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TREATMENT OF ALUMINUM SHEETS

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Fig. 1.

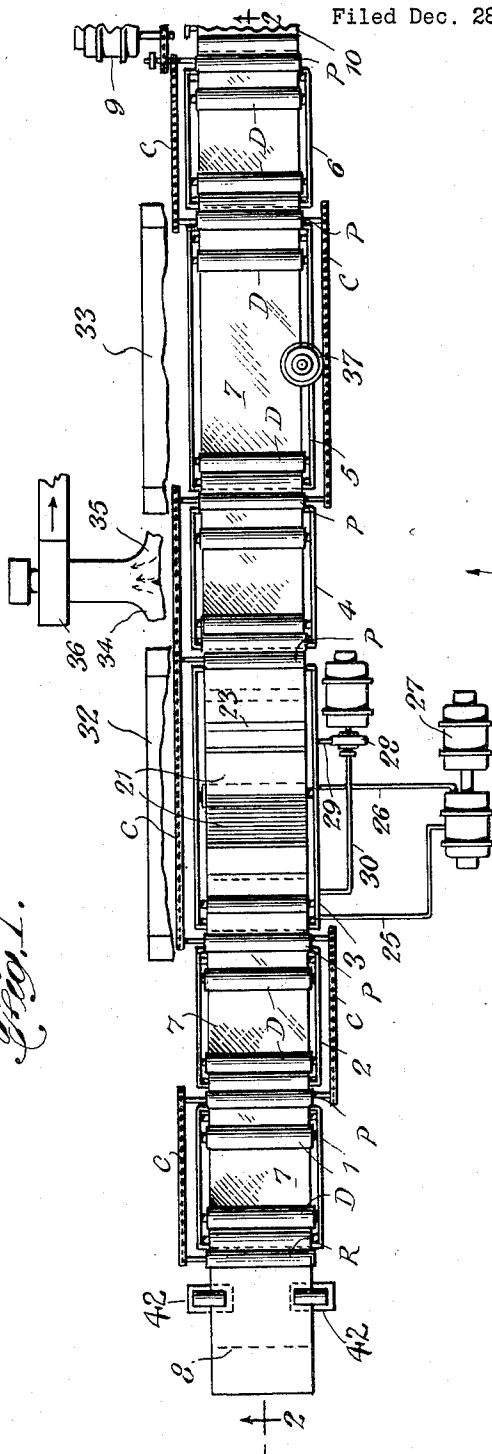
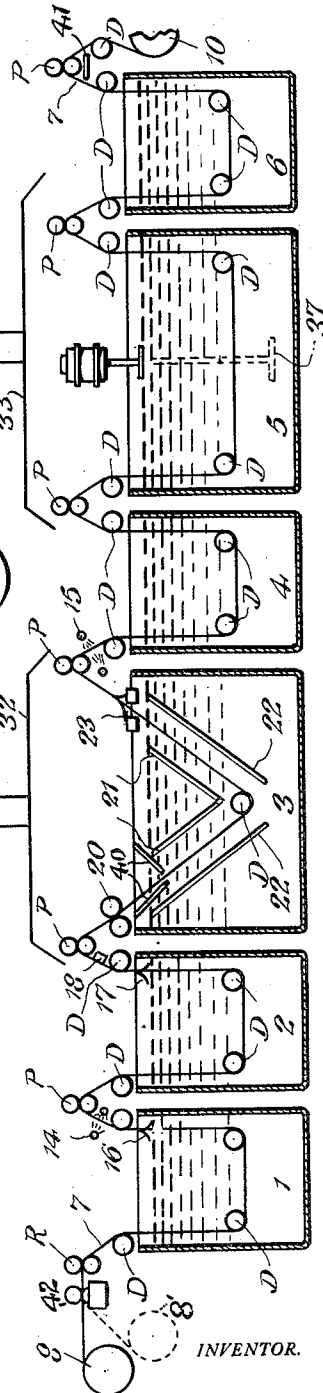


Fig. 2.



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TREATMENT OF ALUMINUM SHEETS

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2 Claims. (Cl. 204—28)

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This invention relates to the anodizing and coloring of aluminum and has for its object the provision of an improved method for carrying out these operations. The invention is especially concerned with aluminum foil and sheets and provides several improved treatment steps, as well as a complete operation, for the anodizing and coloring of aluminum foil and sheets.

