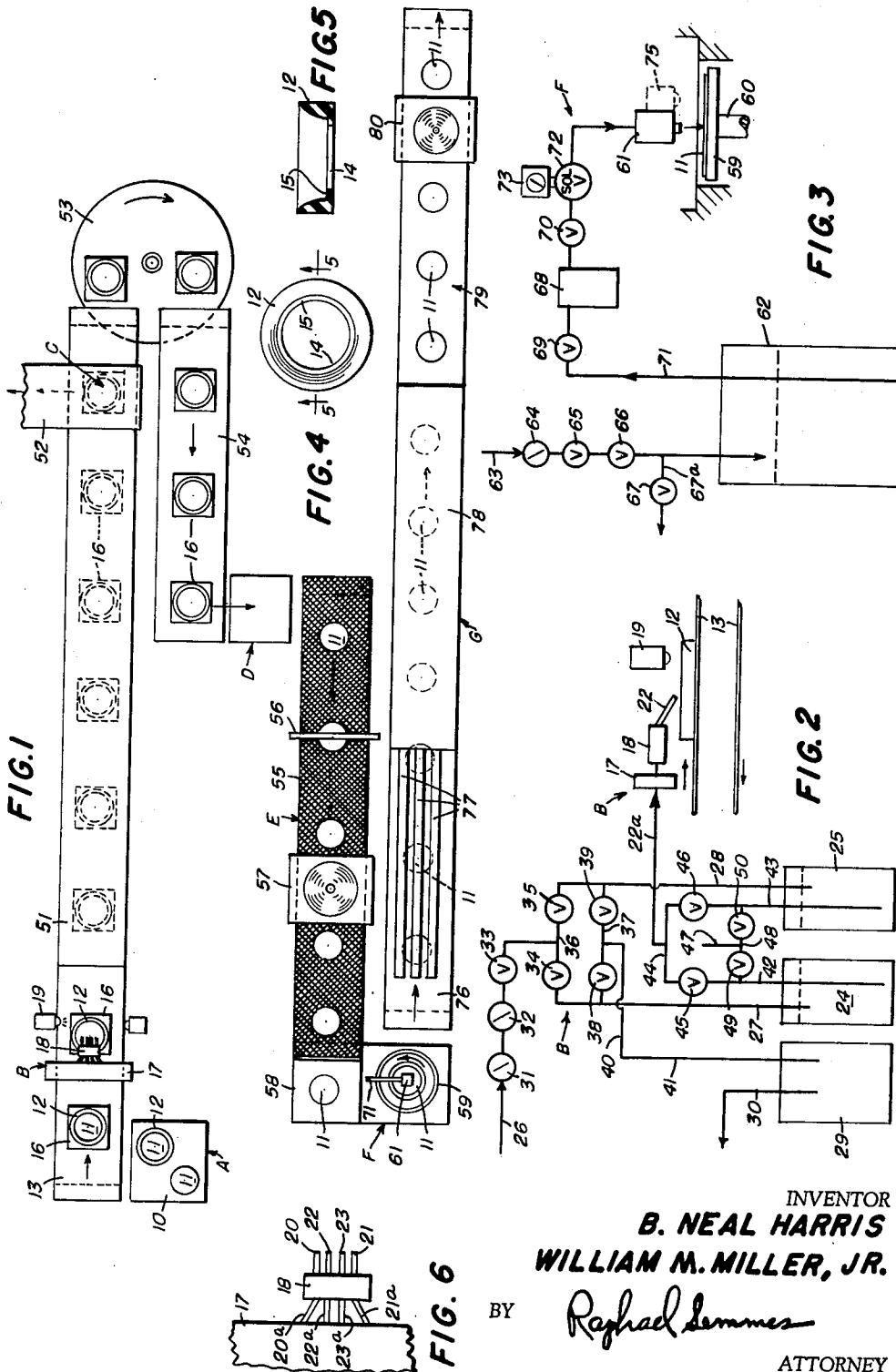


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METHOD AND APPARATUS FOR ACID TREATING AND COATING
METALLIC SURFACES WITH PLASTIC
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METHOD AND APPARATUS FOR ACID TREATING AND COATING METALLIC SURFACES WITH PLASTIC

