UNITED STATES PATENT OFFICE.

JOHN J. CROOKE, OF NEW YORK, N. Y.

IMPROVEMENT IN MANUFACTURE OF TIN-FOILS.

Specification forming part of Letters Patent No. **32,355**, dated May 21, 1861.

To all whom it may concern:

Be it known that I, JOHN J. CROOKE, of the city, county, and State of New York, have invented a new and useful Process for Producing Ribbons or Webs of Compound Foil, or Foil having a Lead Center and a Tin Surface; and I do hereby declare that the following is a full, clear, and exact description of the manner of working my invention.

Compound foil of lead and tin, not alloyed, but the lead existing in the center and the tin composing the surface, is described in an English patent granted to William Betts in 1849. On attempting to put his process into practice certain difficulties were encountered, and the foil produced had a dead and lusterless surface. After a long course of experiment I have devised the process herein described, which is a much cheaper one, and by which webs of foil with a bright planished surface may be produced. Compound tin-foil, to be salable in the market, must show no lead upon the surface, and any appearance of lead is specially objectionable when the foil is to be used in wrapping articles that act chemically upon the lead. The sheets, moreover, should have smooth, even edges, and if profit is to be made in the manufacture the waste arising from trimming, &c., must be reduced as much as possible.

My invention is designed to produce long sheets or webs or ribbons of compound foil with smooth edges and having a uniform uninterrupted tin surface.

In the plan that I prefer for carrying out my invention I first cast the lead into ingots about an inch thick and of a uniform width about that of the finished foil, and of a length governed by that of the finished sheet of foil to be produced. These ingots are then passed two or three times (more or less) through a pair of strong flatting rolls and reduced to about one-quarter of an inch in thickness. Strips of sheet-tin about as wide as the bars of lead are then taken and laid one on each side of the lead over its whole length, being folded over one end and onto the other side an inch or two and extending beyond the other end of the bar a few inches. These sheets of block-tin (not tinned iron) I generally make each of one-sixth the thickness of the lead; but the proportion may be varied. The lead thus covered with tin is then passed through the rolls. The compound bar will be much diminished in thickness by the operation, and it will be found that the tin will become welded fast to the lead, while the lead, stretching more in length than the tin, will to a certain extent underlie the ends of sheet-tin that extended beyond one end of the lead. That end of the lead around which the tin was lapped is to be entered first into the rolls at the first rolling. I find that chilled-iron rolls of about fifteen inches in diameter are very suitable for this operation, which is continued by passing and repassing the sheets through the rolls until the whole sheet is reduced to about 22 wire-gage. A smaller pair of rolls may be employed for the last one or two rollings, and the whole rolling is to be done in the direction of the length of the sheet. The surfaces of these rolls should be smooth and polished, and the sheets are to be passed in by one attendant and received by another.

In order to remove particles of oxide and other dirt from the rolls, I keep bearing upon the upper surface of the upper and the lower surface of the lower a buff of leather, which must be removed from time and scraped or cleansed. The edges of the lead, during the rolling, will extend slightly in width, so that the rough edges will show outside of the tin, and these edges will exfoliate and small pieces drop off. Care must be taken to prevent these particles of lead from adhering to the rolls or dropping upon the tin surface, for in either case they will in subsequent rolling produce a patch of lead surface on top of the tin.

The leather buffs will generally remove and hold all loose particles of lead that adhere to the rolls, and I find it convenient to receive the sheets as they come from the rolls on a board narrower than the sheets, so that particles of lead loosened from the edges can drop freely, and thus be prevented from sticking to the tin surface. When the sheets or strips become thin enough they are rolled into coils by the man on the delivering side of the rolls as fast as they come through the rolls. The narrow board serves as a table to roll them upon, and in practice many sheets are rolled through one after the other without altering the set of the rolls, and the rolls are then set and these same sheets are in succession passed through again. During these rollings the tin will, in spite of all precautions, almost invariably crack away in spots, so as to expose the lead, and the attendant who introduces the sheets or

strips is provided with patches or small pieces of pure tin-foil, which he applies onto these spots. As these patches pass through the rolls they are welded down onto the surface, and after a few rollings it is impossible to discover where they have been applied.

