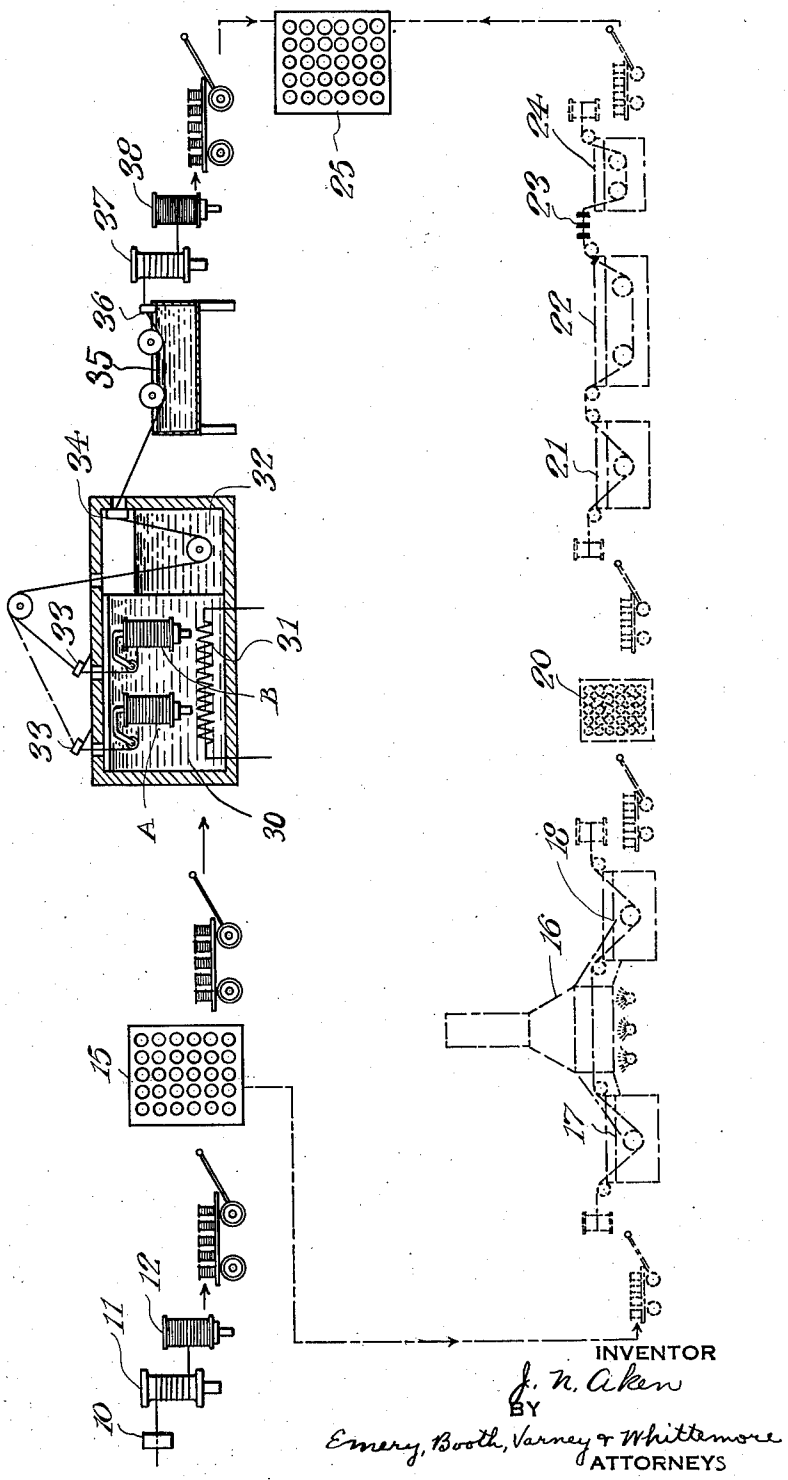
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METHOD FOR TREATING METALS

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METHOD FOR TREATING METALS

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This invention relates to the art of treating metals and has for an object the provision of improvements in this art.

It is believed that the invention will find its principal application in the tinning of copper wire. The invention was developed in this field and will be described with particular reference to this application; but it is known that the invention has broader aspects and uses so it is to be understood that the invention is not to be limited by reference to this particular field of use.

In order to illustrate the advance which the invention has made in the art it will be helpful to compare it with some of the best of the prior practices.

In a typical present-day wire making plant the drawing of the wire is usually carried out in one department or room; the annealing of the wire in another department or room; and the coating or tinning of the wire in still another department or room. The annealing, of course, is made necessary partially or wholly by the die-drawing process which hardens the wire.

After each of these processes the wire is left wound upon spools and, since it is impossible or perhaps impracticable to carry the wire directly from one process to the next, there is necessarily a considerable amount of inter-process storage. It is preferable to have storage immediately after the drawing process while the wire is hard rather than after the annealing process while the wire is soft because the hard wire does not oxidize nearly so badly as the soft annealed wire. It is one of the objects of the present invention to avoid entirely the storage of soft annealed wire.

