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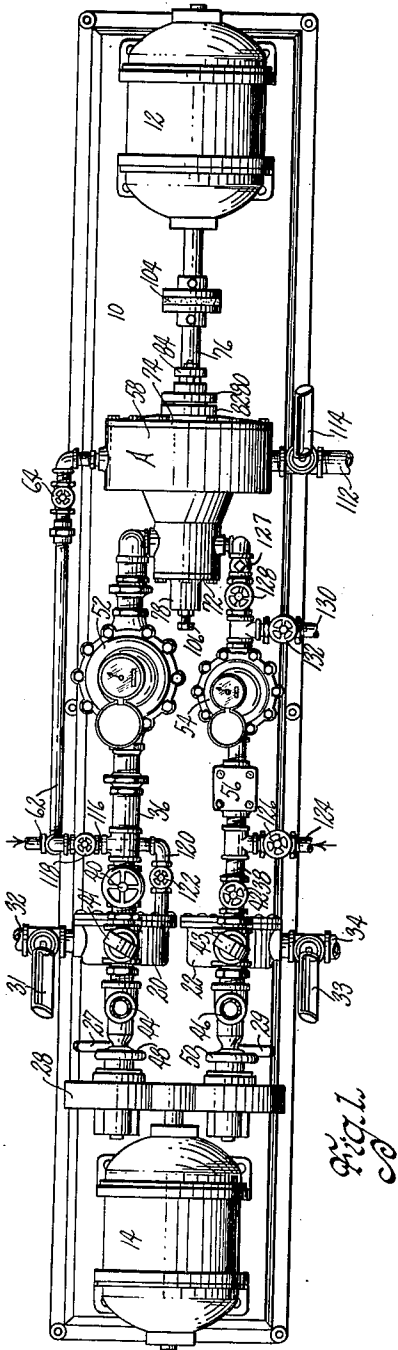
J. L. BARNES

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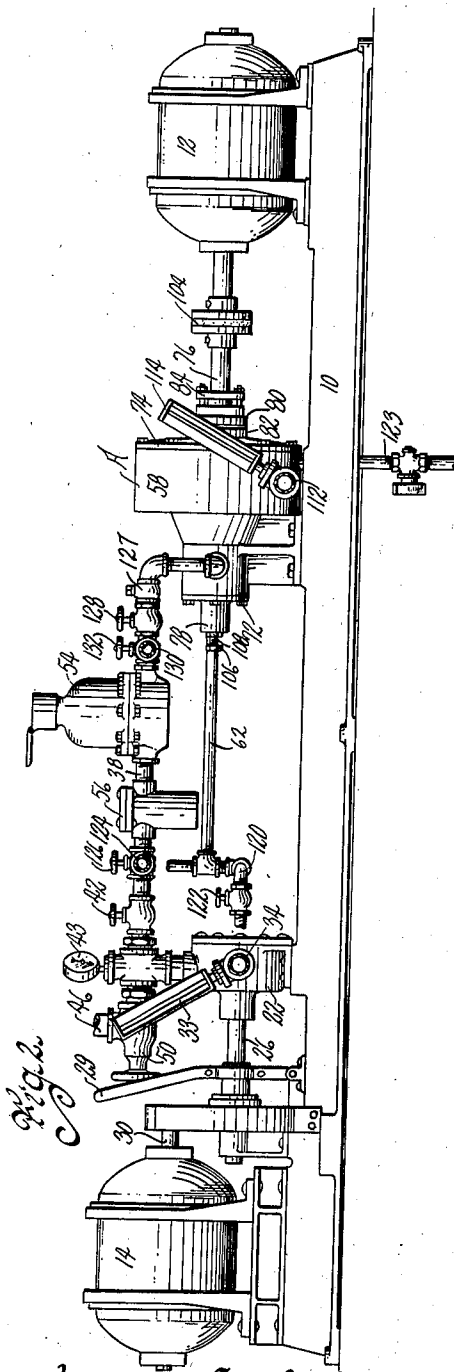
MACHINE FOR MAKING BITUMINOUS EMULSIONS

