

June 9, 1931.

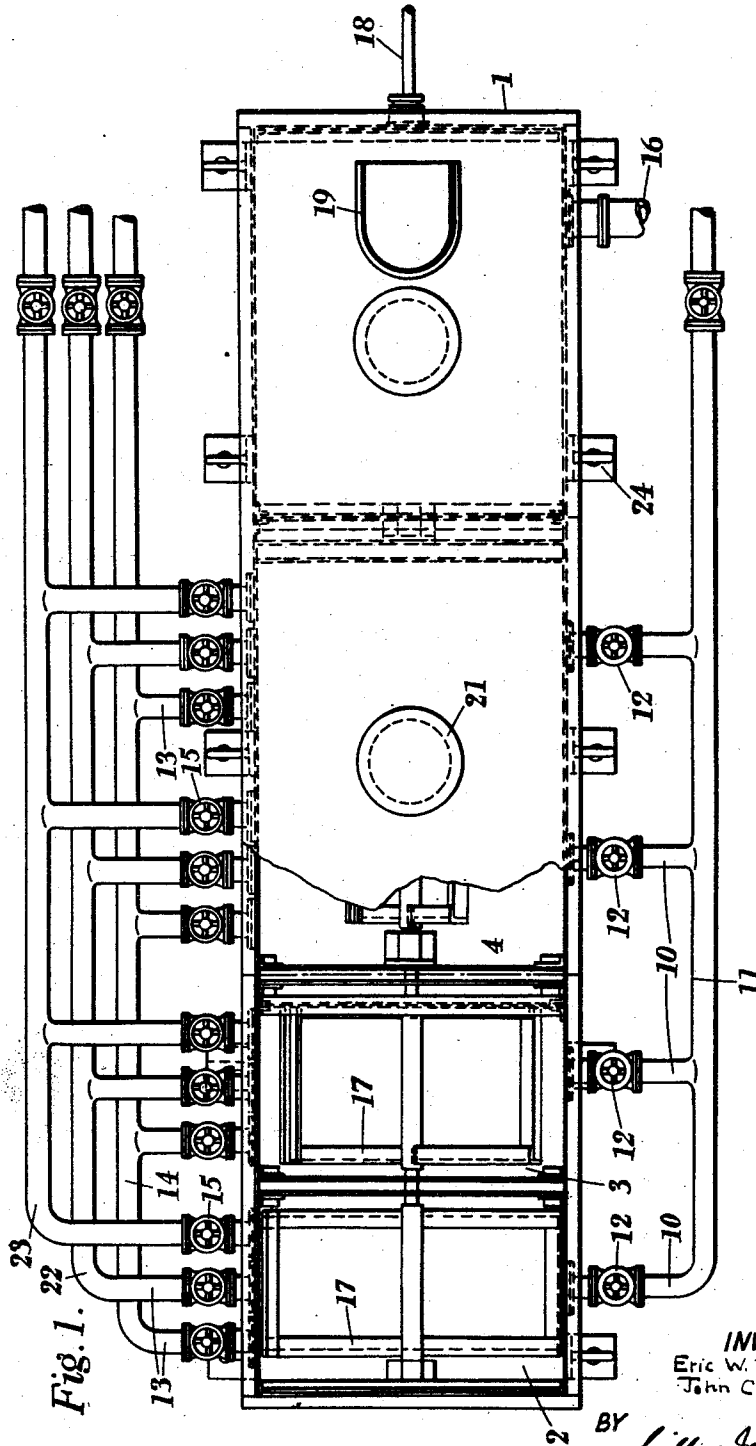
E. W. BUTLER ET AL

1,809,672

APPARATUS FOR MIXING LIQUIDS

Filed July 6, 1929

2 Sheets-Sheet 1



INVENTORS
Eric W. Butler
John C. Mann

BY

Gill & Jennings
ATTORNEYS

June 9, 1931.

