

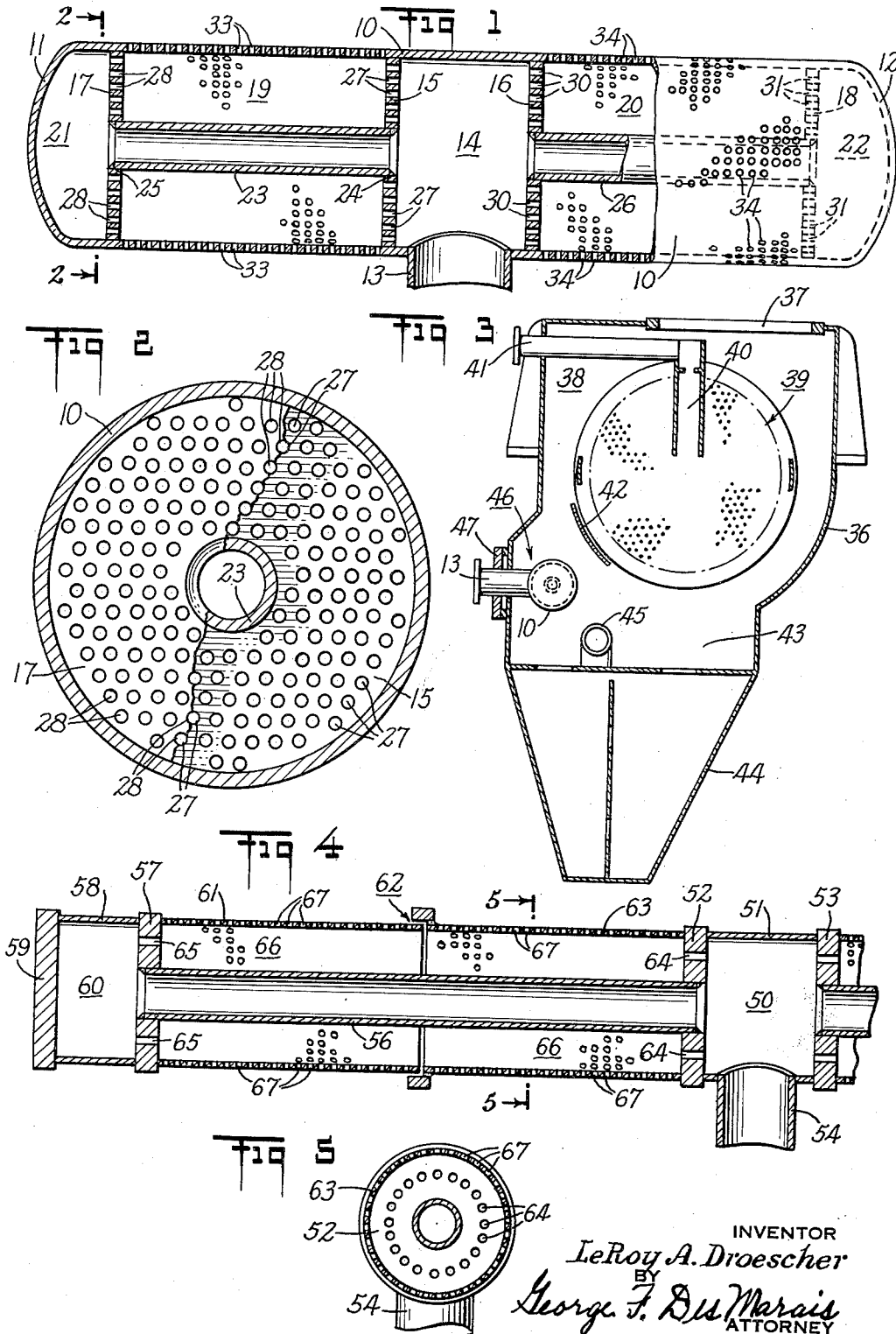
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MEANS FOR DISSIPATING THE ENERGY OF STEAM IN LARGE QUANTITIES

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MEANS FOR DISSIPATING THE ENERGY OF STEAM IN LARGE QUANTITIES

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This invention relates to means for dissipating the energy of steam in large quantities in order to enable high velocity steam to be delivered to the steam space of a condenser at a considerably reduced pressure. The invention is particularly suited for dumping steam from a steam generator into the steam space of a condenser in a manner to protect the vital parts of the condenser structure from erosion and destructive vibration, such as otherwise would be induced by uncontrolled high velocity jets of steam traveling at or near sonic velocity through the internal condenser steam space. The steam is taken at whatever line pressure exists and is divided into substantially equal masses which are respectively further divided into a plurality of steam jets which are directed in opposite directions to meet one another within a restricted zone or chamber, thereby creating a turbulent mass of steam at a considerably reduced pressure within the restricted zone. A first stage pressure reduction from line pressure is thereby accomplished. A further or second stage expansion and reduction of pressure of the steam to whatever the condenser vacuum happens to be is attained by discharging the steam from said zone to the steam space of the condenser as fine and closely spaced jets of steam.