The invention provides a continuous operation for the anodizing and coloring of more or less indefinite lengths of aluminum foil or sheets and is applicable to the treatment of metal in varying thicknesses from the thinnest foil capable of being handled and of carrying the required current, to fairly thick sheets, provided they are not too thick to pass around pulleys and rolls without undue deformation. Herein, for purposes of convenience, we shall refer to all forms of metal foil and sheets simply as "sheet material." In the continuous method of the invention, a sheet of aluminum of indefinite length, for example, from a stock roll, is passed through a series of operations, in one stage of which it is rendered anodic over an appreciable length in an anodizing bath.

In one of its more complete embodiments, the invention comprises a series of connected steps in which the sheet of aluminum is passed through the operation continuously, including immersion in an aluminum cleaner, rinsing to remove adhering materials from the cleaning step, drying if desired, rendering the sheet anodic while immersing it in an anodizing electrolyte, rinsing to remove the anodizing electrolyte, immersion in a dye bath, and then sealing to set the dye. In a continuous operation of the invention, the sheet of aluminum is drawn from a roll or other source of considerable length, through the various treatment steps, and is wound into a finished roll having an anodic coating with the desired color.

In another embodiment of our continuous treatment, we may treat two sheets at once by sealing the edges of two superposed sheets and passing them through the operation of the invention as a single sheet, thereby coating but one side of each sheet. Thin foils may be folded longitudinally and treated in this manner. Two single sheets superimposed on each other may be rolled together as a single in which case the exteriors of both sheets are smooth before coating while the uncoated interior surfaces have a matte finish.

One of the treatment steps of the invention comprises improvements in anodizing in which a clean, preferably dry, sheet of aluminum is

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passed continuously into and through an anodizing electrolyte while maintaining the sheet anodic. In one important aspect of this step of the invention, the sheet of aluminum is passed into the anodizing solution at a place where it is electrically isolated from the cathode and there is no appreciable oxidizing action at the surface. We have found that the passing of an anodic sheet of aluminum through the surface of an anodizing solution where the voltage is sufficient to cause an appreciable flow of current causes disturbances of an electrical or chemical nature at the surface resulting in striations across the sheet normal to its direction of flow. In accordance with our invention, we can prevent these striations by passing the sheet of aluminum through an electrically inactive part of the electrolyte.

In still another aspect of the invention, we provide means for the thorough rinsing and heating of the sheet of aluminum to dryness before immersing it in the anodizing bath and rinsing and drying the sheet after removing it from the anodizing step.

These and other novel features of the invention will be better understood after considering the following discussion taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a plan view, with parts removed, of an arrangement of apparatus embodying the invention, and

Fig. 2 is a view along line 2—2 of Fig. 1.

The apparatus illustrated in Figs. 1 and 2 is for the continuous treatment of sheet aluminum and comprises several tanks for liquids including a cleaning tank 1 for any suitable aluminum cleaner, a rinse tank 2 for clean water, an anodizing tank 3 for an anodizing solution, a second rinse tank 4 for clean water, a dye tank 5 for receiving a dye solution, and a tank 6 for sealing the dye. The cleaning tank 1 for alkali cleaner, the rinse tanks 2 and 4 for water, and the sealing tank 6 for hot water may be made of steel, the anodizing tank 3 may be made of stainless steel or ordinary steel lined with polymerized vinyl chloride or the like, and the dye tank 5 may be formed of stainless steel or aluminum. The tanks are preferably arranged on the same level and as near as practicable to each other. They may be any suitable length or depth to provide the required treatment time for the sheet of aluminum traveling therethrough.

