May 5, 1959 E. G. PETERSON 2,884,898

APPARATUS FOR COATING SHEETS WITH LUBRICANT FOR DRAW DIES

Original Filed Oct. 7, 1954 3 Sheets-Sheet 1

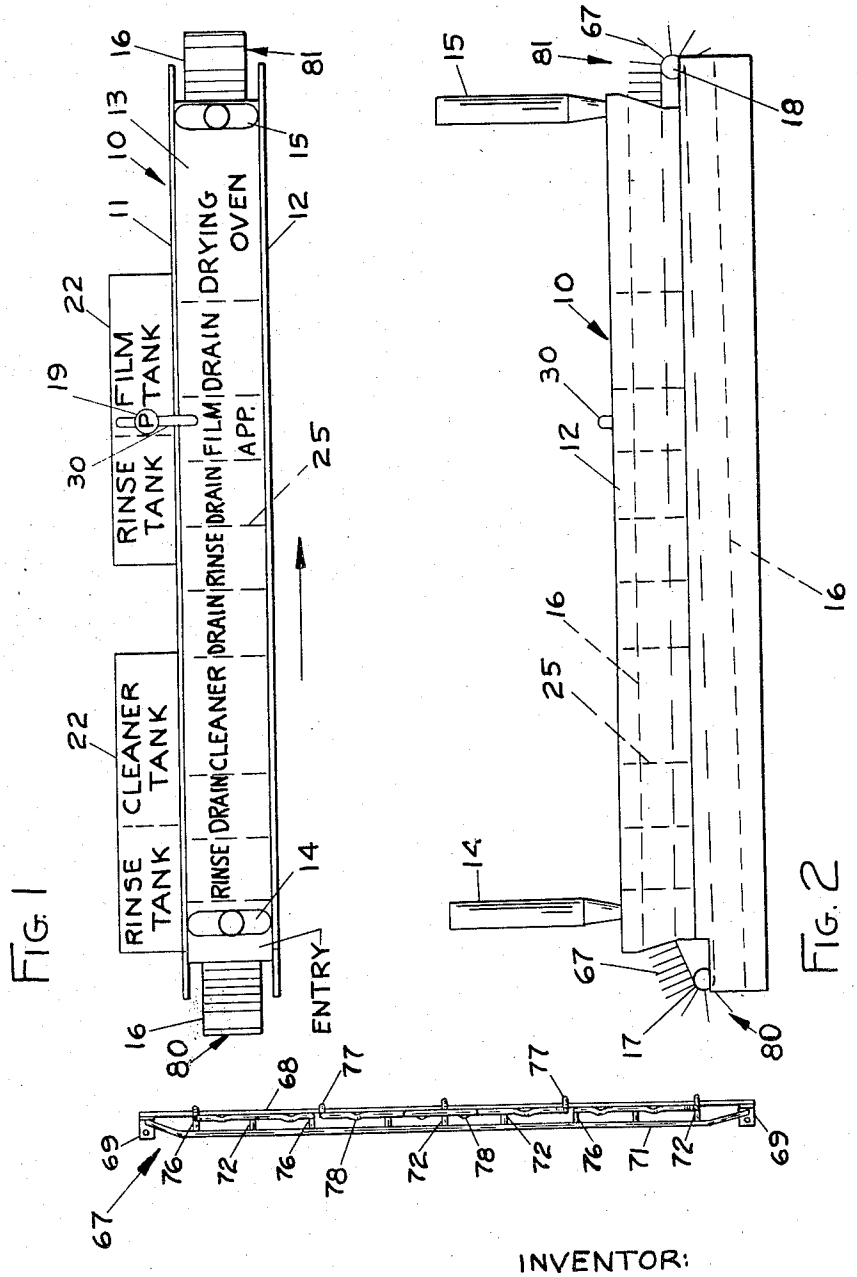


FIG. 1

FIG. 2

FIG. 9

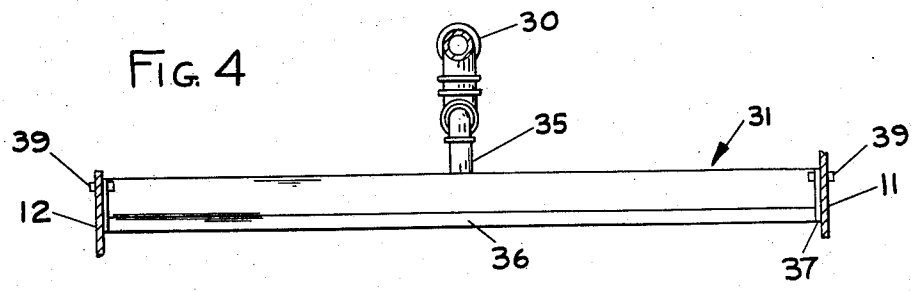
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APPARATUS FOR COATING SHEETS WITH LUBRICANT FOR DRAW DIES

