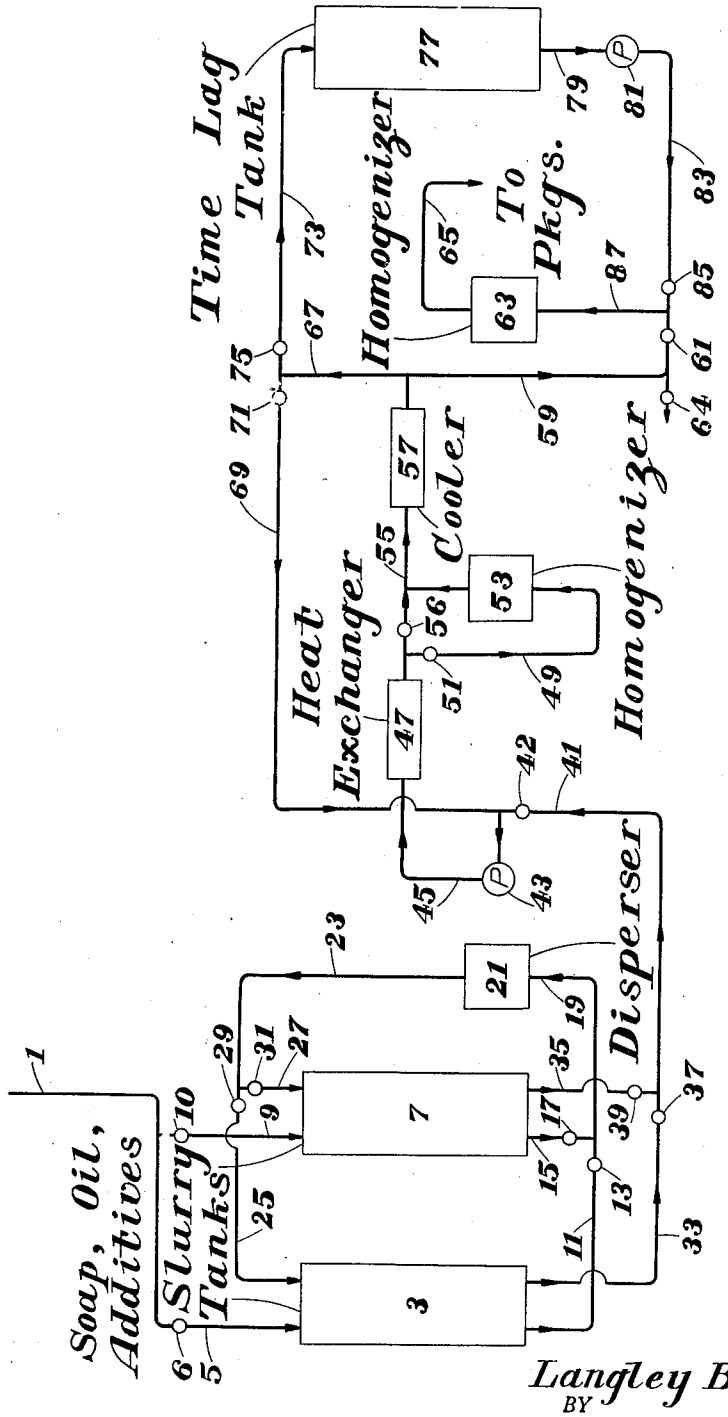
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CONTINUOUS GREASE MANUFACTURE

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CONTINUOUS GREASE MANUFACTURE

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1

This invention relates to apparatus and process for continuous or semi-continuous manufacture of grease.

Various methods have been proposed for the continuous or semi-continuous manufacture of grease. While some of these methods and apparatus have been fairly satisfactory, for the preparation of some types of grease, as for example, the preparation of aluminum soap greases, none of the methods and apparatus are very satisfactory for manufacture of other types of greases, such as sodium soap, calcium soap, and soda-lime greases.

