

March 9, 1948.

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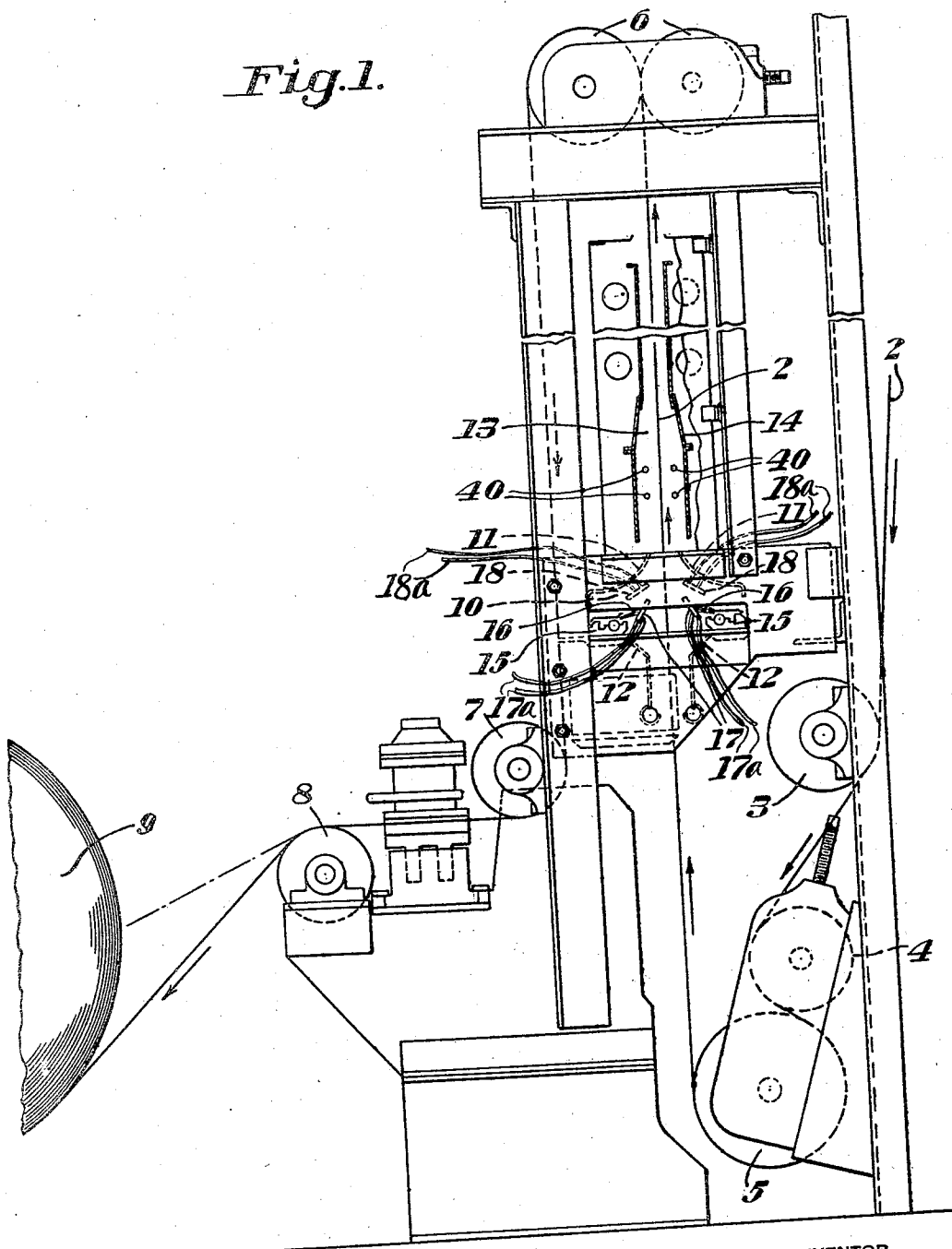
2,437,606

METHOD AND APPARATUS FOR OILING SHEET METAL

Filed Nov. 27, 1944

2 Sheets-Sheet 1

Fig. 1.



