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APPARATUS FOR OILING METAL STRIP

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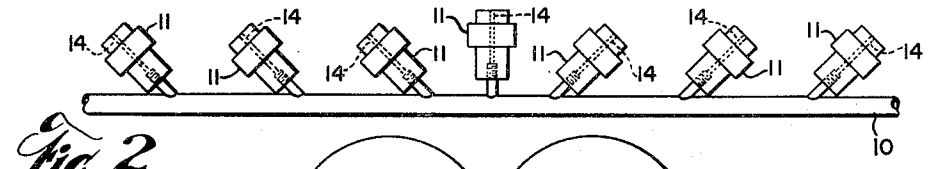


Fig. 2

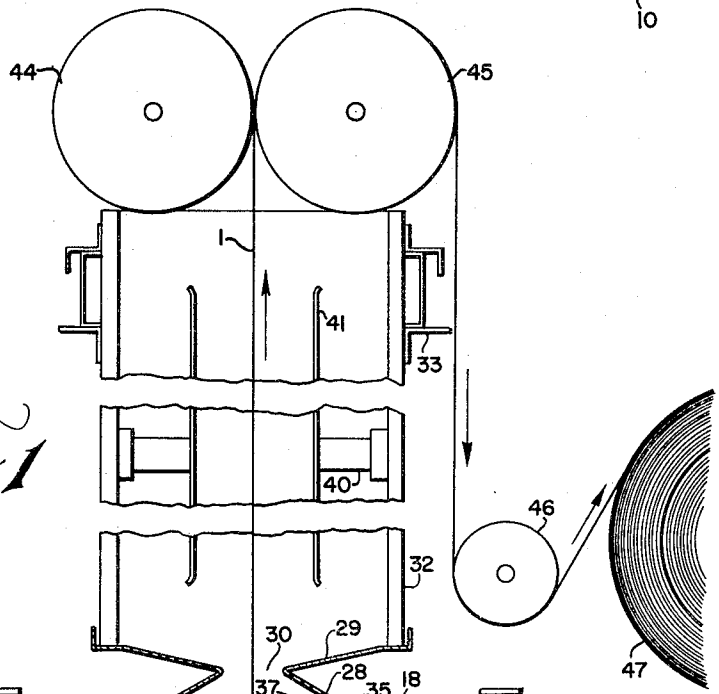


Fig. 1

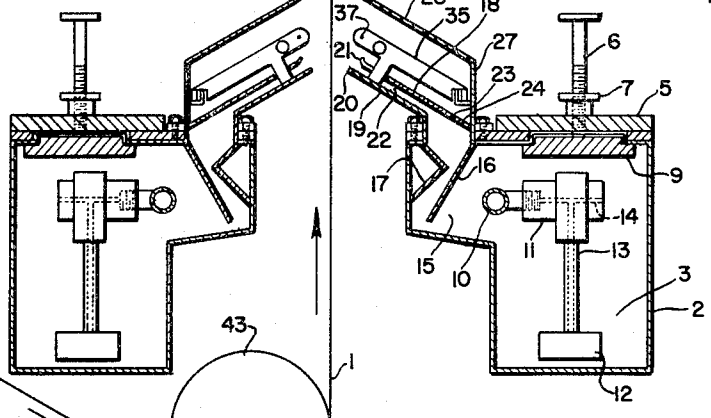
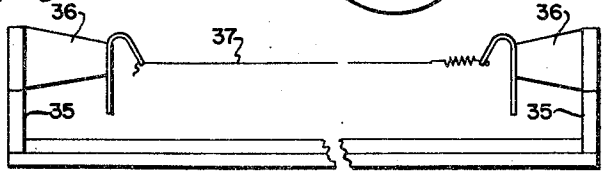


Fig. 3



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APPARATUS FOR OILING METAL STRIP

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5 Claims. (Cl. 118—51)

This invention relates to the oiling of metal strip such as tin plate either in the form of continuous strip or of sheets and is concerned more particularly with method and apparatus for economically applying a very thin film of oil to tinned strip by electrostatic means.

