

Feb. 7, 1933.

D. W. RUDORFF
DESUPERHEATING SYSTEM

1,896,247

Filed Sept. 19, 1931

2 Sheets-Sheet 1

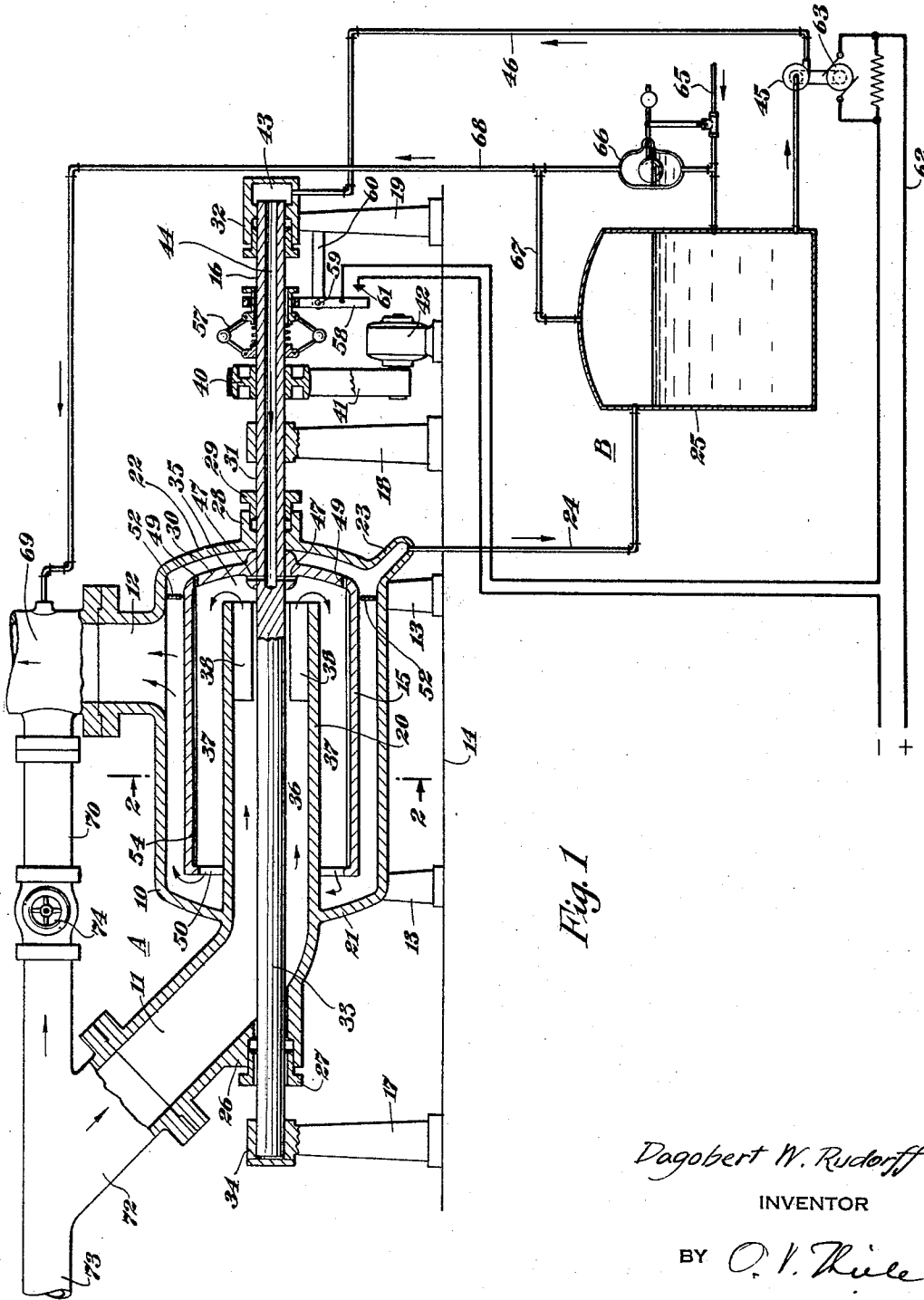


Fig. 1

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2 Sheets-Sheet 2

Fig. 2

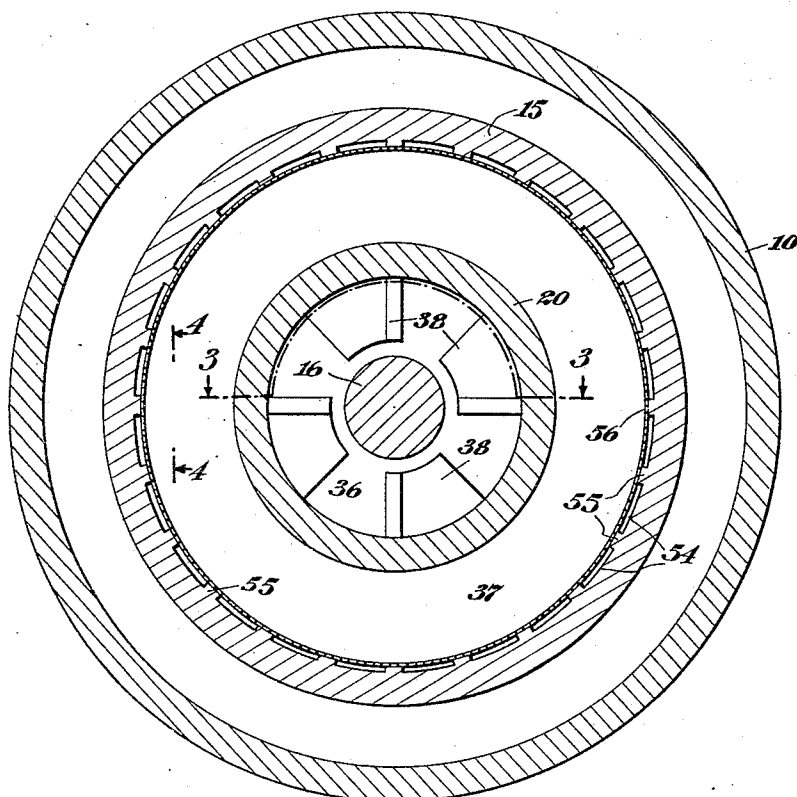


Fig. 3

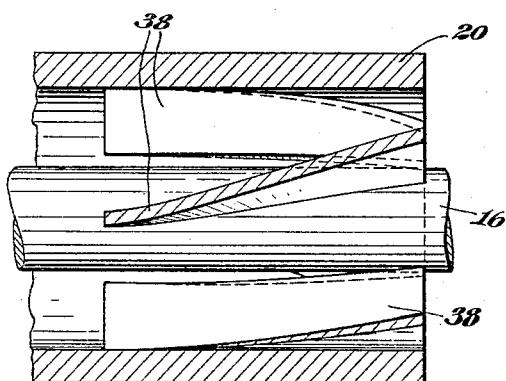
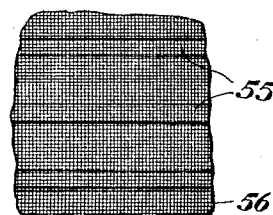


Fig. 4



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DESUPERHEATING SYSTEM

Application filed September 19, 1931. Serial No. 563,782.

The present invention has general reference to a method of and means for converting superheated steam into saturated steam or into steam of less superheat, and more particularly to a desuperheating apparatus of the open type in which the steam to be desuperheated is brought directly into contact with cooling water, without, however, resorting to any injection of water into the steam by means of spray nozzles or the like.

An object of the invention is to provide a desuperheating apparatus in which a thin, rotating film is contacted with superheated steam travelling at a relatively high velocity and transversely with respect to the path of travel of the film.

Another object is to provide a desuperheating apparatus of relatively small size having a high rate of desuperheating a large quantity of steam.

