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GAS LIQUID RECEIVER AND LIQUID SEPARATOR

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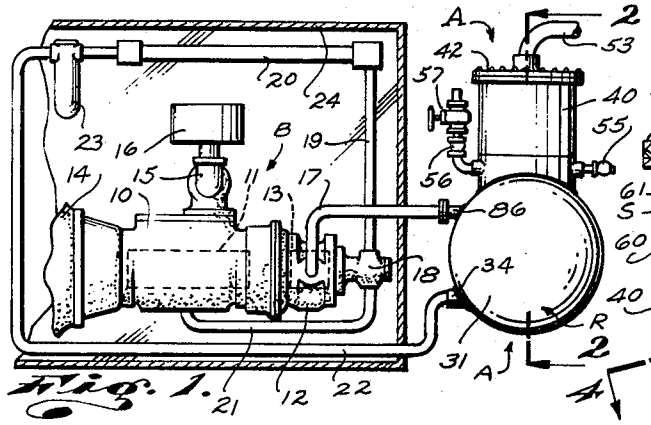


Fig. 1.

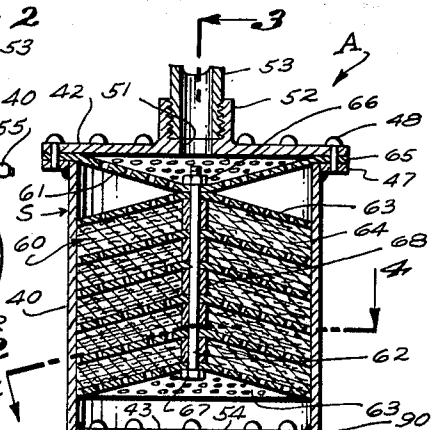


Fig. 2.

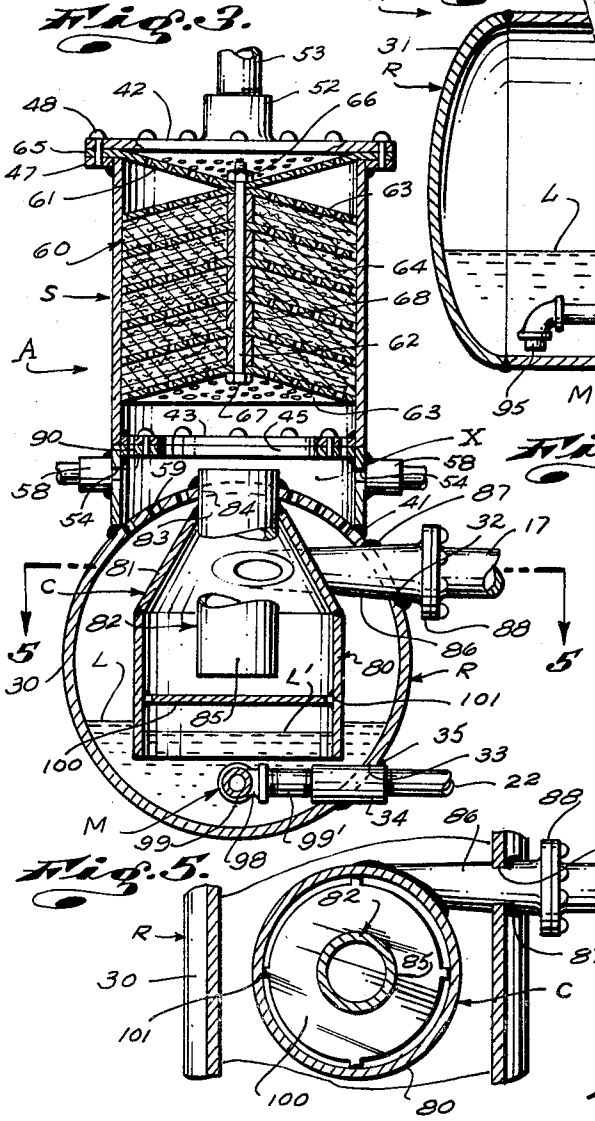


Fig. 3.

