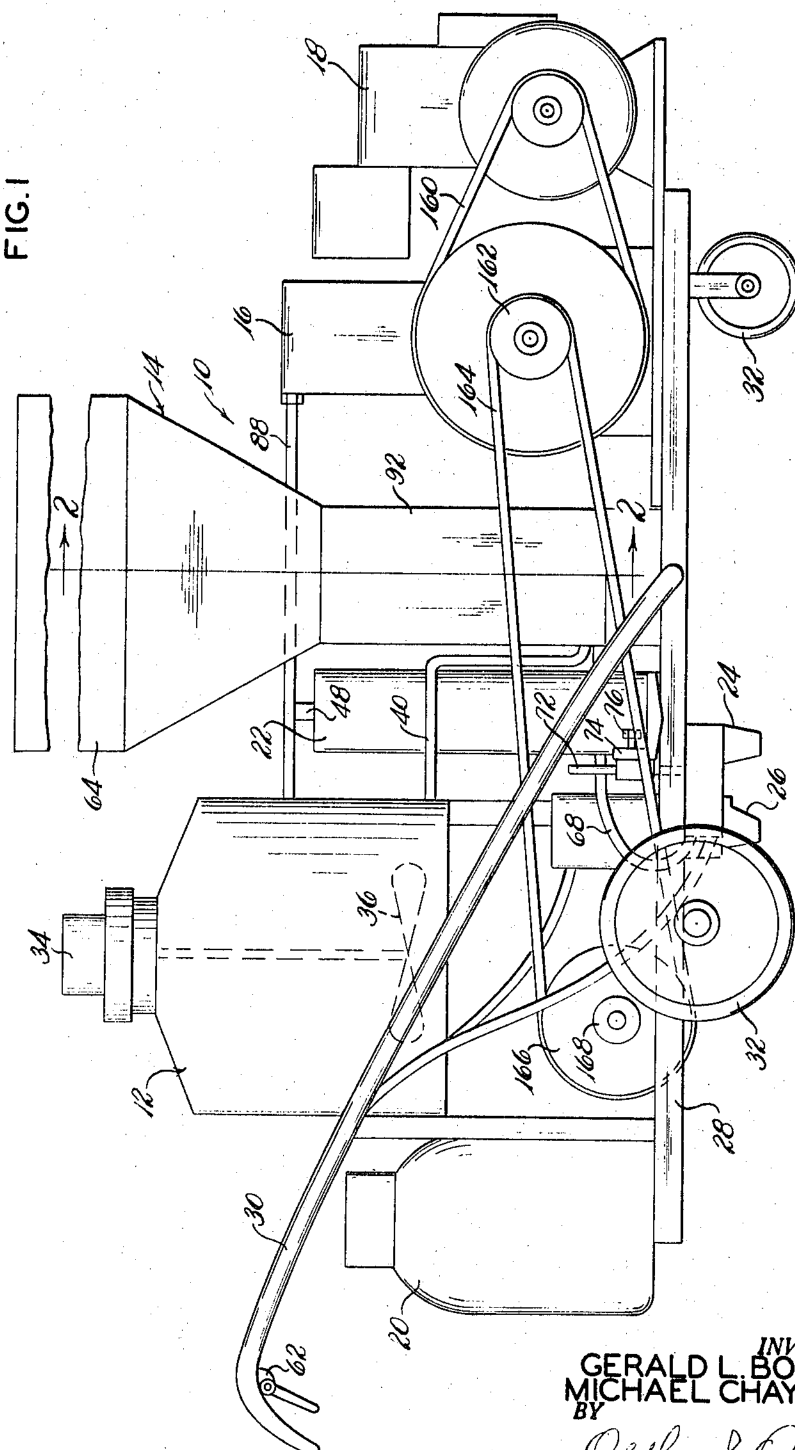
May 13, 1969 G. L. BOETTLER ET AL 3,443,494

METHOD AND APPARATUS FOR APPLYING MARKING STRIPS TO HIGHWAYS AND THE LIKE

Filed April 29, 1964 Sheet 1 of 3

FIG. 1

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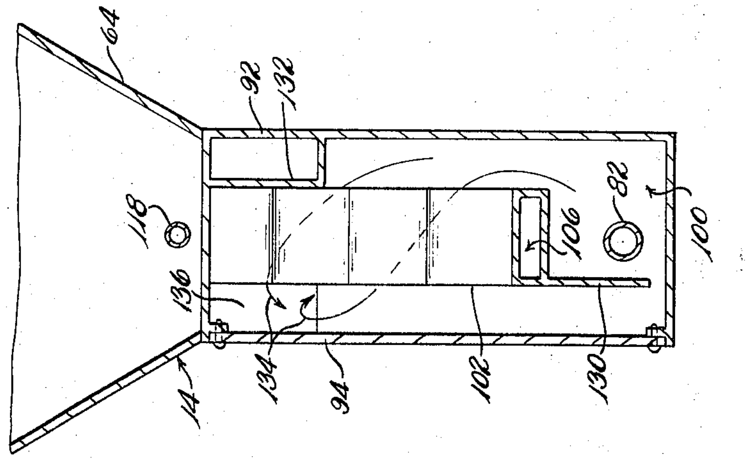


