Feb. 27, 1940. R. G. EWER 2,191,909

CHILLING MACHINE

Filed Oct. 4, 1938 4 Sheets-Sheet 1

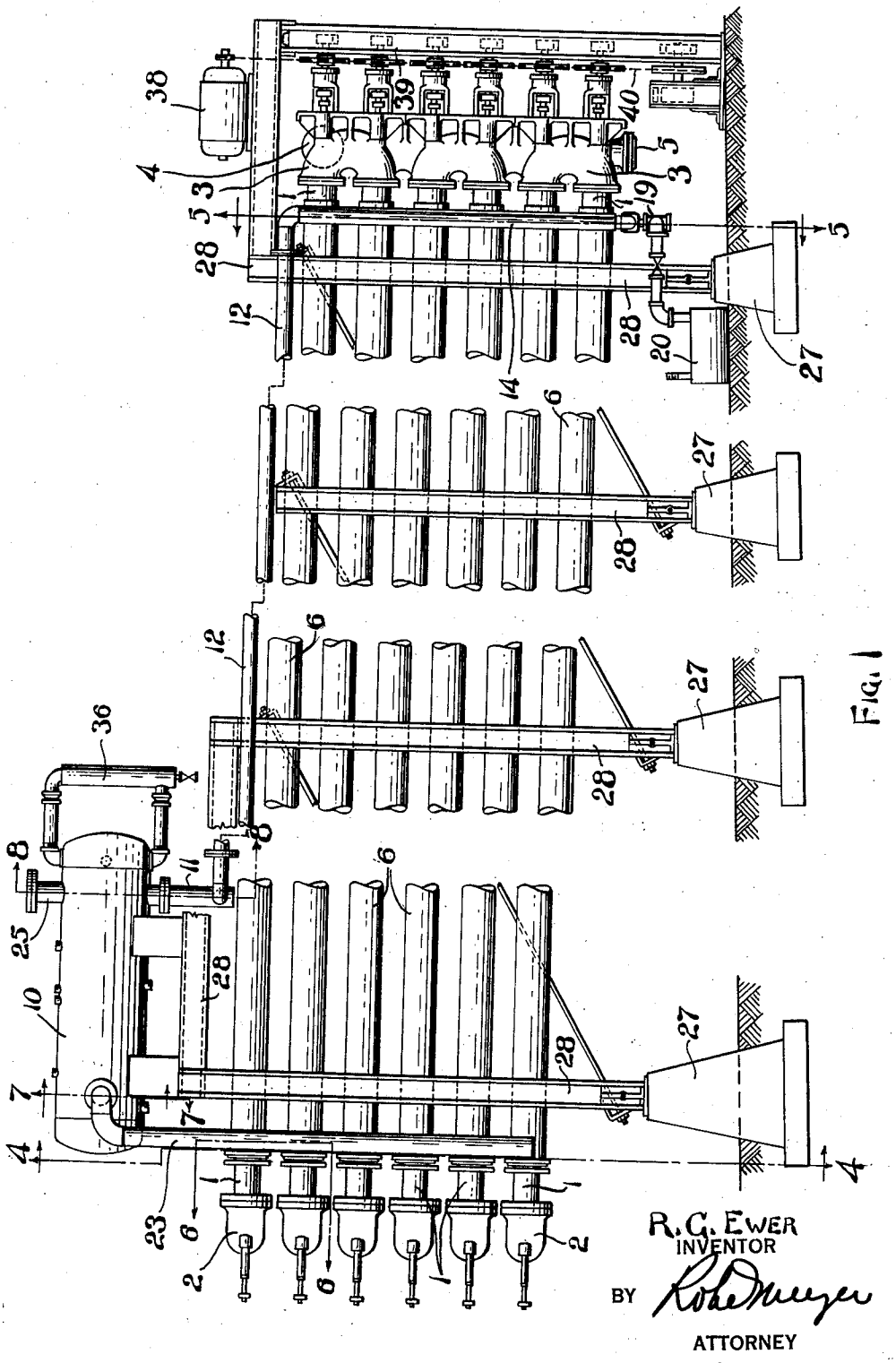


FIG. 1

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FIG. 4