One of the objects of my invention is to provide a method for continuous or semi-continuous manufacture of greases.

Another object of my invention is to provide apparatus for continuous or semi-continuous manufacture of greases.

A still further object of the invention is to provide apparatus capable of manufacturing various types of greases in a continuous or semi-continuous operation.

Other objects of the invention will become apparent from the following description of which the drawing is a diagrammatic, elevational view of apparatus in accordance with the invention.

Referring to the drawing, the numeral 1 indicates a line through which soap, mineral oil and various additives may be fed in proportioned amounts to either slurry tank 3 through line 5 controlled by valve 6, or slurry tank 7 through line 9 controlled by valve 10. Connected to the bottom of the slurry tank 3 is a line 11 controlled by valve 13. Connected to the bottom of slurry tank 7 is a line 15 controlled by valve 17. The lines 11 and 15 are connected through line 19 to the inlet of disperser or homogenizer 21. Any suitable apparatus capable of dispersing additive in the oil may be used as a disperser or homogenizer. We have found that a Cornell mixer or a Marco "Kombinator" is highly satisfactory for this purpose. The Kombinator is described in a brochure entitled "The Flow-Master Line of Processing Equipment," Catalog #10, issued by the Marco Co., Inc., 3rd and Church Sts., Wilmington, 50, Delaware.

The outlet of disperser or homogenizer 21 is connected through line 23 and lines 25 and 27 to the top of slurry tanks 3 and 7, respectively. Lines 25 and 27 are controlled by valves 29 and 31, respectively. By means of the lines and valves just described, a mixture of soap, oil and additives can be circulated from either slurry tank 3 or slurry tank 7 through the homogenizer

2

21 in order to prepare a good suspension of the soap and additives in the oil.

Connected to the bottom of slurry tanks 3 and 7 are lines 33 and 35, respectively, controlled by valves 37 and 39. Lines 33 and 35 are connected through line 41 controlled by valve 42 to the inlet side of the pump 43. The outlet side of pump 43 is connected by line 45 to the inlet of an efficient heat exchanger 47 which is designed to heat the suspension of soap and additive in oil to the desired temperature while continuously passing therethrough and while maintaining the soap and additive in suspension in the oil. An efficient heat exchanger for this purpose is the "Votator" manufactured by the Girdler Corporation, the operation of which is described in Industrial & Engineering Chemistry, vol. 36, No. 6, pages 522–528.

The outlet of the heat exchanger 47 is connected by a line 49 controlled by valve 51 to the inlet of a second homogenizer 53 such as a Kombinator or Cornell mixer, where complete dispersion of the soap in the oil is obtained by means of the extremely high conditions of shear developed in the homogenizer. From the outlet of the homogenizer or disperser 53 the grease passes through line 55 to a heat exchanger 57 such as a cooling Votator, where the grease is cooled down to a desired temperature for further processing. Heat exchanger 47 is directly connected to cooler 57 by by-pass line 55 controlled by valve 56. The outlet of the heat exchanger 57 is connected by means of line 59, controlled by valve 61, to the inlet of a third disperser or homogenizer 63 which may also be a Cornell mixer or a Kombinator and is also connected to valve-controlled withdrawal line 64. A conduit 65 is connected to the outlet of the homogenizer 63 through which the finished grease is withdrawn for packaging.

A line 67 connects the outlet of the heat exchanger 57 through line 69 controlled by the valve 71 to the inlet of pump 43. The outlet of heat exchanger 57 is also connected by means of line 67 and line 73, controlled by valve 75, to the upper portion of time lag tank 77. The bottom of the time lag tank 77 is connected by line 79 to the inlet side of pump 81. The outlet side of pump 81 is connected through line 83, controlled by valve 85 and line 87 to the inlet side of disperser or homogenizer 63.