FIG. 3

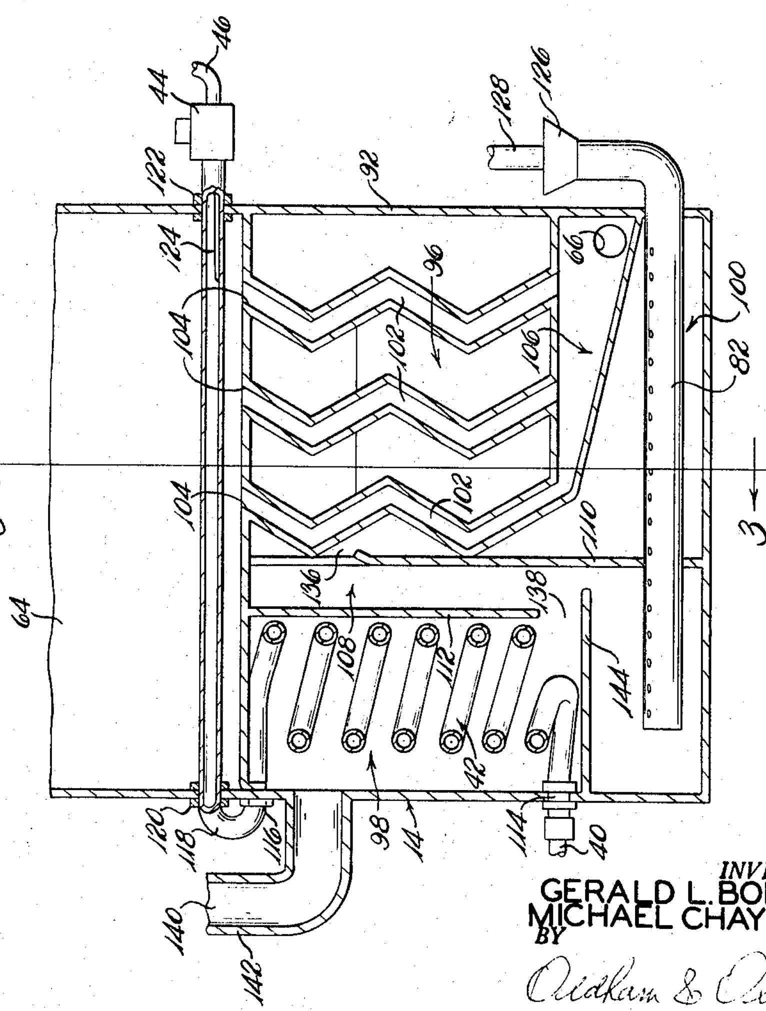


FIG. 2

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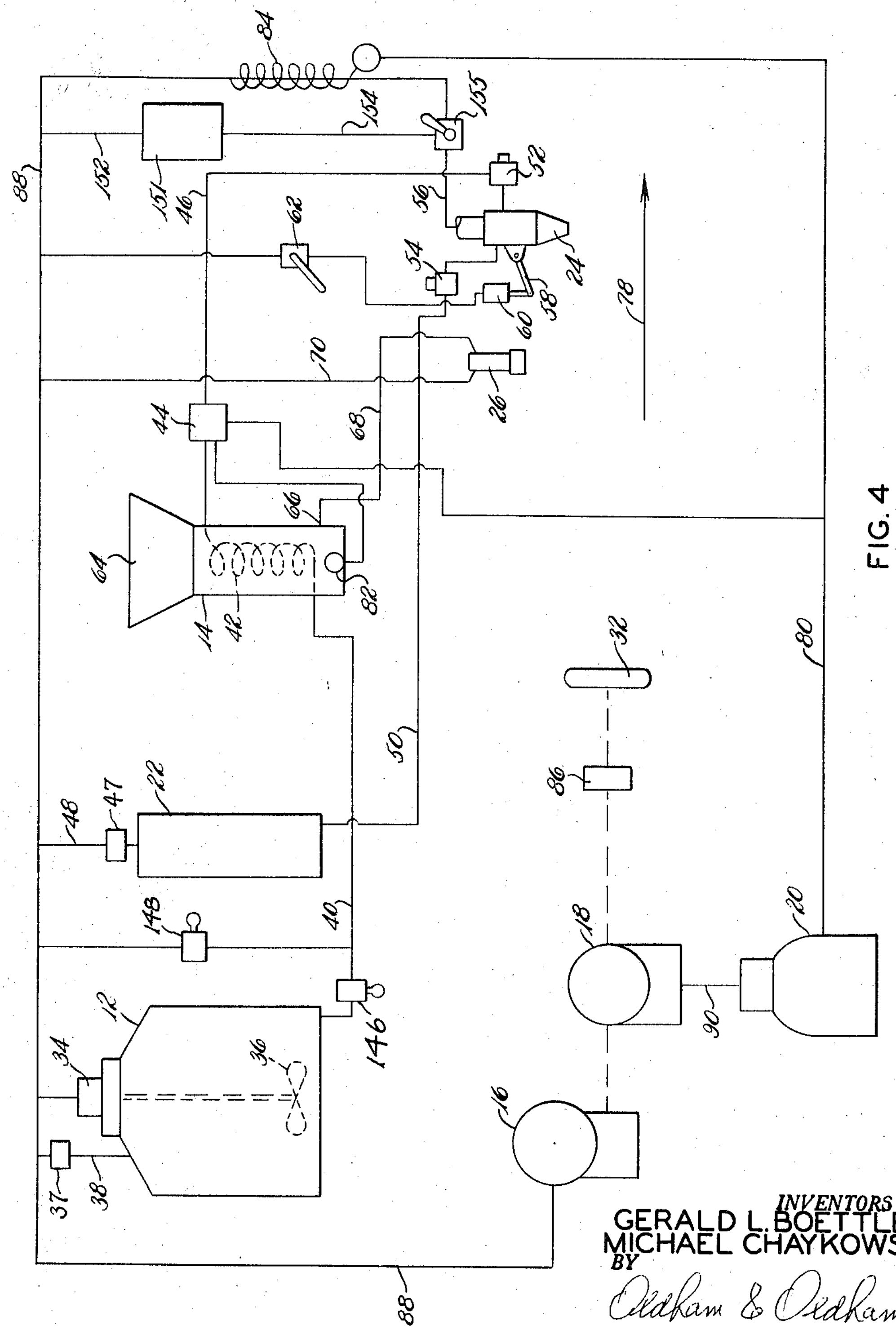


FIG. 4

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3,443,494

# METHOD AND APPARATUS FOR APPLYING MARKING STRIPS TO HIGHWAYS AND THE LIKE

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Continuation-in-part of application Ser. No. 234,978, Nov. 2, 1962. This application Apr. 29, 1964, Ser. No. 364,886
Int. Cl. E01c 23/16
U.S. Cl. 94—22 26 Claims

This application is a continuation-in-part of my copending application Ser. No. 234,978, entitled "Method and Apparatus for Applying Marking Strips to Highways and the Like," and filed on Nov. 2, 1962, now abandoned.

