Sept. 22, 1953 O. F. CAMPBELL 2,652,594

TREATMENT OF PITCH

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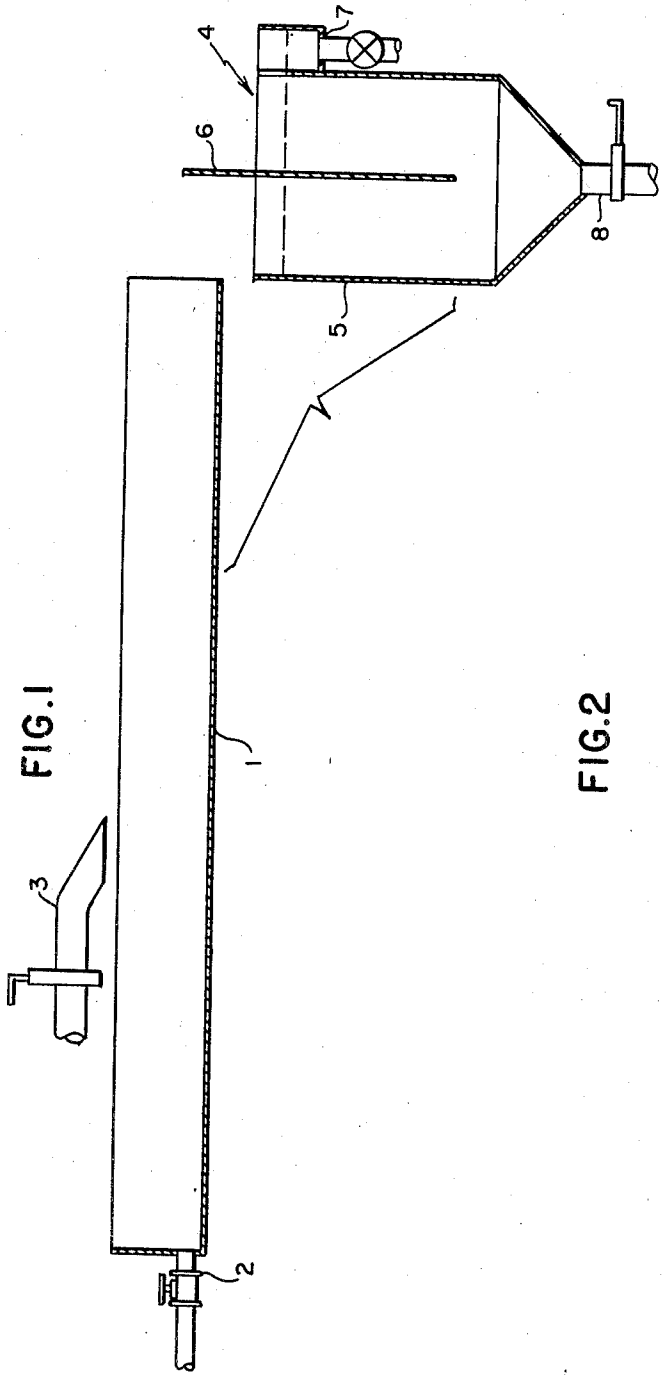


FIG. 1

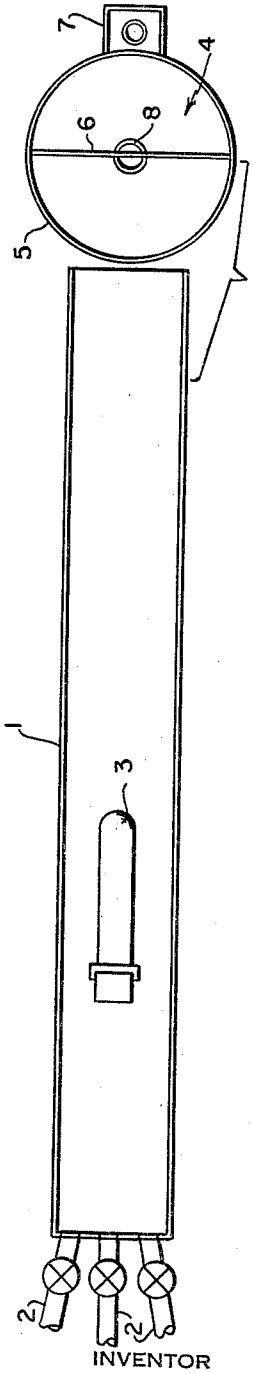


FIG. 2

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TREATMENT OF PITCH

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2 Claims. (Cl. 18—47.3)

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My invention relates to the water quenching of hot molten petroleum pitch to produce a solid pitch conveniently adapted to conventional methods of storage and transportation. My invention is useful in the disposal of waste pitch produced in the conversion of heavy petroleum oils. More particularly, my invention finds special utility in the pitching process, described in the applications for United States Patents, Serial Nos. 136,069 and 135,427, filed on December 28, 1949, by Harry L. Pelzer and by Leroy K. Cheney, respectively, by providing a means for converting the pitch produced therein to a form compatible with commercial handling methods whereby the pitch may be transported to a point of use or storage.