In the manufacture of tin plate it is conventional practice to deposit a film of oil upon the tin plate either in the form of continuous strip or sheets prior to packaging. This oil film serves to retard corrosion of the sheet or strip during shipment and storage and also tends to prevent the formation of black spots on the tin coating caused by the rubbing of one sheet on another. The thickness of this oil film must, however, be very carefully controlled since many products made from tin plate are lithographed, lacquered, or enameled, and the oil film must not interfere with the drying of such coatings. It is desired by tin plate producers to deposit oil in an amount between about .15 gram and .25 gram per "base box" of tin plate and to produce this thin film so uniformly that the entire surface of tin plate is covered without dry spots and without puddles or undue accumulations of oil at any point. A base box of tin plate contains sheets totaling 217.78 sq. ft. of surface, one side.

Because of the extreme thinness of the oil film desired and the impossibility of applying it by conventional coating processes, tin plate manufacturers have adopted various forms of electrostatic precipitation processes to obtain desired results. In these processes, as conventionally practiced, the oil is generally atomized to a spray of fine droplets and these are caused to pass around a wire or other conductor maintained at a high direct current potential with respect to the strip or sheet. The potential applied to this conductor, which is known as an ionizing conductor or wire, is high enough to cause the ionizing wire to discharge and provide a stream of charged particles moving toward objects of opposite potential such as the strip. Oil droplets passing through this region accordingly acquire charges of the same polarity as the ionizing wire and tend to be drawn toward the strip and other objects of the opposite potential. This movement may be accelerated by providing farther along the path of the strip additional conductors in the form of plates or the like arranged parallel to the strip and also charged to a high potential having the same sign as that on the ionizing wire. The field set up by these conductors is not ionized but reacts with charged particles passing into it causing them to move away from the charged conductors. Although all producers of tin plated strip use some electrostatic process for depositing oil on the strip, no such process now in use nor apparatus appropriate thereto is entirely satisfactory. One undesirable feature of all such processes and apparatus is their relative inefficiency. Since the electrostatic apparatus together with the strip must be enclosed in a grounded casing of some sort, both to prevent dispersal of the atomized oil particles and for reasons of safety, much of the oil atomized is deposited upon the inside of the casing, rather than the strip, and so is lost. Another reason for dissatisfaction with proc-

esses and apparatus now known arises from their failure to produce oil coatings of the uniformity desired. The most careful adjustment and supervision does not seem able to prevent the occurrence of small puddles of oil on the strip, which lead to difficulties when the strip is coated.

It is an object, therefore, of my invention to provide an improved process and apparatus for economically coating strip with oil by electrostatic means. It is another object to provide such process and apparatus which will deposit a thin film of oil without the occurrence of heavy spots or puddles. Other objects will appear in the course of the description of my invention.

I have discovered that none of the conventionally employed processes or apparatus for atomizing oil produce droplets of uniform size. Instead, the oil is atomized into droplets of an appreciable range of sizes. I have further found that the relatively large droplets present in the atomized oil cause heavy spots or puddles in the oil coating on the strip. These larger droplets, presumably because of the greater kinetic energy acquired in the atomizing process, appear to travel more or less directly from the atomizing apparatus to the strip and do not seem to be greatly affected by the electrostatic precipitating means. When such a droplet comes in contact with strip, an unduly large amount of oil is deposited at that point. The process of my invention eliminates the possibility of large droplets depositing on the strip by forming a fog or cloud of atomized oil particles in a closed chamber away from the strip and there manipulating or agitating the fog or cloud of atomized oil particles so that the larger droplets are caused to settle out before the oil fog reaches the strip. The apparatus of my invention is designed to prevent the larger particles of oil from being blown by the atomizing means directly onto the strip. I have also discovered that the amount of oil wastefully precipitated upon the inside of the enclosure may be substantially reduced relative to that deposited on the strip by controlling the movement of the fog of atomized oil particles relative to the ionizing wire, and I have invented appropriate apparatus for this control. Furthermore, I have invented apparatus for recovering the oil precipitated upon the inside of the enclosure and returning it to the oil reservoir.

My invention will be more easily understood by reference to the attached drawings of a present preferred embodiment thereof. In these drawings, Figure 1 represents apparatus suitable for applying oil to continuous strip moving in a vertical path and is a vertical cross section through such apparatus taken on a plane through the strip at right angles thereto.

Figure 2 is a plan view of a portion of my atomizing apparatus which is shown in section in Figure 1.

Figure 3 is a detail of the ionizing conductor and mounting therefor.