The operation of the apparatus just described will depend to some extent on the type of grease which it is desired to manufacture. In starting up the apparatus, mineral oil of the proper physi-

cal and chemical characteristics for making grease is charged into either slurry tank 3 or 7. The required amount of soap and such additives as it is desired to add are also charged into the slurry tank.

In making the grease, sodium, calcium, aluminum, lithium, sodium-calcium, sodium-aluminum and other metal base greases may be used. The soap may be made from fat, oil or fatty acid. In addition to common lard or tallow, other suitable fats and oils which may be used are bone fat, castor oil, corn oil, cottonseed oil, horse fat and wool fat. Various fatty acids having from approximately 15 to 24 carbon atoms per molecule, such as oleic acid, stearic acid, animal fatty acids, cottonseed fatty acids, as well as petroleum naphthenic acids and acids obtained from oxidation of paraffin waxes may be used. Whether or not the fatty acid or the fat or oil is used will depend on whether it is desired to have glycerin present in the final product. Various additives for imparting particular characteristics to the grease may also be added. Fillers such as graphite, asbestos and sulfur may be blended into the mixture fed to the slurry tanks. Where it is desired to produce a grease with stringiness, high molecular weight poly-isobutylene polymers or natural or synthetic rubber may be added in small amounts. Anti-oxidants such as phenol, naphthylamine, amino phenols and others may be added in small amounts. Extreme pressure addition agents such as sulfurized fatty oils, sulfurized and phosphorized fatty oil, sulfochlorinated organic compounds and thio-phosphoric acid organic compounds may be added.

Assuming that slurry tank 3 is first charged, the slurry is circulated to and from tank 3 and to and from disperser or homogenizer 21 until the soap and additives are uniformly dispersed in the oil. Circulation to and from the slurry tank should be continued until the entire volume of material in the slurry tank has had an opportunity to pass through the homogenizer 21. Valve 13 in the line 11 is then closed and suspension is withdrawn from tank 3 through line 33 by means of pump 43. At the time withdrawal of suspension from line 33 to tank 3 is begun, tank 7 is filled with the required mixture of soap, oil and additive and cyclic circulation of the mixture to and from tank 7 through homogenizer 21 is carried out until a uniform suspension is obtained and is continued until tank 3 is substantially empty, at which time valves 37 and 17 are closed and valve 39 opened to permit withdrawal of stock from tank 7 by means of pump 43. Tank 3 is then refilled, valve 13 opened and cyclic circulation begun through the tank and the homogenizer or disperser 21. In this manner substantially continuous flow of the ingredients of the grease mixture from the slurry tanks 3 and 7 can be maintained through the remainder of the apparatus.

When initially starting the apparatus, it may be preferable to circulate the dispersion from the slurry tank by means of pump 43 through heat exchanger 47, cooler 57 and back through line 69 until the heat exchanger and cooler have attained a balanced condition thereby insuring proper heating and cooling of the soap stock during actual processing. During this initial circulating operation, valves 51, 61 and 75 as well as the valve in line 64 are closed and valve 56 is opened.

The processing of the grease mixture from the pump 43 through the remainder of the apparatus depends on the nature of the grease. Soaps when subjected to heat, exhibit three transitional temperatures, known as the uni-dimensional, bi-dimensional and tri-dimensional melting points. The bi-dimensional melting point is also known as the plasticity point and the tri-dimensional melting point is also known as the complete melting point. The transitional temperatures depend on the nature of the soap. For example, in the case of sodium stearate, these temperatures are approximately 164° F. for the uni-dimensional melting point; 266° F. for the bi-dimensional melting point; and 374° F. for the tri-dimensional melting point. The transition points become correspondingly lower as the unsaturation of the fat, oil or acid employed in making the soap increases. Since the fats, oils or acids used in making soap for the manufacture of grease are essentially mixtures of stearin and olein or of stearic and oleic acid, the transitional points of the soap will be somewhat lower than those given above for sodium stearate.