Original Filed Oct. 7, 1954 3 Sheets-Sheet 2

FIG. 4



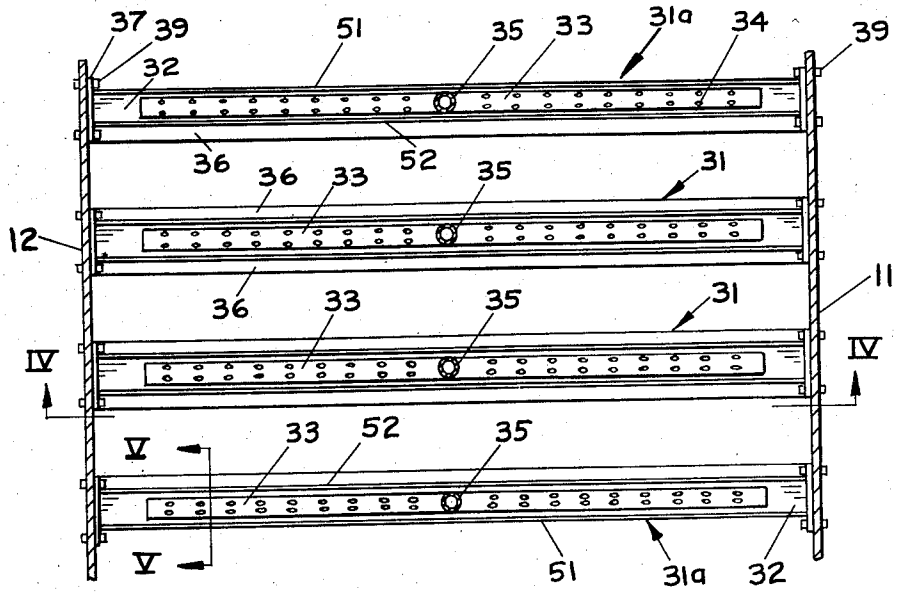


FIG. 3

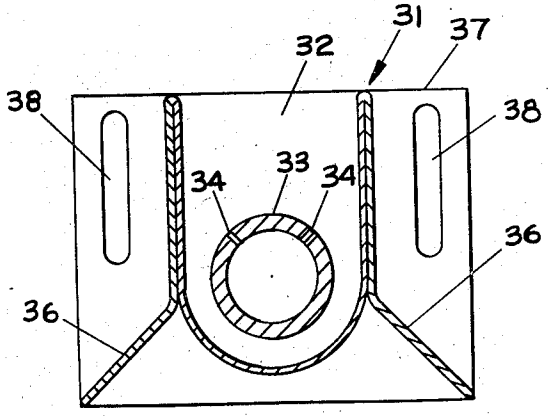


FIG. 5

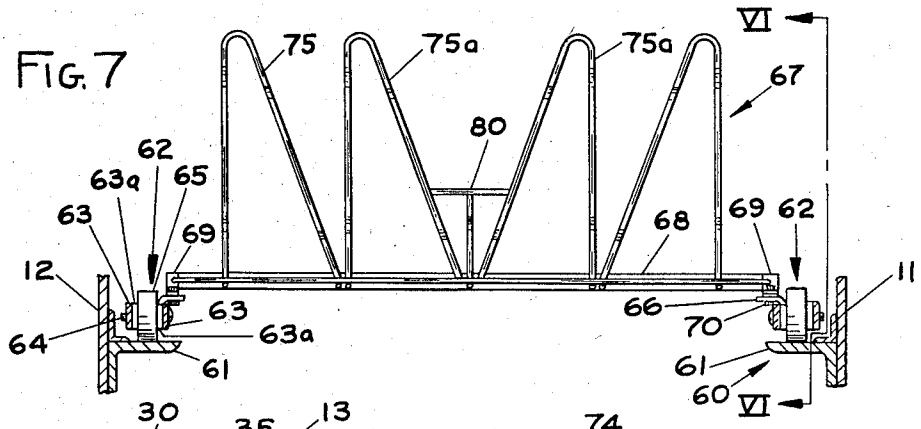
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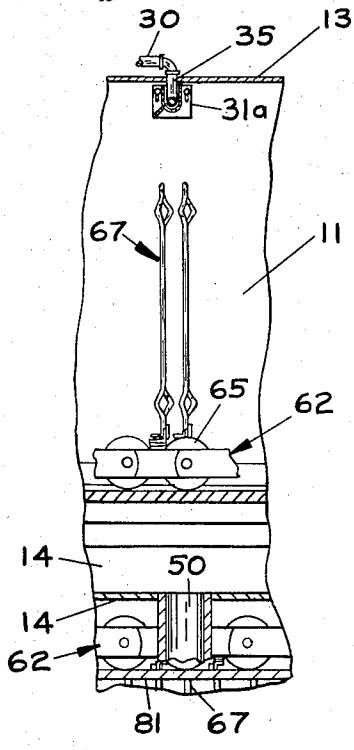
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APPARATUS FOR COATING SHEETS WITH LUBRICANT FOR DRAW DIES

Original Filed Oct. 7, 1954 3 Sheets-Sheet 3

FIG. 7





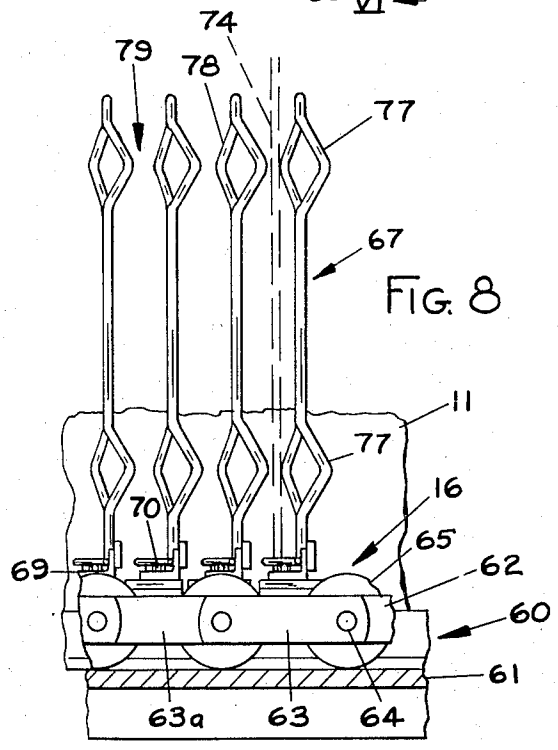


FIG. 8

FIG. 6

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United States Patent Office 2,884,898 Patented May 5, 1959

2,884,898

APPARATUS FOR COATING SHEETS WITH LUBRICANT FOR DRAW DIES

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Original application October 7, 1954, Serial No. 460,945, now Patent No. 2,809,129, dated October 8, 1957. Divided and this application April 15, 1957, Serial No. 653,005

5 Claims. (Cl. 118—324)

This invention relates to apparatus for coating of metal sheets as a preparatory step for their being formed in a die press. This invention is designed to provide the machine to apply a non-oily film to the sheet. The film acts as a lubricant to facilitate the sliding movement of the sheet during the actual forming process between the dies.

This application is a division of patent application Serial No. 460,945, now Patent No. 2,809,129, filed October 7, 1954, and entitled Method of Coating Sheets With Lubricant for Draw Dies.

With the introduction of modern sheet metal forming and drawing processes, particularly those involving what is known as deep drawing, it was found essential to lubricate the material prior to its introduction between the dies so that the material could slip between the faces of the dies as the press closed. Unless the slippage occurs, the sheets will tear due to non-uniform stretching of the material.

At first this lubrication was provided by conventional hydrocarbon oils. These oils provided a satisfactory lubricant but it was exceedingly difficult to remove the oil film after the forming process. Unless such oil films are entirely removed from the metal, any attempt to apply a finish coating such as enamel results in failure due to lack of adhesion wherever a trace of the lubricant remains. As a consequence, substitute non-oily lubricants were developed. These are in the nature of a soap and as such may be removed completely, quickly and easily by a simple washing process. While these soap-like compounds provide an adequate lubricant in the draw presses and are easily to remove, their initial application to the material presents many difficult problems. It is the solution of these problems which is the purpose of this invention.

