June 19, 1951 W. L. KISLING 2,557,788

STEAM SEPARATOR

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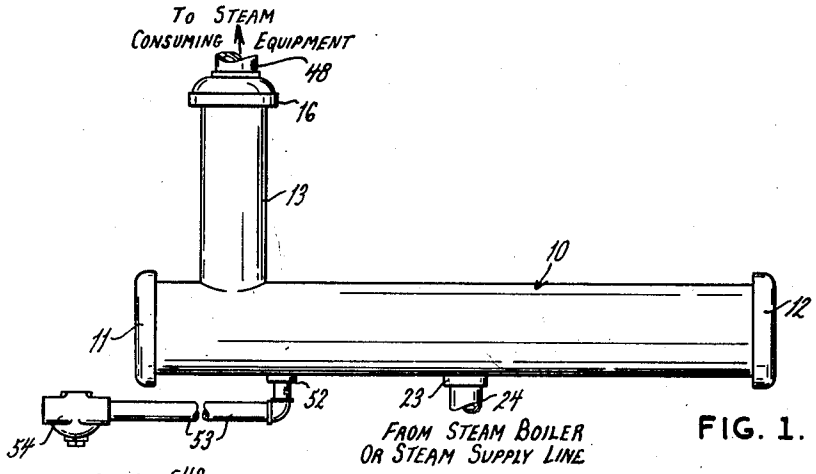


FIG. 1.

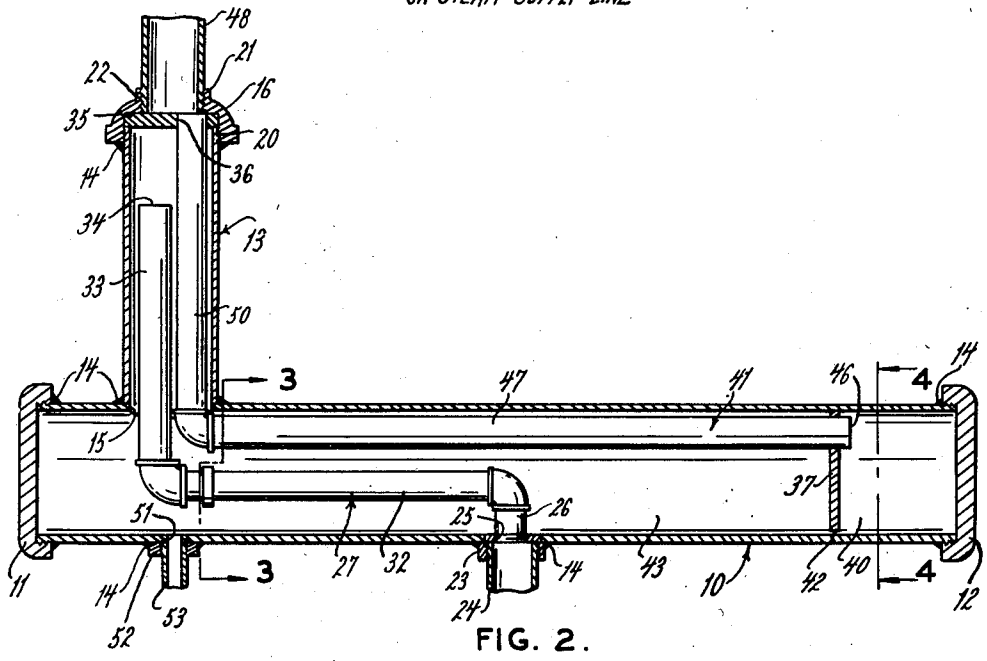


FIG. 2.

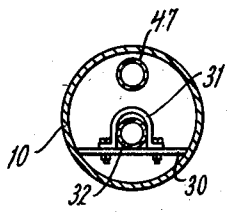


FIG. 3.

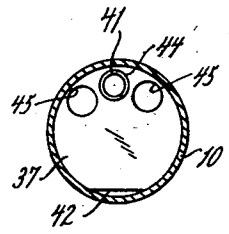


FIG. 4.

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STEAM SEPARATOR

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3 Claims. (Cl. 183—75)

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This invention relates to improvements in steam separators, and more particularly to a combined steam-drying and water-separating device utilized for the purpose of relieving a flow of steam from suspended particles of condensate, under virtually any condition wherein a substantially dry steam is needed or desired.

