(No Model.)

W. J. WILDER.

ART OF PLATING SHEET METAL.

No. 602,532. Patented Apr. 19, 1898.

Fig. 1.

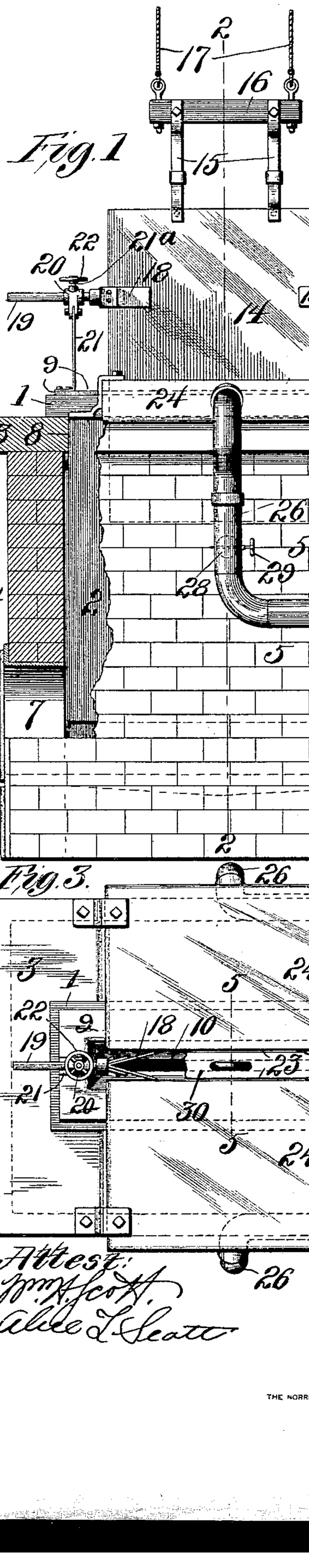

Fig. 4.

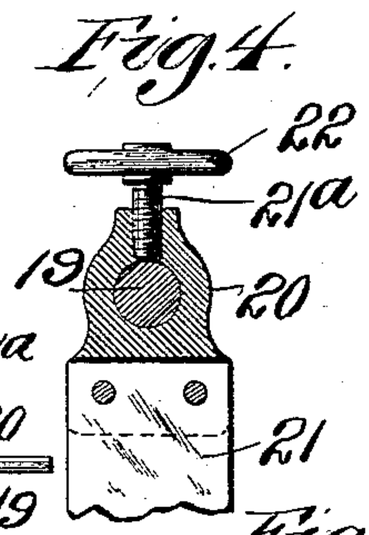

Fig. 5.

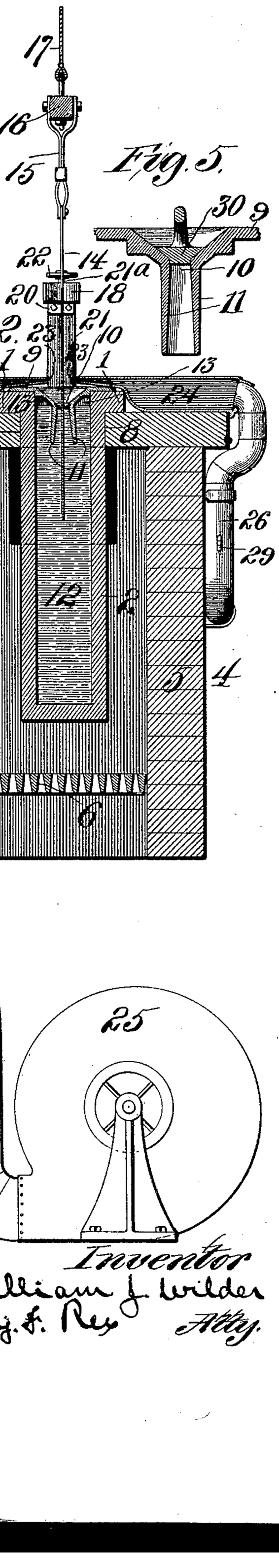

Fig. 2.

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UNITED STATES PATENT OFFICE.

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ART OF PLATING SHEET METAL.

SPECIFICATION forming part of Letters Patent No. 602,532, dated April 19, 1898.

Application filed April 6, 1896. Serial No. 586,305. (No specimens.)

To all whom it may concern:

Be it known that I, WILLIAM J. WILDER, a citizen of the United States, residing in the city of St. Louis, in the State of Missouri, have invented certain new and useful Improvements in the Art of Plating Sheet Metal; and I do hereby declare the following to be a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to use the same.

