

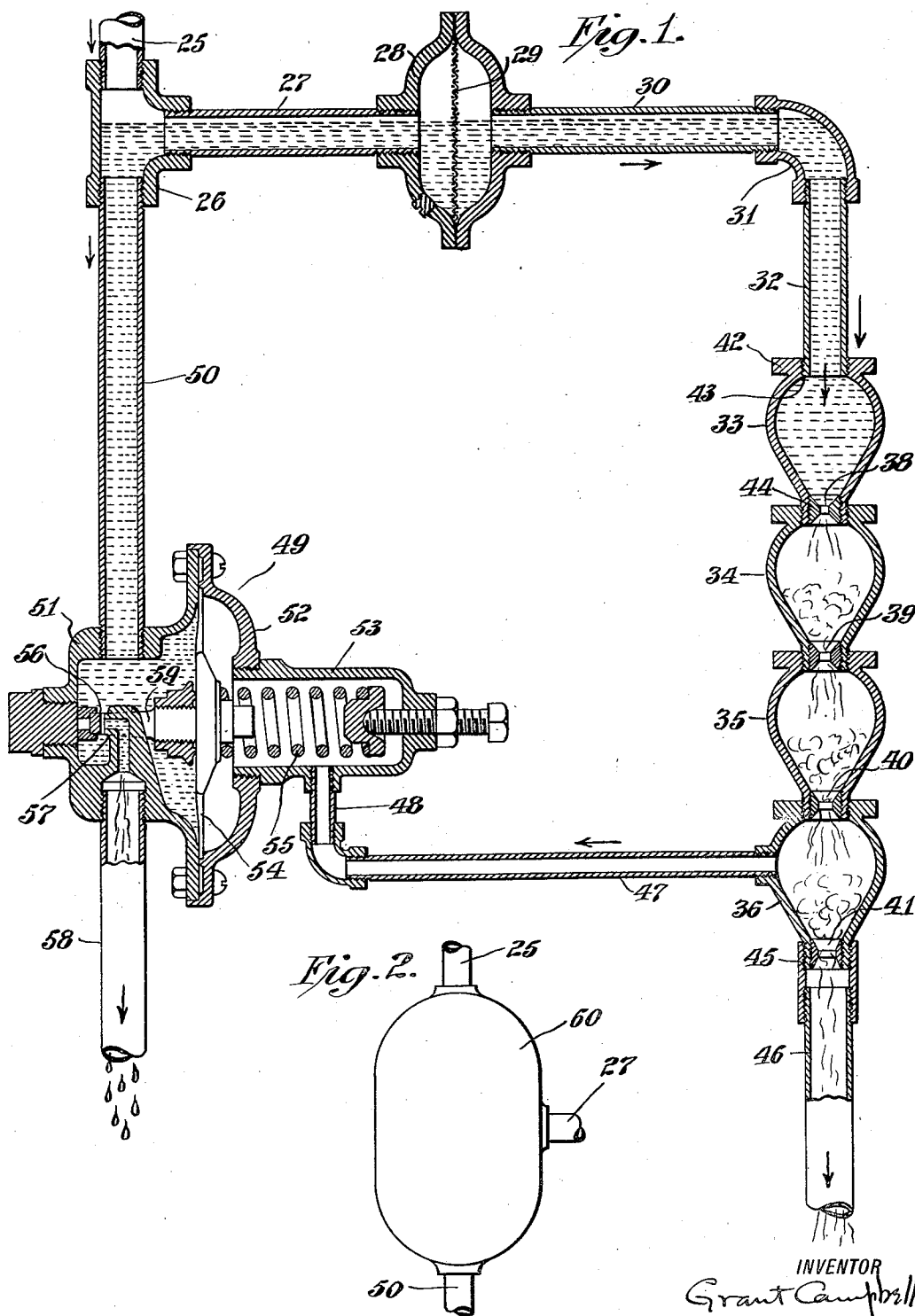
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LIQUID RELIEF APPARATUS AND METHOD

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LIQUID-RELIEF APPARATUS AND METHOD.

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This invention is a novel liquid relief apparatus and method, referring more especially to the relief of liquid condensing from vapor, for example for trapping and separating or removing water from steam carried in the mains of power plants.