Four passages through the rolls are in practice sufficient to weld the tin to the lead and reduce the compound lead and tin of four-twelfths of an inch in thickness as a whole to No. 22 wire-gage; but the precise number of rollings is unimportant except as a matter of economy. When the compound sheets are thus reduced a narrow band of lead of irregular width will appear outside or on each edge of the tin surface, and the next operation is to remove this strip or band of lead and to reduce the strips as a whole to a uniform width throughout and with smooth even edges. I prefer to reduce the sheets to width and remove the lead by circular shears like tinmen's shears, although any other apparatus that will produce the effect may be used, and I in practice use two pair of shears set to the proper distance apart. I place the coil of sheet metal upon a mandrel, then pass the end of it over and under bars of wood or metal covered with leather, thence with the edges through the shears, and I roll up the coil upon a mandrel as it comes through the shears with the edges trimmed. Both edges are thus trimmed at one operation, and in order to be sure that no uncovered lead is left it will generally be necessary to remove a little of the edge that is covered by tin. Each edge may be trimmed separately; but I prefer to trim both at once. As I said before, the best point in the process to trim is when the compound sheets are reduced to about 22 wire-gage; but the trimming may be performed when the sheet is above or below this thickness. There is a time in the process of reduction in thickness after which the lead does not extend laterally so as to crawl out under the tin to any practical extent, and this fact, discovered by me, is one on which my process is partially based, and the trimming may be done as soon as this point in the process is reached. If the sheet be much reduced in thickness after this, without any trimming, the edges will crack, and the cracks will extend into the tin surface, so that more metal must be removed, and greater waste consequently incurred in securing a smooth good edge when the trimming is delayed till this cracking takes place. If the metal be reduced still thinner, there will be the further disadvantage that it is not well supported, or cannot support itself between the shears, and the edge will consequently become uneven. The proper time at which to trim is therefore when the lead has ceased to extend laterally and before the edges begin to crack, or before the foil is too thin to be firmly fed to the shears, and I have found by practice that the best time is when the sheet is of a thickness of about from 20 to 30 wire-gage, although the precise thickness at the time of trimming may vary considerably. After being reduced to this thickness and trimmed, the lead will not practically squeeze out so as to be exposed during the further reduction by rolling and the edges will remain smooth and straight. The coils of trimmed metal are now taken to flatting-rolls of chilled metal or steel, smooth and polished, and one end of a coil is passed over and under bars of metal, which constitute holdbacks and make resistance to the passage of the metal by friction. This end is then introduced into the rolls, and as the sheet passes through it is wound upon a reel. I find that once passing through rolls of six to six and one-half inches in diameter will reduce from 22 wire-gage to the thinnest foil. These rolls, or one of them, are to be provided with apparatus for introducing streams of water at different parts of their length, so as to palliate any difficulty arising from unequal expansion and contraction of diameter in different parts of their length, such streams, or some of them, being shut off and turned on as may be required, and the metal as it passes through these rolls is to be lubricated with soapsuds.

When the buffs on the welding and reducing rolls are not used care must be taken to cleanse the rolls frequently and to prevent particles of lead from being rolled down onto the tin surface, and when the strips of compound are not received upon a narrow board as they pass through the rolls the operation of receiving and handling them must be so conducted that no particles or exfoliations of lead from the edges shall adhere to the tin surface. If such particles are permitted to adhere, they will inevitably be rolled down upon and welded to the tin surface during the subsequent rollings, thus producing patches of lead surface.

The reeling into coils of the strips after they pass through the rolls at various stages of the process, and also after the edges are sheared, is a mere matter of convenience or economy in space and time in handling, and this reeling may be dispensed with.