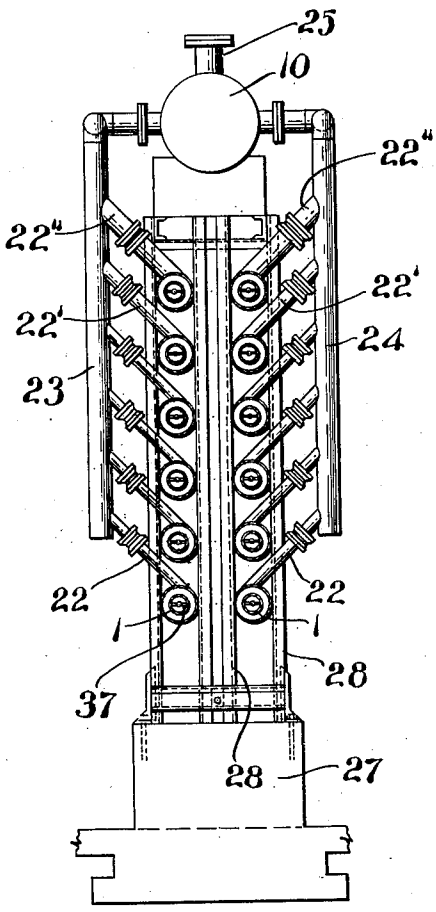
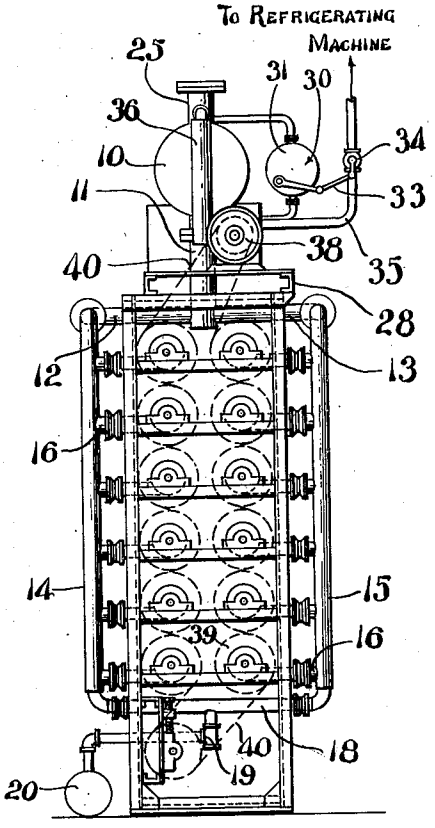


FIG. 2



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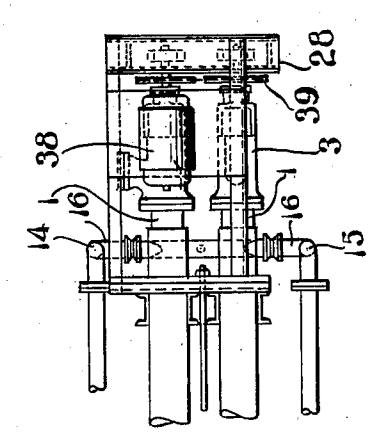


