Dec. 8, 1936. J. FLETCHER 2,063,425

STEAM AND WATER SEPARATOR

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Fig. 1

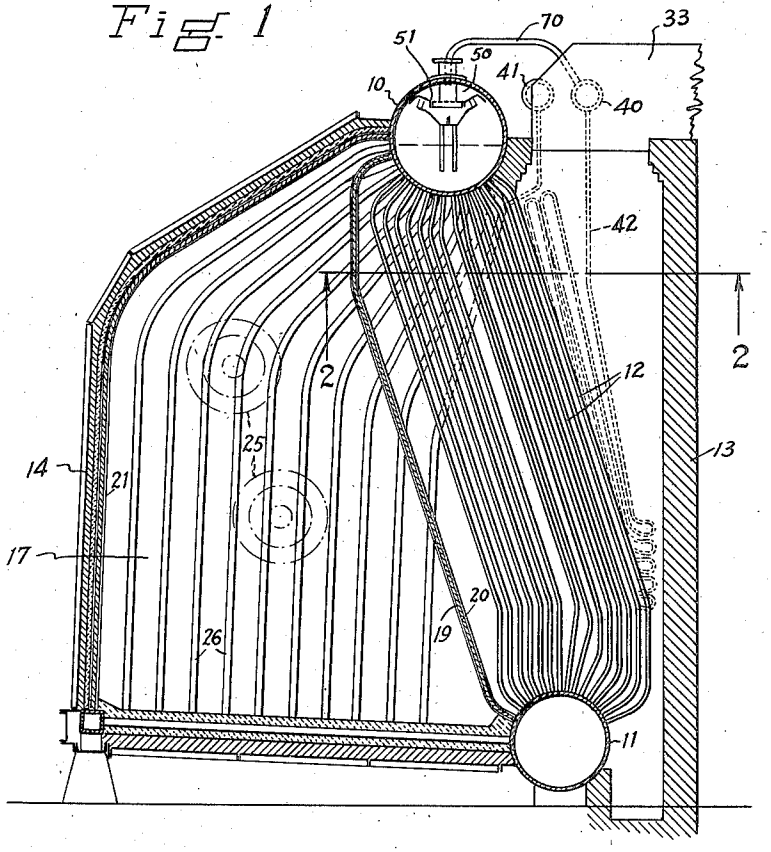
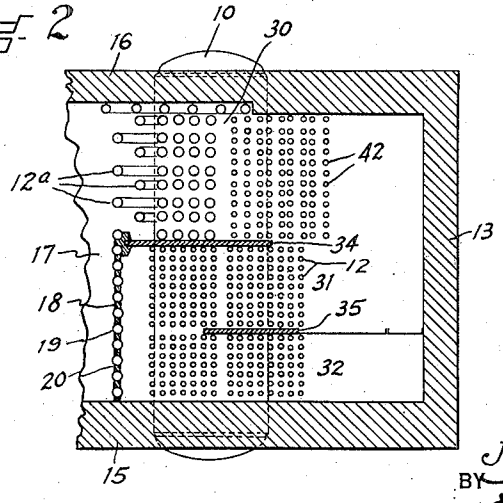


