Aug. 31, 1965 M. J. STOBIERSKI 3,203,826

METALLIC COATING OF WIRE

Filed Sept. 12, 1962

Fig. 1.

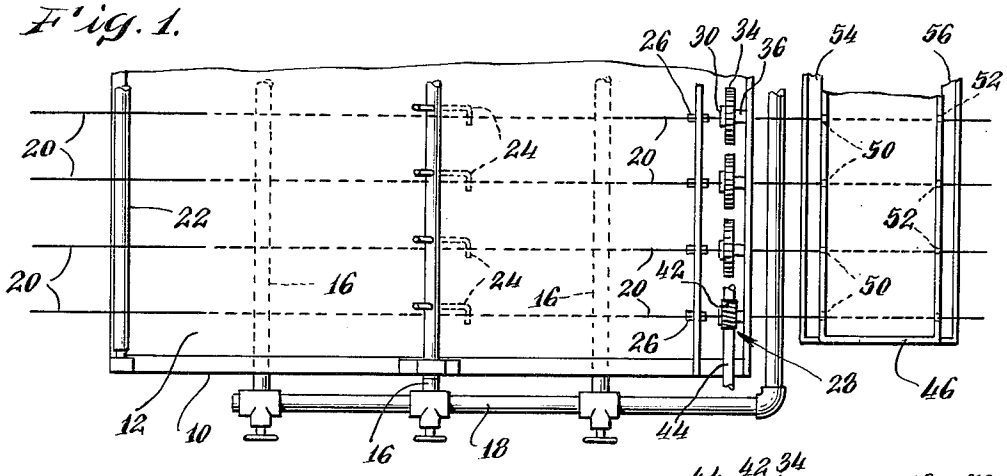


Fig. 2.

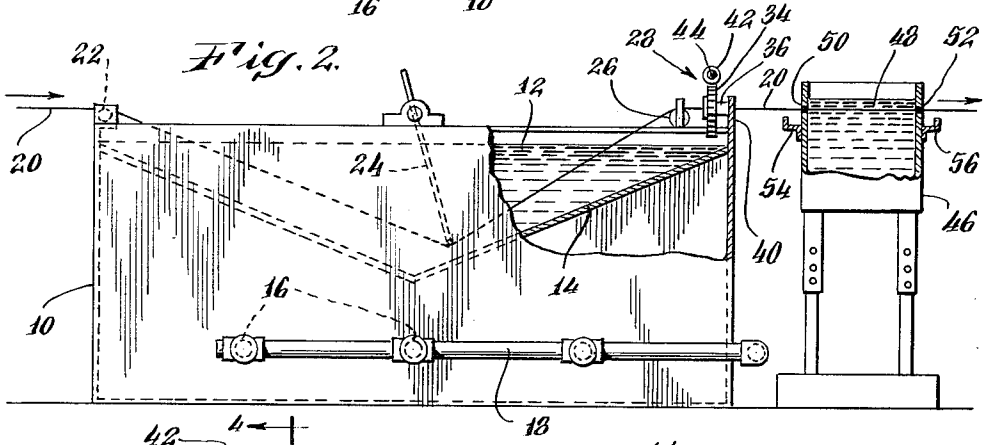


Fig. 3.

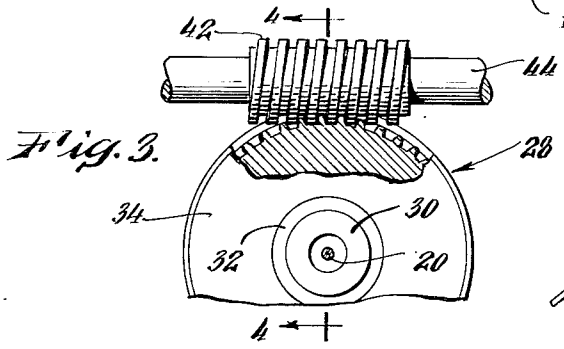


Fig. 4.

