Jan. 10, 1967 C. L. OTIS ETAL 3,297,469

PROCESS FOR PREPARING SHEET METAL SURFACES WITH DRY LUBRICANT COATINGS

Filed Aug. 2, 1963 2 Sheets-Sheet 1

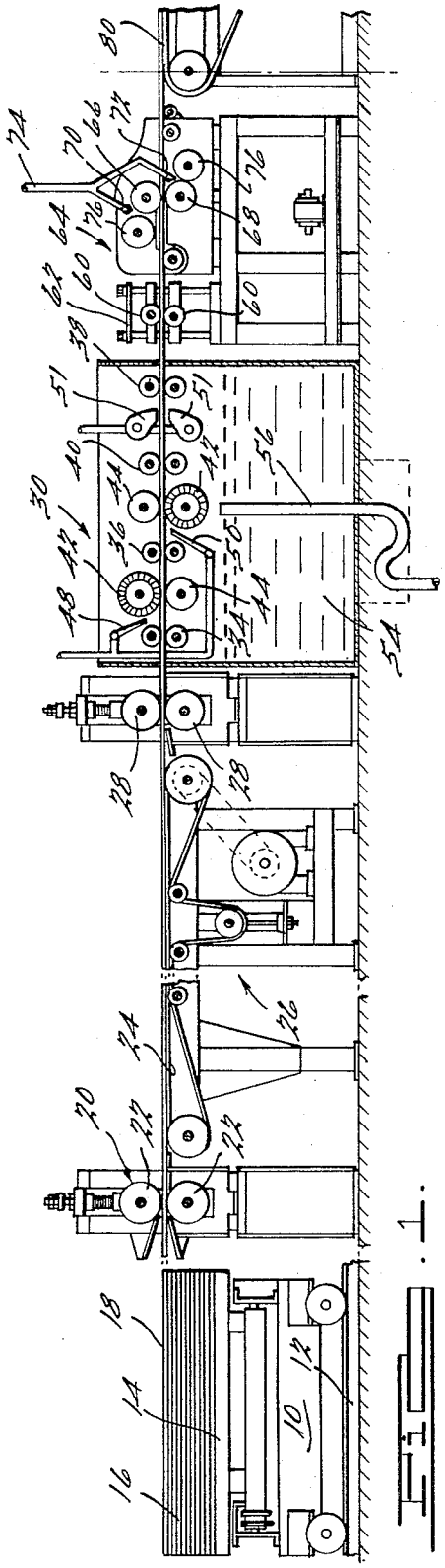


Fig. 1.

