May 6, 1941. N. R. HOOD ET AL 2,240,989

DEGREASING OF METAL ARTICLES

Filed Jan. 9, 1939 3 Sheets-Sheet 1

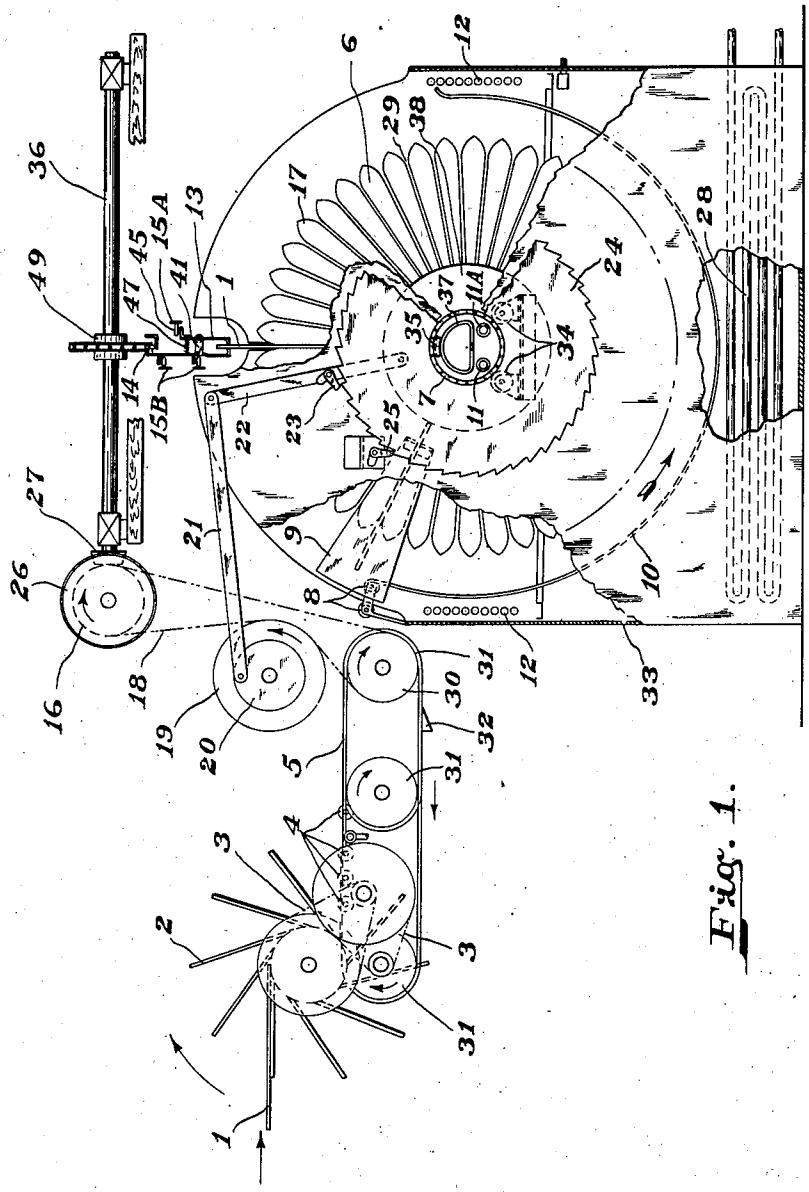

Fig. 1.

