March 20, 1928. 1,663,444

S. A. DAVIS

TINNING APPARATUS

Original Filed June 25, 1919 4 Sheets-Sheet 1

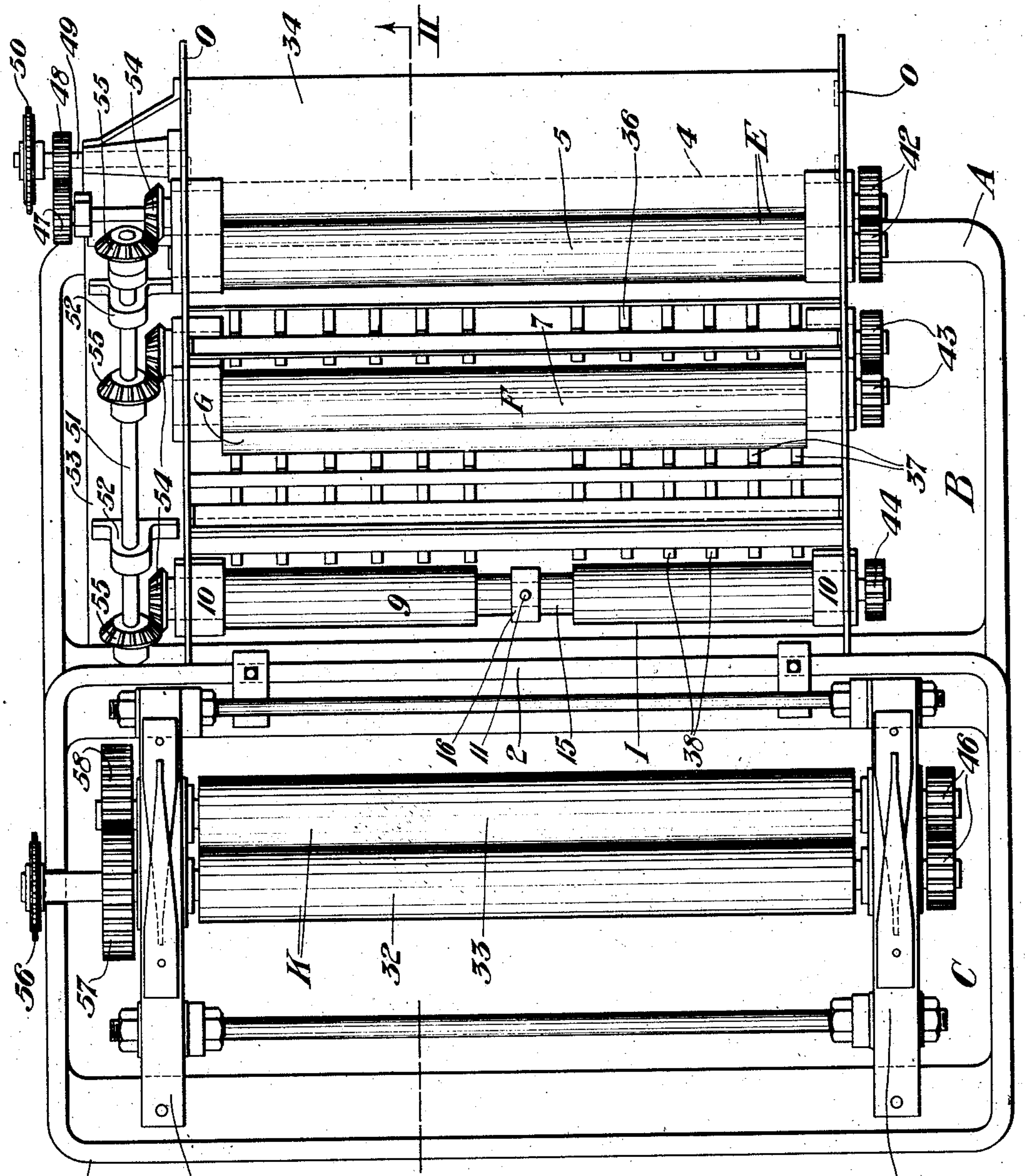

Fig. 1.