Fig. 2



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Fig. 4

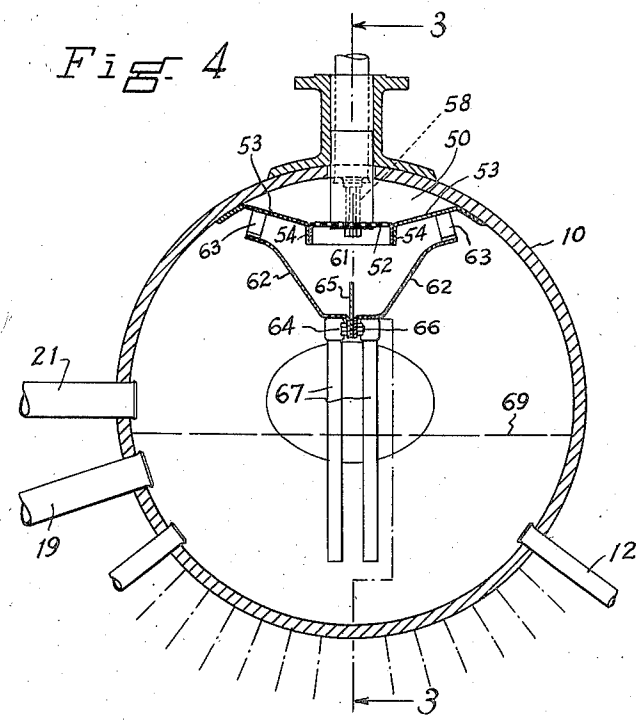


Fig. 3

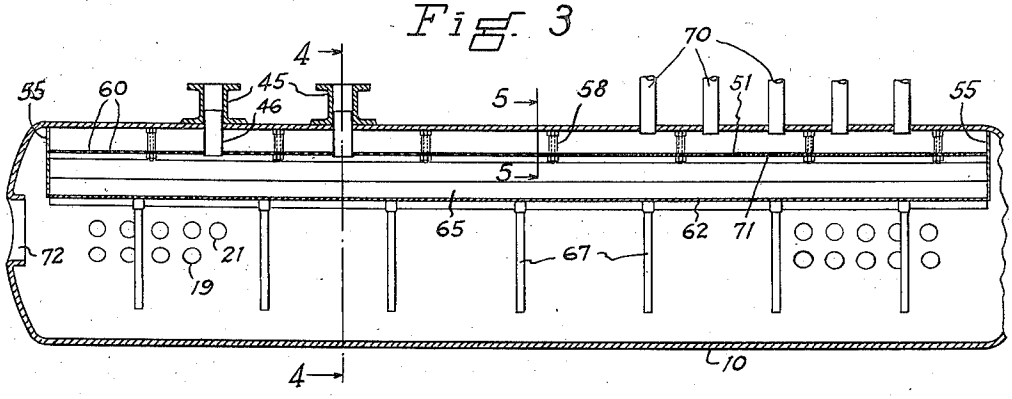
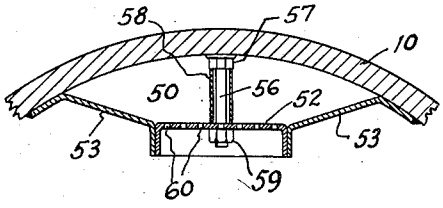


Fig. 5



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2,063,425

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2,063,425

STEAM AND WATER SEPARATOR

James Fletcher, Akron, Ohio, assignor to The Babcock & Wilcox Company, Newark, N. J., a corporation of New Jersey

Application June 30, 1933, Serial No. 678,374

6 Claims. (Cl. 122—491)

The present invention relates in general to the construction and mode of operation of fluid separators and particularly to fluid separators adapted for use in the steam and water drum of a steam boiler for the removal of moisture and other impurities in the steam generated before leaving the drum. My improved fluid separator is especially adapted for use in boilers in which the major portion of the steam output is generated in tubes discharging into an end portion of the steam and water drum.

The general object of my invention is the provision of a steam and water drum separator which is characterized by its effectiveness in operation, simplicity and low cost of construction, small drum space requirements, and location affording adequate accessibility to the interior of the drum for inspection or repairs. A further and more specific object is the provision of an improved construction of a steam and water drum separator for steam boilers of the type in which a major portion of the steam output is generated in tubes discharging into one end of the steam and water drum.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of my invention.

Of the drawings:

Fig. 1 is a sectional elevation of a steam boiler having a steam and water separator constructed in accordance with my invention;

Fig. 2 is a fragmentary horizontal section taken on the line 2—2 of Fig. 1;

Fig. 3 is a longitudinal section on an enlarged scale taken on the line 3—3 of Fig. 4, of the steam and water drum illustrated in Fig. 1;

Fig. 4 is a transverse section on an enlarged scale taken on the line 4—4 of Fig. 3 of the steam and water drum; and

Fig. 5 is a fragmentary transverse section on an enlarged scale taken on the line 5—5 of Fig. 3.

