2 Sheets—Sheet 1.

E. MOREWOOD.

Apparatus for Coating Sheet-Metal.

No. 220,769. Patented Oct. 21, 1879.

FIG. 2.

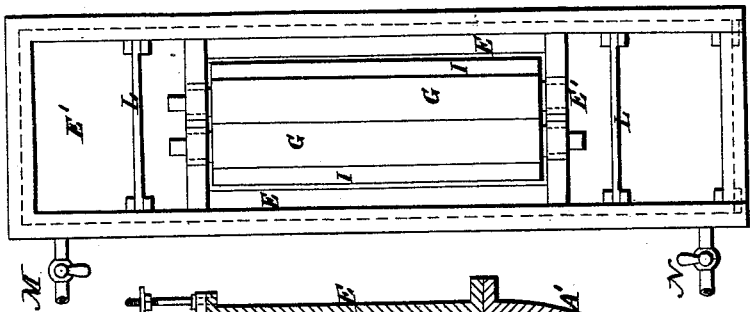

FIG. 1.

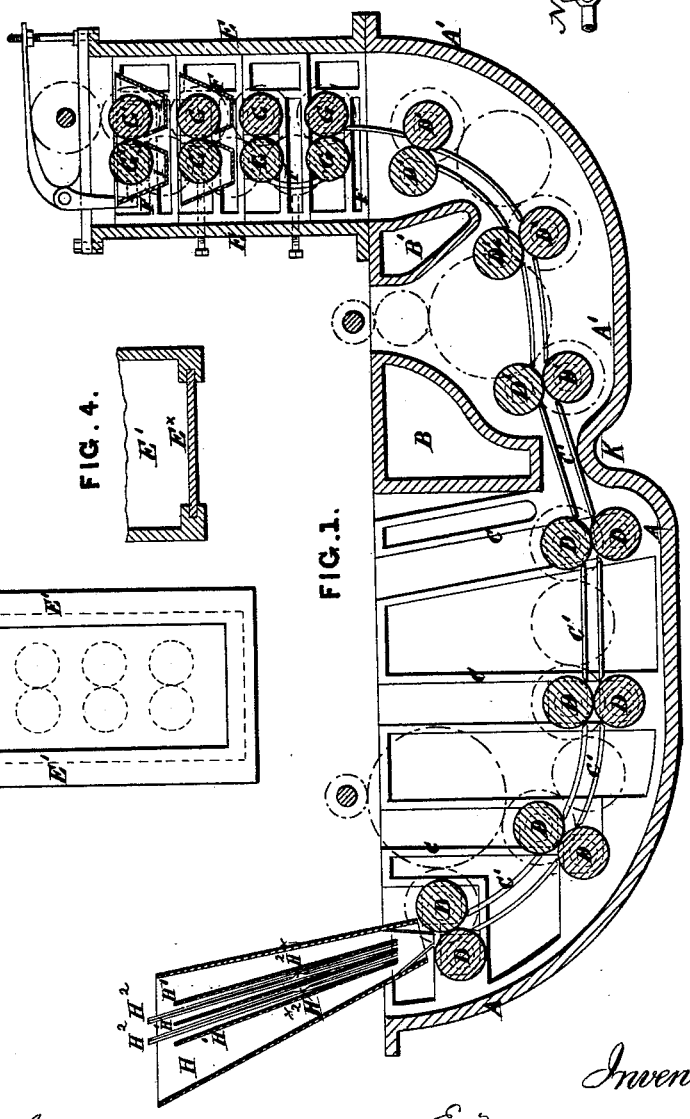

FIG. 4.

FIG. 3.

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2 Sheets—Sheet 2.