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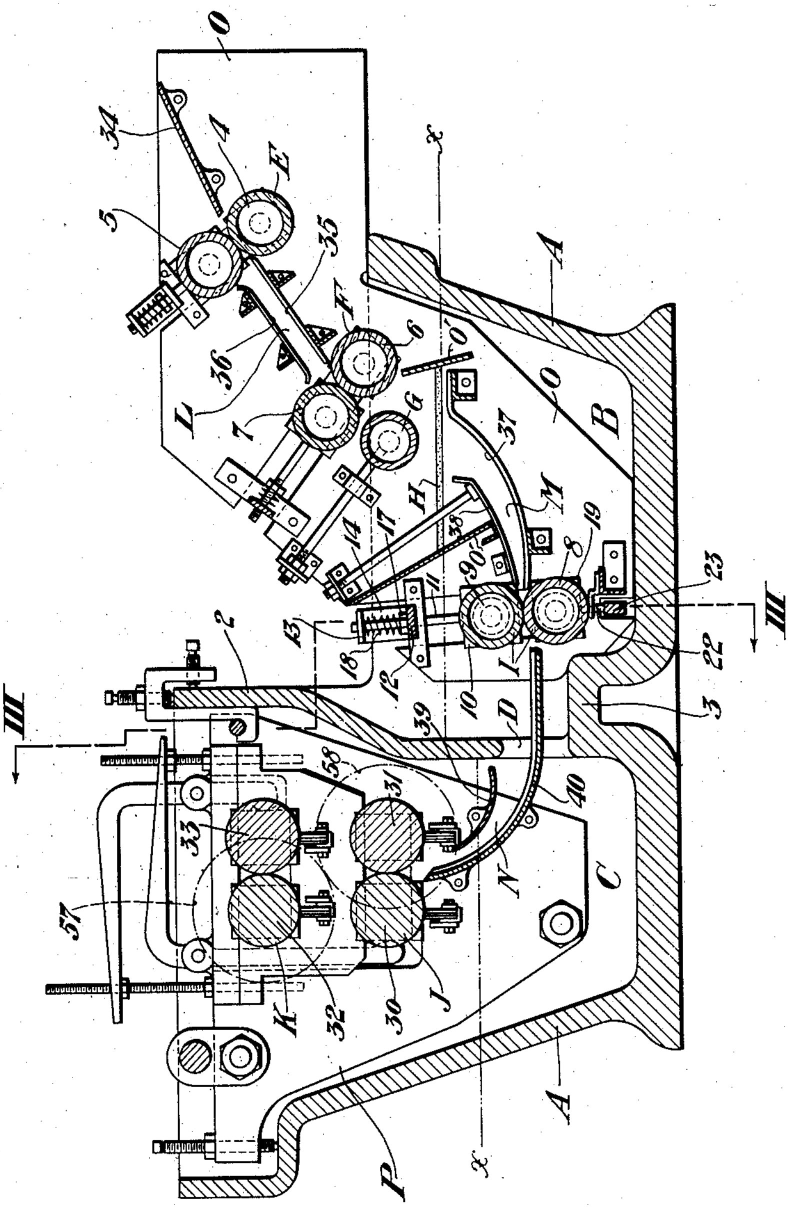
Original Filed June 25, 1919 4 Sheets-Sheet 2

Fig. 2.



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TINNING APPARATUS

Original Filed June 25, 1919 4 Sheets-Sheet 3

Fig. 3.

