

Jan. 31, 1967

H. J. MOZZI

3,301,699

MEANS FOR AND METHOD OF COATING A SURFACE WITH A FLUID FILM

Filed Jan. 21, 1963

2 Sheets-Sheet 1

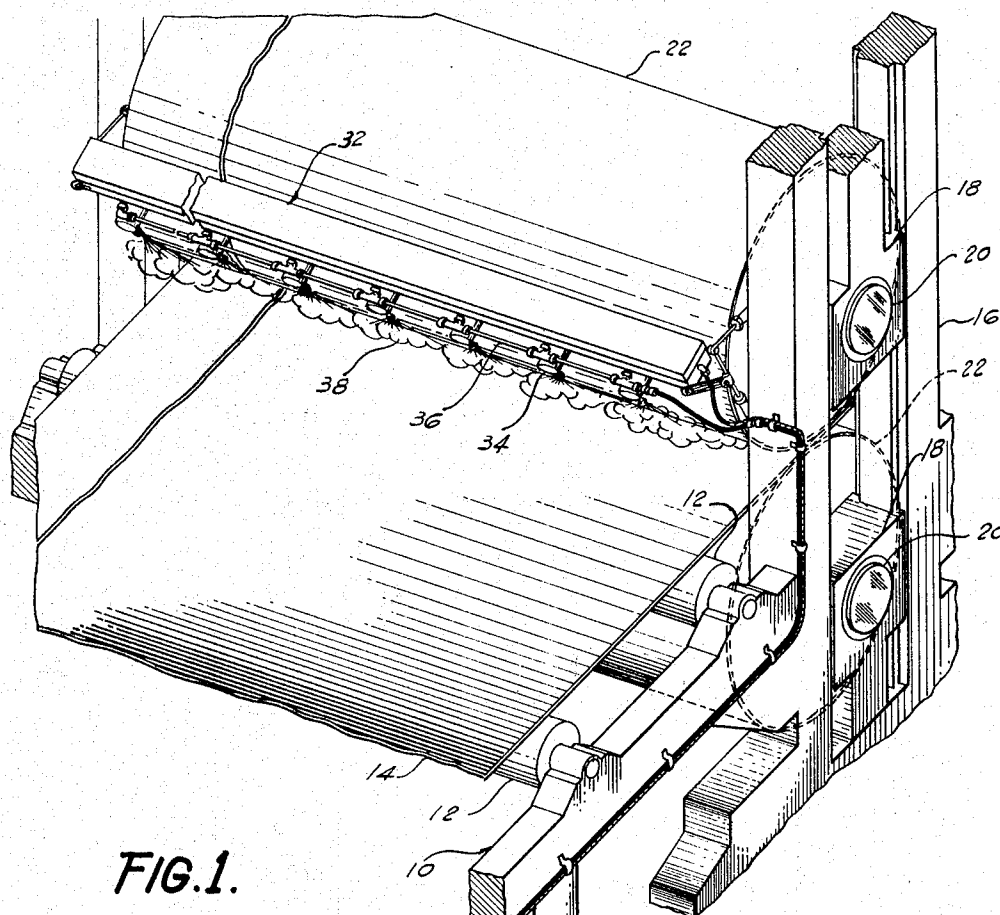
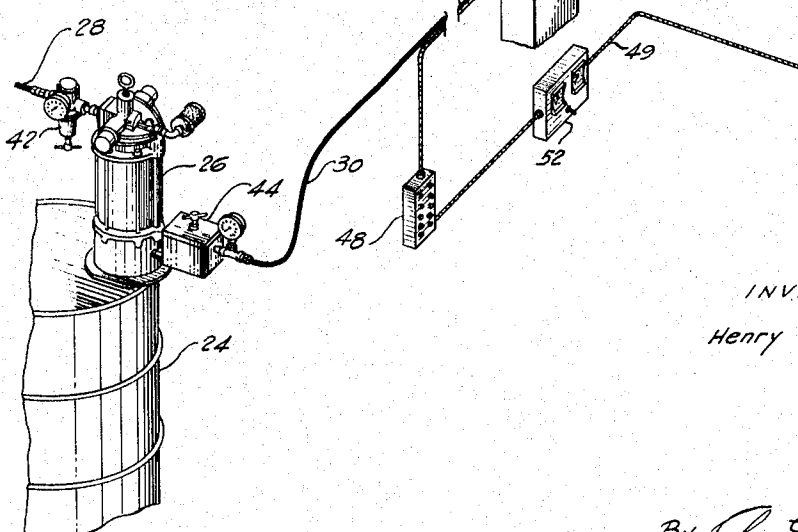