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2 Sheets-Sheet 1



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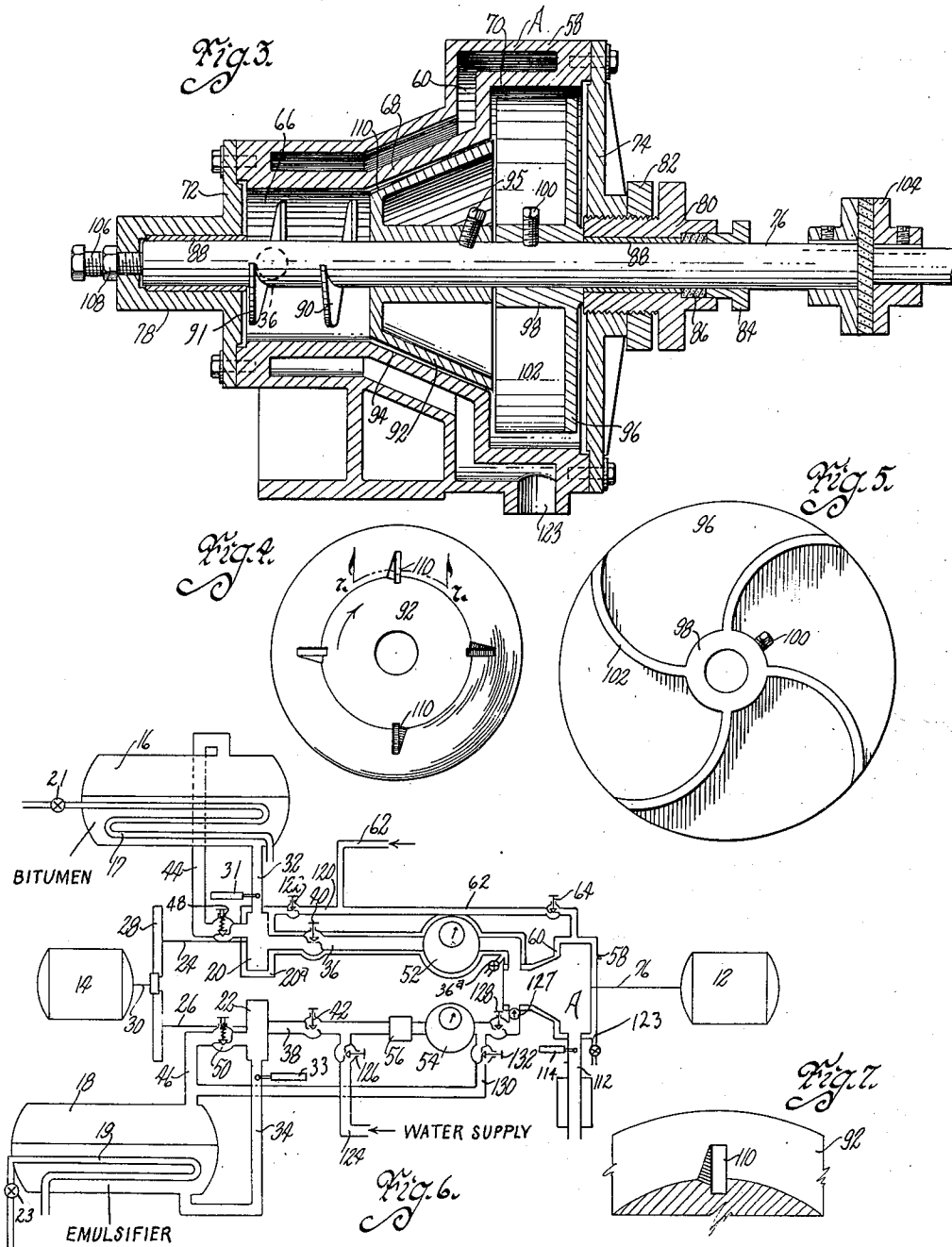
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UNITED STATES PATENT OFFICE

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MACHINE FOR MAKING BITUMINOUS EMULSIONS

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9 Claims. (Cl. 259—9)

My invention relates to a machine for making bituminous emulsion.

