March 31, 1936. H. M. WILLIAMS 2,035,734

REFRIGERATING APPARATUS

Filed Sept. 25, 1934 2 Sheets-Sheet 1

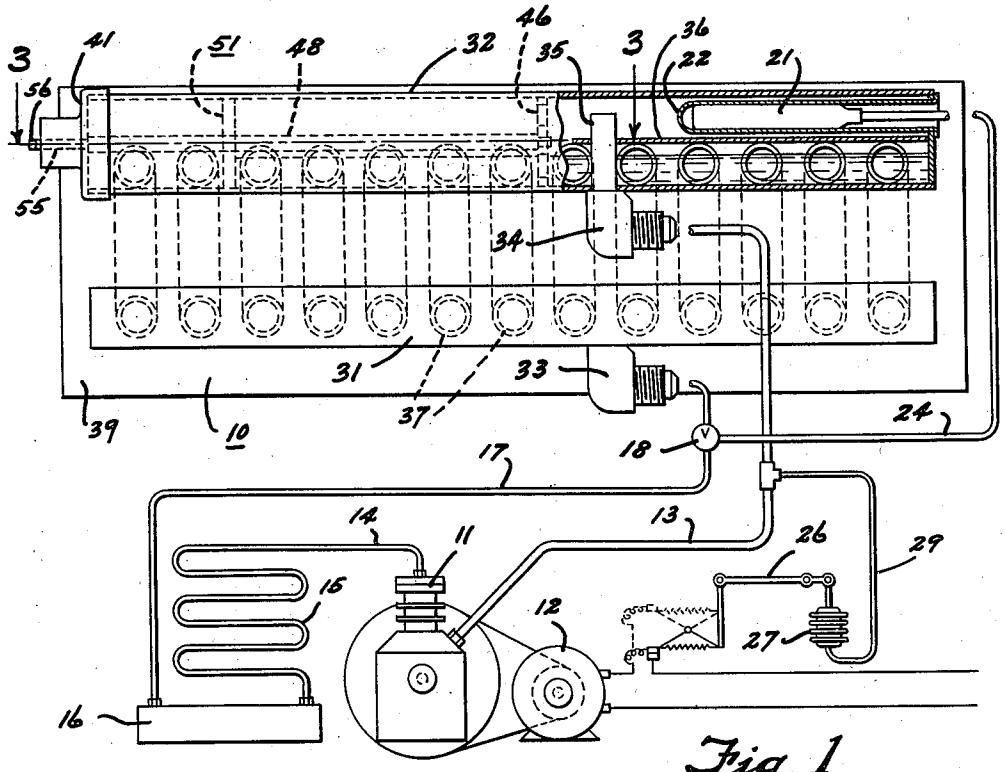


Fig. 1

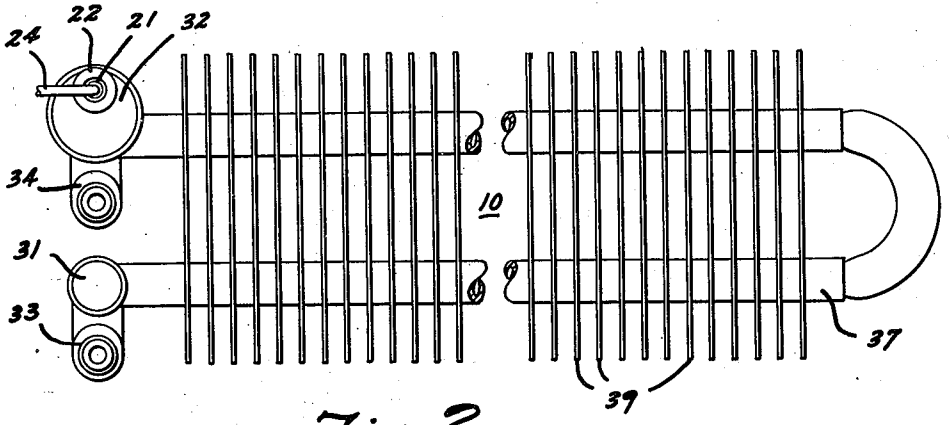


Fig. 2

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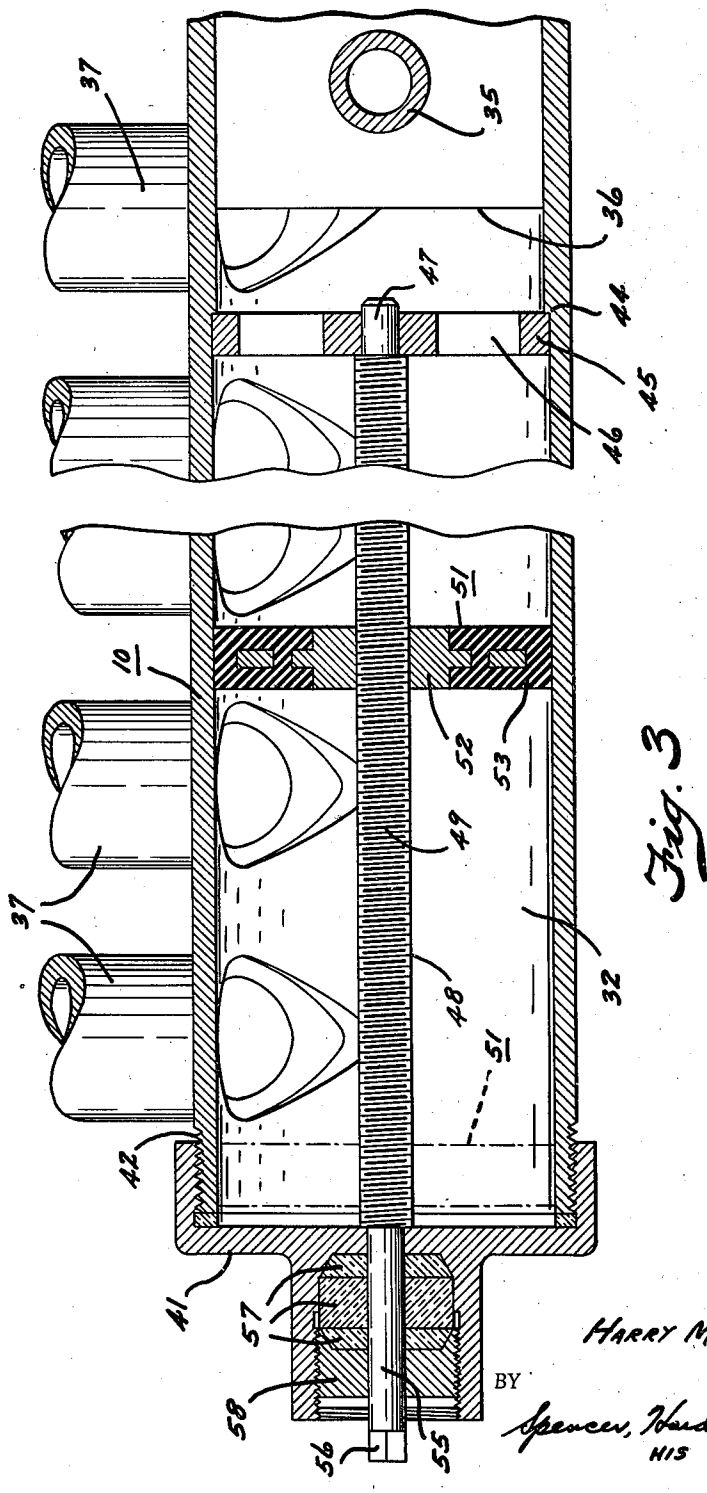


Fig. 3

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UNITED STATES PATENT OFFICE

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REFRIGERATING APPARATUS

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Application September 25, 1934, Serial No. 745,425

10 Claims. (Cl. 62—126)

This invention relates to refrigerating systems and particularly to evaporators for such systems.

An object of my invention is to provide an improved refrigerating system and particularly a system employing an improved evaporator of the flooded type.

Another object of my invention is to provide means for varying at will the effective cooling surfaces of an evaporator of the flooded type without changing the normal liquid refrigerant level therein and without changing the temperature of the remainder of the cooling surface thereof.