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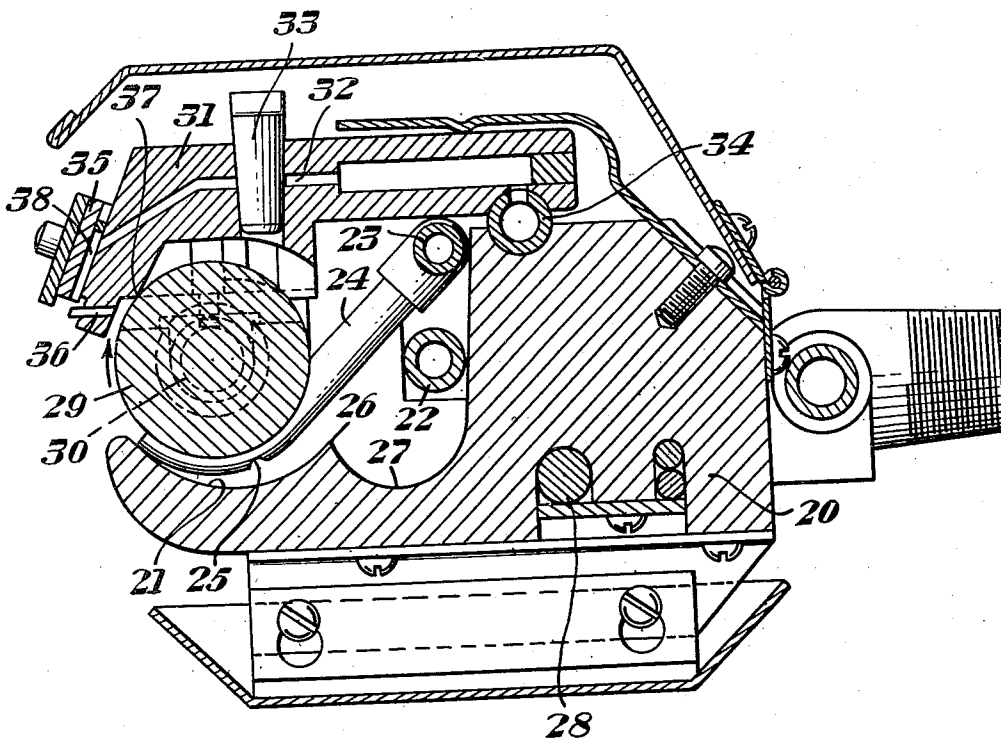
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2 Sheets-Sheet 2

Fig. 2.



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METHOD AND APPARATUS FOR OILING
SHEET METALGeorge A. Kaufman, Aliquippa, Pa., assignor to
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3 Claims. (Cl. 117-93)

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This invention relates to the oiling of sheet metal, such as tinplate, in continuous strip, and more particularly to a method and apparatus for applying a very thin film of oil to electrotinced strip.

An object of the invention is to provide a method and apparatus for applying to sheet metal, such as tinplate, a film of oil of uniform thickness sufficient to protect the metal during storage and shipment, but not so thick as to interfere with subsequent processing.

In the manufacture of tinplate, for example, it is highly desirable to have a thin film of oil on the surface of the plate when it is packaged for shipment, for several reasons. If the plate is packaged without oiling and is stored for a period of time prior to use, it may rust in spots, particularly if stored in damp or humid surroundings. If the plate is packaged without oiling and roughly handled in shipment the individual sheets or plates may rub upon one another sufficiently to produce black spots on the coating—a form of tin oxide objectionable to the user. And finally, uncoiled sheets, after having been stacked, tend to stick together and so jam the automatic feeding machines used by can makers.

For certain applications, however, the thickness of this oil film must be kept to a minimum. Light weight tinplate—that is, plate with a thin tin coating—is quite generally lacquered or enamelled by the can maker for a number of types of cans, and this lacquer or enamel does not adhere well if an appreciable amount of oil is found on the tinplate. Thus the tinplate producer encounters difficulty in applying enough oil to protect the plate in shipment but not so much as to impair lacquer adhesion.