Heretofore sheet metal of different kinds has been coated with other metals and alloys of metals by dipping it into baths of such metals and alloys and afterward withdrawing the sheets from the bath and allowing the melted metal upon them to cool thereon. Sheet-iron and sheet-steel have, for instance, been coated with tin, an alloy of tin and lead, and other metals and alloys which need not be here enumerated, in the manner above mentioned. Where sheet metal is to be plated in this way, it is usually thoroughly cleansed by means of a suitable pickle, and the surfaces of the sheets are usually covered before they are dipped into the melted metal with a substance which will tend to cause the metal used for the coating to form a union with the metal coated. In coating with tin, for instance, tallow or palm-oil to the depth of several inches is usually placed in the pot and floats upon the molten tin. In plating with zinc the surface of the zinc is usually kept coated with sal-ammoniac, which tends to dissolve the oxid of zinc from the surface of the bath. In spite of all precautions, however, there is a great loss from oxidation in coating with zinc, and some difficulty is experienced in securing a perfect union between the coating and the metal beneath. Similar difficulties are experienced in coating with tin and lead and other metals and alloys. Still another difficulty experienced in coating sheet metal with other metals and alloys of metals where the metal or alloy used for the coating runs freely, as tin and the alloy of tin and lead used in making terne-plate do, is that when the sheets being plated are lifted from the metal-bath the metal used in coating runs down off the sheets and back into the bath to such an extent when the sheets are lifted or drawn out of the bath that only a very thin coating can be secured by a single dipping, and part of the melted metal which runs back is oxidized. By reason of this difficulty several dippings have had to be resorted to in making tin-plate, for instance, where a heavy coating has been desired.

Still another difficulty experienced in plating sheet metal by dipping it into a bath of melted metal in the manner heretofore practiced is that both sides of the sheets are coated alike, whereas it is sometimes desirable to place a heavy coat of metal on one side and a thin coat on the other. It is also desirable to manufacture different grades of coated sheet metal, but where it is only dipped once the thickness of the coating cannot be regulated by the old methods of plating. Another difficulty is the tendency of the melted metal to accumulate along the side edges of the plates when they are taken from the bath. This difficulty is more pronounced in plating with zinc than with other metals with which I am acquainted. A great loss commonly results from this cause in coating with that metal. The coating of zinc formed along the side edges is usually so much thicker than elsewhere that the side edges of the sheets have to be trimmed off and the trimmings usually go into the waste pile. A loss of time is usually necessitated in dipping sheet metal by the fact that the coating generally requires several moments after the sheet is withdrawn from the bath to harden sufficiently to permit of the sheet being taken from the dipping-tongs and handled when the old processes are used.

The chief objects of my improvements are, first, to economize time; second, to economize the metal used in coating by reducing the oxidation of the bath; third, to make it unnecessary to place oil or sal-ammoniac or equivalent substances upon the surface of the bath; fourth, to secure a better adhesion of the coating to the plate; fifth, to economize metal by making it unnecessary to trim off the side edges of the plates after they are plated; sixth, to reduce the loss by oxidation of metal drawn from the bath on plates being coated; seventh, to enable a thick coating of a freely-running metal to be secured by a single dipping, and thus economize time, labor, and fuel, and, eighth, to enable the thickness of the coating to be regulated, where

the sheets are only dipped once, and a thicker coating to be formed, when desired, on one side of a sheet than the other.

To carry my improvements into effect, I prevent the oxidation of the melted metal to any substantial extent while in the pot containing the bath by covering the pot with a slotted cover, which prevents the air from circulating from the outside over any portion of the surface of the bath not within the slot, and through this slot I introduce the sheets into the bath. I prevent the formation of a thick coating along the side edges of the plate by drawing it out of the bath between wipers, which wipe off the surplus metal along these edges before it has time to harden and cause it to fall back into the pot. I prevent the melted metal from running down off the sheets or plates when they are taken from the bath to an undesired extent and the consequent reduction in the thickness of the coatings secured and the loss of metal by oxidation by subjecting all or a part of the melted metal drawn from the bath on the sheet, which would flow off if left to the ordinary cooling action of the surrounding air, to a cooling current of air or the influence of other means adapted to cool it and cause it to set in whole or in part and remain on the plate. I regulate the degree of the power of the current of air or other cooling means used to prevent the melted metal from flowing from the sheet either by varying the free or cooling power of the cooling means used or the distance of the line at which their influence is exerted from the surface of the bath. The farther from the surface of the bath the cooling power is exerted the smaller will be the proportion of the melted metal which would otherwise flow off which will be arrested, other things being equal. I also regulate the thickness of the coating by both varying the cooling power or force and the place of its application. I obtain a thicker coating on one side of a sheet than upon the other either by subjecting the melted metal on one side only to the artificial cooling means used or by subjecting the melted metal on one side to a stronger cooling power than the melted metal is subjected to on the other side, or by exerting the cooling power farther from the surface of the bath on one side than the other or by a combination of two or more of said methods. I save time by cooling the coating more rapidly than it is cooled by old methods. Where a coating of maximum thickness is desired, I use a strong cold current of air or other strong cooling means close to the surface of the bath. I have secured good results and a thick coating by applying a blast of cold air an inch above the surface of the bath. In all cases the cooling means should preferably be applied along a line which is passed by each section of each sheet as it is drawn from the bath while melted metal remains thereon, which in the absence of my improvement would flow off the sheet without setting. I prefer to use a current of air as a cooling agent; but there are other well-known means of cooling which may be substituted for the one preferred.