Fig. 3

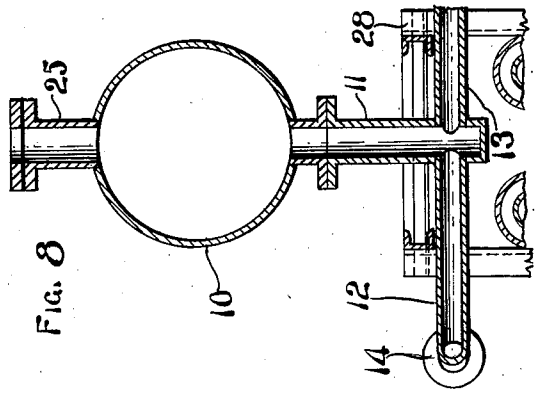


Fig. 8

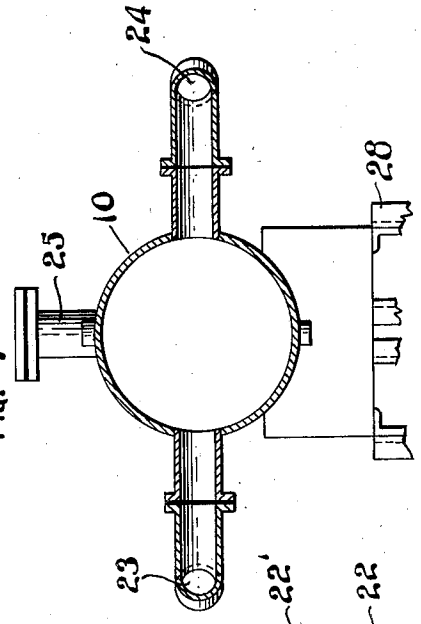


Fig. 7

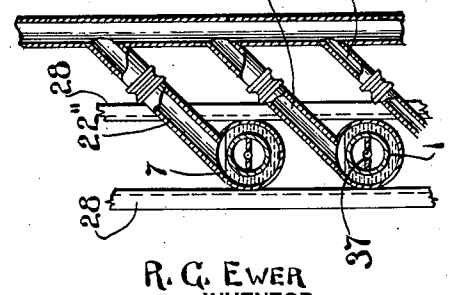


Fig. 6

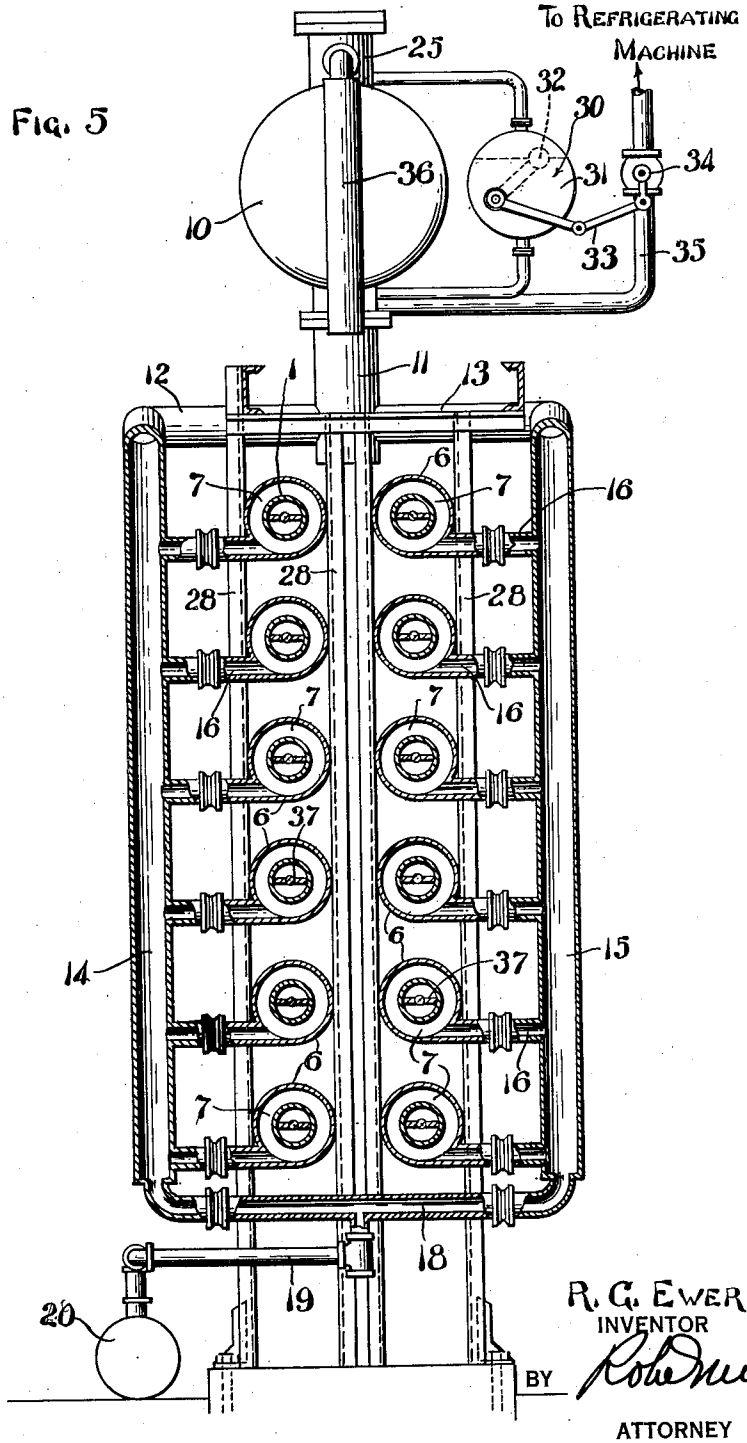
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Fig. 5