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This invention relates to a continuous method and apparatus for the sequential acid treatment and plastic coating of a plurality of metallic surfaces, and consists more particularly in new and useful improvements in such a method and apparatus designed for the production of plastic coated aluminum blanks for use in the manufacture of containers or utensils for cooking food, such, for example, as disclosed in U.S. Patent No. 3,008,601 issued to A. Cahne on November 14, 1961.

In the production of articles of this character, the metal blanks, preferably composed of aluminum or aluminum alloy, are first subjected to a preparatory treatment comprising a chemical attack with a suitable acid or acids in order to produce, on the surfaces to be coated, a series of cavities or holes of predetermined average size. By utilizing the proper acid or mixture of acids for this preparatory chemical attack, the cavities produced have the required size and are contoured with a throttled entrance which facilitates the gripping or anchoring of the subsequently applied film of plastic, preferably polytetrafluoroethylene, a product known in the trade under the name of "Teflon." In other words, the film of Teflon is positively anchored within the cavities with an adherence equivalent to a true bond, despite the recognized non-adhesive nature of Teflon.

Tests have shown that containers or articles manufactured from blanks prepared and coated in this manner may be advantageously used for cooking food without the employment of additional fatty substances, such as oil, butter, fat, lard or the like, normally used for preventing the food from sticking. Furthermore, the Teflon coated utensils readily withstand normal cooking temperatures and the Teflon coating strongly adheres to the metal surface and withstands scoring.

In conventional methods of treating metals with acid, tanks of acid are employed in which the metallic articles are suspended by the use of racks or holders, and the acid in the tanks is normally used repeatedly until its concentration has changed sufficiently to render the bath ineffective. When the acid bath is exhausted, the tank requires draining and refilling, after which it must be brought to operating temperature before the operation can proceed. Furthermore, since there is normally an exothermic heat of reaction associated with acid treating of metallic surfaces, the temperature of the acid in the tank increases with time of use, and with such a system the degree of attack of acid on the metallic surfaces varies with the freshness of the acid in the bath and with the temperature of the bath, neither of which can be readily controlled in a batch method. Obviously, such an acid treating process involves lost production time due to the necessity of having to change the acid bath, and also, in many processes, elaborate temperature control facilities are required.

Another disadvantage of the batch treating method resides in the fact that if it is desired to acid treat only a portion of the object, it is necessary to mask the portion which is not to be treated. Thus, when it is desired to treat only one surface of a metallic blank, such as contemplated in the present invention, the batch method would be completely unadaptable.

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It is therefore the primary object of the present invention to overcome the disadvantages above noted in connection with the batch method of treatment and to provide a continuous method and apparatus wherein the metallic blanks are retained in rings of rubber or other suitable material and conveyed in a continuous operation through an acid treating station, including controlled metering equipment where specific amounts of acid and water are applied to the exposed surface of the blank.

Another object of the invention is to provide a continuous automatic acid treating method wherein each blank to be treated receives a controlled quantity of fresh acid which provides for direct control over the ratio of the mass of acid used and the surface area of the metal to be reacted. By holding this ratio constant, the heat of chemical reaction causes each blank being treated to go through a constant temperature cycle, thus resulting in a uniformity of quality level of the finished product, as well as efficient acid usage.

A further object of the invention is to provide a continuous method and apparatus including the above-mentioned acid treating step and wherein the blanks being treated are successively conducted on belt conveyors from the acid treating step to an acid withdrawal step, through a washing station and drying operation, to a Teflon or plastic coating station, and finally through a drying and baking step.

Still another object of the invention is to provide the apparatus utilized in conducting the blanks through the acid treating step with means for exhausting acid fumes.