This applicant is aware of the numerous steam-water separation devices heretofore devised, but most or all of which, of earlier designs, function with only indifferent success. Many such earlier devices are of so-called dry-pipe type; others involve arrangements of baffles, many others rely upon a centrifugal principle for separation of entrained heavier water particles from a flow of steam. The present invention has as its principal object, the realization of a steam drying and separating device which, while being of simple construction, will overcome the shortcomings of such older separators and will act to remove from a flow of steam all suspended particles of condensate, and at the same time will re-heat the steam as it leaves the separator. These objects are reflected in the operative result that the steam leaving the separator is hot, dry, moisture free and in a condition most efficient for utilization whether for heating or in mechanical steam consuming apparatus. The device may be employed at any location in a steam line, in some cases built into and as a part of a steam boiler or generator; for other fields of usage it may be installed in a steam line as such at any desired location between the source of steam supply such as a boiler, and steam consuming apparatus. In other fields of adaptation the device may be utilized just ahead of or as a part of a steam-consuming unit or plurality thereof.

A further general and important objective of the present devise is realized in a steam separator involving improved relative locations of steam inlet, steam discharge and condensate removal elements within the separator, in such an arrangement that it is practically impossible for a flow of steam entering the separator to entrain liquid particles as it leaves the unit. This result is accomplished by relatively remote and vertically spaced steam inlet and steam outlet zones within the separator, together with an advantageous heat-exchange relation between inlet and discharge steam lines within the separator, so as to produce an optimum heating effect on the outgoing steam, and with the result that all priming and purging effects are wholly obviated.

A still further object, structurally expressed, is realized in an arrangement of parts in assembly

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such that the device is inexpensive, compact, durable, characterized by absence of any necessity for moving parts and which may be formed entirely of readily available stock materials virtually without special tooling of any kind.

The development may perhaps best be summarized by reference to the example currently selected for disclosure, which involves a preferably horizontal, elongate, tubular casing or steam drum provided with caps, plugs or the like end closures. Medially of a lower portion of the drum is provided a steam inlet fitting through which a steam supply line is continued internally of the drum in a horizontal direction, thence in a vertical direction into a vertical tubular extension or stack, the latter being closed at its upper or outer end, and the incoming steam flow acting against the closed end of the stack so as to utilize same as a baffle. The stack is by preference located at or near one end of the drum. The drum is chambered, there being provided in one end thereof remote from the stack, an outlet or dry steam discharge chamber, from the upper end of which is supplied the steam discharge line internally of the drum. Such line is continued horizontally along the uppermost portion and internally of the drum, thence upwardly clear through the stack. The horizontal portions of the inlet steam line and the discharge steam line are, in the disclosed example, parallel and adjacent as are the vertical portions of the respective lines within the stack. Condensate disposal is provided for by a fitting in the lower portion of the drum, in communication with a trap or other condensate removal device.

The objects and advantages of the invention will more clearly appear from the following detailed description of a selected, current production embodiment to be described, particularly when the description is considered in connection with the accompanying drawing, in which:

Fig. 1 is a side elevational view of a separator and drier embodying the present improvements;

Fig. 2 is a sectional view partly in elevation, and on a somewhat enlarged scale, of the device shown by Fig. 1;

Fig. 3 is a transverse sectional view as taken along line 3—3 of Fig. 2, and

Fig. 4 is a transverse sectional view as taken along line 4—4 of Fig. 2.

Referring now by characters of reference to the drawing, a preferably horizontal drum element of seamless steel or like tubing is generally indicated at 10. The otherwise open ends of the tubular element, which for convenience may be

considered as of circular section, are closed as by end caps 11 and 12 which may be threaded, or as shown, will usually be welded in pressure-tight relation to the ends of the tube 10.

Projecting vertically above one end portion of the drum 10 is a riser or stack structure 13 which may be formed of a length of seamless tubing or the like, and which like the drum, is characterized by wall elements of such gauge and tensile characteristics as to resist substantial steam pressures. The length of tubing 13 constituting the stack is welded, as indicated by the fillets 14, to the drum 10, the latter being provided with an aperture 15 substantially coincidental with the inside diameter of the stack. Other welding zones are indicated by the same reference character. At the upper or outer end of the stack is a suitable fitting which may be considered as a reducer 16 and which may readily engage the outer end of the stack as at 20, and which is also provided with an upper reduced-diameter portion 21 provided with internal threads 22, for convenience of attachment to the discharge line leading to the steam-consuming apparatus.

Preferably about midway between the ends of the drum 10, is an inlet fitting 23 preferably provided with internal threads for convenience of attachment to the incoming steam supply line or which may be directly connected to a boiler or steam generator, as desired, a pipe or nipple 24 being shown as a part of a supply line. The fitting 23 may be welded into assembly with the drum, and the latter provided with an opening 25 through which extends a nipple 26 constituting a short vertical riser portion of the steam inlet line generally designated at 27. The horizontal length of the inlet or supply line 27 within the drum, is preferably located about axially of that portion of the drum 10 over which it extends. In larger sizes of separators, added support for the steam inlet tubing is provided by a bridge piece in the form of a bar 30 to which is attached an inverted U-shaped pipe clamp 31 in any suitable manner. Beyond the bracket 30—31, the horizontal portion of the steam inlet line 27, designated at 32, is extended vertically to form a riser section 33 projected upwardly into and extending preferably over the greater portion of the length or height of the stack 13. The steam inlet line is provided with an open outlet end or port 34 a short distance below a closure disc 35. This latter is for convenience assembled as an insert within the fitting 16, and serves to complete the closure of the upper end of the stack except for a pipe opening 36 for the steam discharge line, as will later be described. However, it is to be noted that the chamber within the stack 13 is, as such, sealed off from direct communication with the discharge line.