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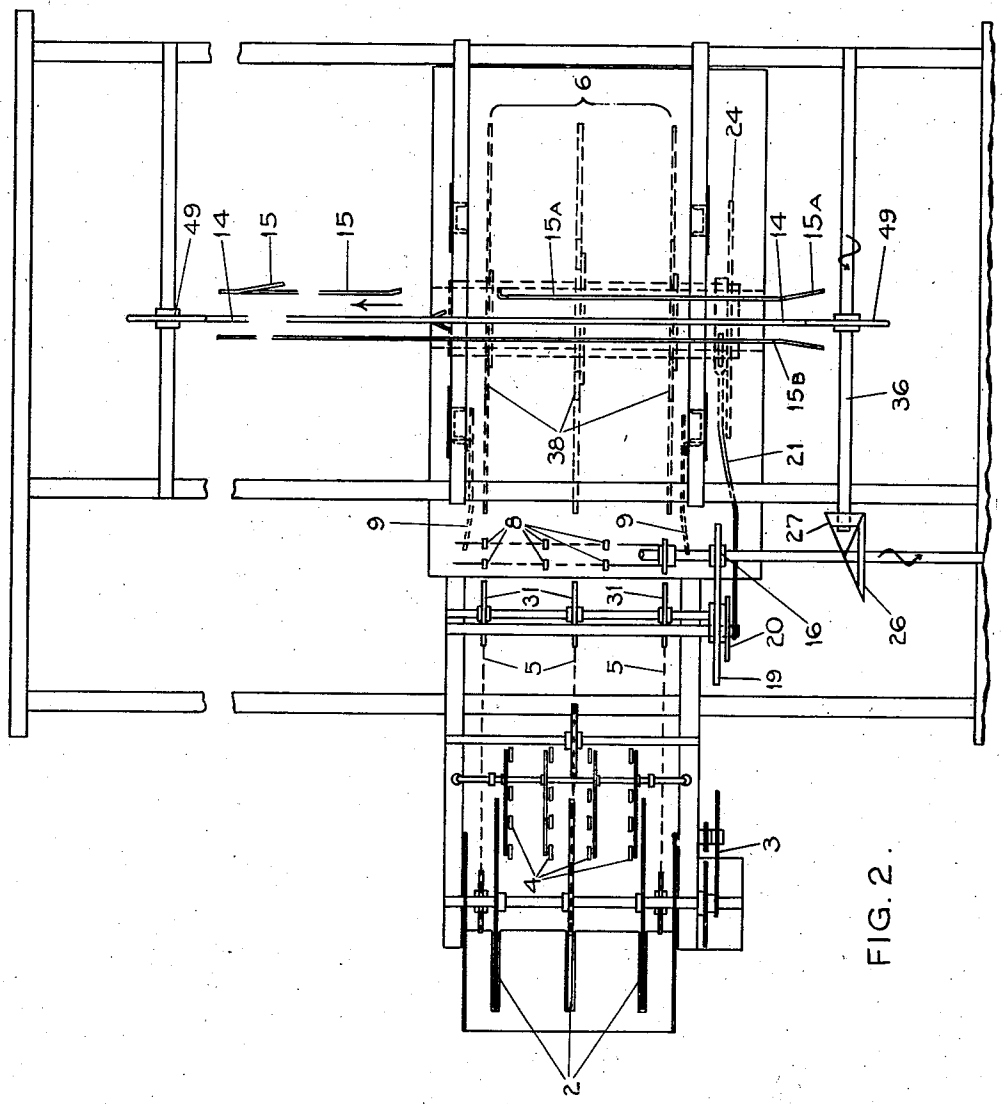

FIG. 2.

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DEGREASING OF METAL ARTICLES

