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MIXER FOR VISCOUS LIQUIDS

Filed June 8. 1960

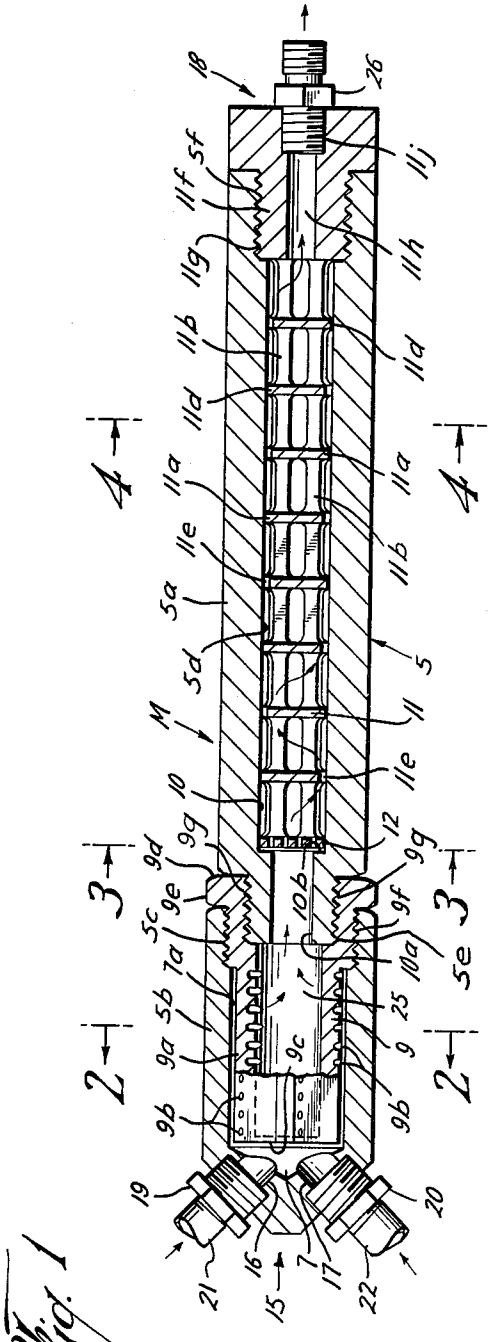

Fig. 1

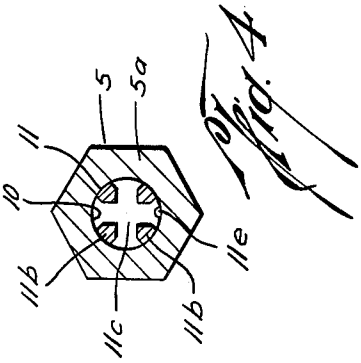

Fig. 4

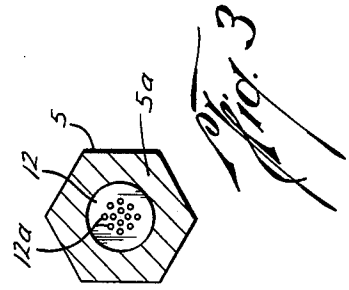

Fig. 3

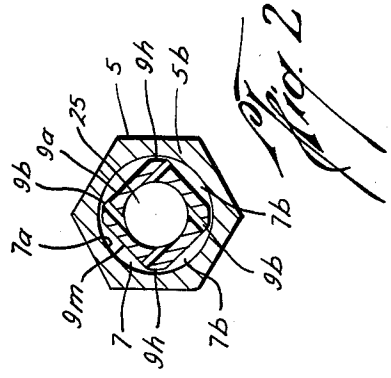

Fig. 2

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MIXER FOR VISCOUS LIQUIDS

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The present invention relates to a new and improved device for mixing viscous liquids and more particularly to a device for mixing a liquid plastic such as an epoxy resin with a liquid catalyst or promoter such as an amine compound.

Heavy viscous liquids, that is those ranging from a viscosity of 5 to 1,000 poise, have in the past, been quite difficult to mix together when such viscous liquids are of different viscosities. In endeavoring to mix liquids of this type there is a tendency for each liquid to retain its own identity and a result similar to that of the well known Stripe toothpaste is obtained. Prior art devices proposed to mix such viscous liquids are expensive, complicated and often only accomplish a partial mixing and do not keep the fluids continually flowing thereby creating dead spots in the mixing machinery. Such dead spots or places where the fluids are, in effect, retained result in a hardening of the fluids and a consequent stoppage or clogging of the mixing apparatus.

It is therefore an important object of the present invention to provide a new and improved device for mixing viscous liquids which is not only simple to operate and economical to make and use but which also is operable free of dead spots and thoroughly mixes heavy viscous liquids of different viscosities.