This invention relates to highway marker machines and methods for laying down a strip of thermosetting plastic, usually an epoxy resin, mixed with reflective material, usually glass spheres, so that the strip forms a marking line on a highway, parking lot, or the like, or is used for any other similar purpose.

Heretofore, it has been known that there are many and varied types of highway marker machines and methods for laying down highway markers of paint, or paint and solvent mixtures, but these markers are inherently not skid proof or long lasting. Certain plastics have been used as markers, together with plastic protective coatings; however, such materials are expensive.

In addition, small glass spheres have been added to marker paints to reflectorize the marker. The glass particles are often applied by hand, sprinkling onto a semi-dry or tacky paint, which is wasteful and inefficient, at least with respect to manpower. Also, the glass particles do not adhere sufficiently to paint and after a short while are all pulled out or rolled out of the surface by the action of tires crossing over the painted marker. A further disadvantage of the present art is the length of time often required for drying of the marker after its application, resulting in undue traffic congestion and/or detours.

A general object of this invention is to provide a new and useful method and machine for applying markers to the surfaces of highways or the like.

It is another object of the invention to provide a new and useful method and machine for producing a thermosetting resin marker containing reflective material.

Another object of the invention is to provide for the fast setting of a thermosetting resin marker in a new and useful manner whereby a marker having reflective properties is produced.

Another object of the invention is to provide a new and useful method or machine according to any of the foregoing objects in which glass particles are strongly adhered within the applied marker.

Still another object is to provide a new and useful method and machine for applying a thin epoxy coating of good durability in the form of a marking strip on a highway or the like, with the coating in sufficient thinness to provide a low-cost marking line relative to its durability, and in which thin coat there may be included reflective material, fillers, pigments, and the like.

Where plastic materials are used in liquid form for laying markers, the plastic materials are normally cut back with volatile solvents because of their high viscosity and the difficulty of handling in the absence of such solvents. The use of such solvents introduces inefficiency into the laying of markers in that greater container volumes and heating capacities must be provided in the apparatus or machine per unit of marking material in the finished solidified marking line.

It is another object of this invention to provide a system in which a plastic material can be laid as a marking line without the need for such solvents.

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A more particular object of the invention is to provide a new and useful method and machine for applying coating material, containing thermosetting resin, to a highway surface using coating material which is high in content, preferably 100%, of solid or solidifiable material, in the absence of solvents.

In addition, many plastic systems require extended cure times or else must be heated, for shortening the cure time, to such elevated temperatures that the pot life is greatly reduced below a desirable limit. Such elevated temperatures increase clogging of nozzles, resin conduits, valves and the like. It is desirable, for good pot life, to maintain the pot temperature low, and it is desirable for shortened cure time to use higher resin temperatures for the applied marker material.

It is another object of this invention to provide fast setting or cure of a heat-convertible material when applied as a marker line while still giving good pot life prior to application.

More particularly, it is an object to provide a new and useful method for laying heat-convertible resins, usually epoxy resins, as marking lines on a highway or the like wherein the heat-convertible material is laid at a temperature below the desired cure temperature and is thereafter subjected to accelerated heat conversion conditions, advantageously by the deposition of hot reflective material thereon, where the reflective material has been heated to a temperature sufficiently above the desired cure temperature to bring the applied resin up to the desired cure temperature when the reflective material is deposited.

Other objects will be apparent from the following description and from the drawings in which:

FIGURE 1 is a side view of one embodiment of the apparatus comprising the invention;

FIGURE 2 is a fragmentary transverse, vertical cross sectional view taken approximately on the line 2—2 of FIGURE 1;

FIGURE 3 is a vertical cross sectional of the heat exchanger taken approximately on the line 3—3 of FIGURE 2; and

FIGURE 4 is a diagrammatic sketch of the flow involved among the various components of the marker machine.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail a specific embodiment of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated.

It has been proposed in the above-identified application, of which this application is a continuation-in-part, and it is proposed herein, to form marking lines on highways or the like using heat-convertible or thermosetting resins such as epoxy resins as the basic material for the marking line. Method and apparatus for accomplishing this result in an advantageous manner are described in the above-mentioned copending application and herein. As has been explained in the copending application, the apparatus and method can be employed to deposit a heat-convertible resin as a marking line. Thereafter, and preferably immediately thereafter, reflective material such as a mixture or complex of sand and glass spheres, heated to a temperature at which the sand and sphere complex is hotter than the resin mixture, is applied to the resin marking line so that the sand and spheres will hasten the setting time of the resin. The sand and spheres also better adhere to and settle in the epoxy resin mixture to become an integral part of the finished marking line.