The general object of the present invention is to afford a simple, durable and effective apparatus, one which will be inexpensive of manufacture, compact, convenient in use, and requiring the minimum of attention and repair. Other and further objects and advantages will be pointed out in the hereinafter following description of an embodiment thereof or will be apparent to those skilled in the subject. To the attainment of such objects and advantages the present invention consists in the novel apparatus, and the novel features of method, operation, combination, arrangement and structure herein illustrated or described.

In the accompanying drawings Figure 1 may be considered as a more or less diagrammatic illustration, taken generally in vertical central section, of sufficient apparatus to illustrate and explain the principles of the present invention. Fig. 2 shows a modification of a part of the apparatus.

The steam main, or other vessel from which it is desired to remove the water contained in the steam, is not shown, but the descending pipe 25 may be considered as leading from the desired point, for example from the drip connection of a steam main. At the foot of this pipe is shown a coupling 26 from which horizontal and vertical branches may be taken. The branch pipe 27 extends from the coupling 26 horizontally to the orifice system to be described. To keep clear the orifices it is desirable to strain out impurities, and the pipe 27 is shown as leading directly to a strainer 28 consisting of a casing enclosing a fabric or mesh 29 through which the water and steam must pass. A pipe 30 from the strainer 28 is connected by an elbow 31 to a downward pipe 32 connecting directly to the orifice system of this invention. By orifice system it is intended to include a single orifice, or preferably a series of two or more of them, so connected and arranged as to give the desired action and control. One or more pressure spaces or chambers are main-

tained between orifices, with pressures intermediate between the initial and final pressures, subject to variation during operation. By orifice it is intended to include equivalents; thus it is well known that the equivalent of a single orifice is afforded by a number of smaller apertures, or by any escape device producing a restricted progressive passage or outflow of fluid with resulting depression of pressure.

The orifice system hereof may, for example, be built up of a series of orifice units or chambers 33, 34, 35 and 36, although a greater or less number might be employed, containing a series of orifices or nozzles 38, 39, 40 and 41, which for some purposes may be of graduated sizes as shown. The orifice elements or units are shown connected in tandem, although this arrangement could be varied for some purposes.

Each of the orifice units is shown as enclosing a chamber having preferably bulging walls so as to afford substantial capacity. The upper or inlet end of each unit may be provided with a bead 42, hexagonal in shape, to facilitate the coupling of the parts. The inlet end may also be interiorly threaded at 43 to receive the incoming connection, e. g. the lower end of the downward pipe 32, so that steam and water entering from the pipe 25 may be passed directly into the first chamber and received there above the first orifice piece 38. The orifice piece may be of various forms, for example with tapered and flared approach and getaway as illustrated. The outlet end 44 of each unit is shown as interiorly threaded to receive the orifice piece, and exteriorly threaded for the purpose of being coupled in tandem with the next succeeding orifice unit.

The final orifice unit 36 is shown as having a coupling 45 to which is fitted a discharge pipe 46 leading to a waste point or place of utilization of the warm water and steam discharged.

The orifice elements 33, 34, 35 and 36 and their intercombination with other elements, generally speaking, are not herein claimed per se as they form the subject of a separate application; the present application being directed to method or apparatus for trapping and removing liquid, and embody-

ing features not necessarily dependent on the particular orifice system described.

The apparatus thus far described, including elements 25 to 46, is serviceable as a liquid relief means without the further apparatus yet to be described, and assuming that the coupling 26 is closed at its lower end. The action will be that the accumulating water is rapidly blown through each orifice from one chamber to another and finally discharged from the system at the outgo pipe 46. In effect there are four orifices separated by spaces forming three intermediate chambers 34, 35 and 36, and a preliminary chamber 33 and discharge passage or chamber 46. There will be a progressive drop of pressure from each of the chambers to the next, and the flow of steam and water will thus be restricted to the quantity that can pass through each orifice under the conditions of difference in pressure between adjacent chambers, character and size of orifice, and condition of the fluid traversing the same, whether water, steam, or a mixture or combination of them. Another factor is involved, namely that in passing through each orifice to a lower pressure some of the water will be evaporated, thus creating a tendency, at the end of the system, to deliver much low pressure steam, which may be made use of for heating purposes or the like. The water descending by pipe 25 is thus rapidly removed from the steam, without undue loss of either fluid, and under conditions and with results meeting the objects as hereinbefore set forth.