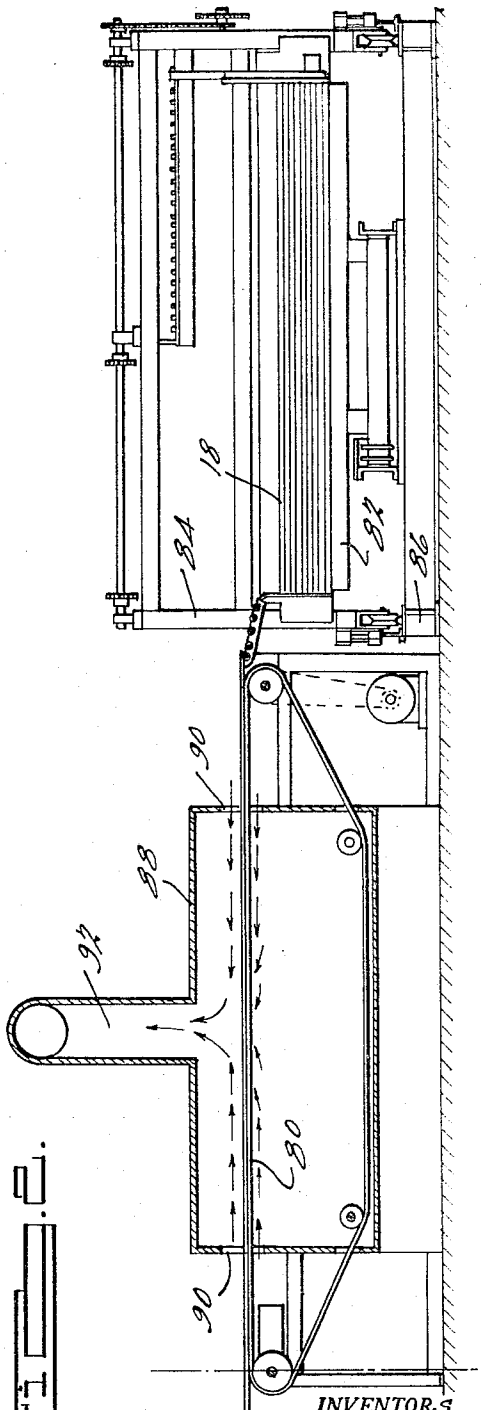


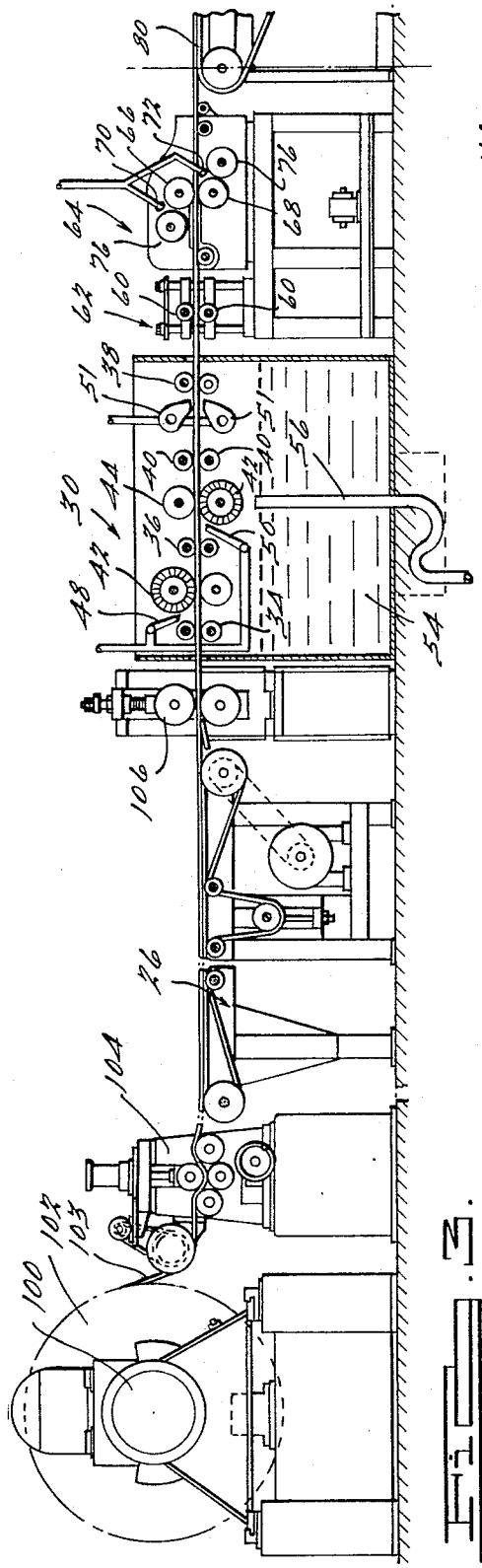
Fig. 2.

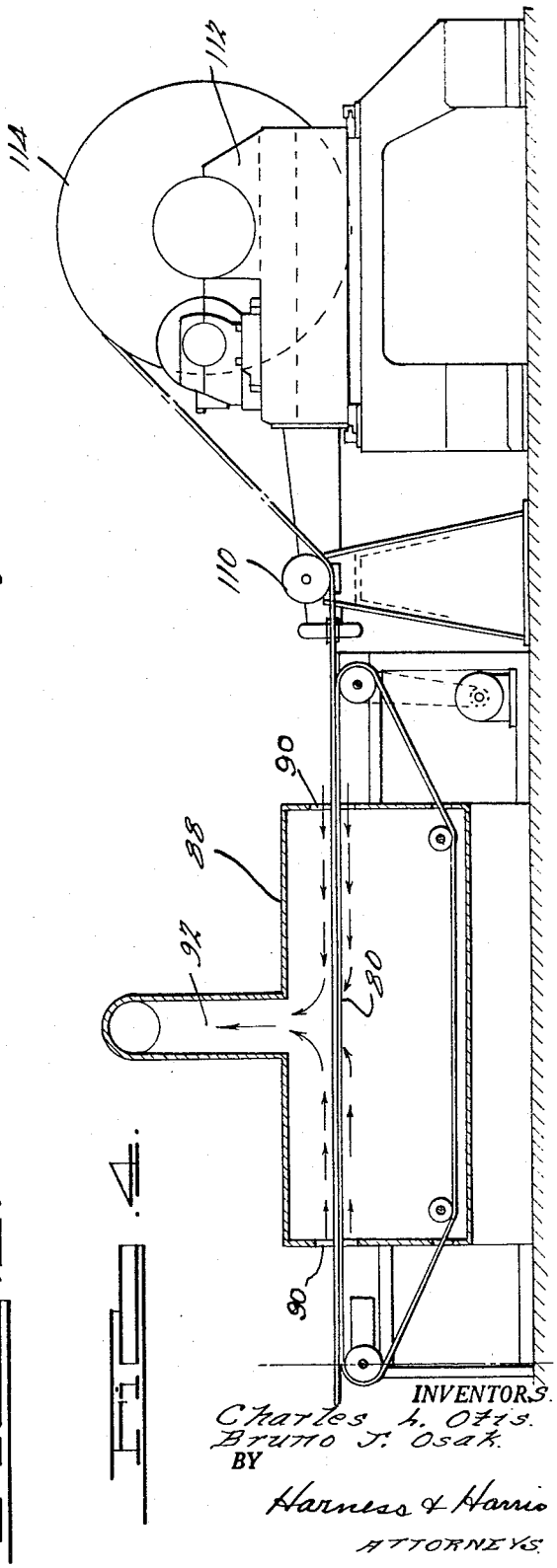
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3,297,469