My improved fluid separator construction is illustrated in the drawings as incorporated in the steam and water drum 10 of a steam boiler of one type in which it is especially adapted for use. In the steam boiler illustrated, the steam and water drum 10 is horizontally arranged and extends longitudinally of the boiler. The drum 10 is connected to a similarly arranged lower water drum 11 by a slightly sloping vertical bank of bent tubes 12 extending between and connected to the drums substantially throughout the length thereof. The drums 10 and 11 and tube bank 12 are arranged along one side of a boiler housing of substantially rectangular horizontal cross-section, and formed by vertical side walls 13 and 14 and front and rear walls 15 and 16 respectively. The side wall 14 is laterally spaced a substantial distance from the inner side of the tube bank, and the space therebetween constitutes the boiler furnace or combustion chamber 17. The furnace chamber 17 is separated from the space containing the tube bank 12 for a portion of its length by an inner or baffle wall 18, formed by a row of longitudinally spaced vertical stud tubes 19 having their upper and lower bent ends connected to the drums 10 and 11 respectively, and forming the innermost row of the tube bank 12. The tube row 19 terminates short of the rear wall 16, and the inter-tube spaces are closed by refractory material 20 carried by the tube studs. The space between the end of the baffle wall 18 and the rear wall 16 forms a hot gas entrance from the furnace chamber to the rear portion of the tube bank 12. The outer side wall 14 and the floor and roof of the furnace chamber are also formed by a row of tubes 21 having their ends connected to the drums 10 and 11 and their inter-tube spaces closed by refractory blocks or material. The furnace chamber is provided with a pair of fluid fuel burners 25 mounted in the front wall 15 and arranged to discharge parallel streams of fuel horizontally into the furnace chamber toward the rear wall 16. The rear wall 16 is protected by a row of laterally spaced bent tubes 26 connected to the drum 10 at their upper ends, and through a header (not shown) at their lower ends to the drum 11.

The space containing the tube bank 12 is advantageously divided into a plurality of serially connected gas passes 30, 31, and 32, extending transversely of the tube bank, and through which a substantially horizontal flow of heating gases is maintained from the furnace chamber to the boiler outlet 33. The gas passes 30 and 31 are separated by an inter-tubular baffle 34 extending normal to the baffle wall 18 and terminating short of the side wall 13, and the passes 31 and 32 by a second baffle 35 extending normal to the side wall 13 and terminating short of the baffle wall 18. The portion of the tube bank in the gas pass 30 is formed by tubes 12^a of larger diameter than the tubes in the gas passes 31

and 32. The inner rows of tubes 12a are widely spaced to provide a slag screen across the entrance to the gas pass 30. The portion of the gas pass 30 at the rear of the tubes 12a is occupied by a superheater consisting of inlet and outlet headers 40 and 41 respectively, connected by a bank of depending multi-looped tubes 42. The specific steam boiler construction heretofore described is disclosed and claimed in Patent No. 1,999,984, dated April 30, 1935, and filed in the name of Ervin G. Bailey et al., and is not my invention.

In the operation of the steam boiler described, the furnace wall tubes receive heat by convection and radiation, and the tubes 12a in the first transverse gas pass 30 are contacted by heating gases at a considerably higher temperature than those contacting with the tubes in the gas passes 31 and 32. Consequently, most of the steam is generated in the furnace wall tubes and the tubes 12a, while a general downflow of water exists in the tubes 12 located in the gas passes 31 and 32.

In accordance with my invention, the steam and water drum 10 is provided with steam and water separating provisions, which are especially adapted for use in a steam boiler of the character described. The drum separator comprises a dry steam space 50 in the drum extending along the uppermost part of the top, and formed by a shallow dry pan 51, having a central perforated inverted channel plate member 52 and the drum wall closed by channel shaped plates 53, the flanges on the side plates 52 being welded to the drum walls and to the central plate flanges to form a pair of flow directing baffles 54 depending from the under side of the dry pan. The ends of the dry steam space are closed by transverse end plates 55 adjacent the ends of the drum 10. The dry pan 51 is held in spaced relation from the top of the drum 10, as shown in Fig. 5, by longitudinally spaced bolts 56 having their heads 57 welded to the drum wall and surrounded by tubular spacing members 58 extending between the bolt heads and the upper side of the plate 52. The threaded ends of the bolts 56 project through the plate 52, and hold the dry pan in position by means of nuts 59 threaded thereon. Entrance to the dry steam space is provided by a multiplicity of perforations 60 in the plate 52 arranged as hereinafter described. Safety valve nozzles 45 are mounted along the top of the drum 10 and connected to the space below the dry pan by tubes 46.

