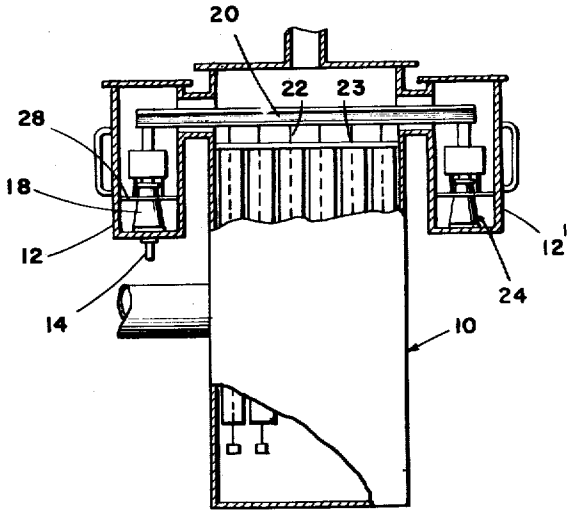
June 4, 1957 R. G. STREUBER ET AL 2,794,847

INSULATOR COMPARTMENT AND CONTROL THEREFOR

Original Filed April 22, 1952 2 Sheets-Sheet 1

Fig 1.



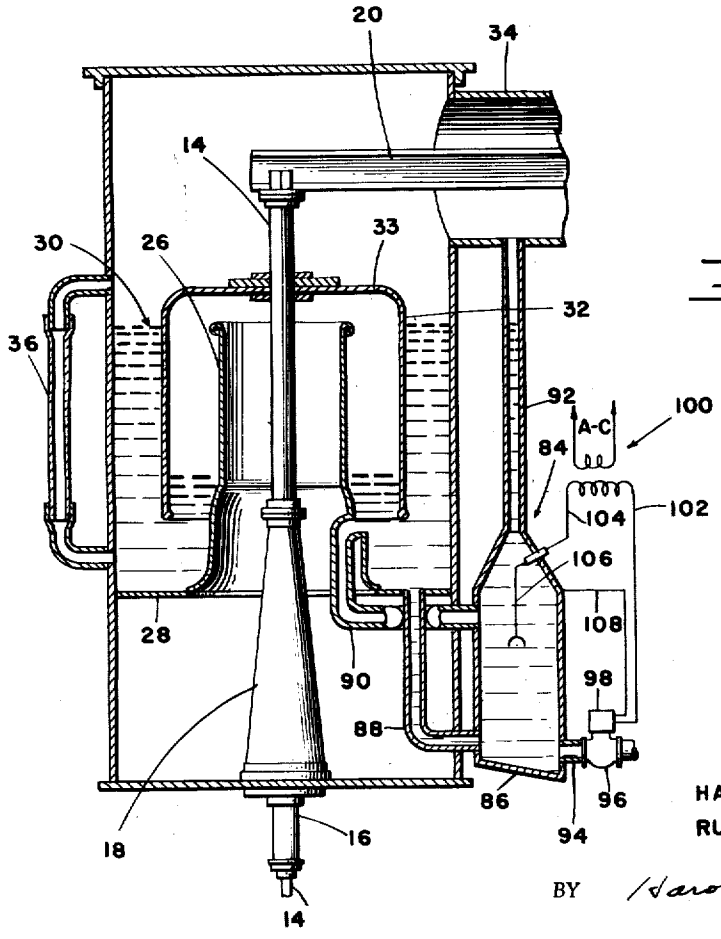


Fig 2.

