Jan. 12, 1937. L. KOOISTRA ET AL 2,067,672

FLUID HEATER

Filed May 14, 1931 2 Sheets-Sheet 1

Fig. 1

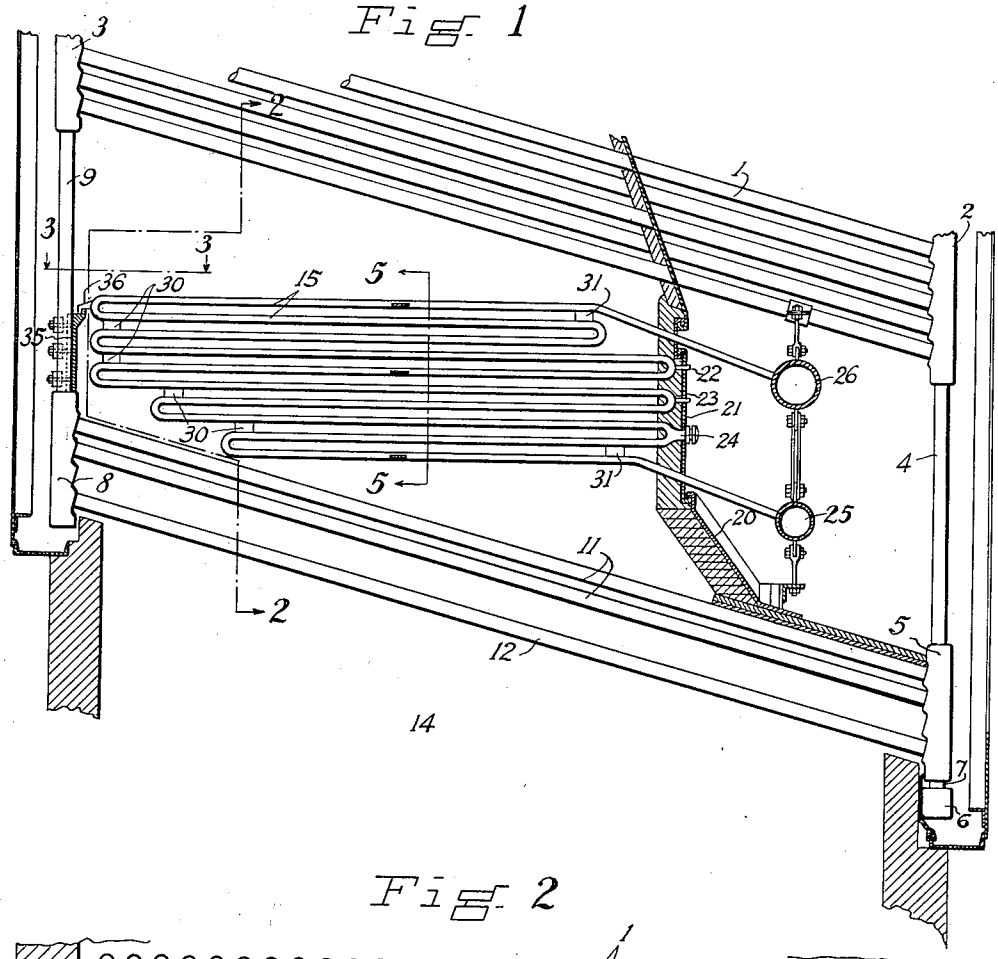
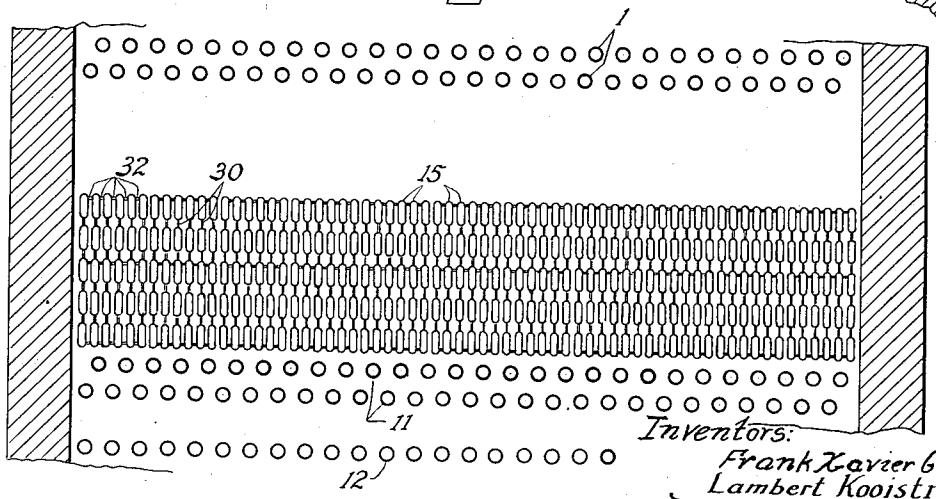