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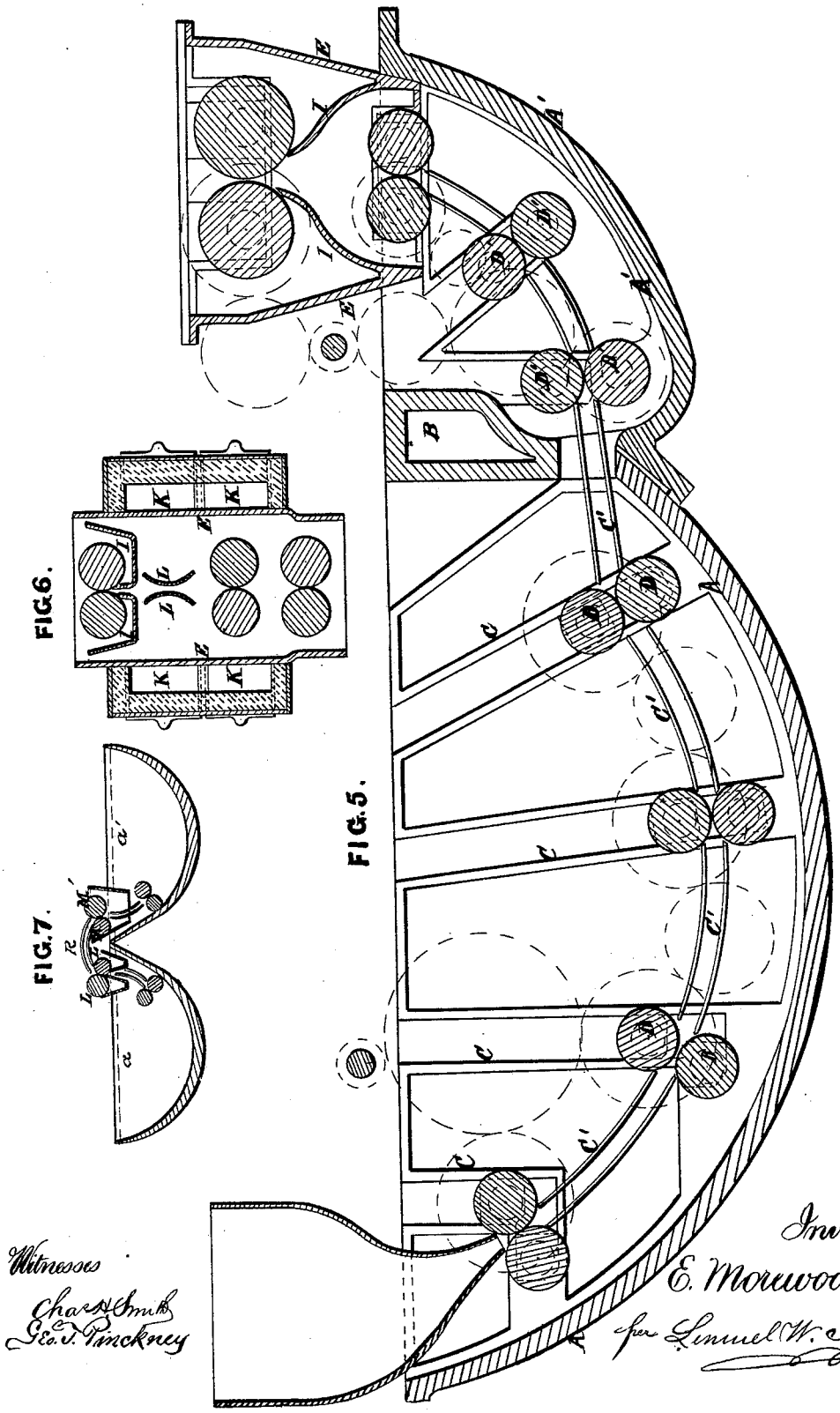

FIG. 6.

FIG. 7.

FIG. 5.

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UNITED STATES PATENT OFFICE.

EDMUND MOREWOOD, OF LLANELLY, COUNTY OF CARMARTHEN, SOUTH WALES.

IMPROVEMENT IN APPARATUS FOR COATING SHEET METAL.

Specification forming part of Letters Patent No. **220,769**, dated October 21, 1879; application filed September 26, 1878; patented in England, January 28, 1878.

To all whom it may concern:

Be it known that I, EDMUND MOREWOOD, of Llanelly, in the county of Carmarthen, South Wales, tin-plate manufacturer, have invented new and useful Improvements in Coating Metals, and in apparatus employed therein, which improvements are fully set forth in the following specification, reference being had to the accompanying drawings.

The main object of this invention is to produce tin or terne plate at one operation, or by a continuous passage from the entrance side of the apparatus to the exit without any intervening hand manipulation.