Methods of applying this non-oily film currently in use, such as spraying or rolling, have not proved satisfactory. The character of the film produced by these methods is not entirely satisfactory.

Further, the methods themselves are difficult to perform. Such methods normally apply the film to one face of the sheet at a time, necessitating a repetition of the process to fully prepare the sheets.

This invention provides a method by which the sheet is quickly and rapidly coated simultaneously on both faces. The resulting coating is substantially uniform and assures proper forming of the sheet in the die. Further, the coating is formed with a minimum use of material, thus, effecting a certain economy in the quantity of filming material demanded by the machine. The machine accomplishes these purposes fully automatically, eliminating high direct labor costs and the cost of storage and transportation incident to a two step application process.

Other objects and purposes of this invention will be immediately seen by those acquainted with the preparation of sheet materials for die presses upon reading the following specification and the accompanying drawings.

In the drawings:

Fig. 1 is a somewhat schematic plan view of a machine designed to carry out my invention.

Fig. 2 is a somewhat schematic side elevation view of the machine illustrated in Fig. 1.

Fig. 3 is a fragmentary enlarged plan view of the film applying troughs located in the film application chamber.

Fig. 4 is a fragmentary elevation view taken along the plane IV—IV of Fig. 3.

Fig. 5 is an enlarged sectional elevation view taken along the plane V—V of Fig. 3.

Fig. 6 is a fragmentary central sectional elevation view of the film applying chamber taken along the plane VI—VI of Fig. 7.

Fig. 7 is an enlarged, sectional, elevation view of one of the conveyor racks for this machine.

Fig. 8 is a fragmentary, enlarged, side elevation view of the conveyor racks for this machine.

Fig. 9 is a plan view of one of the conveyor racks used in this machine.

In executing the objects and purposes of this invention, there has been provided a machine consisting basically of a tunnel divided into a number of compartments. A conveyor passes through this tunnel for carrying the materials through all of the steps of the film applying process. In the machine, the sheets are washed, drained, rinsed, covered with film, drained and dried and delivered at the other end ready for use in the die presses.

In applying the film, the material is cascaded in liquid form onto the sheets from overhead troughs. The troughs are filled and the material caused to flow over the tops of the troughs and thus cascade in a thin sheet onto the sheet material below. As it runs down the sheets, the material forms a thin, lubricating film which adheres to the sheets. The excess material is collected at the bottom of the application chamber and returned to the storage tank for the film material where it is recycled until it is used up in the formation of a film on the sheet material.

Referring specifically to the drawings, the numeral **10** indicates a tunnel having sides **11** and **12**, a top **13** (Fig. 1) and a bottom **14** (Fig. 6). The top, bottom and sides are of sheet metal construction supported by sufficient frame work to make them rigid. The frame work is not shown as it forms no part of this invention. As is indicated in Fig. 1, the main tunnel is divided into ten compartments or operating areas. The direction of movement of the belt is indicated by the arrow in Fig. 1. As the conveyor moves through the tunnel, it passes through an entry area, a rinse area, a drain area, a cleaning area, a second drain area, a second rinse area, a third drain area, a film application area, a fourth drain area and a drying oven. The entry area is vented through a stack **14** and the drying oven is vented through a stack **15**. The use of these stacks assures the removal of hot or moisture laden air from inside the tunnel before it can exhaust through the ends of the tunnel **10** into the faces of the operators as they are loading and unloading the machine.

The various areas and compartments have a common passageway through them for the hereinafter described conveyor **16**. They are partially sectioned off, one from the other, by sheet metal baffles **25** of any suitable construction. Normally these baffles exist only above and below the conveyor for the purpose of preventing intermixing of the various liquid used such as the cleaner and rinses. Further description of these baffles is not believed necessary since they are of conventional design.

Materials treated in the tunned **10** are transported through the tunnel by means of a conveyor **16**. The conveyor **16** passes over a pair of pulleys **17** and **18** at opposite ends of the tunnel. The pulley **17** is an idler. The

pulley 18 is driven, powering the conveyor. The pulley 18 may be driven by any suitable means such as an electrical prime mover. The power source is not illustrated as it is wholly conventional and forms no part of this invention. The return run of the conveyor is spaced just below the floor 14 and therefore is exterior of the operating portion of the tunnel 10. The structure of the conveyor will be described more fully hereinafter.

