressure is required to open it. When the motor is stopped, the check valve 103 closes and the valve 87 moves from the solid line position to the dotted line position shown therein. When the motor is again started before the pressure has been built up in the discharge 102 sufficiently to open the check valve 103, the refuse material, together with a portion of the coolant, discharges through the valve 87 which at that time is in its lower dotted line position. The refuse material is thus discharged to the skimming tank. As soon as the pressure builds up in the discharge 102 the valve 87 closes and the check valve 103 opens, thereby supplying coolant to the nozzle 17. As in the preferred form of my invention, as soon as the pressure in the space surrounding the rotor builds up to the proper amount, the two halves of the casing seat against each other, and dirt, grit, and metal particles accumulate in the separation space 46 ready to be discharged to the skimming tank the next time the motor 32 is stopped and started again.

While I have shown separate discharges for the clean coolant and the refuse material, it would be possible to arrange the system so that all of the material is discharged through the coolant nozzle 17. This latter arrangement would, however, be of considerable disadvantage as it would be necessary to turn the nozzle away from the work and discharge the refuse material to a skimming tank or other discharge point each time the rotor was started. Moreover it would be difficult to flush out the conduit system to clean out refuse material from the conduit. This would be necessary in order to insure the delivery of clean coolant to the work.

While I have shown the preferred forms of my invention, and have described a specific use thereof, it will be appreciated that the apparatus and system have various uses, and that various modifications and changes may be made in the form and relation of parts without departing from the spirit of my invention as set forth in the appended claims.

I claim:

1. A combined pump and centrifuge comprising, in combination, a centrifugal separator having two separable parts forming a separation chamber, means normally acting to separate said parts, a pump having a stationary casing and a liquid propelling member rotatable therein, said pump having a discharge connected to a point of use, and a connection through which the pressure of said discharge normally acts to retain said separable parts in engagement with each other.

2. A combined pump and centrifuge comprising, in combination, a centrifugal separator having two separable parts forming a separation chamber, means normally acting to separate said parts, a pump having a stationary casing and a liquid propelling member rotatable therein, said pump having a discharge connected to a point of use, a connection through which the pressure of said pump normally acts to retain said separable parts in engagement with each other, and means for reducing the pressure on said parts to automatically separate said parts and discharge impurities collected in said chamber.

3. A combined pump and centrifuge comprising, in combination, a centrifugal separator having two separable parts forming a separation chamber, means normally acting to separate said parts, a pump having a discharge connected to a point of use, a line having a normally open valve therein through which impurities from said separator are discharged, a connection through which the pressure of said pump normally acts to keep said separable parts in engagement with each other and said valve closed, and means for

stopping and starting said pump to discharge impurities collected in said chamber through said line automatically.

4. In apparatus of the character described, in combination, a centrifugal separator having two separable parts forming a separation chamber, means normally acting to separate said parts, a pump having a discharge connected to a point of use, a line having a pressure actuated valve therein through which impurities from said separator are discharged, a connection through which the pressure of said pump normally acts to retain said separable parts in engagement with each other and said valve closed, and means for stopping and starting said pump to discharge impurities collected in said chamber through said line and valve automatically, said pump and said centrifugal separator being arranged in series with the pump drawing fluid through said chamber.

5. A combined pump and centrifugal separator comprising a casing, a shaft extending into said casing, a pump impeller mounted on said shaft in said casing, a centrifugal separator mounted on said shaft in said casing, said centrifugal separator being in two parts one of which is movable with respect to the other, the discharge of said centrifugal pump being in communication with the casing whereby the pressure thereof is effective to hold said parts together and the discharge of said centrifugal separator being in open communication with the suction of said pump.

6. In apparatus of the character described, in combination, a centrifugal separator having a movable part forming a separation chamber normally closed against the discharge of impurities, a pump arranged to force the fluid through the separation chamber to enable the collection of impurities in the separation space, a pressure connection connected to the discharge of the pump for maintaining said part in separation chamber closing position, and means for reducing the pressure in said connection to enable movement of said part to separation chamber opening position.