PROCESS FOR PREPARING SHEET METAL SURFACES WITH DRY LUBRICANT COATINGS

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1 Claim. (Cl. 117—49)

The present application is a continuation-in-part of our copending application Serial No. 95,978 filed March 15, 1961, now abandoned.

This invention relates to improvements in preparing metal surfaces, especially those of relatively thin sheet steel in the form of elongated webs or strips of individual sections or pieces with so-called "dry lubricant" coatings (i.e. dried films of aqueous soap drawing compound) to provide lubrication during subsequent metal working operations upon such pieces. It particularly concerns improvements in a process described in a patent to A. M. Fucinari et al., No. 2,966,425, granted December 27, 1960, which by cross reference is made a part hereof.

In accordance with the procedures described in the aforesaid patent individual pieces of sheet material are by a continuous processing subjected to a cold (ambient) liquid cleaning spray and scrubbing treatment for the purpose of removing mill oil on the metal, then to a blast of cold (ambient) air to blow off excess cleaning liquid, then to coating with a cold (ambient) aqueous soap solution liquid at ambient temperature and which contains at least about 5% by weight of soap, then to treatment with circulating hot air at moderately elevated temperatures in a tunnel-like oven which in practice heats the air to a temperature in excess of 500° F., to evaporate water from the aqueous soap coating to dry the same, a condition which is reached when all but between about 5 to 15% moisture is removed from the coating. The patentees emphasize the importance of maintaining the temperature of the metal sheet and aqueous soap coating composition at all times below 150° F., preferably below 120° F., to avoid, it is said, adverse age hardening characteristics in the metal and difficulty at the draw dies if their process is carried out at higher temperatures.

Although this process may be successfully applied with certain thicknesses of metal and coating, it is not satisfactory in commercial operations where metal sheets of a thickness up to 0.125" must be handled and coated with films or layers of the aqueous soap composition weighing between 150 to 300 mg. per sq. ft., dry weight depending upon the drawing operation, the character of the metal coated, and the thickness of the sheet. It is found that with the process advocated by the patentees many of these coatings are not sufficiently dry to avoid sticking between stacked pieces of the coated sheet metal or between layers of a roll thereof even when the coated sheets are treated in a 30' oven operating with circulating hot air at a temperature as high as 575° F. Attempts at slowing down the drying operation to considerably below 150 feet per minute where coatings above 200 mg. per square foot are contemplated produced improved drying but also resulted in sheet temperatures considerably above the maximum 150° F. stipulated by the patentees and too high to enable immediate handling of the coated material by press operators. In such cases the sheets were then usually stacked and stood this way for 6 hours or more before being used. Thus a uniform operation at production speeds of about 150 feet per minute was not possible.

It was also found that the mill oil on sheet steel for anti-corrosion protection, especially hot rolled steel, is insufficiently removed by the cold liquid cleaning treatment of the patentees to enable the subsequent application of uniform and satisfactory coating layers of drawing compound. In addition, it was observed that the cut sheets carried burrs and other surface deformations produced in prior operations which sometimes seriously marred the rubber rolls of the coating apparatus and prevented the application of uniform coatings of the drawing compound on the sheets.

We have now discovered that it is possible for the metallic sheets to be heated prior to applying the aqueous lubricant coating material and for these sheets to carry sufficient residual heat in them to substantially dry the lubricant coating after application thereof to a condition permitting coiling or stacking of the coated material without sticking or blocking. Moreover, we have discovered that adequately dried coatings of substantial weights (200–300 mg. per square foot and higher) are readily obtainable where in addition to imparting heat to the metal sheet prior to coating, the coating itself is applied in a heated condition. Such is found to minimize the number of B.t.u.'s needed to evaporate the moisture of the coating to the required dry condition and to some extent (where the coating is hot enough) even raise the temperature of the metal sheet during vaporization, to thereby permit a more effective drying operation and a minimum drying time. Where coating films of substantial weight are used, drying of the coated sheets may be implemented by mechanically circulated ambient air. Such may also be used to provide cooling of the coated sheet where a hot coating is applied following preheating of the metal sheet. Furthermore, it is found that the short time heating of the metal required by the new processing permits the utilization of high metal and coating temperatures in excess of 150° F., even in excess of about 200° F. heretofore believed impossible without injurious aging effects on the metal and further facilitates the elimination of all oven drying, heretofore a must.