Another object of the invention is to provide apparatus for conducting this method which is arranged to afford a maximum utilization of space and convenience of operators and wherein the size of the objects to be treated, the required retention time, conveyor length and belt speed, can be so adjusted as to afford any required rate of output.

With the above and other objects in view which will appear as the description proceeds, the invention consists in the novel features herein set forth, illustrated in the accompanying drawings, and more particularly pointed out in the appended claims.

Referring to the drawings in which numerals of like character designate similar parts throughout the several views:

FIG. 1 is a diagrammatic plan view of one form of apparatus for conducting the method of the present invention;

FIG. 2 is a diagrammatic view showing one of the controlled acid metering units;

FIG. 3 is a diagrammatic view of the controlled Teflon filtering and coating station;

FIG. 4 is an enlarged top plan view of one of the metal blank retaining rings;

FIG. 5 is a transverse sectional view taken on line 5—5 of FIG. 4; and

FIG. 6 is an enlarged fragmentary view of the acid jet head and nozzles.

In the drawings, referring first to FIG. 1, the sequential processing stations as embodied in one form of the invention are diagrammatically illustrated. The starting station A comprises a suitable platform 10 where the operator initially inserts the metal blanks 11 in individual retaining rings 12 and places the rings one by one on the top run of an endless conveyor belt 13, with the top surface of the blanks 11 exposed. One embodiment of a retaining ring is illustrated in FIGS. 4 and 5 where it will be seen that the annular ring 12 of rubber or other suitable material is provided with a central annular recess 14 bounded by an inwardly directed annular shoulder 15 which supports the peripheral edge of the metallic disc or blank 11, so

that the latter is substantially in sealing engagement with the inner periphery of the ring 12. Thus, only the top surface of each blank 11 is exposed for the subsequent acid treatment to be described.

Returning to FIG. 1, the operator preferably places each ring 12 and its contained blank 11 on a pallet 16 of plywood or any suitable material prior to depositing the same on the endless conveyor 13, and the rings remain on these pallets throughout the acid treating operation, through which they are sequentially conducted by the continuously moving conveyor 13.

The acid treating station is indicated at B and comprises a valve controlled metering system later described in detail, preferably contained in a suitable housing 17. A jet spacer 18 located adjacent the housing 17 supports a series of jet nozzles respectively controlled by solenoid operated valves actuated by an electric eye 19 or other suitable detecting device, one such valve being arranged in housing 17 to control the flow of liquid through each of the jet nozzles 20, 21, 22 and 23 from their respective connecting lines 20a, 21a, 22a and 23a. As seen in the drawings, these nozzles are forwardly and downwardly directed in upwardly spaced relation with respect to the upper run of the conveyor 13, so that the advancing rings 12 present the top surfaces of the blanks 11 contained therein in line for receiving the liquids discharged from the jet nozzles.

While other acids, such as nitric acid, sulfuric acid, chromic acid and mixtures thereof, may be suitable for conditioning the surface of the metal blanks 11 for subsequent coating with plastic material, it has been found that in processing aluminum blanks, highly efficient results have been obtained by using a combination of hydrofluoric acid and hydrochloric acid mixed in suitable proportions with water, and while this acid treating phase may be conducted in a two-stage treatment, first with hydrofluoric acid and then with hydrochloric acid solutions, which is considered within the scope of the invention, the preferred embodiment of the invention contemplates a combined acid treating step at a single station in the operation. The advantage of such a single station treatment resides in the fact that it minimizes equipment and eliminates the complication of removing one acid after it has reacted for the required period, and before introducing the second acid which, again, must react on the metal surface for a prescribed period. Furthermore, it will be apparent that with a combined acid treating station, the total retention time for acid reaction can be materially reduced and the production rate increased.