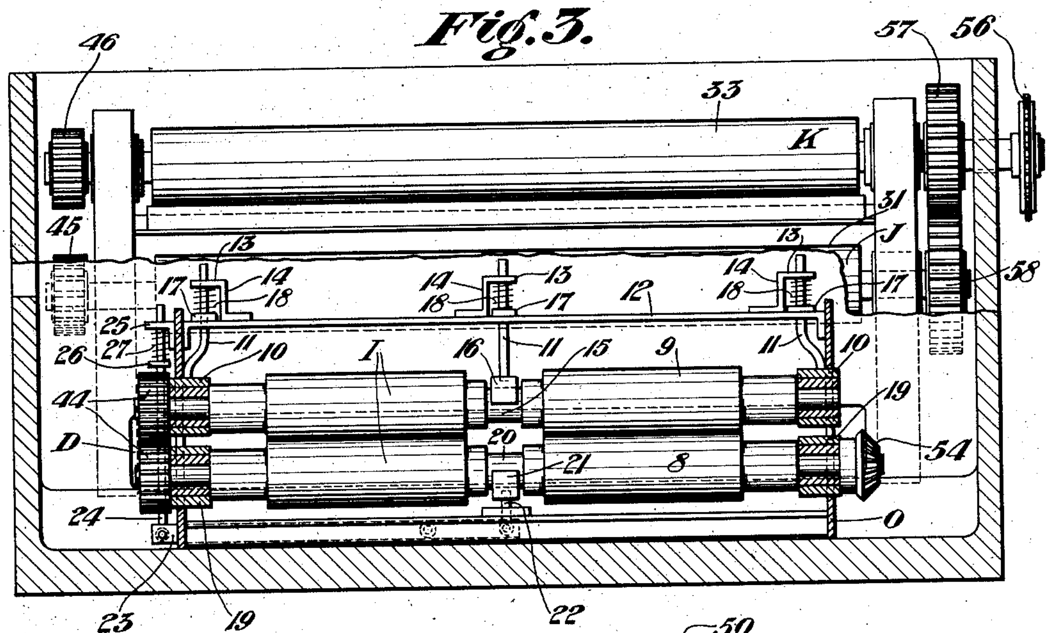
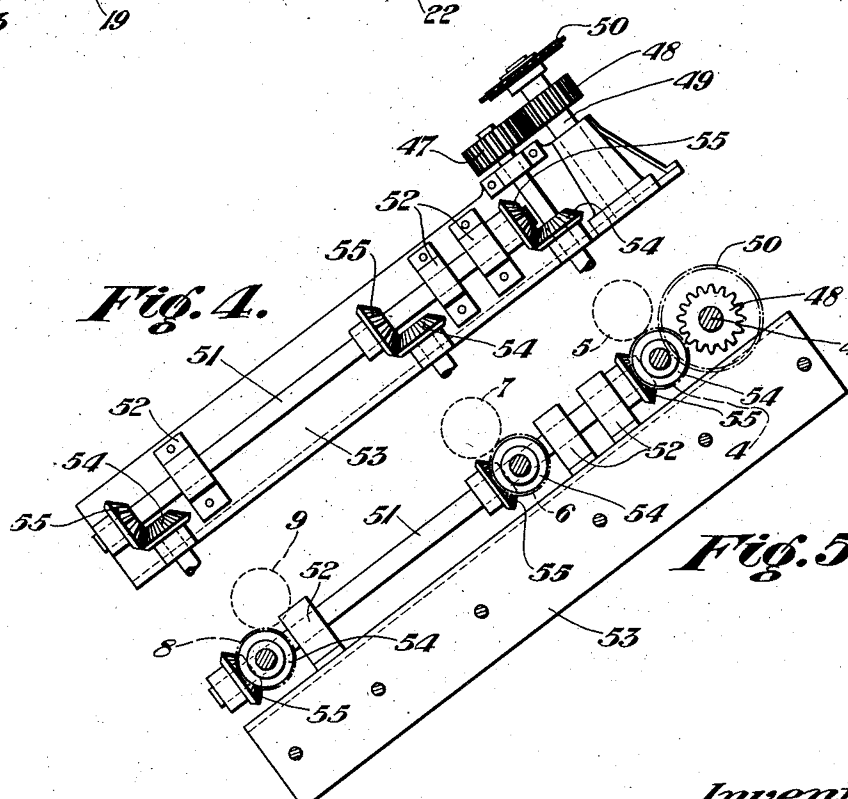


Fig. 4.

Fig. 5.