FIG. 1.



INVENTOR
Henry J. Mozzi.

By *A. G. Dumas*
Attorney

Jan. 31, 1967

H. J. MOZZI

3,301,699

MEANS FOR AND METHOD OF COATING A SURFACE WITH A FLUID FILM

Filed Jan. 21, 1963

2 Sheets-Sheet 2

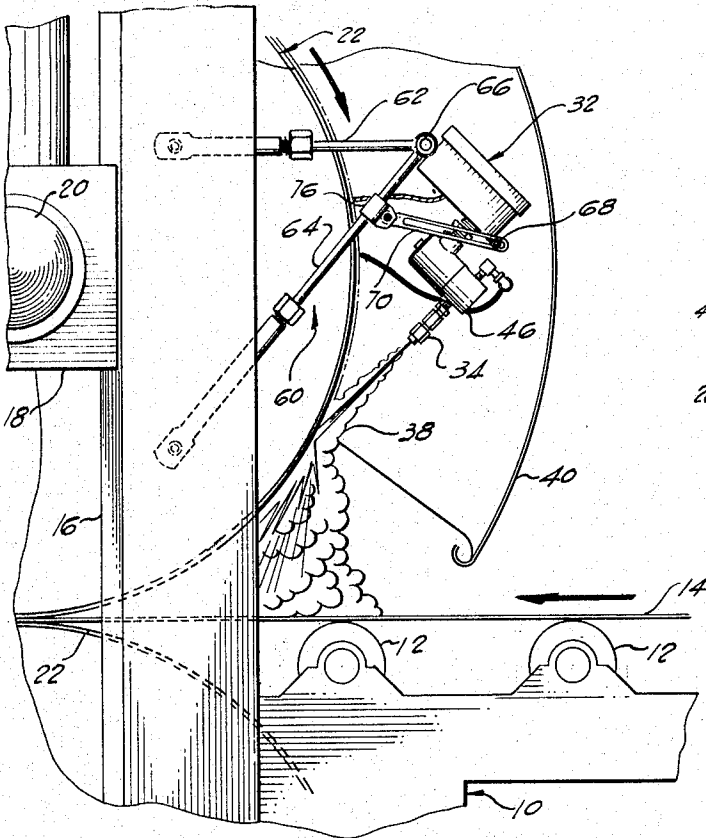


FIG. 2.