Thus, in the preferred form of the invention, hydrofluoric acid and hydrochloric acid are fed from suitable sources of supply to the innermost jets 22 and 23 respectively, through valve controlled lines 22a and 23a, and simultaneously, water is introduced through outer jet nozzles 20 and 21 from connecting lines 20a and 21a. By arranging the jet nozzles in this fashion and metering the volume of liquids being discharged therefrom, the proper velocity can be controlled and splashing reduced to a minimum.

Suitable metering valves in housing 17 are connected to lines 20a-23a for simultaneously metering each of the above mentioned liquids onto the surfaces to be treated, and the valves are so adjusted that the solution generated in contact with the surfaces of the blanks 11 comprises the following preferred composition: hydrofluoric acid—1% by weight; hydrochloric acid—7.9% by weight; water—91.1% by weight.

It will be understood, of course, that the above quantities may be varied, depending upon the exact grade of metal being treated and that such variations are contemplated within the scope of the present invention. In other words, it is considered that suitable ranges of acid proportions are: .25%—5% of hydrofluoric acid and 4%—10% of hydrochloric acid, with water comprising the balance of the particular composition.

As before stated, the solenoid actuated valves in the housing 17 are controlled by the electric eye 19 which is so arranged that as the successive blank-containing rings 12 advance with the conveyor belt 13, the respective rings break a beam of light which has been aimed at a suitable photoelectric cell receiver. The impulse from the photoelectric cell receiver is amplified and in the conventional manner causes a set of relay contacts to change position, thus actuating an electric timer which, in turn, actuates the solenoid valves in the housing 17 for jets 20-23. These valves are simultaneously opened to start the metering of acids and water onto the surfaces of the blanks 11, and at the end of a pre-set time period, a set of electrical contacts in the timer causes the solenoid actuated valves to close. This pre-set period of time is always less than the time required for the surface being treated to pass under the series of nozzles from which the liquids are being metered. After each ring 12 passes through the beam of the photoelectric cell, the receiver can again see light due to the space between the successive rings 12. The timer and photoelectric cell are so wired that the presence of light on the receiver resets the timer so that the cycle is ready to be repeated at such time as another ring 12 breaks the beam of light of the photoelectric cell. At all times during the operation of this device, the acids are kept under pressure at the solenoid actuated valves in lines 22a and 23a, and the system of delivering acid to the jet nozzles and maintaining it under pressure in a safe economical manner is shown diagrammatically in FIG. 2.

Inasmuch as the valve control systems for the acid delivering lines 22a and 23a are identical, a description of one will suffice. In FIG. 2, two acid containers 24 and 25 are shown, from which acid is forced under pressure to the solenoid actuated valves controlling the jets in the spacer 18. In this instance, for purposes of illustration, we will consider that the acid in question is the hydrochloric acid being introduced to jet nozzle 22 through line 22a. Ordinarily, acids are received in carboys at proper concentration for use and, in such case, the containers 24 and 25 would be in the form of carboys.

In the operation of this acid delivery system, air is introduced under pressure from line 26 and is applied to either container 24 or 25 through lines 27 and 28 respectively, by a proper manipulation of the air and acid valves, and while metering from the selected acid container, the valving can be so set that the container not in use can be refilled or replaced with a full container. This permits continuous use of the equipment without interruption for refilling or replacing containers. In the event that containers other than the delivery carboys are used which require refilling when exhausted, a third container 29 serves as a trap to accumulate any overflow of acid that may result from filling either container 24 or 25, and a vent line 30 leading to the fume exhaust system, later described, is provided to permit air and acid fumes to be removed from the space above the acid in a container being filled.

The input of air through line 26 is normally from the plant air supply at some pressure higher than that which is required at the acid containers 24 and 25. Typical pressure at the air inlet line is 125 p.s.i. An air regulator 31 is interposed in line 26 and set at 12 p.s.i. and a second air regulator 32 in said line is set at 10 p.s.i. While the use of two air regulators is not essential, it is advisable as a safety precaution to avoid the application of excessive pressure to the containers in case of failure of one regulator. A further safety precaution comprises the air safety valve 33 in line 26 which is set to relieve pressures exceeding 15 p.s.i. Thus, at the outlet side of the valve 33, an air pressure of 10 p.s.i. is available.