The object of the present invention is to provide a complete machine capable of carrying out a continuous process resulting in the manufacture of a stable liqueous emulsion of a bituminous substance such as asphalt, and including a combination of instrumentalities for performing the succession of steps involved in said process and for regulating and controlling all of the functions necessary to accomplish the desired result.

More particularly, it is my purpose to provide a machine, having means for accurately controlling the temperature of the asphalt and the emulsifier in the supply tanks, and maintaining uniform temperature of the ingredients during the movement of the ingredients to the emulsifying unit and for controlling heat of the emulsion in the unit, so that the temperature control is complete and accurate during the whole process of manufacture.

It is also my purpose to provide such a machine having means for controlling the flow of the ingredients and the fluidity of the asphalt.

The machine includes a steam jacketed emulsifying unit. The last-named unit includes a closed chamber into which the two heated substances are introduced for instance through separate opposed inlet means and in which there is formed a primary bitumen external phase emulsion. The unit also includes means for immediately removing the primary emulsion from the zone of formation and treating it to form a secondary internal phase emulsion which is then subjected to a grinding, rolling, sub-dividing and spreading action between converging surfaces of a rotor and stator, whereby the coarse emulsion is changed to one of finer form. As this fine tertiary emulsion emerges from the aperture between the relatively movable surfaces, it is subjected to centrifugal action to remove air bubbles and to reduce the substance from a foamy to a more fluid state, as well as to increase the thoroughness of mixing and the completeness of dispersion, and to pull the emulsion through the apparatus.

The machine includes means for securing definite pressure with respect to each of the liqueous substances, means for regulating and for measuring the rate of flow and temperature of each substance, and means for regulating and measuring the temperature of the emulsion as it emerges from the emulsifying unit.

It is a further object to provide a method for producing a bituminous emulsion of uniform

quality, and with such proportion of asphalt as may be desired.

With the foregoing and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawings, in which:—

Figure 1 is a plan view of an apparatus embodying my invention.

Figure 2 is a side elevation of the same, elements at the rear side being omitted for the sake of clearness of illustration.

Figure 3 is an enlarged, longitudinal, section of the emulsifying unit.

Figure 4 is a face view of the conical rotor removed from the unit.

Figure 5 is a face view of the centrifuging means removed from the unit.

Figure 6 is a diagrammatic representation of the complete apparatus.

Figure 7 is an enlarged sectional view on the line 7—7 of Figure 4, showing particularly the shape of grooves in the rotor.

The principal elements of the machine may all be mounted upon a base 10 in order to produce a substantially unitary structure in which the elements are associated in their proper relations.

Mounted on the base between the ends thereof is the emulsifying unit A. Near one end of the base is a motor 12 for driving the rotor of the unit. At the other end of the base is a second motor 14 for operating other parts of the equipment, particularly the pumps.

I provide two tanks or containers, suitably located, the container 16 being employed for the bitumen or asphalt and the container 18 being for the emulsifying agent or emulsifier. The containers should be such that heat may be applied, and for maintaining the bitumen and the emulsifier at proper temperature, I have used in the respective containers, the steam coils 17 and 19, controlled by manual valves 21 and 23. The containers, as well as other elements of the apparatus, are of airtight construction to permit of the application of pressure and to facilitate the making of the emulsion by a continuous process, and to help insure maintenance of uniform volumes of materials.

Two suitable pumps 20 and 22 are employed, preferably mounted side by side on the base 10. Their respective operating shafts 24 and 26 are operable by suitable gearing means 28 from the shaft 30 of the motor 14. There are suitable

clutch connections between the driving gears and the pump shafts 24 and 26, said clutch connections being controllable by means of hand levers 27 and 29 respectively.

5 The intake sides of the pumps 20 and 22 are connected respectively with the containers 16 and 18 by means of pipes 32 and 34. The pipes 32 and 34 are equipped with suitable temperature measuring devices such as thermometers 31 and 10 33 respectively, preferably close to the pumps, by which the temperature of liqueous substances introduced to the pumps may be ascertained. The discharge sides of the pumps are connected respectively with the emulsifying unit A by means of supply pipes 36 and 38, these pipes being 15 equipped with manually operable valves 40 and 42 respectively.