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UNITED STATES PATENT OFFICE

2,191,909

CHILLING MACHINE

Roland G. Ewer, East Orange, N. J., assignor to Worthington Pump and Machinery Corporation, Harrison, N. J., a corporation of Delaware

Application October 4, 1938, Serial No. 233,147

2 Claims. (Cl. 62—114)

This invention relates to heat interchangers and more particularly to chilling machines for chilling distillates to separate out, for congelation, paraffin wax or the like. This type of apparatus or machine customarily includes one or more series of horizontally disposed pipes arranged at different levels through which the material to be chilled is circulated. The chilling action in these pipes is provided by a volatile refrigerant which is circulated through jackets or evaporator chambers surrounding the pipes.

Heretofore it has been the custom to build such chilling machines with the sections or series of pipes in horizontal tiers with the result that the machines did not eliminate the volatile gas freely and gas pockets formed in the refrigerant jackets or chambers. Such gas pockets keep liquid refrigerant from contacting the surfaces of the pipes containing the distillate or other material, and also such gas accumulating in pockets forces the liquid refrigerant from the refrigerating jackets or chambers in surges in lieu of the desired steady flow of gas and liquid.

An object of the present invention is to provide a chilling machine which will eliminate the forming of gas pockets in the refrigerant jackets or chambers with the resulting undesirable actions and provide a constant even flow of mixed gas and liquid from each section of the machine, thereby increasing the capacity of each refrigerating unit.

Generically, the chilling machine of the present invention consists of several sections, an accumulator drum, etc., is operated with a flooded re-circulating system which re-circulates several times as much refrigerant as is evaporated in the chilling process. Predetermined refrigerant liquid level is maintained in the accumulator drum by means of a float control valve admitting liquid refrigerant from a refrigerating machine. A portion of the entering liquid immediately evaporates, cooling the balance of the liquid to the saturation temperature for the pressure in the accumulator. The cooled refrigerant liquid flows from the accumulator to liquid headers, from which liquid feed lines lead into the bottom at the lower end of each section of the chilling machine. From the opposite or upper end of each section at the top an upwardly inclined connection leads to another header taking re-circulated liquid refrigerant and gas to the accumulator. In the accumulator, the gas and re-circulated refrigerant liquid separates, the gas passing out to a refrigerating machine, the liquid refrigerant mixing with that admitted by the float valve and passing to the liquid feed headers to repeat the cycle. Each section of the chilling machine is inclined to promote liquid re-circulation and gas elimination, the liquid inlet being at the lower end and the gas outlet at the higher end. By promoting rapid re-circulation and gas elimination, the greatest possible heat transfer is assured, since the least possible amount of surface is in contact with the leaving gas and the whole surface of the material conducting pipes is continuously swept by the re-circulating liquid refrigerant. Short travel in each section, together with a large outlet and inlet headers entails the least possible resistance. The inclining of the sections, together with the large outlet connection, eliminates the possibility of gas pockets forming in the space occupied by the refrigerant.