The piping and valve system to and from the containers 24 and 25 comprises two valves 34 and 35 in a cross-line 36 connecting the air line 26 to the lines 27 and 28 leading to the respective containers. A second cross-line 37

connects lines 27 and 28 posterior to the cross-line 36 and is provided with valves 38 and 39, and between these two valves an air line 40 joins line 41 and leads into the overflow container 29. Acid delivery lines 42 and 43 lead from the lower extremities of the containers 24 and 25 and are joined by a cross-line 44 into which the acid delivery line 22a is connected, valves 45 and 46 being provided in lines 42 and 43 respectively, on either side of the junction of lines 22a and 44.

Assuming that both containers 24 and 25 are filled with hydrochloric acid at the outset of the operation, a typical example of such operation is as follows: Valves 34 and 45 are opened, while valves 35, 38, 39 and 46 remain closed. This applies 10 p.s.i. air pressure to the surface of the liquid in container 24, causing the acid from that container to be forced upwardly through line 42, valve 45 and lines 44 and 22a, to the solenoid controlled valve in housing 17 which, of course, remains closed until actuated by the electric eye mechanism. When the acid in container 24 is exhausted, valves 34 and 45 are closed and valves 35 and 46 are opened, causing acid to be forced under pressure from container 25 through valve 46 in line 43 and lines 44 and 22a to the solenoid actuated valve which controls jet 22.

For purposes of refilling the containers 24 and 25 in the event they are not the carboys in which the acid is delivered, a fill line 47 is connected into a cross-line 48 extending between the acid delivery lines 42 and 43, and valves 49 and 50 are provided on either side of the junction of line 47 with line 48. Thus, when filling container 24, valves 49 and 38 are opened and acid is introduced through line 47 and line 48 to the container 24, the other valve 50 being closed. By opening valve 38, the container 24 may be vented to overflow container 29 so that the air displaced by filling the container 24 can be removed. After filling container 24, valves 49 and 38 are closed.

It will be apparent that when container 25 becomes exhausted, manipulation of the proper valves associated with that container will repeat the operation just described and this cycle is repeated alternately as the containers 24 and 25 are emptied.

Returning to FIG. 1, after passing the electric eye 19, the successive rings 12 carrying the solution covered blanks 11 continue to advance on the conveyor 13 until they reach the acid removal station C which is located a sufficient distance from the acid treating station B to permit the required reaction of the acid on the surfaces of the blanks, taking into consideration the speed of travel of the conveyor 13 between the two points.

As previously stated, the acid treatment of the discs can be effected either at two successive treating stations, one for each acid, or at a combined acid treating station. In the two-stage acid treating method, each disc or blank passing the jets in spacer 18 receives 250 ml. of 4% (by weight) hydrofluoric acid which is removed after a predetermined period of reaction at an acid removal station, such, for example, as at C. Then, at a second acid treating station (not shown), 72 ml. of 20° Baumé hydrochloric acid and 301 ml. of water are metered onto the surface of each disc, and, after a predetermined period, this solution is removed at a second acid removal station similar to C.

The estimated minimum concentration of hydrofluoric acid is 2% by weight, although higher concentrations can be used, up to concentrated hydrofluoric acid, depending on the cost available. The estimated minimum amount of hydrofluoric acid is the physical amount required to cover the surface of each object being treated, the maximum amount being immaterial once the surface has been covered. The minimum and maximum amounts of concentrations of hydrochloric acid depend upon achieving satisfactory etching and will vary with the metal alloy being treated.

