Dec. 3, 1929. W. S. EDSALL 1,737,648

LIQUID SEPARATING APPARATUS

Filed Oct. 17, 1922 2 Sheets-Sheet 1

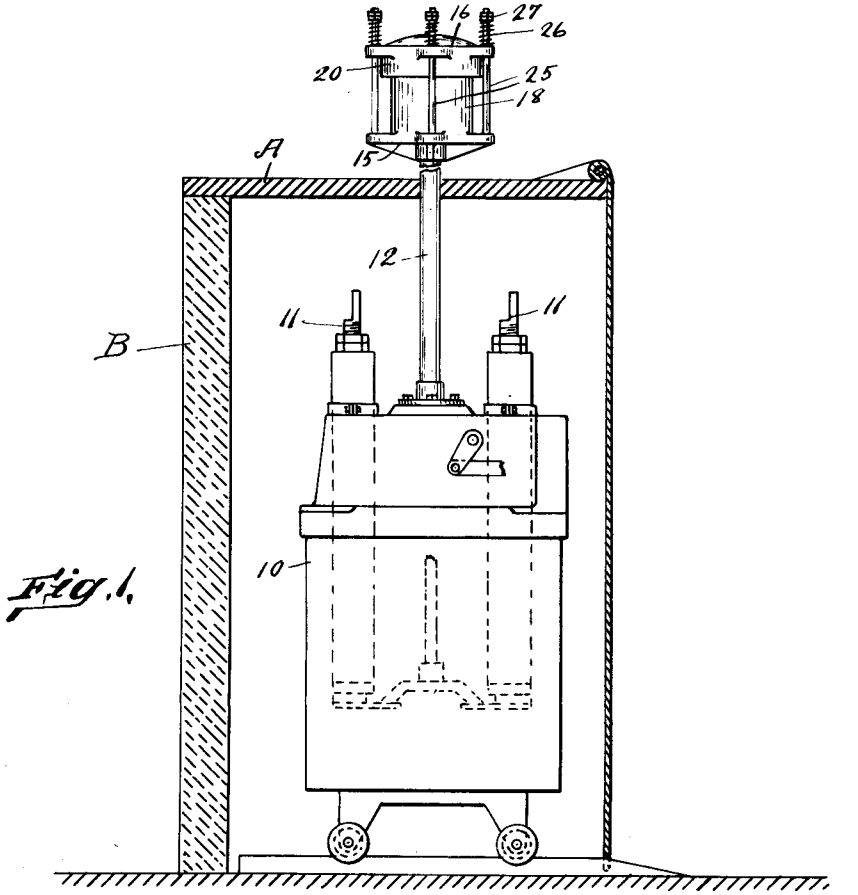


Fig. 1.

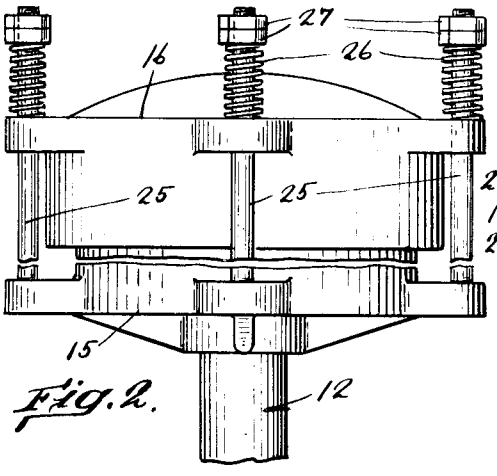


Fig. 2.

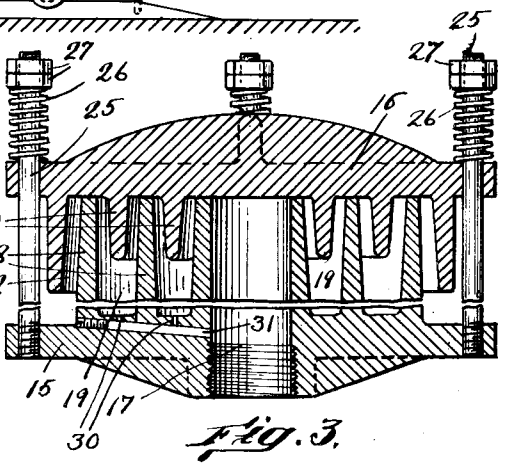


Fig. 3.

