Oct. 10, 1944. W. L. KEENE 2,359,993

WIRE TREATING METHOD

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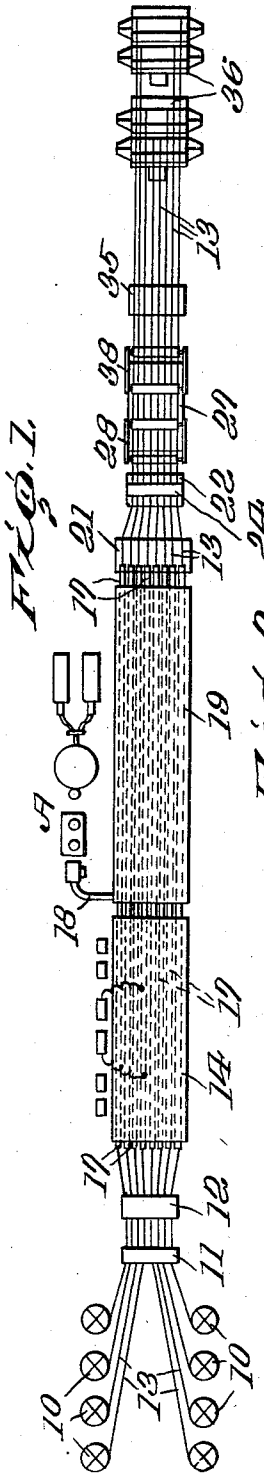


FIG. 1.

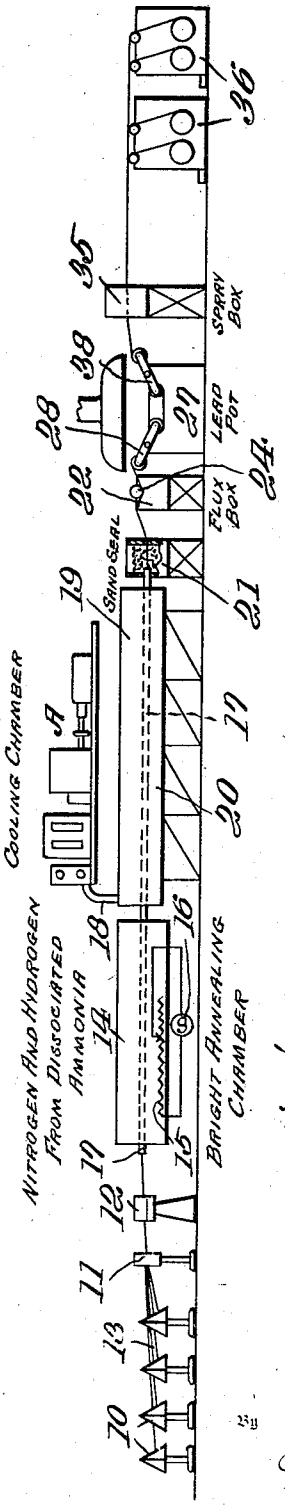


FIG. 2.

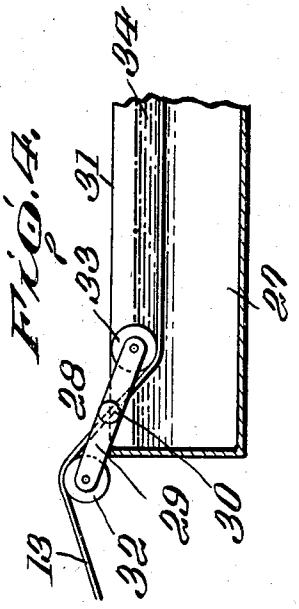


FIG. 4.

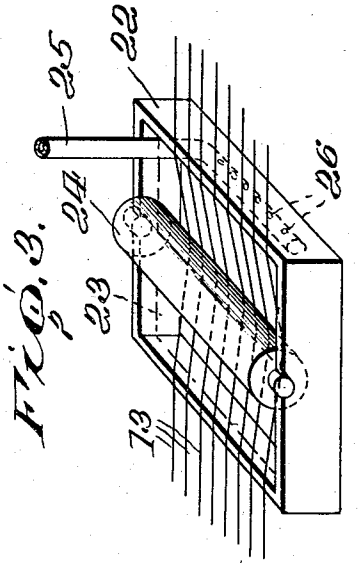


FIG. 3.

