June 4, 1963 E. A. DAUBMAN 3,092,576

CENTRIFUGAL SEPARATORS

Filed Feb. 18, 1959 2 Sheets-Sheet 1

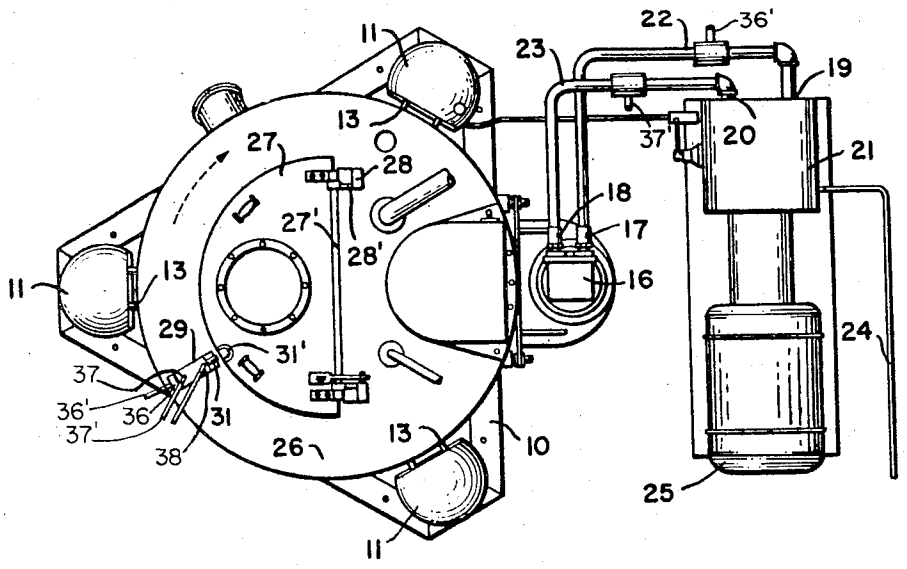


FIG. 2

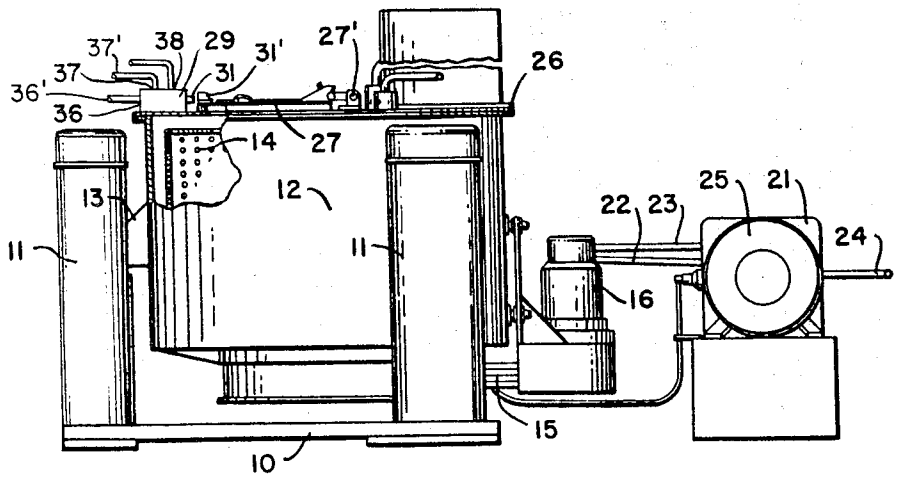


FIG. 1

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Filed Feb. 18. 1959 2 Sheets-Sheet 2