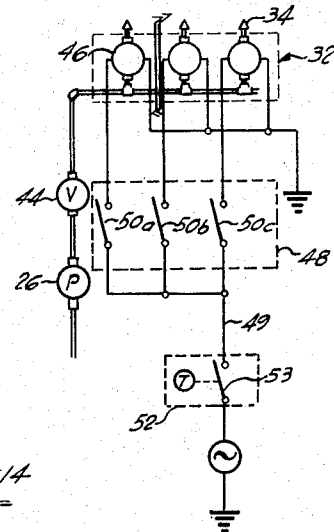


FIG. 5

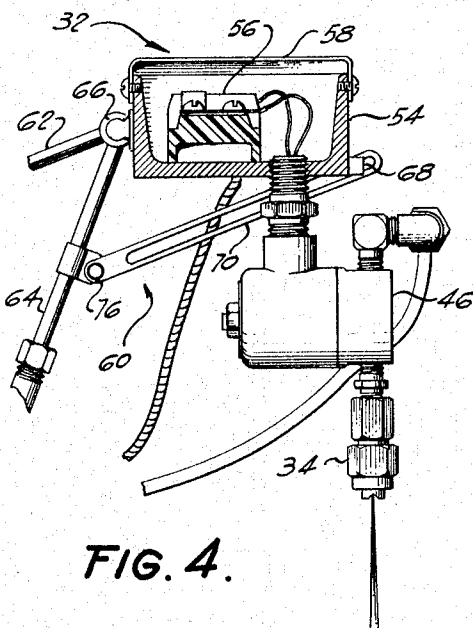
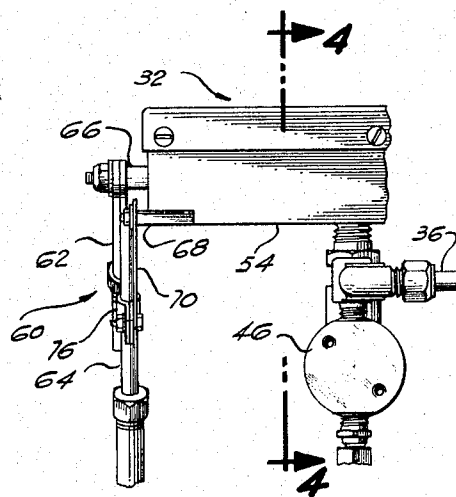


FIG. 4.



INVENTOR
Henry J. Mozzi.

By *A. G. Douras*
Attorney

1

3,301,699

MEANS FOR AND METHOD OF COATING A SURFACE WITH A FLUID FILM

Henry J. Mozzi, Chicago, Ill., assignor to Stewart-Warner Corporation, Chicago, Ill., a corporation of Virginia
Filed Jan. 21, 1963, Ser. No. 252,714
16 Claims. (Cl. 117-111)

This invention relates to means for and method of applying a fluid in the form of a film of uniform adjustable thickness and variable surface coverage to a generally continuous surface moving relative to the applying means at any adjustable rate.

It is common to coat particular products with a fluid for protective and/or decorative purposes. With ferrous metals, for example, it is desirable to coat the stock with a thin film of oil before fabrication, storage or shipment to minimize surface damages such as oxidation, scratching or the like. In most installations the coating is applied by dripping oil onto the surface and spreading the droplets by means of an absorbent roller rolling on the surface. However, this action generally does not establish a film of uniform thickness or ensure uniform surface coverage. Quite commonly the surface is coated patch-worky with heavy thick gobs in certain local areas while being completely void in the other areas. Thus "tiger stripes," as the industry terms it, occur to frustrate the purposes of film coating and possibly cause consequent customer rejections.

Accompanying these fundamental defects, present film coating also is quite limited in the important area of control, such as of the film thickness, the surface coverage, or accurate on-off operation. These controls are important practically for any coating installation, since generally the same installation must handle various sized pieces and/or must coat the piece with various thickness films. Commonly too, the coating equipment is operated simultaneously, for example, with some intermittently operated fabricating machine or conveyor means. Since accurate controls are lacking, to achieve a commercially acceptable oil film, excessive volumes of oil typically must be used to overcome the inefficient oil spillage or waste.

Accordingly, an object of this invention is to provide means for and method of coating a surface with a uniform fluid film in a manner so as to minimize inefficiency, spillage or waste of the fluid.

Another object of this invention is to provide means for controlling the thickness of the uniform fluid film applied to the surface accurately and adjustably over a wide range.

Another object of this invention is to provide means for controlling the surface coverage of the uniform fluid film applied to the surface in such a manner so that it can be varied incrementally within wide ranges.

Another object of this invention is to provide means for and method of coating a surface with a uniform fluid film wherein the surface coverage and/or the thickness of the film can be accurately, independently, and adjustably controlled as desired.