Preheating of the sheet metal web or sections is preferably carried out by applying thereto a hot liquid, preferably a heated cleaning or wash solution, sufficiently hot to accomplish the desired end result. A hot liquid is admirably suited for affecting heat transfer to the metal and quickly raising its temperature. The metal sheet may if desired be submerged in a bath of the hot wash solution but such does not lend itself as well to a scrubbing operation. The temperature of the wash solution will vary with the character of coating, thickness of the coating and of the metal. In one coating operation using a carbon steel sheet .060" thickness moving at a linear speed of 150' per minute, it was found that a wash solution applied to the sheet at a temperature of about 115° F. would provide sufficient residual heat in the sheet as it is carried through the coating applicator and beyond to remove moisture from and adequately dry a coating of aqueous soap drawing compound applied in amount between 150 to 200 mg. dry weight per square foot on each side of the sheet and with a final sheet temperature at stacking of 92° F. In this operation a current of air at ambient temperature was circulated by mechanical action over the opposite sides of the coated material to accelerate adequate drying and minimize stacking temperature. The coatings were found sufficiently dried to permit stacking without sticking between the coating films of adjacent layers, a condition generally represented by the presence of less than about 15% moisture. It was also observed that the use of a narrow ambient air knife to remove excess wash solution from the sheet following scrubbing and squeegee operations had little effect on the temperature of the sheet. This may be a warm air knife if desired to minimize any temperature drop in the sheet before coating. The condition of the coated

material was found to be much superior to that obtainable by a cold wash followed by drying of the lubricant coating at high oven temperatures of 500° F. and greater customarily employed.

In another coating operation, a carbon steel sheet .090" thick while moving at a linear speed of 150' per minute was first treated with a wash solution having a temperature of about 201° F. and then given a coating of aqueous soap drawing compound in amount about 200 mg./sq. ft. The coating was applied at a temperature of about 173° F. The coating was in dry condition (below 15% moisture) after moving 7 feet past the point of coating application. The temperature of the metal sheet after cleaning and just before applying the hot coating was in this case about 155° F. The temperature of the coated sheets at the stack was between 142 to 148° F. and in some cases slightly higher depending upon ambient temperature of the operating area. No oven heating or forced air cooling was required.

Thus wash solutions have been used having temperatures above 100° F. and over 200° F. depending upon the subsequent operational steps. The wash solution will preferably have a temperature below its boiling point but will be sufficiently high to impart a temperature in excess of 150° F. to the metal sheet but not over one which will cause bubbling or other injury to the layer of soap compound subsequently applied.

In some instances, as where a more or less volatile cleaner is required, the sheet may after cleaning be heated by a blast of hot air sufficient in area and amount and at a temperature sufficiently high, to clear the sheet of excess wash solution and simultaneously provide the sheet metal with sufficient residual heat for the subsequent coating drying operation. Moreover, where exceptionally heavy films of drawing compound, for example in amount of 300 mg. per square foot and greater are required it may be necessary to control the cleaning solution operation to obtain metal temperatures substantially higher than 155° F. to provide sufficient residual heat for drying. In such cases a subsequent current of forced air at ambient temperature such as referred to above, may be used when needed to aid in the essential removal of moisture and to reduce the final temperature of the coated sheets after a satisfactory dried condition has been attained. The coated sheets after reaching the correct dried condition by residual heat in the metal alone may also be chilled by a separate air blast at a temperature lower than ambient air temperature. It is also contemplated that where the combination of a heated cleaning solution and a warm air blow-off is to be utilized prior to applying the coating (hot or cold) that the air may be heated by the cleaning solution.

As described above, the coating of precut sheets with drawing compound presents problems of edge burrs and other surface blemishes causing damage to rubber applicator rolls with resultant non-uniform coatings. The present invention also contemplates pretreatment of the sheets in advance of the cleaning operation to remove this source of trouble.

Accordingly, it is the main object of the invention to prepare metal surfaces of sheet-like material with so-called "dry lubricant" aqueous coatings by storing expendable heat is the metal in advance of the wet coating operation which residual heat is to be used for effecting satisfactory drying of the coatings to a condition permitting comfortable handling of the material by workers and such that the coatings of adjacent contacting layers will not stick together.

A specific object is to obtain the foregoing result by the utilization of a hot cleaning solution and/or hot air treatment of the sheet metal immediately preceding the lubricant coating operation.