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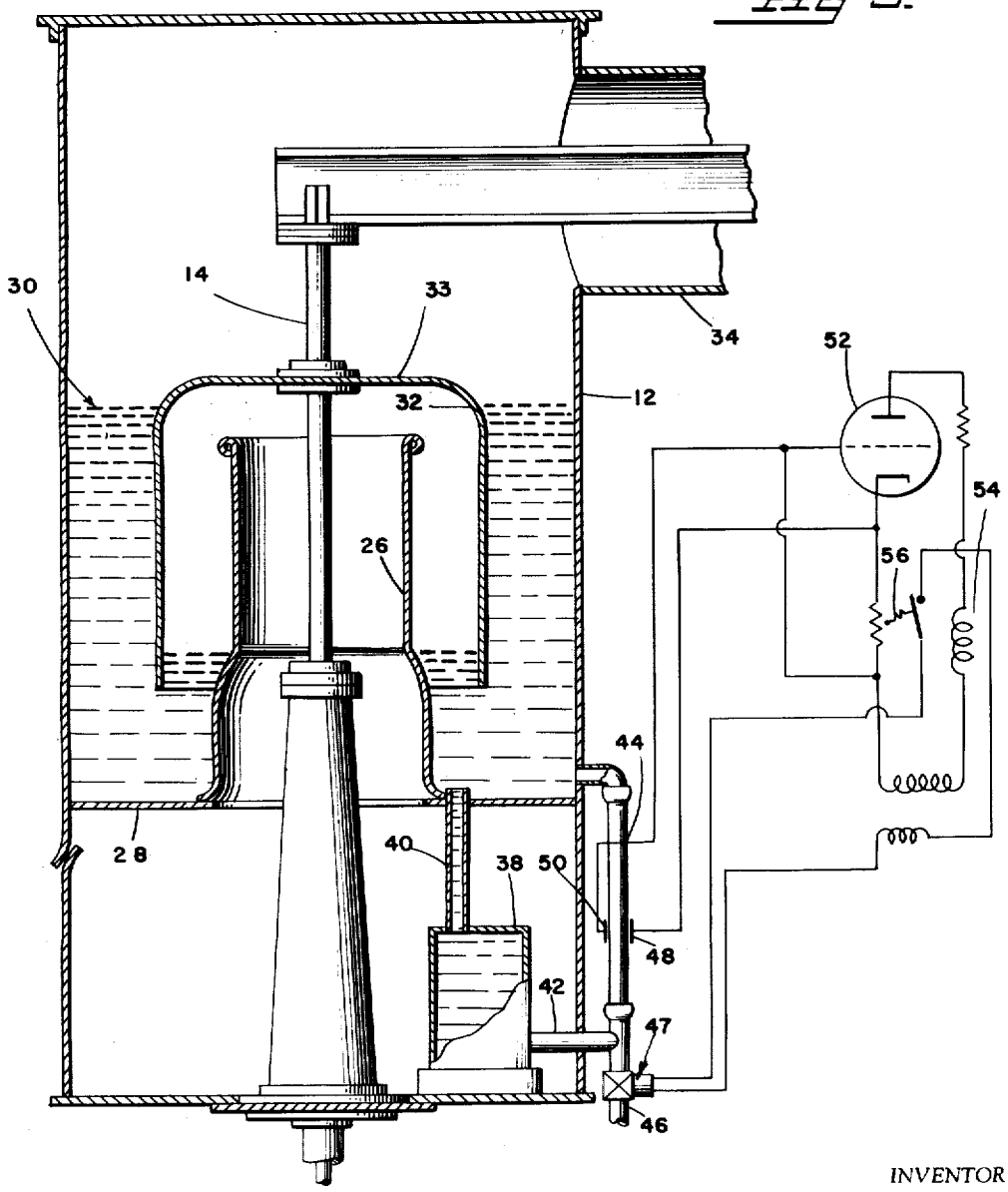
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Fig 3.



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2,794,847

INSULATOR COMPARTMENT AND CONTROL THEREFOR

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Original application April 22, 1952, Serial No. 283,634. Divided and this application May 21, 1953, Serial No. 356,502

4 Claims. (Cl. 174—18)

This invention relates to improvements in insulator compartments and controls therefor, associated with electrical precipitation apparatus, and is particularly directed to an improved insulator compartment that will remain operable under wide fluctuations in the precipitator gas pressure, and to means for removing foreign liquids and gases which accumulate in the compartment.

This invention is a division of application Serial No. 283,634, filed April 22, 1952.

In electrical precipitators the discharge electrode system is generally at high electrical tension while the collecting electrodes and precipitator shell are generally grounded. High tension insulators are required for bringing the high tension conductors into the precipitator chamber. To prevent deposition on the insulator of a coating of conducting materials, it has been the general practice to provide a gas tight seal between the main chamber of the precipitator and the insulator chamber.