According to the present practice annealing is carried out in a gas heated muffle, the wire (or at least copper and other non-ferrous wire) passing through water baths before and after entering the heating muffle. The water entering the muffle with the wire from the first bath must be evaporated during the annealing heating. This entails heat losses. Further, the annealing heat is lost for any succeeding process for the wire becomes completely cold after the annealing process. In addition the heat useful for annealing the wire has to pass through the thick muffle walls and through air or other gases which are poor conductors of heat. This entails further heat losses. Moreover, this method of heating to anneal seems to bake onto the wire any oil or dirt which may and usually does remain from the drawing process in a manner which seriously hinders subsequent cleaning and tinning operation. The water adhering to the wire from the last bath enhances oxidation while the wire is in storage.

Heretofore, the wire preparatory to tinning has been cleaned in an acid bath. This treatment eats away a certain amount of the wire; requires special and expensive castings; gives off dangerous fumes which cannot be turned into the air but must be especially treated and diluted to pass off into the sewerage, this again requiring expensive castings and other accessories; gets the metal into the tin bath to cause trouble; furnishes the wire in a cold state to the tin bath; and has other evil features. The present invention aims to eliminate these evils.

Coming to the coating or tinning treatment the fact that wire from the acid bath comes to the coating apparatus in a cold state requires a long bath of hot molten tin (or such other metal as may be used for coating) to bring the wire to heat. This gives time for the hot tin to attack the surface of the wire to cause dilution of the tin bath. Tests of such baths show the tin to be reduced to 98% or even as low as 94% purity. Below that it cannot be used. The necessary large bath of heated tin also has heavy vapor losses. The present invention aims to avoid these objectionable features; keep the tin bath in a substantially pure state; and provide certain additional benefits and advantages which could not be realized before.

Other objects and advantages of the invention will be apparent from the following description of a preferred form of the invention. The single figure of drawing is a diagram to assist the description.

According to the preferred form of the new invention as well as in the past practice the wire is taken from the drawing dies 10 by a constant speed capstan 11 and wound upon spools 12. These spools are subject to certain delay or storage before the next treatment. This storage point is designated by the numeral 15. The wire here is hard and will not readily oxidize.

Wire from storage point 15 may be used for various purposes. Perhaps only a relatively small part will be coated but it is this part which concerns the present invention.

Previously, as shown in broken lines, the wire was transported to an annealing oven 16 sealed at each end with water baths 17 and 18, wound again upon spools (unless run through the oven on the spools) and placed in soft wire storage at point 20. From the point 20 the wire was transported to the tinning apparatus and passed successively through the acid bath 21 and the tin

bath 22. Finally the wire passed through a series of wipers 23, a water cooling bath 24 and was wound upon spools. Thereafter the spools were transported to storage at the point 25.

In the new process shown in the diagram by full lines, the wire in common with the old process is taken from the storage point 15 and is finally delivered to the storage point 25 but between these points it travels a different route. The annealing and conditioning for the tinning treatment are both accomplished in one and the same treatment by passing the wire through a hot liquid bath 30. This may be an oil bath at a temperature of about 500° F., this having been found suitable for the grades and sizes of wire which have been processed to date. Corn oil has proved most satisfactory because it does not vaporize readily or create a fire hazard at the temperatures to be maintained. It also fulfills the major requirements of the process in a highly satisfactory manner. These requirements are: to anneal the wire, to give a light but effective film over the wire to prevent oxidation, and to act as a flux for the succeeding tinning treatment. In varying degrees other oils such as mineral oil, palm oil, peanut oil, etc. and even non-oleous substances such as molten salts, soaps, etc. have proved successful.

The flux-anneal bath may be heated in any desired manner. It lends itself very well to the use of an immersed electrical heating unit 31 which has various advantages such as avoiding conduction losses through the walls of the vessel containing the bath. With such an arrangement the whole unit may be thermally insulated as indicated by double lines in the drawing. Means of any suitable kind are provided for condensing the vapor from the bath so the liquid thus obtained may be re-used.

The wire from the annealing bath passes directly to the tin bath 32 so as to conserve the heat imparted to the wire by the annealing bath, though it is not necessary to keep the wire from the air since it carries a protective film of the annealing liquid. Thus annealing and tinning are made one continuous process requiring no intermediate soft wire storage.

Since the wire remains hot until it enters the tin bath the latter may be made very short. A bath of about 20% of the present bath capacity is adequate. The tin bath may be at about 450° F. so even with a slight cooling after leaving the annealing bath the wire enters at about the same temperature as the tin bath. A short bath does not give the wire time to go into solution in the tin. Also the bath is rapidly used up and renewed. Both of these factors aid in maintaining the bath in a high state of purity.