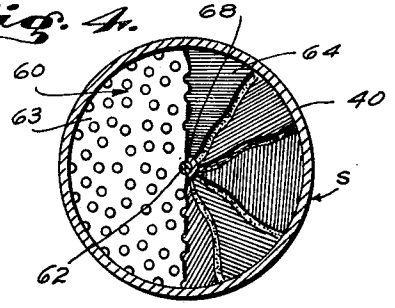


Fig. 4.

Fig. 5.

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GAS LIQUID RECEIVER AND LIQUID SEPARATOR

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ABSTRACT OF THE DISCLOSURE

A receiver-separator unit comprising, a receiver tank, an elongate, vertical casing fixed to and extending upwardly from the tank and closed at its upper end, openings in the tank establishing communication between the interior of the tank and the casing, a supply of oil in the bottom of the tank, a cyclone separator in the tank having an outer vertical flow tube open at its lower end and provided with an upwardly convergent conical head at its upper end, an inner central open ended flow tube extending through the head and having a lower portion terminating within the outer flow tube and an upper portion extending through the tank into the lower end of the casing and an elongate inlet tube with an inner end tangential with and communicating with the interior of the head and an outer end accessible at the exterior of the tank and adapted to connect with the discharge end of an air compressor, a filter pack in the casing above the inner flow tube, an air delivery line communicating with the upper end of the casing above the filter pack and means at the lower portion of the tank to conduct oil therefrom.

This invention has to do with a gas receiver liquid separator and is more particularly concerned with that form of separator related to rotary or screw air compressors and adapted to separate lubricating oil from the air issuing from the compressors.

In the rotary or screw type air compressor art the oil employed to lubricate and cool the compressors is picked up and carried by the air being handled.

In the case of rotary compressors, that is, that form of air compressing machine which includes an elongate, cylindrical rotor with radially shiftable, longitudinally extending blades arranged in an elongate, eccentric chamber, considerable lubricating between the blades and the wall of the chamber is required. To assure proper lubrication in this type of compressor, oil is force fed into the machine and in such a manner that the air being handled becomes highly saturated with the oil.

As a result of the above, it is necessary that separators be provided at the discharge or exhaust end of compressors, to separate the oil from the air, particularly in the case of rotor type compressors.

Further, in the air compressor art, it is common practice to provide a reservoir or receiver tank in close association with compressors to receive and store a volume of compressed air. The principal function of such receiver tanks is well known and requires no further explanation.

It has long been common practice in the art to combine and/or closely relate or associate the separators and receiver tanks for the purpose of economy and space and for the purpose of enhancing the operation of the separators.

A principal shortcoming to be found in the ordinary receiver-separator construction provided by the prior art is the tendency for the oil to break down, creating undesirable sludge and varnish and also to burn or oxidize so as to create carbon.

It has been determined that a major portion of this breaking down and carbonizing of the oil takes place in

or is caused by the operation of the receiver-separator construction employed.

In the ordinary receiver-separator construction oil ladened air issuing from the compressor is divided into the receiver tank in such a manner that the in-flowing air impinges upon a wall of the tank. This in-flowing air and the droplets of oil carried thereby absorb a great deal of work energy in the compressor and are hot as they enter the receiver. When the oil droplets impinge upon the wall of the receiver tank, additional heat energy is created and the droplets are broken up or fractured into finer units. This fracturing and increase in heat results in carbonizing and/or burning down of the oil.

It is notable that the prior art apparently has failed to recognize the foregoing, since in most instances nozzle means are provided in the receiver tanks to deliberately direct the in-flowing air and oil onto a wall of the tank with the view that the oil will stick to the wall and separate more readily.

It is common practice in the ordinary receiver-separator construction to collect the separated oil in the bottom of the receiver tank and to draw oil from the tank, for recirculation in the compressor, through a single outlet port in the bottom of the tank. Frequently this practice is unsatisfactory since the oil collected in the bottom of the tanks comes to rest and a current flow is created through the body of oil to the outlet port which is such that a small position of the oil is continuously recirculated and the major volume of the oil is unused. This results in over use and premature breakdown of the used oil and breakdown of the unused oil.