One form of gas tight seal comprises an annular trough filled with insulating oil or other suitable insulating fluid, and an inverted cup-shaped hood, the lower edges of which extend below the surface of the oil; the conductor extends through an opening in the top of the hood. This type of gas tight seal has not proven entirely satisfactory, as such oil seals can only be set for a limited range of pressure differences between the internal precipitator pressure and the external atmospheric pressure.

When the internal pressure changes suddenly, for example, when a damper in the precipitator flue is closed, the levels of the oil at the two sides of the hood change rapidly and the oil is often ejected from the insulator compartment. Contamination of the oil seal also affects its efficient operation. Industrial gases treated by electrical precipitation are dirty and frequently saturated with water, acids or other liquids which change the specific gravity and the volume of the insulating oil. These changes in turn affect the pressure balance in the insulator compartment and prevent its proper operation.

It is therefore an object of the invention to provide an improved form of seal for closing the opening in the wall of the gas chamber while obtaining suitable electrical insulation between the chamber and the high tension electrical conductor. A further object is to provide a liquid seal which is so shaped that the liquid can assume different levels in the seal with changes in gas pressure without loss of the sealing liquid. A further object is to provide control means for an oil seal to maintain substantially constant the specific gravity of the insulating oil. A further object is to provide means for removal of contaminating liquids and gases to maintain the oil volume substantially constant and to prevent short circuits and explosions in the insulator compartment.

These and other objects and advantages of the invention are provided by the novel insulator compartment comprising an insulator chamber, conduit means connecting the upper end of the insulating chamber and the precipitation chamber, a support including an insulator

axially disposed in the insulator chamber, means for shutting off gaseous communication between the insulator chamber and the precipitation chamber comprising a ring through which the support passes, the walls of the insulating chamber and the ring defining an annular trough for the reception of an insulating liquid, a hood carried by the support concentric with the ring, the lower edge of the hood extending into the annular trough and the upper end of the hood being positioned substantially below the conduit means connecting the insulator and precipitation chambers and means for removing foreign matter from the insulating liquid whereby the volume and specific gravity of the liquid is maintained substantially constant.

The invention will be more fully described with reference to the illustrative embodiments of the invention shown in the accompanying drawings, in which:

Fig. 1 is a diagrammatic view in partial section of an electrical precipitator with insulator compartments constructed in accordance with the principles of the invention;

Fig. 2 is an enlarged sectional view of one form of the insulator compartment of the invention with control means for the insulating oil; and

Fig. 3 is an enlarged sectional view of the insulator compartment shown in Fig. 2 with a modified form of control means for the insulating oil.

With reference to the drawings and in particular to Figs. 1 and 2, **10** is the shell of an electrical precipitator and **12** and **12'** are the shells of the insulator compartments. The insulator compartments **12** and **12'** are identical except that insulator compartment **12'** does not have a conductive member extending therethrough.

A high tension conductor **14** is brought into the bottom of the compartment **12**, through insulating bushing **16** which projects within the supporting insulator **18** and connects with bus bar **20**.

The individual discharge electrodes **22** are suspended from the bus bar **20**, which passes through the precipitator compartment into the insulator compartment **12'** and is supported by insulator **24**.

Within each insulator compartment a ring **26** is supported by a horizontal partition **28** to form an annular trough **30**. The partition **28** is provided with a central opening equal in size to the internal diameter of the ring **26** through which the insulators **18** and **24** pass. The upper portions of the ring **26** is of less diameter than the lower portion whereby the effective volume of the upper portion of annular trough **30** is greater than its lower portion.

Secured to the high tension conductor is a hood **32** in the form of an inverted cup, which is disposed concentrically with the ring **26** with the lower edge of the cup extending below the upper edge of the ring so that the lower edge of the hood is completely immersed in the insulating oil during the normal operating range of the particular precipitator installation.

The upper end **33** of the hood **32** is positioned a substantial distance below the lower edge of the annular conduit **34** which connects the upper end of the insulator compartments with the precipitation chamber.

Under normal operating conditions the insulating oil level will be above the lower edge of hood **32** substantially as shown in Fig. 2 of the drawings. Upon a sudden rise of the pressure within the precipitator, the oil level in the outer section of the seal falls and that in the inner section rises. Since the upper end of ring **26** is reduced in diameter the change in level between ring **26** and hood **32** takes place at a substantially low rate greatly reducing the tendency for the insulating oil to surge over the top of ring **26** and out of the insulator compartment.