In the preferred form of the invention which embodies a single acid treating station for the application of both

acids, 5 ml. of 60% hydrofluoric acid, 78 ml. of 20° Baumé hydrochloric acid, and 267 ml. of water are metered onto the respective discs as they pass the jets in spacer 18. At station C, the acid is removed from each blank as it approaches, and this may be accomplished either manually or by a suitable suction device designed to withdraw the acid solution from the blanks. Preferably, in order to avoid the exposure of operators and the plant atmosphere to acid fumes during the period of reaction, a hood or shroud 51 covers the endless conveyor from a point just past the acid treating zone B to the acid removal zone C, and at this point an acid discharge flue 52 exhausts the acid fumes through an externally directed exhaust fan.

After the acid has been removed, the rings containing the blanks are deposited by the endless conveyor 13 onto a turntable 53 which reverses the direction of travel of the blanks and deposits them successively on a second shorter endless conveyor 54 which conducts them to the washing station D. Here, the blanks are removed from the rings 12 and washed either manually or by any suitable means before being placed on a drying conveyor 55. On this drying conveyor, the washed discs are advanced past an air header 56 provided with a series of downwardly directed air jets which blow the moisture from the top surfaces of the blanks and, thereafter, the blanks pass under a fan 57 which evaporates any remaining moisture from the blanks.

At the terminus of the drying conveyor 55, the dried blanks are deposited on a platform 58 from which they are individually removed manually and placed on a rotatable platen 59 driven by a vertical shaft 60 as best seen in FIG. 3. Here, metered quantities of a suitable plastic dispersion such as Teflon are applied to the rotating top surfaces of the blanks.

In the application of Teflon, for example, it is important that a lump-free dispersion be directed onto the surfaces of the blanks being treated and that waste be minimized. The presence of lumps in Teflon can ruin the product and also cause considerable waste of the liquid Teflon which is very expensive, and one of the primary advantages of the present invention lies in the fact that it eliminates such lumps and effects a maximum economy in conserving Teflon.

In order to thoroughly understand the advantages and improvements of the present invention, it is important that the properties of liquid Teflon dispersion be borne in mind. Despite the best efforts of the Teflon dispersion manufacturer to produce a stable dispersion, those available today are notoriously unstable. The characteristic of instability of such dispersions is true, both of relatively pure Teflon dispersed in water along with appropriate quantities of wetting agents, as well as enamel formulations containing Teflon and other ingredients. The difficulty of instability manifests itself by the formation of lumps within the dispersion. Coagulation of the solid particles within the dispersion and lumping of such particles can occur due to a number of causes, one primary cause being drying. That is, if the liquid Teflon dispersion is exposed to air, a significant amount of lumping occurs at the exposed surface. This lumping can occur even in a completely enclosed container, and apparently is due to the fact that some air is normally present and that the air space is sufficient to allow lumping to occur at the liquid air interface. It is common practice for the manufacturer of such dispersions to filter the dispersion just prior to filling the drum. However, despite such filtration, a freshly opened drum of this material is frequently found to contain large quantities of lumps. It is the normal practice in the use of such materials to withdraw relatively small quantities and to filter these small quantities through wire mesh or other filters prior to attempting to use the dispersion.

In the development of the present invention, it was found that despite the precautions of filtering and han-

dling in small quantities, liquid Teflon dispersion is so unstable that lumping can occur between the time the material is filtered and the time the material is used, even when this time interval is relatively short. The method of handling finally developed and hereinafter described overcomes all of the above-noted difficulties and results in lump-free Teflon available at the point of use on a continuous basis with significant production economy over other known means of handling this material.

Referring more specifically to FIG. 3, the steel drum 62, or other container in which the Teflon liquid dispersion is received from the supplier, has connected into its upper end an air line 63 leading from a suitable source of air at normal plant pressure. Such pressures may be at any value in excess of 2 lbs. per square inch. An air regulator is shown at 64 which is set between 2 and 10 p.s.i., dependent on the flow rate desired at the output of this system. A safety valve 65 for purposes of protecting the drum 62 against excessive pressure is incorporated in line 63, posterior to the regulator 64 as a protection against excessive pressure in case of regulator failure. Said safety valve is set at approximately 2 p.s.i. in excess of the operating pressure. A manually operated valve is provided at 66 for purposes of applying air to a new drum when it is installed and for removing the pressure from an empty drum prior to the time it is disconnected. Another manual air valve is provided at 67 in vent line 67a which leads to the atmosphere. The purpose of this valve is to relieve air pressure from a drum once it has been emptied, so that fittings can be removed for purposes of removing a given drum and inserting another in the system.