The apparatus which I employ is similar to some extent to that shown and described in the specification of a British Patent granted to me, No. 1958, in the year 1863, but with improvements, by which the process is brought under control, and which will enable me to produce perfect plates when working with fluxes, such as grease, which require a high temperature for the tinning operation.

The plates are caused to descend into the tinning-pot through flux, which may be grease or compounds thereof. They are conveyed through the molten metal and are delivered on the exit side between finishing-rollers, which revolve in grease, supported on the surface of the melted metal.

The pot or vessel containing the metal is divided into parts, (but with a passage for the plates to pass,) so that the coating metal may be maintained in one part at the high temperature requisite for coating, and in another part at the much lower temperature, to which it is desirable that the plate should be reduced before it arrives at the finishing-rollers.

I provide for the regulation of the temperature in the cooler part of the pot by forming flues, through which cold air may be passed at pleasure; or by other analogous means I control the temperature of the cooler part of the metal-pot.

On the exit part of the pot I have the finishing-rollers revolving in grease contained in a bath or vessel open at the bottom, and dipping into or standing over the melted metal in this the cooler part of the metal-pot.

I provide for the regulation of the temperature in the bath or vessel containing the finishing-rollers. One mode is by making passages through or around it, through which cold air or other fluid may be passed, and the same passages are available for the passage of hot air or fluid for warming the apparatus at the commencement of working; or in other analogous way I regulate the temperature of the finishing bath or vessel. I also maintain a proper temperature and quality of grease in this bath or vessel by supplying cool grease to it. This may be done through a pipe descending nearly to the surface of the melted metal, while the hotter grease is drawn out into a receiver by a passage provided for the purpose. In some cases I form, in connection with the bath or vessel containing the finishing-rollers, an extension end or side chamber to contain cool grease. The end or side chamber should be so arranged that the grease which it contains does not stand over the melted metal, and a communication is made near the bottom, and, when convenient at other points also, between the main compartment of the bath or vessel and its side chamber.

In order to remove impurities which are liable to accumulate at or near the surface of the molten metal where the grease rests in contact with it, I provide an aperture at the part, which can be opened or closed at pleasure.

I employ in the finishing bath or vessel several pairs of finishing or coating rollers, and I supply melted coating-metal to some or all of these by providing troughs beneath the rollers, which are kept full of metal. This metal may be drawn from a small receiver immersed in the grease to keep the metal melted.

In some cases I cause the plate, as it rises in the finishing-bath, to pass between two surfaces of metal placed near together, so as to leave but a narrow channel between them for the plate to pass, and as the plate rises between these surfaces I cause it to meet a trickle or descent of molten metal descending from a receiver such as that mentioned above. The molten metal dripping from these plates partly feeds the rollers beneath in the grease at the

exit side. The plate must be caused to pass between finishing-rollers after it has been between these metal surfaces.

The employment in the manner described of clean melted coating metal in the finishing-operation, is of great importance when a high heat is maintained in the tinning-pot, as otherwise the plates are liable to be injured by scruff which the plates will bring forward with them.

When fluxes, such as chloride of zinc, are used on the entrance side, a lower temperature will suffice and less scurff is formed; but the use of fluxes of this description is objectionable, as it causes the plates to be liable to rust quickly.

It will be seen that in the process, as above described, which forms the main part of this invention, the plate is never exposed to the air from the time that it enters the apparatus until it issues a finished plate. I however, in some cases, allow the plate to pass through flux in going from the hotter to the cooler part of the tinning-pot.

To allow the plate to issue into the air or even into the flux-vapor, as is suggested in the specification of my former patent, already referred to, is objectionable; but if it be permitted, the conveying-rollers, which are not covered with the metal or flux, should be provided with troughs containing clean melted coating metal or clean liquid flux, so that their surfaces may be constantly bathed with it, which will tend to lessen the evil arising from the exposure.

In order that my invention may be most fully understood and readily carried into effect, I will proceed to describe the drawings hereunto annexed, which drawings, I may remark, are similar to the drawings which I annex to the specification of another patent application bearing even date with the patent application of which this is the specification, the said drawings being there employed to illustrate points of invention different from those which are claimed under the patent to which this specification applies.

Figure 1 is a longitudinal section of apparatus intended especially for the manufacture of tin-plate, but also very suitable for the manufacture of terne-plate at one operation.