E. W. BUTLER ET AL

1,809,672

APPARATUS FOR MIXING LIQUIDS

Filed July 6, 1929

2 Sheets-Sheet 2

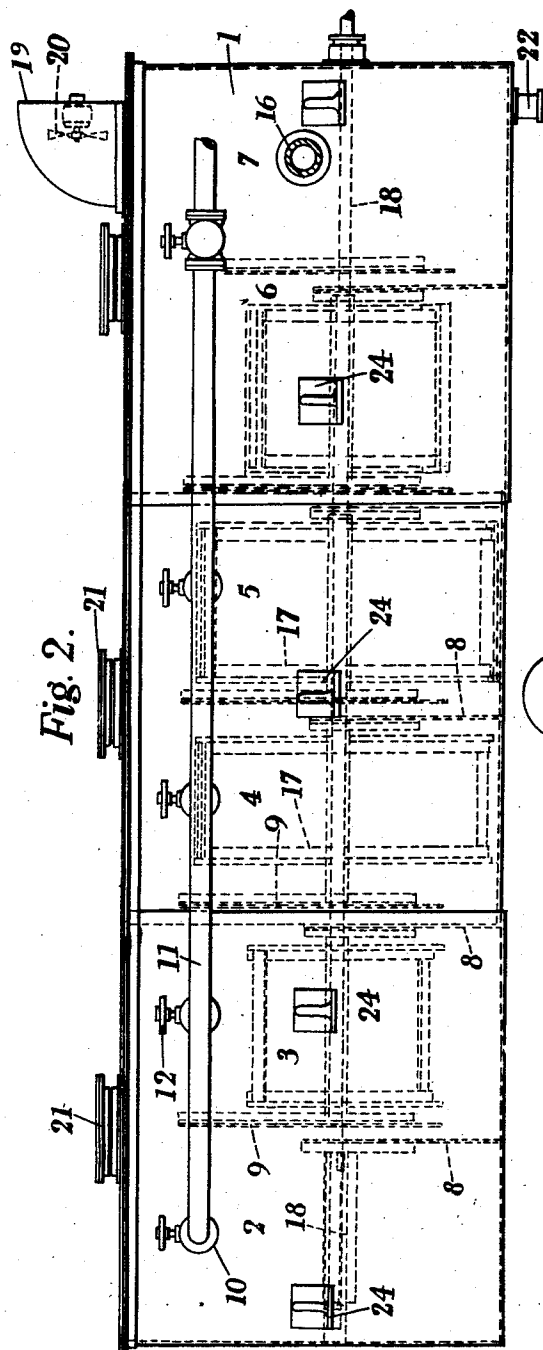


Fig. 2.

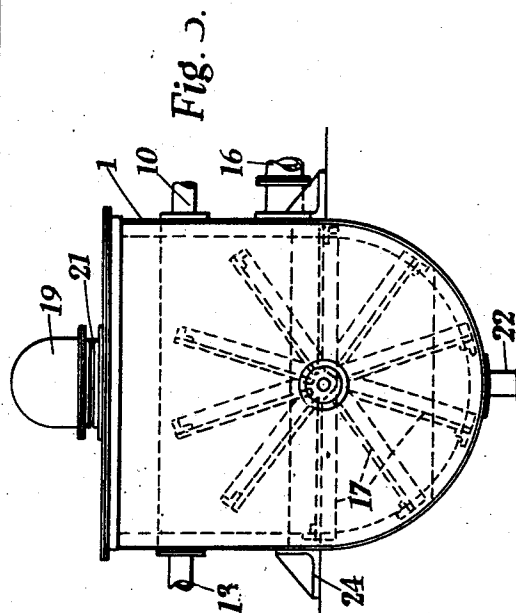


Fig. 3.

INVENTORS

Eric W. Butler
John C. Mann

BY

Gill + Jennings

ATTORNEYS

UNITED STATES PATENT OFFICE

ERIC WAKEFIELD BUTLER, OF BRISTOL, AND JOHN CHRISTOPHER MANN, OF BIRMINGHAM, ENGLAND, ASSIGNORS TO ROBINSON BROTHERS LIMITED, OF BIRMINGHAM, ENGLAND, A COMPANY OF GREAT BRITAIN, AND WM. BUTLER & COMPANY (BRISTOL) LIMITED, OF BRISTOL, ENGLAND, A COMPANY OF GREAT BRITAIN

APPARATUS FOR MIXING LIQUIDS

Application filed July 6, 1929, Serial No. 376,374, and in Great Britain January 19, 1929.