The pumps 20 and 22 are capable of building up certain pressures in the system and are 20 equipped with pressure gauges 41 and 43 respectively. Overflow or by-pass pipes 44 and 46 are also connected with said pumps and lead respectively back to the containers 16 and 18. These overflow pipes are equipped with automatically 25 operable and manually adjustable relief valves 48 and 50 which function to by-pass the ingredients during preliminary heating, to permit the release of excess pressures and liqueous substances to the respective containers in the event 30 the pressures should exceed the desired point at any time, and to maintain constant by-pass flow for agitating the contents of the tanks 16 and 18.

Associated with the supply pipes 36 and 38 which lead to the emulsifying unit are suitable 35 meters 52 and 54 respectively for indicating the rate of flow of the ingredients to the emulsifying unit.

By observing these meters, the operator is enabled to ascertain and regulate the relative 40 amounts of the two liqueous substances which are supplied to the emulsifying unit, and he can then control the flow by manipulation of the pressure relief valves 48 and 50 and the flow valves 40 and 42.

45 The supply pipe 38 for the emulsifier preferably is equipped with a suitable strainer and sediment trap unit 56, in advance of the meter 54.

Attention is now directed to the construction of the emulsifying unit A as disclosed particularly in Figure 3. The unit includes a casing 50 58 which is provided with a steam jacket 60 to permit the admission of live steam through a pipe 62 equipped with a control valve 64. The casing 58 is formed at its initial end with a mixing chamber 66 of cylindrical form, in its intermediate part with a frusto-conical portion 68 and 55 in its terminal part with an enlarged cylindrical portion 70.

60 The mixing chamber 66 is of relatively small capacity and is closed at one end by an end plate 72. The supply pipes 36 and 38 discharge into the mixing chamber 66 and on diametrically opposite sides thereof. The opposite end of the casing is closed by an end plate 74.

65 A shaft 76 extends longitudinally of the casing 58 and is journaled at one end in a closed hub or bearing portion 78 on the end plate 72.

70 The shaft is also journaled in a bearing member 80 which has a threaded connection with the end plate 74. A locking collar 82 prevents relative movement of the bearing and end plate, and a packing gland 84, supplied with suitable packing material 86 is provided to prevent leakage from the casing around the shaft 76. The 75

bearing members 78 and 80 preferably are provided with bronze bushings 88 for the shaft.

Fixed to the shaft 76 within the chamber 66 is a spiral blade 90 located in the terminal portion of the chamber 66 or in other words—beyond the 5 point where the supply pipes 36 and 38 communicate therewith. A spiral blade 91, on the shaft 76 traverses the asphalt and emulsifying inlets and contributes to the rapid and thorough mixing of the ingredients. 10

A frusto-conical rotor 92 is fixed to the shaft 10 76 as by means of a set screw 95, within the frusto-conical portion 68 of the casing, this portion constituting a stator for cooperation with the rotor. The tapering walls of the rotor 92 are 15 spaced a slight distance from the tapering walls of the stator 68 to provide an elongated annular aperture 94 leading from the initial mixing chamber 66 to the enlarged cylindrical chamber 70, and this aperture preferably converges slightly 20 toward its outlet.

In the enlarged terminal chamber 70 of the casing is a centrifuging member consisting of a disc 96 formed with a hub 98 which is fixed to 25 the shaft 76 as by a set screw 100.

A plurality of curved blades 102 extend outwardly from the hub 98 and are connected with the face of the disc 96 on that side toward the rotor 92 and adjacent the annular aperture 94. 30 The disc 96 is of considerably greater diameter than the terminal end of the rotor 92 so that the centrifuging member extends across the terminal end of the aperture and is arranged to act upon fluid substance as it emerges from said aperture. The curved blades 102 have their 35 concaved sides arranged in the direction toward which the centrifuging member is rotated so that they have a tendency to throw liquid substance not only in a radially outward direction but also to cause a sort of swirling motion within 40 the chamber 70.

The rotor shaft 76 is operatively connected with the shaft of the motor 12, preferably through the medium of a suitable universal joint 45 such as 104.