The sheet of aluminum 7 of indefinite length from the supply roll 8 is drawn through the series of tanks by means of the pull rolls P which are

formed of sponge rubber or other gripping material and the crimping rolls R which are preferably formed of steel. These rolls are driven at the same speed through the sprocket chains C which engage spur wheels on the rollers (not shown) by the motor 9 which also drives the take-up roll 10. The sheet of aluminum is guided into and out of the various tanks by direction rollers D which are formed of glass or other inert or non-corrosive material. A water spray nozzle 14 is located near the rinse tank 1 and a similar water spray nozzle 15 is located near the rinse tank 4. Flexible rubber wipers 16 are supported above the tank 1 to wipe off the solution and similar rubber wipers 17 are located above the tank 2 to wipe off the water and thereafter the sheet is dried by the electric heater 18. The clean and dry sheet of aluminum passes between the two brass electrical contact rolls 20 which are connected to the source of current and the sheet is accordingly rendered anodic. In the anodizing tank, the cathodes 21 and 22 are suspended on both sides of the sheet 7. The rolls 20 and cathodes 21 and 22 may be connected to either A. C. or D. C. power lines (not shown). A pair of flexible rubber wipers 23 is placed above the anodizing tank 3 to wipe off excess solution before the sheet reaches the water spray nozzles 15.

As best shown in Fig. 1, the anodizing current is supplied to the contact rolls 20 and to the cathodes 22 by the power cables 25 and 26, respectively, connected to the D. C. motor-generator set 27. Circulation of the anodizing solution is provided by the motor driven pump 28 which sucks the solution in through pipe 29 and pumps it back into the tank through pipe 30. This circulation system may be used in conjunction with a heat exchanger for temperature control.

In order to remove objectionable fumes from the anodizing and dyeing tanks, suitable canopies or covers 32 and 33 are placed thereover and the trapped fumes are sucked out through the ducts 34 and 35 by the exhaust fan 36. The dye solution is agitated by the motor driven impeller 37.

In carrying out a method of the invention in the continuous anodizing and coloring of indefinite lengths of sheet aluminum, an apparatus, such as that illustrated in Figs. 1 and 2, may be used. The roll of sheet aluminum 7 from the feed roll 8 is run through the various feed tanks continuously and wound on the take-up roll 10. The speed of travel of the sheet is dependent upon its thickness and current-carrying capacity. A foil of 0.001 inch thick should travel at the rate of around 25 feet per minute, foil of 0.002 inch thick at around 50 feet per minute, 0.004 inch thick at around 100 feet per minute, etc. A low current density of around 25 amperes per square foot may be used with such anodizing agents as sulfamic acid, while other agents, such as chromic and sulfuric acids, require higher current densities.

The various tanks are proportioned to permit the sheet 7 to remain therein the time required for the particular treatment in that tank. In other words, the length of travel through each tank is correlated with respect to the speed of travel of the sheet 7.

The tank 1 may be filled with any suitable aluminum cleaner. The solution should be heated to from 180° to 200° F. After the sheet emerges from the cleaning solution, it is passed between the rubber wipers 16 to return as much of the solution to the tank as possible. Since the sheet is quite warm, it must be washed promptly to

prevent drying and the incrustation of salts from the cleaning solution forming thereon. The spray nozzles 14 direct blasts of fresh water against both surfaces to effect an initial cleaning and cooling before the sheet enters the tank 2 which is filled with fresh water. After the sheet leaves the tank 2, it passes between the rubber wipers 17 to remove excess water and thereby to facilitate drying of the sheet as it passes over the electrical heating unit 18. The clean and dry sheet makes good electrical contact with the brass contact rolls 20. In order to prevent striations on the surface of the sheet coating normal to its direction of travel, we render that portion of the anodizing solution in tank 3 inactive where the sheet enters the solution. We have found that a body or area of the anodizing solution embracing the surface may be rendered partially inactive by placing insulating barriers, such as the glass plates 40, in the solution in the path of current flow between the sheet and the cathodes 21 and 22. As the sheet passes through the anodizing solution, it acquires a thin uniform film of alumina. As the sheet emerges from the anodizing solution, the excess solution is removed by the rubber wipers 23. Before entering the fresh water tank 4, the sheet is subjected to a preliminary washing by means of blasts of water discharged from the nozzles 15. The clean anodized sheet is then passed into the dye solution in tank 5 wherein a dye of the desired color is absorbed into the alumina coating. The sheet should remain in the dye solution approximately 10 minutes and the solution is continuously agitated by the impeller 37 to insure uniform exposure to the dye. After leaving the dye solution, the sheet is subjected to a sealing treatment of any suitable character, such as by an immersion in water in tank 6, at a temperature of about 200° F. for a period of about 10 minutes. Other sealing means may be resorted to, such as by radiation, electrolysis, or the passing of the sheet through a steam chest.