The stages are effected by an apparatus having a connection with a pipe line which extends through the shell of a condenser and into the steam space of the condenser. The connection delivers the line pressure steam into a casing which is so constructed and arranged as to dissipate the energy of the steam as it is conducted through compartments or chambers in the casing and is passed through a multiplicity of small perforations in the casing to the space surrounding the casing.

The chambers or compartments of the casing are so formed and interrelated as to cause the steam to flow as jets which are directed to impinge on one another and effect their destruction within a restricted zone in the casing. The jet energy of the high velocity jet streams is thereby converted into a turbulent multi-directional steam mass within the confines of the casing. The steam jets subsequently formed and issuing from the restricted zone to the exterior of the casing tend to expand in a direction normal to the line of direction of the issuing jets and to create a non-destructive turbulent mass of steam at a much reduced pressure and velocity a few inches from the perforated casing from whence it distributes throughout the condenser steam space. The merging of the small diameter jets of steam issuing from the casing suppresses the destructive effects of jet streams and also reduces the noise level otherwise associated with high velocity jets of steam discharged into space from a region of high pressure.

The steam dissipator of the present invention conserves valuable space and weight owing to the elimination of external transition piping and of the need for a larger steam-delivering pipe line.

These and other attainments and objects of the invention will appear more fully from a detailed description of an apparatus embodying the invention and by which the invention may be utilized.

In the accompanying drawing, FIG. 1 illustrates a side elevation of an energy dissipating apparatus with

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part of its outer casing and pipe line broken away to more clearly illustrate the interior construction;

FIG. 2 is a section on line 2—2 of FIG. 1 on an enlarged scale and partly broken away to illustrate the alignment of jet-forming orifices in transverse walls or orifice plates of the first stage pressure reduction;

FIG. 3 illustrates generally a cross-section of a condenser incorporating an energy-dissipating apparatus;

FIG. 4 is a longitudinal section through a portion of a modified form of an energy-dissipating apparatus;

FIG. 5 is a section on line 5—5 of FIG. 4.

The structure of the energy-dissipating apparatus shown in FIG. 1 comprises a cylindrical steel casing or pipe 10 having closed end walls 11 and 12 and a pipe line or connecting pipe 13 for introducing steam to a central chamber 14. Except for the connecting pipe 13 the cylindrical wall of the central chamber 14 is imperforate.

The central chamber 14 has transverse side walls 15 and 16 which are formed by plates welded to the interior of the cylindrical casing 10. Similar plates 17 and 18 are respectively welded to the interior of the casing to set apart a chamber 19 intermediate the plates 15 and 17 and a chamber 20 intermediate the plates 16 and 18. The plates 17 and 18 are respectively spaced from the opposite ends of the casing 10 to provide additional chambers 21 and 22 adjacent the closed ends of the casing.

A conduit for the passage of steam from the central chamber 14 to the end chamber 21 is provided by a pipe 23 welded to the interior of an opening 24 in the plate 15 and welded to the interior of an opening 25 in the plate 17. A similar pipe 26 is mounted in like manner to the plates 16 and 18, whereby to provide a passageway for steam from the central chamber 14 to the end chamber 22.

The plates or transverse walls 15 and 17 are, respectively, provided with a plurality of holes or orifices 27, 28, which are disposed in equal number and in like positions in the respective plates so that the holes in one of the plates are aligned with corresponding holes in the other plate. An arrangement of a number of aligned holes is generally illustrated in FIG. 2. The plates 16 and 18, respectively, contain a similar arrangement of aligned holes 30, 31.

It is apparent that the sections of the apparatus at either side of the axis of the pipe line 13 of the apparatus shown in FIG. 1 are similarly constructed and function in like manner. Equal amounts of the total steam entering the apparatus are treated similarly in the chambers at either side of the inlet pipe 13 with the chamber 14 serving as a chamber common to the two like sections of the apparatus. This arrangement is preferred from the steam-distribution point of view in comparison with an apparatus having a steam inlet at one end delivering steam to a casing equivalent to only one of the two end sections described. By using a central inlet it is possible to employ an outer casing 10 and internal conducting pipes 23 and 26 of less diameters because each end section of the apparatus treats with only half of the steam entering through the inlet.