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WIRE TREATING METHOD

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7 Claims. (Cl. 117—51)

My invention relates to the treating of wire and the like for drawing purposes, and especially to the annealing and subsequent lead-coating of wire or similar converted forms fashioned of the ferrous alloys, especially the stainless steel alloys.

One object of my invention is the provision of a method and apparatus for annealing and leading ferrous alloy wire in a simple, rapid, efficient and thoroughly practical manner, correlating a desired annealing treatment of the wire with a thoroughly reliable leading operation giving a uniform and adherent coating to assure efficient drawing in a subsequent operation.

Another object is to produce a method of, and a unit for, continuously lead-coating wire formed of ferrous alloys, characterized by the economy both in time, investment in equipment, and costs of operation and maintenance, and in which the cost of supervision and labor is reduced to a minimum, all with the production of a uniform and adherent lead coating characterized by the absence of sticking between adjacent strands of the leaded wire when the latter is reeled, by the absence of stretching or breaking when the leaded wire is unwound, and by the comparative readiness with which the coated wire can be pulled through the dies.

A further object of my invention is to produce such a method of, and apparatus for, continuously lead-coating wires, possessing marked superiority in the coating of the finer sizes of wire, in the practice of which a uniform thin flux coating is applied and the flux loss is maintained at a minimum, and which method is characterized by its flexibility, and in which the equipment can be designed to handle any desired number of strands of wire.

Yet another object is to produce a composition for fluxing wires formed of ferrous alloys prior to lead-coating the same, characterized by its long useful life with a minimum of supervision and attention, and its low rate of consumption and low cost of operation.

Other objects and advantages in part will be obvious and in part pointed out hereinafter.

My invention accordingly consists in the combination of elements, features of construction and arrangement of parts and in the several operational steps, and in the relation of each of the same to one or more of the others, all as described herein, the scope of the application of which is indicated in the claims at the end of the specification.

For a more ready comprehension of my invention, reference may be had to the accompanying drawing, wherein, in schematic representation:

Figure 1 is a plan view of a continuous lead-coating unit according to my invention;

Figure 2 is an elevation view of the unit of Figure 1;

Figure 3 illustrates in perspective certain details of the flux box which I prefer to employ in the unit of Figures 1 and 2;

While Figure 4 shows in fragmentary elevation certain details of a sinker roller in the lead pot of the unit of Figures 1 and 2.

Like reference characters denote like parts throughout the several views of the drawing.

As conducive to a more thorough understanding of my invention, I may point out at this time, that in the cold-drawing of stainless steel wires, certain difficulties are encountered. It is of course, to be understood that the term wire includes not only wire as conventionally known, but also elongated solids of more important dimensions, such as rods, and in extreme cases, even strip metal. Thus wherever in the following specification and set of claims I employ the term wire, it is used in its more comprehensive sense. Furthermore, while the disclosure is directed particularly to the handling of chromium-containing stainless steels, it may also be employed advantageously in cold-drawing other ferrous alloys of considerable hardness and displaying a tendency towards embrittlement upon cold-drawing. My invention accordingly is directed to the treatment of wires formed of such metals.

Stainless steel wire, even in the fully annealed condition, is considerably harder than annealed wire produced from ordinary carbon or low alloy steels. Also, stainless steel has the peculiar property of seizing upon or galling the die during the cold drawing operation with the result that drafts on uncoated wire are limited to small percentages of reduction in area if a satisfactory cold-drawn surface and economical die life are to be realized. In the case of the austenitic stainless steels which rapidly work-harden during the drawing operation, the difficulties in drawing uncoated wire are greatly enhanced.