Means preferably is provided whereby a slight 45 adjustment may be made of the position of the rotor 92 relative to the walls of the chamber 68, for the purpose of compensating for wear or for regulating the width of the aperture 94. For 50 this purpose I provide an adjusting screw 106 which is threaded in the end of the closed bearing 78 and which engages at its point with the end of the shaft 76. A lock nut 108 on the adjusting screw serves to maintain the adjust- 55 ment when made. The bearing member 80 against which the hub 98 abuts is also adjustable.

In preparation for the operation of the apparatus, the bitumen and the emulsifying agent 60 are placed respectively in the containers 16 and 18. The bituminous substance may be asphalt, adapted to be liquified upon the application of heat. The contents of both containers are brought to the desired temperatures by the use of 65 the steam coils 17 and 19.

The valve 40 may be closed and the pump 20 operated for pumping the bitumen through the by-pass and thus creating a circulation whereby the bitumen may be brought to the desired uniform temperature and fluidity, before supplying 70 any bitumen to the emulsifying unit.

So also the emulsifier can be properly heated before the ingredients are started to the emulsifying unit. 75

It will be noted that the thermometers 31 and 33 are used to indicate the temperatures of the two substances as they pass from their containers to the pumps.

5 The valves 40-42 may then be opened for allowing flow to the unit A.

10 The meters 52 and 54 afford means by which the rate of flow of the two substances may be observed and the valves in the respective supply lines provide means for regulating the flow so that the desired relative proportions of the two substances may be admitted to the emulsifying unit.

15 The two substances, namely the liqueous bitumen and the emulsifier, are introduced through the pipes 36 and 38 to the initial mixing chamber 65 which constitutes a closed confined, receiving or mixing chamber.

20 At the instant when the bitumen meets the emulsifier in the chamber 66 there is a foaming action which greatly increases the volume of the mixture and spreads the bitumen into thin films, thereby forming a coarse or rough emulsion with the bitumen as the external phase—in other words, drops of emulsifier surrounded by films of bitumen and constituting a primary emulsion. The foaming, frothing action serves to stretch the films of bitumen.

25 The primary emulsion is then immediately removed from the zone of formation and is subjected to agitation by the action of the spiral blade 90, whereby the films of bitumen are broken up into minute particles and are thoroughly dispersed and diffused. This produces a coarse or rough emulsion with the bitumen as the internal phase. In other words, the emulsion is inverted and the secondary emulsion consists of particles of bitumen surrounded by films of the emulsifier.

30 The secondary emulsion is immediately forced beyond the chamber 66 and is caused to enter the narrow annular aperture 94 between the relatively movable surfaces of the stator 68 and rotor 92. The coating surfaces act to stretch, sub-divide, roll and spread the particles of bitumen through the emulsifier, thus forming a tertiary finer emulsion. The space between these surfaces is such as to promote the result just mentioned and to thoroughly diffuse and disperse the substances and to that end the surfaces may be suitably serrated or otherwise deformed or roughened as desired.

35 I have found that an efficient method of roughing the surface of the rotor is by the formation of a series of longitudinally extending grooves such as 110. These grooves begin at the initial or smaller end of the rotor and extend lengthwise thereof, and preferably decrease in depth, finally tapering out into the surface of the rotor at points spaced from the terminal end thereof, as shown in Figures 3 and 4. The grooves 110 may be of any desired cross sectional shape, either rectangular or substantially triangular, and in the latter event the leading edge of each groove, with respect to the direction of rotation, preferably is substantially radial of the rotor and the groove decreases in depth in a circumferential direction.

40 The fineness and uniformity of the finished product is controlled to a considerable extent both by size and character of the space between the surfaces and by the speed or movement of the rotor. It is quite desirable that the aperture taper or decrease slightly in depth so that there is a constant decrease in the space between the

surfaces as the emulsion passes between them. This is accomplished by the tapered formation of the stator and rotor and it may be regulated by longitudinal adjustment of the rotor shaft as previously described or by adjustment of the rotor member 92 on the shaft.