Fig. 2



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FLUID HEATER

Filed May 14, 1931 2 Sheets-Sheet 2

Fig. 3

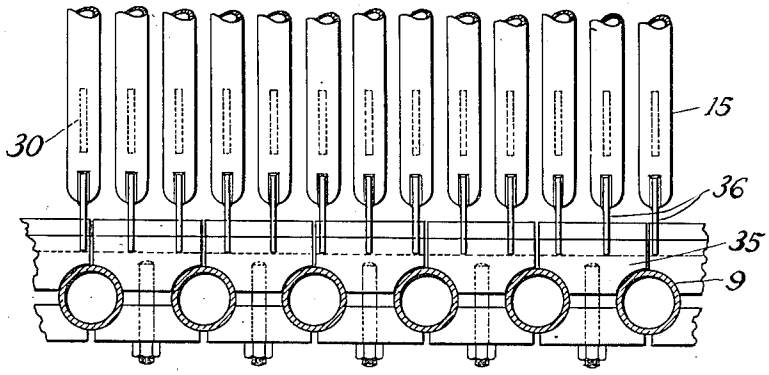


Fig. 4

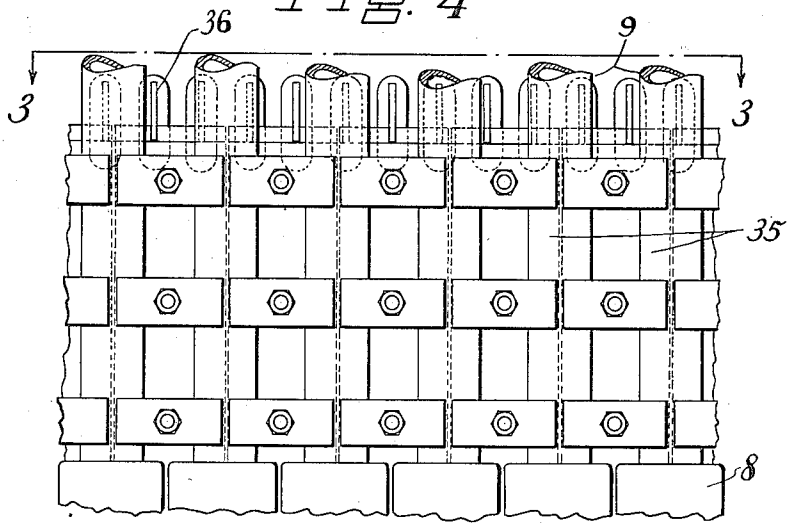
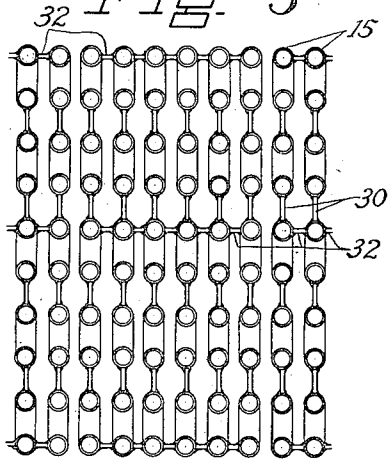


Fig. 5



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UNITED STATES PATENT OFFICE

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FLUID HEATER

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Application May 14, 1931, Serial No. 537,354

18 Claims. (Cl. 122—476)

This invention relates to heat transfer devices and more particularly to a support for a bank of tubes extending across a gas flue in such a device.

An object of the invention is to provide a support for a bank of tubes suspended across a flue in a heat transfer device which permits expansion and contraction of the tubes.

