

April 6, 1948.

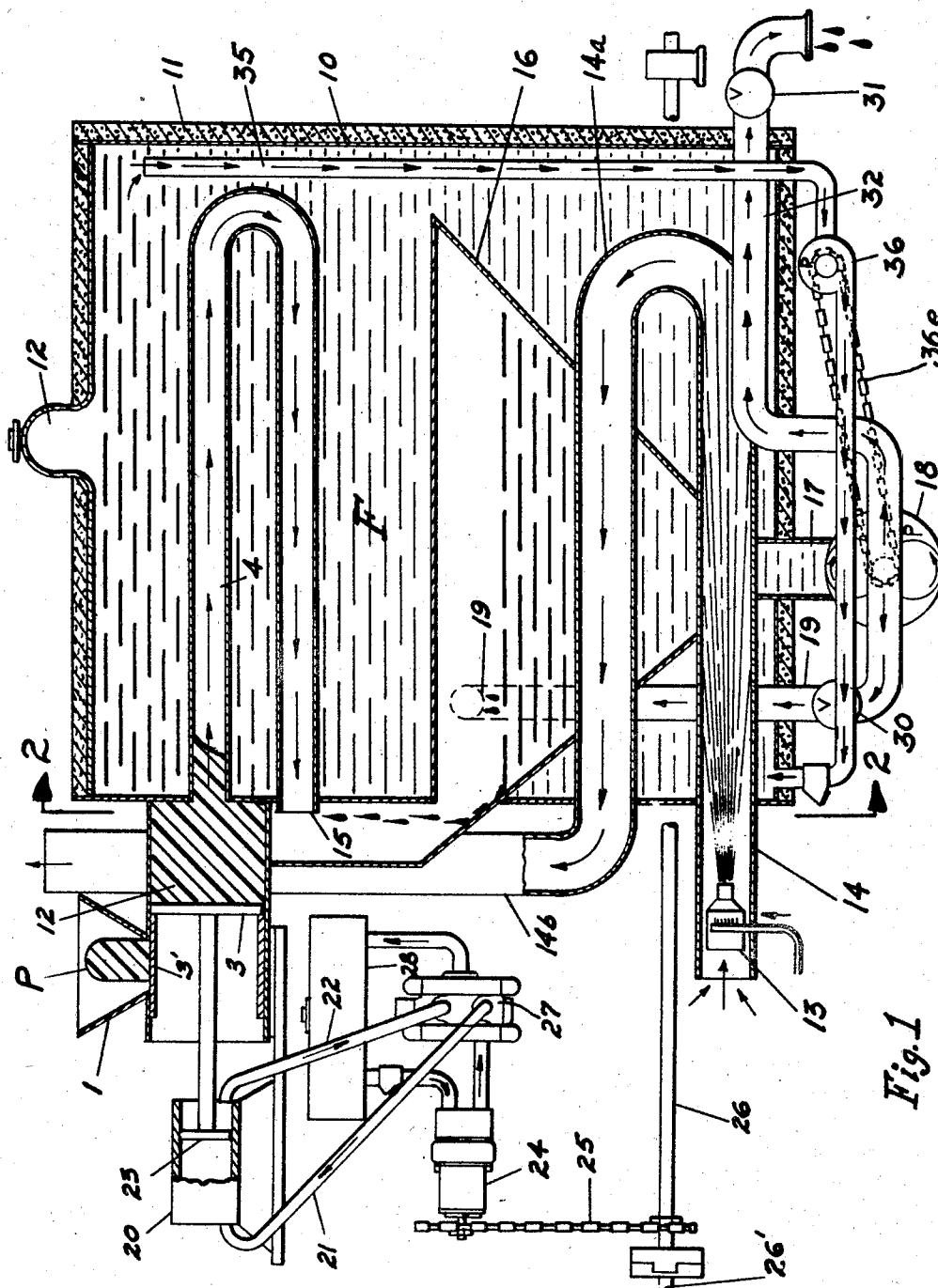
W. F. MIDDLESTADT

2,439,367

APPARATUS FOR MELTING PLASTIC COMPOSITIONS

Filed Dec. 27, 1945

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

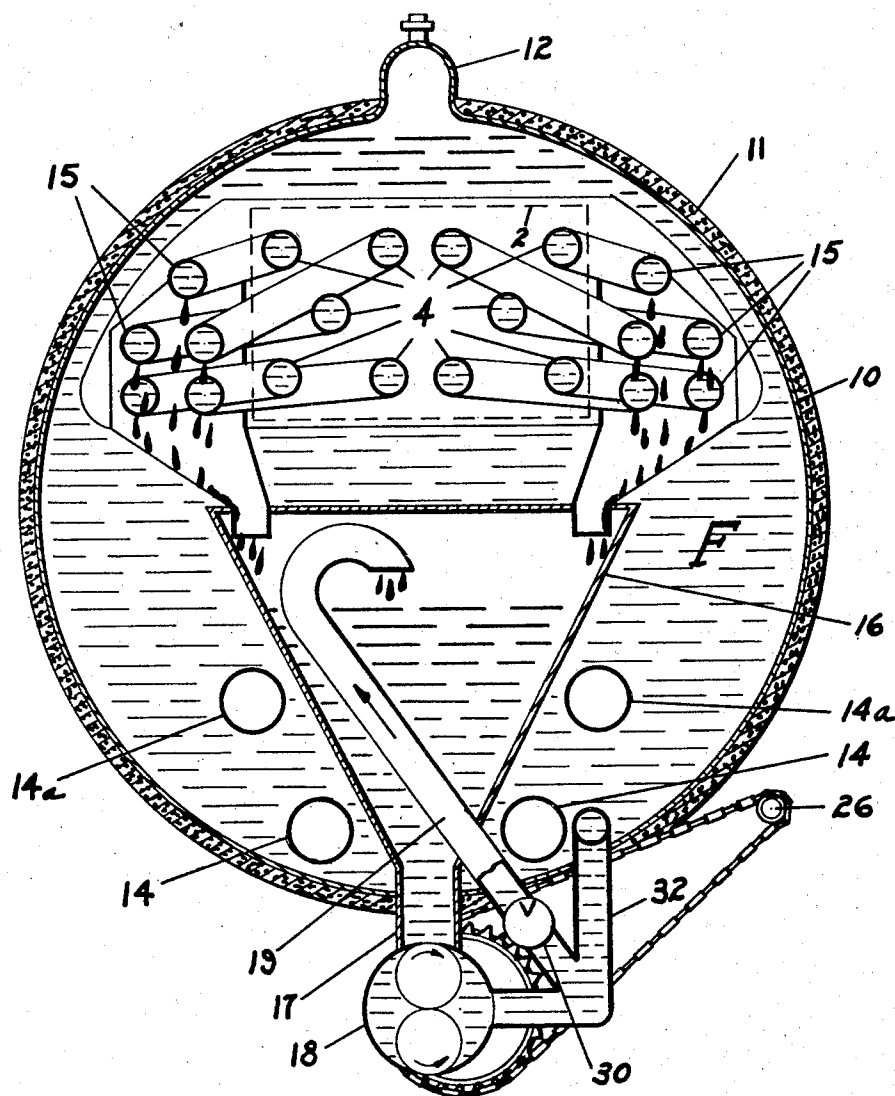


Fig. 2

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3 Sheets-Sheet 3

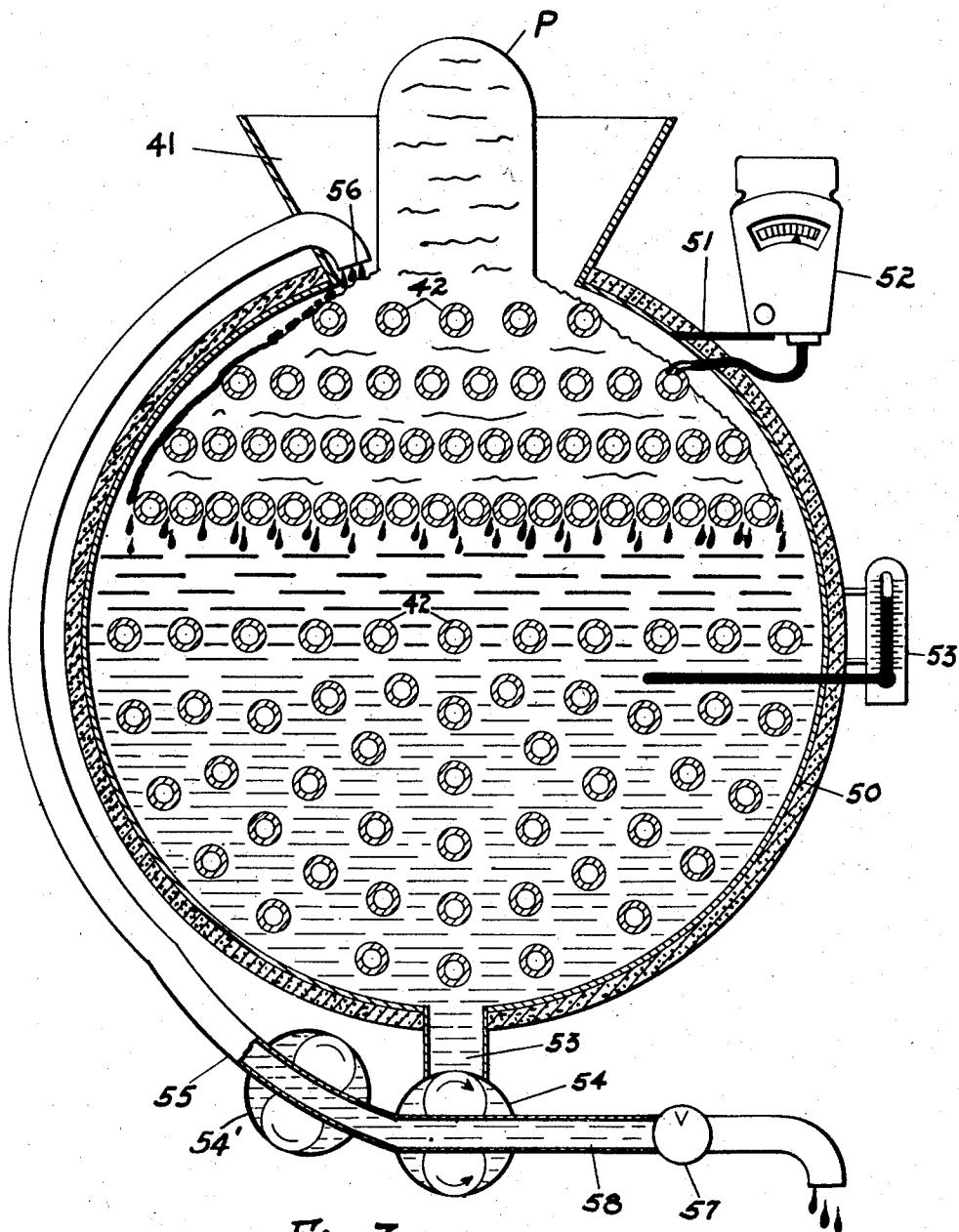


Fig. 3

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UNITED STATES PATENT OFFICE

2,439,367

APPARATUS FOR MELTING PLASTIC COMPOSITIONS

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3 Claims. (Cl. 126—343.5)

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This invention relates to a method of and apparatus for melting plastic masses, particularly those used for structural purposes, for example as fillers for sealing joints of concrete constructions, roof coatings and sealers, and the like.