The rinsing, cleaning and film forming solutions used in the machine are stored to one side of the tunnel 10 in tanks 22 (Fig. 1).

Film application mechanism

The rinsing and draining operations are carried out by conventional equipment. The rinses are normally applied by nozzles operating from both the top and sides of the rinsing areas to completely spray and clean the sheets. The draining areas are no more than areas of sufficient length to allow sufficient time for the liquids remaining on the sheets to drain off onto the tunnel floor where they are taken away by suitable drain conduits and either returned to the rinsing tanks or discharged entirely.

The particular structure by which the film forming material itself is applied is quite important to this invention. The film forming material is in liquid form consisting of the lubricating material in an aqueous solution. While this invention is particularly designed for use with current film forming materials which are utilized in an aqueous solution, it is not intended this invention be so limited. It is designed for use with any film forming material which will form an adequate film on the sheets when applied by the means incorporated into this machine. The film forming material is raised from the tank 22 by means of a pump 19. The pipe 30 (Fig. 4) distributes the material from the pump 19 to the individual troughs 31.

Several troughs 31 are used. These troughs extend laterally across the tunnel just below the tunnel's top member 13. The film forming material is delivered to the troughs under very low pressure. Only sufficient pressure is provided to assure an adequate supply to the troughs. The purpose of this will appear more fully hereinafter. The troughs 31 each have a central channel 32. Extending lengthwise of the channel is a distribution conduit 33 having upwardly directed, small, closely spaced, discharge orifices 34 throughout its length (Figs. 3 and 5). The distribution conduits 33 are closed on each end. Thus, all of the film material is discharged into the troughs through the orifices 34. The distribution conduits 33 are each supplied at the center by means of a pipe 35 connected to the conduit 30. The distribution conduits are located deep in the channels 32 whereby discharge of the film material through the orifices 34 will not cause rippling or waving of the top surface of the body of film material filling the channel.

Four troughs are utilized. It will be recognized that while this number has been found sufficient in this machine, under other circumstances a greater or a lesser number of the troughs may be required. Each of the two intermediate troughs are provided with a pair of downwardly and outwardly inclined baffles 36. The baffles are inclined downwardly at approximately 45° and extend outwardly and downwardly from the channel 32 adjacent the bottom of the channel. The trough in Fig. 5 is illustrated with the channel 32 and the baffles 36 formed from a single piece of material. This is a desirable way of fabricating this particular structure although it may be fabricated from as many different parts as is desirable.

The ends of the channel 32 are closed by a terminal plate 37. Each terminal plate is large enough to cover the entire cross-sectional area of the trough 31 including the baffles 36. The terminal plates are secured to the U-shaped members forming the channel 32 and the baffles 36 by suitable means such as welding. Each of the terminal plates 37 is provided with a pair of vertically elongated slots 38. These provide the means for attachment of the troughs to the side members 11 and 12 of the tunnel. Attachment is effected by means of bolts 39 passing through the side members 11 and 12. By means of the slots 38, the troughs may be leveled so that the film forming material will flow over both edges of the channel in equal quantity.

Below the troughs 31 and below the conveyor 16, the floor 14 of the tunnel slopes downwardly to one side of the tunnel thus causing the excess film material to collect along this side where it is drained through the pipe 50 and returned to the proper storage tank 22 for the film material (Fig. 6).

The end troughs 31*a* are identical to the troughs 31 except that the outside wall 51 of the channel 32 is made slightly higher than the inside wall 52. This prevents the filming material from overflowing on this side of the trough, confining the discharge of these troughs to the inside edge. Since the walls 51 are raised to prevent the discharge of the film material on the outer side of the troughs, the flanges 36 are omitted along the outer side.