Another object of the present invention is to provide a new and improved mixer for viscous liquids which thoroughly mixes together such viscous liquid by simulated agitation without employing any moving parts.

Still another object of the present invention is to provide a new and improved mixer for viscous liquids whereby viscous liquids may be introduced into the mixer from separate streams and which liquids will be discharged from such mixer in a thoroughly mixed single stream.

A further object of the present invention is to provide a new and improved mixer for viscous liquids whereby the application of pressure over a particular area within the mixer forces the mixing of such viscous liquids.

Other objects and advantages of the present invention will become more readily apparent from a consideration of the following description and drawings wherein:

FIG. 1 is a sectional view of the device of the present invention;

FIG. 2 is a view taken along line 2—2 of FIG. 1;

FIG. 3 is a view taken along line 3—3 of FIG. 1; and

FIG. 4 is a view taken along line 4—4 of FIG. 1.

Referring now to the drawings, the device or apparatus of the present invention is generally designated at M and includes a body 5 having a lower chamber 7 therein, and a stationary mixer or mixing means 9 within said chamber. In communication with the mixing means 9 and extending substantially the length of the body 5 is a longitudinal bore 10 for receiving fluid discharged from the mixer 9. A diffuser 11 is positioned in the longitudinal bore 10 and has a baffle or atomizing means 12 on one end thereof which is in communication with the mixer 9. An inlet assembly indicated generally at 15 is positioned at one end of the body 5 and includes the openings 16 and 17 for introducing a plastic and a promoter or catalyst, respectively. An outlet device 18 is positioned at the other end of the body 5 from the inlet assembly 15 and provides an exit for the plastic compound after it has been mixed. The details of the invention will be further described hereinafter.

The mixing device M of the present invention is adapted to be used in carrying out the method disclosed in our United States patent application Serial No. 34,755 filed June 8, 1960, and it may be used with the spray apparatus disclosed in our United States patent application Serial No. 34,689 filed June 8, 1960, now Patent No. 3,032,278. The apparatus M may be used with viscous fluids having a viscosity ranging from 5 to 1,000 poise and is particularly adapted for use with a 100% non-volatile resin such as an epoxy resin, and an aliphatic or aromatic amine. Such epoxy resins normally have a viscosity ranging from 800 to 2,000 centipoise and the aliphatic or aromatic amines normally have a viscosity ranging from 250 to 1,200 centipoise. The resulting mixture has a viscosity ranging from 1,000 to 1,200 centipoise.

The agitation of such heavy viscous fluids of different viscosities is initially obtained with the apparatus M by the use of the mixing means 9, and further agitation is then obtained with atomizing means 12 and the diffuser 11. In the preferred form, the body 5 is principally formed of body portions 5*a* and 5*b* which are connected together as will be explained. Both of the portions 5*a* and 5*b* preferably have an outer hexagonal configuration to facilitate assembling and disassembling (FIGS. 2–4). It should be noted however that the external surface of the body 5 may be cylindrical, octagonal, square or of any other desired configuration.

The chamber 7 in the body portion 5*b* of the body 5 is in communication with the longitudinal bore 10 and is in effect an enlarged portion of such longitudinal bore 10. The internal surface 7*a* of the chamber 7 is preferably cylindrical and has all rounded or smooth surfaces. In the lower end portion 5*b* of the body 5 are the openings 16 and 17 of the inlet assembly 15, in which the couplings 19 and 20 are threadedly engaged therein, respectively. Suitable hoses 21 and 22 are connected to the couplings 19 and 20, respectively, for introducing the plastic or epoxy resin and the catalyst or promoter into the chamber 7. The plastic or catalyst may be introduced through either of the openings 16 and 17 as desired; however for illustrative purposes only, the plastic is introduced through the opening 16 and the catalyst through the opening 17.

The mixing means 9 includes a non-cylindrical member 9*a* adapted to be positioned in the chamber 7 of the lower portion 5*b* of the body 5. The member 9*a* has a plurality of circumferentially and longitudinally spaced openings or passages 9*b* therein, such passages 9*b* being in communication with the chamber 7 and the opening or chamber 25 in the member 9*a*. The end 9*c* of the member 9*a* is closed so that the tangential passages 9*b* are the only means of communication from the chamber 7 into the internal chamber 25. The other end 9*d* of the member 9*a* is open to the chamber 25 and is formed with a flange 9*e* which is positioned between the adjacent ends of the body sections 5*a* and 5*b*. External threads 9*f* on the member 9*a* engage with internal threads 5*c* on the portion 5*b* of the body 5 to secure the member 9*a* to the body portion 5*b*. The member 9*a* also has internal threads 9*g* which engage threads 5*e* on the body portion 5*a* for securing the member 9*a* to the body portion 5*a*. The member 9*a* thus serves as the connector for the body sections 5*a* and 5*b*.