Another object is to provide an operation as in the preceding objects where the aqueous coating itself is in heated condition preferably above the metal temperature when applied.

A further object is to supplement the procedures of the preceding objects with an ambient air treatment of the coated sheet after the residual heat of the metal has been effectively utilized or by air at less than ambient temperature.

A specific object is to provide means for removing burrs and the like surface deformations from precut sheets prior to coating them with a lubricant material in order to prevent injury to the coating rolls and loss of a uniform coating of lubricant.

Other objects and advantages of the invention will be apparent from the following description and from the drawings wherein:

FIGURES 1 and 2 combined are a schematic showing of an apparatus for carrying out the invention and involving the treatment of precut pieces of sheet material; and

FIGURES 3 and 4 combined are a similar showing of apparatus for treating continuous sheet metal.

Referring first to FIGURES 1 and 2 of the drawings, the structures which form part of a continuous operation and from which it will be evident that the apparatus of FIGURE 2 is intended for tandem arrangement with that of FIGURE 1 with the left hand end of the apparatus in FIGURE 2 connecting with that of the right hand end of the apparatus of FIGURE 1, the numeral **10** represents a wheeled carrier brought into position relative to the apparatus on a suitable track **12**. The carrier **10** supports a hydraulically adjustable table **14** on which may be carried a stack **16** of sheets **18** of metal to be treated, customarily sheets of carbon steel for example between about .030" to .125" in thickness suitable for stamping and forming operations.

The individual sheets **18** are fed by suitable means (not shown) to a deburring unit generally designated by the numeral **20** where they pass between a pair of steel pinch and deburring rolls **22** which function to remove edge burrs and other surface deformations left by the cutters in cutting a continuous strip into individual sections and which if not removed tend to cut and otherwise mar the surface of rubber coating applicator rolls and produce non-uniform deposits of coating material on the sheets. If desired, this unit may comprise a series of rolls **22**.

The deburred sheets **18** are deposited by the rolls **22** on a moving belt **24** of a conventional conveyor generally designated by the numeral **26** from which they enter the nip of a pair of driven feed rolls **28** which direct the sheets through a cleaning unit generally designated by the numeral **30**. This unit is provided with pairs of feed rolls **34**, **36**, and **38**, a set of rubber squeegee rolls **40**, offset rotary scrubbing brushes **42**, each having an opposed guide roll **44**, cleaning solution sprays or nozzles **48**, **50**, and air blow-off devices or knives **51**.

It will be evident that as the individual sheets **18** pass between each of the scrubbing brushes **42** and their guide rollers **44**, a cleaning solution will be applied to both sides of the sheet by means of the spray devices **48** and **50** respectively which direct a spray of the cleaning solution into the juncture between each brush and the metal sheet. Mill oil and other contaminates will be removed from the metal sheets **18** by the combined action of the cleaning solution and scrubbing brushes **42**. Excess cleaning solution dripping or thrown from the brushes, rollers, and the metal sheet itself may be trapped in the housing by suitable baffles (not shown) for controlling downward flow of the excess liquid into a collection and supply reservoir **54** from which the supply of cleaning solution to the spray devices **48** and **50** may be pumped for recirculation through suitable filters (not shown).

Because the operation contemplates the use of a hot cleaner the sheets may be carried through the cleaning unit on a belt or other suitable feed arrangement and the brushes dispensed with.

The cleaning solution will preferably be a mild caustic alkali cleaner, usually comprised of a water solution of sodium oxide, sodium carbonate, sodium silicate, and sodium hydroxide. The unit **30** is preferably provided with an overflow pipe **56** which will prevent the level of cleaning solution in the unit **30** from reaching the cleaning apparatus and will serve to drain off oil and light particles removed from the metal sheets **18** to suitable separators (not shown). The hot wash solution when used as in the preferred operation may be heated by steam under pressure, for example live saturated steam at 150 p.s.i. (gage) which will have a temperature of about 367° F. Such will make possible cleaning fluid temperatures of at least about 200° F. and higher and metal temperatures above 150° F. in the order of 155 to 200° F. depending upon the operation used. After emerging from the squeegee rolls **40**, the sheets **18** may be passed between a pair of air blow-off devices **51**, generally narrow air knives, to remove from the sheet any cleaning solution which may have remained thereon after passing through the squeegee rolls. By employing air in the devices **51** at a temperature no less than about the temperature of the metal sheet as it leaves the rubber squeegee rolls **40** a temperature drop may be avoided. Although heating the metal sheet by a hot liquid cleaner is preferred and found most effective, it will be understood that other suitable means such as a hot air treatment of sufficient area may be used in conjunction with an ambient temperature cleaning operation and immediately preceding the coating operation to suitably heat the metal to a comparable temperature sufficiently high, to provide residual heat for the drying operation. In such cases and because the heat transfer is less effective the temperature of the heated air will necessarily be higher than that of the hot cleaner.

