July 28, 1959 G. D. BRADSHAW 2,896,743

APPARATUS FOR SEPARATING LIQUID FROM GASES

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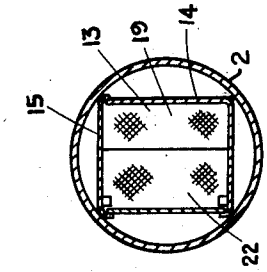


FIG. 4

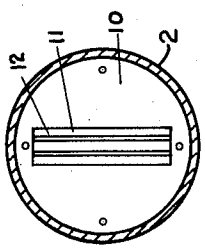


FIG. 3

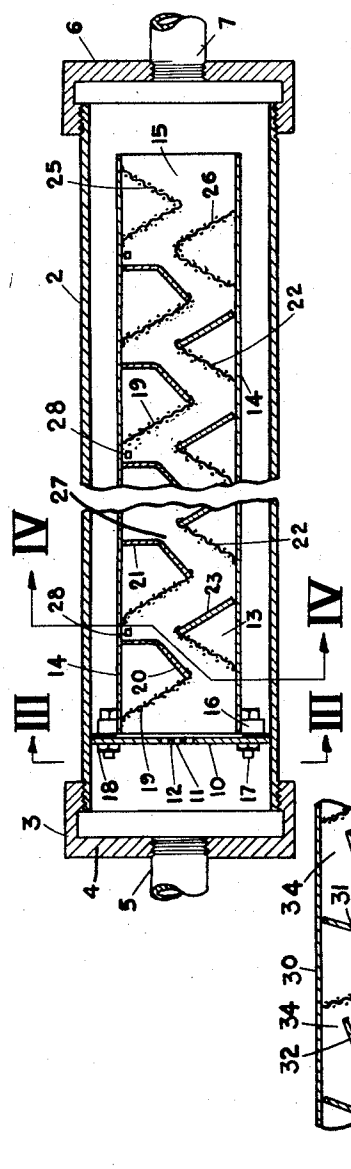


FIG. 1

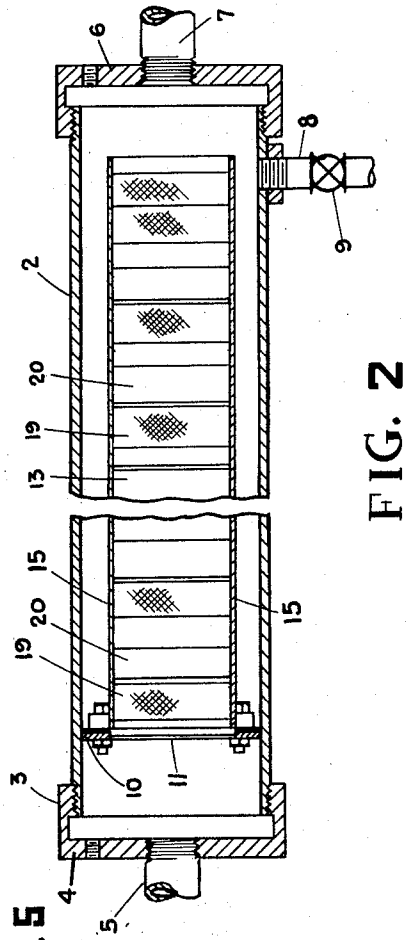


FIG. 2

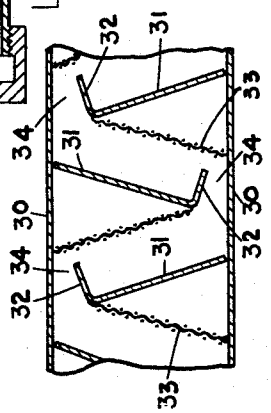


FIG. 5

INVENTOR.
GRANT D. BRADSHAW

BY
Christy, Parmelee & Strickland
attorneys.

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APPARATUS FOR SEPARATING LIQUID FROM GASES

Grant D. Bradshaw, Beaver, Pa., assignor to Bradshaw & Company, Pittsburgh, Pa., a corporation of Pennsylvania

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3 Claims. (Cl. 183—71)

This invention is for an improvement in apparatus for removing liquids from gases in which they are carried, and constitutes an improvement on the invention disclosed in my Patent No. 2,527,392 granted October 24, 1950.

In many cases a gas carries with it liquid which it is desirable to remove before the gas is used for its intended purpose. For example, compressed air may carry moisture above the point of saturation or even entrain particles of water and oil. Other gases may carry vapors of a normally liquid character, and steam may carry water particles which it is desirable to remove. The present invention has for its object to provide a compact, economical, simple unit which will extract and remove liquid so carried by gases. A further object of the invention is to provide a unit which can be placed in a pipe line carrying gases at a convenient location, and which may be in effect a part of the pipe line, simply being interposed between two pipe ends and constituting a coupling between them. To this end, a further object of my invention is to provide a structure for this purpose which may be compact so that when necessary it may be put in a confined space.