The invention encompasses, in a highly advantageous form, the laying of heat-convertible marking line material on a highway or the like at one temperature, followed by deposition or reflective material on the laid heat-convertible material before conversion thereof to its completely cured set, with the reflective material pre-heated to a higher temperature than the resin. The higher temperature of the reflective material is sufficient to markedly accelerate the heat conversion of the resin. In this form of the invention, the resin pot temperature is maintained at a temperature below the desired cure temperature and is applied at such lower temperature. The heat-convertible resin is used at a temperature sufficient to melt the resin and provide sufficiently low viscosity for proper handling of the resin by the line applicator equipment used. It has been found that temperatures as low as 260° F. may be acceptable, but it is preferred to heat the resin to a temperature of 300° F. or more, e.g. up to 350° F. or 400° F., especially where epoxy resins, the preferred heat-convertible resins, are used. Heat-convertible epoxy resins usually melt below about 300° F. and are usually of sufficiently low viscosity for use below such temperature, but the higher temperature are preferred because there may be incorporated into the epoxy resin filler materials, pigments, and the like which tend to increase the viscosity. The reflective material is applied after application of the resin and is applied to the resin at a temperature sufficient to increase the resin temperature to the desired cure temperature. Thus, the reflective material temperature will depend somewhat on the relative mass of reflective material and heat-convertible resin.

As indicated, the preferred heat-convertible resins are the epoxy resins such as the Epon resins, e.g. Epon 828 (epoxy resin having terminal epoxy groups) marketed by Shell Chemical Company, the Devran resins marketed by Truscon Laboratories, and Epi-Rez (epichlorohydrin bisphenol resins) such as marketed by Jones Dabney Company. Any other available heat-convertible epoxy coating material may be used. Other heat-convertible materials which may be useful in accordance herewith include the polyester resins in styrene or other monomer slovent, which should be used on concrete highway surfaces rather than asphalt. Of course, any other heat-convertible resins may be used if desired. Catalysts for reducing the cure time of any of these resins are well known and available from the manufacturers of the resins. Such catalysts or curing agents for the preferred epoxy compounds are often, for example, polyamines such as diethylenetriamine.

Any reflective material which is solid at its application temperature may be used. Glass, in the form of beads, chips, crystals, spheres, or the like, is preferred because of the good reflective properties and the general acceptance of such materials in the industry, especially beads.

Although specific examples of resins and reflective materials are given herein, and whatever the preferred epoxy resins and glass beads are specifically mentioned, it is intended that other materials as may be evident to those in the art may be used.

It will be evident that the ratio of glass beads to epoxy resin may vary greatly and is not critical to the present invention. However, accepted specifications in the industry usually prescribe at least 6–8 pounds per gallon of coating material, although in some applications as little as 2¼ pounds or less and up to 10 pounds or more of glass beads per gallon of coating material may be desirable, depending on the amount of reflectivity required in the set marker product. Of course the greater proportion of glass beads will generally provide greater reflectivity.

Where I have used one volume of glass beads per volume of solids in the coating material, I have usually the beads to 550–650° F., preferably 600° F., and have found that the heated beads give a marked decrease in setting or cure time to an epoxy resin which has been applied as a marking material in the liquid state at a temperature below its desired cure temperature, e.g. about 350° F.



Where the resin is laid at 350° F. without immediate application of glass beads thereto, it usually requires greater than 15 minutes to set the resin. Where the glass beads are applied to the resin immediately after application of the resin, with the glass beads at a high temperature, less than 5 minutes and usually one-half to 1 or 2 minutes cure time is required. In such cases, the beads increase the resin temperature to a fast cure temperature, believed to be about 475° F. Thus, it is an advantageous result of the invention that the epoxy resin may be applied in the absence of solvents at a temperature sufficiently low to prevent unduly shortened pot life, clogging of lines and the like, and also that a higher cure temperature may be used for the resin to set the resin in a shorter period of time with much less difficulty than would be incurred if the resin were heated in the pot to be desired higher cure temperature and then applied. The preferred fast cure temperatures for the resins are usually above 350° F. and below 600° F., although the temperautre may vary depending on the particular resin or catalyst used. The fast cure temperatures for heat-convertible resins using various catalysts are generally known in the art and may be obtained from the resin and catalyst manufacturer.

Although the respective temperatures of the resin and reflective material are important to the extent that the reflective material will heat the resin to the desired cure temperature, the temperatures are not otherwise critical with respect to actual temperature ranges. Of course, the resin used will impose an upper limit in the temperature range in that the resin should not be heated above the destruction, decomposition or flash temperature of any of the components desired to be retained in the laid marker. For example, a white pigment as titanium dioxide pigment may break down in color at 550° F. or higher, and fillers and other pigments may burn or char at temperatures of 1000° F. or higher.

As has been indicated, wherever a heated convertible resin or resin mix is referred to herein, it is intended that the resin or resin mix can include such ingredients as color pigments, extenders, fillers, or like materials usually included in marking compositions of the character described. Anti-slip materials, e.g. white sand, or other inexpensive abrasive-like fillers may be used in the resin mix. Reflective materials may be included in the mix prior to applying the resin mix as a marker, and additional reflective material may be heated to the higher temperature and applied thereover. Other fillers may also be used, such as whiting, ground white marble, calcium carbonate, as well as such extenders as the Arochlors (thermoplastic non-drying chlorinated hydrocarbon) which may improve the moisture and chemical resistance of the marker. The heat-convertible resins, and especially epoxy resins, have excellent binding powers which permit the incorporation of solid fillers and the like, and preferably glass beads, even in major amounts by volume. White sand or the like may also be mixed with the glass beads to be applied over the resin mix.

It is preferred to omit solvents from the resin or resin mix since such solvents are unnecessary in the preferred use of the present invention. Omission of solvents inhibits settling of glass beads deposited on the resin to provide more highly reflective surfaces. The beads are more tightly held and evenly distributed through the marker thickness so that, even after surface wear of the marker, a highly reflective surface is still presented.