A A′ is the pot in which the coating metal is contained. It is divided into two parts by the air-space or flue B, which, serving as a heat-barrier, obstructs the passage of heat from one part of the pot to the other, and admits of the metal in the part A being kept at a much higher temperature than the metal in the part A′, although there is a passage connecting the two parts of the pot of sufficient width to give ready passage to the plates to be coated.

The pot is set in brick-work, as is usual, and beneath the part A a fire-place is formed for heating the pot, and it is so arranged that the heat from this fire shall not reach the bottom and outer sides of the part A′, beneath which, however, another fire-place is formed, the use of this second fire being to warm the part A′ when commencing work after the apparatus has been allowed to get cold, or when, from any cause, this part has become cold.

At other times and when in regular work no fire is used in the fire-place under the part A′; but a current of cold air is allowed to pass through the fire-place to the chimney whenever the temperature of the part A′ of the pot tends to rise higher than the workman desires, and this current of air carries away heat from this part of the pot. Air-currents can also be allowed to pass to the chimney through the space or flue B, and through the similar space or flue B. These air-currents can be controlled by means of dampers. Other means may be taken to cool the end A of the pot when requisite; but I find the application of air-currents the most convenient.

C C are cast-iron frames introduced into the part A of the pot at a short distance from the sides. These frames carry the bearings of the metal-coated rollers D D, which are geared together by spur-wheels contained in the spaces between the frame C and the sides of the pot. The arrangement of this driving-gear is indicated by dotted lines.

The part A′ of the pot contains other rollers D′ D′. Their bearings are held in frames similar to the frames C, but not shown in the drawings. These rollers are driven at the same surface-speed as the rollers D by gearing indicated in dotted lines.

E is the bath, in which is contained the finishing-grease—usually palm-oil or a mixture of palm-oil and tallow. A plan of this bath is given in Fig. 2. Within the bath E the frames F, for holding the bearings of the rollers G, are received and secured. Dotted lines show the gear for driving these rollers.

H is the entrance flux-box. Its lower and smaller end dips into the metal contained in the part A of the pot. The flux-box H is charged with a flux consisting, as I prefer, of sixty-seven parts of resin, twenty-three parts of tallow, and ten parts of palm-oil. This flux is referred to, and claims relating to its use under certain conditions are made in the specification of another patent application bearing even date with the patent application of which this is the specification.

Within the flux-box H there are stationary guides H^1 H^1, and in connection with these there are other guides, H^2, which are movable about centers $H^{2\times}$, and springs tend to close the lower ends of the movable guides H^2 against the fixed guides H^1. There are thus four spaces in the flux-box H, (shown in the drawings between the fixed and the moving guides,) and each of these spaces is adapted to hold a plate to be coated. In working the apparatus each of these spaces in turn receives a plate from the hand of the workman, who, as he introduces each plate, moves the guide H^2, corresponding to the space which he is charging, in order that the plate which the space

already contains may be able to pass out, and with the new plate he pushes down the plate, which is to pass out until the first pair of the rollers D take hold of it. By this arrangement the plates are detained in the flux long enough to bring them to a suitable state and temperature to enter the coating metal.

The number of plates which the flux-box is adapted to retain at one time may be varied; four, however, is a suitable number to insure proper preparation when working rapidly.