In these figures the continuous strip **1** is shown as moving vertically upward, the movement being effected by coiling means **47** which pulls the strip **1** around bottom roll **43**, upwardly between top rolls **44** and **45**, around roll **45** downwardly to and around roll **46**. Coiling means **47** is provided with conventional driving means not shown. Bottom roll **43** and top rolls **44** and **45** define the vertical path followed by the strip **1** as it passes through the apparatus of my invention.

It will be noted from Figure 1 that the apparatus to be described is symmetrically disposed on each side of the moving strip so as to apply simultaneously identical oil films on each side thereof. For this reason, it is necessary to describe apparatus located on one side of the strip only, it being understood that the apparatus on the other side of the strip is a duplicate thereof. I provide a chamber **2** which forms a reservoir for the oil **3** to be used for coating purposes. This chamber

may be of any convenient size or dimensions but preferably should extend across the full width of the strip. This chamber 2 is formed with an opening in its top wall which is provided with a cover plate 5 held in place by a thumb screw 6 which passes through a nut 7 on cover plate 5 and terminates at the bottom in a pivotally mounted clamping bar 9. Within the upper portion of chamber 2 is positioned atomizing apparatus comprising an air pipe 10 carrying a plurality of nozzles 11 each equipped with feed tube 13, terminating at its bottom in a strainer 12. Each nozzle 11 is provided with a bore 14 extending therethrough, and connecting with the air pipe 10. This bore 14 intersects the feed tube 13 so that when air from air pipe 10 is blown through bore 14 air is sucked out of tube 13 and oil from the reservoir is thereupon forced upward by atmospheric pressure and is ejected by the air stream in the form of small particles. Air pipe 10 is connected to a source of air under pressure by means not shown.

The upper portion of my chamber 2 is enlarged at 15 and provided with baffles or partitions 16 and 17, each of which extends across the full width of the chamber 15 to form a horizontally elongated reentrant or zigzag passageway leading from the bottom of chamber 15 out the top thereof. This passageway, designated generally by numeral 22, is continued by members 18 and 19 in a direction sloping upwardly toward the strip 1 but terminates short of the strip itself. The lower edge 20 of the member 19 forming the bottom of this passageway extends out beyond the upper edge 21 of the top member 18. Top member 18 is provided with small holes 23 and 24 near its lower edge. Abutting the lower edge of 18 as well as the top of chamber 2 is a casing 27 of rectangular plan which entirely encloses the strip 1 and other apparatus to be described. This casing is formed with an inclined wall 28 which is more or less parallel to members 18 and 19 previously mentioned and an oppositely inclined wall 29 which together form a projection extending across the casing parallel to the strip 1 and providing a constricted opening 30 between this strip and the junction of the panels 28 and 29. The distance from the strip 1 to the junction of panels 28 and 29 is about the same order as that from the strip to outer edge 21 of member 18 and is greater than the distance from the strip to outer edge 20 of member 19. Above element 29 is positioned a rectangular casing 32 which is supported by structural work 33. Within the space between members 19 and 28 are a supporting member 35 and a supporting insulator 36 to which is attached ionizing wire 37. Between this wire 37 and the strip 1 is maintained a high direct current potential, from 12,000 to perhaps 18,000 volts, by means not shown as they are conventional. Inside casing 32, insulator 40 supports precipitating plate 41 which is likewise maintained at a high direct current potential relative to strip 1 by means not shown. This potential may be as high as 40,000 volts. The potentials of wire 37 and plate 41 with respect to strip 1 are both of the same sign. The ionizing wire 37 and precipitating plate 41 described above will be recognized as the essential elements of conventional electrostatic precipitating means.