Despite all precautions flaws in the tin surface will sometimes occur; but if the process be carefully conducted, as described, such occurrences will be rare and practically unimportant.

The result of the process will be a long sheet of compound foil—a wide ribbon, or "web," if it may be so termed, of practically-uniform width, with smooth straight edges, without any appearance of lead on the surface, suitable for being cut into sheets of any length or for being printed upon or embossed while in the ribbon and afterward cut into sheets proper for wrappers. The surface, moreover, is smooth and bright, and has not the dead lusterless appearance of foil that has been rolled in packs or beaten under a hammer. This bright or polished surface on the foil makes it more salable.

As before stated, the apparatus used for shearing or trimming the edges may be varied

from that specially described as preferred by me. If the apparatus is competent to shear off the uncovered lead from the edges and trim the edges smooth, that is all that is required of it. Rolls of various sizes may be used for the various reducing operations. Those of the diameter described I have found to answer well, and by my process I have produced ribbons or webs of foil eight hundred feet in length and varying from three to sixteen inches in width.

Instead of casting the lead ingots of uniform width from end to end, I find it both convenient and economical to cast them of a little less width at both ends, with a sort of elliptical point. With such points the strips or ribbons are more easily introduced into the rolls and shears and through the holdback bars or stretchers; the finishing-rolls are, moreover, set quicker and with less waste of stock; but the main reason for casting the lead ingots of less width at both ends is for the economy that it entails in the manufacture.

In rolling the strips there is always a rolling wave of metal on that part thereof which is about entering the roll. This wave or undulation is curved, and as the end of the strip approaches the rolls and the wave has less resistance to its transmission the wave becomes straighter and tends to spread, and does spread, the metal sidewise so as to increase its width. The tapering of the ends of the strips permits this increase without widening the tapered part beyond the width of the strips at the parts where their edges are parallel to each other, and thus obviates the necessity of wasting stock by trimming so as to reduce the whole strip to a uniform width. If the ends of the strips which passed through the rolls last were not tapered, they would become wider at the ends. The rolls, by means of which the trimmed strip is reduced into foil, should be carefully ground, so as to taper gradually in diameter to the ends thereof, such tapering commencing at a point three or four inches (more or less) from the ends thereof. This tapering must be very slight—no more than can be manifested by screwing one roll down on the other and holding a candle on one side and then observing a fine line of light between the rolls on the other.

The process may be conducted without the use of tapered or blunt-pointed ingots; but it will in that case be more expensive; and foil can be produced with rolls of uniform diameter throughout; but the product will be an uncertain one and the quality will be inferior.

In my process the sheets or strips from one end of the process to the other are always rolled in the direction of their length, and are never cut up, packed, and rolled crosswise, and this is one distinguishing characteristic of the process. Another characteristic is that the edges are trimmed at some period, substantially such as before described, intermediate between the first welding of the tin onto the lead and the final reduction into the completed sheet of foil.

I do not claim as of my invention compound foil of lead with a tin surface; nor do I claim welding tin and lead together by rolling under pressure; nor do I claim reducing compound metal by rolling generally or as a process by itself; neither do I claim trimming the edges of metal as a separate and distinct process; and I do not claim flatting rolls or shears, but intend to use such rolls and shears or trimming apparatus as may suit my purpose; but

I do claim as of my own invention—

The combined process, substantially as herein described, for producing ribbons or webs of compound foil—viz., by first welding the lead and tin together and then reducing in thickness by rolling; secondly, by trimming the edges and shearing off the exposed lead; and, thirdly, by reducing the trimmed sheets or ribbons into webs or ribbons of foil by rolling, each of these steps of the process and the process as a whole being substantially such as hereinbefore set forth.

In testimony whereof I have hereunto subscribed my name in the city of New York on this 5th day of March, A. D. 1861.

JOHN J. CROOKE.

In presence of—
W. B. NONES,
A. H. NONES.