The pot is filled with metal, so as completely to cover the first pair of rollers, D, and so that these rollers may be clear of the scurff or impurities which float upon the surface of the molten metal. The plates are carried forward by the rollers D aided by the guides C′ C′, which are fixed to the side frames, and in their passage the somewhat highly-heated metal in the part A of the pot becomes attached to the plate and gives to it a sound coating. The plate then passes on through the narrow opening left for it between B and K into the cooler part A′ of the pot. The temperature of this plate is thus rapidly reduced and the coating upon it is brought to a state fit for finishing. If any of the scurff which forms in the hot end of the pot should be carried forward with the plate into the part A′, a large portion of it will rise immediately to the surface of the metal, and the flue B′ acting as a barrier, will prevent it reaching the finishing-grease contained in the bath or vessel E. The plate emerging from the molten coating metal enters the finishing-grease and is carried up through it by the coated rollers G G′. The distances between these rollers can be adjusted by means of regulating-screws acting through springs, and in the case of the uppermost rollers, G′, where it is necessary that the adjustment should be completely under control, the screws act upon the bearings of the roller through spring-levers. Beneath the uppermost rollers, G′, troughs I I are fixed, and in these troughs clean coating metal is contained, and there is grease at the back of the rollers. This metal serves to keep the surface of the rollers in good condition by washing off scurff or impurities which is brought to them by the plates rising up through the grease from the coating metal. A good supply of metal given to the troughs I will cause the surface of the plates to be well washed or freed from scurff. The supply for the troughs I is drawn from supply-vessels, which, however, are not shown in the drawings. There is a supply-vessel for each trough. It is arranged immediately in front of or behind the trough, as the case may be, and is by preference made long and narrow, so that it may occupy but little room in the bath E, which, however, may be made somewhat wider than the drawings represent, in order the better to accommodate these supply-vessels. The supply-vessels are immersed in the grease in the bath E, the heat from which serves to keep the metal in the supply-vessels in a molten state; and with the same object the supply-vessels may also be made deep, so that the lower part of the supply-vessels may dip down into the metal in the pot A′. In order that the heat may be more rapidly communicated from the metal in the pot to the supply-vessels, or in place of making the supply-vessels of this great depth, they may be made with fins or legs of metal long enough to become immersed at their lower ends in the metal in the part A′ of the pot. Slits or orifices in the sides of the supply-vessel allow the metal to flow out into gutters or pipes which lead the metal into the troughs I. The supply can be regulated by slides covering the slits or orifices to a greater or less extent.

This method of maintaining a supply of clean coating metal in a molten state to the rollers or instruments in the finishing-grease is referred to, and claims relating to it are made, in the specification of another patent application bearing even date with the patent application of which this is the specification.

The extensions E′ E′ of the bath or vessel E overhang the pot, and they have floors or bottoms, whereas the central part of the bath or vessel E is without a bottom, the grease in it resting on the melted metal on the exit side of the coating-pot. On one side of the pot a notch or recess is formed to allow of the bottom of the extension E′ on this side to be at a somewhat lower level than the edge or flange of the pot, so that occasionally, as hereinafter explained, the pot may be filled sufficiently full of metal to cause it to flow over the bottom of the extension E′ on this side, although the ordinary level at which I work is just beneath it.

Fig. 3 is an elevation of the extension E′. It is closed by a slide, $E^{\times}$. (Also seen in section in Fig. 4.) The slide works in a groove, and a little packing of hemp or hempen fabric may advantageously be placed in the groove, so that the slide may work easily, and yet remain tight. From the nature of the grease, however, but little difficulty will be found in keeping the slide sufficiently tight, and any grease which may leak out flows to a cistern, in which it is collected.

When it is desired to draw off impurities from the surface of the metal beneath the rollers G, metal is put into the pot until the metal rises into the end E′, to which the slide $E^{\times}$ is fitted, and then the slide is slightly raised, so that the metal may flow out beneath it, and with this metal grease-settlings and impurities floating on its surface will pass out. I prefer to arrange slides $E^{\times}$ in connection with the extension at each end of the bath E, and I also provide other slides or movable partitions, by which the extensions can be shut off from the body of the bath E. By thus closing for a time the communication between the bath and the connections, the warming up of the apparatus when commencing to work is facilitated, and the extensions or ends are rendered more accessible for cleaning.

As is seen in Fig. 2, there is a pipe, M and

N, fitted with a tap in connection with each of the extensions or ends E′; they enter near to the bottom. One of these pipes, say M, is in connection with a cistern at a higher level, in which a supply of cool but fluid and suitable grease is kept, and by adjusting the top, or, preferentially, by means of a float in the extension E′, the amount of this cool grease flowing into the bath E can be regulated. The other pipe N leads to a receiver at a lower level, and it serves for the outflow of hot grease and of grease which by use has become thick, and which requires to be allowed to settle and deposit impurities before it will be again suitable.

By means of the tap the outflow can be adjusted, and so a perfect control is obtained, both of the temperature and quality of the grease in the bath E.