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TINNING APPARATUS

Original Filed June 25, 1919 4 Sheets-Sheet 4

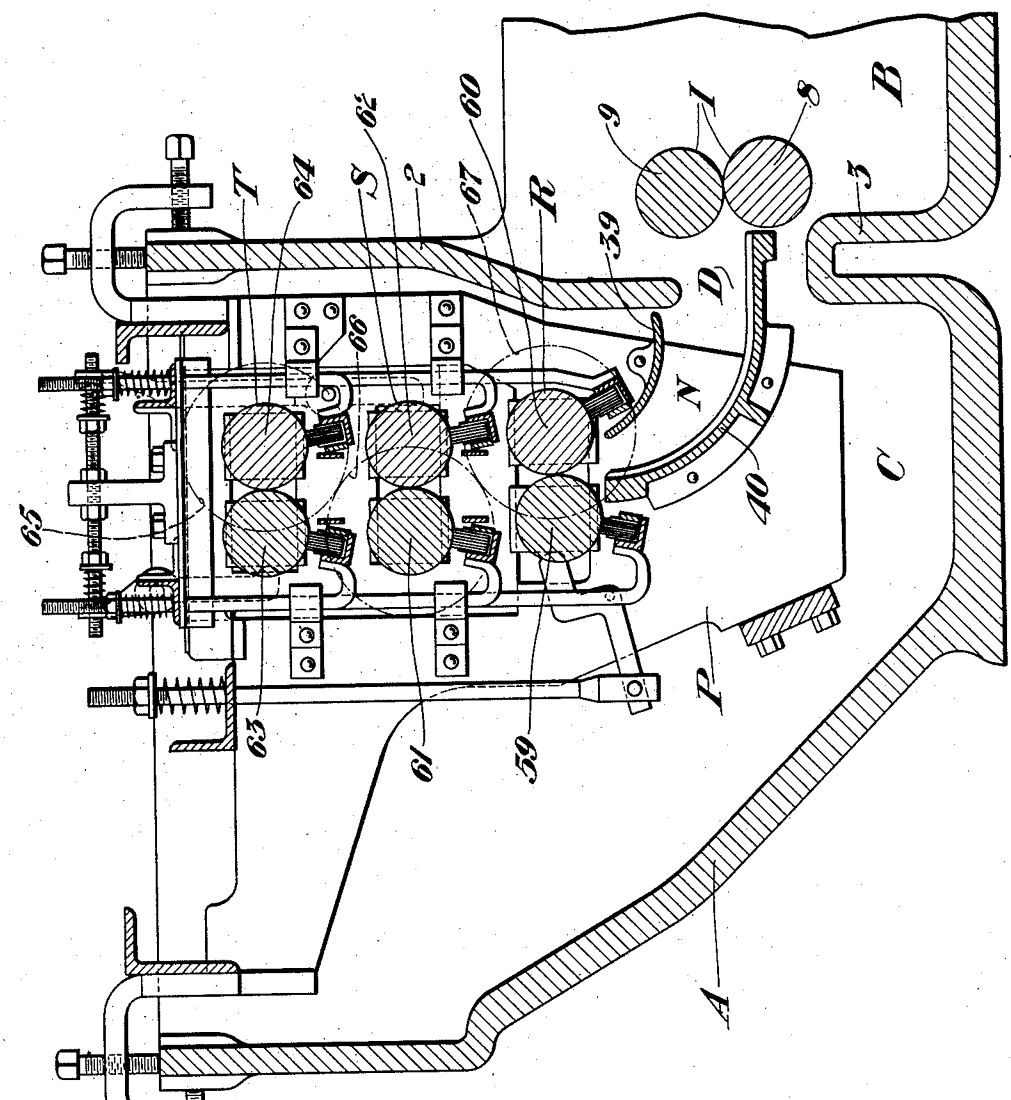

Fig. 6.

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Patented Mar. 20, 1928. **1,663,444**

UNITED STATES PATENT OFFICE.

STEWART A. DAVIS, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO AMERICAN SHEET AND TIN PLATE COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF NEW JERSEY.

TINNING APPARATUS.

Original application filed June 25, 1919, Serial No. 306,521. Divided and this application filed December 18, 1924. Serial No. 756,742.

My invention relates to apparatus used in the manufacture of tin plate, and more particularly in making tin plate having a relatively thin or light weight coating of tin and known commercially as "coke plate".

Tin plate is sold universally by the base box a base box being the equivalent of 112 plates, 14 inches by 20 inches of designated gage, totaling 31,360 square inches superficial area.

The standard commercial grade of coke plate as made heretofore carries approximately one and one-half pounds of tin per base box, is without a high luster and is dull or dry in appearance. The coating on commercial coke plate is not entirely continuous but contains small openings or channels running through the coating to the ferrous sheet underneath and forming what is technically known as "pin holes".

As the thickness of the coating is increased on commercial coke plate its luster is improved, approximately in proportion to the increase in weight of the tin per base box. However, the pin holes do not decrease in this same proportion, the number of pin holes remaining about the same.

In the manufacture of tin plate with extant tinning machines the cleaned iron or steel plate or base is passed through a layer of flux into and at least partly through a bath of molten tin by hand, surplus tin on the plate's surfaces being removed by the set or sets of rotary spring pressed "feed out" or exit rollers located in the oil bath on the exit end of the machine. When the ferrous base first comes into contact with the molten tin, a layer of iron-tin alloy forms on its surfaces. This alloy has a melting point higher than that of the molten tin itself and the result of this action is that fine needle-like crystals of this iron-tin alloy are formed, which protrude from the surfaces of the iron base and form a fine spongy or porous network of crystals, the interstices of which are filled with the molten tin.