This invention relates to an apparatus for continuously mixing together in the liquid state a tarry substance solid at ordinary temperature and a tarry substance liquid at ordinary temperature which substances are initially at different temperatures but the mixture of which is to be kept within definite temperature limits. This is the case, for example, when a bituminous material such as hot pitch has to be mixed with a tarry material such as virgin tar, residual oil and creosote, or any of them and there is water present. When such liquids are mixed, if the temperature is allowed at any instant to rise too much, frothing results, with, of course, an enormous increase in volume which leads to considerable loss and inconvenience. On the other hand, if the temperature is allowed to fall too low in relation to the melting point of the pitch, the condition known as stringing results, that is the bituminous material coagulates into stringy lumps. It is highly important, therefore, to maintain the temperature of the mixture between certain known limits.

The main object of the present invention is to provide a novel mixing apparatus which is particularly suitable for use when liquids such as those mentioned above have to be mixed together.

The novel apparatus consists of a mixing vessel divided by partitions into a number of separate compartments with connections such that the mixture flows from the top or bottom of one compartment to the bottom or top of the next. Each compartment is provided with a stirring apparatus which is so arranged that the mixture is stirred or agitated in a direction at right angles to the flow throughout the vessel as a whole. For example, a single shaft may run lengthwise through the whole vessel, and may carry separate stirrers which sweep through each compartment in such a way as to churn the heavier liquid up from the bottom of the compartment to the top, and thus to cause effective mixing of liquids of different specific gravities or viscosities.

It is preferred to provide at the end of the mixing compartments one or more fur-

ther compartments in which stirring takes place without the addition of any further liquid. The level of the liquid in the compartments may very conveniently be regulated by means of an outflow pipe placed at a suitable height in the last compartment.

It may sometimes happen that when substances such as pitch and tar are being mixed, despite the precautions taken in the novel method, frothing may occur. In order to allow for this a further feature of the invention consists in making the lower partitions extend upwards to only about half the height of the apparatus so that a large space is left above the liquid to accommodate any froth that may be produced. Gaps may be left between the upper partitions and the top of the apparatus so that froth can flow from one compartment to the next, and the stirrers may be made of such dimensions that they pass through any froth produced and assist to break it down.

In order that the invention may be clearly understood and readily carried into effect, one form of novel apparatus will now be described by way of example with reference to the accompanying drawings in which

Figure 1 is a plan showing part of the cover broken away;

Figure 2 a side elevation, and

Figure 3 an end elevation of the apparatus.

This apparatus which is particularly adapted for mixing pitch with virgin tar comprises a closed vessel 1 with straight sides and semicircular bottom, the vessel being divided into six separate compartments 2, 3, 4, 5, 6, 7. Each of the partitions is made double and comprises a plate 8 extending upwards from the bottom of the vessel so as to constitute a weir, and a second plate 9 extending downwards from near the top of the vessel 1 to near the bottom; these two plates 8 and 9 are slightly spaced away from one another so as to allow free passage of the liquid between them. Each of the compartments 2, 3, 4 and 5 is provided on the one side with an inlet 10 branching from a pipe 11 and controlled by a valve 12, and on the other side with three inlets 13 branching from pipes 14, 22 and 23 and controlled by valves

15. The compartment 6 is not provided with any inlet or outlet pipe, but the compartment 7 has an outlet pipe 16 which is placed at about the level of the top of the plates 8.

Each compartment is also provided with a stirring apparatus comprising an iron frame 17, each frame being mounted upon part of a single shaft 18, extending through the whole vessel, and being of such a size that in rotating it nearly touches the semicircular part of the vessel 1. The various stirring frames 17 are set at different angles relatively to one another, so that only one stirrer is breaking through the surface at any one time.

The apparatus is carried by brackets 24 which rest upon columns and the brickwork is so arranged that a furnace can be formed beneath the apparatus so that one or more of the compartments can be heated if necessary.