Thus, the practice has arisen of coating the stainless steel wire prior to cold-drawing with some suitable lubricant, such as lime or lead. Probably a lead coating has proved most satisfactory for the treatment of stainless steels, its use being especially advantageous where heavy drafts or reductions are used between temper-drawing or annealing steps. In general, the accepted practice consists in first annealing the wire, then pickling the same to remove the scale,

then lead-coating the wire, cold-drawing it until it becomes too hard or the lead coating too thin for satisfactory further reduction, then removing the lead coating by some suitable pickling bath, and then starting anew from the annealing step. After the wire has been reduced to the proper gauge, it is simply annealed and pickled to give a scale-free, clean, white surface.

In the actual method of lead-coating, conventional practice has recourse to a batch method of subjecting the wire to the lead bath. According to this customary practice, one or more coils of wire are dipped into a bath of molten lead, on the surface of which is carried an overlying layer of molten flux of special composition. The coil of wire, as it is submerged in the bath, first passes through the flux and then into the metal. By suspending the coil on a hook, it is possible to rotate it, both as it is lowered into the bath and while it is immersed therein, so that all surfaces of the metal come into contact, first with the flux, and then with the lead. When the operator is satisfied that the strands of the coil are properly leaded, the coil is raised from the bath, shaken as by twirling or the like to remove the excess lead, and water-quenched. The wire is then ready for cold-drawing.

It is apparent at once, that such method is intermittent and that because of this is time-consuming and requires large tank equipment and investment in proportion to the tonnage of wire which can be handled.

Furthermore, even assuming most favorable operating conditions with the flux in good condition and the lead at proper temperatures, the lead coating obtained, while continuous and adherent where clean wire is treated, is lumpy and varies widely in thickness from say $\frac{1}{1000}$ of an inch to as much as $\frac{1}{100}$ of an inch or even more. This occasions increase in cost of lead, since such lumps represent outright waste.

A further disadvantage of the batch process is that the lead coating on the several strands of wire which are wound in coils closely adjacent to each other tend to stick upon cooling from a molten condition. The water quench does not completely prevent this sticking. Thus, frequently two or more turns of wire are secured together. Upon unwinding the wire, the sticking together of the strands may cause the wire to stretch, or even to break. This problem is particularly serious in the case of wires of small diameters, say ¼ inch or less. Such a batch process requires careful supervision at all times by skilled labor.

In spite of the difficulties encountered in lead-coating by the batch process, the necessity of a suitable lubricant in cold-drawing stainless steels has caused recourse to some method of lead-coating to be practically invaluable in successful operation of a stainless steel wire mill. A considerable tonnage of stainless steel rods wound in coils, as well as the larger sizes of cold-drawn wire (annealed and pickled) is coated by this method.

An object of my invention is to produce a continuous method of lead-coating wires formed of stainless steels or other ferrous alloys, which is time-saving, requires a minimum of investment for given tonnage output, and which results in a coating which is extremely smooth, uniform, continuous and adherent. A further object is to produce such a method involving a minimum of cost of lead employed and a minimum both of energy input required and of wear on dies resulting from cold-drawing the lead-coated wire. A still further and very important object is to produce such a method of lead-coating wire in which all possibility of the several turns of the coated wire sticking together is avoided.

In the process of coating such wires it is necessary first to flux the same, in order to obtain an active or receptive surface, to which the lead will adhere. Although the wire is clean, bright and dry, following an annealing and pickling treatment it will not take up a coating when it is dipped into the molten lead unless it has thus been preliminarily fluxed.

In the batch process such as described, the practice has been to employ a flux consisting of a mixture of chlorides of zinc, ammonium and sodium. Such a flux melts at about 650° F. I find this flux to be fairly satisfactory. In operation, however, this flux continually loses ammonium chloride by volatilization, so that additions must be made from time to time. This flux is found to require constant stirring. For satisfactory operation, the flux must be cleaned or skimmed off once a day, and replaced by a batch made up fresh. Additionally, difficulty is experienced in keeping the layer of flux of sufficient depth or thickness to ensure a complete and continuous coating. In short, while the use of such a fluxing method is workable, it is found to be wasteful and to require constant attention. The flux is corrosive and tends to attack the pot, resulting in increased maintenance costs. Even with careful supervision, it is found that probably because of the close proximity of the adjacent turns of the coils of wire, the fluxing frequently is spotty, resulting in unleaded spots on the coils. This necessitates a repetition of the fluxing and leading step, with attendant appreciable increase in loss of time.