In order that these and other objects can be more fully appreciated, reference is herein made to the accompanying drawings, wherein:

FIG. 1 is a perspective view of an embodiment of the subject invention, including its various components as used in combination with a typical conveyor and roller setup, for coating a generally flat sheet;

FIG. 2 is an end elevational view of the roller setup of FIG. 1;

FIG. 3 is a partial side elevational view of the manifold spraying equipment as seen from the right of FIG. 2;

FIG. 4 is a section view as seen generally along the line 4-4 of FIG. 3; and

2

FIG. 5 is a typical electrical and fluid schematic diagram of the subject invention.

FIG. 1 shows a roller assembly that includes a frame 10 having a series of conveyors 12 upon which the moving piece 14 rides. The frame 10 further has spaced guide brackets 16 which house therein sliding bearing units 18 for support of each longitudinal shaft 20 of rollers 22. Each roller 22 is composed of a steel frame covered by a firm absorbent material such as canvas, muslin, flannel or the like. The rollers 22 are in generally true rolling flush contact with the piece 14 which advances pass the roller in a direction transverse to the longitudinal axis 20. Means (not shown) such as a spring, a pneumatic power cylinder, or a counterweight arrangement acting on the bearing units 18 force the rollers 22 toward one another and against the piece 14 disposed therebetween.

In the embodiment disclosed, the roller assembly is composed of two opposing rollers 22 which act to coat both the upper and lower sides of the piece 14. However, it is obvious that if it were desirable to coat only one of the surfaces, the opposite roller could be replaced by a simple opposing reaction roller or the like.

The subject invention utilizes the generally standard absorbent roller 22 and provides an improved means for and method of applying the oil or fluid to the surface of the piece 14. As FIG. 1 shows, a fluid supply drum 24, positioned in proximity to the roller 22, is provided with actuating pump means 26 driven by an appropriate power source such as air motor supplied through air line 28. The pump means 26 pumps the fluid from drum 24 through outlet line 30 to a spray manifold 32 supported by the frame 10 proximate the roller 22. A plurality of spray heads or nozzles 34 supported by the manifold 32 are intercommunicated by common flow line 36 and are in direct connection through line 30 with the pressurized fluid outlet from drum 24.

As illustrated in FIG. 2 the spray heads 34 direct streams of atomized fluid generally tangentially of the roller 22 to strike the roller just before the contact thereof with the piece 14. The roller being of a generally absorbent material absorbs the sprayed or atomized fluid to a limited degree and applies the fluid in a form of a uniform film to the surface of the piece 14 moving relative to the roller. The spray heads 34 are spaced from each other along the manifold transversely of the piece 14 so that the spray patterns 38 meet or approximately overlap to form a continuous exposure across the roller 24. The spray patterns 38 as aimed also tend to deflect off the roller 24 toward the surface of the piece 14 as a fine mist. A shield 40 over the roller 22 confines this spray mist in proximity to the roller so that it is acted on by the roller in a manner similar to oil mist in a bearing, and is knocked from the circulating aid and reapplied directly to the sheet 14 and the roller 22.

As is well known, it is often more desirable for maintaining a good spray pattern to spray a particular fluid through a particular spray nozzle within a generally limited pressure range. Thus, as a means of ensuring uniform and optimum operation, the air power line 28 has therein a regulating pressure valve 42 while the outlet oil line 30 has a pressure valve 44. These valves, regulate the output pressure and volume of the fluid from the pump 26 and provide the constant desired fluid inlet pressure to the spray heads 34. Thus, with a particular fluid of known viscosity the maximum volume sprayed from each spray head is known or can be determined, and is a function of the fluid viscosity, output pressure and spray tip orifice size. This volume spread over the spray pattern width and the traversed periphery of the roller and surface of the piece 14 causes a generally uniform film thickness on the surface of the piece. With no further control,

the discharge from the spray heads is generally uniform across the roller 22 and of maximum volume upon continued use.

Each spray head 34, also, is equipped with a spring-closed solenoid-opened valve 46 of conventional construction which can be regulated in an on-off manner to permit or stop through-flow. This individual accurate spray head control is used with other appropriate controls to vary, as desired, both the width or surface coverage of the spray pattern on the roller, and the thickness of film applied to the surface.