A still further and more specific object of my invention is to provide an evaporator of a refrigerating system, having a refrigerant inlet connection and a refrigerant outlet connection and a plurality of paths of flow between the said connections, with a means for closing off or blocking certain of said paths of flow of refrigerant from one of the refrigerant connections to vary the effective cooling surfaces of the evaporator.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 discloses a diagrammatic showing of an improved refrigerating system connected with an evaporator constructed in accordance with the present invention;

Fig. 2 is a front view of the evaporator shown in Fig. 1; and

Fig. 3 is an enlarged fragmentary sectional view of a portion of the evaporator and is taken on line 3—3 of Fig. 1.

For the purpose of illustrating the present invention, I have shown in the drawings, a refrigerating system similar to the refrigerating system disclosed in the copending application of Herman J. Dick, Serial No. 661,201, filed March 17, 1933. The evaporator disclosed in the drawings forming a part of the present application is of substantially the same type as is shown in the said Dick application but has certain features incorporated therein for carrying out the foregoing objects of the present invention.

Referring to Fig. 1 of the drawings a refrigerating system or a refrigerant liquefying and condensing unit is operatively connected to an evaporator or cooling element generally indicated by the reference character 10. The refrigerating system includes a compressor 11 operated, through suitable connections such as belt and pulley connections, by an electric motor 12. Operations of the motor 12 and consequently compressor 11 causes gaseous refrigerant or refrigerant evaporated or vaporized within the evaporator 10, to be withdrawn from the evaporator through a pipe 13 and to be compressed by the compressor 11 and circulated under pressure through pipe 14 to a condenser 15. The condenser 15 may be cooled in any suitable manner well known to those skilled in the art for causing the compressed refrigerant to be liquefied. The liquefied refrigerant flows from the condenser into a receiver 16 and accumulates therein prior to being circulated through the evaporator. A pipe or conduit 17 serves to conduct the liquid refrigerant from receiver 16 to an expansion or any other suitable valve 18 employed to control ingress of liquid refrigerant to the evaporator 10. Valve 18 is opened and closed under the influence of pressure of refrigerant within the evaporator for normally maintaining a predetermined level of liquid refrigerant in the evaporator. During abnormal refrigerating demands on the evaporator 10 valve 18 is opened and closed under the influence of a thermostat bulb 21 located in a well 22 provided in the evaporator. Thermostat bulb 21 is responsive to the temperature of refrigerant in the evaporator and has a pipe or conduit 24 connecting the bulb 21 to a chamber, closed by a diaphragm or bellows (not shown) provided in the valve 18. The chamber provided in valve 18, pipe or conduit 24 and bulb 21 form a closed flow circuit for any suitable fluid employed for charging the thermostat 21. A switch 26 is actuated by movement of a bellows 27 associated therewith and which bellows has its interior connected with the gaseous refrigerant or suction conduit 13 of the system by a pipe 29. The electrical contacts of switch 26 are moved into and out of engagement with one another by expansion and/or contraction of the bellows 27 in response to pressures within the refrigerating system for opening or closing the electric power circuit leading to motor 12.

The evaporator 10 of the refrigerating system described comprises a pair of headers 31 and 32 shown as elongated horizontally extending cylinders disposed one above the other. The lower header 31 is provided with an inlet connection 33 for receiving and conducting liquid refrigerant to the interior of the evaporator from the valve 18. Upper header 32 is provided with a gaseous refrigerant outlet connection 34 which communicates with the suction pipe 13 of the refrigerat-