When the pressure in the precipitator is reduced be-

low the normal range the oil level between the ring **26** and the hood **32** is lowered. To prevent the sealing oil from being sucked through the annular conduit **34**, through which bus bar **20** extends, when the pressure in the precipitator is thus reduced the space provided between the top **33** of the hood and the lower edge of the conduit **34** is great enough to accommodate all of the sealing oil between the hood **32** and the lower edge of the conduit **34**. This form of construction substantially eliminates loss of oil during abnormal low pressure surges within the precipitator.

To remove sludge, water and acid which collect in the sealing oil, and to maintain the volume of oil in the system substantially constant, an automatic control system **84** is provided.

A settling tank **86**, into which sludge, water and acid having a higher specific gravity than the insulating oil collect, is secured adjacent the lower section of the insulator compartment. The foreign matter enters tank **86** by conduit **88** which joins the tank to the bottom of trough **30**.

A second conduit **90** provides sludge-free oil to the upper portion of tank **86**. The settling tank has two outlet conduits designated **92** and **94**. Conduit **92** is connected at one end into the top of the tank and the other end of the conduit discharges into the upper section of the insulator compartment, or, as shown in the drawings, into conduit **34**. Conduit **92** is adapted to remove gas and air bubbles from the separating tank. Outlet conduit **94** is connected into the lowermost portion of the settling tank and is provided with an automatic outlet valve **96**. This valve may be normally held in the closed position by springs and have an electrically actuated solenoid **98** adapted to open the valve when the solenoid is energized. The electric current for the solenoid is derived from the transformer **100**. One of the leads **102** from the transformer is connected to one terminal of the solenoid and the other lead **104** is connected to an electrode **106** supported within the tank **86**. The circuit is completed by an electrical conductor **108** which connects the conductive wall of tank **86** to the other terminal of solenoid **98**.

Since oil is substantially a non-conductor of electricity, no current will flow to the valve actuating solenoid until the oil in the tank is replaced by conductive sludge, water or acid up to the lower end of electrode **106**, at which time the electrical circuit is closed and the valve will be opened. The valve remains open until the conductive material within the tank falls to a level sufficient to break contact with electrode **106**. The above cycle will operate as often as required to keep the accumulated conductive material at a predetermined level within the tank **86**.

A liquid level sight tube **36** may be provided on the insulator compartment.

A modified form of the invention is shown in Fig. 3 and corresponding parts are provided with the same numerals as used in reference to Figs. 1 and 2.

With reference to Fig. 3, **12** is the shell of the insulator compartment which is divided into two sections by a horizontal partition **28**. The partition has a central opening, about which ring **26** is fitted, whereby the partition, ring and the sides of chamber **12** form an annular trough **30** which is filled to a predetermined level with insulating oil. As hereinbefore described with reference to Figs. 1 and 2, the upper portion of ring **26** is of less diameter than the base portion whereby the volume of the upper and lower portions of trough **30** are different.

Secured to the high tension conductor **14** is a hood **32** in the form of an inverted cup, which is disposed concentrically with the ring **26** with the lower edge of the cup extending below the upper edge of the ring so that the lower edge of the cup is completely immersed in the insulating oil during the normal operating range of the precipitator.

The top **33** of the hood is positioned a sufficient distance below the lower edge of the conduit **34** to provide a space between the top of the hood and the lower edge of conduit **34** to accommodate the sealing oil during abnormal low pressure surges within the precipitator.

To remove sludge, water and acid from the sealing oil in order to maintain a substantially constant volume of oil in the system and to prevent arc-overs and possible explosions in the insulator compartment, a settling tank **38** is provided in the lower section of the insulator compartment.

A conduit **40** connects the lower portion of trough **30** with the top of the tank **38** and sludge, water and acid having a higher specific gravity than the insulating oil collect in the bottom of the tank. An outlet conduit **42** is connected at one end into the lower portion of the settling tank and connects into a sight tube **44** at the other end.