Inventor.

William S. Edsall

by

Atty

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LIQUID SEPARATING APPARATUS

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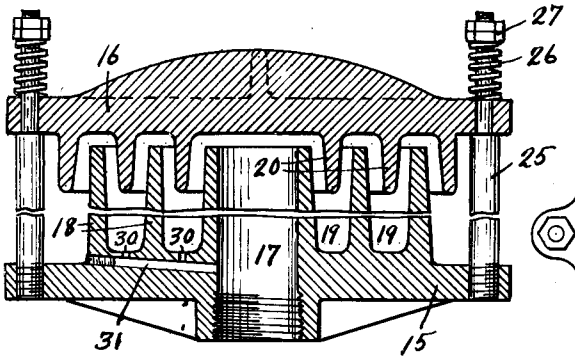


Fig. 4.

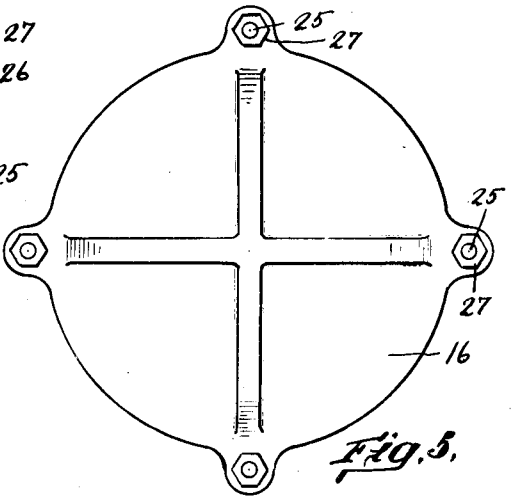


Fig. 5.

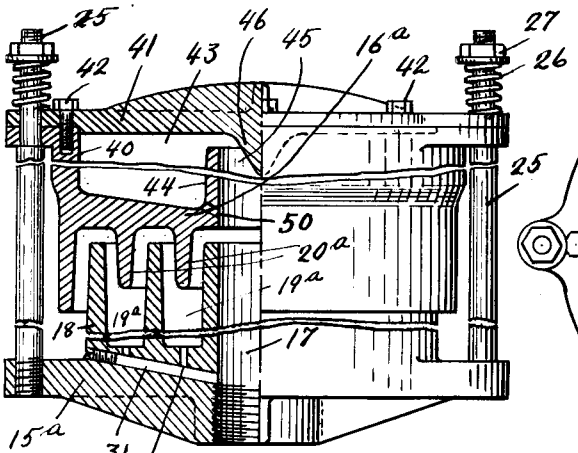


Fig. 6.

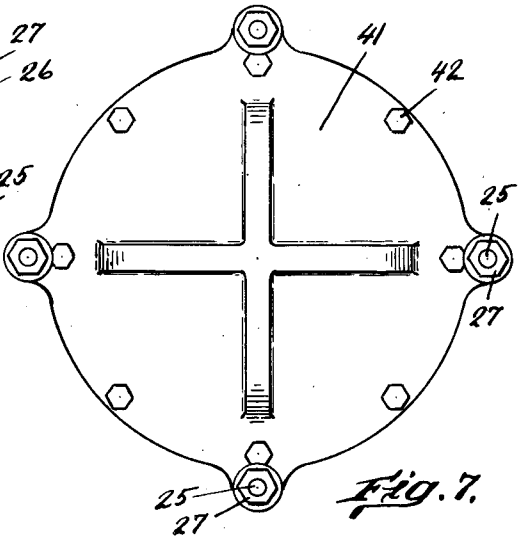


Fig. 7.

Inventor,
William S. Edsall
by
Atty.