The most effective oil separators consist of an elongate series of fibrous filter pads arranged in a suitable housing and through which the air delivered into the receiver flows as it is used. The oil in the air flowing out through the pads contacts and, as a result, collects on the fibers and thence runs along the fibers, by gravitational force to the lowermost portion of the pads and housing to drain therefrom into the receiver.

Frequently the series of filter pads in such separators are arranged in a horizontal line and the oil drains downwardly and laterally of the axis of the series of pads to collect at the lower side of the housing in which the pads are arranged. As a result of this arrangement, the lower portions of the pads become heavily ladened with oil and the upper portions thereof are relatively unladened so that the flow of air through the structure is not uniform and the air rushes freely through the upper portion of the series of pads with sufficient velocity to carry a portion of the oil through and flows slowly or sluggishly through the lower position of the series of pads. The drainage of that oil which is stopped by the pads is, however, excellent.

The oil which accumulates at the lower side of the housing is moved upstream therein by the flow of air and a separate or special drain opening, and line for that oil, not in communication with the receiver tank must be provided to conduct that oil away from the separator, since a pressure drop occurs from one end of the housing or separator construction to the other. As a result of this pressure drop, a special pump means is ordinarily provided to urge that oil back into the receiver or the oil reservoir; or, in some cases, a suction line is provided between the oil collection end of the separator and the inlet side of the air compressor to drain oil from the separator and recirculate it into the compressor immediately; or a combination of such means.

Use of the suction and recirculating oil removing means referred to above robs the construction of a substantial portion of the compressed air and reduces the efficiency of the entire set-up.

Vertical dispositioning of filter pad type separators of

the character referred to above has been avoided since the oil draining downwardly saturates the lower end of the series of pads throughout the cross-section of the pads restricting flow. Further, the up-flowing air opposes the downward flow of oil in the pads and frequently to such an extent that a great portion of the oil is carried directly through the separator by the moving air, rendering the structure substantially ineffective.

An object of my invention is to provide a novel receiver-separator construction which overcomes the several noted shortcomings of ordinary receiver-separators of the general character referred to above.

It is an object of the present invention to provide a structure of the character referred to including a cyclone separator within the receiver tank to receive the incoming air flowing from the related compressor in such a manner that the oil droplets are not directed onto a surface to impinge thereon in such a manner as to create additional and excessive heat and to fracture and further divide the droplets to the end that the oil is carbonized or otherwise broken down by such action and to the end that the oil is less readily separated from the air.

Another object of my invention is to provide a structure of the character referred to wherein the filter involves a plurality of filter pads, within a housing, arranged in vertical series and is such that oil stopped and collected by the fibers drains radially outward from the central vertical axis of the series of pads to the outer perimeter of the pads where it combines in such a manner that it can flow downwardly in the filter and in opposition to the primary flow of air upwardly through the separator, which primary flow of air moves upwardly through the central portion of the series of pads.

An object of this invention is to provide a filter of the character referred to which is such that its oil discharge end occurs at its air inlet and where the oil can be drained directly into the receiver and special pumps, vacuum lines and the like, are not required to scavenge the oil from the separator.

Yet another object of my invention is to provide a structure of the character referred to having novel means for draining oil from the collected supply of oil in such a manner that all of the oil is used and a small portion of the oil is not continuously recirculated as in the case of similar structures provided by the prior art.

Finally, it is an object of my invention to provide a structure of the character referred to which is less costly to manufacture and maintain, more compact and which is more effective and dependable in operation than those receiver-separators of a similar nature or type that are provided by the prior art.