45 By also forming the grooves 110 of gradually decreasing depth, there is a provision of coating surfaces which gradually decrease as to spacing so that there is a variation of convergence between the coating surfaces, which is found to have a beneficial result with respect to securing a product having the desired characteristics.

50 As the emulsion emerges from the narrow converging aperture or annular space between the surfaces of the rotor and stator, it immediately is engaged by the centrifuging member, being projected against the surface of the disc 96 and being taken up and thrown laterally as well as outwardly by the curved blades 102.

55 This accomplishes a re-mixing action and also causes the entrapped air to be released so as to render the emulsion more liquid. It reduces the substance from a foamy to a more fluid state and considerably increases the thoroughness of the mixing and the completeness of the dispersion and is found to be quite a valuable feature in the production of a stable liqueous emulsion.

60 The emulsion is then discharged from the casing through an outlet pipe 112 and is conveyed into a suitable receptacle or container where it preferably is rapidly cooled to normal temperature by any suitable means to increase stability. I provide a thermometer 114 which is placed in communicating relation with the discharge pipe 12 at a point near the emulsifying unit, the purpose of which is to indicate the temperature of the emulsion as it is discharged. This is of importance in that it enables the operator to keep an accurate check on the prevailing temperatures under which the emulsion is formed in order that he may intelligently regulate the application of heat to the substances before they are introduced to the emulsifying unit.

65 I have shown a structure in Figure 1, for heating up the parts, preparatory to supplying asphalt from the pump 20 to the unit A. The valve 40 is closed and steam is admitted from 50 the supply pipe 62 through the valve 118 and pipe 116 to the tube 36 and thence to the interior of the unit and out through the discharge pipe.

70 In Figure 6, I have shown the pump 20, the pipe 36 and the meter 52, provided with a steam jacket 20a, communicating with the steam supply pipe 62 through a control valve 122. The use of the steam jacket facilitates preliminary heating of the parts and the maintenance of proper temperatures.

75 The jacket 60 of the unit A may be provided with a suitable bleeder outlet such as 123 for passage of steam and water of condensation. The steam jacket 20a is also provided at a low point with a bleeder outlet 36a. (Figure 6).

For convenience in introducing water to the container 18 in which the emulsifying agent is mixed and kept, I provide a pipe connection with any suitable source of water supply.

80 This pipe connection includes a supply pipe 124 which is connected with the supply pipe 38 through which the emulsifying agent is carried from the container 18 to the emulsifying unit. The point of connection is located between the

valve 42 and the meter 54, and the supply pipe 124 is provided with a control valve 126. Between the meter 54 and the emulsifying unit the supply pipe 38 is provided with a shut-off valve 128, and between this valve and the meter there is a connection with the pipe 38 of another pipe 130 leading to the container 18, this pipe being provided with a control valve 132.

In the pipe 38 between the valve 128 and the emulsifier unit is a check valve 127 to prevent back flow from the unit.

Ordinarily during the operation of the machine for making emulsion the valves 126 and 132 are closed while the valves 42 and 128 are open to permit the emulsifying agent to be drawn from the container 18 and carried to the emulsifying unit.

When it is desired to supply water to the container 18 the valves 42 and 128 are closed and the valves 126 and 132 are opened, thus permitting water to flow through the supply pipe 124, through a portion of the pipe 38 and through the meter 54, and thence through the pipe 130 to the container. The purpose of connecting the water supply pipe with the supply pipe 38 is to permit measuring of the water as it is introduced to the container 18 by passing it through the meter 54 and thus providing a convenient means, without duplication of meters, for determining and regulating the amount of water that is supplied to the container for making the emulsifying agent.

I purposely make use of the formation of the original or primary bitumen external phase emulsion, arising out of the natural phenomenon of introducing the two liqueous substances at proper temperatures and by opposed inlet pipes, into a substantially closed chamber of the proper size. This is advantageous in breaking the bitumen into films and by proper regulation of the combined temperatures there is produced a maximum frothing or foaming action, and thus maximum thinness of the film. By producing a thin film at this stage the amount of grinding necessary for securing any desired fineness of particles is reduced and the requisite fineness secured with more certainty.