Proceeding now to a description of the steam discharge provisions, it is preferred, particularly in the separator units of larger capacity and size, to provide a partial isolation of the dry-steam discharge region of the separator. In the device shown, this effect is attained through a partition or internal wall member 37. This plate element, with the end cap 12 of the drum 10, forms a dry steam chamber 40, from the upper portion of which is directed the steam discharge line generally indicated at 41. The partition 37, if the drum 10 be of circular section, will be of a general circular plan as shown, and may be either apertured at its lower portion, or frustrate as indicated at 42, so as to permit the free transfer of condensate between the chamber 40 and the

larger chamber 43 within the drum. The upper portion of the partition 37 is provided with a pipe opening 44, the diameter of which is preferably such as to correspond closely to the outside diameter of the inlet end of the piping constituting the discharge line 41. Thus if desired the plate 37 may be positioned within the drum through a driving fit of the disc 37 over the end of the line 41. It may as desired, be welded in place in the drum, prior to assembly of the end cap 12.

By preference the upper region of the partition member 37 is provided with steam apertures 45, these being arranged as shown, one at each side of the pipe aperture 44 which is in the uppermost portion of the member 37.

The discharge line has its open inlet end or port indicated at 46, thence extends horizontally along the drum 10 in its uppermost region, as indicated by the horizontal pass 47. This latter is continued to the region of the stack 13, and thence extends vertically through a section 50 throughout the length of the stack, the pipe 50 being extended through and sealed into the opening 36 in the closure plate 35, beyond which it is directed into the steam line 48 to the consuming unit.

It will be noted that in keeping with present preference, the discharge line 41 specifically the length of tubing 46, extends over substantially the greater portion of the length of the drum, and in fact may if desired, include several connected horizontal passes of the tubing only one of which is shown at 47. Regardless of the extent of the line 41 within the chamber 43, it is preferred that the final portion thereof be brought in close parallel adjacence to the portion 32 of the steam inlet line, so as to provide for a heating effect of the outgoing steam, by the incoming steam. For the same reason it is greatly preferred as shown, that the portion of the inlet and discharge lines within the stack, and respectively indicated at 33 and 50, be in close parallel adjacence. It is preferred that the diameter hence the volume of the stack 13, be considerably smaller than that of the drum 10 so as to minimize the space within the stack about the tubing 33 and 50.

Condensate disposal may be cared for by any conventional or other suitable apparatus, but for completeness of present disclosure it may be noted as including a drain opening 51 directed into a fitting 52 welded to a lower portion of the drum preferably just below the stack 13. Fitting 52 serves as a connection for a drain line 53 directed to a trap 54 or other selected condensate disposal means. The remanent heat values of the condensate may be utilized through suitable exchange apparatus (not shown) for heating of incoming feed water to the boiler or generator, or otherwise as desired.

Although the functional aspects of the device are thought to have become fully apparent from the foregoing description of its parts, it may be noted for completeness that steam from the boiler or other source enters the supply line through elements 24—26 and thence while hot, is projected upwardly through the pipe 32—33 into the steam chamber within the stack 13, and is discharged with considerable impact against the plate 35 functioning as a baffile. The direction of flow is thus changed 180 degrees, being reversed in the upper portion of the stack, through which action the heavy water particles will at once fall to the zone immediately below the stack, which, with

advantage, is the location of the condensate drain opening 51. Through the elements just referred to, the steam will be separated from a substantial proportion of its entrained water particles. Following this first phase of separation, the now partially dried steam will flow lengthwise, or to the right (Fig. 2) into the dry steam chamber 40 through openings 45 and at times, depending upon current condensate levels, through the port defined by the relieved lower portion of the partition 37. This relatively rapid flow of steam through the partition, will result in a certain further separating effect by reason of the baffle action of the partition, it being noted that the openings 45 may be made smaller and utilized in greater number to the extent found necessary in a particular field of usage. Any remaining condensate particles finding their way into the chamber 40, will be thrown down in such chamber incident to the 180 degree reversal of steam flow as same encounters the end cap 12 and return to the inlet of the discharge line, so that only a relatively dry steam will be taken off from the upper portion of chamber 40. Thus from this chamber, the steam is directed through the long hot horizontal pass 47, which is kept in the upper portion of the drum. The flow of steam is then continued outwardly via the vertical riser 50 through the relatively hot stack chamber, it being noted that the heating action on the steam in traversing the line 41 will exhibit a still further drying effect. It may be also noted as desirable under certain conditions, to provide for a slight upward slope of the line 47 so that this line drains back into the chamber 40 and any last vestige of moisture removed through the cutaway portion of the partition at the bottom of the drum.