The foregoing objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of my invention, throughout which description reference is made to the accompanying drawings, in which:

FIG. 1 is a view showing my new construction related to a typical rotary type air compressor unit;

FIG. 2 is an enlarged detailed sectional view taken as indicated by line 2—2 on FIG. 1;

FIG. 3 is a sectional view taken as indicated by line 3—3 on FIG. 2;

FIG. 4 is a sectional view taken as indicated by line 4—4 on FIG. 2; and,

FIG. 5 is a sectional view taken as indicated by line 5—5 on FIG. 3.

In FIG. 1 of the drawings I have shown my new receiver-separator construction A related to a typical rotary type compressor B. The compressor B is a two stage compressor having a primary or lower pressure cylinder **10** with a rotor **11** arranged therein and a secondary or high pressure cylinder **12** with a rotor **13** therein. The rotors are carried on a common shaft and are driven by a suitable prime mover **14** at one end of the shaft and compressor construction.

Since the prime mover **14** can be of any suitable type and construction, I have elected to show but a portion of such means related to the compressor.

The compressor B is further provided with air intake means **15** related to the primary cylinder and including a suitable air filter **16** and a discharge line **17** connected with the secondary cylinder **12**.

In addition to the foregoing, the compressor B is provided with a lubricating system, which system includes an oil pump **18**, connected with the end of the compressor remote from the prime mover, a suction line **19** connected with and between the inlet side of the oil pump and the discharged end of the oil cooler **20**, a delivery line **21** connected with and between the discharge side of the oil pump and the compressor and a supply line **22** between the inlet side of the oil cooler and a supply of oil, which supply of oil, in the instant case, is in the bottom of a receiver tank provided by this invention and which will be considered in detail in the following.

In practice, a suitable oil filter **23** can be provided in the line **22**.

In the case illustrated, the line **21** is shown connected with the low pressure cylinder **10** of the compressor B and is adapted to deliver oil into that cylinder for lubricating and cooling purposes. The oil thus delivered into the cylinder **10** is carried by the air being compressed into the high pressure cylinder **12** to provide necessary lubrication and cooling therein and is thence carried out of and away from the compressor, with the compressed air through the line **17**.

The structure thus far described can, in accordance with common practice, be enclosed in a suitable housing **24**.

The construction A that I provide includes, generally, a receiver R, a filter separator S and a cyclone separator C related to the receiver and the separator. The construction further includes a suction manifold means M.

The receiver R is a simple, elongate, horizontally extending tank having cylindrical side wall **30** and closed ends **31**. The receiver tank is fabricated of steel and is mounted in fixed position relative to the compressor B by suitable mounting means (not shown).

The receiver tank is provided with an air inlet port **32** in its upper portion and an oil outlet port **33** in its lower portion.

The air inlet port **32** is a simple, laterally opening port established in the outer portion of the side wall **30** of the tank and is adapted to receive a portion or part of the cyclone separator C, as will hereinafter be described.

The oil outlet port **33**, like the port **32**, is a simple, laterally opening port in the side wall **30** of the tank, but is located in the lower portion of the tank.

An elongate horizontal nipple **34** is engaged through the port **33** and is fixed therein by welding **35**. The outer end of the nipple **34** is threadedly connected with the oil return line **22** and the inner end thereof connects with the suction manifold means M, as will hereinafter be described.

The filter separator S includes an elongate, vertical tubular casing **40** having a lower end formed to seat on the top of the side wall **30** of the receiver tank and is fixed thereto by welding **41**. The upper end of the casing is closed by a suitable closure **42**.

In the preferred carrying out of the invention and as illustrated in the drawings, the casing is cylindrical in cross-section and is sectional, there being an upper section, indicated by the reference number **40**, and a lower or base section **40'** of limited vertical extent. The lower section **40'** which is formed to seat on and which is fixed to the receiver tank establishes a base for releasably mounting the upper section **40** of the casing on or with the receiver tank. The upper end of the lower section **40'** is provided with a radially inwardly projecting mounting flange **45** and the lower end of the upper

section 40 is provided with an inwardly projecting mounting flange 43 to seat on the flange 45. The flanges 45 and 43 are secured together by suitable fasteners engaged through registering openings provided in the flanges.