The relief apparatus thus described, without the further features below described, is not herein claimed per se, but has been made the subject of complete disclosure and claim in my copending application Serial No. 36,928, filed June 13, 1925, and has subsequently been divided out of said copending application and made the subject of disclosure and claim in my divisional application, Serial No. 302,025, filed August 25, 1928; the present application being directed to the full combination including the separate discharge or valve means controlled by the changes of pressure in the orifice system.

In some plants there may be emergencies when a very excessive amount or rate of water of condensation is produced, and the following apparatus is intended to meet this situation and create a rapid discharge of the excess water, automatically, at such intervals as conditions require, or in some cases a substantially continual or progressive discharge. Control of the additional discharge means may be effected by any sort of connection, such as pipe 47, extending from an intermediate point, such as the chamber 36, of the orifice system, the pipe 47 shown connected directly by a pipe 48 to the valve 49

about to be described. In this way the lowered pressure existing at the selected point is utilized as a motive force for control purposes.

The valve 49 is an automatic valve, preferably pressure controlled by the pressure in orifice chamber 36. A pipe 50 is shown extending from the coupling 26 to the main valve chamber through the valve casing part 51. The valve casing may also comprise a second part or shell 52 attached to shell 51, and a third part or barrel 53 extending from shell 52. A diaphragm 54 is shown clamped between casing parts 51 and 52. A piston type of valve would serve as well. A spring 55 presses on the diaphragm in a manner tending to open the valve, which is shown in open condition in the figure, the valve disk 56 being removed from the seat 57, permitting the water in pipe 50 to discharge rapidly through the valve and out by waste pipe 58. The valve disk is shown supported by a yoke member 59 from the diaphragm.

Assuming that a flood or excess of water of condensation has formed in the steam main, the operation may be substantially as follows. The valve 49 normally is closed, the spring 55 being so adjusted that the steam pressure on the diaphragm inner side overbalances the spring and the normal pressure at the outer side. The water from the main normally fills the valve chamber and down pipe 50. When excessive the water overflows through pipes 27 and 30 into the orifice system, filling pipe 32 and chamber 33 as shown. When water is present only in small quantities this will not occur, but steam, substantially free from water, will pass through the orifice system. This causes a low resulting pressure to exist in the final chamber 36. For example 100 pounds initial pressure may deliver only 12 pounds in the final orifice unit 36. As soon, however, as water floods in and the orifice units commence to receive a preponderance of water the conditions change. When water is delivered to the first unit at 100 pounds pressure there may be an ultimate pressure in chamber 36 as high as 44 pounds. This gives the means of control of the valve 49. The flood of water, flowing into the orifice system, causes a substantial rise of pressure at the end of the system, due to the difference in action in the passage of steam and water through the orifices and evaporation of the latter. This pressure rise is communicated through pipes 47 and 48 to the valve 49. Normally the spring 55 is insufficiently strong to open the valve; adjustment being provided for this purpose. The increase of pressure due to the presence of a surplus of water, reinforces the pressure of the spring, thus forcing the diaphragm inwardly and opening the valve by moving the disk from the seat. A quantity of surplus water

is thereupon immediately relieved or discharged from the pipe 50 through the valve 49 to the waste pipe 58. The parts are shown in their position when this discharge has partly taken place. In due course the pipes 27, 30, and 32 and chamber 33 will be drained and normal conditions restored, the pressure in the control chamber 36 dropping again from 44 to 12 pounds per square inch for example, the valve 49 closing, and the pipe 50 filling up to the normal point, substantially at a level with the pipe 27 leading to the orifice system. The pipe 50 will not necessarily drain substantially below its upper portion, as the operations may consist of repeated small or partial discharges without changing the level of the water beyond a small extent.

In using the term gas herein it is intended to include vapor, and by fluid is intended gas, vapor or liquid. In one aspect this invention may be described as comprising two discharge means, the liquid passing both to the orifice system and the valve by separate passages; the orifices giving a slow, continuous restricted discharge, and the valve a more direct discharge, which may be considered as a discharge in bulk; and the depressed pressure in the orifice system being utilized to control the bulk discharge by valve, which may be continuous and variable or intermittent according to the arrangement and adjustment.