The current production of heavy petroleum residual products vastly exceeds the natural demand for such residua in any form. The before noted copending applications describe a process of pitching which increases the recovery of more desirable hydrocarbons from such residua, but which is, itself, accompanied by a large production of petroleum pitch. The problem of the disposal of such pitch is enhanced by almost complete lack of utility as such in quantity, since it is obtained in the liquid state at temperatures usually in excess of 500° or 600° F. and ranging upwards to 900° F. or more. Moreover, petroleum pitch has a softening point (R & B) which is of the order of 200° to 400° F. and, consequently, cannot be conveniently transported by pipe lines of any extended length without heavy insulation and expensive reheating requirements in order to maintain it in fluid condition. In addition, liquid pitch cannot be kept at temperatures necessary to maintain it in the liquid state for excessive lengths of time, as it is subject to coking and tar separation whereby the pipe lines and other vessels carrying such liquid pitch become plugged. As a consequence of these considerations, any means for solidifying the pitch, of necessity, must be located in the proximity of the pitching unit. Furthermore the high softening point of the material prohibits conventional tank storage.

It has seemed necessary to dump the hot liquid at some convenient location such as in a lake or on an open field. But, as the material cannot be dumped at one location continuously for any extended period of time, unless unlimited space is available, such procedure provides only a temporary solution. Ultimately, a new location must be found or the solid mass of pitch must be removed by blasting or other equally impractical means. Since extended pipe lines are not commercially feasible, eventually, the pitching unit must be closed down for lack of space in which to dump pitch.

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The desirable solution of the problem is obviously a means by which hot liquid pitch may be cooled, solidified and fragmented so that it may easily be handled by conventional conveyors, elevators and other methods of transportation. It is even more desirable than the fragmented pitch should have some utility of itself, for example, as a fuel. It is to these ends that my invention is specifically directed.

By reason of the quantities of pitch which must be handled by any practical cooling means adaptable to commercial operation, water appears to be the most feasible coolant from an economic standpoint.

I have found that hot liquid pitch can be economically and practicably quenched with water on a commercial scale by introducing pre-cooled liquid pitch into a rapidly moving stream of water.

Several previous proposals have been made using water as a coolant.

It has been proposed to use a water-cooled drum flaking unit to produce a flaked solid pitch. Such a system is satisfactory in small scale operation, but is not practical when normal commercial production is contemplated, as equipment costs and size become prohibitive. For example, for such a unit to handle 10 barrels of liquid pitch per hour, a relatively small quantity in a commercial sense, would require a pair of drums 10 feet by 10 feet. Moreover, vast amounts of power are consumed in rotating the drums against the flaking edge in order to overcome the strong adhesion of the solid pitch to the drums.

It has been proposed to effect cooling by water sprays directed against liquid pitch on a flexible steel conveyor belt. To operate such a system satisfactorily, even at the low pitch rate of 10 barrels per hour, would require a flexible steel belt conveyor of 120 inches width. The largest such unit which appears to be available at this date is only 72 inches wide. Again, the equipment size for commercial operation is excessive.

Previous proposals of quenching liquid pitch by direct contact with a water coolant have been unsatisfactory because the product is friable, and bulky with low apparent density, and has a multitude of pores. Also, there is a large production of fines. Such solid fragments as are produced quickly crumble when handled by conventional equipment such as conveyors and elevators. The fine particles are extremely difficult to dry and

tend to clog standard mechanical handling equipment.

Moreover, hot fluid pitch is lighter than water and floats upon the surface forming a blanket. The underside of the blanket, which is in immediate contact with the water, as it cools and solidifies becomes a thin, tenacious, rubber-like, flexible sheet which is an inefficient conductor of heat. The molten pitch above builds up and tends to spread over the surface of the water. Such heat as is transmitted through the blanket to the water generates steam which bubbles up through the molten pitch causing it to froth. Ultimately, the pitch solidifies in a sponge-like mass.