Patented Dec. 3, 1929 1,737,648

UNITED STATES PATENT OFFICE

WILLIAM S. EDSALL, OF READING, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO CONDIT ELECTRICAL MANUFACTURING CORPORATION, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS

LIQUID-SEPARATING APPARATUS

Application filed October 17, 1922. Serial No. 595,173.

This invention relates to oil immersed electrical apparatus and particularly to electric switches adapted to interrupt relatively large values of current.

During circuit interruption, a considerable amount of gas and vapor may be generated in an oil immersed electric switch and, to relieve the internal pressure that may otherwise be created by the gas and vapor, the switch casing may be vented and the vent may include a pipe of suitable dimensions which is in communication with the interior of the switch before the oil level therein and may be extended to a suitable venting place. Usually the vent pipe terminates a short distance above the switch. Under severe circuit-interrupting conditions the evolution of gas and vapor within the switch may be rapid and violent, and liquid oil may be and usually is forced with the vapor and gases through the vent pipe and discharged from the switch. A discharge of oil from the switch is highly undesirable as, upon repeated operations, the oil level may descend to so low a point that the switch may be rendered ineffective to interrupt its circuit safely. Furthermore, the oil and gas vapor are usually at an elevated temperature when expelled from the switch and may even be on fire, or at such a high temperature as to ignite spontaneously when discharged into the atmosphere, whereby burning oil may be scattered about and may cause disastrous fires.

An object of this invention is to provide a switch with venting means including means to catch oil which may be expelled from the switch casing, and return it to the switch casing; and cool the hot gases and vapors before passing them into the atmosphere; and condense condensible vapors and return them to the switch.

A further object is generally to improve the construction and operation of electric switches.

Fig. 1 is a side elevation of an electric switch embodying the invention.

Fig. 2 is a side elevation of the separator apparatus embodying the invention.

Fig. 3 is a sectional elevation of the structure of Fig. 2.

Fig. 4 is a modification of the structure illustrated in Fig. 3.

Fig. 5 is a plan view of Fig. 2.

Fig. 6 is an elevation, partly in section, of a further modified form of separator apparatus.

Fig. 7 is a plan view of Fig. 6.

As here shown, my invention is or may be applied to an electrical apparatus, as an oil immersed electric switch which may be of any suitable construction and may have the casing 10 adapted to contain oil or other suitable equivalent fluid. Said casing may contain the movable and stationary switch members; and the stationary switch members 11 may extend upwardly above the casing for attachment with circuit leads. The switch may be enclosed in a cell or compartment having the top wall A and the rear wall B.

The switch may be vented in any suitable manner as through the vent pipe 12 which may be in communication with the interior of the switch casing and extend upwardly above the switch, and through the top wall A of the cell or to any suitable location at which gases and vapors formed within the switch may be discharged into the atmosphere.

As previously stated, liquid oil may be and usually is carried along with the gas and vapor through said vent pipe and, in accordance with this invention, I provide means to separate oil from the gas stream and catch the oil and prevent it from being discharged into the atmosphere and return the oil to the switch casing; and said means may also serve to cool the gas and vapor and condense the vapor and return the condensate to the switch, whereby but cool gas may be finally discharged into the atmosphere.

Preferably said oil-separating and gas and vapor cooling means is included in the gas venting passage of the switch and may be a part of said vent pipe and preferably is attached to the upper end of said pipe and the gas and vapor and liquid oil are adapted to be discharged into said means.

Said oil separating and cooling means may comprise an apparatus which may include the co-acting upper and lower members or plates

15 and 16 which may be and preferably are in the form of circular discs. Said lower plate may have a passage 17 extended through it in the lower portion of which the upper end of said vent pipe may be threaded; and said passage may comprise the gas entrance to the separating apparatus. Said lower plate may also be formed or provided with one, or preferably a plurality, of ribs or walls 18 which are spaced from each other and are preferably annular in form and concentric and extend upwardly from the upper face of said plate. The spaces between said walls are adapted to form compartments 19 in which the oil is separated and collected from the gas stream passing through the apparatus; and said walls are or may be relatively high as compared to the distance between them, whereby to form relatively narrow and deep compartments.