Another object of the invention is to provide intertube supports for a bank of tubes, suspended across a gas flue, that permits expansion and contraction of the tubes making up the bank.

A specific object of the invention is to provide for a tube bank characterized by a plurality of tubes extending horizontally across a gas flue in a plurality of return bends arranged in vertical rows, intertube supports between certain of the tubes supporting the tubes as a bank, and supporting members at the ends of the bank to support the tubes in their entirety while permitting expansion and contraction of the tubes making up the bank and of the bank as a whole.

Other objects will be apparent to those skilled in this particular art from the claims and the description in the specification in connection with drawings, in which—

Fig. 1 is a side view in section of a portion of a boiler illustrative of the invention;

Fig. 2 is a sectional end view taken along the lines 2—2 of Fig. 1;

Figs. 3, 4 and 5 are enlarged sectional views of structural details of the invention.

In the embodiment of the invention which has been chosen for purposes of illustration, in Fig. 1 is shown a portion of a boiler associated with a boiler setting with the upper steam generating parts, steam and water drum, and a portion of the combustion chamber broken away. In this figure, a bank of steam generating tubes, 1 is connected at one end to downtake headers 2 and at the other end to a row of uptake headers 3.

A row of nipples 4 connects the lower ends of the downtake headers 2 with a second row of downtake headers 5 disposed therebelow. A mud drum 6 is connected by nipples 7 to a second row of downtake headers 5. A second row of uptake headers 8 is connected by nipples 9 to the lower end of uptake headers 3.

A bank of steam generating tubes 11 is spaced apart from the tube bank 1 and is connected at each end to headers 5 and 8. A lower row of tubes 12 is disposed directly above a combustion chamber 14 and is also connected to these headers. The row of tubes 12 acts as a slag screen for the rest of the tubes making up the steam generating system. Corresponding headers 2 and 5 and nipples 4 unite to form separate downtake circulator conduits, while corresponding headers 3 and 8 and nipples 9 form uptake circulator conduits from the lower steam generating tube bank.

A superheater 15 is located between the steam generating tubes 1 and 11 and comprises a plurality of horizontally disposed tubes arranged in vertical rows which extend across the gas flue 16 in a plurality of return bends of unequal length.

A baffle 20 has a vertical portion 21 to which is secured bent portions 22, 23, and 24 of the superheater. The inlet and outlet ends of the superheater extend through the vertical portion 21 of the baffle and are connected respectively in the inlet header 25 and the outlet header 26. By virtue of this construction the baffle 20 through its vertical section 21 acts as a support for one part of the superheater.

Secured to the uptake nipples 9, adjacent the end of the superheater disposed opposite to the baffle end, in any desired manner, but in this instance by bolting, are members 35 upon which rest members 36 secured to the bent portions of the uppermost row of tubes of the superheater at this end. As the members 36 rest upon the members 35, expansion and contraction of the superheater bank is permitted since the members 35 and 36 may have relative horizontal sliding movement with respect to each other. Because of their engagement this end of the tube bank is supported in its entirety.

A plurality of members 30 is secured between adjacent tubes of adjacent bent portions. A plurality of similar members 31 is secured between the uppermost row of tubes and the next adjacent bent portion and between the lowermost row of tubes and its next adjacent bent portion at the baffle supported end of the superheater. By virtue of this construction, alternately, the metal constituting the bent portion of the tubes and the members 30 and 31 serve as intertube supports to prevent sagging of the otherwise unsupported tubes and preserve their assembled shape as a vertical flat coil or grid. At the same time expansion and contraction of the tubes is permitted through either sliding movement between members 35 and 36 or movement at the tube bends.

Secured laterally between the tubes of the upper and lower rows of the superheater, and similarly secured between the tubes of an inter-

mediate row of tubes of the superheater bank are cross tie members 32, these members connect adjacent vertical flat coils to form a grid, and at the same time they prevent buckling of the coils. This construction is best shown in Figs. 2 and 5.

These members are exposed to the sweep of combustion gases of high temperature but since they are secured in good thermal contact as by welding to the tubes of the superheater 15, and since a heat absorbing medium is circulated through the tubes these members will not become heated to a destructively high temperature. In addition to the foregoing, although located in the gas pass the elements 30, 31 and 32 do not present sufficient area to seriously impede the flow of combustion gases.