The conveyor

The upper run of the conveyor 16 is supported on a track 60 consisting of a pair of L-shaped rails 61 (Figs. 7 and 8). The rails 61 are located one on each side of the tunnel and are secured to the sides 11 and 12 of the tunnel. The conveyor has a pair of side chains 62. Each side chain 62 consists of alternately arranged link pairs 63 and 63*a* pivotally joined adjacent their ends by pins 64. Rotatably mounted between the links on each of the pins 64 is a carrier wheel 65. The carrier wheels 65 support the chain on the rails 61 of the track 60. The inner link of each of the link pairs 63 and 63*a* is equipped with an inwardly turned, horizontal ear 66. The ears 66 on the inner link of the link pairs 63*a* is slightly longer than the ear on the inner link of the link pair 63 to account for the differential in location of these links since one pair is mounted exteriorly of the other.

The main body of the conveyor is formed by racks 67 which extend between the conveyor chains 62. The racks each consist of a lateral supporting bar 68 to each end of which is secured an L-shaped anchor bracket 69. The bottom, horizontal leg of each of the anchor brackets 69 rests upon one of the ears 66 and is secured thereto by means of a bolt 70. The racks 67 each have a foot portion formed by a rod 71 extending across the conveyor between the anchor brackets 69, parallel to the supporting bar 68 and spaced a short distance therefrom (Fig. 9). The rod 71 is connected to the supporting bar 68 by short rod segments 72. The ends of the rod 71 are bent back to contact the vertical leg of the brackets 69. The rod segments 72 are secured to both the supporting bar 68 and the rod 71 by welding. In a similar manner, the ends of the rods 71 are secured to the anchor brackets 69 by welding.

The individual sheets 74 (Fig. 8) are supported by vertically extending nesting frames 75*a* are mounted to each support bar 68. The nesting frames 75 and 75*a* are identical except that the bottom ends of the nesting frames 75 are turned horizontally and extend across the foot of the rack to contact the rod 71 (Fig. 9). Each of the nesting frames is of generally triangular shape having one inclined and one vertical leg. The lower ends of the nesting frames 75 and 75*a* are firmly secured to the support bar 68 by suitable means such as welding.

The nesting frames 75 and 75*a* adjacent both their upper and their lower ends have an offset portion 77, offset longitudinally of the conveyor. The inclined legs of the nesting frames 75 and 75*a* are provided with a corresponding pair of offset portions 78 also offset longi-

tudinally of the conveyor but in the opposite direction from the offset portions **77**. The racks **67** are so spaced, longitudinally of the conveyor, that the offset portions **77** of one rack cooperating with the offset portions **78** of the adjacent rack form a slot **79** (Fig. 8) slightly wider than the thickness of the sheet **74** whereby the sheet will seat between two adjacent racks with its lower end resting on the rod **71** of the rack's foot portion. The sheet is held in vertical position by the offset portions. The offset portions **77** are spaced from the offset portions **78** transversely of the conveyor (Fig. 9). This arrangement provides means for holding the sheets in vertical position as they pass through the tunnel with the sheets fully exposed since the racks are formed of a thin, rod-like material and with the sheet being held in position by a minimum number of points of contact between the racks and the sheet. This arrangement assures a thorough coating of the sheet with the filming material.

At the center, between the pair of nesting frames **75***a*, a T-shaped brace **80** is provided to support the nesting frames **75***a* and generally strengthen the structure.

The upper run of the conveyor moving through the tunnel has the nesting frames **67** projecting upwardly above the wheels **65**. On the return run, the nesting frames **67** hang downwardly from the wheels **65** with the conveyor supported from above by the return track structure **81** (Fig. 6).

Operation

Before the machine is put into operation, it is essential that the troughs **31** be properly leveled. These troughs must be level both crosswise and lengthwise of the tunnel so that the liquid will be discharged in an even film over all edges of these troughs. For this purpose, the bolts **39** are loosened to permit the trough to be adjusted in any direction necessary to produce this level condition. It will be seen, when the process carried out in this machine is described, that this leveling of the troughs is essential to produce a satisfactory film on the sheets.

The sheets are initially placed on the conveyor at the loading end **80**. As the racks **67** pivot about the idler pulley **17**, they are caused to separate. With the racks **67** separated, the sheets may be easily placed between them. As the conveyor completes its turn about the idler pulley **17**, the racks again close up to hold the sheets closely between them. The movement of the conveyor then carries the sheets into the tunnel **10**.