It is the object of the present invention to provide arrangements for liquefying plastic masses of the hot-poured type in a manner to bring these masses into a fluid state capable of being poured into the crevices or joints between concrete sections without overheating the mass in order not to destroy the effectiveness of the composition in its functioning following the installation thereof.

It is the object of the present invention to treat sealing compositions for pavements, which are normally shipped in the form of solid blocks or slabs, in a manner to liquefy the same to adapt the composition to be poured in a molten state by means of conventional pouring spouts or by automatic filling machines of the type disclosed in my application Serial No. 600,538, filed June 20, 1945, without causing any deleterious chemical changes to take place in the composition as a result of the heating treatment. The invention is applicable to all types of plastic compositions used for such purposes, particularly bituminous type fillers which may be composed of various ingredients known in the art. These fillers may be formed of bituminous material alone, or bituminous material with fillers, or bituminous material with rubber and fillers, as well as bituminous material with natural or synthetic resins, with or without fillers. The invention is of particular utility in the treatment of rubberized bituminous materials of the type disclosed in the patent to Ross, No. 1,817,933, or in the commercial products such as "Sealz" marketed by Dispersions Process, Inc., a subsidiary of United States Rubber Co., or "Para Plastic," manufactured and distributed by Serviced Products Company, Chicago, Illinois.