Thus, the mixing means or mixer 9 may be quickly and easily placed in the body 5 or removed therefrom. This greatly facilitates cleaning and repairs and replacements if needed.

As the liquid or fluids which will normally be used or mixed in the apparatus M are of relatively high viscosity, ranging from 5 to 1,000 poise, no additional sealing means has been found necessary to seal between the

members 5*a*, 9*a* and 5*b*; however, if desired suitable sealing means can be employed without departing from the scope of the invention.

The outer shape of the member 9*a* is substantially rectangular as best seen in FIG. 2 and the corners 9*h* of the member 9*a* are rounded so as to fit substantially adjacent the internal surface 7*a* of the body portion 5*b*. The result is that the chamber 7 is substantially filled with the mixing means 9 except for the small areas 7*b* between the internal surface 7*a* of the chamber 7 and the external surface 9*m* of the member 9*a*. Liquids introduced into the hoses 21 and 22 pass through the openings 16 and 17, respectively, into the chamber 7, into the areas 7*b*, through the openings or passages 9*b* and into the chamber 25 which is in communication with the bore 10 of the body 5. The action of the heavy viscous liquids in passing through the openings 9*b* is one of a simulated agitation and a circular mixing motion is imparted to such liquids thereby initially mixing the liquids together. The openings 9*b* are formed in the mixer 9 in such means that they are tangential with the walls of the chamber 25. This arrangement of the openings can best be seen in FIG. 2 of the drawings. Such tangential flow of the liquids results in the circular or spiral motion of the liquids as the liquids are moved by external pressure. The mixing means 9 has no moving parts which makes it considerably more economical to manufacture and to operate as well as easier and more effectively to clean.

In order to further assure that the plastic and promoter liquids are thoroughly intermixed together, a diffusion means or diffuser 11 is positioned in the longitudinal bore 10 of the body 5*a* which creates a turbulent flow of the liquids thereby insuring a complete mixture of the liquids prior to the ejection of such liquids through the outlet means 18. The longitudinal bore 10 has a decreased or diminished portion 10*a* which is in communication with the chamber 25 in the mixing means 9. Such decreased portion 10*a* forms a shoulder 10*b* which serves as a stop for the diffusion means 11. The baffle or atomizing means 12 which may be an integral part of the diffuser 11 or may be constructed separately therefrom rests on the shoulder 10*b* and contains a plurality of relatively small openings or passages 12*a* which are in communication with the bore portion 10*a* and which atomize the liquids as they are forced from the portion 10*a* into the diffusion means 11. Such atomization or screening breaks the liquids into sufficiently small enough particles so that they are easily mixed together as they are forced through the diffuser 11.

The diffuser 11 comprises a longitudinal bar which has been milled out or has been otherwise formed to provide a plurality of discs 11*a* connected together by a plurality of projections or connecting members 11*b*. The internal area 11*c* defined by the projections 11*b* is best seen in FIG. 4. The outer surfaces or edges 11*d* of the discs 11*a* are substantially adjacent and preferably in slidable contact with the internal surface 5*d* of the body portion 5*a*. The member 11 may be easily positioned in or removed from the body portion 5*a*. Each of the discs 11*a* has an opening 11*e* which permits passage of the fluids or liquids from one group of projections 11*b* to the next group of projections 11*b* in a wave-like motion or undulating movement so as to create a turbulent flow in the fluids. The opening 11*e* in each of the discs 11*a* is relatively small, and the openings 11*e* are arranged in such manner that the opening 11*e* in each successive disc 11*a* is located approximately 180° from the opening 11*e* in the cylindrical rib 11*a* preceding it. Such arrangement creates an undulating motion in the liquids as they are forced through such openings 11*e* which completes the mixing of the viscous liquids. The diffuser 11 has an enlarged portion 11*f* connected therto or formed integrally therewith which has threads 11*g* thereon which are engaged with the internal threads 5*f* on the body portion 5*a*. Again, because of the relatively high viscosity of the fluids mixed in the apparatus M, no additional seal means has been found to be necessary, but suitable seal means may be inserted between the members 11*f* and 5*a*, if desired or if found necessary with lower viscosity fluids. A longitudinal opening or bore 11*h* of the diffuser 11 is in communication with the outlet device 18. The outlet device 18 includes a coupling 26 which is engaged in a threaded opening 11*j* in the end portion 11*f* of the diffuser 11. The unitary construction of the diffuser 11 allows it to be readily positioned in the body 5 or removed therefrom.