An automatic outlet valve **46** is provided on the sight tube below the union of the sight tube with conduit **42**. The outlet valve **46** may be of any well-known electrically actuated type. For example, the valve may be spring urged in the closed position with a solenoid **47** for opening the valve, as to be more fully described hereinafter. The solenoid of the valve is energized when the foreign matter in the glass portion of the sight tube reaches a predetermined level. It functions by the difference in capacitance of the sealing oil and the foreign matter between two curved plates **48** and **50** on opposite sides of the glass tube.

The plates **48** and **50** are connected across the grid bias resistance of a triode **52**. When the space between the plates is filled with oil, an extremely low electrical capacity exists and no current flows in the switch actuating coil **54**. However, when acid, for example, rises in the space between plates **48** and **50** the capacity between the plates increases permitting a flow of current through coil **54** which closes switch **56** and sends an electrical signal to the electrical actuator of valve **46**. The electrical signal continues to flow to the electrical actuator until oil replaces the acid between plates **48** and **50**.

From the foregoing description it will be seen that the present invention provides an improved insulating compartment, and controls therefor, whereby the aims, objects and advantages of the invention are fully accomplished.

We claim:

1. An insulator compartment for an electrical precipitator having a precipitation chamber comprising an insulator chamber, conduit means connecting the upper end of the insulating chamber and the precipitation chamber, a support including an insulator axially disposed in the insulator chamber, means for shutting off gaseous communication between the insulator chamber and the precipitation chamber comprising a ring through which the suppose passes, the walls of the insulating chamber and the ring defining an annular trough for the reception of an insulating liquid, a hood carried by the support concentric with the ring, the lower edge of the hood extending into the annular trough and the upper end of the hood being positioned below the conduit means connecting the insulator and precipitation chambers, the distance between the upper end of the hood and the lower edge of the conduit means being so selected that all of the sealing oil may be accommodated between said hood and the lower edge of the conduit means during reduced pressure operation of the precipitator, and means for removing foreign matter from the insulating liquid whereby the volume and specific gravity of the liquid is maintained substantially constant.

2. An insulator compartment for an electrical precipitator having a precipitation chamber comprising an insulator chamber, conduit means connecting the upper end of the insulating chamber and the precipitation

chamber, a conductor mounted in an insulating bushing axially disposed in the insulator chamber, means for shutting off gaseous communication between the insulator chamber and the precipitation chamber comprising a ring through which the conductor passes, the walls of the insulator chamber and the ring defining an annular trough for the reception of an insulating liquid, a hood carried by the conductor concentric with the ring, the lower edge of the hood extending into the annular trough and the upper end of the hood being positioned below the conduit means connecting the insulator and precipitation chambers, the distance between the upper end of the hood and the lower edge of the conduit means being so selected that all of the sealing oil may be accommodated between said hood and the lower edge of the conduit means during reduced pressure operation of the precipitator, and means for removing foreign matter from the insulating liquid whereby the volume and specific gravity of the liquid is maintained substantially constant.

3. An insulator compartment for an electrical precipitator as defined in claim 2 wherein the means for removing foreign matter from the insulating liquid comprises a tank positioned below the lowest extremity of the trough, conduit means connecting the bottom of the trough with the upper portion of the tank, valve means adjacent the lower portion of the tank and an actuator for said valve responsive to the volume of foreign matter in the tank.

4. An insulator compartment for an electrical precipitator having a precipitation chamber comprising an insulator chamber, conduit means connecting the upper

end of the insulating chamber and the precipitation chamber, an insulator axially disposed in the insulator chamber, means for shutting off gaseous communication between the insulator chamber and the precipitation chamber comprising a ring through which the insulator passes, the walls of the insulating chamber and the ring defining an annular trough for the reception of an insulating liquid, a hood carried by the insulator concentric with the ring, the lower edge of the hood extending into the annular trough and the upper end of the hood being positioned below the conduit means connecting the insulator chamber and the precipitation chamber, the distance between the upper end of the hood and the lower edge of the conduit means being so selected that all of the sealing oil may be accommodated between said hood and the lower edge of the conduit means during reduced pressure operation of the precipitator, and means for removing foreign matter from the insulating liquid whereby the volume and specific gravity of the liquid is maintained substantially constant.

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