According to past practices, the heating of the compositions of the types described above in standard asphalt kettles, to bring the products into a molten state for the purposes of enabling the pouring and depositing of the same into the joints between concrete sections, has resulted in the burning, oxidation and charring of the mass, causing a chemical breakdown or segregation of the constituents of the composition so that fol-

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lowing the heating operation the sealing properties of the material would thereafter be destroyed. This was true despite the care with which the materials were prepared and the relatively high cost of the ingredients which were intended to render the sealing composition adaptable to perform the sealing functions under freezing weather conditions and repeated expansive and contractile movements of the pavement sections between which the composition was adapted to be poured and adherently affixed to the lateral walls thereof.

The invention proceeds upon the principle of bringing the solid lumps of the sealing material into a molten state adapted for pouring without possibility of overheating of the mass, or the heating thereof in an unduly rapid manner which causes the carbonization of the bitumen, the melting of the rubber, or any other undesired deleterious effects upon these and other ingredients of the sealing compositions. By means of the invention, the composition is rendered fluid at a temperature below the normal melting point of the composition, and far below any point at which any of the ingredients undergoes any chemical change or that at which any chemical breakdown or segregation of the constituents takes place.

This general objective is attained by applying a controlled degree of heat to the mass of material from its solid state to its ultimate molten state while mechanically manipulating the particles of the mass to supplement the heating thereof so that no parts thereof may reach temperatures sufficiently high to exert a destructive effect upon the chemical properties of the composition or the several ingredients thereof. The heating is performed by indirect means so that the composition at no time is exposed to any hot spots, and the control may be rendered automatic so that the heating range may be kept within predetermined limits without the necessity of human intervention, assuring that the requirements of the specifications in the handling of the different materials may be attained. In addition to the heat, which is applied externally by means of heated air or liquid, or insulated electrical heat, internal heat is produced in the mass by the attrition of the particles thereof as the same are passed through rotary pumps such as

gear pumps and/or extrusion devices, which further serve to bring the individual particles into more intimate heat exchange relationship with the surrounding source of indirect heat. Thus, the combination of indirect heat with the manipulation or mastication of the plastic mass as may be attained by the recirculation of the molten mass through a gear pump, result in a rapid and effective mode of rendering the mass fluid without any tendencies for the constituents thereof to separate or segregate, whereupon the mass is in condition to pour by withdrawing the same from the apparatus into portable kettles or any other pouring devices of the prior art of the type shown in the above mentioned application, Serial No. 600,538. If desired, the apparatus in accordance with the present invention may form part of the pouring unit as shown in said application.

Other objects and purposes will appear from the detailed description of the invention following hereinafter, taken in conjunction with the accompanying drawings, wherein

Fig. 1 is a vertical sectional view with certain parts in elevation of a preferred embodiment of the invention;

Fig. 2 is a vertical sectional view along line 2—2 thereof; and

Fig. 3 is a vertical sectional view of another simplified embodiment of the invention.

In Figs. 1 and 2 is shown one embodiment of the apparatus for melting solid blocks of plastic material P, which may be of the bituminous types enumerated above. This apparatus may be a stationary installation or may be mounted upon a truck or other vehicle to render the same portable. The blocks P, in the form of small pieces of about 5 pounds, may be cut from larger blocks, and are fed into a hopper 1 opening into a casing 2 in which a piston 3 is adapted to operate to press or extrude a mass of the plastic material in advance of the piston through a series of pipes 4 which are shown of U-shaped configuration in Fig. 1. The piston is formed with an integral valve element 3' to prevent the entry of the blocks P behind it in order not to interfere with the working stroke of the piston which is actuated from a hydraulic cylinder 20 having inlet conduit 21 and outlet conduit 22 operative at the opposite ends of the cylinder to alternately control the working piston 23 interconnected with piston 3 and of smaller cross sectional area than the latter in the casing 2 in order to multiply the force exerted upon the plastic mass being extruded through the pipes 4. The hydraulic unit is activated by the pump 24, which may be driven by sprocket 25, gears or any other suitable transmission from a drive shaft 26 which is coupled at the end 26' thereof to an internal combustion engine, electric motor or any other form of prime mover. The liquid of the hydraulic unit is controlled by the valve casing 27 which controls the communication between the outlet of the pump and the conduits 21 and 22 alternatively with the outlet of the pump and the by-passing of the circulating fluid through the tank 28. A hydraulic actuating unit of the type disclosed may assume various forms and is indicated only generally, since the essential features of the invention are not concerned therewith.