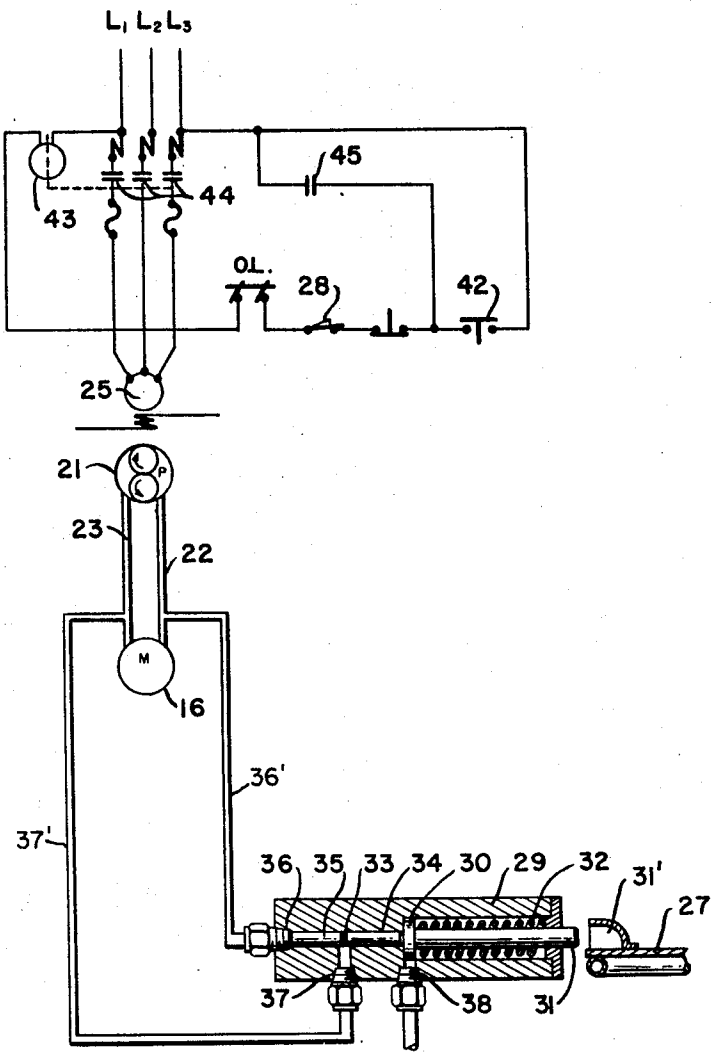


FIG. 3

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CENTRIFUGAL SEPARATORS

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2 Claims. (Cl. 210—146)

The present invention relates to centrifugal separators, and particularly to a new and improved cover interlock mechanism that will prevent access to the interior of the separator while the same is operating.

A principal object of this invention is to provide a cover interlocking mechanism, effective during the accelerating and decelerating of the rotatable basket of a centrifugal separator that is driven and braked by hydraulic components in a closed hydraulic circuit.

Another object of the invention is to provide a cover interlock mechanism for a centrifugal separator that will require manual restarting of the main motor each time the cover is opened.

One aspect of the invention may be to provide a centrifugal separator with a closed circuit hydraulic system embodying an hydraulic pump that is driven by an electric motor and wherein the hydraulic pump supplies liquid under pressure in a closed circuit to an hydraulic motor that is belted or otherwise drivingly connected to the rotatable basket of the separator. A hinged cover plate may provide access to the interior of the separator and a limit switch may be provided that is connected in series with the electric motor that drives the hydraulic pump. The hydraulic pump may be of the variable displacement type incorporating hydraulic braking for decelerating the rotatable basket of the separator. An hydraulically actuated piston and cylinder mechanism may be provided for locking the cover plate during the accelerating, running and decelerating periods of activity of the separator.

The interlock actuating mechanism may comprise a multi-piston arrangement that may be rendered effective by the application of differential hydraulic pressures applied thereto from either side of the closed circuit including the hydraulic pump and motor units. Resilient means may be provided for positively retracting the interlock for the cover when no differential hydraulic pressure is applied to the multi-piston arrangement.

The above, other objects and novel features of the invention will become apparent from the following specification and accompanying drawings which are merely exemplary.

In the drawings:

FIG. 1 is an elevational view of a centrifugal separator to which the principles of the invention have been applied;

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

FIG. 3 is a schematic wiring diagram and hydraulic circuit of certain components of the invention.

Referring to the drawings, and particularly to FIGS. 1 and 2, the principles of the invention are shown as applied to a centrifugal separator of the bottom discharge type, although they may with equal facility be applied to any type of centrifugal separator. The separator shown may include a bedplate **10** on which are mounted three equally spaced pedestals **11** that include mechanism for supporting a housing **12** for limited oscillatable movement. The housing **12** may have fixed to its sides, brackets **13** that extend into the pedestals **11** to cooperate with supporting mechanism therein.