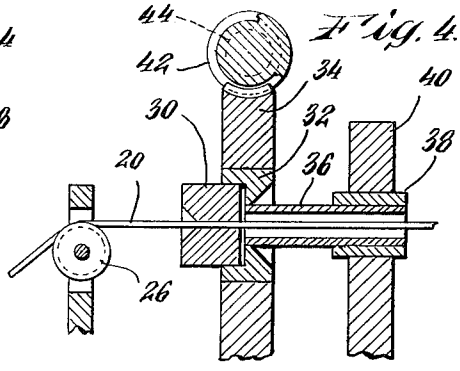
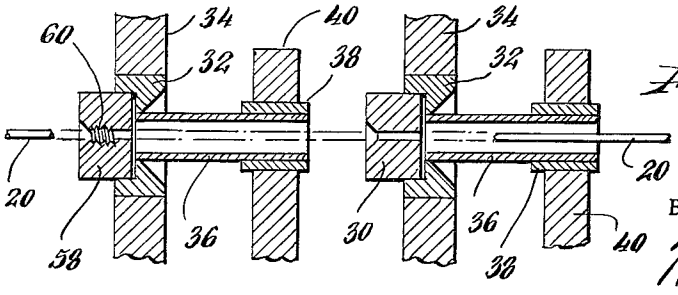


Fig. 5.



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METALLIC COATING OF WIRE

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9 Claims. (Cl. 117—102)

This invention relates to the metallic coating of wire, and more particularly to an improved method and apparatus for applying a smooth, fault-free coating to a wire.

In the wire manufacturing art it is customary to apply a coating of a dissimilar metal to a metallic wire. The manner in which tinning of a wire is accomplished is set forth in detail in my copending U.S. patent application Serial No. 100,634, filed April 4, 1961, now U.S. Patent No. 3,085,547, dated April 16, 1963. As explained therein, a number of wires to be tinned are treated simultaneously but independent of one another. The individual wires are drawn from suitable coils through an acid cleaning tank and then through wipes of cotton waste to remove surplus acid. The wires are then passed into a water rinse tank where they dip down into the water under guides that are submerged beneath the water surface. The emerging wires are passed through stationary cotton wipes whereby most of the water is removed and are then passed through an acid tank and then a flux tank. Upon leaving the flux tank they are once again wiped by waste so as to remove excess acid and flux while leaving enough for the subsequent tinning operation. The actual tinning operation involves passing the wire into a bath of molten metal which is retained in a molten state by suitable gas burners under the tank. Upon leaving the tank of molten metal, the wire is wiped to remove any excess and to leave a smooth finish. In the prior art and in the invention disclosed in the referenced application, this wiping step is accomplished by means of fabric wipes, such as cotton or asbestos. After wiping, the coated wire is passed into a water tank for cooling. This is accomplished by passing the wire downwardly into the tank, under a guide positioned in the bottom of the tank and then up and out of the tank. The cool water causes the molten coating to congeal and harden on the surface of the wire. The wire is then wiped again before passing onto suitable reels or similar devices which may also function as power drives for drawing the wires through the coating machinery.

One difficulty faced in the metallic coating of wire is that the molten metal bath often contains inclusions, such as small metal splinters. When using a stationary wiper there is a tendency for such splinters to collect at the leading edge of the wiper and cause a pile-up of the molten metal coating. This causes defective coating and increased scrap production.

Another disadvantage of prior art tinning methods is that fabric wipers have a relatively short life. In order to overcome this latter disadvantage it has been proposed to employ diamond dies. These dies are customarily formed of diamond chips embedded in brass and are consequently expensive. As the diamond itself is used as the cutting or smoothing surface, it will be seen that a very thin cutting edge is employed. Dies of this type do not prevent the pile-up of metallic slivers, as previously referred to, but they do have increased temperature resistance during normal operation. However, all operation is not normal. For example, the melting furnaces customarily employed in the wire coating industry are manually controlled. Occasionally the heat will "run away" and increase to a point far beyond that required to maintain a molten condition. Under circumstances such as these, the brass may soften so as to release the diamond chips embedded therein and ruin the die.