Filed Jan. 9, 1939 3 Sheets-Sheet 3

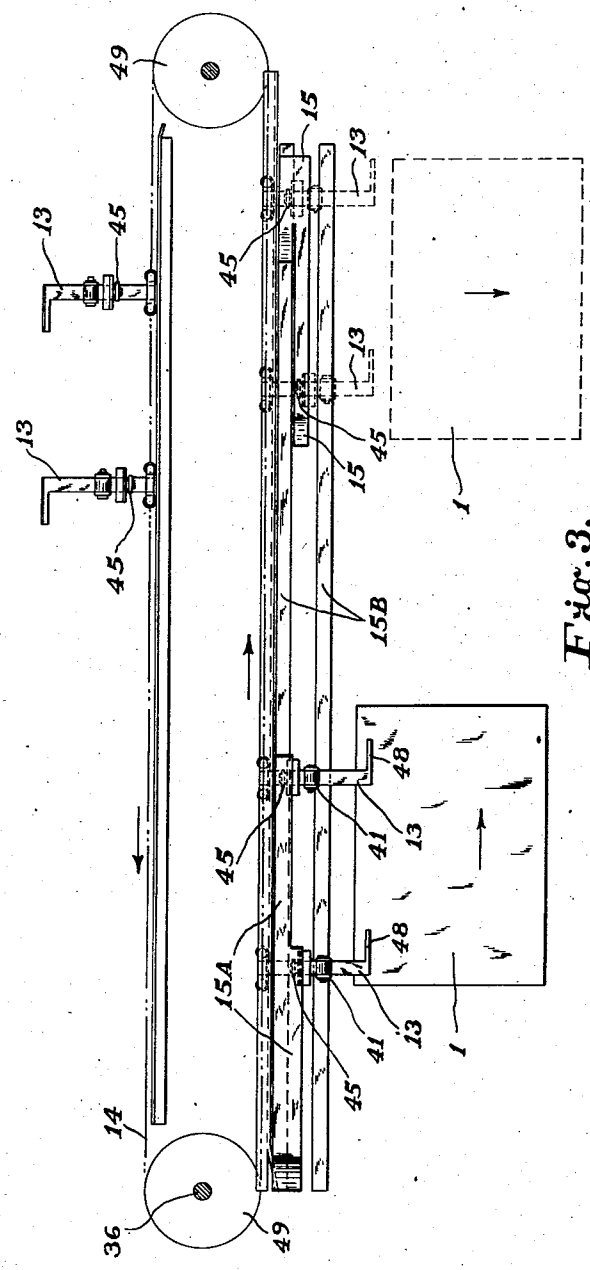

Fig. 3.

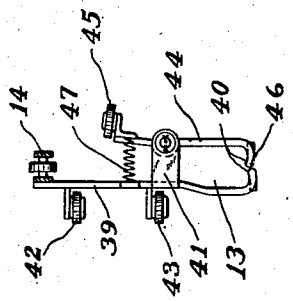

Fig. 4.

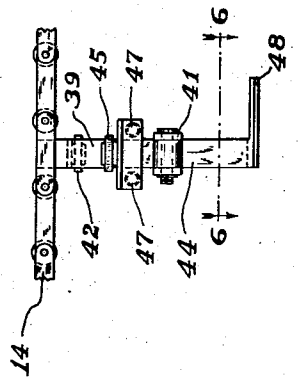

Fig. 5.

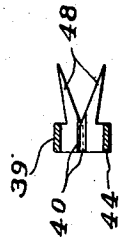

Fig. 6.

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UNITED STATES PATENT OFFICE

2,240,989

DEGREASING OF METAL ARTICLES

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Application January 9, 1939, Serial No. 250,032
In Great Britain January 11, 1938

8 Claims. (Cl. 202—170)

This invention relates to improvements in degreasing metal articles and more particularly to degreasing metal sheets by treating them with a volatile grease solvent.

It is well known to remove grease from metal and like non-absorbent articles by exposing them to the vapour of a volatile grease solvent which condenses on the articles, and thereby dissolves the grease and drains off leaving them finally clean and dry. An apparatus has been described for degreasing articles in this manner by carrying them through a bath of solvent vapour, comprising a wheel having a number of compartments round the periphery into which goods to be treated can be packed, the wheel being adapted to revolve partly immersed in a tank containing solvent vapour, while within the wheel condensing coils are arranged so as to shower condensate on the goods as they pass beneath, thereby washing off adherent insoluble matter.

Such an apparatus is not suitable for the treatment of metal sheets, e. g. tinplate or terneplate, since if sheets are packed in such a carrier some sheets will prevent condensate reaching the remaining sheets in the same compartment, and even a thorough vapour treatment may be impossible. Moreover, with a plurality of sheets packed in one compartment in this way it is difficult to secure complete drying before the sheets leave the treating zone because solvent is held between them by capillary attraction, and on this account solvent losses are high.