A typical process is then as follows: Initially, tar at about 75° C. is admitted to the first three compartments through the inlet 13. Hot pitch is then added through the inlet 10 and thereafter tar at about 40° C. is admitted to the compartments 2, 3 and 4 through the inlets 13, and pitch to the compartments 2 and 3 through the inlets 10. The proportions of the pitch and the tar are so regulated that neither frothing nor stringing takes place. For example, supposing that the tar is at 40° C. and contains 5 per cent of water, and the pitch of melting point of 100° C. is at 250° C., then in the whole apparatus 1 part by volume of pitch may be added to 3 parts by volume of tar without either frothing or stringing taking place. The liquids are, of course, added continuously through the pipes 11 and 14 and the amounts flowing to the various compartments are controlled by the valves 12 and 15. The control is such that the temperature in the first compartment 2 is maintained at about 90° C. with a maximum of 100° C. and gradually decreases in the successive compartments to about 750° C. in compartment 7. As the mixture progresses through the apparatus the proportion of pitch to tar can be varied, since the temperature at which stringing occurs falls and that at which frothing occurs rises as the tar is added to the pitch, and water is evaporated from the mixture. Thus, owing to the latter feature not only does the water content become considerably lower, but, on account of the removal of the latent heat the temperature of the mixture falls considerably, with the result that the risk of frothing is very much reduced.

No further liquid is added in compartments 5, 6 and 7, but the complete mixture is stirred in those compartments. The mixture flows out through the overflow pipe 16, disposed at a level intermediate the top and bottom of compartment 7 and preferably below the vertex of the circular path of the

tips of the stirrers 17, which arrangement thus serves to regulate the level of the liquid in all the compartments, as the outlet pipe 16 is so placed that the stirrers 17 always break through the surface of the liquid; this adds considerably to the stirring effect and also assists to break down any froth formed.

It will be appreciated that by the provision of the plates 8 and 9 the mixture is always transferred from the top of one compartment to the bottom of the next; this ensures thorough mixing of the two liquids, since any viscous material is brought to the top of the liquid and mixed with incoming lighter or thinner material before flowing to the next compartment.

Since the plates 9 do not extend completely to the top of the vessel 1 all the compartments 2, 3, 4, 5, 6, 7 are in communication with one another at the top. A hood 19 is arranged at the top of the compartment 7 and a fan 20 is mounted in it so that the vapours given off from any of the compartments can be drawn off through the hood 19 by means of the fan 20, and condensed.

Three manholes 21 are arranged for cleaning purposes, each immediately above one of the partitions so that each manhole gives access to two compartments. A drain-cock 22 is provided at the bottom of the compartment number 7, and in order that the whole vessel may be drained by this cock, small holes are formed in the plates 8 at the bottom.

Many modifications may be made to suit different liquids. For example, one or more of the compartments may be mounted in brick work so that they can be directly fired, or alternatively they may be steam-jacketed in order to keep the temperature high or to increase it in any one compartment. Again, it may well be found that the properties of the mixture vary to such an extent from compartment to compartment that it is desirable to stir at different speeds. For this purpose either separate shafts may be arranged in the different compartments to carry the stirrers and cause them to rotate at different speeds, or separate lengths of a single shaft disposed throughout the whole vessel may be connected by gearing so as to obtain the same result. The same effect may be obtained by altering the shape or character of the stirrers.

As another modification, in place of the double partition described the mixture may be conducted from one compartment to another by means of pipes, either internally or externally arranged. In the latter case the pipes may be lagged or steam-jacketed if the temperature is to be raised, or may be cooled if the temperature is to be lowered.

In cases where it is desired to take off all the moisture and light vapours, the apparatus may be placed under vacuum.

It will be appreciated that the invention is not limited to the precise construction de-

scribed by way of example, and that many different liquids besides pitch and tar can advantageously be mixed in apparatus in accordance with the invention. Further, the apparatus may be used for the mixing of a number of liquids at the same time. In fact it is in order to allow of mixing several different liquids that there are three separate inlet pipes 14, 22 and 23 in the apparatus illustrated in the drawings, so that with this apparatus four different liquids can be mixed together at one time, these liquids passing, of course, through the pipes 11, 14, 22 and 23.