Thus surface coverage control 48 has separate switches (shown as 50a, 50b and 50c in FIG. 5) each connected in series circuits with the electrical power line 49 and solenoid operated valve 46, or solenoid-operated valves. By controlling the various switches in the proper combinations it is possible to open some or all of the spray heads. Control of the spray heads is generally more practical from the center of the roller out, because a narrower-than-maximum width piece 14 generally is centered on the conveyor system. However, the grouping of valves with each switch 50 of control 48 can be in any manner desired, and can in fact be individually to permit maximum variations of spray patterns. Thus the spray pattern on the roller and in turn the surface coverage as a film on the piece 14 will be regulated in an expedient manner by control 48.

Similarly, an adjustable on-off cycling control 52 having contacts 53 in series with electrical power line 49 and the control 48 can regulate the opening and closing of the various operating spray heads set by the surface coverage control 48. Such a cycling control 52 can be formed of readily available product commercially, such as the product numbers HP5 and HP501 Cycliflex Control Timers of the Eagle Signal Company of Moline, Illinois. Such timers are adjustable to operate with a given on-time with contacts 53 closed, and with a given off-time with the contacts 53 open. The time of each cycle is adjustable independently of the other; but when the cycles actuate each other sequentially, combined together the control forms an on-off ratio. Thus, when the cycling control 52 cycles at a 50% on 50% off basis the inlet fluid to the spray heads being under a generally constant pressure will discharge approximately one-half the total volume of fluid as if the spray heads were open 100% of the time. Similarly, any other setting in on-off time, such as 25% on 75% off, controls to a generally comparable degree the total volume discharged as a percentage of maximum, in this case 25%. The cycling control 52 regulates the thickness of the applied film. Since the film thickness control 52 is independent in operation from the surface coverage control 48, the setting as to the actual nozzles to be cycled will not be effected.

Thus, for example, with a spray manifold having eleven evenly spaced spray heads and the surface coverage control 48 set to operate all but each two end nozzles, the third through the ninth nozzle counting from left to right as seen in FIG. 1 will cycle. This determines the spray pattern or surface coverage. The film thickness control 52 cyclically opening and closing the third through ninth nozzles, the first, second, tenth and eleventh nozzles always remaining closed, determines the volume discharged from the cycling nozzles as a determinable percentage of maximum continuous spraying. Thus both the width of spray pattern or the surface coverage, and the volume of fluid applied or the thickness of film are accurately controlled. It has been found that with this method, a fluid film is coated uniformly over the desired area coverage, regardless of the film thickness or coverage.

The pump used in the subject device is a demand-type pump having an outlet pressure which even during flow conditions remains substantially constant. Thus when one or more nozzles are opened, the pump delivers the volume of fluid needed to satisfy the output of the nozzles.

The fixed nozzles provide a uniform spray pattern at a fixed spraying pressure and fluid viscosity. This ensures full roller coverage, which in turn ensures full film coverage of uniform thickness to the advancing piece. Also, since the spray is airless and powered by the pressure of the motive fluid, any fog, bounce-back or spray drifting is reduced to a minimum.

It has been observed that pieces having widths up to 100" are sometimes encountered. With the center spacing between the spray heads determined by the fluid sprayed, the spray pressure and a nozzle tip used, the maximum width of the spray pattern is increased merely by adding spray heads along the length of the manifold 32. A simple construction for this purpose is shown in FIGS. 2, 3 and 4 and includes a channel member 54 adapted to extend the length of the roller. The spray heads 34 are threaded or otherwise secured to the channel 54 at the appropriate spacing along its length. Electrical connections are contained within the channel to a terminal block 56 positioned therein and are enclosed and protected by a cover plate 58. The adjacent spray heads 34 are all interconnected by means of the previously-mentioned common inlet line 36 extending entirely across the manifold.