This problem is most acute with electrolytically tinned sheets. The great bulk of electrolytic tinplate is made with thin tin coatings, on the order of $\frac{1}{2}$ to $\frac{3}{4}$ lbs. of tin per "base box" of plate. A "base box" of tinplate contains sheets totalling 217.78 sq. ft. of surface, one side. Nearly all of this product is lacquered by the can maker. Although oil is widely used in the brightening stage of the manufacture of electrolytic tinplate, the film left on the plate is generally not the weight and type desired by the user and therefore the finished plate must be oiled as a separate step in the production process. It is with this step in the manufacture of tinplate that my invention is concerned.

Electrolytic tinplate is all produced as continuous strip, and is only sheared to sheets as the last step before sorting and packaging. It is

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therefore highly desirable to apply the oil to the continuous strip. Because of this, the methods of controlling the oil thickness employed for hot dip tinplate, which is produced commercially as separate sheets—are not readily applicable, and in any case are not satisfactory. Conventional methods, such as oiling by spraying or dipping the sheet, or dipping followed by branning to remove excess oil, have been adapted to continuous strip but have been found incapable of producing a uniform oil film of the desired thinness. The method has been reversed, and a fixed quantity of oil added to the bath, through which the strip is then run, but also without the desired result. Other processes have been tried, but it can be said of the oil films they deposit, that those providing protection impair lacquer adhesion, and those which do not impair lacquer adhesion do not provide sufficient protection. Prior to my invention, no method of oiling electrolytically tinned strip was known which deposited a film sufficient to provide protection in storage and transit but thin enough not to impair lacquer adhesion.

In the application of Robert A. Woofter and Robert H. Smith, Serial No. 565,314, filed November 27, 1944, now Patent No. 2,429,862, issued October 28, 1947, there is disclosed a continuous process for oiling strip which produces an exceedingly thin but continuous film of oil on the metal surface, sufficient to provide protection in storage and transit, and not detrimental to lacquer adhesion. That process comprises atomizing oil with air to form a mist of oil particles suspended in air, heating such a mist to vaporize the oil particles, and finally causing the oil vapor so formed to condense on the surfaces of the strip. In this manner they can deposit on the metal an oil film so thin that only .1 of a gram of oil is sufficient for a base box, or one pound of oil covers 2,000,000 sq. ft. of surface; such a film has been found to have no detrimental effect on lacquer adhesion. This film, moreover, is so uniform, and covers the surface of the tinplate so completely that it provides adequate protection to the plate. Such tinplate, with a uniformly distributed oil film of this thickness, is a new article of manufacture, never before available.

The present invention is an improvement over the Woofter and Smith invention. According to my invention, the condensation of the oil vapor on the sheet metal is made more efficient by carrying out the condensation in an electrostatic field. By this means the molecules of oil vapor are charged with a high potential with re-

spect to the strip so that the molecules of oil vapor are attracted toward the strip and condensation of the oil vapor on the strip is made more rapid and more efficient. By the employment of an electrostatic field a wider range of oil thicknesses can be obtained. Coatings at least as thin as those obtainable by the Woofter and Smith process can be obtained according to my invention. With a given apparatus and speed of strip travel, I can obtain a uniform oil coating thicker than that obtainable according to the Woofter and Smith process. A very important advantage of my invention is that the strip may be run at a higher speed and still obtain a uniform oil coating of desired thickness. By carrying out the condensation of the oil vapor in an electrostatic field whereby a potential difference is created between the molecules of the vapor and the strip, the time necessary for the vapor to be in contact with the strip is greatly reduced. Furthermore, the condensation of the oil vapor on the strip is so complete that practically no vapor escapes from the cooling chamber. Accordingly, practically all of the oil fed to the sprays is condensed on the strip so that the thickness of the oil coating can be predetermined from the amount of oil fed to the sprays.

In the accompanying drawings which illustrate a preferred embodiment of my invention

Figure 1 is a vertical longitudinal section illustrating the general arrangement of the apparatus, parts being broken away and other parts being shown in elevation and

Figure 2 is a vertical section through one of the spraying devices.