In the usual operation of the device M of the present invention, a plastic or heavy viscous liquid such as an epoxy resin is pumped through the hose 21, through the opening 16 and into the chamber 7, and a catalyst or promoter such as an aliphatic or aromatic amine is pumped through the hose 22, through the opening 17 and into the chamber 7 where an initial mixing of the two liquids takes place. As the fluids or liquids are pumped from the chamber 7 through the passages 9*b* and into the chamber 25 and agitation of the liquids is simulated, the liquids are substantially mixed together. The device M of the present invention could be constructed largely as the mixing means 9 by lengthening the means 9 and eliminating the diffusion means 11 and baffle means 12; however, such a construction does not always provide a complete or thorough mixing of the plastic and the catalyst. In addition it is possible that a continuous flow of some small amounts of the liquids would not occur which would result in a hardening of such small amounts and clogging of the mixer 9. To assure that the fluids as they are pumped out of the outlet device 18 are thoroughly mixed together, the fluids or liquids are pumped from the chamber 25 through the baffle means 12 and the diffusion means 11. The drops or particles of the fluid mixture from the chamber 25 are atomized or reduced in size as they pass through the small holes 12*a* of the atomizing means 12. A turbulent undulating flow is caused by the forcing of the liquids through the openings 11*e* and across the projections 11*b* of the diffusion means 11 so that the drops or particles of both fluids are thoroughly mixed together. The use of the diffusion means 11 and the baffle means 12 assures a thorough mixing of the plastic and the catalyst prior to ejection from the device M without requiring any moving parts in the device M.

It can be appreciated that the device of the present invention provides a new and improved mixer for viscous fluids, especially epoxy resins and promoters or hardening agents, which device thoroughly mixes such fluids together, has no moving parts and which may be readily assembled or disassembled for ease in cleaning, repair and replacement.

The actual effectiveness of the mixer has been tested by mixing a black epoxy resin and a white catalyst and vice-versa. The plastic mixture emerging from the outlet means 18 is a thoroughly mixed stream of gray plastic liquid. The viscosity of such plastic mixture normally ranges from about 1000 to 1200 centipoises. It will be understood, however, that the invention is not limited to use with liquids of such viscosity ranges.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A device for mixing viscous liquids comprising a body, said body having at least two inlet means therein whereby separate streams of viscous liquids may be conducted into said body, a chamber in said body for receiving the viscous liquids from said inlet means, stationary mixing means within said chamber having a plurality of circumferentially and longitudinally spaced transverse passages therein, said circumferentially and

longitudinally spaced transverse passages being in communication with said chamber and being tangentially in communication with the interior of said stationary mixing means whereby a circular motion and tangential flow is imparted to the viscous liquids as they are forced through said passages, said body having a longitudinal bore extending substantially the length thereof and in communication with said chamber, atomizing means in said bore for dividing the stream of viscous liquids from the mixing means into a plurality of smaller streams, diffusion means in said bore for imparting an undulating flowing motion to the viscous liquids as they are forced therethrough whereby the viscous liquids are thoroughly mixed together, and an outlet means whereby the viscous liquids are emitted from said diffusion means in a single intimately mixed stream, said diffusion means including a plurality of spaced discs, each of said discs having a relatively small opening therethrough, said small opening being longitudinal in relation to said longitudinal bore, and a plurality of projections extending between and connected to each of said discs, said projections being longitudinal in relationship to said bore.

2. A device for moxing viscous liquids comprising a body, said body having at least two inlet means therein whereby separate streams of viscous liquids may be conducted into said body, a chamber in said body for receiving the viscous liquids from said inlet means, stationary mixing means within said chamber having a plurality of circumferentially and longitudinally spaced transverse passages therein, said circumferentially and longitudinally spaced transverse passages being in communication with said chamber and being tangentially in communication with the interior of said stationary mixing means whereby a circular motion and tangential flow is imparted to the viscous liquids as they are forced through said passages, said body having a longitudinal bore extending substantially the length thereof and in communication with said chamber, atomizing means in said bore for dividing the stream of viscous liquids from the mixing means into a plurality of smaller streams, diffusion means in said bore for imparting an undulating flowing motion to the viscous liquids as they are forced therethrough whereby the viscous liquids are thoroughly mixed together, and an outlet means whereby the viscous liquids are emitted from said diffusion means in a single intimately mixed stream, said diffuser being integrally formed whereby it may be inserted and withdrawn from said bore, said diffuser including a plurality of discs which are connected together in spaced relation longitudinally of the diffuser by projections which are secured to said discs, said discs having a relatively small opening therethrough, with the opening in said discs being offset from the opening in the adjacent disc to mix the liquids as they pass through the device.

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