It is to be understood that two stages of pressure reduction of different quantities of steam are effected by each end section of the apparatus. The first stage of pressure reduction in each section is effected by the two opposed orifice plates 15, 17 (16, 18) in which the orifices are so arranged as to have the jets formed thereby in substantial axial alignment with one another in order to effect their collision and destruction within the zone or chamber 19 (20) while traveling in opposite directions. The jet energy is dissipated by converting the high velocity steam jets into a turbulent steam mass within the limited zone or chamber 19 (20). The size and number of orifices in the orifice plates are variable for different adaptations so long as opposite orifices are aligned and

are of the same size in a given apparatus. In general, the total nozzle area of the orifices of the four orifice plates is preferably less than about fifty percent of the area of the inlet pipe 13. However, this ratio is variable in different designs and is dependent on pipe line pressures and the end point of pressure desired to be reached in the first stage of pressure reduction.

The flow of steam through the orifices of each of the orifice plates of either end section is substantially the same, and this is accomplished by providing a pipe 23 (26) of such diameter that the drop in pressure between chamber 14 and the chamber 21 (22) is negligible. The area of the pipe 23 (26) should preferably be at least three times greater than the total area of the orifices of any one of the orifice plates.

The first stage of pressure reduction is accomplished by the orifice plates which effect a reduction in pressure within the chambers 19 and 20 to a few pounds per square inch above atmospheric pressure, say, of the order of about 5 to 15 pounds per square inch gage, for example, from whatever line pressure exists. The line pressure may be of the order of 100 or 1000 pounds per square inch gage, more or less, depending on the source of supply. The turbulent mass of the steam from the first stage is confined in a restricted zone where it cannot do damage to the internal condenser structure.

The second stage of pressure reduction and expansion is from whatever pressure obtains in the chambers 19 and 20 to the condenser vacuum which may be quite high or just under atmospheric pressure.

Steam is emitted from the chambers 19 and 20 of the apparatus through a large number of relatively small holes 33 and 34 in the casing 10. The holes 33 are distributed around the casing between the transverse walls 15 and 17, and the holes 34 are distributed around the casing between the transverse walls 16 and 18. The holes in each of these areas of the casing 10 are closely spaced and the fine jets of steam discharge therethrough diffuse into one another and thus destroy their jet-effect and form a cloud of steam around the casing a few inches from its outer surface. The passage of the steam through the holes 33, 34 further reduces the pressure of the steam below the pressure existing in the chambers 19 and 20.

As shown in FIG. 3, the energy dissipator is shown in association with a condenser comprising a shell 36 having an inlet 37 for introducing exhaust steam to a steam space 38 containing a nest of condensing tubes, as generally shown at 39, which extend between tube sheets at either end of the condenser.

It will be understood that the condenser is provided with customary equipment including such devices and apparatuses as an air offtake 40 having an air exhausting duct 41 for conducting air to the outside of the shell, baffles, such as the baffle 42, a condensate reheating section 43, a condensate hotwell 4, a hotwell vent 45, and various other elements of equipment which are not shown since they are not essential for understanding the present invention. The casing 10 of the energy-dissipator is shown at 46. The conduit 13 through which steam is introduced to the casing 10 extends through an opening in the shell 36 which is tightly closed around the conduit. The conduit 13 is supported by a flange 47 which is fastened to the condenser shell 36.

The modification illustrated in FIG. 4 includes a central chamber 50 formed by a hollow cylinder 51 having its ends welded to perforated plates 52 and 53, respectively. Steam is introduced to the chamber 50 through an inlet conduit 54. The plate 52 has a central opening in which a pipe 56 is fitted and secured by welding. A perforated plate 57 is similarly attached to and supported by the pipe 56 and the plate 57, in turn, supports an imperforate cylinder 58 and an imperforate end plate 59. The two transverse plates 57 and 59 and the hollow cylinder 58 are welded together and form an end chamber 60 in which the direction of steam coming through the pipe 56 is

reversed. A hollow cylinder 61 is welded to and supported from the plate 57. The other end of the hollow cylinder 61 forms a slip joint at 62 with an overlapping lip of another hollow cylinder 63 which is welded to and supported from the plate 52.