The sheet emerging from the sealing treatment is preferably dried before it is wound upon the take-up roll 10 as a finished article of commerce. Any suitable drying may be resorted to, such as by passing the sheet over the electrical heating unit 41, before it is wound onto the roll 10.

In one adaptation of the continuous treatment of the invention, we may subject various aluminum alloys to the treatment and use in the tank 3 an anodizing medium which has the property of combining with one or more of the alloying constituents of the aluminum to form in the anodic film an inorganic salt. Such a salt may impart a desired color to the anodic film, in which case we may dispense with the use of an organic dye. In this connection, we may use, for example, an aluminum sheet comprising 0.20% copper, 0.60% silicon, 1.5% manganese, 0.70% iron and 0.10% zinc and employ for the anodizing medium 50 g. of oxalic acid per liter and produce a milky violet color. The formation of salts, in situ, may be used to impart the desired color, in which case we may dispense with the use of a dye, as in the treatment in tank 5. We may, however, pass the sheet having its film and contained inorganic salt into the dye tank to contact an organic dye capable of reacting with the salt. In this connection, we may use with the aforementioned alloy an anodizing solution of sulfamic acid and pass the sheet into a solution containing the dye chloramine sky blue. The use of aluminum alloys with anodizing solutions

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capable of forming inorganic salts therewith and the use of organic dyes in connection with such salts is not our invention.

In that aspect of our invention in which we apply an anodic coating to but one surface of the aluminum sheet, we may do this by folding a sheet of aluminum upon itself along its longitudinal axis and sealing the edges so that the inside of the folded sheet passed through the various treatment solutions is not contacted with them and is not affected by the anodizing or dyeing. The sheet of aluminum may be folded and sealed when delivered as roll 8, or it may be sealed by passing it through the rolls 42 in which a thermoplastic sealing material, such as a phenolic adhesive resin, is wiped on the edges before the sheet passes through the crimping or sealing rolls R.

Two separate sheets of aluminum may be brought together from separate feed rolls such as the roll 8 and the roll 8' shown in broken lines and sealed along both side edges with thermoplastic cement in passing over the applying rolls 42 and the crimping or sealing rolls R. Single sheets with the anodic coloring on but one surface may be formed by running the sheet through edge trimmers and cutting off the folded or sealed edges as the case may be.

We have found that we may produce sheet aluminum with one surface containing a dyed anodic coating and with the other surface uncoated and having a matte finish. We may form such a product by passing two superposed sheets of aluminum through the reduction rolls. In the rolling operation, the opposite surfaces of the sheets in contact with the rolls are given the usual fine glossy finish, whereas the interior contacting surfaces of the sheets acquire a dull or matte finish. We leave these sheets together as rolled, seal the edges, either by crimping them while rolling or later by means of a sealing agent as previously described, and pass this double sheet through the treatment of the invention. The exterior smoothly finished surfaces acquire the anodic colored surfaces, whereas the interior matte surfaces remain unchanged. By trimming off the edges and separating the sheets, we have two sheets of aluminum each containing a fine uniform colored surface and a matte surface. A product of this character may be used effectively where it is desired to attach the sheet as by means of cement, glue, or other bonding agent to another surface. The matte surface is much more firmly attached by means of the bonding agent than a glossy surface.

We claim:

1. In the formation of anodic coatings on sheet aluminum, the improvement which comprises

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continuously rolling two superposed sheets of aluminum to reduce the thickness thereof and form on each sheet a gloss finish on the sides which contacted the rolls and a matte finish on the sides which contacted each other, then sealing the edges of the two contacting sheets by applying cement thereto, and then passing the sheets through an anodizing treatment to form on the gloss surfaces an anodic film, and then separating the two sheets each of which has an anodic coating and a matte surface.

2. In the formation of anodic colored coatings on sheet aluminum, the improvement which comprises continuously rolling two superposed sheets of aluminum to reduce the thickness thereof and form on each sheet a gloss finish on the sides which contacted the rolls and a matte finish on the sides which contacted each other, then sealing the edges of the two contacting sheets by applying cement thereto, then passing the sheets through an anodizing and coloring treatment to form on the exterior gloss surfaces a colored anodic coating, and then separating the two sheets each of which has an anodic colored coating and a matte surface.

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