The immediate removal of the primary emulsion from the zone of formation before the bitumen can agglomerate, and bringing about the inversion of phase without changing the relative proportions of ingredients is also important, this being accomplished by the spiral agitating member 90.

By causing the secondary emulsion to pass between the elongated surfaces for the grinding action, the relatively coarse emulsion is changed to one of finer form.

The passing of the material between converging moving surfaces causes a greater variation of size than would otherwise result, thus making for low voidage between particles and permitting maximum bitumen content as well as making for minimum surface area and thereby permitting the use of a minimum amount of emulsifier. These results are obtained without sacrifice of fluidity.

The final step of subjecting the bituminous emulsion to centrifugal action, immediately after the formation and as it leaves the aperture between the converging surfaces is also important. This step reduces the hot emulsion from a foamy to a more fluid state, further breaking down the size of the particles, releases air and increases the thoroughness of mixing and dispersion so that the

emulsion will be stable and remain fluid when cooled.

There is provided in my machine a unitary structure whereby all the factors, entering into the making of bituminous emulsion can be accurately controlled. The advantages of such a structure are largely obvious from the foregoing description. The maintenance of proper temperatures of the ingredients and the emulsion is of great importance and can be assured with this equipment.

I have found after many trials that gravity flow to the unit is not practical. The pumps provide the desirable positive pressure which may be accurately controlled by the valves. The centrifuge functions in part like a pump and affords a further control and a means for avoiding too great back pressure in the unit.

The closed system, from containers through the emulsifier unit, avoids intake of air, and helps to insure temperature control and accurate proportioning of the ingredients.

It has been found that a machine having the characteristics set forth herein is very efficient for producing a bituminous emulsion possessing the desired properties of fineness and uniformity of texture and complete coating and enveloping of individual particles of bitumen with the emulsifying solution.

It is to be understood that various changes may be made in the form and arrangement of certain parts of the machine within the scope of the appended claims without departing from my invention.

For instance, I would suggest that the closely approximated relatively moving surfaces may be of any desired shape and arrangement and that the convergence of the surfaces, as well as the method of deforming or roughening them, may be varied from the present disclosure. It is also within the scope of my invention to employ a single motor for operating the emulsifying unit and the pumps, it being clear that the motor 12 may be omitted and that a suitable driving connection may be made directly from the motor 14 to the shaft of the unit A.

I claim as my invention:

1. In a machine for making bituminous emulsion, a container for bitumen, an emulsifying unit, a pipe line from the container to the unit, a pump in the pipe line, a by-pass pipe from the pump back to the container, a by-pass valve in said by-pass pipe, a regulating valve for regulating the flow of bitumen from the container arranged in said pipe line between said pump and said unit so that bitumen may be caused to flow from the container only to the pump and back through said by-pass pipe and valve to the container or only through the pump and the regulating valve to the unit, or through the pump and partly through the by-pass pipe and valve back to the container and partly through the regulating valve to the unit, and means for indicating the temperature of the bitumen passing through the pump.

2. In a machine for making bituminous emulsion, a container for bitumen, an emulsifying unit, a pipe line from the container to the unit, a pump in the pipe line, a by-pass valve between the pump and the container, a regulating valve for regulating the flow of bitumen from the container arranged so that bitumen may be caused to flow from the container only to the pump and back through said by-pass valve to the container or only through the pump and said regulating valve to the unit, or through the pump and partly to

through the by-pass valve back to the container, and partly through the regulating valve to the unit, means for indicating the temperature of the bitumen passing through the pump, means for supplying emulsifier to the unit, and means for indicating the temperature of the emulsion in the unit.

3. In a machine for making bituminous emulsion, a container for bitumen, an emulsifying unit, a pipe line from the container to the unit, a pump in the pipe line, a by-pass valve between the pump and the container, a regulating valve for regulating the flow of bitumen from the container arranged so that bitumen may be caused to flow from the container only to the pump and back through the by-pass valve to the container or only through the pump and the regulating valve to the unit, or through the pump and partly through the by-pass valve back to the container and partly through the regulating valve to the unit, means for indicating the temperature of the bitumen passing through the pump, means for supplying an emulsifier to the unit, means for indicating the temperature of the emulsifier before it reaches the unit, and means for indicating the temperature of the emulsion in the unit.