My invention is believed by me to be a generic one, and in the broadest sense includes the use of any and all means adapted to cool the melted metal upon the sheets and produce the desired effect.

Where a current of air is the cooling agent, many different forms of apparatus may be used for generating and directing the current. So, also, many different forms of apparatus may be used in carrying out my other improvements in plating sheet metal. I have, however, invented an apparatus for use in carrying out my improvements, and have made a separate application of even date herewith for Letters Patent of the United States therefor.

The preferred form of my apparatus is illustrated in the accompanying drawings, in which—

Figure 1 represents a side elevation of the apparatus with a sheet of metal in the position preferably occupied while it is being drawn out of the bath and showing one side wall of the furnace partly broken away. Fig. 2 is a vertical cross-section on line 2 2, Fig. 1. Fig. 3 is a top view of the apparatus as it appears when the slot in the cover of the pot is closed by a lid shown partly broken away. Fig. 4 is an enlarged detailed view in cross-section of a portion of one of the guides or wiper-stands; and Fig. 5 is an enlarged detailed view in cross-section, on line 5 5, Fig. 3, of the cover of the pot with its lid in place. Similar figures refer to similar parts throughout the several views.

The flanges 1 1, &c., of the pot 2 rest upon the top 3 of a furnace 4, having walls 5 5, &c., a grate 6, a door 7, and an opening 8 through the top 3, through which the pot 2 hangs. The top of the pot 2 is provided with a cover 9 shown removable, but not necessarily so, and having a slot 10 through it. A single slot is shown, but where the pot is large several such slots may be provided. The top of the cover preferably slopes toward the slot or slots, and each slot is preferably provided with a downwardly-extending lip 11, which projects down into the melted metal of the bath 12 and prevents air from passing through the slot or slots 10 of the cover to the inclosed space 13 between the cover and the bath. The sheet 14 to be treated is, in the apparatus shown, held by two pairs of tongs 15 15, attached to a cross-piece 16, elevated and lowered by ropes 17 17 or in any other suitable manner. The sheet is preferably lowered between guides 18 18, which when it is drawn from the bath act as wipers. These guides or wipers are arranged opposite each other and are V-shaped in the apparatus illustrated. Each of the wipers 18 is preferably attached to the end of a rod 19, which passes through a collar 20, attached to the up-

per end of an elastic standard 21. The rods 19 19 are movable longitudinally toward and from each other in their respective collars 20 20, and when adjusted are held in position by means of set-screws 21ª 21ª, operated by means of hand-wheels 22 22. By moving the guides or wipers toward or from each other they may be made to accommodate sheets of different sizes. The elasticity of the standards 21 21 makes it possible to secure a yielding pressure upon the edges of the sheets without binding them and interfering improperly with their movement when being lowered into the bath or withdrawn from it. The standards 21 are shown attached at their lower ends to the cover of the pot.

The yielding pressure exerted by the wipers 18 upon the side edges of the sheets is particularly desirable when the sheets are being taken from the bath, as it enables the wipers to effectually wipe the surplus metal from the side edges of the sheets. The V shape of the preferred form of wiper enables it to fit the edges of sheets of different thicknesses. The yielding character of the wiper may be secured in other ways than the one shown, as will be obvious. I prefer to make both standards 21 elastic where the apparatus shown is used; but good results can be secured by making one of the standards elastic and the other rigid.

The wipers should be so arranged as to operate upon the surplus metal on the side edges of the sheets before it hardens, and they are preferably arranged, as shown, so that the metal wiped from the edges of the sheets falls back into the bath, where it can be used instead of being substantially lost, as it is where, as at present, it is allowed to adhere to the edges of the sheets and harden thereon and has to be removed by trimming the sheets.