Below the dry steam space and coextensive therewith, is a symmetrically formed steam and water separating space 61, the sides and bottom of which are closed by a pair of oppositely inclined baffle plates 62 having their upper ends outwardly curved and spaced from the under side of the corresponding plate 53 by clips 63 at longitudinally spaced points. The lower ends of the plate 62 extend horizontally toward one another and are provided with adjacent depending flanges 64. The baffle plate flanges 64 have an impingement plate 65 positioned therebetween and held in position by bolts 66 connecting the flanges 64. The impingement plate 65 extends upwardly into the steam and water separating space terminating short of the under side of the perforated plate 52. The lower portions of the baffle plates 62 and plate 65 form moisture collecting pockets in the bottom of the steam and water separating space and are provided with a series of vertical drain pipes 67 arranged in a staggered row at the opposite sides of the impingement plate 65. The lower ends of the drain pipes 67 extend below the normal water level in the drum, indicated by the line 69 in Fig. 4.

With the separator construction described the entering wet steam divides in the drum in the space below the separating space 61 and enters the latter in two thin streams through the slot-like entrances adjacent the drum wall. The entering streams are deflected downwardly by the flange baffles 54 into the pockets formed by the plates 62 and 65, impinging on the latter and being deflected upwardly toward the perforated plate 52. With most of the steam entering the drum through the rear portion thereof above the gas pass 30, the length of the steam flow path in the drum is advantageously lengthened by confining the plate perforations 60 to the front portion of the drum, i. e., to the relatively quiescent drum sections above the gas passes 31 and 32. Most of the steam thus passes through the slot-like entrances in the separator, and passes longitudinally in the separating chamber toward the front end of the drum. The moisture separated during the steam flow through the separting space collects in the bottom thereof and drains into the drum pool through the pipes 67. More moisture is separated when the steam impinges on the under side of the dry pan. A further lengthening of the steam flow path in the drum is effected by arranging the row of steam outlet tubes 70 to the superheater inlet header 40 along the rear portion of the drum, i. e., at the opposite end of the drum from the perforations 60 in the plate 52. The steam jets passing upwardly through the perforations 60 impinge upon the adjacent portion of the drum wall and a further moisture separating action occurs. Any moisture separated in the rear of the dry steam space 50 drops into the separating space through one or more drain holes 71.

The wet steam during its passage through the drum to the steam outlets 70 is thus subjected to successive abrupt changes in direction and impingement on plate surfaces in a prolonged flow path. By the time the steam reaches the outlets 70 it is of the suitable high quality required in modern steam generating units. The separator provisions are compactly arranged in the upper portions of the drum, so as not to obstruct the passage of workmen from the man-hole 72 in the drum end to all portions of the drum.

While in accordance with the provisions of the statutes I have illustrated and described herein the best form of my invention now known to me, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by my claims, and that certain features of my invention may sometimes be used to advantage without a corresponding use of other features.

I claim:

1. In a steam and water drum, a steam and water separator comprising a dry pan extending longitudinally above the normal water level and forming a dry steam space in the upper portion of said drum, upwardly flaring longitudinally extending baffle plates suspended from and symmetrically arranged in spaced relation to said dry pan and forming a steam and water separating space below said dry pan having narrow inlets along opposite sides thereof and above the normal water level in said drum, a vertical impingement plate extending along the bottom of said separating space and terminating short of

said dry pan and forming moisture collecting spaces at the bottom of said separating space, depending baffles on said dry pan arranged to deflect the entering steam towards said impingement plate, a series of submerged drain pipes connected to the bottom of said separating space at opposite sides of said impingement plate, and perforations in said dry pan between said depending baffles for the passage of steam from said separating space to said dry steam space.