A basket may be located within the housing **12** and may comprise a perforated cylindrical member **14** for passing liquid therethrough, which liquid is collected within an annular chamber within the housing **12**. The

bottom of the basket **14** may be provided with discharge passages for gravitating solids therein out through the bottom of the housing **12**.

The basket **14** may be provided with a multiple V-belt sheave (not shown) on its vertical axis of revolution that is in driving engagement with V-belts **15**. The belts **15** also engage another similar sheave (not shown) on the axis of rotation of an hydraulic motor **16**. The motor **16** is of the constant displacement type and includes ports **17** and **18**. The ports **17** and **18** are connected to ports **19** and **20**, respectively, of a variable volume hydraulic pump **21** by lines **22** and **23**. The hydraulic pump **21** by means of a control may be adjusted to deliver from zero to maximum volume of liquid to the hydraulic motor **16**. An electric motor **25** may be provided for driving the pump **21** at a constant speed.

From the foregoing it is evident that adjusting the displacement of the pump **21** will cause different rates of rotation of the basket **14**. The speed of the motor **16** during the unloading operation is approximately 50 r.p.m. The capacity of pump **21** may be adjusted to cause the motor **16** to rotate basket **14** at a loading speed that is substantially faster than the unloading speed; and, the pump **21** may be adjusted to cause the motor **16** to rotate basket **14** at an extracting speed that is very much faster than the unloading speed. Since the electric motor **25** rotates at a constant speed and the pump **21** cannot be reversely driven, sudden adjustment of pump **21** from an extracting speed to any lower speed will cause the motor **16** to act as a pump tending to drive the pump **21** as a motor. However, since pump **21** cannot be driven by the motor **16** acting as a pump, a braking action on the rotation of the basket **14** is provided.

The structure thus far described is substantially the same as that shown and described in application Serial No. 657,801, filed May 8, 1957, now Patent No. 3,038,611, in the names of Frank O'Conor et al., to which application attention is directed for details not specifically described herein.

The top of the housing **12** is adapted to be covered by a top plate **26**, and a cover plate **27** of semicircular form mounted on a hinge pin **27'** may cover a correspondingly shaped opening in the top plate **26** to provide access to the interior of the basket **14**. A normally-closed limit switch **28** adapted to be operated by a cam **28'** on the cover hinge pin **27'** may be arranged so that it opens when the cover plate **27** is opened, thus preventing the starting of motor **25** when cover plate **27** is open. The cam **28'** may be a finger fixed to the cover hinge that opens switch **28** when the cover plate **27** is opened. The circuitry for the limit switch **28** will be described later.

In order to prevent opening of the cover plate **27** when the basket **14** is rotating, an hydraulic interlock is provided. It may comprise a cylinder **29** (see FIG. 3) mounted on top of the plate **26** of the housing **12** and may include a plurality of aligned piston means including a piston **30** having a rod **31** extending outwardly through one end of the cylinder **29** and serving as an interlock adapted to be moved to a position over the edge of cover plate **27** and into a socket member **31'** to prevent the opening of the cover plate **27**, or retracted under the action of a compression spring **32** for permitting opening of the cover plate **27**.

A bore **33** within cylinder **29** that is axially aligned with piston **30** may support, for reciprocation therein, separate pistons **34** and **35**. A pressure port **36** may be provided in cylinder **29**, which when subjected to a predetermined pressure from line **22** through a line **36'** will force pistons **35**, **34** and **30** rightwardly or forwardly, causing rod **31** to move over the edge of the cover plate **27** and into socket **31'** against the action of spring **32**.

Another pressure port **37** may be provided in cylinder **29** in position to be effective on piston **34** to cause it and piston **30** to move rightwardly while maintaining piston **35** in its lefthand or rearward position when liquid is supplied to port **37** from line **23** through a line **37'** under a pressure that is in excess of the pressure of the liquid being supplied to port **36** from line **22**. Of course, when liquid is supplied to port **36**, the pressure of which is in excess of that supplied to port **37**, pistons **35**, **34** and **30** will move rightwardly or forwardly to effect the interlocking action.