The invention is usually employed in conjunction with applying a coating or marker strip of thermosetting plastic to a traffic carrying or highway surface and hence it has been so illustrated and will be so described.

With specific reference to the form of the invention illustrated in the drawings, the numeral **10** indicates generally a machine incorporating the principles of the invention comprising a resin container in the form of mixing tank **12**, means for heating the resin from tank **12** in the form of a heat exchanger **14**, an air compressor **16**, a prime mover such as engine **18**, a fuel tank **20**, a catalyst container or tank **22**, a resin applicator in the form of spray apparatus **24**, a reflective material container in the form of glass bead chamber **106**, means in the form of burner **82** in burner area **100** for heating the reflective material in chamber **106**, and a reflective material applicator in the form of spray apparatus **26**. All the component parts, together with other detailed mechanism hereinafter described, are mounted on a frame **28**, guided by handles **30**, and movably supported by wheels **32**.

Now, with specific reference to the schematic drawing in FIGURE 4, the general structure and operation of the machine will be explained. In a typical arrangement, a basic resin mix containing epoxy resin, coloring pigment, and filler, may be prepared. Such a mix may be, for example:

| Ingredient: | Parts by wt. |
|---|---|
| Epon 828 | 50 |
| Thermoplastic non-drying chlorinated hydrocarbon as an extender or plasticizer | 14–20 |
| Titanium dioxide paste [1] | 3–5 |
| Ground white marble of 200–300 mesh [2] | 40–50 |

[1] Prepared by milling titanium dioxide on a three roll paste mill in the presence of sufficient Epon 828 to form the paste
[2] Water ground.

A suitable catalyst for use with the above is 1–1.5% by weight Epon Curing Agent (believed to be a polyamine such as diethylenetriamine), based on total weight of the resin mix.

The mix is placed in tank **12** and kept agitated or mixed by an air motor **34** driving blades **36**. In the cold state, i.e. at room temperature, the resin mix is of about the same viscosity as molasses, but as it is heated in the heat exchanger **14** to the optimum temperature between about 325° F. to about 400° F. it becomes more fluid and can be sprayed. The catalyst for the resin mix is added to unheated tank **22**.

Air pressure from the air compressor **16** is preferably applied to the top of the tank **12** through a pressure regulator **37** by the conduit **38** to assist in forcing the mixture through the discharge tube **40**, a heat exchanger coil **42**, a thermostat control valve **44**, a tube **46**, and thence to the spray nozzle **24**. Air under pressure also connected to the top of the catalyst tank **22** through a pressure regulator **47** by conduit **48** forces the catalyst through conduit **50** and thence to the spray nozzle **24**. Before reaching the spray nozzle **24** both the epoxy resin mixture and the catalyst are fed through manually adjustable orifice valves **52** and **54** whereby the relative proportions of catalyst and resin is controlled, in the above specific example to provide 1 to 1.5 weight percent catalyst. Air pressure is directed into the spray nozzle by conduit **56**. The spray nozzle **24** includes an operating lever **58** moved on and off by an air cylinder **60**. The air cylinder **60** is controlled in turn by an air valve **62** mounted on one of the handles **30** grasped by the operator in guiding the apparatus of FIGURE 2. The spray nozzle **24** is placed on about the longitudinal centerline of the machine **10** to permit the operator to easily follow a guide line. It is noted that by adjusting the regulators **37** and **47** the catalyst enters the spray nozzle at a slightly higher pressure than the hot resin mixture which assures an even mixing of the catalyst through the epoxy resin mixture at the time of application onto the surface to be coated or marked.

It will be understood that putting resin mix down hot accomplishes three major objectives, namely, (1) the resin mix makes and keeps good bond with uneven or cracked pavement, (2) allows embedding of reflective material in the soft surface or strip, and (3) greatly speeds up the action of the catalyst so that setting up the deposited strip is very rapid.

Reflective glass spheres or beads (usually between **10** and **40** mesh and of a type available on the commercial market) are placed in the storage bin portion **64** at the top of the heat exchanger **14**. The beads pass by gravity out through the opening **66** from the heat exchanger **14** in a heated condition and then directly by conduit **68** into the spray nozzle or blow gun **26** which is aligned longitudinally in trailing position with respect to nozzle **24**. Air pressure is directed into the other side of the nozzle **26** by conduit **70**. The bead spray nozzle **26** is of the known commercially available type including a rotary member used to spray sand with air.

The width of the strip to be sprayed can be adjusted by repositioning the spray nozzles **24** and **26** up or down as shown in FIGURE 2. For this purpose nozzles **24** and **26** are carried on a rod **72** sliding in a bracket **74** and locked therein at adjustable height by screw **76**. An upward adjustment makes the sprayed strip wider, whereas a downward adjustment makes the sprayed strip narrower.

In FIGURE 4 as shown, the spray nozzles **24** and **26** are moved along the road surface in the direction of the arrow **78**. Therefore, the resin spray nozzle **24** first deposits a coat of the epoxy resin mixture with catalyst added, and the nozzle or gun **26** applies immediately thereafter a coat of glass particles on top of the epoxy resin mixture. It is noted, at this point, that with the epoxy resin mixure heated to the desirable temperature of approximately 350° F. with catalyst added, this mixture will permanently harden by known chemical reaction in about 5 to 20 minutes, regardless of thickness. But, because of the subsequent, preferably immediate, application (perhaps one-fourth to one-half second after the epoxy coating depending on the speed of the machine) the coating of relatively heavy glass particles will have time to sink into the still hot and soft resin mixture before it permanently hardens. As the beads sink in, their heat accelerates the conversion of the resin so that the resin sets up in a much lesser time, e.g. ½ to 1 minute. It has been found that the glass beads have affinity with the resin and tend to sink into the epoxy mixture just far enough to be permanently adhered to said mixture and to provide the adhesive and reflective qualities desired in the strip. Also, the pigment color, usually white, yellow, or orange, of the epoxy resin tends to be drawn up through the glass and sand coating by capillary action so that the proper coloring is achieved on the top surface of the deposited strip.