The plates 52 and 57 are each provided with a number of jet-forming orifices 64 and 65 distributed in the respective plates in like number and position to form jets directed toward each other in the chamber 66 around the pipe 56. The steam received in this chamber is discharged therefrom through a large number of holes or orifices 67 distributed throughout the hollow cylinders 61 and 63. It is to be understood that the section of the energy-dissipator to the right of the central chamber 50 is constructed similarly to the section to the left of the central chamber with the plate 53 corresponding to the plate 52. As shown in FIG. 5, the orifices 64 in plate 52 (as well as their counterparts 65 in the plate 57 and in the perforated plates in the other end section of the apparatus) are arranged in a circle.

In one form of the apparatus the hollow cylinders 61 and 63 are made of ten-inch extra heavy pipes and contain approximately 19,000 holes. The holes 67 are one-eighth of an inch in diameter. They are spaced on one-quarter inch centers around the pipes and lengthwise of the pipes. Even though the velocity of the jet streams is near or at sonic level, a relatively low steam density is maintained at the exits from the holes. The fineness and relatively close spacing of the large number of holes create a non-destructive turbulent mass of steam outside of the casing. There are twenty orifices in each of the orifice plates consisting of three-eighth inch holes drilled on a base circle seven and one-half inches in diameter. The interior conduits are three-inch pipes and the steam inlet or supply pipe 54 is a five-inch pipe. The apparatus functions in a manner to attain the results hereinabove related.

While I have shown a preferred form of the invention, numerous modifications, alterations and substitutions will be obvious to those skilled in the art after a study of the foregoing description. Consequently, the description is to be considered in an illustrative rather than a limiting sense; and it is my desire and intention to reserve all modifications and substitutions falling within the scope of the claims which follow.

What is claimed is:

1. In a condenser, the combination with a condenser shell containing condensing tubes and having an inlet for the admission of exhaust steam to a steam space in the shell, of means for delivering steam at relatively low pressure to said steam space from a source of high pressure steam, said steam delivering means comprising a casing in said shell, a conduit for introducing high pressure steam to a chamber said chamber enclosed by a wall including a portion of said casing and partitions spaced apart from one another, a second chamber defined by another wall including a portion of said casing and said partitions, passage means through said partitions for conducting steam from said first chamber to said second chamber, said second-named means comprising jet-forming orifices arranged in pairs, the orifices of each pair of said orifices being aligned opposite one another for introducing the conducted steam to said second chamber as jets of steam meeting one another from opposite directions in said second chamber, and means comprising a multiplicity of perforations through said second-named portion of said casing for passing steam from said second chamber to the steam space of said condenser.

2. In a condenser, the combination with a condenser shell containing steam condensing tubes and having an inlet for the admission of exhaust steam to a steam space in the shell, of means for delivering steam at relatively low pressure to said steam space from a source of high pressure steam, said steam delivering means located in said steam space and comprising a chamber, said cham-

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ber enclosed by a wall including partitions spaced apart from one another, means for delivering high pressure steam to said chamber, a permeable enclosure, means in said partitions for delivering high pressure steam from said chamber to said permeable enclosure in the form of jets of steam, said last-named means comprising opposed orifices in substantially axial alignment with one another and forming jets of steam meeting one another in said permeable enclosure while traveling in opposite directions, said permeable enclosure having a multiplicity of closely spaced perforations of relatively small size for the flow of fine steam jets from said permeable enclosure into said steam condensing space of said condenser.

3. In a condenser, the combination with a shell having an inlet for the admission of steam to a steam space in the shell, of means for delivering steam at relatively low pressure to said steam space from a source of high pressure steam, said steam delivering means comprising an elongated casing having closed ends and a conduit for introducing steam to said casing from a high pressure steam source, a pair of perforated walls disposed transversely of said casing and setting apart an intake chamber between said walls for receiving steam from said conduit, a third and a fourth perforated transverse wall respectively located adjacent opposite ends of said casing, said third transverse wall separating a first end chamber at one end of said casing from a first steam-dispensing chamber located between said first end chamber and said intake chamber, said fourth transverse wall separating a second end chamber at the other end of said casing from a second steam-dispensing chamber located between said second end chamber and said intake chamber, passageways for the flow of steam from said steam intake chamber to said first and said second end chambers, a plurality of orifices through each of said transverse walls, said orifices in said first and said third transverse walls being aligned to cause opposing jets of steam passing through said aligned orifices to impinge on one another in said first steam-dispensing chamber, said orifices in said second transverse wall being aligned with said orifices in said fourth transverse wall to cause opposing jets of steam passing through said second and said fourth transverse walls to impinge on one another in said second steam-dispensing chamber, and perforations in the exterior of said casing for distributing steam from said steam-dispensing chambers to said steam space.