With the apparatus in the condition as shown in FIG. 3, closing start push-button switch **42** energizes relay coil **43** which closes switches **44** in lines L_1, L_2 and L_3, thereby energizing motor **25**, and closes a normally open holding switch **45**, to hold the circuit for relay coil **43** when switch **42** is released.

Energization of the motor **25** causes rotation of the pump **21**. With pump **21** set for zero delivery, the pressure in lines **23** and **22** is the system back pressure of about 125 p.s.i. Accordingly, the pressure on each end of piston **35** cancels, and the pressure on piston **34** is overcome by the strength of spring **32** maintaining piston **30** in its retracted position. Therefore, at zero speed of rotation of the basket **14**, the cover plate **27** may be opened at will; however, so opening it opens cover limit switch **28**, thereby de-energizing relay coil **43**, thus causing de-energization of motor **25**.

During an operating cycle, adjustment of pump **21** to deliver liquid to motor **16** at a rate to rotate basket **14** at a loading, extracting or unloading speed causes a pressure to build up within line **23** that is far in excess of the back pressure in line **22** and which may vary between about 300 and 1700 p.s.i., thereby forcing pistons **34** and **30** rightwardly and maintaining piston **35** in its outward positon since the only pressure on the lefthand end of piston **35** is the back pressure in line **22** of about 125 p.s.i.

With the basket **14** rotating, adjustment of pump **21** to reduce supply liquid to motor **16** causes braking to occur. Thus, this change decreases the supply of high pressure liquid to line **23**, but builds up a high pressure (300–1700 p.s.i.) in line **22** that is connected to port **36**, whereupon pistons **35**, **34** and **30** are forced rightwardly against the action of spring **32**, effectively preventing opening of the cover plate **27**.

With the basket **14** rotating at the unloading speed of approximately 50 r.p.m. the pressure in line **23** under certain conditions may be below 300 p.s.i. Exerting external pressure of sufficient magnitude on piston rod **31** at this time would assist spring **32** in forcing piston **30** backward, causing the interlock to become ineffective. Therefore, socket **31'** has been added to cover plate **27** to prevent this possibility.

When the pressure in lines **22** and **23** falls below a predetermined value in the neighborhood of 125 p.s.i., spring **32** becomes effective to force piston **30** backwardly so that rod **31** clears cover plate **27**, permitting its opening at the will of the operator.

Any accumulation of liquid within cylinder **29** between pistons **30** and **34** may be drained through a port **38**.

From the foregoing it is evident that a simple hydraulic interlock has been provided that will mechanically prevent access to the interior of a centrifugal separator during rotation of the basket while permitting access to said interior when the basket is stationary.

Although the various features of the new and improved cover interlock for centrifugal separators have been shown and described in detail to fully disclose one embodiment of the invention, it will be evident that numerous changes may be made in such details, and certain features may be used without others without departing from the principles of the invention.

What is claimed is:

1. In a centrifugal separator having a stationary housing within which a rotatable basket is mounted, a closed hydraulic circuit including an hydraulic pump and motor means for rotating as well as stopping the rotation of said basket; an electric motor for operating said pump and motor means; a cover plate adapted to provide access to the interior of said separator; switch means within the circuit for said electric motor for de-energizing said electric motor when said cover plate is opened; an interlocking element; a cylinder mounted on the top of said housing; inter-communicating axially aligned relatively small and large cylindrical passages within said cylinder; a piston within said relatively large cylindrical passage; a rod connected to said piston and adapted to interlock with said cover plate to prevent its opening; a pair of freely floating pistons within said relatively small passage, all of said pistons being in successive axial abutting relation when the piston in said large cylindrical passage is in retracted position; means for connecting the one side of said hydraulic pump and motor means to the end of said cylinder at a port such that a hydraulic force is applied in line with said pistons; means for connecting the opposite side of said pump and motor means to said cylinder at a port in position to act on both of the pistons in said small passage when they are in their retracted positions; and a compression spring within said large passage and acting on the piston therein tending to move it to its retracted position.

2. A centrifugal separator as claimed in claim 1, in which means mounted on said cover plate cooperates with the free end of said rod when said rod is in interlocking position to prevent an operator from assisting the action of said compression spring.

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