With the casing construction set forth above, if necessary or desired, the upper section 40 can be made smaller in diameter than the lower section, in which case the flange 45 would project radially outward from the lower end of the upper section 40.

The upper end of the upper section 40 is provided with a radially outwardly projecting mounting flange 47. The closure 42 is a simple, disc-shaped part overlying the upper end of the section 40 and the flange 47 and is secured there by suitable fasteners 48 engaged through registering openings in the closure and the flange 47.

The closure further includes a central flow passage 51 and a suitable upwardly projecting boss 52 through which the flow passage 51 extends and with which an outlet pipe or line 53 is connected. The line 53 is adapted to conduct oil-free or dry air from the construction to the equipment or system in which the compressed air is to be used.

In addition to the foregoing, the filter separator is provided with the laterally outwardly opening ports 54 in the lower portion of the casing to connect with suitable safety and control means, such as a pressure relief valve 55 and unloading means comprising a check valve 56 and a manually operable gate or plug valve 57. In the case illustrated, there are two ports 54, each provided with a suitable fitting 58 to facilitate mounting the check valve 56 and the valves of the unloading means.

The ports 54 are preferably arranged in the lower section 40' of the casing so that the upper section 40 thereof can be removed and replaced or otherwise worked upon without requiring disconnecting and working upon or modifying the noted safety and control means. For example, should it be desired to change the upper section 40 of the casing to provide a longer or shorter casing section or a casing of greater or lesser diametric extent, the safety and control means related to the separator need not be tampered with.

In practice, a single port 54, with its related fitting 58 can be provided and the safety valve 55 connected directly with the fitting, the check valve 56 of the unload ing means connected directly with the safety valve and the manually operable valve 57 connected with the check valve without the changing the operation of the invention and eliminating the cost of establishing and providing one of said ports and its related fitting.

The top of the receiver tank is provided with a plurality of apertures or perforations 59 which establish communication between the interior of the tank and the interior of the separator casing at the lower end thereof.

In addition to the foregoing, the filter separator includes a filter pack 60 within the upper section 40 of the casing. The filter pack 60 includes a hanger 61 in the upper portion of the casing, a central, vertical stem 62 fixed to and depending from the hanger, a plurality of vertically spaced dividers 63 on the stem, and a plurality of filter pads 64 about and between the stem and the dividers.

The hanger can be of any suitable design and construction. In the case illustrated, the hanger is shown as a perforated sheet metal disc. The hanger disc is provided with a rim 65 about its periphery to occur between the flange 47 and the closure 42. The disc is preferably conical in form, converging downwardly and radially inwardly so as to provide clearance between its central portion and the closure to accommodate the upper end of the stem and a related upper retaining nut 66.

The stem 62 is an elongate cylindrical rod, the upper end of which extends through a central opening provided in the hanger 61 and on which the retaining nut 66 is engaged. The nut 66 is larger than the opening in the hanger and prevents downward shifting of the stem relative to the hanger.

The lower end of the stem terminates at the lower end of the casing section 40 and is provided with an enlarged head or lower stop nut 67.

The dividers 63 are radially outwardly and downwardly divergent perforated sheet metal discs, the outer peripheral edges of which slidably engage the interior of the casing section 40 and are provided with central openings through which the stem is slidably engaged. The dividers are maintained in predetermined vertical spaced relationship by spacer sleeves 68 between each adjacent pair of dividers and slidably engaged about the stem.

The lower surface of the lowermost divider is engaged by the head or lower stop nut 67 on the stem and occurs in vertical spaced relationship above the lower end of the section 40 so that an expansion chamber X is provided between the lower end of the filter pack and the bottom of the casing, defined by the perforated portion of the side wall 10 of the receiver tank related to the casing.

It will be apparent that the upper retainer nut 66 and the lower stop nut or head 67 on the stem maintains the hanger 61, dividers 63, sleeves 68 and pads 64 assembled as a unit on the stem 62. Further, it will be apparent from the foregoing that the filter pack is a unitary assembly that can be easily and conveniently removed from and replaced within the casing, as desired or as circumstances require.