Said upper plate 16 is or may be formed in a similar manner and, accordingly, may be formed with the concentric and spaced annular depending walls 20 which are adapted to enter the compartments 19 of said lower plate 15 and depend for a substantial distance therein and be spaced from the upstanding walls 18 of said lower plate. Said upper plate may be spaced above the tops of said walls 18 as illustrated in Fig. 4, for instance, whereby to provide a gas passage from the middle passage 17 of said lower plate over the edges of said walls 18 and 20 into and out of the compartments 19, or said plate may rest upon the walls 18 of said lower plate, as illustrated in Fig. 3 and, in such position, the passage through the separator apparatus is normally closed although the closure may not be absolutely gas tight, and the switch may "breathe". The cooled gas, from which liquid oil has been separated, is adapted to leave the separator apparatus in a downward direction through the annular passage 22 formed between the outermost walls 18 and 20 of the lower and upper plates.

Said plates are held in spaced relation by suitable means which may include the studs 25 which may be threaded in or otherwise secured to the lower plate 15 preferably beyond the outermost wall thereof and extended upwardly. Said upper plate 16 is preferably slidably received on said studs and, in its lowermost position, is adapted to engage the walls 18 of said lower plate, Fig. 3, or shoulders on said studs, Fig. 4. Compression springs 26 may be disposed on said studs and are adapted to bear against said upper plate 16 and nuts 27 which are threaded on the upper ends of said studs. This arrangement is such that normally the upper plate 16 is held yieldingly in its lowermost position with relation to said lower plate and may move upwardly against said springs upon the occurrence of a predetermined increase in pressure between said plates, whereby to increase the area of the gas passage through the apparatus and relieve, to some substantial degree, the gas pressure in the apparatus, and also to reduce the strain on the plates and studs. Preferably, however, the extent of upward movement is not so great as to withdraw the annular walls 20 of said upper plate from an effective position within the compartments 19 of said lower plate.

When the circuit including the switch is interrupted under heavy load, gas and vapor are generated due to the action of the arc upon the oil or other arc-quenching fluid, and the gas and vapor, and also liquid oil are expelled from the switch into the vent pipe 12. The gas stream and the oil pass into the passage 17 in said lower plate and impinge against the upper plate 16 and are deflected laterally and pass into and downwardly through the annular space between the first annular walls 20 and 18 and into the first compartment 19 of said lower plate. The gas stream thence whips abruptly about the lower edge of said annular wall 20 and passes upwardly along said wall and into the next compartment and so on until it leaves the separator apparatus through the final vent passage 22. The gas stream is adapted to pass at a relatively rapid rate through the apparatus and as it passes over the lower edge of each wall 20 its direction of motion is changed abruptly. The oil contained in the gas stream is relatively heavy, as compared to the density of the gas and, consequently, as the gas stream is deflected over the edges of said walls 20, the oil particles are projected downwardly beyond and out of the gas stream and fall into the bottoms of the compartments. Said compartments are adapted to be relatively deep and the lower portions thereof are adapted to form dead gas spaces in which the oil is retained and prevented from re-entering the gas stream.

Oil may be separated from the gas stream in each compartment and the gas stream may finally flow from the separator apparatus substantially free from oil.

The entrapped oil in said compartments may subsequently flow back into the switch through the passages 30 which extend from the bottoms of said compartments into a passage 31, which latter is or may be arranged in communication with the middle passage 17 in said lower plate. If desired, however, each compartment may be provided with separate draining passages, although not herein shown. Said passages 30 and 31 are adapted to be relatively small in cross-section, as compared with the main gas passage through the apparatus, whereby to prevent the separated oil from being blown back into the gas stream passing through the upper portion of said compartments.

The oil will be returned to the switch

through the vent pipe 12 immediately subsequent circuit-interruption.