ing system. The outlet connection 34 includes an extension or standpipe 35 which extends above a horizontally disposed baffle 36 provided in header 32 to a point near the top wall of the header 32 to prevent liquid refrigerant from flowing or being drawn into the suction line 13 of the system. The well 22 has its inner end closed and is located at one end of the header 32. A plurality of refrigerant conveying or distributing conduits 37 are connected in parallel to the headers 31 and 32 and form a plurality of paths of flow for refrigerant through the evaporator between the inlet and outlet connections 33 and 34 respectively thereof. These conduits 37 may be of any desired form and are preferably of the form as shown in the drawings. Conduits 37 extend laterally from header 31 thence upwardly and horizontally to header 32. Each of these conduits may be constructed from a single length of tubing bent into the required form or they may be provided by two straight lengths of conduit connected at their ends opposite the headers 31 and 32 by any suitable U-shaped end connections. A plurality of fins 39 of any desired shape and form are secured to and bridge the horizontally extending portions of conduits 37 to increase the heat absorbing capacity of the evaporator 10. The particular shape and arrangement of the fins 39 form no part of the present invention and they may, if desired, be individual fins secured to a single pipe or conduit 37. The baffle 36 secured to the inner walls of the header 32 is provided with an opening for receiving the extension or standpipe 35. Baffle 36 is positioned above the point of communication of conduits 37 with header 32 and under the well 22 and extends from the one end of header 32 to a point substantially midway of the length of the header.

The end of header 32, opposite the end thereof in which the thermostat bulb 21 and baffle 36 are positioned, is closed by a cap member 41 (see Figs. 1 and 3). The cap member 41 is threaded upon threads 42 provided on the outer surface of header 32 and together with a gasket thereunder serves to seal the end of header 32 as well as to retain various parts, to be presently described, in position within the evaporator. The diameter of the inner wall of header 32 is greater at the one end than at the other end of the header so as to provide a shoulder 44 located intermediate the ends of the header. A spider or the like member 45 having openings 46 therein is held into abutting relation with the shoulder 44 by the cap member 41 and a shaft 48 and this spider member forms a journal or bearing for a reduced end 47 provided on the shaft 48. The shaft 48 is threaded as at 49 or otherwise grooved or arranged to adjustably carry a plug or the like member 51. Plug 51 comprises a metallic center or hub portion 52 having a rubber or other suitable material 53 integrally molded thereon or secured thereto in any desired manner. The portion 53 of plug 51 is adapted to tightly engage the inner wall of header 32 to prevent rotation thereof during the act of rotating the shaft 48 to cause movement of the plug. A reduced end portion 55 provided on shaft 48 extends through an opening in the central portion of cap member 41 to the exterior of the evaporator or header 32 and has a squared end portion 56 formed at its outer end for the reception of a key or wheel employed for facilitating rotation of shaft 48 to cause horizontal movement of plug 51 within the header 32. The header 32 is sealed around the reduced end 55 of shaft 48 by any desired number of packing glands 57 or other suitable material. A packing gland nut 58 is threaded into the cap 41 to compress the packing material or glands 57 for causing same to tightly engage the reduced portion 55 on shaft 48 to seal the header 32 against leakage of refrigerant.

In the system disclosed the refrigerant expansion valve 18 is set to normally admit liquid refrigerant to the evaporator 10 in accordance with the rate of evaporation of liquid refrigerant in the evaporator to maintain the level of liquid refrigerant at a desired point preferably just below the baffle 36. The fluid content of the thermostat circuit is such that as long as no liquid refrigerant is present in header 32 above the baffle 36 its influence on valve 18 is negligible. However, if and when during certain refrigerating demands upon the evaporator, liquid refrigerant may enter the space above the baffle 36 in header 32 and the liquid refrigerant will contact with the wall of well 22 and consequently thermostat bulb 21 since the bulb is preferably in intimate thermal contact with walls of the well. The temperature of bulb 21 and consequently its fluid content, will be lowered by the increased amount of liquid refrigerant in the evaporator and the fluid in bulb 21 and conduit 24 will contract or condense due to its contact with the cold liquid refrigerant. This contraction of the fluid in the thermostat circuit affects the operation of valve 18 in that it closes same to prevent further increase of liquid refrigerant to the evaporator 10. This function of the thermostat circuit to modify operation of valve 18 and the construction of valve 18 are believed to be well known to those skilled in the art and a more detailed description is believed to be unnecessary. Obviously after liquid refrigerant contained in header 32, above the baffle 36 therein, evaporates or vaporizes the liquid refrigerant level will fall below the bulb 21 and baffle 36 and the temperature of thermostat 21 will again rise and permit the valve 18 to operate normal to open or close in response to pressures within the evaporator to maintain the preferred level of liquid refrigerant therein. The normal level of liquid refrigerant maintained in the evaporator 10 as described keeps all the conduits 37 of the evaporator flooded when the plug 51 is adjacent the cap member 41 as shown by the dot-dash-lines in Fig. 3 of the drawings since the spider member 45 has apertures therein which permits the liquid refrigerant to attain a common level on each side thereof.