The filter pads 64 are disc shaped pads of relatively loosely related fibers. In practice, the fibers of the pads can be disposed in a random manner in accordance with common filter pad construction.

In the preferred carrying out of the invention, the pads are made of laminations of sheets of fibrous material in which the overwhelming number or bulk of the fibers run parallel in one direction and only a minor number of transverse binding fibers are provided to retain the bulk of the fibers in position for handling. Each of the disc-shaped sheets or laminations of fiber roving going to make up each filter pad is rotated relative to each adjacent sheet so that the fibers of each sheet are out of alignment with the fibers of each adjacent sheet and so that a tortuous path for air and oil flowing axially or vertically through the pads is established, but, at the same time, horizontal flow of oil through each sheet or lamination is not impeded.

The filter pads being between and supported by the conical dividers are conical in form and extend radially outwardly and downwardly relative to the central stem. Accordingly, the opposite end portions of the parallel fibers of each sheet or lamination going to make up the pads are inclined downwardly and terminate at the outer peripheral edge of the filter pads, adjacent the inner surface of the casing section 40 and in such a manner that oil caught and between the fibers is free to run or drain downwardly along and between the fibers to the outer periphery of the pack and onto the inner surface of the casing.

The droplets of oil collected by the fibers and running outwardly and downwardly therealong and/or therebetween to the periphery of the pack accumulate and combine with other droplets to create increased density of oil in the outer peripheral portions of the pack and an eventual substantial saturation and constant flow of oil about the outer periphery of the pack, adjacent the casing. The oil thus caught and accumulated by the filter pack flows continuously down through the pack and along the inner surface of the casing, by gravity, into the outer periphery of the chamber X at the lower end of the filter separator and thence through the perforations 59 in the top of the receiver tank. The oil thus delivered into the receiver tank collects at the bottom thereof.

While each filter pack can be established of two or more laminations of roving material, it will be apparent

that the fibers of each pad can all run in the same direction with considerable success. In such a case, the perforated dividers break up the flow of air from one pad to the next and so that a flow pattern through the entire pack, which would adversely affect operation of the separator, will not be established.

The cyclone separator C that I provide is arranged within the receiver tank and connected with the filter separator and the discharge line **17** extending from the compressor B. For the purpose of distinction and clarification, the cyclone may be referred to as a primary separator, and the filter separator S may be referred to as the secondary separator.

The primary separator C includes an elongate, vertically extending, outer cylindrical flow tube **80** with an open lower end terminating in the lower portion of the receiver tank below the oil level L therein and closed at the upper end by an upwardly and radially inwardly convergent conical head **81**. The centrifugal separator C further includes a central inner flow tube **82** extending through the head **81** having an upwardly opening upper portion **83** extending through a suitable opening **84** provided in the top of the wall **30** of the tank in central alignment and communicating with the interior of the filter separator casing and chamber and a downwardly opening lower portion **85** extending downwardly through the center of the outer flow tube **80** and terminating therein above the oil level L' occurring in a the lower submerged portion of the tube **80**.

The primary separator C further includes an elongate, horizontal inlet tube **86** with an inner discharge end communicating with the interior of the head and an outer end portion projecting through the opening **32** in the side wall **30** of the tank. The inlet tube is fixed and sealed in the opening **32** by welding **87** and is provided with a mounting flange **88** at its outer end to facilitate connecting the flow tube **86** with the line **17**.

The inner end of the inlet tube **86** is tangential with the conical head **81** so that air and oil flowing through the tube **86** into the head **81** engages and is directed circumferentially within the head and outer tube **80**. The inflowing air and oil displaces previously introduced air and oil downwardly in the tube **80**. The circular motion of the air and oil flowing downwardly through the tube **80** causes the heavy droplets and particles of oil to move outwardly into engagement with the inner surface of the tube **80** to collect thereon. The oil separated in the above manner collects and combines to create a layer of oil on the inner surface of the head and outer flow tube which readily takes on and tends to collect other oil particles or droplets brought into contact with it.