Other objects, advantages and features of the invention may be best understood by reference to the following detailed description of an illustrative embodiment thereof shown in the accompanying drawings in which,

Fig. 1 is a sectional, and partly a schematic view of the desuperheating arrangement.

Fig. 2 is an enlarged sectional view, taken along the line 2—2 of Fig. 1.

Fig. 3 is a partial sectional view on the line 3—3 of Fig. 2.

Fig. 4 is a fragmentary inside view of the drum showing particularly a portion of the closely meshed screen taken along the line 4—4, Fig. 2, in the direction of the arrows.

In accordance with the invention, the desuperheating system comprises a desuperheating apparatus, generally denoted A, associated with a water storage, and a water circuit, broadly designated B. The desuperheating apparatus includes a cylindrical casing 10 having an inclined superheated steam inlet pipe 11 and a vertically disposed steam outlet pipe 12. The casing 10 includes supporting legs 13 for spacing the desuperheating casing above the flooring 14.

A rotatable drum, broadly designated 15, is disposed within the casing 10 and is secured to the longitudinally disposed shaft, generally designated 16, the latter being suit-

ably journaled to the spaced stanchions 17, 18 and 19.

Forming a part of inlet 11 and in spaced relation with shaft 16 and surrounding a portion of the latter is a horizontally arranged overhanging stationary pipe 20 which merges and is integral with the inclined inlet pipe 11 and side 21, integral with casing 10. Extending downwardly and outwardly and integral with casing 10 and side 22 thereof is the hollow water leg 23 which receives overflow water from the rotatable drum 15, and transmits said water to the return pipe 24 connected to the feed water supply storage tank 25.

Inclined inlet pipe 11 includes an offset perforated portion 26, through which shaft 16 extends; and packing, kept in place in the usual way by packing gland 27 between the shaft and the opening in the offset, provides a steam tight joint, although permitting the shaft to rotate freely. Side wall 22 of the casing embodies a fixed bearing 28 which in association with packing held in place by packing gland 29 provides a fluid tight joint preventing leakage between bearing 28 and the shaft 16.

The revolving drum or rotor 15 comprises a perforated side wall 30 secured to the hollow portion 31 of shaft 16 in any preferred manner. The hollow portion of shaft 16 extends from a point adjacent the inner surface of side wall 30 of the drum exteriorly thereof through bearing 28 and packing gland 29 to the bearing 32 carried by the stanchion 19. Solid portion 33 of the shaft is suitably connected to the hollow portion 31 or may be unitary with it and extends across the interior of the drum through packing gland 27 and into bearing 34 on stanchion 17. It will be noted that the superheated steam inlet pipe 20 terminates within the drum 15 but in spaced relation with respect to wall 30 to provide a passageway 35 for the steam after having left the annular channel 36 between inner faces of pipe 20 and the shaft 16, to pass into the duct or channel 37 between the outer face of pipe 20 and the inner surface of the rotatable drum.

Superheated steam from inlet pipe 11 be-

fore leaving the inner over-hanging pipe 20 is preferably given a whirling motion, being increased in velocity and twisted out of its course of direction to flow substantially in the path of a helix, the direction of the latter being counter to the rotation of a cylindrical water film, hereinafter more particularly set forth, with which it contacts. To this end, pipe 20 on its inner surface is provided with a plurality of longitudinally disposed, stationary, spaced, twisted fins or vanes 38. The superheated steam passing in annular duct 36 strikes the spaced vanes 38 which impart a vortex motion to it.

For driving the drum at a constant speed, shaft 16 has secured thereto pulley 40 driven by endless belt 41 placed in motion by the constant speed electric motor 42.

Bearing 32 in which the hollow portion 31 of the shaft is journaled includes a chamber 43 communicating with the bore or water duct 44 in the hollow shaft portion 31. Water from the storage tank 25 is forced into the delivery pipe 46 by the action of pump 45 and into chamber 43, and through duct 44, and from the latter the water is transmitted into drum 15, revolving at high speed, through the opposed orifices 47 disposed transversely of the shaft and terminating within proximity to the inner surface of the side wall 30 of the drum.

