March 25, 1969 G. DOQUIRE ETAL 3,434,865

PROCESS AND APPARATUS FOR CONTROLLING A CONTINUOUS SPRAY TO PRODUCE INTERMITTENT MARKS

Filed Oct. 7, 1965 Sheet 1 of 2

Fig. 1.

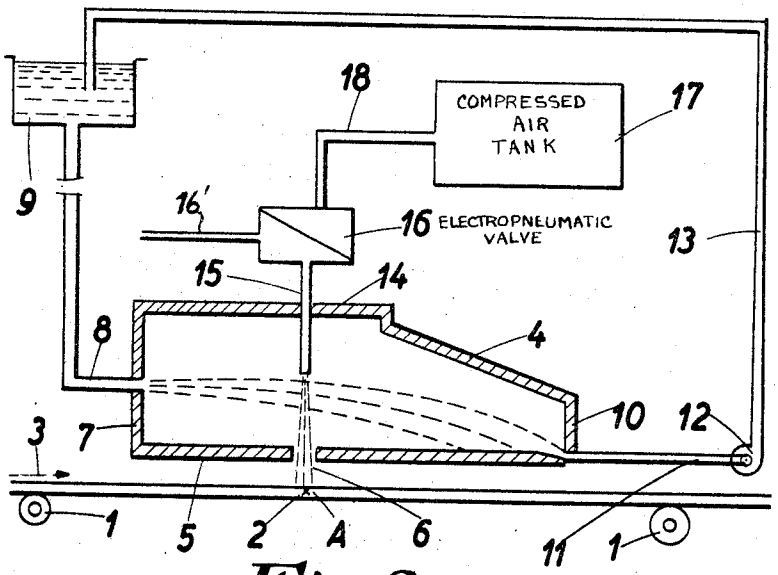
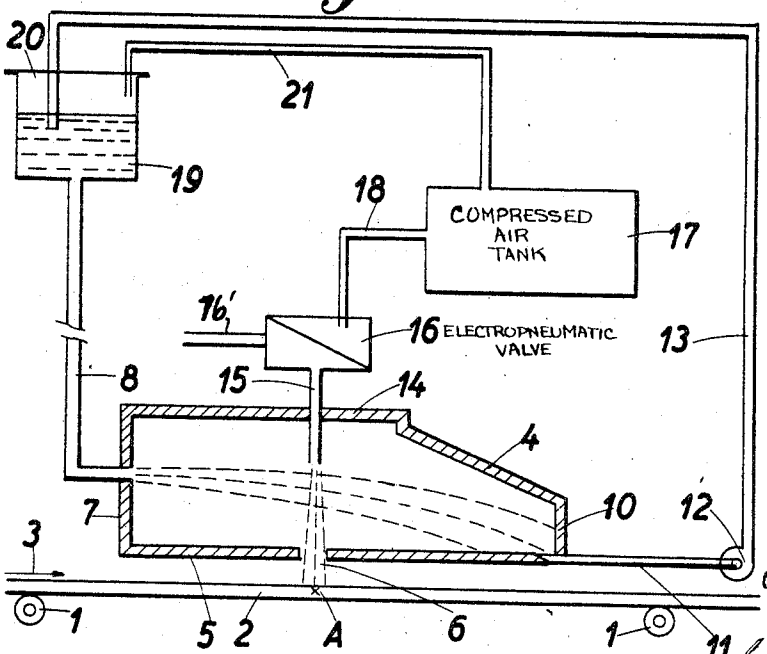


Fig. 2.



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Filed Oct. 7, 1965 Sheet 2 of 2

Fig. 3.