The channel 54 is supported in spaced parallel relationship to the roller 22 by means of adjustable mounting brackets 60. Each bracket 60 includes a pair of telescoping arms 62 and 64 triangularly positioned with corresponding ends being secured at spaced locations to the frame 16 and the opposite ends being secured to aligned bearing pins 66 on the channel 54. Bearing pins 68 on the opposite side of the channel from pins 66 support slotted arms 70 triangularly positioned and secured at sleeve 76 to the telescoping arms 64. Adjustment of sleeves 76 toward and away from the bearing pins 66 and/or adjustment in lengths of the arms 62 and 64 vary the angle of impingement and overlapping of the spray pattern 38 with respect to the roller as required in the separate installations.

The actual spraying pressure will vary depending upon the viscosity of the fluid sprayed and the orifice sizes, but generally will range between 30 and 500 p.s.i. The maximum spraying rate similarly can be varied by regulating in combination with the spraying pressure the orifice size, which typically is from 0.010" to 0.030" diameter. Similarly, the distance from the spray tips to the roller and the impinging angle of the spray pattern against the roller can be varied to ensure the proper continuous or approximate overlapping spray pattern. In practice, the linear speed of the piece 14 beneath the roller can vary widely such as from less than 30 feet per minute to upward of 2000 feet per minute. The roller 22 is mounted to freely follow the moving piece so as to roll it generally non-slip full surface contact therewith, or can be driven by synchronous means for the same purpose. A cycling control 52 adjustable incrementally from 10 seconds off and 1/3 second on, to 1/3 second off and 10 seconds on provides adequate film thickness control for most practical applications; from a dry coating to a wet heavy coating.

While the coating apparatus shown is more particularly applicable for sheet stock having a generally elongated roller sprayed by a bank of spray heads, it will be obvious other modifications are possible. Thus, for example, a bar, cylinder, or an I beam could be coated by means of a generally complementary roller sprayed with the coating fluid. Accordingly, it is desired, that the scope of the invention be limited only by the claims hereinafter following.

What is claimed is:

1. A method for coating a moving metal surface adapted to move at any one of a plurality of speeds with an oil film of desired thickness, the improvement comprising the steps of positioning an oil absorbent roller in direct contact with said surface while moving said metal

5

surface relative to said roller, directing an oil spray under any one of a plurality of different pressures upon said roller, and controlling the rate at which said oil is sprayed at any one of said pressures to ensure that said absorbent roller remains unsaturated while depositing an oil film of desired uniform thickness on said metal surface.

2. The method claimed in claim 1 in which said spray is directed tangentially at said roller with said spray engaging the periphery of said roller at an area intermediate the ends of the quadrant of said roller initiating contact with said surface whereby aerated products of said spray are confined.

3. The method claimed in claim 1 in which the rate at which said oil is sprayed is controlled by periodic interruption of said spray.

4. In the method claimed in claim 1, the step of selectively directing a plurality of said oil sprays at said roller for controlling both the area across said surface and the location of the area of said surface to be coated, and the step of regulating the pressure at which said oil is sprayed to maintain a generally constant selected pressure at each spray irrespective of a variation in the number of said sprays.

5. A method for coating a moving metal surface adapted to move at any one of a plurality of speeds with an oil film of desired thickness, the improvement comprising the steps of positioning an oil absorbent roller in direct contact with said surface while moving said metal surface relative to said roller, directing an atomized oil spray at a pressure of at least thirty pounds per square inch upon said roller, and periodically interrupting said oil spray at any one of a plurality of time intervals to ensure that the volume of oil deposited on said roller per time increment does not saturate said absorbent roller with oil while depositing sufficient oil on said roller to coat an oil film of desired uniform thickness on said metal surface.

6. An arrangement for coating a continuously moving metal surface with an oil film of desired thickness with said metal surface adapted to be moved at any one of a plurality of speeds, the improvement comprising a rotatable roller having an oil absorbent material along its periphery and adapted to be placed in direct contact with said surface while said metal surface is moved past said roller, means for operating and directing an oil spray upon said absorbent material with said oil adapted to be sprayed under any one of a plurality of different pressures, and means for controlling the rate at which said oil is sprayed to ensure that said absorbent material remains sufficiently unsaturated with oil to control the deposit of said oil upon said metal surface in a uniform coat of desired thickness.