4. In a machine for making bituminous emulsion, a container for bitumen, an emulsifying unit, a pipe line from the container to the unit, a pump in the pipe line, a by-pass valve between the pump and the container, a regulating valve for regulating the flow of bitumen from the container arranged so that bitumen may be caused to flow from the container only to the pump and back through the by-pass valve to the container or only through the pump and the regulating valve to the unit, or through the pump and partly through the by-pass back to the container and partly through the regulating valve to the unit, means for indicating the temperature of the bitumen passing through the pump, means including a pump for supplying emulsifier to the unit, means for indicating the temperature of the emulsifier before it reaches the unit, valve control means in the emulsifier line, and means for indicating the temperature of the emulsion in the unit.

5. In a machine for making bituminous emulsion, a container for bitumen, a container for emulsifier, an emulsifying unit, pipe lines from the respective containers to the unit, pumps in the pipe lines, valves for controlling flow through the pipe lines, controllable means for heating the containers, thermometers for indicating the temperature of the bitumen and the emulsifier before they reach the unit, and means for indicating the temperature of the emulsion in the unit, and flow meters in the pipe lines, whereby the temperatures, and relative volumes of the bitumen and emulsifier flowing to the unit may be controlled by said controllable means and by said values respectively.

6. In an emulsifying machine, a container for bitumen, a container for emulsifier, an emulsifying unit, pipe lines from the containers to the unit, pumps in said pipe lines, means for operating said pumps for forcing the ingredients from the containers to the unit, said unit including a

casing with inlet and outlet openings, a rotor, said casing and rotor having emulsifying surfaces, a rotary centrifuge near the outlet opening and spanning the space between said surfaces whereby emulsified bitumen emitted therefrom will impinge against said centrifuge, and means for operating the centrifuge.

7. In a machine for making bituminous emulsion, a bitumen container, an emulsifier container, an emulsifying unit, pipe lines leading from the containers to the unit, pumps in said pipe lines for forcing the ingredients to the unit under pressure, means for heating the containers, a water supply pipe leading to the pipe line from the emulsifier container to the unit and communicating therewith at a point between the pump therein and the unit, a measuring meter in the emulsifier pipe line between the water supply line and the unit and a pipe leading from the emulsifier pipe line between the meter therein and the unit and arranged for conducting a new supply of fluid through the meter to the emulsifier tank.

8. In a structure of the kind described, an emulsifying unit comprising a casing having an inlet and mixing chamber of size sufficient for permitting the foaming and expansion of the ingredients and the formation of a coarse emulsion, having a truncated cone-shaped portion leading therefrom and having an enlarged cylindrical portion at the discharge end of the truncated cone-shaped portion, larger in diameter than the diameter of the outlet of said last-named portion, a shaft projecting through said unit, a truncated cone-shaped rotor thereon in the truncated cone-shaped portion of the casing, an outlet leading from the cylindrical portion of the unit, a centrifuge on the shaft in the cylindrical portion extending from the shaft across and beyond the outlet from the truncated cone-shaped portion, means for heating the unit, said inlet and mixing chamber having opposite inlet openings for hot melted asphalt and an emulsifier, a spiral member on the shaft in the inlet chamber adapted to traverse said inlet openings and mix the ingredients and advance them toward the rotor, and a second spiral member on the shaft spaced from said first spiral member in the direction of the rotor and adapted to mix and advance the ingredients toward the rotor.

9. In a machine for making bituminous emulsion, a container for bitumen, an emulsifying unit, a pipe line from the container to the unit, a pump in the pipe line, a by-pass pipe from the pump back to the container, a by-pass valve in said by-pass pipe, a regulating valve for regulating the flow of bitumen from the container arranged in said pipe line between said pump and said unit so that bitumen may be caused to flow from the container only to the pump and back through said by-pass pipe and valve to the container or only through the pump and the regulating valve to the unit, or through the pump and partly through the by-pass pipe and valve back to the container and partly through the regulating valve to the unit.

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