It is to be noted that the supply spools of wire are disposed within the annealing bath thus permitting the wire to heat before it is unreeled. For each take-off spindle there are in the bath 30 two spools of wire, spool A annealing while spool B is being run off and vice versa. For annealing #30 copper wire it should be in the bath at 500° F. about five minutes. Then, no matter what drawing speed through the tin bath may be wanted the annealing treatment will not prevent its realization. A speed of 600 ft. per minute has been found to give good results for #30 wire. A wipe 33 is used for the wire leaving the annealing bath while a wipe 34 is used for the wire leaving the tin bath. Thereafter the wire may be passed through a cooling bath 35 provided with wipe 36.

If the spindles for the spools on which the wire is reeled from the tinning bath run at constant speed the wire will be pulled through the bath at varying speed which increases as the spools fill up. This causes a part of the wire, when the spool first starts to fill up, to be over-tinned on account of its slow speed through the bath while when the spool is almost completely filled the wire is under-tinned due to its increased speed through the bath. According to the present process a uniform coating is put on the wire throughout its entire length. This is provided by drawing the wire through the bath at constant lineal speed.

Herein capstans 37 have several turns of the wire placed around them and are run at a constant speed to deliver the wire to spools 38. The spools 38 are driven in resilient fashion as by friction drive means to take up the wire as fast as it is delivered from the capstans.

It is found that the wire is cleaner when produced by the present process due to the fact that it has not oxidized as much as it did with previous methods and of course dirt and oil from the drawing process have not been burned into the wire as they were in the dry annealing process. The hot oil used in the present method acts to remove the oil and refuse left on the wire by the drawing process.

Also it is noted that a thinner and more even coating of tin is present when the wire reaches the wipe than with previous processes. There is very little excess tin on the wire at this point. Whereas two wipes were previously necessary, satisfactory wire can now be produced with one wipe, and even then very little tin is collected at this wipe.

There is a great saving in time by the new process due to the fact that there is no storage of wire as previously between the annealing and tinning treatments. Considerable saving in floor space is also realized because of the fact that one storing is omitted; because one treating device is omitted; and because the treating devices which are retained are much smaller than previously. Further, a great deal of labor is saved by omitting operations and avoiding unnecessary handling between operations. Mention has already been made of the saving in heat. Tin is also saved because the oil appears to form a film on the surface thereof to reduce dross. Tests carried out according to the method of the American Society of Testing Materials, Specification B 33—21 "Standard Specifications for Tinned Soft or Annealed Copper Wire for Rubber Insulation" have shown that the coating applied according to the present process is superior to coatings previously applied. Of seven samples of wire tinned according to the present process and seven samples of wire tinned according to the generally acknowledged as best previous commercial process the following comparative results were obtained:

Previous:
- 3 samples failed at 5 cycles.
- 2 samples failed at 6 cycles.
- 1 sample failed at 8 cycles.
- 1 sample failed at 11 cycles.

Present:
- 2 samples failed at 9 cycles.
- 2 samples failed at 13 cycles.
- 3 samples failed at 14 cycles.

In addition to the above advantages the cost of acid is saved and the danger of operators being burned by acid or injured by acid fumes is avoided. The oil or other fluid used is an added

cost but is much less than the saving effected on the acid alone.

While one embodiment of the invention has been described for purposes of illustration it is to be understood that the invention is not thus limited but may be variously embodied within the scope of subjoined claims.

What I claim is:

1. The method of treating unannealed copper wire which comprises, storing spools or packages of the wire in hot corn oil until the annealing temperature is reached, unreeling the wire from such spools while alternate spools of wire are annealing, passing the wire as it unreels from the oil bath and before it cools, into a hot tin bath, wiping the wire to remove excess tin, passing the wire through a cooling bath and a drying wipe, and winding the wire at constant lineal speed upon spools.

2. The method of treating unannealed cuprous wire which comprises, subjecting the same to an annealing-fluxing bath of hot corn oil which removes adherent substances from the previous die-drawing process, forms a protective film thereover and anneals the wire, and subsequently while the wire is hot subjecting it to a tinning bath in a separate vessel for the purposes set forth.

3. The method of treating cold-worked, cuprous wire which comprises subjecting the wire to a hot fluxing-annealing bath of oleaginous material for a period long enough and at a temperature high enough to flux and anneal the wire, removing the wire from the fluxing-annealing bath, and subjecting the wire to a bath of molten metal to form a metal coating thereon.

4. The method set forth in claim 3 in which the cuprous wire is passed before cooling from the annealing oil bath through the metal-coating bath.

5. The method set forth in claim 3 in which the annealing oil bath is in a separate vessel and is of a higher temperature than the metal-coating bath and in which the cuprous wire passes from the annealing bath to the coating bath so as to reach the latter at approximately the temperature thereof.

6. The method of treating cuprous wire which comprises subjecting the wire to a hot bath of oleaginous material for a period long enough and at a temperature high enough to effect an annealing-fluxing treatment at a single stage, and subsequently tinning the annealed wire.

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