Due to the relatively small spacing between the walls 18 and 20 of said upper and lower plates, the hot gas and vapor may come in intimate contact with said cold walls and become cooled and vapor may be condensed and the gas may be relatively cool when it finally passes into the atmosphere.

It is to be noted that the area between the walls of the upper and lower plates is increased from the center toward the periphery of the plates and the gas consequently expands as it passes through the apparatus, and the expansion of the gas aids in the cooling of the gas and the condensing of the oil vapor.

Fig. 6 illustrates a modified form of separator apparatus. In this modification the lower plate 15^a is or may be identical with the plate 15. The upper plate 16^a may be similar to the upper plate 16 and have the depending annular walls 20^a which are adapted to enter the compartments 19^a of said lower plate. The said upper plate may be formed with the upstanding peripheral flange 40 on top of which a cover plate 41 is or may be secured by suitable means, as the screws 42, whereby to form a closed upper compartment 43. Said plate 16^a is or may be formed with a hub 44 which extends into said compartment 43 and may terminate a suitable distance below the cover plate 41. Said hub is provided with a passage 45 which preferably is disposed above and may be substantially equal in cross-section to the passage 17 in said lower plate 15^a. Said cover plate may be formed with the projecting portion 46 which depends into said passage 45 and serves as a guide-member adapted to direct oil from said passage into said compartment 43.

The gas and oil in said pipe 12 may be moving at considerable velocity at the moment of entering the separator apparatus and the oil partcles consequently may have considerable momentum. Due to the momentum, the oil particles may be projected upward from the gas stream as said stream is deflected laterally to pass outwardly between said plates 15^a and 16^a. The projected oil particles may enter said passage 45 at considerable velocity and may be guided by said cover plate 41 to enter the closed compartment 43 wherein the oil may be entrapped. With this arrangement, the larger proportion of oil may be separated from the gas stream before it enters said compartments 19^a and much of the remaining oil, and especially the more finely divided particles may be separated from the gas stream in said compartments 19^a. Oil may return to the oil receptacle from said closed compartment 43 through the drain passage 50 subsequent to the circuit interruption.

The structure may be otherwise modified without departing from the spirit of the invention.

I claim:

1. Separating apparatus including a casing having a plurality of liquid separating, open-top compartments, and means to guide a liquid-containing gas stream in succession through said compartments including a cover spaced above said compartments having flanges depending into the uppermost portions only and spaced from the side walls of said compartments, and yielding means responsive to pressure conditions in said casing for normally holding said cover in the aforesaid relation.

2. Separating apparatus including a casing having a gas inlet passage and an annular open-top compartment surrounding and in communication at its top with said passage, a cover spaced above said passage and compartment and having a flange depending into the uppermost portions only and spaced from the side walls of said compartment, and yielding means responsive to pressure conditions in said casing for normally holding said cover in the aforesaid relation.

3. Separating apparatus including a casing having a gas inlet passage and a plurality of annular, open-top compartments surrounding said passage, and means to guide a liquid-containing gas stream from said passage in succession through said compartments including a cover spaced above said passage and compartments and having flanges depending into the uppermost portions only of and spaced from the side walls of said compartments, said compartments having channels in communication with the lower portions thereof and with said gas inlet passage.

4. Separating apparatus including a casing having a gas inlet passage and a plurality of annular, open-top compartments surrounding said passage, and means to guide a liquid-containing gas stream from said passage in succession through said compartments including a cover spaced above said passage and compartments and having flanges depending into and spaced from the side walls of said compartments, said compartments having channels in communication with the lower portions thereof and with said gas inlet passage, and yielding means holding said cover in the aforesaid relation.

5. A liquid separator apparatus including a plurality of annular compartments arranged in series, and means to guide a gas stream successively between and over the tops and through the top portions only of said compartments and deflect the gas stream at the entrance of said compartments, whereby to project liquid out of the gas stream into the bottom portions of said compartments, the bottom portions of said comparments

being out of the gas stream, and means including said gas venting passage to conduct the separated liquid out of said compartments.