As shown in Fig. 2, the casing 2 and the piston 3 are of rectangular configuration and the number of tubes or conduits 4 opening into this chamber may be varied depending upon the desired capacity of the apparatus. Thus, there may be as

many as 50 one-half inch, outside diameter, tubes fed from a single plunger or piston. These tubes may be of configurations other than U-shaped as shown in the drawing, for example, spiral or serpentine. The tubes 4 are disposed at the upper part of the housing 10 which may be enclosed by an insulating jacket 11 and provided with a vent 12. The housing 10 is filled with a heated fluid medium F which may be oil. This fluid medium may be heated by means of a fuel oil burner 13 disposed at the end of tube 14 which directs the combustion gases along the base of the housing and reverses direction in portion 14a and exhausts to the atmosphere through the upwardly extending portion 14b which may be disposed as a stack in heat exchange relation to one end of the housing 10 and in the path of which may be disposed the casing 2 containing the plastic mass to cause a softening up of the material prior to the extrusion thereof through the pipes 4. The extruding pressures upon the plastic material into the plurality of pipes communicating with the casing 2 give rise to an attrition of the particles of the mass to cause a frictional heat to be generated therein, which, in conjunction with the heat of the fluid medium F surrounding the pipes, serve to melt the plastic mass without any local hot spots and with no possibility of chemical change of the ingredients of the plastic mass. While the discharge of the plastic mass from the ends 15 of the pipes 4 might be accumulated in a dispensing unit for pouring purposes, a greater degree of fluidity may be imparted to the mass by permitting the same to drop into the chamber 16 disposed at the base of the housing which is also surrounded by the fluid mass F and which is maintained in a desirably heated state by the proximity thereto of the combustion gas flues 14 and 14a. The chamber 16 discharges through the outlet conduit 17 to a gear pump 18 which recirculates the molten mass through the outlet of the gear pump and the conduit 19 to the top of the chamber 16. Not only does the gear pump serve to render uniform the degree of heat in the mass of molten material undergoing recirculation, but the same in addition serves to masticate the particles of the mass to supplement the mastication imposed originally on the particles in the extruding operation through the tubes 4. A control valve 30 in the conduit 19 may be operated selectively to permit circulation to take place or to block the same in conduit 19. This valve may be operated conjointly with another control valve 31 in outlet conduit 32 in order to permit selective withdrawal of the fluid material from the outlet of the gear pump in conjunction with the recirculation of some of the material or to the exclusion of such recirculation. Also, valve 30 may be opened and 31 closed to effect a recirculation of the mass with no withdrawal thereof. If desired, these two valves may be united in a common structure.

In order to render uniform the heating effects of the body of oil F in the housing 10, a pipe 35, extending upwardly through the housing, may be connected to a secondary or auxiliary circulating pump 36, having the outlet thereof communicating with the base of the housing in order to set up a forced circulation of the heating fluid. Any body of liquid, or even air, may be used as the heating medium F in the housing. Pump 36 may be driven by any suitable source of motive power, and as shown in Fig. 1, the same may be driven from pump 18 by the chain 36e.

As shown in the drawings, the drive shaft 26

operating the hydraulic pump 24 may be also used to drive the recirculating gear pump 18, as shown in Fig. 2. These drives may be taken off by chains and sprockets, as shown in Figs. 1 and 2, or by any equivalent transmission mechanisms.

In the simplified embodiment of the invention shown in Fig. 3, the lumps of plastic masses of reduced size are introduced through the hopper 41 and are allowed to rest upon heated elements 42. These heated elements may be hollow conduits through which hot air or liquid are circulated, or as shown in Fig. 3, they may take the form of insulating heating tubes 42 in which the heating elements are covered by a ceramic coating so that the plastic mass may flow in contact therewith and may be melted down to a plastic mass which gravitates to the bottom of the housing 50, as shown in Fig. 3.