The operation of my apparatus and process will now be described, likewise with reference to the attached figures. As has been mentioned, when air under pressure is blown through pipe 10, a spray of atomized particles of oil 3 will be emitted from apertures 14—14. These oil particles will not necessarily be of uniform size. In order to prevent larger sized particles from impinging directly on the strip and so depositing excess oil thereon, my atomizing nozzles 11 are directed away from strip 1 and toward the outer wall of my chamber 2. A fog or cloud of atomized oil particles soon builds up within chamber 2 and because of the pressure of the incoming air is forced out through the indirect or zigzag channel 22 defined by members 16 and 18 on one side and 17 and 19 on the other. By forcing the fog of oil droplets to follow a tortuous or zigzag course as shown through narrow passageway 22, I achieve two significant results. First, I prevent direct impingement of the larger oil droplets on the strip and provide opportunity for these larger oil droplets to settle out of the fog on the walls of the passageway. Second, I deliver the cloud of oil droplets in the form of a flat blanket which rises substantially between the strip 1 and the ionizing wire 37. By delivering the atomized oil particles in such fashion, I reduce greatly the precipitation of charged particles on the walls 27 and 28 of the casing over that which would occur if member 18 were removed and the oil droplets allowed to rise in a cloud surrounding ionizing wire 37. I do not find, however, that the action of ionizing wire 37 upon the oil droplets is impaired in any way by substantially confining these droplets between the strip 1 and the ionizing wire 37 as before mentioned.

The oil droplets carrying charges imparted by ionizing wire 37 are pulled along by the "windage" of the moving strip 1 upwardly into the chamber defined by casing 32, and precipitating plate 41 accelerates their migration to the strip 1 in the conventional manner. However, the constriction formed by members 28 and 29 tends to keep the charged particles from leaving the vicinity of strip 1 and so greatly reduces the number which precipitate upon the casing wall 32. It will also be observed that the design of my apparatus is such that oil which does precipitate upon the casing walls run down back into the oil reservoir by gravity and so may be reused. This action is insured by the slope of members 29 and 19 and by the projection of edge 20 of member 19 beyond that of the junction of 28 and 29. The greater portion of the oil deposited on the interior of casing 32 runs down panel 29 and drips over the lower edge thereof in relatively large drops which are caught by projecting edge 20 of member 19. Although these particles drop directly in front of ionizing wire 37, their size is such that they are little affected by the field there set up. A certain amount of the deposited oil may run back along the underside of panel 28 and down panel 27, and this is permitted to drain through panel 18 through the small holes 23 and 24, previously mentioned. These holes are not large enough to permit the escape of any significant amount of atomized oil fog.

The pressure of the air introduced into air pipe 10 must be sufficient not only to atomize the oil but also to force the fog or cloud of atomized oil particles out through channel 22 at a rate sufficient to provide the desired coating on moving strip 1. This air pressure, therefore, depends upon the speed with which strip 1 is moving. In an installation with which I am familiar, an air pressure of 3 lbs. per sq. in. is sufficient to provide an oil film of between .15 and .25 gram per base box on tinned strip moving at about 500 ft. per minute. When the speed of the strip is increased to about 700 ft. per minute, it is necessary to increase the air pressure to about 6 lbs. per sq. in. The air pressure needed in any given installation for any given strip speed may be readily determined by examination of the oiled strip.

I have described and illustrated a present preferred embodiment of my invention adapted for oiling vertically moving continuous strip. It will be understood that my invention may be adapted to the oiling of individual sheets moving in succession along a predetermined path. The limits of my invention are to be found in the appended claims.

I claim:

1. Apparatus for continuously applying a uniform film of oil to moving metal strip comprising means conveying the metal strip upwardly along a predetermined vertical path, casing means enclosing the strip path, an oil reservoir, an atomizing chamber communicating therewith, means positioned within the atomizing chamber providing

a cloud of atomized oil particles, some of said particles being large enough to produce undesired puddles of oil on the strip upon contact therewith, an enclosed zigzag passageway inclined upwardly from the atomizing chamber and terminating within the casing means in an upwardly facing opening adjacent the strip path, means causing the cloud of atomized oil particles to move through the passageway, whereby the direction of movement of said particles is changed abruptly, said large particles are caused to settle out on the inclined passageway enclosure and drain back into the oil reservoir and the remaining oil particles issue upwardly adjacent the strip path, and means positioned within the casing means adjacent the strip path and upwardly facing opening and above said opening for charging atomized oil particles to a high electrical potential with respect to the strip, whereby the particles are attracted to the strip.