By virtue of this invention a support is provided for a bank of tubes in its entirety that permits expansion and contraction of the bank as a whole without placing undue stress upon any part. At the same time a plurality of members is provided that cooperate with the tubes to support the bank in its entirety, which, though exposed to the sweep of combustion gases at a high temperature will not fail during operation and will maintain the tube bank in position and securely braced against distortion due to any stresses which may occur during normal operation of the device in which the tubes are installed.

A specific supporting structure has been described in some detail as being especially adapted to support and brace a bank of tubes, comprising a plurality of tubes arranged in vertical rows and extending across a gas flue in a plurality of return bends of unequal length, but it is to be understood that such a combination of supporting and bracing members may have other uses, and though a specific embodiment of the invention has been described in some detail, it is to be understood that changes, additions, substitutions and omissions may be made, within the spirit of the invention as defined by the appended claims.

What we claim is:

1. In a water tube boiler characterized by a plurality of vertically spaced banks of steam generating tubes connected to uptake and downtake headers, a row of nipples connecting adjacent vertically spaced headers at one end of said banks, a bank of tubes extending across a gas flue in a plurality of return bends disposed between adjacent banks of steam generating tubes and supported at one end by a hook member movably engaging a cooperating member secured to said row of nipples.

2. In a water tube boiler having a row of vertical circulating tubes and a wall member defining opposite sides of a vertical gas pass, a tube bank extending across said gas pass and comprising a row of tubes, each consisting of a plurality of horizontally extending superposed tube legs connected for a serial flow therethrough by return bend portions at each end of said tube bank, a pair of headers connected to opposite ends of said tubes, and means supporting said tube bank in position and permitting longitudinal expansion and contraction thereof comprising means rigidly connecting adjacent tube legs of each tube, means for rigidly supporting one end of said tube band from said wall member, and means for slidably supporting the opposite end of said tube bank from said circulating tubes.

3. In a water tube boiler having a row of vertical circulating tubes and a wall member defining opposite sides of a vertical gas pass, a tube bank extending across said gas pass and comprising a horizontal row of tubes, each consisting of a plurality of horizontally extending superposed tube legs connected for a serial flow therethrough by return bend portions at each end of said tube bank, a pair of headers at the outer side of said wall member and connected to opposite ends of said tubes, and means supporting said tube bank in position and permitting longitudinal expansion and contraction thereof comprising means rigidly connecting said tubes into a unitary structure, means for rigidly supporting return bend portions at one end of said tube bank in said wall member, and a supporting connection between return bend portions at the opposite end of said tube bank and said circulating tubes permitting longitudinal expansion and contraction of said tube bank.

4. In a water tube boiler, a gas flue, vertically spaced banks of horizontally inclined steam generating tubes extending across said gas flue, a row of uptake and downtake headers at opposite ends of each tube bank, vertical nipples connecting corresponding headers at each end of said tube banks, a substantially vertical baffle dividing said gas flue into side-by-side passes, a steam superheater comprising a row of tubes extending across one pass of said gas flue and each consisting of a plurality of horizontally extending superposed tube legs of unequal length connected for a serial flow therethrough by return bend portions at each side of said pass, steam inlet and outlet headers positioned externally of said pass, means for supporting intermediate return bend portions of each tube in said baffle, a supporting member secured to the vertical nipples connecting the rows of uptake headers, means projecting from a return bend portion of each tube adjacent said nipples and slidably supported on said supporting member, and metallic plate members rigidly connecting vertically adjacent legs of each tube.

5. In a water tube boiler having a heating gas pass, a horizontally inclined bank of steam generating tubes extending across said gas pass and vertically arranged circulation conduit elements at one side of said gas pass connected to the corresponding end of said steam generating tubes, a fluid heater extending across said gas pass above said steam generating tube bank and formed in a series of side-by-side flat coil sections, each of said sections having a series of superposed substantially horizontal tube portions connected by return bends arranged in a substantially vertical plane, a supporting tie between successive horizontal tube portions of each section, and means for supporting said fluid heater comprising a member mounted on one of said coil sections and having a supporting connection with a cooperating member secured to one of said vertical conduit elements, said supporting connection being so constructed that said coil section is free to expand longitudinally relative to said vertical conduit element.