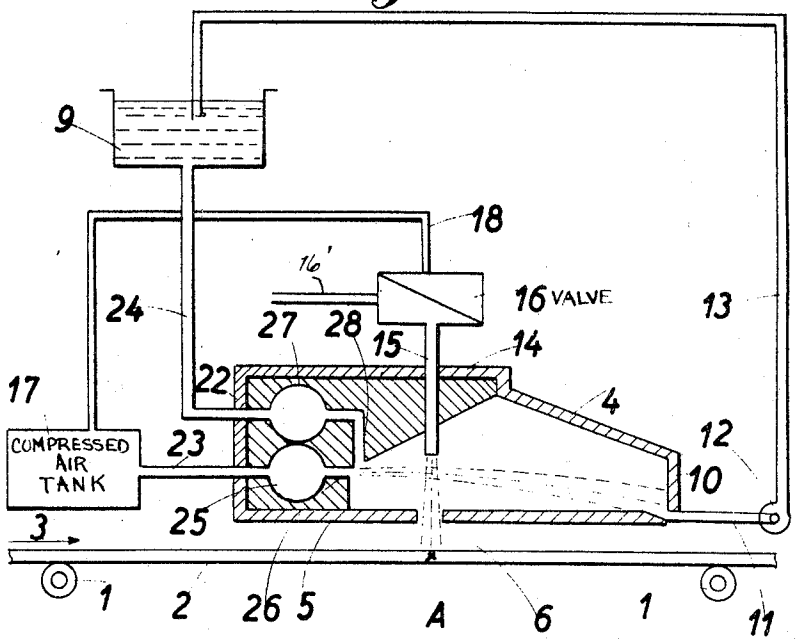
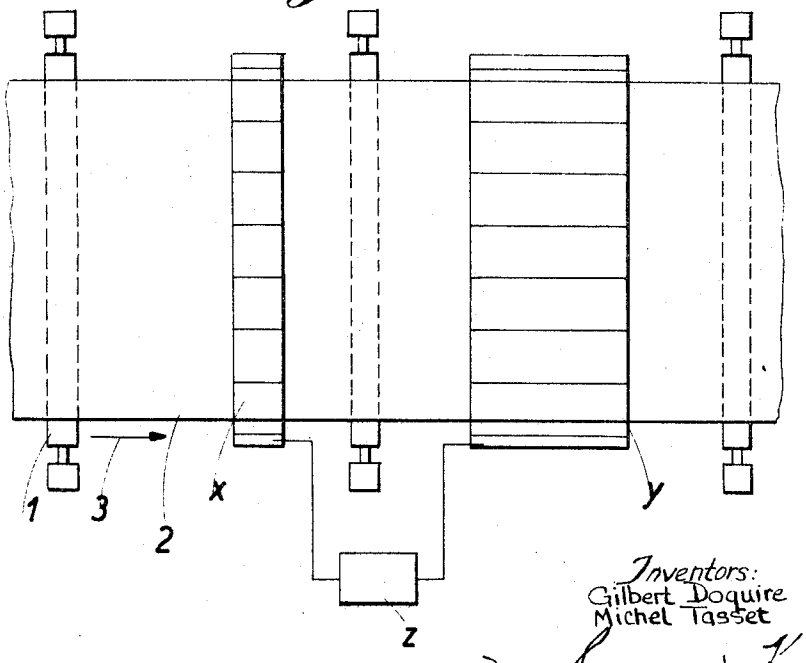


Fig. 4.



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PROCESS AND APPARATUS FOR CONTROLLING A CONTINUOUS SPRAY TO PRODUCE INTERMITTENT MARKS

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U.S. Cl. 117—37 15 Claims

ABSTRACT OF THE DISCLOSURE

A process and apparatus for controlling a continuous jet of marking fluid so as to intermittently mark the surface of a material by causing the jet to normally travel transverse to an opening disposed close to the material surface, by providing a gas jet which travels transversely to the liquid jet in a direction toward the opening and which impinges on the liquid jet, and by activating the gas jet intermittently so as to deflect portions of the liquid jet through the opening and onto the surface to be marked each time a mark is to be provided.

The present invention relates generally to the marking art, and more particularly, to a process as well as a device for marking the surfaces of materials.

In various industries, for example, glassworks, mirror factories, the bottle industry, and other industries, the manufacturing of holloware as well as the factories manufacturing plastic and ceramic materials and certain structural steel engineering works, currently use processes and devices which are well known for mechanically marking the outer surfaces of goods. These goods may be manufactured for either decorative purposes or for easily indicating surface or superficial defects and making them rapidly discernible. Even with transparent or translucent goods, defects situated inside the goods and previously detected either by a person who technically supervises the manufacturing process, or by means of a detection device designed for the purpose may be marked.