The fuel utilized in tank **20** is preferably gaseous, for example, propane gas, in order to avoid the greater fire and explosion hazard of liquid fuels like gasoline. It is to be noted from the schematic that the propane gas from fuel tank **20** feeds through a conduit **80** into the thermostatic control valve **44** and thence to the burner barrel **82** of the heat exchanger **14**. The valve **44** does not restrict the flow of the resin mixture but acts in response to the temperature of the mixture to control the amount of fuel to the burner **82** and thereby controls the temperature of the mixture. Also, as a desirable option, gas can feed a heat exchanger **34** surrounding the air line **56** so that the air is heated just prior to the air entering the spray apparatus **24**. The motor **18** directly drives the air compressor **16** and through a clutch means **86** may also controllably drive the wheels **32**. The air compressor **16** sends air through the conduit **88** to all the component parts of the machine. The motor, or prime mover **18** may be a gasoline driven engine having its own gasoline tank, but the invention prefers the use of a prime mover supplied with gaseous fuel from tank **20** as by conduit **90**.

After applying the resin mixture and the glass beads by the machine with the properly adjusted settings, a resultant coating on the pavement of about 50% basic resin, and about 50% glass beads is achieved. This has proved to result in the most satisfactory coating proportions, and gives the most permanent and stable characteristics to the sprayed strip. Some of the glass beads, e.g. one-half of those to be used, may be premixed with the resin mix while preparing the resin mix, if desired.

Normally, when securing the machine after use, the spray gun **24** is cleaned by solvents, in the same manner as a conventional paint spray gun, to prevent clogging for the next use. For this purpose, a solvent tank **151** is provided connected by conduit **152** with air line **88**. Conduit **154** extends from the bottom of tank **151** through a two-way manual control valve **155** in conduit **56** for cutting off air to the nozzle **24** and for blowing solvent therethrough. Also, the remaining resin mixture in the system is cleared by closing valve **146** on resin conduit **40** and opening valve **148** off air conduit **88** to thereby blow the resin lines clear.

Thus, with the structure and operation of the machine described, specific reference is directed to FIGURES 2 and 3, which show the heat exchanger portion of the machine, which is an important feature of the invention. The heat exchanger **14** consists of a housing **92** which is normally integral, being built up from heavy sheet metal to the form shown. A removable inspection plate **94** is provided on the front of the housing. The housing includes a rectangularly funnel-shaped glass particle storage bin **64** on top, glass bead heating area generally denoted by **96**, a resin mixture heating area generally denoted by **98**, and a burner area generally denoted by **100**. Heating area **96** is heated to and maintained at the desired glass bead temperature, e.g. 600° F., by burner **82** in burner arm **100**.

The glass bead heating area **96** contains a plurality of Z-shaped chutes **102** with openings **104** into the bottom of the storage bin **64**, the chutes **102** pass into a sloping chamber **106** having discharge opening **66**. A chimney area **108** is formed by baffles **110** and **112** respectively, and this separates the glass bead heating area **96** from the resin mixturer heating area **98**. In the area **98**, a helically wound tubular coil **42** extends from its entrance point **114** near the bottom of the heat exchanger **14** to its exit point **116** at the top of the heat exchanger. The burner barrel **82** extends longitudinally across the bottom of the heat exchanger centrally positioned beneath the Z-shaped chutes **102**, chamber **106**, and the coil **42**.

The tube **40** from the resin mixing tank **12** connects to coil **42** near entrance point **114**. The exit point **116** of coil **42** connects to tube **118** which makes a 180° bend and enters the lower portion of the bin **64** at connection **120**, passes through the bin **64** (for insulation purposes) and leaves the bin on the opposite side at connection **122** where said tube **118** enters into the manually adjustable thermo control valve **44**.

The thermo control valve **44**, by means of sensitive element **124**, determines at what temperature the resin mixture will be maintained by controlling the amount of fuel supplied to the burner in area **100**. Since the epoxy resin mixture is a good conductor of heat, there will not be an appreciable difference between the temperature of the mixture in the coil **42**, at the sensitive elemnt **124**, or at the spray gun **24**. Therefore, a safe limit control for the hating of the epoxy resin mixture to a manually selected temperature within the limits set forth above, but preventing overheating to a dangerous temperature, or to a temperature at which the catalyst would be rendered ineffective when mixed with the resin, is provided.

The glass spheres or crystals previously described fill the storage bin **64** and pass by gravitational force down through the openings **104** in the bottom of the bin **64**. The beads fall down through the Z-shaped chutes **102**, to the chamber **106**, and from there out through the discharge opening **66**. The entire flow of the glass particles is by gravitational force. However, it is aided by the shaking and rattling of the machine as the motor runs, and as it moves along the highway.

The gas, usually propane, is fed into the burner barrel **82**, positioned in area **100**, through a funnel-shaped adjustable gas and air mixer **126**, by means of pipe **128**. As the propane gas is burned in the burner **82**, the hot gases of combustion pass up, through, and around the outside of the Z-shaped chutes **102** directed by the baffles **130** and



**132**, respectively, as shown by arrows **134** in FIGURE 3, over the top of baffle **110**, through the access opening **136**, down the chimney **108**, into the access opening **138**, and from there up around and along the coil **42** and out the opening **140** into an exhaust stack **142** and the atmosphere. The various baffles are placed to so conduct the hot gases of combustion as to provide the greatest exchange of heat to the epoxy resin mixture passing through the coil **42** and the glass particles passing through the Z-shaped chutes **102**. In one form of the invention, baffles **130** and **132** may be omitted.