This invention has as an object to devise a new apparatus for degreasing metal sheets. A further object is to devise such an apparatus which will both degrease and subsequently dry metal sheets both rapidly and efficiently. A further object is to devise such an apparatus which will operate without scratching the metal. A further object is to devise such an apparatus which will be compact. Further objects will appear hereinafter. These objects are accomplished by the following invention.

We have now found that these disadvantages are overcome, and that in consequence metal sheets are degreased efficiently in an apparatus which is very compact in comparison with its capacity, by providing in a compartment adapted to contain a volatile solvent, a carrier rotating on its axis and adapted to hold a plurality of metal sheets spaced apart from each other and radially disposed with respect to the said axis.

Such a carrier may be employed for immersing metal plates in liquid solvent, solvent vapour or both. When vapour treatment is employed we may also provide means for projecting a stream or streams of liquid solvent nearly radially with respect to the said axis so as to impinge almost tangentially upon the metal sheets while they are immersed in the vapour.

In one form of our invention the carrier has its axis in a horizontal plane approximately at the level of the top of the solvent treating zone, and an intermittent progressive movement of the carrier about its axis is imparted by a driving mechanism which also in the intervals while the carrier is at rest, both feeds to the carrier a metal sheet to be degreased and withdraws from it a sheet which has been subjected to the degreasing treatment, such introduction and removal of the metal sheets being effected above the solvent or solvent vapour level.

One form of our invention in which metal sheets are treated with solvent vapour and with streams of liquid solvent will now be more particularly described with reference to the accompanying figures representing a suitable apparatus for carrying out our invention of which—

Figure 1 represents an elevation partly in section.

Figure 2 represents a plan.

Figure 3 represents an elevation (partly diagrammatic) of the mechanism for removing tin plates from the apparatus.

Figure 4 represents an enlarged end-on view of one clip 13 of Figure 3.

Figure 5 represents a side view of clip 13, and

Figure 6 represents a section on the line 6—6 of Figure 5.

In these figures, wherein like numerals indicate like parts, the degreasing compartment is provided in the lower part with a steam coil 28 for vaporizing solvent placed therein, while in the upper part are condensing coils 12 which limit upwardly the solvent vapour level. In this compartment is the carrier represented generally at 6, having a hollow perforated axle 7 approximately at the level of the coils 12 and carrying three discs 38 rigidly attached thereto one near each end and one in the middle of the axis. The ends of axle 7 beyond discs 38 rest on ball bearings 34. Three sets of guides 17 which are preferably of low heat capacity and which may be formed for example of heavy gauge wire or metal strip, are fixed one set to each disc and are spaced a short distance apart (if they are resilient they may be practically touching one another) to provide a number of radial slots 29 into which the metal sheets can be inserted. Each sheet is thus held between six guides, three on each side, and while

above the horizontal, rests on the edges of discs 38. To prevent the sheets sliding out while they are below the level of axle 7 fixed guides 10 concentric with the carrier are provided. Within the perforated axle 7 are two pipes 11 and 11A, connected to a source of liquid solvent (not shown) and having a row of perforations along their length so disposed that jets of solvent can be projected radially to strike almost tangentially the sheets held in the rotating guides when they are disposed some 30–40° on either side of the vertical, one pipe projecting solvent on one surface of the plates and the other on the second surface. Conveniently solvent which thus enters the vapour compartment is allowed to collect in the lower part and can be drawn off through an overflow (not shown) leaving a depth of liquid sufficient to cover coils 28. The liquid drawn off is diverted to a still distilling solvent at a high rate, and the distillate is returned to the jet pipes by a pump which forces a stream of solvent out through the jets. A duct 35 is also provided inside the axle 7 through which air can be sucked under a small pressure from the space between the plates when they are almost vertically above the solvent bath. A condensing coil 37 running along the inside of the axle to which cooling water can be supplied also facilitates the recovery of vapour from the spaces between the sheets in the guides above the axle.