7. In apparatus of the class described, in combination, a centrifugal separator having a separation space and including a movable part, a pressure pump having its suction connecting directly with the separating space and in a manner such that the fluid flows immediately and directly from the separating space to the suction of the pump, the impurities in the fluid being removed therefrom as the fluid passes through the separating space to the pump and a connection communicating with the discharge of said pump, said connection being arranged with respect to said movable part so that the pressure therein normally retains the separation space closed against the egress of impurities.

8. In apparatus of the character described, in combination, a centrifugal separator having a separation space with an open position and closed position, said space being normally closed against the egress of impurities, a pump having its suction communicating with the separating space, the impurities in the fluid being removed therefrom and retained in the separation space as the fluid passes through the separating space to the suction of the pump, a connection communicating with the discharge of said pump, said connection being arranged with respect to the separator so that the pressure therein normally retains the separation space closed.

9. In apparatus of the character described, in combination, a centrifugal separator having separable parts forming a separation chamber, means normally acting to separate said parts, a pressure pump having its suction connected directly with the separating chamber and in a manner such that fluid flows immediately and directly from the separation chamber to the suction of the pump, and a connection through which the pressure of said pump normally acts to retain said separable parts in engagement with each other against the action of said separating means.

10. In apparatus of the character described, in combination, a centrifugal separator having a separation chamber normally closed against the egress of impurities, means normally acting to open said separation chamber, a pressure pump having its suction connected directly with the separating chamber and in a manner such that purified fluid flows immediately and directly from the separation chamber to the suction of the pump, means including a connection through which the pressure of said pump normally acts to retain said separation chamber closed, and means for reducing the pressure in said connection to enable the separation chamber to open automatically and discharge the impurities collected therein.

11. In an apparatus of the character described, in combination, a centrifugal separator having a separation space, said separation space having an open position in which position the impurities are discharged and a closed position in which position the impurities are retained in said separation space, a pressure pump for flowing the liquid to be purified through said separation space, means including a pressure connection to the discharge of the pressure pump for retaining the separation space closed, and means for reducing the pressure in said pressure connection to enable the separation space to open and discharge impurities therefrom.

12. In apparatus of the character described, in combination, a centrifugal separator having a movable part forming a separation chamber closed against the discharge of impurities, a line having a valve therein through which impurities from said separator are discharged, a pump having its suction communication with the separation chamber, a connection through which the pressure of said pump normally acts to retain said movable part in separation chamber closing position, and means for reducing the pressure in said connection to enable movement of said part and the discharge of impurities through said line and valve.

13. In a coolant circulating system for a machine, in combination, a collector into which the coolant flows from the machine, a line having a hand controlled valve therein through which coolant is supplied to the machine, a pump for pumping the coolant through said line, a motor for operating said pump, a switch electrically connected to said motor, means for actuating the switch to shut off the motor when the hand controlled valve is operated, means including a centrifugal separator between said collector and said valve for separating impurities from said coolant, and means for discharging impurities from said centrifugal separator automatically and by centrifugal force upon actuation of said hand controlled valve.

14. In apparatus of the character described, in combination, a centrifugal separator having a

separation space, a pump connected with the separation space for flowing liquid to be purified through said separator, means for discharging impurities collected in said centrifugal separator comprising a discharge connection having a valve therein, said valve being normally retained in a closed position by the pressure of said pump.

15. In apparatus of the character described, in combination, a centrifugal separator having separable parts forming a separation space, a pump connected with the separation space for flowing liquid to be purified through said separation space, a connection through which the pressure of said pump acts to normally maintain said separable parts in a closed position, means for discharging impurities collected in said centrifugal separator comprising a discharge connection having a valve therein, said valve normally being retained in a closed position by the pressure of said pump.

16. A combined pump and centrifuge comprising, in combination, a centrifugal separator comprising a casing formed of two separable parts, a chamber at least partly surrounding said casing, a pump having a rotatable impeller and a stationary casing forming a pressure space, and a connection between the pressure space of said pump and said chamber for exposing the exterior surface of at least one of said parts to said pressure and maintaining said separable parts together.

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