6. Separating apparatus including a casing having a plurality of liquid-separating, open-top compartments and means to guide a liquid-containing gas stream in succession through said compartments including a loose cover for said compartments having flanges depending into the uppermost portions only and spaced from the side walls of said compartments, thereby to provide dead-gas pockets beneath said cover-flanges, studs carried by and extended above said casing externally of said compartments and extended loosely through said cover, and springs encircling said studs above said cover and bearing upon said studs and cover, whereby to hold said cover yieldingly in the aforesaid relation.

7. Separating apparatus including a casing having a gas inlet passage and a plurality of annular open-top compartments surrounding said passage, and means to guide a liquid-containing gas stream from said passage in succession through said compartments including a cover spaced above said passage over said compartments and having flanges depending into the upper portions only and spaced from the side and bottom walls of said compartments, and yielding means normally holding said cover in the aforesaid relation arranged to permit said cover to be raised by and upon occurrence of an abnormal pressure within said casing.

8. Separating apparatus comprising a pair of opposed and spaced plates provided with intermeshing annular ribs spaced apart to provide a gas passage therebetween and thereover, said passage being freely open to the atmosphere at the peripheries of said plates, one of said plates having an inlet in the middle of said plate adapted to communicate with said gas passage, and yielding means responsive to pressure conditions in said passage securing said plates in the aforesaid relation.

9. Separating apparatus including a casing having a gas inlet passage and plurality of annular, open-top compartments surrounding said passage, and means to guide a liquid-containing gas stream from said passage in succession through said compartments including a cover spaced above said passage and compartments and having flanges depending into the upper portions only of and spaced from the side and bottom walls of said compartments, and studs carried by and extended above said casing externally of said compartments, said cover having a sliding support on said studs and arranged to yield and slide thereon upon occurrence of an elevated pressure in said casing.

10. Separator apparatus having a gas entrance, a closed compartment having an entrance opposite said gas entrance, and a gas exit passage arranged in front of said closed compartment and at an angle with the gas entrance.

11. Separator apparatus having a gas entrance, a closed compartment having an entrance opposite said gas entrance, and a gas exit passage arranged in front of said closed compartment and at an angle with the gas entrance and a plurality of oil separating compartments arranged in series in said exit passage.

12. The combination of a casing adapted to contain oil and having means to provide a gas venting passage, and separator apparatus having a gas entrance arranged in communication with said gas venting passage and an oil-catching compartment having an entrance disposed above and opposite said gas entrance, said separator apparatus also having a gas exit passage extended laterally between said gas entrance and said compartment-entrance and oil-separating compartments arranged in said gas exit passage.

13. Separator apparatus comprising a casing having a gas inlet passage and a plurality of annular open-top, liquid-separating compartments surrounding said passage, and means to guide a liquid-containing gas stream to pass in succession from said inlet passage through said annular compartments including a cover located above said passage and compartments and having a plurality of annular flanges depending into and spaced from the side and bottom walls of said compartments, said cover having a closed compartment located above said separating compartments and having an entrance opposite said gas inlet passage.

14. Separator apparatus comprising a casing having a gas inlet passage and a plurality of annular open-top, liquid-separating compartments surrounding said passage, and means to guide a liquid-containing gas stream to pass in succession from said inlet passage through said annular compartments including a cover located above said annular compartments and having a plurality of annular flanges depending into and spaced from the side and bottom walls of said compartments, said cover having a closed compartment located above said separating compartments and having an entrance opposite said gas inlet passage, and pressure-responsive yielding means to hold said cover in the aforesaid relation.

In testimony whereof, I have signed my name to this specification.

WILLIAM S. EDSALL.

CERTIFICATE OF CORRECTION.

Patent No. 1,737,648. Granted December 3, 1929, to

WILLIAM S. EDSALL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, line 13, for the word "before" read "above"; page 3, line 43, before the word "pipe" insert the word "vent", and line 46, for the misspelled word "partcles" read "particles"; page 4, line 114, claim 14, for the word "annular" read "passage and"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of January, A. D. 1930.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)