After leaving the feed rolls **38** of the wash unit **30**, the individual sheets **18** are fed by a roll **60** of a feed roll unit **62** to the lubricant coating unit designated by the numeral **64**. Thus the sheets **18** are passed through a pair of generally vertically aligned adjustable resilient rolls **66, 68**, preferably of "Neoprene" rubber for applying the wet lubricant coating composition preferably in hot condition to the cleaned sheets **18**. The coating composition is preferably applied to the rubber rolls **66, 68** under a suitable pressure head by feed pipes **70, 72**, respectively, to which the composition is delivered by suitable feed means **74** from a source of supply of the composition, usually a tank (not shown). The feed pipes **70, 72** flow the coating composition between the converging surfaces of each rubber roll **66, 68** and an associated adjustable steel doctor roll **76** preferably of about the same diameter (for example, 5 to 8 inches) as the rubber coating roll and which is adjustable relative to the rubber roll. The pressure of each doctor roll **76** against its associated rubber coating roll controls the thickness of the coating film applied to the coating rolls **66, 68** and the pressure of the pair of opposed coating rolls **66, 68** on the sheets **18** control the amount and thickness of the film of coating composition that is transferred to the opposite sides of the steel sheets **18**. Experience has indicated that a satisfactory coating layer will be transferred by a rubber covered roll having a rubber layer of about ¾" thickness and a durometer hardness in the range of 25 to 55. In order to heat the coating composition the source is preferably heated by suitable steam coils or other means. Mechanical agitation as by stirring may be employed to keep the composition mixed and at a substantially uniform temperature, but such is generally found unnecessary as the heating means appears to maintain adequate circulation. Steam at about 10 p.s.i. (gage) will usually be sufficient to provide a coating at the rolls of about 160°–180° F. temperature.

The coating composition supplied to the rolls **66, 68** may be any non-congealing aqueous solution of suitable soaps described in said Patent 2,966,425 of which stable aqueous mixtures of one or more of sodium, potassium, ammonium, and amine soaps of the low titer acids are examples, which composition will produce on the sheet metal a uniform overall dry film of drawing compound of adequate thickness for the character of drawing operation to which the coated material is to be subjected. The composition may include conventional thickeners, rust inhibitors, and other adjuncts which will improve the character of the film without deleterious effect upon the metal. Satisfactory applications are obtained with an aqueous composition containing at least about 5% by weight of soap and preferably having about 30% to 36% by weight of soap. This produces a viscous liquid composition of the consistency of a 20 to 30 SAE oil that is readily handled by the coating rollers **66, 68**. For preparing sheet stock between about .030 to .125" in thickness coating layers containing between about 100 to 300 mg. per square foot of compound (dry weight) on each side will generally be satisfactory. If the coating is too heavy, excessive die build-up and flaking of the coating may result.

An important requirement of the coating composition is that it be readily dryable to a condition where the layers of coated metal, whether in coil form or stacked, will not adhere to each other and when in cut sections will not readily slide when tilted to an angle of 20° or more. Either of these conditions if not fulfilled will complicate handling by the press operators of cut sheets of the material. Coating compositions of the foregoing specific character will provide these properties. In addition, their use will permit spot welding of the formed parts without substantial increase in the surface welding resistance. Moreover, the dried coatings may be readily washed off by hot water or mild hot alkali solution to facilitate treatment of the welded structures with phosphate coatings and paint to protect against corrosion.

As previously described, the soap coating will dry to a satisfactory condition by the residual heat of the metal layer. To facilitate this action the coating may as described be hot when applied and the coated sheets **18** as they leave the coating applicator **64** may be carried away on a foraminous belt **80** of sufficient length usually about 30 feet and less to facilitate additional drying where desired. Moreover, where desired forced air drying and/or cooling may supplement the above operations but is not such normally required. The belt **80** may conveniently be made of steel mesh or the like construction and in a manner minimizing contact of the belt with the coated sheets **18** so as to permit a maximum area of exposure of the coating to the ambient air and to minimize any marring of the coating. It will also be recognized that by the above combinations of operations including drying of the coatings through the inherent heat provided in the metal sheet, temperatures may be obtained at the output end of the apparatus so that the sheets will be cool enough for handling by the operators at the forming presses. Moreover, the featured drying process eliminates the need for ovens which caused variable heating of the coated sheet material, uncertain drying where heavy coatings of 300 mgs. per square foot were required and high oven temperatures which in many cases leave the coated sheets in a hot condition difficult to handle and reduces the effectiveness of the compound in the drawing operation if used in this hot condition.