My invention may be more fully understood by reference to the accompanying drawings, in which:

Fig. 1 is a longitudinal horizontal section through a unit constructed in accordance with my invention;

Fig. 2 is a longitudinal vertical section through such a unit;

Fig. 3 is a transverse vertical section in the plane of line III—III of Fig. 1;

Fig. 4 is a transverse section in the plane of line IV—IV of Fig. 1; and

Fig. 5 is a fragmentary longitudinal section similar to Fig. 1 showing a modified baffle arrangement.

In Figs. 1 to 4 of the drawings 2 designates a cylindrical casing which may conveniently be formed of a section of pipe of large diameter. One end of this casing is threaded and a pipe cap 3 is screwed onto it, this cap having a central opening 4 into which is screwed a fluid supply pipe 5. The end of the unit to which the pipe 5 is connected may be designated the inlet end. At the opposite end, designated the outlet end, the casing 2 is similarly threaded and provided with a cap 6 with a central opening into which an outlet pipe 7 is screwed. At the bottom of the casing near the discharge end there is connected a drain pipe 8 which may be provided with a valve 9 or other means for closing it against the normal free flow of gas from this pipe.

Near the forward or inlet end of the casing there is a transverse plate 10 which is welded to the interior of the casing, and which forms a partition within the casing, the plate 10, however, having a vertical slot 11 therethrough constituting an orifice from which the gas may flow from the inlet end of the casing through the unit, and for the purpose of better directing the flow of gases the opening 11 may be provided with louvres or spaced vanes 12.

Supported on the plate 10 is an elongated shell or box-like structure designated generally as 13, and having parallel vertical walls 14 and parallel top and bottom

walls 15. This casing, which may conveniently be formed of thin sheet metal, is provided near the inlet end with lugs 16 to which are secured bolts 17 that pass through the plate 10, and which are provided with nuts 18 to firmly draw and hold the forward end of the casing 13 against the transverse plate 10. The casing is of a generally square section and its transverse dimensions are such that it will just be received within the circular pipe or casing 2, as clearly shown in Fig. 4. Its length is such that its discharge end opens into the casing in spaced relation to the cap 6. Inside the casing 13 there is a series of equally spaced screens 19, which are formed preferably of fine wire mesh. These screens 19 as here shown extend at an angle to the longitudinal axis of the casing, the screens having their edges which are attached to the side walls forwardly of the edges which are closest to the center so that the screens are inclined outwardly and rearwardly from the side walls, and in the direction of the flow of the gases, but this inclination is not essential, and they may be perpendicular or nearly so. Behind each screen 19 there is a sheet metal baffle 20, the outer end of which is joined to and forms a support for the outer end of the screen 19. This baffle is sloped in a direction generally opposite the slope of the screen 19, and preferably has a bend, 19*a* intermediate its outer and inner ends providing a vertical part 21 which begins between the center line and the wall 14.

On the opposite wall 14 of the casing there is a similar series of screens 22, and the screens of the series 22 are staggered midway between the screens 19 and they project from the side plate at approximately the same angle as the screens 19. Behind each screen 22 there is a baffle 23 which has its outer end joined to the screen 22 and its inner end joined to the wall 14, and which is angled oppositely the screen 22 throughout its full length. Each screen 22 with its baffle 23 defines a generally triangular section, the point or apex of which is between the outer ends of the screens 19. There is thus provided within the casing 13 a zig-zag passage defined partly by the screens 19 and 22, and partly by the baffles 20 and 23, this zig-zag passage extending throughout the full length of the casing 13. At the end of the casing most remote from the inlet end the baffles 20 and 23 are omitted from the last two screens 19 and 22, and in place thereof there are screens 25 and 26 respectively.

By reason of the form of the baffle 20—21, the continuous zig-zag passage narrows down at each area defined by the apex of the triangle having the two sides 22 and 23 and the place where the baffle 20 bends to provide the transverse portion 21.

When the gas carrying liquids and easily condensible vapors are discharged under pressure into the forward end of the unit, they pass through the orifice 11 in the plate 10 and immediately expand, thus checking their velocity, which causes some of the moisture to be thrown out. Some of the gas of course flows directly through the screens 19 and 22 into a relatively quiescent pocket forwardly of the respective baffles 20 and 23. The current of gas continues to flow through the zig-zag passage, and at the restriction above described and designated as 27, the velocity of the gas is again increased and again it expands in front of a pair of screens 19 and 22, the gas which passes through the screens again entering the quiescent spaces in front of the respective baffles 20 and 23. In this manner the gas flows from the inlet to the discharge end of the shell 13, encountering a succession of pockets or chambers wherein the velocity of the gas is substantially reduced, and its expansion results in a drop in temperature. Both conditions, the slowing down of the gas and the expansion, cause the liquid particles to be thrown out, much as dew condenses on a screen on a foggy day. The moisture which is

thrown out of the gases tends to collect principally on the screens and to run down the screens to the bottom of the shell. The water flows out of the end of the shell **13** and into the casing **2**. At intervals the valve **9** may be opened to drain off the collected water or other liquid. At the discharge end of the shell **13** the gases are expanded into the larger space provided at the end of the shell **13** and within the casing, and for this reason the baffles are replaced by screens **25** and **26**, it being undesirable at this point to too effectively baffle the flow of gases.