My process is most conveniently carried out at a point in the tin line just before the final coiler, where the strip can be made to run vertically. As shown in Figure 1, a continuous tinned strip 2 coming from the electroplating line passes around rollers 3, 4 and 5 and then upwardly between rollers 6 at the top of the apparatus and then downwardly around one of the rollers and around a roller 7 and over a roller 8 to a coiler 9. In traveling upwardly between the rollers 5 and 6, the strip passes first through a vaporizing chamber 10 formed by upper plates 11 and lower plates 12 and then through a cooling chamber 13 formed by a housing 14. On each side of the strip and located in the vaporizing chamber is a row of atomizing nozzles 15, each of which provides a stream of oil mist consisting of oil particles suspended in air. These nozzles and associated parts are described in more detail hereinafter in connection with Figure 2. The atomizing nozzles may be of any type which thoroughly atomizes the oil, that is to say which forms a mist of oil droplets or particles suspended in air. The air and oil may or may not be heated; in the case of an oil such as palm oil or paraffin which is a solid at ordinary temperatures sufficient heat to liquify the oil is, of course, essential. It is generally desirable to heat the air to insure its dryness but neither the oil nor air is heated to a temperature much higher than 200° F. In any case after passing through the spray nozzles 15, the mist or oil-air mixture is probably cooled to a temperature near room temperature by the expansion. The nozzles 15 are preferably placed about 6 to 7 inches from the strip and the streams of oil mist are directed as shown by the reference numeral 16 and impinge first upon the baffles 17

and then rebound to baffles 18 by which they are directed toward the strip 2. The baffles 17 and 18 are heated by any convenient means such as by electricity supplied through leads 17a and 18a to temperatures high enough to cause the oil particles in the mist to vaporize and are so placed that no particles of unvaporized oil impinge on the strip.

In order to accelerate condensation of the oil vapors on the strip, I arrange a pair of fine wires 40 in the bottom of the hood 14 on each side of the strip 2. The wires 40 are connected to the negative terminal of a source of high potential direct current, not shown. The strip 2 forms the positive terminal and is grounded. The wires 40 impart a negative charge to the molecules of vapor rising around them whereby the charged particles are attracted toward the strip by a force depending upon the difference in potential between the wires and strip. If no direct current potential is applied to the wires 40, vapor emerges from the top of the hood 14, but if potential is applied, the molecules of vapor are charged in the electrostatic field and practically all, if not all, the vapor is caused to condense on the strip.

The thickness of oil film deposited is controlled both by the amount of oil fed to the spray nozzles 15 and the potential applied to the wires 40. If the apparatus is placed in the tin plating line, as mentioned, the speed of the strip is determined by the operating conditions of the line and may vary as it is taken up or let out of the looping towers. For a uniform oil film therefore, it is necessary that the oil supply pump be driven from the tin line drive itself, directly or indirectly. Similarly, the potentials applied to wires 40 must be held reasonably constant. Conversely, the thickness of the film may be adjusted by changing the rate of delivery of the oil pump, or adjusting the D. C. potential on wires 40. The latter adjustment is easily made by a rheostat in the D. C. power supply source. We find that for normal operation a voltage of 12,000 to 15,000 volts on wires 40 is satisfactory with the wires about 1½" from the strip on each side. The electrostatic field so set up therefore has a strength of between 8000 and 10,000 volts per inch.

The amount of heat necessary to introduce into the baffles 17 and 18 is quite easily determined from observation. If the baffles are observed to be wet, not all the oil is being vaporized, and more heat is required. If the baffles are too hot, some oil will burn, producing smoke which is easily detected. For cottonseed oil, we find that each baffle, if electrically heated, requires about 100 watts per inch width of strip. The temperature of the heaters may be controlled by controlling the electrical power input, or by adjusting the pressure of the air supplied to the spray. At higher air pressures more air is blown upon the heaters, thus cooling them.

A preferred type of spray or atomizer is illustrated in Figure 2, this figure being a vertical cross section through one of the spray heads. A number of spray heads are arranged on each side of the strip so as to cover the width of the strip to be sprayed. A block or housing 20 is formed with a trough 21 which receives oil flowing through pipes 22, 23 and 24. The oil flows through an opening 25 in the pipe 24 into the trough 21 and the overflow passes over a dam 26 into a sump or return 27 from which it is re-

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turned to a pump (not shown). The housing may be provided, if desired, with an electrical heater 28 for heating the oil. Wheels or discs 29 are mounted on a shaft 30, the shaft being driven directly or indirectly from the driving means for the strip so that the shaft and wheels 29 rotate in accordance with the speed of passage of the strip through the apparatus. A nozzle 31 is located above each wheel 29. The nozzle is provided with a passage 32 controlled by a valve 33, the passage communicating with a pipe 34 which supplies air. Adjacent the outlet of the air passage 32 is a plate 35 which directs the air downwardly past an atomizing tube 36 formed in the nozzle. The tube 36 is located adjacent a shoulder 37.