Since drum 15 revolves at high speed, the water therein is distributed by centrifugal force to the inside cylindrical surface thereof, forming a cylindrical film of water whose depth is regulated automatically by the overflow openings as 49.

For synchronizing the speed of the film with the drum, the inner surface thereof includes a plurality of longitudinally disposed shallow water receiving troughs or grooves as 54 spaced apart by intervening ribs 55 to which is secured the fine-mesh cylindrical screen 56, which provides sufficient friction between the drum and the film to prevent the latter from slipping or lagging behind the speed of the drum. In addition, the screen retains a small portion of water from the grooves due to surface tension, even though the desuperheater drum has been stopped and this retained water is utilized in starting the operation of the desuperheater.

The screen has the further purpose of preventing moisture from being entrained in the steam traversing the annular space 37, as particles of moisture which might have a tendency to leave the surface of the rotating film or the screen, are held back by centrifugal force if the drum is rotating at or above a predetermined speed. Although the drum preferably includes troughs as 54 suitably screened by closely spaced wire meshing, it is to be understood that the invention is not limited in this respect and in practice the screen may in some cases be omitted and the

inner surface of the rotatable drum may in some cases be made smooth and unbroken without any water receiving troughs and with such a construction the desuperheated steam between the drum and casing will also be free of entrained moisture as the centrifugal force on the film prevents any particle of moisture to leave it and intermingle with the steam in the process of desuperheating.

With the steam traveling at a relatively high velocity and having substantially a rotary movement when entering into the passageway 35 and into the annular pass 37 between the over-hanging pipe 20 and the rotating water film of the drum, a sufficient quantity of water will be evaporated to desuperheat the steam to the desired temperature. Obviously a very high rate of heat transmission between the steam and the film is attained due to the direct contact and high relative velocities between the superheated steam and the rotating film.

The cooled steam leaves opening 50 and passes between the outside cylindrical surface of drum 15 and the inner face of the casing 10 and is directed into outlet pipe 12 to which the nipple 69 is connected.

Annular baffle 52 secured to the casing prevents intermingling of the water discharged from orifices 49 with desuperheated steam between the outer cylindrical surface of the drum and casing.

To increase further the rate of evaporation of the film of water it will be noted that the desuperheated steam passes along the outside surface of the drum, transmitting a slight amount of heat thereto which preheats the water film on the inner surface of the drum.

Provisions have been made to prevent flooding of the drum with water in the event shaft 16 is below a predetermined speed. For this purpose, a fly ball governor broadly denoted 57 is operatively connected to the circuit making and breaking arm 58 which is pivoted at 59 on arm 60 secured to stanchion 19. Below a predetermined speed of shaft 16 contact 61 is open and consequently the electric circuit 62 of motor 63 for water pump 45 is also open. Therefore, at this time pump 45 is at rest and no water is delivered into the drum.

However, at or above the predetermined speed for which the governor is set, circuit 62 will be closed rendering effective pump 45 to supply the drum with a required amount of water for desuperheating the steam.

Splash or any overflow of water is taken care of at the overflow orifices 49 spilling any excess water into the water leg 23 which is drained by the return pipe 24 and the latter empties into the storage tank 25, the return water being substantially at evaporating temperature.

Feedwater is supplied to the storage tank

through pipe 65 connected to a suitable water supply source (not shown) and the water float regulator 66 automatically maintains the head of water in the tank constant.

5 Pipe 67 connects the steam space of the tank to pipe 68 which in turn is connected to the steam space of the water regulator 66 and the coupling 69 to which outlet 12 and pipe 70 are connected. Pipe 68 directs any steam
10 from the storage tank and water regulator to the coupling. This steam will almost be negligible in quantity and will be intermixed with the desuperheated steam, imparting thereto practically no undesirable effect.

15 Superheated steam is directed into inlet 11 from pipe 72 which is connected with pipe 73 associated with a superheated steam source (not shown). Pipe 70, connecting pipe 72 with coupling 69, includes a valve 74 which
20 may be adjusted to by-pass a certain amount of superheated steam for intermingling with the desuperheated steam to regulate the temperature thereof.