It may be noted that the present device embodies certain of the principles of the structure disclosed and claimed in Letters Patent No. 2,071,128, issued to this applicant February 16, 1937, and entitled "Steam Separator and Superheater."

A single embodiment of the invention has been described in substantial detail; the detail of description should however be understood as being informative, rather than being presented in any restrictive or limiting sense, numerous variants of the structure being recognized as possible within the scope of the claims hereunto appended.

I claim as my invention:

1. In a steam drier and separator unit for location in a steam line between a steam source and a zone of steam consumption, an elongate horizontal drum, a vertical stack open at its lower end into an upper portion of the drum, a steam supply line directed into the drum, thence over a substantial portion of the length of the drum, thence upwardly over the major part of the length of the stack but short of the upper end of the stack so as to discharge steam into said upper end, a closure for the upper end of the stack, located across and in baffling relation to the delivery end of said steam supply line, a partition element within the drum and in an end region thereof remote from the stack, a steam discharge line having an open end on the side of said partition opposite the stack, thence extending along an upper portion of the drum, thence upwardly into the stack substantially parallel and close to the delivery end of the steam supply line in the stack, thence outwardly through the stack closure, said partition serving to form with the drum, a chamber adjacent the inlet end of the steam discharge line, and condensate disposal means including a condensate drain fitting substantially remote, in a direction along the drum, from the said partition and discharge line inlet.

2. In a steam separator and drier, an elongate steam drum formed and arranged as a horizontal tubular element, a steam inlet fitting located intermediate the length of the drum, inlet tubing structure internally of the drum and extended somewhat upwardly of said fitting and the bottom of, thence along the drum, thence extended upwardly and terminating in an open end, a vertical, tubular stack element adjacent one end of and open into the drum, the stack element enclosing the discharge end of the said steam inlet tubing, the upper end of the stack being provided with a transverse closure element, a steam discharge line of tubing with an open intake end in the region of the drum remote from said stack, a transverse partition constituting a support for the inlet end of the steam discharge tubing, the partition being apertured to provide for a restricted steam transfer between the spaces separated by said partition, but serving as a baffle between such spaces, the partition having a bottom opening to permit a flow of condensate between the spaces separated by the partition, the said line of discharge tubing extending from the partition substantially along and over a major part of the uppermost portion of the drum, thence extending upwardly into and through the full length of the stack, thence outwardly through the stack closure of the stack to supply the steam line beyond the separator, a steam trap located below the separator, a condensate connection in a lower portion of the drum, and tubing between said condensate connection and trap, those portions of the steam inlet tubing and the steam discharge tubing within the drum and stack, extending in adjacence to each other substantially over the full length of the inlet tubing, whereby to promote heat exchange between the tubing.

3. In a steam separator and drier, an elongate steam drum arranged for substantially horizontal mounting, and formed as a tubular element of circular section, a steam inlet fitting located at the bottom of and intermediate the length of the drum, inlet tubing structure internally of the drum and extended somewhat upwardly of said fitting and the bottom of the drum, thence along the drum, thence upwardly and terminating in an open end, a vertical, tubular stack element adjacent one end of the drum and opening at its lower end into said drum, the stack element enclosing the discharge end of the said steam inlet tubing, the upper end of the stack being provided with a transverse closure element, a reducer serving to secure the closure in assembly on the upper end of the stack and providing a discharge fitting for connection of a steam line beyond the separator; a steam discharge line identified with tubing having its origin with an open intake end adjacent the end of the drum remote from said stack, a partition structure arranged transversely of the last said end of the drum, and constituting a support for the inlet end of the steam discharge tubing, the partition being further apertured to provide for a restricted steam transfer between the spaces separated by said partition, but serving as a baffle between such spaces, the partition having a bottom opening to permit the free movement of condensate between the spaces separated by the partition, the partition, drum walls and inlet end of the discharge line being arranged to define a discharge chamber at one end of the drum and to

compel a 180 degree change in direction of steam flow within the discharge chamber, the said line of discharge tubing extending from the partition substantially along the uppermost portion of the drum, and over the major portion of the length thereof, thence extending upwardly into and through the full length of the stack, thence outwardly through the closure of the stack into said reducer to supply the steam line beyond the separator, a steam trap located below the separator, a condensate connection in a lower portion of the separator and drum, and immediately below said stack, and tubing between said condensate connection and trap, the final portions of the steam inlet tubing and the steam discharge tubing extending in close parallel adjacence in the stack, whereby to promote heat exchange therebetween.

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