A further object of my invention is therefore, to produce a flux and method of fluxing for use in preparing stainless steel wire for taking a lead coating, which is characterized by its small loss of material from vaporization or volatilization, which requires little if any agitation, which requires but little supervision, which can be readily maintained at proper depth or thickness, which is economical and in the practice of which a thin, continuous and adherent coating of flux on the wire is ensured.

In the practice of my invention, I pass the wire continuously from take-off reels, through the several stations of the annealing and lead-coating units, to take-up reels. The speed at which the wire moves is so calculated, and the several elements of the annealing and lead-coating units are so dimensioned that the wire is retained at each station for the length of time required to carry out each operation in a satisfactory manner. Extreme flexibility of the apparatus results from the fact that within reason, any desired number of separate strands can be passed through the unit without contacting each other, all without materially increasing the volumetric dimensions of the unit and its several elements. This results in substantial economies, both in equipment and materials. Since the wire is unwound from separate take-off reels, and is passed over separate guide sheaves to separate take-up sheaves, the several strands of wire come into contact with one another at no point during the process and are entirely independent of each other. In the following discussion I will limit my description to but a single strand of wire, although it is to be understood that it is intended

that the method be applied to the simultaneous lead-coating of any desired number of strands.

Referring more particularly to Figure 1 of the drawing, a plurality of like constructed take-off reels 10 are provided. Eight of these are illustrated, indicating that this particular apparatus is adapted to handling eight strands of wire. It, of course, will be understood that it can be readily adapted to the handling of any other desired number of strands. In alignment with the take-off reels I provide guides 11, 12. These guides may be of conventional type, and are shown as of suitable anti-friction construction, to facilitate passage of the wires therethrough.

To initiate operation, the wire is received from the wire mill, and if coated, this coating is removed by suitable pickling baths. The coils of wire are then placed on the take-off reels 10. As shown, I prefer to dispose these reels 10 vertically, although it is of course quite feasible to mount them for rotation about horizontal axes, if this is desired. A tow-line is then attached to a strand of wire 13 from one of the take-off reels 10, and is passed through the guides 11 and 12, to an annealing furnace 14.

The annealing furnace may be of any suitable and conventional type. At the present time I prefer to employ a bright-annealing furnace heated by a regulatable electric heating element 15, energized from any suitable source of electric energy supply 16. Alloy tubes 17 extend longitudinally through the furnace 14, and the wire 13 is passed through one such alloy tube. Preferably, but a single strand 13 of wire is passed through any one alloy tube 17. However, it is feasible to pass two or more strands through each tube if desired.

The temperature of the furnace, the rate of movement of the wire through the furnace, and the length of the furnace are all so determined that the wire is brought to a suitable annealing temperature while in the furnace. During its passage through the alloy tubes, the wire is maintained in a controlled atmosphere free from any traces of oxygen, water vapor, carbon dioxide, carbon monoxide, or other oxygen-containing gases. Preferably it is washed with a stream of mixed hydrogen and nitrogen gases resulting from the dissociation of anhydrous ammonia gas. This mixture of gases is introduced into alloy tube 17 from an ammonia dissociating unit generally indicated by the reference letter A, through a suitable conduit 18. The gases prevent any oxidation or discoloration of the surface of the wire during the annealing operation, thus preserving the original clean unoxidized metal surface. Contamination from the outside atmosphere is prevented by assuring a flow of the mixed gases outwardly through the tube entrances. The gas preferably is burned at that point, thus giving visual indication of the outward flow.

As a continuation of the annealing furnace, I preferably provide a cooling element 19 through which extend the tubes 17 carrying the strands of wire 13. While this cooling element 19 may be of any suitable type now available, it preferably has a water-cooled cooling chamber 20 surrounding the tubes 17. The element 19 is so dimensioned, and the initial temperature of any refrigerant which may be employed is so selected, that by the time the wire 13 reaches the exit end of the furnace, it is cooled to room temperature.