4. In a condenser, the combination with a shell having an inlet for the admission of steam to a steam space in the shell, of means for delivering steam at low pressure to said steam space from a source of high pressure steam, said steam delivering means comprising a cylindrical casing having closed ends and a conduit for introducing high pressure steam to a chamber centrally disposed with respect to the closed ends of said casing, said central chamber having oppositely disposed transverse walls with perforations therethrough and a wall provided by said casing, a third and a fourth perforated transverse wall disposed, respectively, adjacent opposite ends of said casing, said third and fourth transverse walls and the closed ends of said casing forming chambers adjacent the ends of said casing, pipes extending from said central chamber to said chambers adjacent the ends of said casing, each of said pipes being secured in openings in pairs of said transverse walls for conducting steam from said central chamber to said end chambers, each pipe and pipe-connected pair of transverse walls defining an annular space inside of said casing and outside of the pipe, said perforations in each pair of transverse walls comprising orifices aligned to cause jets of steam passing therethrough to impinge on one another from opposite directions in said annular spaces, and perforations in the portions of said casing circumscribing said annular spaces for delivering steam from said annular spaces to the steam space of the condenser.

5. Apparatus for dissipating energy of high velocity

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steam, said apparatus comprising a casing, a conduit for introducing high pressure steam to a chamber in said casing, said chamber enclosed by a wall including a portion of said casing and partitions spaced apart from one another, a second chamber in said casing, said second chamber defined by another wall including a portion of said casing and said partitions, passage means through said partitions for conducting steam from said first chamber to said second chamber, said means comprising jet-forming orifices arranged in pairs, the orifices of each pair of said orifices being aligned and opposite one another for introducing the conducted steam to said second chamber as jets of steam meeting one another from opposite directions in said second chamber, and means comprising a multiplicity of perforations of small diameter through said second-named portion of said casing for dispensing steam from said second chamber.

6. Apparatus for dissipating energy of high velocity steam, said apparatus comprising a casing containing a plurality of steam-processing sections in communication with a common chamber, said chamber enclosed by a wall including portions of said casing and a plurality of partitions spaced apart from one another, an inlet for introducing high pressure steam to said common chamber, each of said sections having a steam-dispensing chamber, said steam-dispensing chamber of each of said sections defined by another wall including a portion of said casing and a pair of said partitions, said partitions having orifice means for the flow of steam from said common chamber into said steam-dispensing chamber, said orifice means of each of said sections comprising aligned orifices arranged for directing jets of steam from opposite directions for collision in said steam-dispensing chamber, said last-named portions of said casing having a multiplicity of small holes for discharging jets of steam from the steam-dispensing chamber of each of said sections at a reduced pressure.

7. Apparatus for dissipating energy of steam, said apparatus comprising an elongated casing closed at both ends and having an inlet for supplying steam to a steam intake chamber within said casing, a plurality of transverse walls spacially disposed within said casing, a first of said transverse walls serving as a side wall of said intake chamber and a second of said transverse walls serving as a side wall of an end chamber adjacent a closed end of said casing, a pipe extending through openings in said first and second transverse walls, said pipe providing a passageway for the flow of steam from said intake chamber to said end chamber, said first transverse wall having a plurality of orifices for the passage of steam from said intake chamber and said second transverse wall having a plurality of orifices for the passage of steam from said end chamber, the respective ones of said orifices in said first transverse wall being aligned with respective ones of said orifices in said second transverse wall for causing jets of steam passing through said orifices in said respective walls to impinge on one another in a chamber between said transverse walls, and a multiplicity of perforations through said casing for dispensing steam from said last-named chamber, said perforations located in the portion of said casing extending between said first transverse wall and said second transverse wall.

8. A method for introducing steam supplied from a high pressure source into the steam condensing space of a condenser at a considerably lower pressure which comprises

apportioning a flow of high pressure steam into substantially equal masses of steam, effecting a first stage expansion and reduction in pressure of the steam by subdividing each of said masses of steam into a plurality of steam jets and directing the jets issuing from the respective masses in opposite directions into a restricted zone, each jet originating from one of said masses aligned

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with a jet originating from the other of said masses and meeting one another within said restricted zone, thereby effecting the destruction of all of said jets and the commingling of the steam of said jets within said restricted zone,
and effecting a second stage expansion of the steam and further reduction in pressure by discharging steam from said restricted zone and intro-

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ducing the discharged steam into the steam condensing space of the condenser in a multiplicity of fine jets of steam.

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