The burner barrel **82** can extend into the side of the heat exchanger containing the coil **42** as shown in FIGURE 2, with a baffle **144** protecting the bottom of the coil **42** from the direct impingement of the flames. This provides a little faster heating of coil **42** because the gases from the other side of the heat exchanger have cooled somewhat by the time they pass up through the opening **136**, down the chimney **108**, and through the opening **138** into the area containing the coil **42**. However, the invention contemplates that the burner barrel **82** can be terminated before it enters the coil side **98** of the heat exchanger **14**.

There is normally no provision for any thermostatic control over the heating of the glass and sand complex because overheating is not dangerous or harmful to this material.

With specific reference to FIGURE 1, the motor **18** directly drives the air compressor **16** by means of a belt **160**. A smaller pulley **162** on the air compressor **16** drives another belt **164** which in turn drives a pulley **166**. The pulley **166** drives a shaft which has affixed to it contact rollers **168** adapted to engage the tread surface of the rear wheels **32** of the machine **10**. The pulley **166** with its shaft and contact rollers **168** is adapted to be moved up and down to position the rollers down and against the wheels **32** to drive the machine forward or to position the rollers up and the wheels to stop the machine and provide a clutching action.

It will be recognized that the objects of the invention have been achieved by providing a highway marking machine which rapidly lays down a strip of epoxy thermosetting resin combined with glass particles to give a marking strip strip that sets up solidly in a very short time, usually five to twenty minutes, or in the preferred form less than five minutes, is durable and rugged to wear, has reflectory characteristics, and may also have other characteristics, such as anti-skid characteristics.

The present machine and method is capable of laying heat-convertible resin markers in three to four inch wide strips at rates of one to two or more gallons of resin per minute. The strips may be laid very thin, e.g., 10 mils or less in thickness, or up to 200 mils in thickness or thicker. The laid marker materials can contain more than 50% by volume of reflective material, and the reflective material is tightly held against rolling out under traffic conditions.

We claim:

**1.** The process of curing a resin which can only be cured at elevated temperatures and which cures at faster rates at elevated temperatures than at room temperature comprising bringing the resin into intimate embedded contact with a finely divided, heated, solid chemically inert material.

**2.** The process of curing a resin which cures at room temperature but which cures at a faster rate at elevated temperatures comprising bringing the resin into intimate embedded contact with a finely divided, heated, solid chemically inert material.

**3.** The process of curing a resin, which resin cures only at elevated temperatures, comprising bringing the resin into intimate embedded contact with a finely divided, heated, solid chemically inert material.

**4.** The process of curing a resin system, said resin system comprising a mixture wherein a physical change takes place only at an elevated temperature, causing the resin to cure, comprising bringing the resin system into intimate embedded contact with a finely divided, heated, solid chemically inert material.

**5.** The process of claim **1** wherein the finely divided material is heated to a temperature of at least 200° F.

**6.** The process in claim **1** wherein the finely divided solid material is sand.

**7.** The process of claim **1** wherein the finely divided solid material is heated glass reflective beads, which beads are only partially embedded in the resin.

**8.** The method of forming a marking strip on a hard surface comprising applying an uncured heat-convertible resin in liquid state to the surface at a temperature below the proper cure temperature for the resin and thereafter curing the resin by depositing thereon a sufficient quantity of solid reflective particles at a temperature sufficiently above said cure temperature to raise the temperature of the resin to said cure temperature.

**9.** The method of claim **1** wherein said heat-convertible resin is epoxy resin.

**10.** The method of claim **1** wherein said solid reflective particles comprise glass beads.

**11.** The method of applying a reflective marking strip to a hard surface comprising the steps of providing a source of thermosetting resin consisting essentially of a light pigmented epoxy resin and a separate source of catalyst for said epoxy resin, said catalyst and thermosetting resin when mixed having an elevated fast cure temperature in the range of 350–600° F. for setting to a solid within a period of less than five minutes, continuously flowing controlled amounts of the resing along a path to said hard surface, heating the epoxy resin to a temperature in the range of 260–400° F. but below said fast cure temperature, mixing relatively cold setting catalyst from the catalyst source with said heated resin, immediately applying the resulting hot mixture against the hard surface in the form of a strip while effecting relative movement of said flow path along the surface, providing a source of light reflecting particles, heating the reflecting particles to a temperature in the range of 550–650° F. and substantially above said fast cure temperature, and applying the heated reflecting particles to the catalyst-resin mix while said mix is still liquid and hot in a quantity sufficient to bring the temperature of the mix up to said fast cure temperature for solidifying the mix.

**12.** The method of claim **11** wherein said source of thermosetting resin is a mixture of thermosetting resin and reflecting particles.

**13.** The method of claim **11** wherein the reflecting particles are applied to the catalyst-resin mix in an amount sufficient to provide a total amount of reflecting particles in the range of 2¼ to 10 lbs. per gal. of total epoxy resin and catalyst.

**14.** The method of forming a marking strip on a hard surface comprising applying a heat-convertible epoxy resin in liquid state and in the absence of resin solvent to the area of the surface defining the marking strip at a temperature in the range of 260–400° F. while mixing catalyst with the resin adjacent said hard surface, and thereafter depositing thereon a quantity of solid glass particles at a temperature in the range of about 550–650° F. to raise the temperature of the resin to a temperature in the range of 350–600° F.