I prefer to extend the tubes 17 to a sand box 21 shown partly in elevation and partly in section. This sand seal, in combination with the positive pressure of the gas, serves to prevent all ingress of air to the annealing furnace, thus guarding against oxidation of the wire therein. By the time the wire has passed through the sand seal it has cooled to a temperature at which there is no danger of significant oxidation upon exposure to air.

Upon passage from the sand seal, the wire is ready for fluxing prior to being subjected to coating in the lead pot. Accordingly, the wire is passed through a flux box 22, shown in greater detail in Figure 2. The flux box 22 contains a suitable flux, the surface of which is indicated at 23. A roller 24 is suitably mounted, as by trunnions, transversely of the box 22, and the wires 13 are forced in anti-friction manner by said roller beneath the surface of the flux. The flux is maintained at proper temperature by suitable heating means, as by steam exhausted through ports 26 of a steam pipe 25.

As previously indicated, the fluxing operation must precede the lead-coating step for, although the metal is clean, bright and dry when it comes from the annealing furnace, a flux must be applied before the wire enters the molten lead. If the fluxing step is omitted, the wire will not take the lead coating.

Considering more particularly the fluxing step employed, it is interesting to note the development work which I have undertaken in this direction. At first, I employed a welded mild steel tank, heated by means of a gas-fired immersion tube unit. In this unit I employed the same flux as had previously been used in connection with the known batch processes, that is, a flux consisting of a mixture of zinc, ammonium and sodium chlorides, either some or all, placed on top of the lead bath so that the wire would have to pass through the flux before it could reach the lead.

Although this technique proved moderately satisfactory, producing a fairly good coating, it nevertheless possessed serious disadvantages. First of all, the corrosive action of the flux resulted in destruction of guide sheaves and the like. In addition, the flux required constant stirring. Frequent additions of ammonium chloride were required to replenish this ingredient which was lost by volatilization. Furthermore, it proved to be necessary, for consistently satisfactory results, to clean off the spent flux each day and to replace it with flux made up fresh. Such a requirement, of course, is undesirable in a continuous method.

Moreover, difficulty was encountered in keeping the flux of sufficient depth to ensure complete and continuous covering of the metal with a coating of flux. Thus, while the method was found to be workable, it required constant attention, and was wasteful of flux. Moreover, a difficulty was encountered which also was present in the treatment of coils in the batch process, namely that sometimes not all parts of the surface of the wire were fluxed, so that these parts would not take the lead coating in the subsequent treatment. A spotty wire would result, with tendency to pull and give an unevenness of gauge and also to scratch the drawing dies. While such spotty leading was not so important in the instance of batch processing, where it was a relatively simple matter to re-lead a spotty coil, this drawback was serious in the case of my continuous process. Here the wire must be properly coated in the

first place, because there is little possibility of repairing the coating at a later time.

I next conceived the idea, which represents the structural embodiment of the flux equipment of my present unit, of fluxing the wire before passing it into the lead pot. To this end, I provide a container consisting of a small, open-top box, on which I mount a roller. The roller guides the wire through the flux, from whence guide sheaves conduct the wire to the lead pot proper, later to be described.

Before finally evolving the composition of flux which I now employ, I experimented with many types of fluxing agents. For example, I employed a flux consisting of a molten mixture of various combinations of zinc, ammonium and sodium chlorides. This was substantially the flux commonly used in the known batch process. This flux resulted in a fairly good lead coating, and the corrosive action of the flux was fairly well confined to the flux box. However, the flux taken up froze to the wire and displayed a tendency to crack off before the wire passed under the surface of the lead in the lead pot. Thus bare spots resulted to which the lead failed to adhere. This, of course, results in an undesirable action during the subsequent cold-drawing operation. Additionally, flux losses were found to be excessively high.

A second flux with which I experimented comprised concentrated hydrochloric acid and ammonium chloride. Here again, a fairly good lead coating was obtained, but the salt was observed to have a tendency to settle out of the acid. At times, by consequence, the wire was found to pick up no lead in the subsequent leading step. With the use of suitable mechanical agitators, however, I found this fluxing operation to be rather satisfactory.