2. Apparatus for continuously applying a uniform film of oil to moving metal strip comprising means conveying the metal strip upwardly along a predetermined vertical path, casing means enclosing the strip path, an oil reservoir, an atomizing chamber communicating therewith, means positioned within the atomizing chamber providing a cloud of atomized oil particles, some of said particles being large enough to produce undesired puddles of oil on the strip upon contact therewith, an enclosed zigzag passageway inclined upwardly from the atomizing chamber and terminating within the casing means in an elongated opening having a cross section narrow with respect to its horizontal dimension, means causing the cloud of atomized oil particles to move through the passageway whereby the direction of movement of said particles is changed abruptly, said large particles are caused to settle out on the inclined passageway enclosure and drain back into the oil reservoir, and the remaining oil particles issue upwardly adjacent the strip path, and means positioned within the casing means adjacent the strip path and the elongated opening and spaced therefrom for charging the atomized oil particles to a high electrical potential with respect to the strip, whereby the particles are attracted to the strip, the elongated opening being positioned with respect to the strip path and the charging means so as to direct the upwardly issuing cloud of atomized oil particles between the charging means and the strip path.

3. Apparatus for continuously applying a uniform film of oil to moving metal strip comprising means conveying the metal strip upwardly along a predetermined vertical path, casing means enclosing the strip path, an oil reservoir, an atomizing chamber communicating therewith, means positioned within the atomizing chamber providing a cloud of atomized oil particles, an enclosed passageway inclined upwardly from the atomizing chamber and terminating within the casing means in a horizontally elongated opening adjacent the strip path, means causing the cloud of atomized oil particles to move through the passageway and issue upwardly therefrom, means positioned within the casing means adjacent the predetermined strip path and horizontally elongated opening for charging the atomized oil particles to a high electrical potential with respect to the strip, whereby the particles are attracted to the strip, said horizontally elongated opening having a bottom edge spaced from said strip path a distance less than that between said strip path and its top edge, whereby falling oil particles are caught and conducted back through the passageway into the oil reservoir.

4. Apparatus for continuously applying a uniform film of oil to moving metal strip comprising casing means, means conveying the metal strip upwardly along a predetermined vertical path successively through a plurality of spaced regions of the casing means, an oil reservoir, an atomizing chamber communicating therewith, means positioned within the atomizing chamber providing a cloud of atomized oil particles, an enclosed passageway inclined upwardly from the atomizing chamber and terminating in a horizontally elongated opening adjacent the strip path in a first region, means for causing the cloud of atomized oil particles to move through the passageway and issue upwardly therefrom, means positioned in the first region adjacent the predetermined path but spaced therefrom for charging atomized oil particles to a high electrical potential with respect to the strip whereby the particles are attracted to the strip, and a second region positioned immediately above the first region and connected therewith by a passageway having a short constricted portion closely approaching and sloping downwardly toward the strip path but spaced therefrom so as to confine the upwardly issuing cloud of atomized oil particles to the immediate region of the strip path.

5. Apparatus for continuously applying a uniform film of oil to moving metal strip comprising casing means, means conveying the metal strip upwardly along a predetermined vertical path successively through a plurality of spaced regions of the casing means, an oil reservoir, an atomizing chamber communicating therewith, means positioned within the atomizing chamber providing a cloud of atomized oil particles, an enclosed passageway inclined upwardly from the atomizing chamber and terminating in a horizontally elongated opening adjacent the strip path in a first region, means for causing a cloud of atomized oil particles to move through the passageway and issue upwardly therefrom, means positioned in the first region adjacent the predetermined strip path but spaced therefrom for charging atomized oil particles to a high electrical potential with respect to the strip whereby the particles are attracted to the strip, the horizontally elongated opening having a bottom edge spaced from said predetermined strip path a distance less than that between said predetermined strip path and its top edge, a second region positioned immediately above the first region and connected therewith by a passageway having a short constricted portion closely approaching the strip path, said constricted portion sloping downwardly toward the strip path but spaced therefrom a distance greater than that separating the strip path and the bottom edge of the opening, whereby oil particles deposited on the casing in the second region drain off the constricted portion and are caught by the bottom edge of the passageway and conducted back therethrough into the oil reservoir.

References Cited in the file of this patent

UNITED STATES PATENTS

2,053,781	Reichel	Sept. 8, 1936
2,181,777	Davis	Nov. 28, 1939
2,222,539	Meston	Nov. 19, 1940
2,334,648	Ransburg	Nov. 16, 1943
2,429,862	Woofter	Oct. 28, 1947
2,528,087	Schoepe	Oct. 31, 1950