2. In a steam and water drum, a steam and water separator comprising a dry pan extending longitudinally above the normal water level and forming a dry steam space in the upper portion of said drum, said dry pan being formed by a central perforated channel plate and imperforate side channel plates, said plates having adjacent depending flanges connected together, a pair of upwardly flaring longitudinally extending baffle plates suspended from and symmetrically arranged in spaced relation to said dry pan and providing a steam and water separating space below said dry pan having slot-like inlets along opposite sides thereof and adjacent the wall of said drum, a vertical impingement plate extending along the bottom of said separating space and terminating short of said dry pan and forming moisture collecting spaces at the bottom of said separating space, a series of submerged drain pipes connected to the bottom of said baffle at opposite sides of said impingement plate, and the perforations in said dry pan central plate being confined to a quiescent portion of said drum for the passage of steam from said separating space to said dry steam space.

3. In a steam boiler drum, a steam and water separator comprising a dry pan extending longitudinally of and forming a dry steam space in the uppermost portion of said drum, said dry pan being formed by a central longitudinally extending plate having its opposite side edge portions connected to outwardly flaring side plates extending and connected to the drum wall, an upwardly flaring longitudinally extending baffle spaced below said dry pan and providing a steam and water separating space between said dry pan and baffle having inlets at opposite sides thereof, and a series of perforations in said dry pan central plate for the passage of steam from said separating space to said dry steam space, said dry pan and baffle being relatively arranged to effect a relatively abrupt change in direction of the steam in said separating space between each of said inlets and said dry pan perforations.

4. In a steam and water drum, a steam and water separator comprising a dry pan extending longitudinally above the normal water level and forming a dry steam space in the uppermost portion of said drum, said dry pan being formed by a central longitudinally extending plate having its opposite side edge portions connected to outwardly flaring side plates extending and connected to the drum wall, an upwardly flaring longitudinally extending baffle suspended from and symmetrically arranged in spaced relation to said dry pan and providing a steam and water separating space between said dry pan and baffle having restricted inlets at opposite sides thereof and above the normal water level in said drum, and a series of perforations in said dry pan central plate in a quiescent portion of said drum for the passage of steam from said separating space to said dry steam space, said dry pan and baffle being relatively arranged to effect a relatively abrupt change in direction of the steam in said separating space between each of said inlets and said dry pan perforations.

5. In a steam and water drum, a steam and water separator comprising a dry pan extending longitudinally above the normal water level and forming a dry steam space in the uppermost portion of said drum, said dry pan being formed by a central longitudinally extending plate having its opposite side edge portions connected to outwardly flaring side plates extending and connected to the drum wall, longitudinally extending baffle plates in spaced relation to said dry pan and forming a steam and water separating space between said dry pan and baffle plates having inlets at opposite sides thereof and above the normal water level in said drum, a vertical impingement plate supported by said baffle plates and extending along the bottom of said separating space and forming moisture separating pockets in the bottom of said separating space at both sides of said impingement plate, and a series of perforations in said dry pan central plate confined to a quiescent portion of said drum for the passage of steam from said separating space to said dry steam space.

6. In a steam and water drum, a steam and water separator comprising a dry pan extending longitudinally above the normal water level and forming a dry steam space in the uppermost portion of said drum, said dry pan being formed by a central longitudinally extending plate having its opposite side edge portions connected to outwardly flaring side plates extending and connected to the drum wall, upwardly flaring longitudinally extending baffle plates in spaced relation to said dry pan and forming a steam and water separating space between said dry pan and baffle plates having inlets at opposite sides thereof and above the normal water level in said drum, a vertical impingement plate extending along the bottom of said separating space and forming moisture separating pockets in the bottom of said separating space at both sides of said impingement plate, drain pipes opening to said pockets and having their lower ends below the normal water level in said drum, and a series of perforations in said dry pan central plate confined to a quiescent portion of said drum for the passage of steam from said separating space to said dry steam space.

JAMES FLETCHER.