As a further possibility, I had recourse to cold, water solutions of ammonium and other chlorides either with or without additions of acid. These fluxes, either with or without additions of acid, were found to be not particularly satisfactory, because too much water was carried over into and under the lead, where it exerted an oxidizing action on the wire, and by virtue of the oxide coating produced kept the lead coating from adhering to the wire.

Finally, I worked with a hot solution of water, non-oxidizing acid, and ammonium chloride. This flux I found to give a completely satisfactory performance, the wire thus fluxed taking a clean continuous coating of lead. Working from this general combination, I evolved a flux which I now prefer to use in production work, comprising a 10% to about 20% aqueous solution of hydrochloric acid saturated with ammonium chloride, and maintained at a temperature of at least about 200° F. Preferably I maintain an undissolved excess of ammonium chloride in the flux box **22**, to ensure that the solution is saturated with ammonium chloride at all times.

While I have illustrated a manner and equipment for heating the solution by the direct introduction of steam, it will be understood that other heating methods may be employed, although where steam is directly introduced, I find that the water supplied by the steam just about compensates for that lost through evaporation and that dragged out with the wire.

The efficacy of elevating the temperature is strikingly emphasized by my experiments, which show that over twice as much ammonium chloride can be dissolved in water at a temperature of 212° F. than can be dissolved at 68° F. The addition of the 10% hydrochloric acid apparently does not appreciably affect this solubility of ammonium chloride in water.

Referring back to the operation of my lead coating process, the bright annealed wire **13**, emerging from the cooling chamber **19** of furnace **14**, passes through this flux **23**, and picks up a coating of flux. While I am not certain of the exact action which the flux has on the wire, and desire not to be bound by my proffered suggestion, I surmise that the acid presumably activates the surface of the wire, and as the wire emerges from the solution **23** it carries a thin film of saturated ammonium chloride solution. Upon cooling, this solution throws off its excess ammonium chloride, most of the water evaporates, and the wire is then coated with a thin, uniform, adherent film of acidified ammonium chloride. The wire **13**, bearing the film of ammonium chloride, is then carried into lead pot **27**.

When the wire with its coating of acidified ammonium chloride is carried under the molten lead, the ammonium chloride volatilizes, thus further cleaning and activating the wire. This cleaning action is probably what prevents the formation of an oxide film on the wire, which if present would prevent the lead from adhering.

While best results are had with the flux thus described, in which the acid is in about the percentages noted, good results are achieved where a high or lower acid content is used. For example, I have found that satisfactory results are realized where the percentage of acid is varied from about 5% to about 100%. In all cases, however, it is desirable to have the solution saturated with ammonium chloride.

I have also found that for best operation, the flux, regardless of percentage composition, at all times should be maintained at a temperature of at least about 200° F. The boiling point for such a flux is about 250° F. I have found operation at a fluxing temperature lower than 200° F. to result in lead coatings which in the larger wire sizes are not completely satisfactory. By the use of such a temperature, I find that the wire carries over to the lead pot just the necessary quantity of flux. Satisfactory lead coatings are had and, moreover, the flux wastage is minimized.

While, of course, additions of both salt and acid are made from time to time as the flux is used up, no constant observation of the flux box is required. Since perfunctory supervision on the part of the attendants of the annealing furnace is sufficient for good results in the flux ing step, no direct labor is charged against the fluxing operation. The maintenance cost, therefore, is largely in the required heating and in salt and acid consumed.

I find it advantageous to dump the flux and make it up anew after a long shutdown of the unit, but one make-up will last about a week or so under normal steady operating conditions. After that, the old flux should be dumped and a fresh batch made up.

In the practice of my process, I find it sufficient, for satisfactory fluxing, to pass the wire through the flux for an interval as short as one second. A good lead coating is obtained with the flux taken up. The usual variation of fluxing time is from about one second to about five seconds, although a greater length of time is not prejudicial. Apparently the time spent is sufficient to heat up the wire enough to aid in drying

the flux retained as it leaves the flux bath. Moreover, the subsequent cooling of the wire and the adherent flux, apparently, tends to crystallize the flux, possibly because of the lower solubility of the salt at the lower temperature. In any event, I find that the time specified is sufficient to produce a satisfactory uniform adherent flux coating and a desired subsequent lead coating.