On each side of the space through which the sheets pass when lowered into and when being withdrawn from the bath a nozzle 23 is arranged in position to direct a blast of air against the sheet as it is withdrawn from the bath. These nozzles 23 23 are preferably arranged opposite each other for ordinary work and extend substantially the length of the slot 10, as shown. The nozzles may be provided with a continuous opening, as shown; but a continuous opening is not essential, as it is obvious that a series of perforations or slots would answer substantially the same purpose. The nozzles are preferably arranged so that the sheets will pass close to them when they are taken from the bath and are arranged close enough to the surface of the bath to enable the blast from them to cool and cause to set upon the sheets melted metal drawn up from the bath, which would flow off the sheet without setting if left to the natural cooling action of the surrounding air. I do not mean that the position of the nozzles shall be such as to prevent any portion of the melted metal on the sheet from escaping, but that their position shall be such as to prevent some portion from escaping which would otherwise flow off. As will be obvious, it is not essential that the blast shall be applied to both sides of the sheets where a coating of the same thickness is not desired on both sides, and in such cases one of the nozzles may be dispensed with. Each nozzle 23 is connected with an air-chamber 24, and each air-chamber is connected with an air-moving device 25. The means of connection shown consists of pipes 26 26, one passing from each chamber 24 to a main pipe 27, connected with the air-moving device 25. A valve 28 is shown in each pipe 26. Each valve has a handle 29, and by opening or closing the valves either partially or wholly the air blast or current can be regulated at will and shut off when not needed. The temperature of the blast may be controlled by any convenient means, no particular means being shown.

Where a sheet is to be provided with a thick coating of free-flowing metal and it is intended to be of the same thickness on both sides, I apply the blast to the metal on the sheet as it is lifted from the bath, near the surface of the bath. One inch is a suitable distance from the surface of the bath at which to apply the blast in such cases; but no particular distance is essential. Where the coating desired is thicker than would be secured by the ordinary processes, but not so thick as can be secured by using a strong cold blast near the surface of the bath, I use a weaker or a warmer blast, or apply it farther above the surface of the bath, or resort to a combination of two or more of these methods of weakening the effect of the blast; but I always apply the blast near enough the surface of the bath to enable it to act upon melted metal on the sheet, which, but for the use of artificial cooling means, would flow off the sheet without setting. In like manner I secure a thinner coating of metal on one side of the sheet than the other either by subjecting one side only to the blast or subjecting one side to a blast which, either from its character, strength, or mode of application or two or more of these, produces less effect than the blast applied to the melted metal on the other side does.

I prefer not to subject the sheet to a blast adapted to cool it when it is being introduced into the bath. Where the temperature of the blast is such as not to lower the temperature of the plate, it is immaterial whether it is stopped while the plate is being lowered into the bath or not.

I have described the preferred method of using the cooling apparatus shown; but, as I have stated, I do not wish to be understood as confining my claims to the use of the cooling means described.

While sheets are being dipped, one sheet follows another so fast that there is no substantial loss by oxidation of the molten metal in the slot of the cover.

When the dipping is temporarily stopped, the slot 10 is preferably closed by means of a lid 30.

Where I speak of "artificial cooling means," I mean any apparatus or device by means of which a cooling agent of any kind, whether natural or artificial, is brought into action.

Where in my claims I use the phrase "bath of melted metal," I wish to be understood as including within my meaning a bath of an alloy as well as a bath of pure metal, and also baths which include elements not metallic as well as metal. Other things are sometimes mixed with metal in the baths in use.

In the apparatus shown there is a space 13 between the cover of the pot and the surface of the bath; but, as will be obvious, it is not essential that any such air-space should exist between the cover and the bath in order to carry out that portion of my improvement to which the cover more particularly relates. It will be obvious that by securing the cover in place the metal in the pot might be caused, by introducing a sufficient quantity, to rise within the slot in the cover to a higher level than the bottom or under side of the cover. Where melted metal or any fluid upon the surface of the melted metal of the bath stands within the slot of the cover, the cover projects into the bath within the meaning of my claims whether the bath rises above the lower end of the slot elsewhere or not.

I claim—

1. In coating sheets of metal by immersing them in a bath of melted metal and then drawing them therefrom, with melted metal adhering thereto, causing melted metal drawn from the bath on both sides of the sheets to set and remain, by subjecting it to the action of artificial cooling means while on the sheets in a condition to flow, and forming a thicker coating on one side of each sheet than the other, by subjecting the side on which the thicker coating is desired, to the action of a more powerful cooling means than the other is subjected to.

2. In coating sheet metal by immersing the sheets in a bath of melted metal and then drawing the sheets from the bath, applying artificial cooling means to the melted metal on both sides of the sheets as they are taken from the bath and wiping off the surplus metal along the side edges of said sheets before it hardens, substantially as described.

3. In coating sheet metal by immersing the sheets in a bath of melted metal, and then drawing them out again reducing the oxidation of the surface of the bath by protecting said surface from the outside air, except where the sheets are introduced; applying artificial cooling means to the melted metal on both sides of the sheets as the sheets are taken from the bath, and wiping off the surplus metal accumulated on the side edges of the sheets before it has time to harden.

WILLIAM J. WILDER.

Witnesses:
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