In the first rinse chamber, the sheets are thoroughly rinsed to remove any foreign particles such as shavings, chips or other coarse material which may be deposited on their surfaces. As they progress through the tunnel, in the first drain chamber this rinse water is drained off. They then pass into the cleaner chamber. In the cleaner chamber, the sheets are sprayed with a cleaning solution designed to strip from them any remaining foreign material and any oils or other films which may be on their surfaces. From the cleaner chamber, the sheets pass through a second draining chamber where the cleaner is drained and then into a rinsing chamber where the last traces of cleaner are removed by a thorough flushing.

The sheets then progress into the film application chamber. In this chamber the troughs **31** and **31***a* are kept constantly full with sufficient film material being supplied to the troughs to force the material to run over the edges of the trough. Sufficient material is supplied to assure a constant thin film of material spilling over the tops of the channel **32**. This film of material cascades down the sides of the channel and over the baffles **36**. The baffles **36** perform the service of joining any divergent streams of the material which may form and cause it to cascade onto the sheets **74** in a continuous, unbroken film. Such a cascading process assures a complete coverage of the surfaces of the sheets **74**. The rate at which the filming material is supplied to the troughs and the force with which it is discharged through the orifices **34**, is such that the filming material in the channel **32** forms a level lake so that it will spill in an even quantity along the entire length of the troughs. It is seen that the troughs must be level, both longitudinally and crosswise to assure the constant discharge of the film in even quantities from all the portions of the troughs.

More material is discharged from the troughs than adheres to the sheets to form the film. This excess material cascades down the sheets and through the conveyor. Since the conveyor is open at the bottom, the material drains freely through the conveyor onto the floor **14** of the tunnel where it runs to one side and is discharged through the return conduit **50**. This excess film material is returned to the storage tank **22** for the film material. The open design of the feet of the racks **67** permits the material to drain away easily and quickly from beneath the sheets **74**, thus assuring the complete discharge of all material which does not adhere to the surfaces of the sheets.

The high outer sides **51** of the troughs **31***a* confines the cascading action to the central portion of the film application chamber. Thus, the film will not be accidently caused to splash into the adjacent rinsing and draining chambers.

After the sheets have been subjected to the cascading film applying operation, they move through a draining area where the last of the excess film material is drained off. As in the application chamber, this drained off material is collected on the floor of the tunnel and returned to the film storage tank. The conveyor then passes through a drying oven where the sheets are heated to sufficient temperature to set the filming material and dry off the remaining moisture. The open construction of the racks **67** assumes even and adequate heating of all parts of the sheets **74**. The open foot portion of the racks assures circulation of the heated air about the bottom of the sheets.

Heating may be effected in the drying oven by any suitable means such as by supplying the oven with adequate quantities of hot, dry air. This is a preferable arrangement because the heat source may be provided separate and apart from the tunnel and may be closely regulated to the requirements of the material being processed. However, it is entirely possible to substitute infrared heating units within the drying oven.

As the conveyor **16** emerges from the drying oven, the stack **15** removes the hot air so that it does not discharge into the operator's face. The sheets, as they exit from the tunnel, are completely coated and dried ready for use in the die press. The conveyor then passes over the driven pulley **18** at its discharge end **82**. As the conveyor turns about the pulley, the racks **67** are caused to separate, thus permitting the sheets **74** to be removed quickly and easily by the operator. The conveyor then returns to the loading end of the conveyor **80** beneath the floor of the tunnel in inverted position.

The open design of the racks assures a complete coverage of the sheets and at the same time assures complete drainage of the sheets so there will be no wet points on the sheets after they have passed through the drying oven. Further, the design of the rack **67** is such that the conveyor is capable of carrying a large quantity of sheets since the sheets are spaced only about three inches apart along the conveyor. Thus, the machine, although necessarily moving slowly through the tunnel, is capable of processing as a continuous operation a large quantity of material in a short period of time.

It will be seen that the operation, as carried out in this machine, is entirely automatic, the only operator necessary being a loader and unloader. It will be recognized that even these operators may be eliminated by

the use, in association with this machine, of automatic mechanical loading and unloading equipment.

The coating of the sheets with a cascading action of a continuous film of the film forming material assures complete coverage. Furthermore, it makes it possible to coat the sheets simultaneously on both faces, thus doing the entire job in a single passage through the machine. The construction of the machine is such that practically none of the film forming material is wasted since that which does not adhere to the sheets is collected and cycled for reuse. The use of excess quantities of the film made possible by cascading action assures complete coverage. As a result, there are no uncoated spots to cause difficulty when the sheets are placed in the die presses. The operation is carried out swiftly and completely, permitting large quantities of sheet material to be prepared rapidly and completely with practically no opportunity for defective coating of the sheets.