The object of the chilling machine as above generically described is to obtain an increased efficiency of operation in apparatus of this type by avoiding pockets of gas, which form in horizontal sections and induces the gas bubbles to travel upward and be quickly liberated, and also the liquid refrigerant travels upward in the inclined sections faster than it would through the horizontal sections, all of which increases the heat transfer and efficiency of the apparatus.

With this and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing a chilling machine embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

In the drawings:

Figure 1 is a side elevation of the improved chilling machine with parts broken away.

Figure 2 is an end elevation of the improved chilling machine.

Figure 3 is a top plan of the improved chilling machine.

Figure 4 is a vertical section of the improved chilling machine on the line 4—4 of Figure 1.

Figure 5 is a vertical section through the improved chilling machine taken on the line 5—5 of Figure 1.

Figure 6 is an enlarged detail section through the chilling machine showing the outlet or return connections from the evaporating chambers to the header.

Figure 7 is a detail section through the accu-

mulator drum and return connections taken on the line 7—7 of Figure 1.

Figure 8 is a detail cross section through the accumulator and connections and taken on the line 8—8 of Figure 1.

Referring more particularly to the drawings, the improved chilling machine comprises a plurality of pipes 1 arranged vertically in spaced tiers, through which the liquid to be chilled circulates. The pipes in each tier are connected by suitable connecting elbows 2 while the pipes in each tier are connected to the pipes in the successive or in the tier next therebelow by suitable elbows 3 so as to provide a continuous path for the circulation of the liquid to be cooled, which enters the series of tiers of pipes through the inlet 4 and leaves them through the exit 5.

Refrigerant jackets 6 are disposed about the pipes 1 and form evaporator chambers 7 through which a suitable liquid refrigerant, preferably a volatile liquid refrigerant is circulated for chilling the liquid circulating through the pipes 1.

The liquid refrigerant flows from the accumulator drum 10 downwardly through an outlet pipe 11 and through feed pipes 12 and 13 to substantially vertical headers 14 and 15. The headers 14 and 15 which are the inlet headers extend vertically, one on each side of the tiers of evaporator chambers 6 and have inlet connections 16 opening therefrom into the lower portions of each evaporator chamber as clearly shown in Figure 5 of the drawings. The headers 14 are connected at the bottom by a connecting pipe 18 which permits flow of refrigerant from one header to the other. A drain connection 19 is connected to the connecting pipe 18 and leads to a drum 20. The drain 19 and drum 20 are provided for receiving oil or other foreign matter which would drain from the liquid refrigerant.

The liquid refrigerant passing into the evaporator chambers 7 at the lower portions of the lower ends of the chambers passes longitudinally through the chambers to their upper ends from which the liquid refrigerant and evaporated gases pass through outlet connections 22 into the return headers 23 and 24. From the return headers 23 and 24 the liquid and gaseous refrigerant returns to the accumulator drum 10 wherein the gas separates from the liquid and gas passes through a gas outlet 25 to a refrigerating machine (not shown) where it is compressed and returned to the accumulator drum as needed for recirculation through the chilling machine.

As clearly shown in Figures 4 and 6 of the drawings the return connections 22 communicate tangentially with the uppermost portions of the evaporator chambers at their upper ends and includes upwardly and outwardly to the headers 24 so as to provide an upward travel of the liquid and gas at all times after it enters the refrigerant chambers and until it is returned to the accumulator 10.

As clearly shown in Figure 1 of the drawings the tiers of pipes 1 and their surrounding jackets 6 which form the evaporator chambers are inclined, such inclination being provided in the form shown by variation in the heights of the supports 27 upon which the supporting frame 28 of the chilling machine rests. While this particular construction for providing the inclining of the pipes 1 and jackets 6 is shown it is to be understood that the invention is not limited thereto but that any suitable means for providing an inclining of the evaporator chamber 7 upwardly from their inlet ends to their outlet ends may be provided without departing from the spirit of the present invention.