When the iron base and adherent alloy layer of crystals later pass between the exit rollers in the oil bath, the network of crystals is crushed and flattened against the iron base, and a considerable proportion of the molten, interstitial tin is squeezed out and flows off the plate.

The plates, as they emerge from between the exit rollers, consist of a ferrous base covered with a coating composed of a mixture of crystals of iron-tin alloy and pure tin. The presence of the crystals produces what is shown by a microscope to be a rough, irregular surface. It is this rough, irregular surface which imparts the dull, or as technically termed, the "dry" appearance to the surface of "coke plate" as heretofore made.

Great care is taken to keep the "yield" at or below a certain limit, the yield varying with different grades of tin plate and being determined by the particular grade of tin plate being made. It was the universal belief that the yield increased with an increase in the speed of passing the plates through the tinning bath and a speed of 100 to 120 inches per minute was considered the maximum speed that could be employed in the manufacture of coke plate. It is known that keeping the plates within the molten tin bath for too long a time interval results in making plates having black spots (i. e. spots where the tin does not adhere to the base).

One object of my invention is the provision of tinning apparatus having novel features of construction whereby the capacity of the tinning apparatus is increased, a superior product is obtained and the cost of making the tin plate is lessened. A further object of the invention is to provide tinning apparatus particularly adapted for use in carrying out the method of making tin plate described and claimed in my copending patent application, Serial No. 306,521, filed June 25, 1919, (Patent No. 1,528,407, granted March 3, 1925) of which this application is a division.

Referring now to the drawings forming part of this specification, Figure 1 is a plan showing a tinning pot constructed and arranged in accordance with my invention.

Figure 2 is a longitudinal section, the section being taken on the line II—II of Figure 1.

Figure 3 is a sectional end elevation, on the line III—III of Figure 2.

Figure 4 is a plan, and Figure 5 a side elevation, showing details in the construction of the feed roller driving mechanism forming part of my improved tinning machine.

Figure 6 is a longitudinal section showing the feed out or exit side of a modified form of pot.

In the accompanying drawings, the letter A designates a tinning pot, in itself an old and approved form. The pot is separated transversely by a vertical wall or partition 2 into compartments B and C. The lower edge of this partition 2, which terminates above the bottom of the tinning pot, and the upper edge of a rib or projection 3 on the bottom of the pot define the width or vertical dimension of a narrow opening forming a passage D through which the plates, while submerged in the bath of molten tin, pass from the compartment B into the compartment C of the pot A.

The particular pot shown is of a width which permits of two or more plates, side by side, being passed through the tinning pot. (See Figures 1 and 3.) Obviously, when desired, a narrower pot of a width slightly greater than the width of the widest plate may be used. Any of various known means may be used for heating the tinning pot and, preferably, these means will be constructed and arranged to maintain the tin in compartment B at a considerably higher temperature than the tin in compartment C. The pot heating apparatus, not forming part of this invention, is not shown nor further described.

The side walls of the compartment C at the exit end of the pot are extended upwardly so that this compartment is considerably deeper than the compartment B, this old and well known construction making it possible to maintain a body of oil, (generally palm oil) of the requisite depth or thickness, on top of the molten tin in compartment C. The levels at which the bath of molten tin is maintained in the pot are indicated by the line X—X of Figure 2, and a layer H of flux is maintained on top of the tin in the compartment B at the entrance end of the pot. Due to the weight of the body of oil on the tin bath in the compartment C of the tin pot, the level of the molten tin in this compartment is somewhat lower than that of the tin in the compartment B. (See Figure 2.)

A supporting frame O is mounted in the compartment B, and is composed of suitable side plates which extend above the top of the tin pot. A pair of transverse plates O′ extend between and are connected to the side plates of the frame O so as to cooperate therewith and serve to form a flux box to confine or retain the layer of flux H on top of the tin in the compartment B of the pot.

Located immediately above the upper edge of the compartment B, at the plate entering side of the tinning pot, are two sets of spring pressed feed rollers E and F, which are arranged to move the pickled and washed plates forwardly and downwardly into the tin pot at an angle to the horizontal.