7. In an arrangement claimed in claim 6, means for directing said spray generally tangentially of said roller and directing said spray to engage said roller in the quadrant thereof adapted to initiate contact with said metal surface for counteracting the aeration of said spray.

8. The arrangement claimed in claim 6 in which said means for controlling said rate comprises cyclically operable means for controlling the time interval during which said oil is sprayed whereby the thickness of said oil film is adapted to be controlled in accordance with the rate at which said roller and metal surface are moved relative to each other.

9. In the arrangement claimed in claim 8, means for selectively controlling the breadth of the area across said roller to which said oil is applied, while maintaining the rate of oil spray at a desired value irrespective of the breadth of said area.

10. An arrangement for coating a continuously moving metal surface with a liquid film of desired thickness, the improvement comprising a rotatable roller having an absorbent material adapted to be placed in direct contact with said surface while said metal surface is moved past

6

said roller, means for operating and directing at least one liquid spray upon said roller, and means for controlling the rate at which said liquid is sprayed to prevent saturation of said absorbent material while providing a liquid film of desired uniform thickness on said surface in accordance with the rate said surface is moved.

11. The arrangement claimed in claim 10 in which said controlling means comprises a cyclically operable timer for periodically interrupting said spray.

12. The arrangement claimed in claim 11 in which said timer is adjustable for selecting the time period during which said liquid is sprayed and is adjustable for selecting the time period during which said spray is interrupted.

13. The arrangement claimed in claim 10 in which said controlling means comprises a pressure regulator adapted to control the pressure of said liquid to prevent substantial variation in said pressure irrespective of the number of operated sprays.

14. An arrangement for coating a continuously moving metal surface with a film of desired thickness, the improvement comprising a rotatable roller having a liquid absorbent material adapted to be placed in direct contact with said surface while said metal surface is moved past said roller, means for operating and directing a plurality of different substantially airless liquid sprays upon said roller, means for selecting any desired number of said plurality of sprays for operation whereby a desired number of liquid sprays are directed at said roller, and means for maintaining the pressure of said selected operated number of said sprays substantially at a desired value irrespective of the number of said selected operated sprays.

15. An arrangement for coating a continuously moving metal surface with an oil film of desired thickness with said metal surface adapted to be moved at any one of a plurality of speeds from at least 30 feet per minute to upward of 2,000 feet per minute, the improvement comprising a rotatable roller having an oil absorbent material along its periphery and adapted to be placed in direct contact with said surface while said metal surface is moved past said roller, means for directing an oil spray upon said absorbent material with said oil adapted to be sprayed under any one of a plurality of different pressures upwards of at least 30 pounds per square inch, and means for periodically interrupting said spray to control the rate at which said oil is sprayed and ensure that said absorbent material does not become so saturated with oil as to prevent the deposit of said oil upon said metal surface in a film of uniform desired thickness.

16. The arrangement claimed in claim 15 in which said means for directing said spray is adapted to provide said spray at any pressure between 30 and 500 pounds per square inch, and said means for periodically interrupting said spray is adapted to be adjusted for interrupting said spray for a selected one of a plurality of different time intervals and is adapted to be adjusted for providing said spray for a selected one of a plurality of different time intervals.

References Cited by the Examiner

UNITED STATES PATENTS

951,425	3/1910	Minahan	118—249 X
1,262,707	4/1918	Smith	101—366 X
1,719,017	7/1929	Moe et al.	101—366 X
1,837,702	12/1931	Canfield	118—259 X
1,988,179	1/1935	Natwick et al.	
2,696,449	12/1954	Ericks et al.	118—11 X
2,730,947	1/1956	Davis	101—366
2,747,541	5/1956	Chew	118—259 X
2,813,485	11/1957	Harless	101—366
3,021,227	2/1962	Richardson	118—323 X

RALPH S. KENDALL, *Primary Examiner*.

RICHARD D. NEVIUS, *Examiner*.

J. A. HAUG, E. B. LIPSCOMB, *Assistant Examiners*.