The oil thus collected flows downwardly through the outer flow tube to the oil in the bottom of the receiver-tank in which the lower end of the outer flow tube is submerged. The surface tension of the oil in the tank and oil flowing down the inner surface of the outer flow tube induces the downward flow of the oil in the tube.

The downward movement of air flowing through the outer flow tube **80** is stopped by the surface L' of the oil in the lower submerged portion of the outer flow tube and is displaced radially inwardly and upwardly into and through the inner flow tube **82** and thence into the secondary separator S, at the lower end thereof.

In practice and as illustrated, the inlet tube **87** can be tapered longitudinally inwardly from its outer end to its inner end to establish a nozzle and to increase the velocity of the air flowing into the inner tube.

It is to be noted that the primary separator construction C illustrated in the drawings and described above can be varied widely in form and construction without departing from the spirit of this invention.

The air flowing from the inner flow tube **82** into the secondary separator S enters the chamber X at the lower end of the casing of said separator S and is permitted to expand therein to effect limited cooling of the air and resulting condensation of certain of the oil vapor carried by the air, before it moves upwardly into and through the filter pack **60**.

Further, the air moving into the chamber X, from the primary separator C, is still rotating and tends to cast outwardly in such a manner that it will not pick up and carry oil which is flowing down the wall of the separator casing, as above described.

It is highly important and it should be noted that the oil separated by the filter pack **60** and flowing downwardly along the wall of the casing **40** is in direct heat conducting contact with the wall of the casing, the exterior of which casing is in direct heat transferring contact with the ambient atmosphere. Accordingly, the casing of the secondary separator S acts as a cooler for the oil running down its wall and enhances the operation of the separator S by cooling the construction for increased and improved condensation of oil vapor.

The above-noted cooling and condensing effect is of readily determinable magnitude due to the fact that the oil separated by the filter pack flows radially outwardly into contact with the entire inner surface of the casing and the entire casing is utilized as a heat transfer medium between the oil and ambient atmosphere. Such cooling effects cannot be advantageously obtained in a horizontally disposed filter separator of the character referred to where all of the oil collects along the bottom side of the casing or in a filter separator construction of the character referred to which is wholly within a receiver tank or the like and is not subjected to the cooling effect of the ambient atmosphere.

In practice, if desired or as circumstances require, suitable circumferentially spaced, axially extending flow ports **90** can be provided in the inwardly projecting flanges **45** and **43** to assist or enhance the flow of oil downwardly from the upper section **40** of the casing to the lower section **40'** thereof. Obviously, the provision of such ports is only required in that form or carrying out of the invention where the casing for the separator S is sectional and the flanges provided to connect the sections together are disposed radially inwardly, as illustrated.

The suction means M that I provide includes a pair of longitudinally spaced, downwardly opening suction heads **95** and **96** arranged in opposite end portions of the receiver tank, a line **97** extending between and supporting the heads, and means **98** communicating with the line **97** and the inner end of the nipple **34** in the side wall of the tank and which is connected with the line **22**.

One purpose of the manifold means M is to draw oil from the tank, for recirculation through the system, from spaced points in the tank so that all of the oil in the tank is used and recirculated.

If the nipple **34** is arranged midway between the ends of the tank and equi-distant from the suction heads **95** and **96**, the heads are the same size, that is, they are such that they conduct the same volume of oil. On the other hand, and as illustrated, if the distance between the nipple **34** and one of the heads, for example, the head **95**, is less than the distance between the nipple and the head **96**, so that greater friction loss occurs between the head **96** and the nipple than occurs between the head **95** and the nipple, the head **95** is made smaller or more restricted so as to compensate for the differential in friction loss and so that an equal amount of oil flows inwardly through each of the heads **95** and **96**.

The means **98** connecting the line **97** with the nipple **34** in the tank is shown as including a T-fitting **99** engaged in the line **97** and a short pipe section **99'** engaged with and extending between the nipple and the T fitting.