The flux composition which I have described will prove satisfactory for the rapid and efficient fluxing of practically all grades of stainless steels with the exception of those of the 18–8 type (18% chromium, 8% nickel) containing additions of molybdenum, columbium or titanium. I find, however, that the addition of a few percent of hydrofluoric acid, say about 1% to about 5%, to the flux will ensure proper fluxing of these grades. The extreme range of this addition is from about 1% to about 20%.

It may be noted here that although the addition of hydrofluoric acid is not necessary to the flux used for stainless steels of other than the 18–8 grades aforementioned, I find that small percentages of such acid added to the flux result in smoother, more even coating of the lead on all grades of stainless irons and steels. This no doubt is due to the avidity with which this acid attacks the surface oxides and impurities, as well as the surface metal itself.

Continuing with the operational steps of my process, as the wire **13** travels from the flux box **22** to the lead pot **27** (Figures 1 and 3), it passes over sinker roller **28** (Figure 3). This comprises an elongated rod **29**, pivotally mounted at its midpoint **30** on edge **31** of pot **27**. The ends of rod **29** carry in suitable bearings, anti-friction rollers **32**, **33**. The wire **13** passes over the topmost roller **32**, and thence down and under the roller **33**, being tensioned by take-up rollers, to be described. Roller **33** is fixed in a position partially submerged in the molten lead **34**. The moving wire is thus properly maintained in the lead bath in spite of the tension from the take-off reels and the tendency to lift the roller **33** out of the lead.

The wire **13** thus picks up a coating of lead on its passage through the pot **27**. This coating is continuous and adherent. The lead coating is found to be unusually smooth and even. This means good drawing in the dies. Moreover, it means a saving in lead, since lumps represent a waste of material. In the leading step of my process, I find that a good working temperature is around 700° F. This temperature preferably should range from about 700° F. to about 900° F.

Depending upon the temperature of the lead, smooth coatings up to several thousandths of an inch are obtained. For example, with the lead at a temperature of 700° F.±20° F., the normal thickness of coating ranges from 2 to 4 thousandths of an inch.

It is sufficient, for a satisfactory leading operation, after proper fluxing, to pass the wire through the molten lead for a period of from about 10 seconds to about 60 seconds, depending on the size of the wire.

As a practical matter, I find it advantageous in operation according to my new invention, to keep the surface of the molten metal **34** clean at the point of entry of the wire **13** thereinto. The rest of the surface of the lead preferably is covered with carbon to prevent loss of lead through oxidation by the atmosphere.

Following the passage of wire **13** through lead pot **27**, I pass the coated wire through spray box **35**. Here the wire is cooled by being subjected to a water spray. It then passes to variable speed take-up reels **36**. The cooling station **35** is a very important element in the lead-coating unit, in that by cooling the coating to room temperature, I ensure that the lead is cold before the strands of wire are wound into a coil on the take-up reels **36**. In this way I ensure a freedom from adjacent strands of wire sticking together when coiled. As a consequence, the wire does not stretch or break when it is unwound. This is of particular value in the coating of the finer sizes of wire. It will be found that the wire as wound on take-up reels **36** is soft, clean, perfectly coated and ready for drawing.

In addition to the foregoing, other noteworthy advantages are obtained by the practice of my invention. As contrasted with known batch leading technique, my new method possesses the advantage of requiring but little attention and direct labor inasmuch as it is in series with the bright-annealing step, so that the operators handling the annealing operation can also care for the lead-coating operation. The known batch method, as pointed out above, being an independent operation, is chargeable with its own labor and similar costs. Additionally, I find that my new method is extremely economical of flux materials, no more flux being employed than is actually needed. The absence of lumps in the lead coating and its uniformity minimize the costs of this material per ton of wire. No difficulty is encountered in maintaining the temperature of the lead at a constant value, and the lead coating produced is found to be smoother and more uniform in thickness and the wire consequently is found to be easier to draw and, moreover, to present a more uniform drawn surface and be more uniform in gauge.