The set of feed rollers E, as shown, is formed of rollers 4 and 5, and the set of rollers F, consisting of the rollers 6 and 7 are at a somewhat lower level than the set E. An adjustable deflecting roller G, although not always necessary, preferably will be provided below and on the discharge side of the set of rollers F, to guide and direct the front end of the plates forwardly and downwardly through the flux H into the molten tin in the compartment B.

Positioned within the compartment B, at a point closely adjacent to the passage D, is a set of pressure rollers I formed of rollers 8 and 9. The upper roller 9 is mounted in sliding bearing blocks 10 which have upwardly extending tension rods 11 that extend through a transverse bar 12 and through the overhanging portion 13 of a bracket 14 on the bar 12. The roller 9 is provided midway of its length with a bearing surface 15, and a bearing shoe 16 engaging the upper portion thereof has a rod 11 by which it is yieldingly mounted on the bar 12. The rods 11 are provided with shoulders 17 and a coil spring 18 is mounted on each of the rods 11, above the shoulder 17, so that one end of the springs bears against the shoulders 17 and the other end against the overhanging portions 13 of the brackets 14. The resilient springs 18 serve to normally hold the roller 9 in close contact with the roller 8.

The roller 8 is mounted in bearing blocks 19 and is provided with a center bearing portion 20 which is supported by a bearing shoe 21 mounted on a post 22, which is pivotally supported at its lower end on a bar 23, this bar being pivotally secured by one end to the frame O and having its other end pivotally connected to a link 24. The upper end of the link 24 passes through the bracket 25 on the frame O and is provided with a shoulder 26 at a point below the bracket 25, which supports the lower end of a coil spring 27 on the link, the upper end of the spring 27 bearing against the bracket 25. (See Figure 3.) The bearing shoe 21 and its resilient mounting act to normally force the roller 8 toward the roller 9 and to prevent bending of the roller 8.

The pair of pressure rollers I, which are submerged in the bath of molten tin in compartment B of the tinning pot, have the double function of feeding the plates from the compartment B into the compartment C of the tinning pot and at the same time flattening and smoothing the layer of iron-tin alloy that forms on the iron or steel plates or sheets as they enter the molten tin in compartment B of the tinning pot.

It will be noted that the sets of feed in rollers E and F and the guide roller G are above the layer of flux H, and that the successive plates are mechanically fed and guided into, through and out of the tinning pot. This mechanical feed is important, since it permits the plates to be fed successively and interruptedly through the flux at the same speed as they are fed through the tin.

The location of the pressure rollers I with respect to the layer of flux H is to be particularly noted, because it has heretofore been considered impossible to use submerged rollers in a tinning machine. This is because experience shows that long contact of the rollers with the molten tin bath causes the layer of tin on the rollers to flake off and bare the surface of the rollers, and such occurrence results in making defectively coated plates, known in the art as having "black spots" or plates having uncoated spots on the surfaces thereof.

I have found that by positioning the rollers I so that the distance from the flux H is not too great and by feeding the plates at a constant and fairly high speed, enough flux will be carried down on the surfaces of the plates and the flux will be carried so uniformly on such surfaces as to maintain the rollers I in uniformly good working condition. Also, I propose to use a single set of rollers submerged in the tin bath because it is not practicable to use two or more such sets in succession and still carry the flux uniformly to the second or later set and in such quantity as to prevent the production of plates with black spots.

In the construction of Figures 2 and 3, sets of feed-out rollers J and K are provided, which are located within the body of oil maintained on top of the tin bath in compartment C of the pot A. The pair of rollers 30, 31 forming the set J, and the rollers 32, 33 forming the set K, are arranged to not only feed the plates out of the tin pot but also act to squeeze off surplus tin from the smooth, tin coated surfaces of the plates as the plates pass upwardly through the oil bath out of the tinning pot. The body of oil, in which the feed-out rollers are submerged, acts to prevent the molten coating on the surfaces of the plates from contacting with the atmosphere until after the excess coating has been removed therefrom.

It will be noted that, the sets of rollers E, F, I, and J are relatively positioned or apaced so that the front end of the plates Y will be engaged in the bite of a succeeding set of rollers before the rear end emerges from between the rollers of the preceding set. That is to say, the rollers are so positioned that the distance the plates must travel from one set of rollers to the next set is less than the length of the plates. It will also be seen by reference to Figure 2 of the drawings that the set of rollers I is the only one submerged in the tin bath.

An inclined apron 34 at the entrance end of the compartment B of the pot, receives the plates as they are delivered to the tinning pot. The plates 35 and 36 form a guide L for directing the front end of successive plates into the bite of the set of rollers F as it emerges from between the set of rollers E.