A thermostatic control element 52 may be mounted upon bracket 51 and may embody an indicating thermometer or pyrometer which is connected to one of the heating elements and the electric circuit for the heating elements may be controlled automatically by a thermostat in order to limit the heating of the elements so that no charring or undesired local burning of the plastic mass will take place. A supplemental temperature indicating instrument 53 may be disposed in the lower portion of the housing to indicate the temperature of the liquid mass of plastic material which is discharged from the conduit 53 and which may be recirculated by the recirculating pump 54 to the conduit 55 which discharges into the top of the housing at 56. By selectively operating the valve 57 in outlet conduit 58, some of the material issuing from the circulating pump 54 may be withdrawn for utilization, while some is recirculated to effect a mastication of the plastic mass particles while subjecting them to heat-exchange with the heating elements 42 disposed in the housing 50.

In the handling of certain materials, it may be desirable to increase the masticating effects of the circulating pumps, whereupon a plurality of such pumps may be disposed in series in the conduits issuing from the housing; in the embodiment of the invention shown in Fig. 3 these may be disposed in either the conduit 55 and/or the conduit 58 so that the mastication is effected incidental to the recirculation of the material or immediately prior to its discharge from the heat exchange apparatus. Thus, as shown in Fig. 3, circulating pump 54' adds to the masticating effect performed by the pump 54.

The invention disclosed herein has been found particularly useful and effective in the preparation of expansion joint fillers of the hot-poured type for joint-sealing of concrete sections, Federal specifications for which may be found in Federal Standard Stock Catalog, Section IV, part 5, SS-F-336, May 6, 1942. These are as follows:

Joint-sealing filler of the hot-poured type for concrete shall be furnished in one grade only.

The joint-sealing filler shall be composed of a mixture of materials which will form a resilient and adhesive compound capable of effectively sealing joints in concrete against the infiltration of moisture throughout a complete cycle of expansion and contraction.

Material furnished under this specification shall be suitable for melting in the usual type of asphalt kettle. It shall be capable of melting readily and uniformly to a pouring consistency at a temperature of not more than 450° F. and

shall comply with the detail requirements specified below. The material shall not be damaged when heated to the temperature required for satisfactory pouring.

Material furnished under this specification when tested in accordance with the methods described in section F shall conform to the following requirements:

- (a) Pour point, not more than 450° F.
- (b) Melting time, not more than 60 min.
- (c) Penetration:
At 32° F., 200 g., 60 sec., not less than 0.28 cm.
At 77° F., 150 g., 5 sec., 0.45 to 0.75 cm.
- (d) Flash point, not less than 550° F.
- (e) Flow, not more than 0.5 cm.
- (f) Bond test.

There shall be no cracking of the material or failure in bond between the materials and the mortar test blocks at the end of five cycles.

By means of the invention, the material is not damaged when heated for pouring purposes as required in the third paragraph above, which occurs when the usual types of asphalt kettles are used.

Aside from the specific materials mentioned above, all types of plastic compositions subject to damage upon overheating may be melted in accordance with the present invention.

While I have described my invention as embodied in a specific form and as operating in a specific manner for purpose of illustration, it should be understood that I do not limit my invention thereto, since various modifications will suggest themselves to those skilled in the art without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

I claim:

1. An apparatus for transforming a solid thermoplastic rubbery composition composed of rubber and/or bitumen, resins and inert fillers to a liquid pourable state, comprising a closed housing containing a heated liquid medium therein, a combustion gas conduit for heating said liquid medium, conduits disposed in said housing, hydraulically operated means for forcing said thermoplastic rubbery composition through said conduits in heat exchange relation to said liquid medium to transform said composition into molten particles, a container in said housing for receiving the extruded molten particles of said composition and means for applying additional heat thereto to liquefy the composition for hot flow purposes with no chemical breakdown or segregation of the constituents thereof, a pipe extending into said housing and opening into said container, a recirculating pump having the inlet thereof connected to the outlet of said container and the outlet of said pump connected to said pipe and control valve means in said pipe for controlling the quantity of the molten mass undergoing recirculation in and withdrawal from the apparatus.

2. An apparatus as set forth in claim 1, including a secondary circulating pump for maintaining the heated liquid medium in circulation.

3. An apparatus as set forth in claim 1, including a secondary circulating pump for maintaining the heated liquid medium in circulation and a prime mover for actuating the hydraulically operated forcing means and said recirculating and secondary circulating pumps.

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