The mechanism for supplying metal sheets and driving the carrier comprises a chain wheel 16 connected to a source of power (not shown) which, through endless chain 18 drives chain wheel 19 and chain wheel 30, the former of which, through eccentric 20, link 21, arm 22, pawl 23 and ratchet wheel 24 coaxial with carrier 6 and rigidly attached thereto, imparts an intermittent progressive rotary motion to the carrier in the direction of the arrow, while the latter (chain wheel 30) drives endless bands 5 around chain wheels 31 in the direction indicated. Through chain wheels and chains indicated generally at 3, end chain wheel 31 also rotates spider 2, while by means of ball bearings 4 sheets delivered by the spider 2 are held above moving bands 5 until a projection 32 thereon comes up against the edge of the sheet and carries it forward. In this way scratching of the metal sheet through relative motion of sheet and bands is prevented. Ball bearings 8 and guides 9 are also provided to direct sheets leaving the band into the space between two guides in the rotating member. One sheet is thus shown in position.

The mechanism for removing the sheet comprises an endless chain 14 passing over pulleys 49 one of which is free, and the other of which is driven through gears 26, 27 and shaft 36 from the same source of power as wheel 16. The chain is oriented vertically above axle 7 of the carrier 6, extends well beyond the side of the degreasing compartment, and carries several pairs of spring clips 13 (in Figure 3 three pairs are shown), the clips of each pair being spaced apart along the chain by a distance less than the width of the metal plates to be treated. The clips are of such a length that as they are carried by the portion of the chain beneath the pulleys they are able to grip that part of the plate in the guide vertically above axle 7 which projects out of the carrier. The clips are of course narrow enough to avoid fouling the plate in the adjacent guide.

One pair of clips and the manner in which they operate will now be described in more detail with special reference to Figures 4, 5 and 6. To avoid complicating the drawing they have been omitted from Figure 2. Each clip 13 comprises an arm 39 fixed to a link of chain 14, and carries on one side two ball races 42 and 43 at different levels, while on the other side is a fixed member 41 to which is pivoted a second arm 44 carrying above the pivot an outwardly projecting ball race 45. The lower ends of arms 39 and 44 are bent to form jaws 46 normally held closed by the action of coil springs 47. Jaws 46 have fork-like projections 48 pointing in the direction of progression of the clips, which act as guides to direct the sheets to be moved into the jaws. The coacting faces 40 of the jaws are rounded and one is at a slightly higher level than the other as it is found that a better grip on the sheets can thereby be obtained.

Each of the pair of clips is similar except that in the leading clip of each pair ball race 45 is at a higher level than the ball race 45 of the following clip, for the purpose which will be subsequently explained.

To operate the clips there are provided guides 15, 15A, and 15B. Guides 15B extend substantially the whole distance between the chain wheels 49 carrying chain 14 at such a height and in such a position that while clips 13 are moving along beneath chain 14, ball races 42 and 43 bear one against each of them. Guides 15A are parallel to guides 15B and comprise two members one above the other, the upper extending from beyond the carrier 6 on the side opposite to that at which the sheets are removed from carrier 6 to vertically above the forward portion of a sheet in the carrier and at the level of the ball race of leading clip 13, while the lower guide 15A extends from the same side of carrier 6 to vertically above the rear portion of the sheet and is at the level of the ball race 45 of the following clips 13. Herein "forward" means towards the side of the degreaser from which the sheets are removed. The distance between guides 15A and 15B is such that chain 14 carries the clips between them, and that while ball races 42, 43 of each clip bear against guide 15B springs 47 of the leading clip 13 are compressed by the ball race 45 bearing against the upper guide 15A thus opening jaws 46, and springs 47 of the following clip 13 are compressed by the ball race 45 bearing against the lower guide 15A thus opening jaws 46 of that clip. The difference in length of upper and lower guides 15A corresponds to the distance apart of the following and leading clips 13, so that when ball race 45 of the former comes to the end of the lower guide, ball race 45 of the latter reaches the end of the upper guide. Further movement of chain 14 then carries the ball races past the guides thereby simultaneously releasing each of springs 47 thus closing jaws 46 causing each clip to grip the sheet in the carrier at the same time, and carry it out of the carrier to beyond the degreasing apparatus. Figure 3 shows one sheet 47 about to be gripped by clips 13.