6. A steam generator comprising a furnace chamber and a steam boiler above the furnace chamber, said boiler comprising opposite rows of vertical headers, a bank of horizontally inclined water tubes connecting said rows of headers, means providing a gas pass for the flow of products of combustion adjacent one of said rows of headers, a row of vertical conduits connected to

and extending vertically from one of said rows of headers, a bank of return bend tubular fluid conduit elements of substantial length extending across said gas pass, a support on one of said vertical conduits at one side of said gas pass, and means on the return bend portion of each of said tubular elements movably engaging said support and cooperating therewith to provide a supporting connection for said tubular elements permitting substantially free expansion thereof relative to said support.

7. A steam generator comprising a furnace chamber and a steam boiler above the furnace chamber, said boiler comprising upper opposite rows of vertical headers, lower opposite rows of vertical headers below the upper headers and spaced therefrom, opposite rows of nipples connecting vertically aligned headers, a lower bank of horizontally inclined water tubes connecting the lower headers, an upper bank of horizontally inclined water tubes connecting the upper headers, means including a vertical baffle providing an up-pass for flow of products of combustion adjacent one of the rows of nipples and the headers connected thereto, superheater elements within said up-pass, supporting means secured to the last mentioned row of nipples, and feet secured to said superheater elements and resting on said supporting means.

8. A steam generator comprising a furnace chamber and a steam boiler above the furnace chamber, said boiler comprising upper opposite rows of vertical headers, lower opposite rows of vertical headers below the upper headers and spaced therefrom, opposite rows of nipples connecting vertically aligned headers, a lower bank of horizontally inclined water tubes connecting the lower headers, an upper bank of horizontally inclined water tubes connecting the upper headers, means including a vertical baffle providing an up-pass for flow of products of combustion adjacent one of the rows of nipples and the headers connected thereto, superheater elements within said up-pass, supporting means mounted on the lower headers associated with said up-pass, and feet secured to elements of the superheater and resting on said supporting means.

9. A steam generator comprising a bank of horizontally inclined steam generating tubes, a steam and water drum above said tube bank, and uptake and downtake conduits connecting the uptake and downtake ends respectively of said tube bank to said steam and water drum to form a natural circulation steam generating section, a steam superheater positioned above said tube bank and below said steam and water drum and comprising a pair of headers and a plurality of return bend tubes connecting said headers and having looped portions adjacent the uptake end of said tube bank, means for supporting said headers in a substantially fixed position, and means for supporting said return bend tubes at the uptake end of said tube bank and substantially independently of the subjacent portion of said tube bank and comprising a fluid cooled metallic support mounted at the uptake end of said tube bank and adjacent looped portions of said return bend tubes and supporting lugs mounted on said adjacent looped portions of said return bend tubes and movably engaging said fluid cooled support to permit substantially free expansion of said return bend tubes at the uptake end of said tube bank.

10. In a water tube steam boiler having a bank of steam generating tubes extending across a vertical gas pass and a circulator conduit connected to one end of said tube bank and vertically arranged along one side of said gas pass, an auxiliary fluid heater comprising a return bend tube extending across said gas pass above said tube bank and having a looped end portion adjacent said circulator conduit, and means for supporting the looped end of said return bend tube from said circulator conduit, said means being constructed and arranged to permit longitudinal expansion of said return bend tube towards said circulator conduit.

11. In a water tube steam boiler having a bank of horizontally inclined steam generating tubes extending across a vertical gas pass and an uptake circulator conduit connected to the upper end of said tube bank and vertically arranged along one side of said gas pass, an auxiliary fluid heater comprising a return bend tube extending across said gas pass above said tube bank and having a looped portion adjacent said circulator conduit, and means for supporting said fluid heater at its end adjacent said circulator conduit comprising a support member secured to said circulator conduit at the side of said gas pass and adjacent the looped portion of said return bend tube and a supporting lug mounted on said return bend tube and movably engaging said support member to permit longitudinal expansion of said return bend tube relative to said tube bank.