The foregoing disclosure has been given
25 by way of example for purposes of illustration and understanding of the scope and underlying principles of my invention. Accordingly, no unnecessary limitations should be understood and the appended claims
30 should be construed as broadly as the state of the art permits.

What I claim is:

1. In a desuperheating system, a casing, a shaft extending through and journaled there-
35 to, a steam intake spaced from and surrounding said shaft, a rotatable drum fixed to the latter and spaced from the walls of said casing and intake and extending between the two, driving means for said shaft, means to
40 supply fluid into the drum through a portion of said shaft and establish a fluid film to rotate within and with said drum, means to regulate the amount of fluid supplied in response to the speed of the shaft, means with-
45 in the aforementioned intake for translating the linear travel of the superheated steam in the intake into a substantially helical path for travel between the intake and rotatable drum to contact with said rotating film and
50 desuperheat the steam, and means for directing the desuperheated steam to a point of use.

2. In a desuperheating system, a casing, a shaft extending through and journaled to
55 said casing, a drum spaced from the latter and mounted on said shaft, a superheated steam intake extending exteriorly of said casing and within the latter and being interposed between the drum and shaft and spaced
60 therefrom, a plurality of spaced vanes associated with said intake for twisting the path of travel of said steam admitted substantially into the form of a helix, means for directing twisted steam between the intake and drum,
65 means for feeding water into the drum to es-

tablish therein a water film to contact with and desuperheat the steam passing between the intake and the drum, and means for directing the desuperheated steam between the drum and the casing to a point of use. 70

3. In a desuperheating system, a casing, a shaft extending through and journaled to said casing, a drum mounted on said shaft, means for admitting superheated steam into said casing, driving means for said shaft, 75 means for supplying water into said drum through a portion of said shaft to set up a revolving water film in the drum to contact and desuperheat said steam, and means responsive to the speed of the driving means to regulate the amount of water supplied. 80

4. In a desuperheating system, a casing, a shaft extending through and journaled to said casing, a drum mounted on said shaft, means for admitting superheated steam into said 85 casing, driving means for said shaft, means for supplying fluid into said drum to set up a revolving fluid film therein and desuperheat the steam admitted, means responsive to the speed of the driving means to regulate the amount of water supplied, outlet means for said desuperheated steam, and means to prevent entrained moisture in the latter. 90

5. The system according to claim 4 wherein means are provided for controlling the 95 thickness of said film.

6. The system according to claim 4 wherein said supply means comprise a water storage tank operatively connected to the casing and a portion of said shaft. 100

7. In a desuperheating system, a casing, a shaft extending through and journaled to said casing, a drum mounted on said shaft, inlet means admitting superheated steam into said casing, stationary vanes in the path of said steam for translating the linear motion 105 of the latter into a substantially rotary motion, driving means for said shaft, the latter including a hollow portion in communication with the interior of said drum, a water tank, means for forcing water from said tank into the hollow portion to set up in response to a predetermined speed of said driving means a thin water film in the drum to contact with and desuperheat said steam, and regulating 115 means associated with said shaft to control the supply of water entering into said drum, and outlet means associated with said casing for said desuperheated steam.

8. The system specified in claim 7 in which the casing includes a water leg in communication with said tank. 120

9. The system according to claim 7 wherein said drum comprises a plurality of fluid receiving grooves and a screen, the latter being adapted to synchronize the speed of the film with the drum and prevent entrained moisture in the desuperheated steam. 125

10. The system according to claim 7 further characterized in that means are pro- 130

vided between the inlet and outlet means on said casing to by-pass superheated steam for controlling the temperature of the desuperheated steam in said outlet means.

- 5 11. In the art of desuperheating steam, the step of contacting a thin rotating film of water rotating at a relatively high velocity with superheated steam traveling in a direction counter to said film and at a high relative velocity to desuperheat said steam.

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