The dried coated sheets **18** are delivered from the belt **80** to a hydraulically adjustable table **82** on which the dried sheets **18** are stacked in a conventional manner. The table is supported on a wheeled carrier **84** which is operative on a track **86** enabling movement of the stacked sheets directly to the presses for receiving the forming operations.

In those cases where a minimum wash solution temperature is to be employed at the cleaning unit **30** or, stated otherwise, the metal sheet is to be preheated to a temperature as low as possible and no heating of the coating is to be employed it is found expedient to assist the inherent heat in the metal in its drying of the coating while the sheets are moving down the belt **80** by using a forced current of ambient air applied to the opposite sides of the coated sheets **18**. For this purpose the conveyor **80** may be enclosed in a housing **88** having open ends **90** and having a central exhaust outlet **92** through which air may be pulled by suitable pump means (not shown). In this operation ambient air will be drawn across both faces of the coated material over the full length of the housing and will assist the removal of moisture from the coatings and accelerate their drying to a satisfactory condition.

The apparatus shown in FIGURES 3 and 4 is similar to that of FIGURES 1 and 2 so far as the cleaning, coating, and drying operations are concerned and the description given above will therefore apply in a like manner to this structure. The main difference between the two structures is that whereas the arrangement in FIGURES 1 and 2 is concerned with the handling of cut sheets, FIGURES 3 and 4 disclose apparatus for coating a continuous web of sheet metal and rewinding the same after coating and drying in which form the treated material may be stored for subsequent cutting into sections and forming. Thus FIGURES 3 and 4 disclose an unwinding reel **100** on which is supported a roll **102** of sheet metal to be treated and which is fed by means of pull roller mechanism **104** of a conveyor mechanism **26** through a second set of feed rollers **106** to the cleaning apparatus **30**. It will be understood that the feed table mechanism **26** in this construction may, if desired, be entirely omitted or may be used as an inspection area for observation of the sheet material before it passes to the cleaning apparatus. After the sheet is coated and has become dried, it leaves the belt **80** and after passing through a guide roller **110**, is fed to a rewind mechanism **112** which winds the coated material into a roll **114**. It will be understood that if desired the coated web **103** may be fed directly to a shearing mechanism for cutting the web into individual sections **18** and delivering them directly to the press operators.

The following examples illustrate applications of the principles of this invention in the treatment of cut sheets to provide them with satisfactory dry films of drawing compound and utilizing the apparatus of FIGURES 1 and 2. It will be understood that the same processing may be applied to a continuous sheet using the apparatus of FIGURES 3 and 4, and that in all cases the resulting product is one wherein adjacent layers of metal having the films of drawing compound thereon will not stick together in the stack or roll as the case may be.

Example A

Carbon steel sheets .060" thick were fed from the stack **16** to the deburring rolls **22** where the sheets were deburred and fed to the washer unit **30**. There the sprays **48** and **50** delivered a spray of alkali cleaning solution heated by steam to a temperature of approximately 115° F. against the opposite faces of the metal sheet and concurrently the brushes **42** scrubbed these faces to remove mill oil therefrom. In this treatment the liquid cleaner transferred heat to the sheets **18** and in this heated condition they were then moved to the coater apparatus **64** where a relatively viscous aqueous soap solution in amount between 150 to 200 mg. per square foot, dry weight, was applied as a uniform coating by the rubber rollers **66, 68**. In this operation the rollers **66, 68** were set 0.55" apart (.005" less than the thickness of the metal stock **18**, such that the coating was pressed against the metal sheet on both faces. The coatings were then dried by the residual heat imparted to the metal sheet by the cleaner solution prior to application of the coatings, such drying occurring while the sheets **18** were moved by the belt **80** through air at ambient temperatures toward the discharge end thereof. The coated sheets **18** with their dried coatings were then stacked. Their temperature was approximately 92° F., a temperature at which they could easily be handled by workmen if fed directly to the forming presses or from a stack thereof. During movement of the coated sheets on the belt **80** they were treated by a moving current of ambient air in the unit **88** to facilitate insofar as necessary, depending upon the character and thickness of coating, the drying operation and cooling down of the coated sheets to the stated temperature. The apparatus was set to move the sheets **18** at approximately 150' per minute. The coated sheets were sufficiently dry at the stack to prevent sticking between adjacent sheets in the stack.

Example B

Carbon steel sheets .060" thick were treated in accordance with the procedure of Example A using an alkali cleaning solution at a temperature of 157° F. As in Example A, the metal sheets **18** were moved along the apparatus at a speed of approximately 150' per minute. The temperature of the metal of the sheets **18** following blow-off by the device **51** with ambient air was 148° F. and where no blow-off used was above 150° F. After receiving films of the soap compound as applied by the rollers **66, 68**, the temperature of the sheet was approximately 143°–150° F. and approximately 133° F. upon delivery of the coated sheets to the stack. The sheets **18** with their films of drawing compounds were dry to the touch and did not stick together in the stack.