To release the sheet from the clips a similar pair of guides 15 are provided beyond the degreasing compartment which coact with ball races 45 in a corresponding fashion to open simultaneously the jaws 46 of each spring clip, thereby releasing the sheet. Further movement of chain 14 will carry the clips beyond guides 15 whereupon the jaws 46 will close and they will travel back along the upper side of the chain and down between guides 15B and 15A again thereby causing the jaws to open. They will then pick up another sheet and so on. To direct

the clips between the guides and to enable pressure on ball races 45 to be applied gradually thereby facilitating smooth working the ends of the guides at which the clips enter may be bent outwards as shown in Figure 2.

In the above apparatus the various movements, introduction and removal of the sheets to be treated, rotation of the carrier and so forth are all brought about by one prime mover, and the timing of each movement so that the whole operation proceeds smoothly is brought about by appropriate choice of the length of band 5 elements 21, 22 and the diameter of elements 19, 20, 26, 27, etc. It can thus be arranged, that while arm 22 is moving towards the vertical (the carrier being prevented from moving with it by pawl 25 being thus at rest) clips 13 are in position to pick up a sheet between the two guides vertically above the axle and carry it beyond the side of the apparatus, and simultaneously the bands 5 deliver a sheet over bearings 8 into a slot in the rotating carrier. When these two operations are completed, arm 22 starts to move in the opposite direction, and, arm 22 coacting with pawl 23, the carrier is rotated to bring the next guide carrying a degreased sheet into the vertical position, while the next empty guide is brought into position to receive a sheet. At the same time a sheet (indicated at 1) is fed into spider 2 by hand ready to be placed on bearings 4 and conveyed along band 5 to be delivered into the carrier when it is next at rest, while clips 13 are made by guides 15 to release the degreased sheet and are then carried by band 14 into a position where they can pick up another sheet from the carrier 6.

In addition the degreasing apparatus is provided with the usual distillate trough, store tank and like accessories, and a cover may also be provided leaving only those openings which are necessary for introducing and removing the plates, and to allow for the movement of arm 22.

In using the apparatus sheets fed into the spider by hand travel along the band to be inserted into the carrier in the manner above indicated, and then pass into the degreasing zone. The further operation of the plant can be understood by following the treatment of one plate as it passes through, its position being indicated by the angle through which it has travelled after being inserted into the carrier. At 40°, the cold sheet enters the vapour zone, and solvent condenses thereon, to drain off and be replaced by fresh condensate which in turn drains off. This treatment, of course, continues as the plate moves through the vapour zone until it attains the temperature of the vapour; thereafter vapour will not be condensed, and any adherent solvent liquid will evaporate. At 70–80° one surface of the sheet is washed by jets of solvent which strike the surface at a very small angle and wash off adherent solids already loosened by the vapour treatment; as the plate moves further it passes through the vertical position and is drained, and at 170–180° the other surface receives a similar treatment from the other jets. By this time the plate is hot and as a result both of draining and evaporation it reaches the 200° position clean and dry. Here it leaves the vapour zone, and as it ascends to the 270° position any heavy vapours between it and adjacent plates sink downwards again towards the axis; between the 270° position and the 310° position the last traces of vapour are removed by a slight suction created in the duct 35. At the 310° position the plate is removed by clips 13, carried beyond the side of the apparatus and released from the clips by the action of guides 15, to be delivered to a chute or other receptacle.