Curved plates 37 and 38 forming a guide M are positioned within the compartment B so as to direct the forward end of the plates being tinned into the nip of the set of pressure feed rollers I, as is clearly shown in Figure 2. These guide plates 37 and 38 preferably are of skeleton form, so as not to interfere with scruff and dross or other foreign material in the molten tin settling to the bottom of the pot.

Curved guide plates 39 and 40 form a guide N which directs the forward end of the plates emerging from the set of rollers I upwardly into the bite of the lower set J of the feed-out rollers located in the upper end of the compartment C. Reference to Figure 2 shows that the rear end of the lowermost guide plate 40 extends backwardly through the passage D into proximity to the set of rollers I.

The framework O, which supports the sets of feed rollers E and F, guide rollers G and pressure rollers I, and the stationary guides L and M, is removably secured within the compartment B so as to permit the feed-in apparatus to be bodily removed from the pot while the tin bath is molten. This is done at intervals in order to clean the tinning pot and to make necessary repairs to the feed-in apparatus. The sets of feed-out rollers J and K and guide N are mounted in a similar manner on the framework P in the compartment C of the pot and can be taken out of and replaced in the compartment C in the same manner as the apparatus within the other compartment B.

The feed rollers 4 and 5 of the set E are connected by a pair of spur gears 42 so that both of these rollers are positively driven, and the rollers 6 and 7 of the set F are likewise connected by spur gears 43. The rollers 8 and 9 forming the submerged set I are also connected by spur gears 44 so as to be positively rotated.

The rollers 30, 31 forming the set J, are connected by spur gears 45 so as to be positively rotated, and the rollers 32 and 33 forming the set K are similarly connected by spur gears 46.

The rollers 4 and 6 of the feed-in rollers and roller 8 of the pressure feed rollers are the driven members of their respective sets. The feed roller 4 is provided with a spur gear 47 which meshes with the spur gear 48 on the stub shaft 49 which is journaled in the frame O, this shaft having a drive sprocket 50 driven by a chain from a suitable motor (not shown). A drive shaft 51 is journaled in suitable bearings 52, these bearings being mounted on an angle support 53 fastened to one side of the frame O. Each of the rollers 4 and 6 and roller 8 is provided with bevel gears 54 which mesh with bevel gears 55 on the shaft 51.

The rollers 30, 31 and 32, 33 forming the sets of feed-out rollers J and K, respectively, are driven by a sprocket wheel 56 which is mounted on an extension of the shaft of the roller 32. The roller 32 is also provided with a spur gear 57 which meshes with a spur gear 58 on the roller 31.

The gears and other drive mechanism for the sets of feed-in rollers E and F, feed pressure rollers I and feed-out rollers J and K are arranged so that each individual roller is positively driven at a uniform surface speed of at least 120 and up to 150 inches per minute, thereby providing for feeding plates into, through, and out of the tinning machine at a uniform and relatively high speed.

The exit or feed-out side of the slightly modified form of tinning machine shown in Figure 6 is the same as that of Figures 2 and 3, excepting that in the machine of Figure 6 the compartment C is made slightly deeper and is provided with three sets of feed-out rollers R, S, and T formed of the rollers 59 and 60, 61 and 62, and 63 and 64, respectively.

The roller 64 of the set T is positively driven from a source of power (not shown), and is provided with a spur gear 65 which meshes with a spur gear 66 on the roller 61 of the set S, and the gear 66 meshes with a spur gear 67 on the roller 60 of the set R, so that all of the rollers are positively driven. The third set of feed-out rollers in the modified apparatus of Figure 6 serves, like the other two sets, to squeeze more of the molten tin from the plates as they pass upwardly through the oil in the compartment C.

In carrying out my method of making tin plate with the apparatus forming this invention, the ferrous metal plates, after having been pickled and washed, are successively placed on the apron 14 and moved downwardly (either mechanically or by hand) until the front end of the plate enters the nip of the set of feed rollers E.