In the bottle industry, a device used for mechanically marking the outer surfaces of the bottles by means of inking rollers is well known. These rollers are often lined with felt or with synthetic sponges which are impregnated with a coloring liquid. When the bottles pass under the marking device a predetermined part of the outer surface of each bottle passes under the inking roller which at this time is lowered and pressed onto this portion of the above-mentioned surface. Masks are often used in conjunction with the inking rollers for providing inscriptions or decorative designs. After marking the bottles, the marking ink which is applied to the rollers is often dried by means of suitable dryers and sometimes made to solidly adhere to the surface of the bottles when the latter are reheated in an annealing furnace.

In glassworks, the process for mechanically marking the upper surface of the glass sheet upon its leaving the furnace by means of an inking device is well known. These inking devices are similar to the above-mentioned inking rollers. They are especially used for indicating on one of the marginal zones of the glass sheet the surface or superficial defects or the internal defects which are deemed unacceptable and which have been previously located by an automatic device which is arranged for detecting them. Such a detecting device emits an output signal when an unacceptable defect or flaw has been detected. When the emitted signal is received, the marking device operates a mechanism which is capable of

applying the inking device to the portion of the glass sheet marginal zone which faces the defect. The ink which is applied is normally dried in the open air so that the workman cutting the glass sheet into pieces can easily locate the defect and consequently do his job more efficiently.

The above-mentioned marking systems are well known as are the devices used for atomizing a coloring liquid and making it also possible to mechanically mark the outer surface of goods constructed of glass, ceramic, plastic or metallic material. In these devices, the coloring liquid is dispersed in fine droplets by means of a gas under pressure which shapes them into a jet. The jet of droplets in suspension in the gas can be used, for example, for providing decorative designs and indicating defects previously detected so they can be more easily and rapidly seen with a view to subjecting the defective goods to a subsequent appropriate treatment. The droplets which are applied to the surface are then dried in the open air or in appropriate furnaces depending upon the circumstances.

All of these marking means are reliable when the marking device is operating continuously; however, they prove to be quite unreliable when they are discontinuously operated. In fact, it has been ascertained that, for example the atomizers which have been idle during a certain period of time, no longer respond automatically to the pulses emitted by the defect-detecting device. The reason for this is that when the liquid inside the atomizer stagnates and lies idle during a sufficiently long period of time, it forms deposits or scales which harden until the orifices, through which the atomized liquid is to be discharged, are clogged. On the other hand, it has also been ascertained that the surfaces of the materials are no longer marked when the rollers and the inking devices have lain idle during a certain period of time. The reason for this is that the coloring liquid dries when the rollers and inking devices operate discontinuously or periodically. These defects are known to those whose job it is to localize defects using devices operating discontinuously.

With this in mind, it is a main object of the present invention to provide for the marking of materials in a manner which obviates the inconveniences mentioned above.

Another object is to provide for material marking in a manner which is satisfactory even when the marking is not performed continuously.

A further object is to provide for material marking wherein the marking ink is continuously maintained in motion to prevent clogging and the like due to the drying of the marking ink.

These objects and others ancillary thereto are accomplished in accordance with preferred embodiments of the invention wherein a liquid is atomized and shaped into a jet of droplets and then used for marking goods. This jet is arranged to pass at a small distance from the surface of the material which is to be marked and the droplets can be projected onto the surface by a gas jet. Although the jet of droplets is at a small distance from the surface of the material to be marked before the gas comes into contact with it, it is nevertheless precluded from contacting the surface, and is only directed toward this surface when the gas jet is utilized.

This process is an extremely reliable one even if the rollers and inking devices operate rather discontinuously and this is accounted for by the great fluidity of the liquid used for marking purposes when applying this process. Such a liquid is advantageously atomized by forcing it through an orifice of a sufficiently small diameter. In other cases, when it is desirable to atomize the liquid into finer droplets, the liquid is held in suspension in a gas.

In an embodiment of the present invention, a jet of

ink droplets can be provided within a substantially closed tank and directed in the same direction as the sheet of material to be marked. Normally, the jet of ink droplets is not deposited upon the material because of the substantially closed tank. A discharge opening which is provided in the tank is passed over by the jet of droplets and therefore no marking occurs. However, when it is desired that marking should occur, a gas jet passes through the droplet jet in such a direction as to change the direction of at least a portion of the droplets which then pass through the opening which is provided and toward which the gas jet is directed.