As many embodiments and variations may be made of my invention, and as changes may be made in the embodiments hereinbefore set forth, it will be understood that all matter described herein or shown in the accompanying drawing is to be interpreted as illustrative, and not in a limiting sense.

I claim:

1. In the lead-coating of stainless steel wire, the art which comprises the steps, in a continuous process, of passing the wire through a bright annealing furnace employing a dry atmosphere of hydrogen and nitrogen; thence into a fluxing bath comprising an aqueous solution of hydrochloric acid and ammonium chloride, at a temperature of about 200° to 250° F., to form, upon withdrawal into the air a thin adherent coating of flux thereon; and thereafter passing the wire through a bath of molten lead at a temperature ranging from about 700° F. to about 900° F.

2. In the lead-coating of stainless steel wire, the art which comprises, in a process in which the wire is continuously passed through the several sequential steps of the process, the steps of passing the wire through a bright annealing furnace employing a dry atmosphere of hydrogen and nitrogen, thence through a cooling chamber likewise having a dry atmosphere of nitrogen and hydrogen, then passing the wire through an aqueous flux solution comprising hydrochloric acid saturated with ammonium chloride and at a temperature of about 200° to 250° F., thence through air to permit evaporation of the solvent and deposit of an adherent flux coating, and thereafter passing the flux coated wire through a bath of molten lead maintained between 680° and 900° F.

3. In the lead-coating of wire formed of stainless steel, the art which comprises, in a process in which the wire is continuously passed through the several sequential steps of the process, the steps of passing the wire through a heating chamber, thence through a cooling chamber, both containing cracked anhydrous ammonia, then passing the wire through an aqueous flux of hydrochloric acid saturated with ammonium chloride maintained at a temperature of 200° to 250° F. and thence into the air, and thereafter passing the wire through a bath of molten lead maintained between 680° to 900° F.

4. In the lead-coating of wire formed of stainless steel, the art which comprises, in a process in which the wire is continuously passed through the several sequential steps of the process, the steps of passing the wire through a bright annealing furnace, thence through a cooling chamber, subjecting said wire while in said furnace and cooling chamber to an atmosphere of dry hydrogen-nitrogen gas, then passing the wire through an aqueous flux of hydrochloric acid saturated with ammonium chloride and maintained at a temperature of 200° to 250° F. and thence out into the air to dry, thereafter passing the wire through a bath of molten lead maintained between 680° and 900° F., and then passing the wire through a cold water spray before reeling the same onto take-up reels.

5. In the lead-coating of stainless steel wire, the art which comprises the steps, in a continuous process, of passing the wire through a bright annealing furnace employing a dry atmosphere of hydrogen and nitrogen, thence into a flux bath comprising an aqueous solution of hydrochloric acid and ammonium chloride at a temperature of 200° to 250° F. in which any one part of the wire is subjected to said hot bath for a period of from about one second to about five seconds, removing the wire from the bath to permit the flux to dry thereon in the air, and thereafter subjecting the wire to a bath of molten lead maintained between 680° and 900° F. for a period of ten seconds to about sixty seconds.

6. In the lead-coating of stainless steel wire, the art which comprises, continuously passing the wire into a fluxing bath comprising an aqueous solution of hydrochloric acid, hydrofluoric acid and ammonium chloride at a temperature of about 200° to 250° F. to form, upon withdrawal into the air, a thin, adherent coating of flux on the wire; and thereafter passing the wire through a bath of molten lead at a temperature ranging from about 700° F. to 900° F.

7. In the lead-coating of stainless steel wire containing one or more of molybdenum, columbium and titanium, the art which comprises, continuously passing the wire through a heating chamber, thence through a cooling chamber, both chambers containing a dry atmosphere of hydrogen and nitrogen, then passing the wire through an aqueous fluxing bath of hydrochloric acid and hydrofluoric acid saturated with ammonium chloride and maintained at a temperature of about 200° to 250° F., and thence into the air to dry, and thereafter passing the wire through a bath of molten lead at a temperature of 680° to 900° F.

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