While I have described a preferred embodiment of my machine, it will be recognized that various modifications of this invention may be made. Such modifications are to be considered as included in the hereinafter appended claims unless these claims by their language expressly state otherwise.

I claim:

1. In a machine for automatically coating sheet material with a film forming lubricant, the combination comprising: a tunnel open at each end; a powdered conveyor and means supporting one run of said conveyor for travel through said tunnel; said conveyor having a plurality of closely spaced racks thereon; said racks being adapted to support said sheets in vertical position with each individual sheet separated from each adjacent sheet longitudinally of the conveyor; an elongated trough in said tunnel adjacent the top thereof; means mounting said trough to said tunnel transversely thereof; said means adapted to hold said trough level both longitudinally and transversely thereof; a supply of said film forming lubricant and a conduit for supplying and filling said trough with said film forming lubricant; means on the sides of said trough for causing said film forming lubricant to cascade from said trough in a substantially uniform sheet; a drain below said conveyor for removing excess quantities of said film forming material.

2. In a machine for automatically coating sheet material with a film forming lubricant, the combination comprising: a tunnel open at each end; a powered conveyor and means supporting one run of said conveyor for travel through said tunnel; said conveyor having a plurality of closely spaced racks thereon; said racks being adapted to support said sheets in vertical position with each individual sheet separated from each adjacent sheet longitudinally of the conveyor; a plurality of troughs in said tunnel adjacent the top thereof; means mounting said troughs to said tunnel transversely thereof; said troughs being spaced longitudinally of said tunnel; said means adapted to hold said troughs level both longitudinally and transversely thereof; a supply of said film forming lubricant and a conduit for supplying and filling each of said troughs with said film forming lubricant; means on the sides of said troughs for causing said film forming lubricant to cascade from said troughs in a plurality of substantially uniform sheets; a drain below said conveyor for removing excess quantities of said film forming material.

3. In a machine for automatically coating sheet material with a film forming lubricant, the combination comprising: a tunnel open at each end; a powered conveyor and means supporting one run of said conveyor for travel through said tunnel; said conveyor having a plurality of closely spaced racks thereon; said racks being adapted to support said sheets in vertical position with each individual sheet separated from each adjacent sheet longitudinally of the conveyor; a plurality of troughs in said tunnel adjacent the top thereof; means mounting said troughs to said tunnel transversely thereof; said troughs being spaced longitudinally of said tunnel; said means adapted to hold said troughs level both longitudinally and transversely thereof; each of said troughs having a central chamber open at the top; the sides of the chambers of certain of said troughs being of uniform height; one side of the chamber of the trough at each end of said plurality of troughs being higher than the other of the sides thereof; a supply of said film forming lubricant and a conduit for supplying and filling each of said troughs with said film forming lubricant; means on the sides of said troughs for causing said film forming lubricant to cascade from said troughs in a plurality of substantially uniform sheets; a drain below said conveyor for removing excess quantities of said film forming material; a drying oven in said tunnel downstream of said conveyor from said troughs.

4. In an elongated trough for cascading a liquid material in a substantially uniform sheet along the entire length thereof, the combination comprising: a U-shaped channel open at the top; support plates secured to and closing each end of said channel; an outwardly and downwardly projecting baffle along each side of said channel and extending the entire length thereof; a supply conduit within said channel adjacent the bottom thereof; the length of said supply conduit being equal to a major portion of the length of said channel; said conduit having a plurality of restricted discharge orifices therein; said discharge orifices being equally spaced along said supply conduit.

5. In an elongated trough for cascading a liquid material in a substantially uniform sheet along the entire length thereof, the combination comprising: a U-shaped channel open at the top; support plates secured to and closing each end of said channel; an outwardly and downwardly projecting baffle along each side of said channel and extending the entire length thereof; a supply conduit within said channel adjacent the bottom thereof; the length of said supply conduit being equal to a major portion of the length of said channel; said conduit having a plurality of restricted discharge orifices therein; said discharge orifices being arranged in two parallel rows; the axis of said orifices diverging in an upwardly direction; said discharge orifices being equally spaced along said supply conduit in each row.

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