Thus, marking only occurs when the gas jet is utilized and the gas jet can be selctively operated whenever defects or flaws are noted either manually or automatically.

The device of the present invention is provided with means for producing a jet of droplets from a liquid used for marking purposes, and means for injecting a fluid under pressure transversely with respect to the direction of the jet of droplets.

In a first embodiment of the invention, the means for producing the jet of droplets from a liquid used for marking purposes includes a closed marking tank having a bottom with an orifice. The bottom is placed at a small distance from the surface of the material to be marked. The tank is also provided with a side wall through which a pipe is disposed which has an orifice which opens inside the tank at a level which is below the level of the marking liquid contained in a reservoir or feed tank and which is subjected to atmospheric pressure. In this same marking tank, the side wall facing the above-mentioned side wall is used for collecting the droplets of liquid which have not been used for marking purposes and which are returned to the feed tank for being recycled.

In the second embodiment, the means for producing a jet of droplets from a liquid for use for marking purposes includes a closed marking tank also provided with a bottom in which there is an orifice, the bottom being disposed at a small distance from the surface of the material to be marked. This tank is also provided with a side wall through which a pipe is disposed and which has an orifice which opens interiorly of the marking tank and at a level which is at any desired level with respect to the level of the liquid contained in the feed tank which is subjected to superatmospheric pressure. The marking tank side wall facing the above-mentioned side wall is used for collecting the droplets of liquid which have not been used for marking purposes and which are to be returned to the feed tank for being recycled.

In a third embodiment of the invention, the means for producing a jet of droplets of a liquid for marking purposes includes a closed marking tank provided with a bottom in which there is an orifice, the bottom being disposed at a small distance from the surface of the material to be marked. This tank also has a side wall through which at least two pipes pass, the orifices of the pipes opening into the tank at right angles to each other. The orifice of one pipe has its axis disposed in a direction parallel to the bottom of the tank and discharges air or other gas under pressure which is capable of projecting, in the form of droplets, the liquid which is used for marking purposes and which flows through the orifice of the other pipe. In this same tank, the side wall which faces the above-mentioned wall is used for collecting the droplets of liquid which have not been used for marking purposes and which are thus returned to the feed tank for being recycled.

In accordance with the present invention, the means for injecting a fluid under pressure transversely with respect to the direction of the jet of droplets includes a valve which discharges a predetermined quantity of fluid under pressure and which is sufficient for projecting a certain number of droplets of the jet through the orifice constructed in the bottom of the tank and thus apply these droplets to the surface of the material which is to be marked.

The device which is used for marking the material is, in an advantageous manner controlled by a device used for detecting the defects. This defect-detecting device is disposed upstream of the marking device in the direction of displacement of the material to be marked. The two devices are connected to a time delay device so that the marking device will place a mark on the material at that location where the defect has been ascertained to be.

Additional objects and advantages of the present invention will become apparent upon consideration of the following description when taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a schematic vertical sectional view of a first embodiment of the invention wherein the feed tank is at atmospheric pressure and the ink is discharged in a jet of droplets.

FIGURE 2 is a schematic vertical sectional view of a second embodiment of the invention wherein the feed tank is at superatmospheric pressure and the ink is formed into a jet comprising droplets.

FIGURE 3 is a schematic vertical sectional view of a third embodiment of the invention wherein the feed tank is at atmospheric pressure and the jet of ink is atomized into fine droplets.

FIGURE 4 is a plan view of the arrangement including a detecting device.

With more particular reference to the drawings, the embodiments of FIGURES 1, 2 and 3 illustrate spaced horizontal conveying rollers **1** on which a glass sheet **3** is transported in the direction indicated by arrow **3**. A device used for detecting surface flaws or defects is disposed above these conveying rollers and at a small distance from the glass sheet **2**. Such a device is well known and is not shown in these figures, but will be discussed in more detail below. It may include a plurality of cells, the number of which is sufficient for scanning the entire width of the glass sheet **2**. A marking device is disposed downstream of the detection device and above the horizontal conveying rollers **1** and at a small distance from the glass sheet.