Since the liquid solvent is jetted onto the plates at but a small angle and each plate is separated from its neighbour, no difficulties are experienced in securing adequate flushing, draining and vapour treatment, and yet a large number of plates can be treated simultaneously. Moreover, even with such a small rate of movement of the carrier 6—e. g. 1 revolution in two minutes—that no disturbance of the vapour level is caused it is possible to treat as many as 1000–1500 sheets per hour.

Many variations of the invention are possible; for example, more than two jetting pipes may be provided and it may be arranged that while for the last jetting treatment pure solvent is used, earlier jetting is carried out with less pure solvent. Thus the lower part of the vapour zone may be divided into two by a vertical partition in the plane of the axis of the carrier and pure solvent supplied to pipe 11A; this will collect in the right hand division of the vapour zone and may be pumped thence directly to pipe 11, to collect in the left hand division whence it may be delivered to a still for purification and redelivery to pipe 11A.

In another variation of our invention the plates may be given two separate vapour treatments before removing them from the apparatus by providing the rotating carrier with an odd number of slots and arranging that each movement of the carrier rotates it through twice the angle between successive slots. If the angle between the plane in which a plate leaves the apparatus and the plane in which it enters it corresponds to an even multiple of the angle between successive slots, a plate on first emerging from the vapour will be carried past both the position where clips 13 can coact with them and where a new plate would be delivered into the same slot, so that it is immersed for a second time in the vapour. On emerging for the second time, however, it will be brought into position where clips 13 can remove it from the apparatus, and the empty slot will be brought into position to receive another plate. The cooling which the plate will receive while it is rotating above the vapour after its first immersion ensures that condensate will form on it during its second immersion.

Further if it is not so important to avoid scratching of the plates it would be possible to dispense with the spider 2 and put in its place a hopper adapted to take a number of plates in a horizontal position the lowest of which will rest on the ball bearings 4. A stop would be arranged on the delivery side of the hopper so that only the lowest plate would move when the projection 32 came round and forced this lowest plate on to the travelling band 5.

The apparatus can also be adapted for use with a liquid solvent in which case the depth of the liquid would be such as to reach to the axis, the air draught through the duct 35 would have to be increased so as to dry the plates which in this case would be cold. If necessary a duct carrying heated air could be brought into the chamber near the top so that it will play on the plates. Ducts 11 and 11A might be omitted but

the movement of liquid over the plates induced by the jets from 11 and 11A would probably be found useful. The heating and cooling coils 28 and 12 could also be omitted.

This invention is a valuable advance in the art as it gives a compact device efficient in operation which will deal with a large output and work in a continuous and simple manner to deliver the plates both degreased and completely dry.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

We claim:

1. An apparatus for the degreasing of metal sheets comprising a compartment adapted to contain a volatile solvent for the grease, a heating element situated near the bottom of the compartment and adapted to maintain at least a portion of the solvent in the vapour phase, a cooling element situated above the heating element adapted to condense the solvent and thereby prevent the solvent vapour from rising above the level of the cooling element, a carrier adapted to rotate within the compartment and adapted to hold a plurality of metal sheets spaced apart from each other and held radially in the carrier which is so disposed within the compartment that as the carrier rotates the metal sheets are firstly completely immersed in the solvent vapour and then lifted completely above the solvent vapour, and spray means positioned at the axis of rotation of the carrier to create at least one distinct zone of relatively narrow arc in which a stream of solvent in the liquid phase can be passed over the sheets while said sheets are immersed in the solvent vapor.

2. An apparatus for the degreasing of metal sheets comprising a compartment adapted to contain a solvent for the grease, a carrier adapted to rotate within the compartment, and adapted to hold a plurality of metal sheets spaced apart from each other and held radially in the carrier which is so disposed within the compartment that as the carrier rotates the metal sheets are firstly completely immersed in the solvent and then lifted completely clear of the solvent, and means whereby at least one stream of solvent can be passed over the sheets from the axis of the carrier in a radial direction while the sheets are immersed in the solvent.