I have discovered that if the soap-oil mixture is subjected to homogenizing action at/or slightly above its bi-dimensional melting or plasticity point but below the tri-dimensional melting point of the soap, a grease of excellent texture and appearance can be made in a continuous operation.

When preparing sodium soap greases, sodium soap and mineral oil in the required portions are charged to slurry tank and brought to proper dispersion after which it is pumped by means of pump 43 through the Votator or other heat exchanger 47 wherein the dispersion is raised to a temperature of approximately 220 to 290°, depending on the plasticity point of the particular soap employed. When making sodium soap greases, the mixture charged to the slurry tank will contain approximately 2 to 50% by weight of soap, about 50 to 98% by weight of mineral oil of proper viscosity, less than 1% by weight of water and from approximately 0 to 5% by weight of glycerin. Where additives are used, the proportions of the aforesaid ingredients will be accordingly reduced. The mixture leaves the Votator or other heat exchanger 47 in a uniform state of suspension, and passes through Kombinator or other homogenizer 53 where complete dispersion of the soap in the oil is obtained and orientation of the soap molecules into a definite pattern or lattice takes place by the extremely high conditions of shear developed in the homogenizer. The same action takes place to some extent in conventional kettle grease operations, but the orientation of the soap molecules is less definite because of the lower conditions of shear.

From the Kombinator or other homogenizer 53 the grease passes to a cooling Votator or other suitable cooling means 57 where the temperature of the grease is lowered to a point between its uni-dimensional and bi-dimensional melting point. Depending on the particular soap employed, its temperature will vary from about 150° to 200° F. in order to obtain a grease with a fibrous texture. During the cooling process, in the Votator or other cooling element, the grease structure may be partially broken down, making the grease unsatisfactory for wheel-bearing lubrication and unable to consistently pass the CRC wheel-bearing test. In order to obviate this difficulty, the grease after leaving Votator 57 passes into a third Kombinator or other homogenizer 63 at a temperature approxi-

mating uni-dimensional melting point of the soap, namely, 150 to 200° F. Passage of the grease through the Kombinator or Cornell grease homogenizer at this temperature has the desired effect of restoring the grease to the desired texture.

From the homogenizer **63** the grease is taken through line **65** and is at a sufficiently low temperature for packaging.

When it is desired to produce a sodium soap grease having a smooth rather than a fibrous texture, the grease leaving Kombinator or other homogenizer **53** is cooled down to a temperature of 75° to 125° F. in the cooling Votator or other heat exchanger **57**, that is, the grease is cooled to a temperature below its uni-dimensional melting point while being subjected to a certain amount of shear in the cooling Votator. Grease prepared in this manner is ready for packaging after it leaves the cooling Votator **57** and does not require further processing in the Kombinator or other homogenizer **63**.

When the apparatus is used to prepare calcium soap grease, an amount of water equivalent to approximately 5–15 by weight based on the weight of soap used, should be present in the mixture in the slurry tank in order to stabilize the lubricating grease. The mixture will contain approximately 1 to 40% of soap, approximately 60 to 99% of oil, and from 0 to 4% of glycerin. These percentages will be reduced accordingly if additives are used.

The suspension is pumped to the heating Votator or other heat exchanger **47** where the temperature is raised to approximately the bi-dimensional melting point of the calcium soap or somewhat above this point but below the tri-dimensional melting point. The melting points of the calcium soaps are lower than in the case of the sodium soap. With respect to calcium soaps, a temperature of approximately 212° to 250° F. will be reached in Votator **47** depending on the specific fat used in preparing the soap. From the heating Votator **47**, the mixture passes at the aforesaid temperature to the Kombinator or other homogenizer **53** where the combination of soap, oil and water into grease takes place. From the Kombinator or other homogenizer **53** the grease passes through the cooling Votator **57** where the grease is cooled to a point which experience indicates is best for the particular grade or consistency of grease involved. This temperature is directly proportional to the soap content or consistency of the grease and generally will vary from about 130° F. for a zero consistency to approximately 210° F. for a No. 6 consistency. The grease leaving the cooling Votator **57** may be packaged directly through valve-controlled line **64** or may be subjected to further homogenizing in the Kombinator or homogenizer **63** to insure proper texture. If a homogenizer such as a Cornell grease homogenizer is used in this last step, deaeration of the grease is effected.