A first embodiment of the marking device is illustrated in FIGURE 1. As can be seen in FIGURE 1, a closed tank **4** is provided and which is one unit among a plurality of units which are disposed side by side so that the zones covered by the closed tanks **4** are sufficient to include at least the width of the glass sheet. Each closed tank **4** has a bottom **5** in which an opening or orifice **6** is provided. The upstream side wall **7** of the tank **4** supports a pipe **8** which opens into the interior of tank **4**. The pipe **8** is fed with an ink which contains alcohol and is quick drying. Alcohol is needed for conveying the ink from its support. The pipe **8** is fed with ink from the feed tank or reservoir **9** which is disposed above the closed tank **4** and is analogous to a water tower. In this embodiment of the invention, the ink in feed tank **9** is only subjected to atmospheric pressure.

In each of the closed tanks **4**, the downstream side wall **10** is used for collecting those droplets of liquid which have not been used for marking the material. At the foot of this wall **10**, the unused ink flows through a pipe **11** into a pump **12** which may return the remainder of the ink to the feed tank **9** via pipe **13**.

A tube **15** penetrates the cover **14** of the closed tank **4** at a suitably chosen place and an electropneumatic valve **16** is disposed in this pipe. This electropneumatic valve **16** is connected to a compressed air tank **17** by means of a pipe **18**, and is operated by the corresponding cell of the detection device by means of an electric mechanism of a type which is known. The valve **16** is operated via its control line **16'**. The tube **15** is disposed so that its axis is perpendicular to the bottom **5** of tank **4** and passes through the center of orifice **6**. Furthermore, the length of tube **15** is adjusted so that the outlet of this tube **15** gently touches the upper surface of the jet of droplets being discharged from pipe **8**.

This embodiment of the invention can mark the defects

of the surface of a sheet of glass in the following manner. The glass sheet 2 of appropriate dimensions is placed in the inspection zone and is moved forwardly by means of the horizontal conveying rollers 1 which bring the sheet below the device which is used for detecting the surface or superficial defects of the glass sheet. As the glass sheet 2 passes below the detection cells, a well known mechanism operates the marking device shown in FIGURE 1.

The ink which is disposed in the feed tank 9 is situated on a level which is above the level of the covers 14 of the tanks 4. In order to use all of the closed tanks 4, the ink which flows from the feed tank 9 is distributed to the pipes 8 which convey the ink to the outlets formed in the side wall 7. These outlets can be in the form of nozzles with a sufficiently small diameter as to discharge the liquid ink in the form of a continuous jet of droplets. The droplets are projected forwardly so that the lowest trajectory of the droplets intersects the bottom 5 of the tank 4 at a point which is sufficiently remote from the orifice 6 in the bottom 5 of the tank that the droplets will normally not pass through the orifice. The distance between this point of intersection and the orifice 6 can be adjusted by suitably adjusting the difference in level between the tanks 4 and the feed tank 9. After the droplets have followed the trajectories inside the tank, the jet strikes against the wall 10 through which the suction pipe 11 extends and which conveys the droplets collected by the wall to a pump 12 which returns the unused ink to the feed tank 9 via pipe 13 so that the ink, after completing one cycle, can be recycled.

The marking device in the embodiment of FIGURE 1 is started by means of compressed air which is delivered by the tank 17 and conveyed through the pipe 18 to electropneumatic valve 16 for operation of the latter. The starting period for the marker device is adjusted so that it is completed when the glass sheet 2 begins to pass under the bottom 5 of the tanks 4. If a defect, such as A, is detected by the detection cell, a suitable mechanism emits an output signal which is capable of operating the corresponding electropneumatic valve 16 at the moment when the area in which the defect has been detected passes under the orifice 6.

At this moment, the electropneumatic valve 16 discharges a predetermined quantity of compressed air through the tube 15 which has been disposed in a direction which is judiciously chosen, as has the level of the output of the tube 15. The jet which is expelled from the tube 15 then comes into contact with the jet of ink droplets and changes the direction of at least some of these, which are then hurled through the orifice 6 and applied to the defective part of the upper surface of the glass sheet 2.