Many variations and extensions of the described invention are available. Owing to the small capacity of pipe 50 it might in some cases tend to drain and possibly permit direct steam escape through valve 49 before the orifice system has drained; which is avoidable by enlarging the body of pipe 50 into a closed water drum or vessel or using the expedient of Fig. 2. The pipe 58 instead of discharging to waste may be caused to lead to a supplemental orifice system with successive chambers of decreasing pressure, permitting utilization of the fluid in any chamber for any purpose, such as a radiator heating system. The outgo of the orifice system 33-41 may be combined with the one just described, discharging into the same supplemental orifice chambers, with an ejector element preventing the fluid from pipe 58 backing up into pipe 46. In such case the supplemental orifices should be larger and involve lower ranges of pressure than the main ones from which the valve control is obtained. A heating system so connected to any orifice chamber may act in effect as an enlarged chamber, the heating coils increasing the chamber capacity, and the proper pressure being maintained due to the resistance of the orifices following after such chamber. Other variations suggest themselves, within the purport and scope of the embodiment illustrated.

The pipe 50 can be used to accumulate and discharge solid matters thus relieving the strainer; but for such purpose it is better to replace the coupling 26 and upper part of pipe 50 by a vessel or chamber 60 as shown in Fig. 2.

An example of the use of the present invention is for continuously discharging the water condensing in the steam system of a railroad car. A system of small orifices may serve and preferably the discharge valve is supplementally used. The service can be calculated approximately to minimize steam discharge by maintaining water discharge, knowing the rate of condensation. Such application of the principles hereof is made the subject of claim in a copending application.

When variations of existing pressure in the steam main are likely to occur the valve 49 should be carefully adjusted to remain closed when steam only, at the maximum pressure, is delivered to the orifice system, and to remain open when the water only is delivered, even at the minimum probable pressure, this adjustment being readily effected in a valve, such as that illustrated, having spring regulation.

It will thus be seen that there has been described a liquid relief apparatus and method, embodying the principles and attaining the advantages of the present invention. Since many matters of method, operation, arrangement, combination, construction and detail may be variously modified without departing from the principles of the invention it is not intended to limit the same to such matters except to the extent set forth in the appended claims.

What is claimed is:

1. The method of separating liquid from gases consisting in conducting the same by two passages, one controlled by valve to regulate discharge, and the other leading to an orifice system, and utilizing the lowered pressure at an intermediate point in the orifice system to open or close the valve in accordance with increase or decrease in quantity of liquid to be removed.

2. An apparatus for discharging excess liquid from a vessel, comprising a controllable discharge means, an orifice system, a liquid passage from the vessel to the controllable discharge means, and a second passage from the vessel to the orifice system, and means operated from the orifice system for controlling the action of the liquid discharge means.

3. An apparatus for removing excess liquid from a pressure vessel containing liquid and vapor under pressure, comprising an orifice system of successive orifices, a liquid and vapor passage from the vessel to the orifice system, a second passage from the vessel, a liquid discharge valve to which the second

passage leads, and means whereby the variable depressed pressure in the orifice system regulates the discharging action of the valve.

4. An apparatus as in claim 3 and wherein
5 is a chamber beyond an orifice in which evaporation of hot liquid may occur, resulting in higher pressure with greater liquid supply, and the valve regulating means operating with higher pressure in the orifice system to
10 open the valve and vice versa.

5. An apparatus as in claim 3 and wherein the successive orifices are of increasing area.

6. A relief apparatus for separating excess liquid from gases comprising a vessel adapted to receive and accumulate the liquid to be trapped, a regulable discharge valve connected with the lower part of said vessel, an orifice or flow restriction system connected with a higher part of said vessel, and means
20 operated by the variable depressed pressure in said system for regulating said valve whereby excess of liquid causes increased discharge and vice versa.

7. Apparatus for removing excess of liquid
25 from a pressure vessel comprising a system

of orifices with chamber between each two, a connection from the pressure vessel to the first orifice, a valve connected for removing liquid from the vessel without traversing the orifices, and means utilizing the varying
30 pressure in the orifice system as a motive power to control said valve.

8. Liquid relief apparatus for removing from vapor passages the liquid condensing therein, comprising a constantly open flow
35 restriction system connected with such passages and containing a pressure chamber in which the pressure varies with the excess of accumulated liquid, in combination with a separate liquid discharge means receiving
40 liquid from such passages and adjustable for increase or decrease of discharge of accumulated liquid, and a connecting means from said pressure chamber to said discharge
45 means operating to adjust the latter to increase the discharge with increase of chamber pressure and vice versa.

In testimony whereof, I have affixed my signature hereto.

GRANT CAMPBELL.