Where it is desired to manufacture aluminum soap grease, the suspension of aluminum soap and oil is pumped into the Votator or other suitable heat exchanger **47** where it is heated to approximately 275° to 310° F. For the preparation of aluminum soap greases, the mixture charged to the slurry tank will contain approximately 2 to 25% by weight of soap, about 75 to 98% of oil, with these proportions reduced in the event additives are used.

The mixture of soap and oil passes directly

from Votator **47** through line **55** to Votator **57** where the temperature is reduced to about 150° F. From Votator **57** the mixture passes to time lag tank **77** to give the mixture sufficient time for gelation. The time lag tank or unit **77** should be of sufficient size to permit the mixture to move continuously therethrough. From the time lag tank **77** the mixture is pumped to Kombinator or other homogenizer **63** in order to homogenize the mixture into the finished grease. From the homogenizer **63** the grease leaves through line **65** for packaging.

Where it is desired to prepare mixed soap greases such as sodium-lime, sodium-aluminum, or calcium-aluminum soap greases, the temperatures to be observed in each step will be intermediate to those for the temperatures required with regard to the individual soaps. Since the sodium soap generally comprises the dominant portion of the soap in mixed sodium soap greases, the processing temperature will generally approach that of the temperature required for preparing sodium soap greases. In general the temperature will approach the temperature required for the soap present in dominant proportions.

The proportions of the various ingredients such as soap, mineral oil, additives, and water which are used in preparing the soaps in accordance with my process, are the same as those which are generally used in the industry for preparing the various types of soap aforementioned. The type of oil used in preparing the grease is that conventionally used in preparation of greases by common batch method. The oil may be derived from paraffinic, naphthenic or mixed base crude, and may be a residual or distillate fraction suitably refined by acid, clay or solvent treatment. The viscosity of the oil used will, in general, vary between approximately 35–300 seconds Saybolt at 210° F. depending somewhat on the nature of the soap used in the preparation of the grease.

It is to be understood that although I prefer to use a Votator for the heating and cooling steps, any efficient mechanism for continuously heating or cooling plastic materials, such as greases, may be used in place thereof. The mixing action obtained in the Votator is immaterial to my process except insofar as it aids in obtaining efficient heating or cooling of the grease components.

An advantage of my process not heretofore mentioned is that it presents an easy way of getting rid of slop, line-cleanings and various materials which accumulate during grease manufacture. Such materials may be dumped into the slurry tanks and processed along with the oil and soap charged thereto.

It will be seen, therefore, that I have devised apparatus which is capable of continuously or semi-continuously making grease from various types of soap bases and that I have discovered that by heating and cooling the grease components to certain critical temperatures in a definite sequence, greases of excellent properties can be prepared in a continuous operation.

It is claimed:

1. The method of preparing sodium soap grease in a continuous operation comprising preparing a slurry of said soap in mineral oil, heating the slurry to a temperature between approximately 220° and 290° F., at which the soap is above its plasticity point but below its true melting point, homogenizing the slurry while at said temperature until it has attained the desired grease structure, and then reducing the temperature of

the resulting grease below the plasticity point of the soap before packaging.

2. Method in accordance with claim 1 in which the grease is cooled to a temperature below the uni-dimensional melting point of the soap, namely, 75° to 125° F., after homogenization, and then packaged.

3. Method in accordance with claim 1 in which the grease subsequent to homogenization is cooled to a temperature approximating the uni-dimensional melting point of the soap, namely, 150° to 200° F., and again homogenized at this temperature prior to cooling and packaging.

LANGLEY B. STEVENS.

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