As previously stated in the preamble to the specification, the upward inclining of the evaporator chambers prevents the formation of gas pockets due to the evaporation of the volatile refrigerant, in the evaporator chambers, with the resultant reduction in heat transfer efficiency, and such inclination also, in providing, together with the outwardly and upwardly inclining outlet connections 22, a continuously upward flow of the refrigerant, both liquid and gas, results in free, rapid circulation of the refrigerant and eliminates surging flow, such as caused by gas pockets.

The quantity of liquid refrigerant flowing through the evaporator chambers 7 is regulated by the quantity of liquid refrigerant in the accumulator 10 which is positioned above the higher or upper end of the evaporator chambers and the desired level of liquid refrigerant in the accumulator is maintained by a float valve structure 30 of any approved form. In the construction shown in the drawings, the float valve 30 includes a receptacle 31 having connection with the accumulator 10 and in which a float 32 is mounted. The float 32 through a series of arms 33 operates a valve 34 in the supply pipe 35 between the accumulator and the refrigerating machine (not shown).

An indicator or gage 36 is shown connected to the accumulator to provide visible reading of the quantity of liquid refrigerant in the accumulator.

The various sections of the pipes 1 are shown as having rotary scrapers 37 therein of approved type which are driven by a suitable motor 38 through a series of sprockets 39 and a sprocket fan 40.

As shown clearly in Figures 4 and 6 of the drawings the outlet connections 22' which connect with the evaporator chambers in the next to the uppermost tier are of larger diameter than the outlet connections 22 which connect the outlet headers 23 and 24 to the evaporator chambers of the lower tiers, while the outlet connections 22'' which connect the outlet headers 23 and 24 to the evaporator chamber 7 of the uppermost tier of the evaporator chambers are of still greater diameter than the outlet connections 22'. This variation in the sizes of the outlet connections is provided because there is generally greater evaporation and heat transfer in the uppermost tiers of the chilling machine than in the lower tiers. However it is to be understood that the invention is not to be limited to the use of such larger size outlet connections, as such larger size outlet connections would be used only in instances where cooling through a considerable temperature range is carried on, resulting in the pipes and evaporator chambers of the upper sections doing considerably more work than the lower ones. The majority of installations operating under normal or usual conditions would not require the larger size gas outlet connections and consequently the invention is not to be limited thereto.

It is to be understood that the invention is not to be limited to the specific construction or arrangement of parts shown but that they may be widely modified within the invention defined by the claims.

What is claimed is:

1. In a chilling apparatus, a conduit for conducting liquid to be treated comprising a plurality of vertically spaced pipe sections arranged in serially connected superposed tiers, evaporator

jackets individual to said pipe sections and forming evaporator chambers about the pipe sections, said pipe sections and evaporator chamber being inclined lengthwise to the horizontal, a liquid refrigerant supplying accumulator above the highest part of said evaporator chambers and having liquid refrigerant supplying connections with the lowermost ends of the evaporator chambers, and outlet return connections connected to the highest ends of the evaporator chambers and to said accumulator whereby a constant upward flow of liquid and gaseous refrigerant through said evaporator chambers to said accumulator will be provided.

2. In a chilling apparatus, a conduit for conducting liquid to be treated comprising a plurality of vertically spaced pipe sections arranged in serially connected superposed tiers, evaporator jackets individual to said pipe sections and forming evaporator chambers about the pipe sections, said pipe sections and evaporator chamber being inclined lengthwise to the horizontal, a liquid refrigerant supplying accumulator above the highest part of said evaporator chambers and having liquid refrigerant supplying connections with the lowermost ends of the evaporator chambers, outlet return connections connected to the highest ends of the evaporator chambers and to said accumulator whereby a constant upward flow of liquid and gaseous refrigerant through said evaporator chambers to said accumulator will be provided, a float valve structure for controlling the level of liquid refrigerant in said accumulator outlet headers communicating with said accumulator, upwardly and outwardly inclining outlet connections between said evaporator chambers and said outlet headers, the outlet connections connected to the upper-most tiers of said evaporator chambers being of larger diameter than the outlet connections connected to the evaporator chambers in the lower tiers.

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