A special filter 68 is provided in Teflon line 71, and we have found that for this purpose a filter known in the trade as Filterite-type L10-3/4DV manufactured by Filterite Corporation of Timonium, Maryland, has proven very satisfactory due to the fact that it is extremely selective in its action. For example, lumps, to be a problem, must normally exceed about 20 microns in size. The basic particle size of the Teflon particles in the dispersion is well under 1 micron in size. The filtering element in the filter 68 is a selective element, capable of passing particles less than 10 microns in size and retaining those exceeding 10 microns. It can thus be seen that with a significant factor of safety, this filter will pass all particles which are part of the normal dispersion and retain particles which are regarded for in-use purposes as lumps.

Valves 69 and 70 of the hand-operated type are connected into the Teflon line 71 on either side of the filter 68 for isolating the filter in a filled condition from all air sources in case it is ever necessary to remove the air pressure from the system. A solenoid valve 72 connected to a suitable timer 73 is connected into line 71 posterior to valve 70. This valve can be left open for any given amount of time, dependent on setting of the timer 73, and it can be actuated either manually or automatically, as, for example, from the relay at the output of a photoelectric cell 75 located adjacent the Teflon discharge device 61 which can be any one of several types of discharge devices. For example, if the Teflon is to be applied as a continuous stream, the device 61 can be simply a piece of rubber tubing, while if the Teflon is to be applied by a spraying technique, the device 61 can be the nozzle of a spray gun. As seen, the Teflon discharge device 61 is located immediately above a disc 11 carried on the rotating platen 59.

It will be apparent that the function of the above described system is to bring freshly filtered Teflon or other suitable plastic directly to the point of use without having it exposed to air at any point past the point of filtration. In operation, this device works as follows: Connections are made to a drum 62 of Teflon with valves 66, 67, 69 and 70 closed. Air is regulated with regulator 64 to the required pressure. Valve 66 is opened allowing such

pressure to enter the inside of the drum 62. This air pressure forces the liquid up line 71 towards valve 69 which, together with valve 70, is opened, allowing the liquid to displace the air in the system and to be available at the solenoid valve 72 for delivery to the output at 61, as required. At such time as the drum 62 is exhausted, valves 66, 69 and 70 are closed and valve 67 in line 67a is opened. At this point, the fittings on the drum can be loosened and the drum can be removed and a new drum inserted, after which the cycle can be repeated.

While Teflon is described as the preferred plastic material for use in coating the blanks 11, other materials in liquid or solid form which can be fused by heat can also be used in this process. For example, successful tests have been conducted when coating these blanks with fluorinated ethylene propylene which may be readily fused in accordance with this process. Other popular thermoplastics which will adhere to chemically treated metal surfaces are polyethylene, polyvinylchloride, polypropylene and polystyrene.

When Teflon is employed as the coating material, the maximum thickness of one application of the coating should not exceed .0015 inch, as thicker coats have a tendency to crack. However, if a final coating of greater thickness is desired, additional coats can be applied by the same process after the previous coat or coats have dried.

Returning to FIG. 1, after the coated blanks are removed from the platen 59, they are transferred to the heat treating station G, wherein an endless conveyor 76 successively conducts the coated blanks beneath a series of radiant heat elements 77 which afford preliminary drying. Thereafter, the conveyor conducts the blanks through an oven section 78 and from there to a cooling section 79, and, finally, beneath a fan 80 which completes the cooling.