The supply of grease may be poured into the bath by hand, from time to time, although much less conveniently than by the arrangement which I have described; but removal of the grease by baling out would not give any satisfactory result, as the overheated and impure grease near the bottom could not be thus removed conveniently.

Fig. 5 is a longitudinal section of an apparatus which differs in some details from that shown in Fig. 1. This apparatus in intended especially for the manufacture of terne-plate; but it may be used also for the manufacture of tin-plates, although I do not recommend it for that purpose. It is provided with a flux-box, O, on the entrance side, which is of a funnel-like form, and it dips at its lower end into the metal in the pot to a depth sufficient to maintain the column of flux. On the exit side the bath E is formed with troughs I, containing clean coated metal for the supply of the uppermost rollers. The bath E has extensions E′, as already described; but they are shallower than the extension in Fig. 1, as in this case the finishing-grease stands considerably below the level of the uppermost rollers, and there is an air-space between the surface of the grease and the nip of these rollers.

Where the bath containing the grease on the exit side is deep, as it is in the apparatus which I prefer for tin-plate, I sometimes, in order to have more complete control over the working, provide air-flues in connection with it, as is shown in Fig. 6. In this figure, K K are flues running along the sides of the bath E, and there are suitable connections, provided with dampers, by which either cold air to carry away heat can be admitted through these flues to the chimney, or by which, when commencing to work when the apparatus is cold, hot air from the fire may be conducted.

In some cases I find it advisable to fix facing-plates in the bath E, and the plates under treatment have to pass between them as they rise to the uppermost rollers. L L in Fig. 6 represent the facing-plates, made of steel or wrought-iron. They are themselves carefully coated before they are put to work, and they are supplied with clean coating metal, either by causing the troughs I, which supply the rollers above, to overflow, or, as is to be preferred, a separate supply from the store-vessel is conducted to them by channels provided for the purpose.

The facing-plates are set at a distance apart such that the plates can pass quite freely between them; but nevertheless, being stationary, they retain to some extent the supply of coating metal between them, and this metal washes the surface of the plate and tends to prevent impurities reaching the surfaces of the uppermost rollers.

Where facing-plates are not employed, it is sometimes advisable to give a separate supply of coating metal to a pair of the rollers G, and for this purpose troughs I may advantageously be applied to such rollers. Thus I am enabled to insure that the plates shall be washed with clean metal before they reach the uppermost rollers without giving too liberal a supply of metal to the uppermost rollers themselves, which might cause the plates to be coated more thickly than was required.

Although I consider the most advantageous way of working is with a divided pot kept at different temperatures at its different parts, as already described, nevertheless I can employ two separate pots of coating metal, the one hot and the other cool. This I do by providing rollers immersed in clear molten metal or in liquid flux, such as grease, to convey the plates from one pot to another. The arrangement is shown in Fig. 7. L L are a pair of conveying-rollers, one larger than the other. In order that the plate may take a curved course in leaving them, these rollers raise the plate out of the hotter pot *a*. They are driven at the same surface-speed, and are, by preference, provided with troughs kept supplied with clean coating metal separate from that in the coating-pot. Any impurities which the plates may bring over with them will be removed from the rollers by the metal in which they are bathed, or mix with the flux on the back of these trough-rollers, and can be skimmed off by the workman from time to time from the surface of the metal in the troughs at the back of the rollers.

Curved guides R insure the entrance of the plates, leaving the rollers L between the rollers M M, and these revolve in grease or flux supported upon the surface of the metal in the cooler pot *a′*, the rollers themselves being above the level of the metal. In consequence of the lower temperature maintained in this pot, grease or flux can be maintained in good order upon its surface. Other rollers carry the plate forward, as already described.

In the arrangement of apparatus and the method of working hereinbefore described there are several different points of invention involved, and some of these I claim in another patent application bearing even date with the

patent application of which this is the specification. In this present specification, and under the patent to which it applies, I claim—

1. In an apparatus for coating sheet metal with tin, lead, or their alloys, a two-part pot formed of the compartments A and A′, for melted metal of two temperatures, in combination with the flue B, that passes between the compartments, and is used for a current of air that regulates the relative temperatures of the two compartments, substantially as specified.

2. The bottomless grease-box E, with the extensions E′, in combination with the slides E× and L, frame F, and coating-rollers, substantially as and for the purposes specified.

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