3. An apparatus for the degreasing of metal sheets comprising a compartment adapted to contain a solvent for the grease, a carrier adapted to rotate within the compartment, and adapted to hold a plurality of metal sheets spaced apart from each other and held radially in the carrier which is so disposed within the compartment that as the carrier rotates the metal sheets are firstly completely immersed in the solvent and then lifted completely clear of the solvent, means whereby at least one stream of solvent can be passed over the sheets from the axis of the carrier in a radial direction while the sheets are immersed in the solvent, and means for passing a stream of air over the sheets and towards the axis of the carrier after they have emerged from the solvent.

4. An apparatus as claimed in claim 1 in which means are provided for passing a stream of air over the sheets and towards the axis of the carrier after they have emerged from the solvent vapour.

5. An apparatus as claimed in claim 2 in which means are provided to rotate the carrier with an intermittent motion, means being provided to place each metal sheet in position in the carrier at a time when the carrier is stationary; further means being provided for removing each sheet, after degreasing, from the carrier while the carrier is stationary.

6. An apparatus for the degreasing of metal sheets comprising a compartment adapted to contain a solvent for the grease, a carrier adapted to rotate within the compartment, and adapted to hold a plurality of metal sheets spaced apart from each other and held radially in the carrier which is so disposed within the compartment that as the carrier rotates the metal sheets are firstly completely immersed in the solvent and then lifted completely clear of the solvent, and means to rotate the carrier with an intermittent motion, means being provided to place each metal sheet in position in the carrier at a time when the carrier is stationary; said means comprising a moving belt and guides adapted to lead the plate into its correct position in the carrier above the level of the solvent; further means being provided for removing each sheet, after degreasing, from the carrier while the carrier is stationary, said means comprising clips carried on a travelling belt which clips are adapted to close on the sheet when the sheet is above the level of the solvent and carry it out of the compartment.

7. An apparatus as claimed in claim 1 in which means are provided to rotate the carrier with an intermittent motion, means being provided to place each metal sheet in position in the carrier at a time when the carrier is stationary; said means comprising a moving belt and guides adapted to lead the sheet into its correct position in the carrier above the level of the solvent; further means being provided for removing each sheet, after degreasing, from the carrier while the carrier is stationary, said means comprising clips carried on a travelling belt which clips are adapted to close on the sheet when the sheet is above the level of the solvent and carry it out of the compartment.

8. An apparatus for the degreasing of metal sheets comprising a compartment adapted to contain a volatile solvent for the grease, a heating element situated near the bottom of the compartment and adapted to maintain at least a portion of the solvent in the vapour phase, a cooling element situated above the heating element adapted to condense the solvent and thereby preventing the solvent vapour from rising above the level of the cooling element, a carrier adapted to rotate within the compartment round an axis approximately level with the surface of the solvent vapour and adapted to hold a plurality of metal sheets spaced apart from each other and held radially in the carrier in such a manner that as the carrier rotates the metal sheets are first completely immersed in the solvent vapour and then lifted completely above the solvent vapour, at least one duct situated within the axle of the carrier adapted to spray liquid solvent through perforations in the axle onto at least one metal sheet when situated within the vapour zone, at least one further duct adapted to draw a current of air over at least one metal sheet after it has emerged from the zone of solvent vapour, means whereby the rotating carrier is given an intermittent motion

and means driven from the same source of power as rotates the carrier comprising a spider adapted to deliver the metal sheets one by one on to a moving band which is adapted to coact with guides and bearings to deliver the said metal sheets to the carrier when the carrier is stationary; further means also driven from the same source of power comprising a travelling band, spring clips adapted to coact and be operated by guides in such a manner as to grip a cleaned metal sheet in the carrier and carry it outside the compartment at such a time as the carrier is stationary.

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CERTIFICATE OF CORRECTION.

Patent No. 2,240,989. May 6, 1941.

NORMAN ROY HOOD, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, second column, line 3, claim 5, for the claim reference numeral "2" read --1--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office,

Signed and sealed this 17th day of June, A. D. 1941.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)