We claim:—

1. In an apparatus for mixing tarry liquids in a continuous process, in combination, a mixing vessel having a semi-cylindrical bottom, a rotatable shaft extending through the vessel and coaxial with the aforesaid semi-cylindrical bottom, stirrers mounted upon said shaft and arranged with their tips passing in proximity to the aforesaid bottom, a plurality of pairs of baffles within said vessel spaced along it and dividing it into a series of compartments each pair constituting a conduit connecting the compartments, and means for admitting liquid to some at least of said compartments, said terminal compartment having an outlet, said conduits and said outlet being operative to maintain a free surface of liquid at a substantially uniform level in said vessel, the stirrers being disposed to break through said liquid level upon rotation of the shaft.

2. In an apparatus for mixing tarry liquids in a continuous process, in combination, a plurality of mixing chambers arranged end to end in a horizontal series, each having a semi-cylindrical bottom, all said bottoms being coaxial, means for admitting liquid to some at least of said chambers, a rotatable shaft extending through all said chambers and coaxial with the aforesaid semi-cylindrical bottoms, stirrers mounted upon said shaft and arranged with their tips passing in proximity to the aforesaid bottoms, conduits connecting each chamber (except the last of the series) at a level adjacent its top to the chamber next to it in the series near its bottom, said last chamber being provided with an outlet at a level intermediate its top and bottom, and below the vertex of the circular path of the tips of the stirrers, whereby a free surface of liquid is maintained in all of said chambers.

3. In an apparatus for mixing tarry liquids in a continuous process, in combination, a mixing vessel having a semi-cylindrical bottom, a rotatable shaft extending through the vessel and coaxial with the aforesaid semi-cylindrical bottom, stirrers mounted upon said shaft and arranged with their tips passing in proximity to the aforesaid bottom, a plurality of pairs of baffles within said vessel spaced along it and dividing it into a series

of compartments each pair constituting a conduit connecting each compartment (except one terminal compartment) at a level adjacent its top to the compartment next to it in the series near its bottom, and means for admitting liquid to some at least of said compartments, said terminal compartment having an outlet at a level intermediate its top and bottom and below the vertex of the circular path of the tips of the stirrers, whereby a free surface of liquid is maintained in said vessel.

4. In an apparatus for mixing tarry liquids in a continuous process, in combination, a mixing vessel, means within said vessel for agitating liquid within it, a plurality of pairs of baffles within said vessel spaced along it and dividing it into a series of compartments, each pair constituting a conduit connecting each compartment (except one terminal compartment) at a level substantially remote from its bottom to the compartment next to it in the series near its bottom, and means for admitting liquid to some at least of said compartments, said terminal compartment having an outlet at a level intermediate its top and bottom, whereby a free surface of liquid is maintained in said vessel, each compartment having an unobstructed aperture in one of its walls above the level aforesaid.

5. In an apparatus for mixing tarry liquids in a continuous process, in combination, a mixing vessel closed at the top, means within said vessel for agitating liquid within it, a plurality of baffles spaced along it and dividing it into a series of compartments, one baffle of each pair extending from the bottom of the vessel to a level intermediate the top and bottom thereof and the other extending from a point spaced from the bottom but below said level to a point spaced from the top but above said level, each said pair constituting a conduit connecting each compartment (except one terminal compartment) to the compartment next to it in the series, and means for admitting liquid to some at least of said compartments, said terminal compartment having an outlet at a level intermediate its top and bottom, whereby a free surface of liquid is maintained in said vessel.

6. In an apparatus for mixing liquids in a continuous process, in combination, a plurality of mixing chambers arranged end to end in a horizontal series, each having a semi-cylindrical bottom, all said bottoms being coaxial, means for admitting liquid to some at least of said chambers, a rotatable shaft extending through all said chambers and coaxial with the aforesaid semi-cylindrical bottoms, stirrers mounted upon said shaft and arranged with their tips passing in proximity to the aforesaid bottoms, conduits connecting each chamber (except the last of the series) at a level adjacent its top to the cham-

ber next to its in the series near its bottom,
said last chamber being provided with an out-
let at a level intermediate its top and bot-
tom, whereby a free surface of liquid is main-
5 tained in all of said chambers.

In witness whereof we hereunto subscribe
our names this 28th day of June, A. D. 1929.

ERIC WAKEFIELD BUTLER.

JOHN CHRISTOPHER MANN.

10

15

20

25

30

35

40

45

50

55

60

65