After engagement with these rollers the plate is thereafter mechanically fed forward through the guide L into the nip of the second pair of feed rollers F, which are located immediately above the layer of flux H in the flux box. In passing from between the rollers F, the plate is directed into the flux H by the guide roller G, so that at no time does it come into contact with any extension or guide projecting below or beyond the level of the flux. The provision of means for entering the sheets into the tin bath through the flux without having the plates come into contact with any stationary part of the pot avoids dislodgment of flux and other substances previously deposited on the plate and which desirably should be carried down to the pressure feed rollers I. The uniform rate of movement of the plate into and through the flux and tin bath also aids in causing a sufficient quantity of flux to be carried down to the rollers I, to keep these rollers in proper working condition. Heretofore, with the well known hand-feed apparatus the plates are first moved through the flux very fast and then at a comparatively slower rate of speed through the tin bath, with the result that the plates are not sufficiently fluxed and poorly coated plates being produced.

After passing through the flux, the plate enters the molten tin in the compartment B, passing through the curved guide M which delivers the plate into the nip of the pressure feed rollers I.

As the plate passes through the tin bath in the compartment B an iron-tin alloy coating is formed on the surfaces thereof, and as it passes between the pressure feed rollers I the coating is compressed and flattened, and surplus tin is sequeezed off and removed from the alloy coating on the plate. The plate, having an iron-tin alloy coating, then passes through the opening D and is deflected by the curved guide N upwardly through the bath of tin in the compartment C and into the nip of the first pair of feed-out rollers J which are in the oil bath above and supported upon the tin in the compartment C.

As the plate passes between the feed-out rollers of the sets J and K, any excess tin adhering to the surfaces of the plate is removed by the pressure of these rollers and a finished plate is produced having an outer layer of substantially pure tin which has the luster and other properties and characteristics of the heavy coating of charcoal plates.

As has been said before, all of the rollers of the several sets in the machine are positively driven at a substantially uniform and relatively high surface speed and, therefore, the plates are fed through the machine at a uniform speed. This, together with the other novel features of the machine, permits the plates to be fed into, through, and out of the tinning apparatus at a speed of from 120 to 150 inches or even more per minute, without increasing the yield and in some cases, with an actual decrease in the yield, such speeds being considerably higher than is possible without an increase in yield, with the tinning apparatus heretofore used.

While a specific embodiment of my invention has been described herein, it will be understood that the invention has been described herein, it will be understood that the invention is not limited to the specific details shown and described, since various modifications may be made without departing from the scope of the invention as defined in the appended claims.

I claim—

1. Tinning apparatus comprising a tinning pot having compartments for the molten tin bath communicating with each other below the top of the tin bath, means in one compartment for maintaining a body of flux on top of the tin bath, means in the other compartment for maintaining an oil bath on top of the tin bath, a feeding mechanism above the flux to feed the plates into and through the flux into the tin bath, an intermediate feed mechainsm to feed said plates through the tin bath into the oil bath, said intermediate mechanism comprising a single pair of rollers set in the tin bath close to the flux so that the flux is carried rapidly and at a uniform rate to said rollers, and a feed-out mechanism in the oil bath to feed the tinned plates out of the oil bath, said feed mechanisms being operatively connected to successively and uninterruptedly feed plates into, through and out of the flux, tin bath and oil bath at a relatively high and substantially equal and uniform speed.

2. Tinning apparatus comprising a tinning pot having compartments for the molten tin bath commuicating with each other below the top of the tin bath, means in one compartment for maintaining a body of flux on top of the tin bath, means in the other compartment for maintaining an oil bath on top of the tin bath, a feeding mechanism above the flux to feed the plates into and through the flux into the tin bath, an intermediate feed mechanism on the flux side of the tinning pot to feed said plates through the tin bath into the oil bath, said intermediate mechanism comprising a single pair of rollers and a feed-out mechanism in the oil bath to feed the tinned plates out of the oil bath, said feed-in and feed-through mechanisms being directly and unyieldingly connected to a common driving mechanism adapted to operate them at a relatively high and equal and uniform speed.

3. Tinning apparatus comprising a tinning pot having compartments for the molten tin bath communicating with each other below the top of the tin bath, means in one compartment for maintaining a body of flux on top of the tin bath, a feeding mechanism above the flux to feed the plates into and through the flux into the tin bath, an intermediate feed mechanism on the flux side of the tinning pot to feed said plates through the tin bath into the oil bath, said intermediate mechanism comprising a single pair of rollers and a feed-out mechanism in the oil bath to feed the tinned plates out of the oil bath, and driving mechanism positively and unyieldingly connected to said three feeding mechanisms and adapted to drive them at a relatively high and equal and uniform surface speed.

In testimony whereof I have hereunto set my hand.

STEWART A. DAVIS