12. In a water tube steam boiler having a bank of steam generating tubes extending across a vertical gas pass and a row of circulator conduits connected to one end of said tube bank and vertically arranged along one side of said gas pass, an auxiliary fluid heater comprising a plurality of return bend tubes extending across said gas pass above said tube bank and having looped portions adjacent said circulator conduits, and means for supporting said fluid heater at opposite sides of said gas pass including means for fixedly supporting said return bend tubes at the side of said gas pass opposite said circulator conduits and means for supporting said return bend tubes from said circulator conduits arranged to permit longitudinal expansion of said return bend tubes relative to said circulator conduits.

13. In a water tube steam boiler having a bank of steam generating tubes extending across a vertical gas pass and a row of circulator conduits connected to one end of said tube bank and vertically arranged along one side of said gas pass, an auxiliary fluid heater comprising a plurality of return bend tubes extending across said gas pass above said tube bank and having looped portions adjacent said circulator conduits, a vertically extending baffle supported on said tube bank and defining the opposite side of said gas pass, and means for supporting said fluid heater at opposite sides of said gas pass including means for fixedly supporting said return bend tubes in said baffle and means for supporting said return bend tubes from said circulator conduits arranged to permit longitudinal expansion of said return bend tubes relative to said circulator conduits.

14. In a water tube steam boiler having a heating gas pass, a horizontally inclined bank of steam generating tubes extending across said gas pass and vertically arranged circulation conduit elements at one side of said gas pass connected to the corresponding end of said steam generating tubes, a fluid heater extending across said gas pass above said steam generating tube bank

and formed in a series of side-by-side coil sections, each of said sections having a series of superposed tube portions connected by return bends, a supporting tie between successive vertically spaced tube portions of each section, means for rigidly connecting laterally adjacent coil sections, and means for supporting said fluid heater comprising a member mounted on one of said coil sections and having a supporting connection with a cooperating member secured to one of said vertical conduit elements, said supporting connection being so constructed that said fluid heater is free to expand longitudinally relative to said vertical conduit elements.

15. Fluid heating apparatus comprising a heating gas pass, vertically extending supporting tubes extending along one side of said gas pass, an auxiliary fluid heater comprising fluid heating tubes each having a series of superposed tube legs extending across said gas pass and serially connected by return bend portions adjacent said supporting tubes, and means for supporting said fluid heating tubes from said supporting tubes comprising cooperating members mounted on said supporting tubes and adjacent return bend portions of said fluid heating tubes respectively and arranged to provide a supporting connection permitting expansion of said fluid heating tubes relative to said supporting tubes.

16. A steam boiler comprising a steam and water drum, an auxiliary fluid heater arranged below said drum and having return bend fluid heating tubes formed with superposed tube legs serially connected by return bend portions, and means for supporting said fluid heater including a series of vertically extending supporting tubes having their upper ends connected to said drum, and cooperating support members mounted on said supporting tubes and return bend portions of fluid heating tubes respectively and arranged to provide a supporting connection for said fluid heating tubes permitting expansion of said fluid heating tubes relative to said supporting tubes.

17. A steam boiler comprising a steam and water drum, a bank of inclined steam generating tubes below said drum, an auxiliary fluid heater arranged above said tube bank and having return bend fluid heating tubes each formed with a series of superposed tube legs serially connected by return bend portions arranged in vertical planes, means forming a support between adjacent tube legs of each fluid heating tube, and means for supporting said fluid heater including a series of vertically extending supporting tubes having their upper ends connected to said drum, and cooperating support members mounted on said supporting tubes and fluid heating tubes respectively and arranged to provide a supporting connection for said fluid heating tubes independent of the subjacent portion of said tube bank and permitting expansion of said fluid heating tubes relative to said supporting tubes.

18. A steam boiler comprising a steam and water drum, a bank of inclined steam generating tubes below said drum, upcomer and downcomer conduits extending upwardly from the upper and lower ends of said tube bank respectively to said drum, a steam superheater positioned above said tube bank and below said drum and comprising a bank of horizontally extending return bend tubes having superposed tube legs, and means for supporting said superheater from said upcomer conduits comprising cooperating members mounted on said upcomer conduits and adjacent portions of said superheater tubes respectively and arranged to provide a supporting connection for said superheater tubes permitting expansion thereof relative to said upcomer conduits.

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