To reduce the refrigerated cooling surface of the evaporator 10 shaft 48 may be rotated by turning the key or a wheel affixed to the squared end 57 of shaft 48. Rotation of shaft 48 causes the plug 51 to move horizontally, for example, from its dot-dash-line position shown in Fig. 3 to any point along a portion of the length of header 22 in order to block off or prevent communication of the upper ends of certain of the refrigerant conduits 37 from certain other of the conduits. The plug 51 being in tight engagement with the inner wall of header 32 thus prevents the plug 51 from rotating during rotation of shaft 48 thereby causing horizontal movement of the plug 51 due to its threaded or other connection with the shaft. Plug 51 may be moved in this manner to block off communication of any desired number of the refrigerant conduits 37 from suction created in the evaporator by the compressor to thereby prevent evaporation of refrigerant from the blocked-off conduits 37 in order to destroy their refrigerating effect. There-

fore I have provided a means to close off certain of the plurality of paths of flow of refrigerant from certain others thereof between the liquid refrigerant inlet and the gaseous refrigerant outlet connections of the evaporator. Refrigerant contained or trapped in the blocked or closed-off conduits **37** will in time vaporize and this vapor or gaseous refrigerant upon accumulating therein will build up pressure and force liquid refrigerant from these conduits to render the closed-off conduits ineffective for producing refrigeration. Obviously therefor my improved evaporator construction provides the feature of increasing or decreasing the exposed refrigerated or cooling surface thereof without changing the refrigerant level therein and without altering the temperature of the effective portion of the evaporator.

I have disclosed my invention as applied to an evaporator or cooling element in which the liquid refrigerant level is normally maintained just below the baffle **36** so that the entire length of the refrigerant conduits **37** and a portion of the upper header **32** will be flooded. It is to be understood however that the liquid refrigerant level may be maintained at any desired height in the conduits **37**. For example, the conduits **37** may be flooded with liquid refrigerant only throughout their lower portions and under such conditions it will be obvious to those skilled in the art that the improvement herein disclosed for reducing or adjusting the refrigerated cooling surface of the evaporator may be incorporated in the lower header or manifold **31** if desired. Should the plug **51**, and its operating or associated parts, be incorporated in the lower header **31** the plug will prevent flow of liquid refrigerant, from the inlet connection **33**, to certain of the blocked-off conduits **37**. When all the liquid refrigerant, which has been trapped in the conduits **37** by adjustment of plug **51**, has been evaporated from the blocked-off conduits these conduits become ineffective for producing refrigeration because entrance of liquid refrigerant thereto is prevented.

It will be apparent from the foregoing that I have provided a novel refrigerating system and an improved evaporator for use therein which evaporator has a variety of uses for producing various results. My improved evaporator is adapted for use in cooling chambers wherein the size of the chambers are often changed to meet certain requirements. For example, my improved evaporator is particularly useful in cooling chambers wherein baffles or partitions are employed to divide a chamber into a plurality of compartments or to increase the number or size of compartments within the chamber to be cooled by a single evaporator. Furthermore, my improved evaporator permits the humidity within a refrigerated chamber to be varied by increasing or decreasing the refrigerated or cooling surface of the evaporator which are exposed to the air within the chamber.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An evaporator of a refrigerating system comprising, a cylindrical header, a refrigerant inlet and a refrigerant outlet connection for said evaporator, a plurality of conduits connected to and extending outwardly substantially at right angles to said header and providing a plurality of paths of flow for refrigerant through said evaporator between the inlet and outlet connections thereof, and a movable plug closely engaging the inner walls of said header for sealing certain of said paths of flow of refrigerant through said evaporator from certain others thereof.