Another and primary purpose of the means M is to assure drawing and recirculating the first to be heated oil, so that desired lubrication of the compressor is achieved as soon as possible after the compressor is put into service.

The oil supply in compressor units of the general char-

acter referred to cool when the compressors are stopped and put out of service. When so cooled, the oil does not flow sufficiently freely and the compressors are inadequately lubricated for a prolonged period of time when put back into service. Proper lubrication is not re-established until such time as the supply of oil is re-heated by operating the compressor.

In the instant invention, the primary separator structure C is the first structure to receive the work heated air issuing from the compressor when it is put into operation. The separator C is a heat sink and its lower submerged end is in direct heat conducting contact with the oil. As a result of the above, that part of the oil supply within and directly below the separator C is the first to be heated oil.

In accordance with the above, one of the nozzles of the means M, (the nozzle **96** in the case illustrated) is arranged to occur below and preferably as near to the central vertical axis of the separator C, as is practical. With such a relationship of parts, that oil of the oil supply which is first to be heated by operation of the compressor is available for recirculation through the compressor and proper lubrication of the compressor is not unduly delayed, waiting for the entire oil supply to be heated.

It will be apparent from the foregoing that the means M is supported by the nipple **34**.

Since the means M is a rather simple means, fabricated of suitable pipes and fittings, it will be apparent that the details of construction illustrated and described above are not critical and controlling, but can be varied widely without departing from the spirit of this invention.

In practice, when the rate of flow of air and oil through the primary separator C is high and the distance between the lower end of the inner flow tube **82** and the oil level L' in the outer flow tube **80** is so restricted that the air tends to pick up oil in the lower end of the tube **80** and carry it up through the inner flow tube **82**, a baffle **100** can be provided in the lower portion of the tube **82** and the level L' of the oil.

The baffle **100** is a simple, flat, horizontal, disc-shaped plate slightly smaller in outside diameter than the inside diameter of the tube **80** and arranged outwardly of the tube **80** to define an annular slot-like opening between the inner surface of the tube **80** and the outer periphery of the baffle and through which the oil and the heavier, oil ladened air, flowing downward and about in the tube **80** will flow. The lighter, slower moving dry air, which occurs radially inward of the noted heavier air, impinges upon the baffle and is directed upwardly into and through the tube **82**.

The baffle is mounted in the tube **80** by a suitable number of radially outwardly projecting fingers **101** on the baffle, which fingers engage and are fixed to the inner surface of the tube **80** by welding.

Having described my invention, I claim:

1. A receiver-separator unit comprising a receiver tank, an elongate, vertical casing fixed to and extending upwardly from the tank and closed at its upper end to define a chamber, openings in the tank establishing communication between the interior of the tank and the casing, a supply of oil in the bottom of the tank, a cyclone separator in the tank having an outer vertical flow tube open at its lower end and provided with an upwardly conical head at its upper end, an inner central open ended flow tube extending through the head and having a lower portion terminating within the outer flow tube below said conical head and an upper portion extending through the tank and communicating with the lower end of the chamber defined by said casing and an elongate inlet tube with an inner end tangential with and communicating with the interitor of the head and an outer end accessible at the exterior of the tank to connect with the discharge of an air compressor, a filter pack in the chamber and spaced above the inner flow tube, an air delivery line communicating with the upper end of the chamber above the filter pack and means at the lower portion of the tank to conduct oil therefrom, said filter pack including a hanger having means engageable in and with the upper end of the casing, an elongate stem fixed to and depending from the hanger centrally of the casing, a plurality of perforated dividers engaged about the stem and extending radially outwardly and downwardly relative to the axis of the stem and slidably engaged in the casing, a plurality of spacer sleeves engaged about the stem and between the dividers to maintain the dividers in predetermined vertical spaced relationship and filter pads coextensive with and arranged between adjacent dividers.

2. A structure as set forth in claim **1** wherein the lower end of the tube is submerged in the oil in the tank and the lower end of the inner flow tube terminates in the outer flow tube above the oil in the tank.

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