**15.** The method of forming a marking strip on a hard surface comprising heating normally solid uncured epoxy resin to a melt at a temperature in the range of 260–400° F., heating a mass of particulate glass beads to a temperature in the range of 550–650° F., applying the heated epoxy resin melt to a hard surface in admixture with catalyst for said resin, and thereafter applying to the resin a sufficient amount of the heated glass beads before solidification of the uncured resin on said surface sufficient to raise the uncured resin temperature and thereby quickly cure the resin with the glass beads embedded therein.

**16.** The method of claim **15** wherein said epoxy resin comprises about 50 parts by weight epoxy resin, 14–20 parts by weight chlorinated hydrocarbon, 3–5 parts by weight titanium dioxide paste and about 40–50 parts by weight ground white marble of 200–300 mesh and wherein said catalyst is a polyamine used in an amount from about 1–1½ weight percent, based on said epoxy resin.

**17.** The method of applying a marking strip to a hard surface including the steps of providing a source of thermosetting resin, continuously flowing controlled amounts of the thermosetting resin along a path to said hard surface, applying the hot mixture against the hard surface in a strip forming amount while effecting relative movement of said flow path along the surface, heating the thermosetting resin in its movement along the path to a fast cure temperature below that adversely affecting the resin, introducing a setting catalyst for the resin into the flow path and hot mixture at a position adjacent the hard surface, and progressively heating a mass of reflective particles having an affinity with the mixture and substantially simultaneously applying the heated reflective particles to the deposited mixture immediately after its deposit and while still hot.

**18.** A machine for strip marking highways and the like comprising a carriage for riding on the highway surface, first container means, a source for thermosetting resin in said first container means, means for preheating the thermosetting resin to a first temperature, second container means, a source of light reflecting particles in said second container means, third container means, a source of catalyst for said preheated thermosetting resin in said third container means, means for conducting the preheated resin and the catalyst to a position adjacent the highway surface, means at said position for mixing said catalyst and resin and for applying the preheated resin and catalyst mixture to the surface as a strip as the carriage moves over the surface, means for delivering particles from said source to a second position adjacent the first-mentioned position near the highway surface, means for heating said particles to a temperature above the resin preheat temperature sufficient to set the applied preheated resin and catalyst mixture, and means at said second position for applying the heated particles to the preheated resin as the carriage moves over the surface.

**19.** The machine of claim **18** wherein said particle heating means comprises means for heating the particles during their delivery from said second container means to said second position.

**20.** The machine of claim **18** including means generating a common heating medium for supplying heat to both the resin preheating means and particle heating means.

**21.** A machine for strip marking highways and the like comprising a carriage for riding on the highway surface, first container means, a source of a mixture of thermosetting resin and glass beads in said first container means, means for heating said mixture, second container means, a source of additional glass beads in said second container means, means for heating said additional glass beads to a temperature substantially above the temperature of said mixture, means for conducting the heated mixture to a position adjacent the highway surface, means at said position for blending relatively cold catalyst for the resin with the heated mixture and for immediately applying the resulting blend to the surface, and means for delivering a sufficient amount of said additional heated glass beads into contact with said blend to aid in rapidly setting the blend.

**22.** A machine for strip marking highways and the like comprising a carriage for riding on the highway surface, first container means, a source of thermosetting rein in said first container means, means for receiving and preheating said resin and having a resin outlet, means responsive to resin temperature adjacent said outlet for controlling the preheating means to heat the resin to a preselected temperature, second container means, a source of light reflecting particles in said second container means, means for conducting the preheated resin to a position adjacent the highway surface, means at said position for applying the resin to the surface, means for delivering particles from said particle source to said conducted resin to contact the resin, and means for heating said particles to a temperature above the resin preheat temperature before contact with the resin.

**23.** A machine for strip marking highways and the like comprising a carriage for riding on the highway surface, first container means, a source of thermosetting resin in said first container means having a fist thermoset temperature in the range of 350–600° F., means for heating the resin to a temperature in the range of 260–400° F. and below said fast thermoset temperature, second container means, a source of glass beads in said second container means, conduit means for conducting the heated resin to a position adjacent the highway surface, means at said position for applying the heated resin to the surface, means for heating said glass beads to a temperature in the range of 550–650° F., and conduit means for delivering an amount of the heated glass beads to said conducted resin to contact the resin to raise the resin temperature.

**24.** A machine for strip marking highways and the like comprising a carriage for riding on the highway surface, container means, a source of thermosetting resin in said container means, means for heating the thermosetting resin for providing preheated liquid non-set thermosetting resin, means for conducting the preheated resin to a position adjacent the highway surface, means at said position for spraying the preheated resin on the surface in a strip form as the carriage moves over the surface, and means mounting said spraying means for adjustable vertical movement between a plurality of positions spaced above the surface to thereby vary the width of the strip.

**25.** The machine of claim **24** including second container means a source of light reflecting particles in said second container means, means for heating said particles to a temperature above the resin preheat temperature, means for delivering the hot particles to a second position adjacent the first-mentioned position near the highway surface, means at said second position for applying the heated particles to the applied resin on said surface in a strip of limited width as the carriage moves over the surface, and adjustable means for mounting said last-mentioned applying means on said carriage at a plurality of positions above the surface to thereby vary the width of the strip of dispensed hot particles.

**26.** A machine for strip marking highways and the like comprising a wheeled carriage for riding on the highway surface, first container means, a source of thermosetting resin in said first container means, second container means, a source of glass beads in said second container means, separate means for conducting the resin and beads for application to the highway surface, common heat exchange means for heating the resin to a temperature below its desired fast setting temperature and for heating said beads in a sufficient quantity to a temperature sufficiently above said desired fast setting temperature to bring said resin up to said desired fast setting temperature upon contact of the quantity of beads with the resin, means at said position for applying the preheated resin to the surface, and means for applying the beads from said heat exchange means to the preheated resin.

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