Thus, if liquid pitch is poured into a water stream, it covers the surface with such a blanket. If it is broken up by spraying the liquid pitch or similar means, each fragment hardens at its surface with the described flexible, thin coating and eventually agglomerates with other particles, causes the production of steam and all solidify together in a frothy, sponge-like mass.

The flexible coating formed not only prevents quick solidification because it is an inefficient conductor of heat and because the temperature differential between the pitch and coolant is low, but also prevents further contact of water with the still liquid pitch beneath such flexible coating or surface.

It is indeed surprising in view of these considerations to find that pitch may be simultaneously quenched and fragmented by direct contact with the water by a process of gerat simplicity and low cost. Moreover, the pitch produced has substantially uniform fragment size, high density, and is non-friable. The fragments formed are smooth, hard, glass-like pellets which are particularly useful as a solid bituminous fuel, are easily dried, and do not crumble when subjected to the rough handling of a screw conveyor.

I employ a high velocity water stream as a coolant in which the velocity is sufficient to maintain the water in the turbulent state. I have found that a shredding action on the liquid pitch occurs when the pitch is introduced into the highly turbulent stream of water before it solidifies. The shredding breaks the pitch into small fragments, so that rapid, effective cooling and solidification can occur as the pitch is transported to a collecting zone.

It is also essential to the production of hard, fragmented pitch, as described above, that, prior to pouring the liquid pitch into the stream of water, it be cooled to a temperature between the softening point temperature of the pitch and the temperature at which the density of the liquid pitch is equal to that of the coolant water. Failure so to pre-cool the liquid pitch results in a soft, porous product, produces a less even fragment size and causes a large production of fines and floaters.

The drawings are of an apparatus suitable to illustrate the practice of my invention. Figure 1 illustrates a partially sectioned elevation of the apparatus and Figure 2 is a plan view of the apparatus shown in Figure 1.

In the drawings the reference numeral 1 indicates a horizontally positioned trough open at its top. Nozzles 2 are arranged at one end of trough 1, which is closed to support the nozzles, and project water along the trough at a high velocity. Pitch is introduced into the trough 1 by a convenient means such as a valved nozzle 3 as shown. The water and pitch are discharged from the open end of the trough into dewatering hopper 4 which comprises a vertical cylindrical tank 5 open at its top. A vertical baffle is placed in hopper 4 in contact with the sides of the tank 5 extending above the top of the tank as illustrated. Launder 7 serves the dual purpose of maintaining the water level in hopper 4 and of providing a water outlet. Valved line 8 is provided for the removal of solidified pitch fragments which sink to the bottom of hopper 4.

In carrying out my process, hot molten pitch, which typically is withdrawn from a pitching unit such as is described in the before noted copending applications of Harry L. Pelzer and Leroy K. Cheney, is first subjected to a pre-cooling operation.

Pre-cooling may be effected by several means. It is preferred that the step be carried out in a conventional shell and tube heat exchanger using high pressure steam or hot oil as the coolant. It is, however, practicable to cool the pitch in a drop stack using air, steam or a water fog as a direct contact coolant. The drop stack method is considered less desirable, primarily as it does not provide a good temperature control. Temperature control in the pre-cooling operation is quite critical as the pitch must not be cooled so close to its softening point that it may clog the nozzle used to introduce it into the water stream.

If a heat exchanger is employed, as in the preferred form, almost any coolant, consistent with economics involved, will be satisfactory if it is capable of being maintained at a temperature above the softening point of the pitch. Water is not satisfactory. The temperature of cooling water without pressure is too low so that a film of pitch solidifies on the inner surface of the tubes, thereby resulting in poor heat transfer and eventual clogging of the tubes. High pressure steam may be used but advantageously fresh feed to the pitching unit is employed. The pitcher feed will normally arrive at the unit hot or will receive preheat by exchange in the usual manner prior to the exchange with the hot pitch. Also, additional preheat is provided for the feed, assisting the thermal balance of the unit.

The liquid pitch, at the temperatures at which it is withdrawn from the pitching unit, has a density which is less than that of the water in the quench tank. However, as liquid pitch is cooled, its density increases, and equals and then exceeds that of water before the pitch hardens.