As the wheel 29 is rotated, it picks up a film of oil from the oil in the trough 21 and raises it to a point adjacent the tube 36 where the film of oil is scraped off by the shoulder 37 and flows through the tube 36 in a very fine stream. The oil issuing from the tube 36 is atomized by the air flowing through the passage 38 forming a mist of oil droplets or particles suspended in air. This stream of mist is directed against the heated baffles 17 and 19 as previously described and the mist is condensed on the strip 2. In the embodiment shown, the air nozzles 31 and discs 29 are spaced about 1 inch apart over the width of the strip. This spray produces a very uniform oil mist because the rotating discs 29 bring up oil to the air stream at a rate varying only with the speed of rotation of the shaft 30. The amount of oil atomized is thus easily controlled by controlling the speed of rotation of the shaft.

The pressure of air required is low, 2 to 4 lbs. being satisfactory, except when the air flow is also used to control the baffle temperature as previously mentioned. Under such conditions, pressures up to 12 lbs. have been employed, with satisfactory results.

The type of oil used depends, of course, on the customer's requirements. Palm oil is occasionally used by me for electrolytic plate, but cottonseed oil is more generally employed. For some purposes a synthetic compound such as dibutyl sebacate is more desirable. Paraffin oil, and hydrogenated fish oil have also been used occasionally. It is understood that my process is capable of utilizing any oil required and is not limited as to type of lubricant.

It will be understood also that my process is not confined to tinplate, but is applicable to any metal plate or strip which requires a thin, uniform film of oil.

The invention is not limited to the preferred embodiment which has been given merely for purposes of illustration, but may be otherwise embodied or practiced within the scope of the following claims.

I claim:

1. The method of continuously applying a thin, uniform film of oil to both sides of continuous strip metal comprising moving the strip vertically, continuously supplying oil at a predetermined

rate to a plurality of air streams disposed on both sides of the strip, atomizing the oil with the air to form a mist of oil particles suspended in air, directing the mist against a plurality of heated surfaces interposed between the air streams and strip in such manner that no oil particles impinge on the strip, maintaining the heated surfaces at a temperature sufficient to vaporize the oil particles, and charging the molecules of the vapor to a high potential with respect to the strip by causing them to pass through an electrostatic field having a strength between 8000 and 10,000 volts per inch, whereby said molecules are attracted toward the strip and condensed thereon.

2. Apparatus for applying a uniform film of oil to sheet metal, which comprises a vaporizing chamber, a cooling chamber, means for passing the sheet metal continuously through the vaporizing chamber and cooling chamber, means in the vaporizing chamber for atomizing oil with air to form a mist of oil particles suspended in air, at least one baffle interposed between said atomizing means and the strip, and heating means for maintaining the baffle at a temperature sufficient to vaporize the oil particles, the baffle being arranged so that no oil particles can impinge on the sheet metal, and means for charging the molecules of vapor to a high potential with respect to the strip, whereby the molecules are attracted toward the strip and condensed thereon.

3. Apparatus for applying a uniform film of oil to sheet metal, which comprises a vaporizing chamber, a cooling chamber, means for passing the sheet metal continuously through the vaporizing chamber and cooling chamber, means in the vaporizing chamber for atomizing oil with air to form a mist of oil particles suspended in air, the atomizing means comprising a plurality of nozzles each having an air passage and a wheel associated with each air nozzle and adapted upon rotation to carry a film of oil adjacent the outlet of the air passage and be atomized, at least one baffle interposed between said atomizing means and the strip, and heating means for maintaining the baffle at a temperature sufficient to vaporize the oil particles, the baffle being arranged so that no oil particles can impinge on the sheet metal, and means for charging the molecules of vapor to a high potential with respect to the strip, whereby the molecules are attracted toward the strip and condensed thereon.

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