2. An evaporator of a refrigerating system comprising, a cylindrical header, a refrigerant inlet and a refrigerant outlet connection for said evaporator, a plurality of conduits connected to and extending outwardly substantially at right angles to said header and providing a plurality of paths of flow for refrigerant through said evaporator between the inlet and outlet connections thereof, a movable plug closely engaging the inner walls of said header for sealing certain of said paths of flow of refrigerant through said evaporator from certain others thereof, said plug being threadedly mounted upon a shaft, and said shaft being rotatable from the exterior of said evaporator for moving said plug along the length of said header.

3. An evaporator of a refrigerating system comprising, a pair of headers, a refrigerant inlet connection for one of said headers, a refrigerant outlet connection for the other of said pair of headers, a plurality of conduits connected to said headers and providing a plurality of paths of flow for refrigerant through said evaporator between the inlet and outlet connections thereof, and means movable longitudinally within one of said headers relative to said conduits for closing off certain of said paths of flow of refrigerant from one of said connections.

4. An evaporator of a refrigerating system comprising, a pair of headers, a refrigerant inlet connection for one of said headers, a refrigerant outlet connection for the other of said pair of headers, a plurality of conduits connected to said headers and providing a plurality of paths of flow for refrigerant through said evaporator between the inlet and outlet connections thereof, and means movable longitudinally within one of said headers relative to said conduits for closing off certain of said paths of flow of refrigerant from one of said connections, said means being adjustable from the exterior of said evaporator.

5. An evaporator of a refrigerating system comprising, a pair of horizontally disposed headers extending parallel with one another and positioned one above the other, a refrigerant inlet connection for one of said headers, a refrigerant outlet connection for the other of said pair of headers, a plurality of conduits connected to said headers and providing a plurality of paths of flow for refrigerant through said evaporator between the inlet and outlet connections thereof, and means movable longitudinally within one of said headers relative to said conduits for closing off certain of said paths of flow of refrigerant from one of said connections.

6. An evaporator of a refrigerating system comprising, a pair of horizontally disposed headers extending parallel with one another and positioned one above the other, a refrigerant inlet connection for one of said headers, a refrigerant outlet connection for the other of said pair of headers, a plurality of conduits connected to said headers and providing a plurality of paths of flow for refrigerant through said evaporator between the inlet and outlet connections thereof, and means movable longitudinally within one of said headers relative to said conduits for closing off certain of said paths of flow of refrigerant from

one of said connections, said means being adjustable from the exterior of said evaporator.

7. An evaporator of a refrigerating system comprising, a pair of horizontally disposed headers extending parallel with one another and positioned one above the other, a refrigerant inlet connection for the lower header, a refrigerant outlet connection for the upper header, a plurality of conduits connected to and extending outwardly from said headers and providing a plurality of paths of flow for refrigerant through said evaporator between the inlet and outlet connections thereof, and means movable longitudinally within the upper header relative to said conduits for closing off certain of said paths of flow of refrigerant from said outlet connection.

8. An evaporator of a refrigerating system comprising, a pair of horizontally disposed headers extending parallel with one another and positioned one above the other, a refrigerant inlet connection for the lower header, a refrigerant outlet connection for the upper header, a plurality of conduits connected to and extending outwardly from said headers and providing a plurality of paths of flow for refrigerant through said evaporator between the inlet and outlet connections thereof, and means movable longitudinally within the upper header relative to said conduits for closing off certain of said paths of flow of refrigerant from said outlet connection, said means being adjustable from the exterior of said evaporator.

9. An evaporator of a refrigerating system comprising, an elongated header, a refrigerant inlet and a refrigerant outlet connection for said evaporator, a plurality of conduits connected to and extending outwardly along the length of said header and providing a plurality of paths of flow for refrigerant through said evaporator between the inlet and outlet connections thereof, and means engaging the inner walls of said header and movable therein longitudinally relative to said conduits for closing off certain of said paths of flow of refrigerant from one of said connections.

10. An evaporator of a refrigerating system comprising, an elongated header, a refrigerant inlet and a refrigerant outlet connection for said evaporator, a plurality of conduits connected to and extending outwardly along the length of said header and providing a plurality of paths of flow for refrigerant through said evaporator between the inlet and outlet connections thereof, and means engaging the inner walls of said header and movable therein longitudinally relative to said conduits for closing off certain of said paths of flow of refrigerant from one of said connections, said means being adjustable from the exterior of said evaporator.

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