Preferably, the oven section comprises three closed ovens successively arranged so that the coating is first pre-dried to drive off any water content, and the temperature is raised from room temperature (72° F.) to 220° F., requiring a period of one minute, forty seconds. The coating is then raised from 220° F. to a temperature of 750° F. over a period of two minutes, during which the coating is fused. The temperature is then held at 750° F. for a period of five minutes, after which it is cooled from 750° F. to handling temperature (approximately 130° F.) for a period of seven minutes.

The raising of the temperature from room temperature to fusion temperature can be effected at various speeds, dependent upon the heating equipment used. However, to achieve fusion, the temperature must reach at least 650° F. Maximum temperature can range upward to the practical limit of Teflon vaporization and it should be noted that Teflon vaporization begins very slowly at approximately 400° F., but increases greatly from fusion temperature upward. Therefore, the maximum temperature is limited by the practical amount of Teflon the operator is willing to lose in processing.

When using coating materials other than Teflon, it will be understood that the range of times and temperatures will vary according to the fusion temperature, decomposition temperature, and characteristics of the specific material being used. From the standpoint of pressures used in the air wiper 56, we have satisfactorily used 15 lbs. per square inch with a filtered air input to remove moisture in the air, with jet holes of a diameter of .054 inch and with jets spaced ¾ of an inch apart, operating at two inches above the blanks being dried, and with the blanks moving at a rate of 6 feet per minute in passing under the jets. The general principle being used is that of high velocity air to wipe or blow water from the surface of the blanks at 56, followed by evaporation of residual moisture with the fan 57. This residual moisture is due

to a lower velocity air flow at the periphery of the individual air streams as they hit the aluminum blanks.

Satisfactory wiping and drying results for other sizes of objects being treated can be achieved with various combinations of air pressure, jet diameter, spacing between jets and distance of jets from the object, as well as speed of the object traveling under the jets.

From the foregoing, it is believed that the invention may be readily understood by those skilled in the art without further description, it being borne in mind that numerous changes may be made in the details disclosed without departing from the spirit of the invention as set forth in the following claims.

We claim:

1. A continuous method of acid treating and coating one surface only of aluminum blanks with plastic material, comprising confining the bounding edges of individual blanks in sealing engagement within open-top retainers for masking the under-surfaces of respective blanks while exposing the top surfaces thereof, sequentially advancing individual retainers and blanks through an acid treating station where a mixture of acid and water in metered quantities is directed into said retainers and onto the exposed upper surfaces of respective blanks, retaining the acid-water mixture in said retainers and on said surfaces for a predetermined reaction period while continuing to advance said retainers and blanks, removing the acid-water mixture from said surfaces while still confined in said retainers, removing the blanks from said retainers, washing and drying said blanks, applying a coating of liquid plastic to respective acid treated surfaces, and heat treating said coated blanks to fuse said plastic coatings thereon.

2. A method as claimed in claim 1, wherein said plastic coating comprises polytetrafluoroethylene.

3. A method as claimed in claim 1, including the step of rotating respective acid treated blanks while applying said coating of liquid plastic thereto.

4. The method as claimed in claim 1, wherein said liquid plastic is a polytetrafluoroethylene dispersion and including the step of filtering a stream of said dispersion

immediately in advance of its application to the surfaces of said blanks.

5. The method as claimed in claim 1, including the steps of isolating from air and filtering a stream of polytetrafluoroethylene dispersion, and, immediately following said filtering step, directing said dispersion onto respective acid treated surfaces.

6. The method of acid treating a plurality of aluminum blanks, comprising confining the bounding edges of individual blanks in sealing engagement within open-top retainers, continuously conveying a succession of said retainers and blanks through a treating zone while directing onto the exposed surfaces of said blanks metered quantities of acid and water in selective proportions, retaining the acid-water mixture in said retainers and on said surfaces for a predetermined period of reaction, removing the acid-water mixture from said surfaces, controlling the period of acid-metal reaction by regulating the time of travel from the point of application of said mixture to the point of removal thereof, and washing the acid-water mixture from said surfaces after reaction.

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