Even if the marking device works discontinuously it nevertheless operates reliably for placing a mark on the glass sheet and will do so satisfactorily under any circumstances. Such a marking process makes it possible to rapidly locate the defects which are better made visible by these ink spots.

With more particular reference to FIGURE 2, another embodiment of the invention is illustrated wherein those elements which are similar to the embodiment of FIGURE 1 are provided with identical reference numerals. The main differences in the embodiment of FIGURE 2 is that a feeding tank or reservoir 19 is provided for feeding ink to the marking device, and has a cover 20 through which the delivery pipe 13 passes. A further pipe 21 passes through the cover 20. This latter pipe branches off from the compressed air tank 17 and conveys compressed air to the inside of the feed tank 19 for exerting a superatmospheric pressure upon the upper surface of the ink which is contained in tank 19. Because of this arrangement, a difference in level between the feed tank and the closed tank is not necessary since compressed air is used. The pressure may be suitably chosen, depending upon circumstances. A marking device of this type requires less floor space when compared with the first embodiment of the invention although it does atomize liquid in the same manner.

FIGURE 3 illustrates a third embodiment of the marking device of the present invention. A feed tank or reservoir 9 is provided in order to feed the marking device with ink and is identical to the feed tank 9 of FIGURE 1. With the exception of the feed tank 9 which is subject to atmospheric pressure, this third embodiment of the invention has some marked differences as compared with the first and second embodiments of the invention. The closed tank 4 is provided with an upstream side wall 22 through which two pipes 23 and 24 are disposed. The pipe 23 is fed with compressed air which is delivered by a tank 17 at a pressure of, for example, 1 kg./cm.^{2}. Inside closed tank 4, the pipe 23 leads to an expansion chamber 25 and a tube or nozzle 26 which is like an extension of the pipe 23 and the axis of which is disposed in a direction parallel to the bottom 5 of closed tank 4.

The pipe 24 is fed with ink which is delivered from feed tank 9 disposed at a higher level than the closed tank 4 so that it operates in a manner analogous to a water tower. Inside the closed tank 4, the pipe 24 is completed, or has as a prolongation thereof a chamber 27 which is used for regulating the flow of ink and a tube or nozzle 28 which is bent into an elbow at a right angle to the tube 26.

In operation, the compressed air from feed tank 17, which is kept at a pressure, for example, of 1 kg./cm.^{2}, is first admitted to the pipe 23 through which it reaches the expansion chamber 25. After passing through the chamber 25, it is discharged through the nozzle 26 in the form of a continuous high speed jet.

The ink which flows out from feed tank 9 because of gravity is then admitted to the pipe 24. Each pipe 24 conveys the ink to the respective chamber 27 used for regulating the flow of the ink. It then flows out from the nozzle 28 in the form of a continuous jet which crosses at a right angle to the gas jet. The ink is then atomized so as to form a mist which moves forwardly in the form of a blanket of a certain thickness and containing a large number of droplets. As mentioned above, there may be a plurality of such units side by side. This third embodiment of the invention has the advantage of providing very fine particles by atomizing the ink. It is preferably used when a precise marking is desired which is particularly useful in certain applications of the marking process.

FIGURE 4 illustrates a partial view of a glass sheet 2 which is supported by the rollers 1 and which is displaced in the direction of arrow 3. The devices x for detecting the defects in the glass are placed above the glass sheet 2. Such devices could be, for example, photoelectric cells receiving a beam of light and the intensity of the light is affected by the presence of a defect in the material. Each detection device x is followed by a marking device y of the type described above which is operated by a time delay device z. This time delay device z delays the controlling pulse of the detection device x until the defect passes under the marking device.

It should be noted that in order to increase to a larger extent the fluidity of the liquid to be used for marking purposes, the dispersion of the jet of droplets is adjusted so that the droplets follow predetermined trajectories in the space provided and which is situated at a small distance from the surface of the material. For example, this dispersion can be adjusted by modifying the form and cross section of the orifice or of the orifices of a small diameter, or by varying the pressure of the liquid at the outlet of the atomizer so that it is possible to obtain ink markings of very small size.