Like the construction shown in my patent above referred to, the device provides a zig-zag open passage from one end of the unit to the other through which the gas may flow so that if all of the screens become completely clogged there would be no obstruction to the flow of gas. It differs from my former patent, however, in two important respects, the first being that there are a number of substantially impervious baffles back of a screen area forming a quiescent pocket to more effectively check the velocity of the gases, and the second being to provide a series of restrictions at **27** to increase the velocity of the gases in advance of each pair of screens and baffles. A further important difference is that it is so organized as to be compact and easily included in a pipe system designed to handle relatively small volumes of gas, although it may be built in various sizes.

In the modification shown in Fig. 5 the two side walls carrying the opposed series of baffles and screens are designated **30**. The solid baffle elements **31** incline forwardly and have ends **32** that are turned at a sharp angle so as to slope toward the rear, the baffles being of generally L-shaped form. The associated screen elements **33** are perpendicular to the side walls or nearly so. The leg of the L is back of the screen while the foot portion is the part **32**. A restriction in the gas passage through the unit is provided between each terminal portion **32** of the baffle and the confronting side wall **30** of the unit. These restricted areas are in the region of the places marked **34**. The restricted passages **34** cause the gas flow to be restricted and thereby increase its velocity just prior to encountering the succeeding screen and associated chamber of increased area where the gas may expand as its velocity decreases, the restricted passageways so provided directing the flow of gas directly against the succeeding screen and into the chamber behind such screen. This unit, of course, is received in a casing, as is the baffle carrying unit in Fig. 1.

I have shown and described one present preferred embodiment of my invention and a modification, but it is to be understood that my invention is not limited to these specific constructions, and that the arrangement of the screens and the baffles may be variously changed to secure the benefits of my invention and obtain the conditions above described.

I claim:

1. Apparatus for extracting liquid from gas in which the liquid is carried comprising a shell having four flat sides forming an elongated horizontal tubular chamber, a plate over one end of the shell to which the shell is attached and having an orifice therethrough for the introduction of gas into one end of the tubular chamber, a succession of screens projecting from the interior of one side wall of the shell past the longitudinal center line thereof toward the other side wall, a succession of similar screens projecting from the opposite side wall of the shell and staggered between said first screens, imperforate plates extending from the outer ends of the screens to the respective side walls and forming behind each screen a pocket, said plates being angled from the side walls forwardly toward the inlet end of the tubular chamber, an enclosing casing around the shell having an inlet pipe at one end and an outlet pipe at the other end, said casing being larger in diameter than the shell and providing a chamber below the shell for receiving liquid that is collected from the gas by the screens and plates in the shell and which drains into said last-named chamber, means for removing liquid from the shell, said plate at the end of the shell forming a transverse partition in the casing so that gas entering one end of the casing must flow through the orifice, means for introducing gas to be treated into the casing in front of the orifice, the discharge end of the shell opening into the casing and being larger in area than the orifice in said plate whereby to produce a pressure drop in the gas flowing through the orifice.

2. Apparatus for extracting liquid from gas in which the liquid is carried comprising a hollow tubular body of quadrangular section, means for supplying gas to be processed at one end and removing it at the opposite end, imperforate baffles attached to each of the two opposite internal side walls of the body and extending toward the opposite side wall past the center line of the body but terminating short of the other wall, the baffles in one wall being staggered with respect to those on the other walls, the gas being forced to travel a tortuous path crosswise of the body around each successive baffle in flowing from one end of the body to the other, the passageway for the gas being restricted in area around the end of each baffle to increase the velocity of the gas in such areas, said baffles being diagonally disposed with reference to the axis of the body in a direction to form a pocket at the upstream face of each baffle, a wire screen secured at one edge to the tubular body and at its other end to the outer portion of the baffle and extending over each such pocket, a casing surrounding the said hollow body with the corners of the quadrangular-shaped body contacting the casing and the sides being spaced from the casing, the hollow body having a plate at its inlet and fitted into the casing to prevent gas which enters the casing from flowing around the exterior of the hollow body, said plate having an orifice therethrough at one end of the tubular body whereby gas may flow from the casing into the tubular body, the tubular body being shorter than the casing, the casing having inlet and outlet fittings at its respective ends.

3. Apparatus for separating liquid from gas in which it is carried comprising an elongated horizontal tubular body of quadrangular section, means for introducing gas to be treated into one end of the body, said body having a series of spaced internal baffles attached to one side wall and extending toward but terminating short of the opposite side wall and extending the full distance between the top and bottom walls, said baffles being diagonal to the longitudinal axis of the tubular body with their free ends directed toward the inlet end of the body so as to provide along with the top and bottom walls of the tubular body a succession of pockets closed on three sides, a similar series of spaced baffles on the opposite side wall intermediate the baffles of the first series and providing like pockets, a screen over each pocket formed by each series of baffles in a plane that is divergent to the baffle forming the pocket which it covers, each baffle having at its outer end a reversely-turned flange that converges toward the opposite side wall and forming with said opposite side wall a passageway of decreasing dimension in the direction of the gas flow through the tubular body, and which opens directly toward and substantially normal to the screen over the next pocket.

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