Pitch is drawn from a pitching unit typically at temperatures of about 550° F. to 650° F. The softening point and the temperature at which the specific gravity of the pitch is equal to that of water will vary according to the particular quality of the pitch. According to my invention the pitch is pre-cooled to about 350°–450° F. in the case of a pitch having a softening point of 282° F. and having a specific gravity of about 1.0 at 550° F. or to about 425°–550° F. in the case of a pitch having a softening point of 354° F. and having a specific gravity of about 1.0 at 650° F., at which temperatures the pitch has a specific gravity appreciably greater than that of water, but is in a free and running condition and not thick and viscous as it would be at temperatures closer to the softening point.

The cooled liquid pitch is delivered without substantial loss of temperature to nozzle 3 which is positioned above trough 1 to discharge the liquid pitch into the stream of water being maintained in trough 1 by nozzles 2. The stream of water must have a velocity sufficient to main-

tain a turbulent state. The location of nozzle 3 must be such that the pitch enters the stream where it is turbulent.

The liquid pitch, as it contacts the turbulent stream of water in trough 1, is broken or shredded into small fragments which become suspended in the stream of water coolant. The particles are of such size that they are cooled and solidify into small, hard pellets as they travel along trough 1. The required length of travel will vary with the temperatures and relative quantities involved and the nature of the pitch, but in any case will not be large, e. g. about 10 to 20 feet.

The wash from trough 1 discharges into hopper 5. Baffle 6, placed in hopper 5, causes the water passing therethrough to flow in a U-shaped path, depositing the solid particles of pitch at the bottom of hopper 5 from which they are conveniently withdrawn through valve 8. The water passes through hopper 5 into overflow launder 7 from which it is withdrawn and may be recycled to nozzles 2 with a small quantity of make-up water to account for evaporation losses. The solid pellets of pitch withdrawn from valve 8 average about ⅛ inch in diameter and substantially all settle to the bottom of hopper 5.

An example of the dimensions and rates to be employed at a specific pitching rate of 10 barrels per hour follows:

Trough 1 is made from a 12 inch horizontal pipe the top 4½ inches being cut off. Nozzles 2 are three ¾ inch pipes placed at one end of the trough located near the bottom. Nozzle 3 is placed approximately 3 feet along the trough from nozzles 2. A water rate of 150 gallons per minute is employed, giving a nozzle discharge velocity of 30 feet per second. The three streams from nozzles 2 are directed to converge between 18 and 24 inches along trough 1 from the nozzles 2. The length of trough 1 is 12 feet, and the pitch fragments recovered are uniform in size and of hard, dense appearance.

Various nozzle arrangements including a single nozzle and nozzles of different orifice shapes may be employed as desired to control the linear velocity of the water traveling through the trough. A ratio of 2 gallons of water per pound of pitch provides satisfactory operation but does not appear to be critical, even when the coolant is to be recycled. Although a trough of short length may be employed, I have found it advantageous to transport the pitch in the cooling system directly to a storage area, in which case a small pond may take the place of hopper 5 and the

length of the trough may extend up to several hundred feet as required to reach storage. In such an arrangement booster nozzles are placed along the trough at approximately 50 foot intervals in order to prevent the pitch from falling out of suspension in the water which is used as a transporting medium. The pitch pellets may be removed from the bottom of the pond as by a clam shell which need be operated only part of the time. The pond should be large enough to retain at least a day's collection of pitch, but preferably should be able to retain a larger quantity in order to yield a certain flexibility in the operation of both the pitching unit and the dredging means.

The water temperature may vary over the atmospheric range or higher without significant effect on the operation of the process although, if the water coolant is at a temperature approaching its boiling point, a less dense, friable pitch pellet is produced.

I claim:

1. In the process of cooling and solidifying hot molten pitch by contact with a water coolant, the steps of simultaneously solidifying and fragmenting hot molten pitch by introducing the pitch at a temperature above the softening point temperature of the pitch but below the temperature at which the specific gravity of the pitch is equal to that of the water coolant into a stream of water coolant having a velocity which maintains a turbulent state at the point of pitch entry, and transporting the solid fragments of pitch in the water coolant to a collecting zone.

2. In the process of cooling and solidifying hot molten pitch by contact with a water coolant, the steps of cooling the hot molten pitch to a temperature above the softening point temperature of the pitch but below the temperature at which the specific gravity of the pitch is equal to that of the water coolant, simultaneously solidifying and fragmenting the pitch by introducing the cooled liquid pitch into a stream of water coolant having a velocity which maintains a turbulent state at the point of pitch entry, and transporting the solid fragments of pitch in the water coolant to a collecting zone.

OLIVER F. CAMPBELL.

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