As has been described above, the droplets which are not used for marking purposes are, in an advantageous manner, returned to the feed tank and recycled. Because

the droplets of the liquid are constantly being moved and constantly flowing, the reliability of the device is appreciably increased. The tendency of the liquid to dry up is lessened as the droplets circulate at a higher speed.

As can be seen in accordance with the invention, when devices essentially operating in a discontinuous manner are placed into operation, for example for locating defects on the surfaces of materials, it is desirable that the gas jet which is used for this purpose be controlled by means of a controlling mechanism. In this manner, the defective spots distributed on the surface of the materials and previously examined by means of a detection apparatus can be easily and reliably marked. Usually, and preferably, air under pressure is used for placing the droplets of the jet into suspension and also for projecting them. Air under pressure often serves the purpose in the most economical manner.

For example, interesting results have been obtained by using a device identical to the one represented in FIGURE 3 for which the diameter of the tube 15 is 2 mm. and the diameter of the orifice is 4 mm.

In the same device the compressed air used for atomizing the ink has a pressure of 1 kg./cm.^{2}.

It will be understood that the above description of the present invention is susceptible to various modifications changes and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

What is claimed is:

1. A process for marking the surface of material, comprising the steps of:

forming into a jet of droplets a liquid to be used for marking purposes;

transporting this jet past, and at a small distance from, and in a path substantially parallel to, the surface of material to be marked along a path which normally remains out of contact with the material; and

discharging a jet of gas through said jet of droplets and transverse to the material surface, and at a point along said path, to project some of the droplets onto the surface.

2. A process as defined in claim 1 wherein said liquid is atomized to form said jet of droplets.

3. A process as defined in claim 2 wherein said liquid is atomized by forcing said liquid through an orifice of small diameter.

4. A process as defined in claim 2 wherein said liquid is atomized by placing it in suspension in a gas.

5. A process as defined in claim 1 wherein said jet of droplets is transported to follow a trajectory which is disposed at a small distance from the surface of the material to be marked.

6. A process as defined in claim 1 wherein those droplets which are not projected onto said surface by said gas jet are returned to again be formed into a jet of droplets.

7. A process as defined in claim 1 wherein the jet of gas is selectively discharged to selectively project the droplets onto said surface in accordance with a controlling phenomenon.

8. A process as defined in claim 4 wherein compressed air is the gas used for placing the liquid in suspension and also for projecting the droplets.

9. A device for marking the surface of material, comprising, in combination:

marking tank means including a bottom having an orifice therein and which may be placed at a small distance from the surface of material to be marked;

a feed tank for containing a marking liquid;

means connected to said feed tank for forming such liquid into a jet of droplets, normally having a path of travel within said marking tank means which prevents the passage of any droplets through said orifice; and

means for injecting into said marking tank means a fluid under pressure into and transversely to the direction of said jet of droplets to alter the path of travel thereof to pass through said orifice.

10. A device as defined in claim 9 wherein said marking tank means includes a side wall, said jet forming means including a pipe connected to said feed tank and discharging through said side wall interiorly of said marking tank means, and a further side wall facing the abovementioned side wall for collecting those droplets of liquid which are not altered in their path of travel and recycling them to said feed tank.

11. A device as defined in claim 10 wherein said injecting means includes valve means for discharging a sufficient quantity of a fluid under pressure to sweep away a certain number of droplets of the jet and alter their course so that they pass through the orifice in the bottom of said tank means and apply the droplets to the surface of the material.

12. A device as defined in claim 11 comprising defect-detecting means for controlling operation of said valve means to alter the course of the jet of droplets when a defect is detected.

13. A device as defined in claim 10 wherein said pipe discharges into said marking tank means at a level which is below the level of the liquid contained in said feed tank, said feed tank being subjected to atmospheric pressure.

14. A device as defined in claim 10 wherein said pipe is arranged to discharge into said marking tank means at any desired level, said feed tank being subjected to superatmospheric pressure.

15. A device as defined in claim 10 wherein said jet forming means includes a conduit means for discharging a gas under pressure through said side wall interiorly of said marking tank means adjacent to said pipe and in a direction parallel to the bottom, and said pipe being disposed at a right angle to said conduit so that said gas sweeps away, in the form of a jet, the liquid used for marking purposes and flowing out through said pipe.

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