Example C

Carbon steel sheets **18** were treated in accordance with Example B, but with the moving air current in the unit **88** conditioned to be at a temperature below ambient temperature to reduce the discharge temperature of the coated sheets to approximately 100° F. Suitable means were provided at the openings **90** to connect the same to a source of cold conditioned air.

Example D

Carbon steel sheets .090" thick 65° F. were treated as in Example A, employing a cleaning solution heated to 170° F. and with the apparatus set to move the sheets at approximately 125 ft. per minute. The temperature of the metal immediately ahead of the coating applicator **64** was between 150° F. to 155° F. and between 140° F. to 142° F. upon delivery to the stack. The coated sheets were adequately dry when received at the stack so as not to stick together in the stock.

Example E

Carbon steel .090" thick were treated at 150' per minute speed with a hot spray of cleaning solution as in Example A, the solution being heated by steam at about 150 p.s.i. (gage) and temperature of about 367° F. The temperature of the solution applied against the opposite sides of the metal sheet was approximately 201° F. and the temperature of the sheet as delivered to the coating rolls was about 155° F. A coating of a glycol and tallow fatty acid modified aqueous potassium tall oil soap was applied to the metal sheet at a temperature of about 173° F. A coating of between 150 to 300 mg. per sq. ft. was applied depending upon the die requirements. The coating was dry about 7 feet from the coating rolls and the sheets as stacked after moving a distance of about 30 feet were about 142 to 148° F. No circulating air was used in this operation. On leaving the coating rolls there appeared to be a slight rise of temperature of the metal sheet above its input temperature which again dropped before reaching the point of complete drying.

By slowing down or increasing the speed of the conveyor line, the above temperature could be somewhat

varied, for example, using the same hot cleaner, but a line speed of 95 feet per minute and a coating temperature of between 116° F. and 175° F. at the rolls and no circulating air, the dried sheet temperature at the stack or wound rolls was between 120 to 140° F. and between 2 to 10% lower when circulating air was applied for cooling and/or drying. Moreover, if the speed of the conveyor was increased to about 165 feet per minute applying the same hot cleaner and a coating temperature at the rolls of between 170° F. to 180° F., the dried metal sheets had a terminal temperature at the stack of between 150 to 160° F. and were somewhat lower with air cooling. These results were also somewhat changed by variations in metal and coating thickness.

From the foregoing description of our invention, it will be apparent that we have provided a novel processing for the application of films of drawing compound to metal sheets or webs and to condition the films such that they are sufficiently dry to prevent sticking between adjacent layers thereof in a stack or roll and wherein aging effects upon the metal when the coated sheets are stacked or in a roll and some time must elapse between the stacking or rolling operation and further use of the material at the drawing presses is avoided.

It will be understood that various changes and modifications may be made in the described operations and apparatus without departing from the spirit and intent of our invention and all such changes and modifications as may come within the scope of the appended claim and equivalent thereof are, therefore, contemplated. For example, instead of pressing the coating or film of drawing compound against the sheet **18** by the rubber transfer rollers **66**, **68** these rollers may be spaced from the sheet and the coating be impelled against the metal sheets **18** by a rotary brush (not shown); also the film may be produced by spraying the coating material against the sheet under hydrostatic pressure. This is especially true where a continuous web is being coated.

We claim:

A process of preparing sheet metal of between .030" to .125" thickness for subsequent drawing and forming operations comprising moving said sheet rapidly past successive treating stations at a speed of about 95 to 165 feet per minute, applying a hot cleaning solution to said sheet at a first station to clean said sheet, said solution having a temperature above about 150° F. but under the boiling point thereof to impart substantial heat to said sheet such that it attains a temperature in the order of 150° to 200° F., immediately following cleaning pressing a film of hot non-congealing aqueous soap solution containing between about 5 to 36% by weight of soap and in amount between about 100 to 300 milligrams per square foot, into intimate contact with a surface of said heated sheet at a second station while said sheet is at a temperature above about 150° F. but not high enough to cause bubbling of the soap film, said soap solution being liquid at ambient temperature and having a temperature between 115 to 180° F. and below the boiling point thereof, and evaporating water from said film by the residual heat stored in said sheet whereby to reduce the moisture content thereof to an amount less than 15% wherein said film is sufficiently dry to inhibit sticking between layers of said soap filmed sheet metal when brought into pressure contact with each other, said film being sufficiently dry when it has moved within a distance in the order of about seven feet from said film applying station but not more than 30 feet.

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