A still further disadvantage of all wipers known to the prior art is that, if the wire coating machine comes to a stop, the coating on the section of wire between the molten metal surface and the wiper congeals. The metallic coating is then uneven and the wiper is ineffective until this portion has passed. Accordingly, every time the machine stops a certain amount of scrap is created. It would, therefore, be desirable to heat the wire that extends between the molten metal surface and the wiper to resoften the coating metal. However, the wipers presently employed are incapable of withstanding the necessary temperatures.

A still further disadvantage of prior art wire coating methods arises from the construction of the water rinse tank that is employed immediately following the wiping step. In prior art water cooling tanks the wiped wire with the still soft metallic coating is passed downward into the rinse tank, under a guide, and up out of the tank. It will be apparent that there is a tendency for the soft metal surface on the wire to flow as the wire dips downward into the tank. This also results in an undesirable unevenness of coating.

It is, therefore, an object of this invention to provide an improved wire coating method and apparatus. Other objects are to provide such method and apparatus which result in a reproducibly uniform metallic wire coating; wherein a minimum of scrap results; and wherein more efficient and less costly procedures may be followed in coating wire.

The manner in which the above objects are attained will be more apparent from the following description, the appended claims and the figures of the attached drawing, wherein:

FIG. 1 is a plan view of apparatus constructed in accordance with this invention;

FIG. 2 is an elevational view of the apparatus of FIG. 1 shown in partial cross section;

FIG. 3 is an enlarged front view of the novel die of this invention;

FIG. 4 is a cross section taken along the line 4—4 of FIG. 3, and

FIG. 5 is a cross section showing a variation of the die of this invention.

in FIGS. 1 and 2 there is illustrated a tank **10** which supports a bath **12** of molten metal above oppositely inclined walls **14** which form the bottom of the tank. A series of suitable gas burners **16** connected to a gas supply header **18** maintain the molten metal at its proper temeprature. The wires **20** coming from the pretreating procedure pass over the guide roller **22** and under guides **24** in the molten bath. At the opposite end of the tank the wires **20** emerge and pass over suitable guides **26** to a coating die assembly **28** manufactured in accordance with this invention.

The die assembly **28** is illustrated in detail in FIGS. 3 and 4. The advantages and objects of this invention are achieved by means of a metal die **30** which has a relatively long bearing surface as compared to the wire diameter. Furthermore, the metal die **30** may be rotated while the wire **20** passes through it. The metal that is used for the die may be chosen from a wide variety of suitable metals. However, it is important, of course, that the metal not stick to the coating material. For example, stainless steel makes a suitable die for use in tin coating, but stainless steel sticks to lead. However, titanium metal is suitable for applying lead coatings to wire. Rotation of the die may be important under some circumstances. As pointed out above, metallic slivers that are present in the melt and are carried along on the wire surface tend to pile up on prior art dies and wipers and thereby prevent the application of a smooth, continuous coating to the wire. The rotation of the die of this invention prevents such an accumulation. Furthermore, the length of the bearing surface must be greater than the diameter of

the wire. An approximate lower limit for the length of the hole in the die is approximately five times the diameter of the wire. The upper limit of the length is defined merely by the friction which occurs as the wire passes through the bearing. The internal diameter of the hole is the same as the external diameter of the finished wire.

As an example of a die manufactured in accordance with the invention, a bearing length of approximately 5/16 inch has been found suitable for use with a .040 inch diameter hole. In the illustrated embodiment of FIGS. 3 and 4 a titanium die **30** is shown mounted in the copper hub **32** of a gear **34**. Gear **34** is rotatably mounted on a hollow shaft **36** supported in a bearing **38** supported by an upper rim **40** of tank **10**. Gear **34** is driven by a worm **42** mounted on a drive shaft **44** which extends across the top of tank **10** and simultaneously rotates all dies. After passing through the rotating die **30** the wiped wire **20** passes into a water rinse tank **46**, as illustrated in FIGS. 1 and 2.

The tank **46** is of a novel configuration which greatly assists in maintaining a uniform wire coating. It will be noted that in this embodiment the wire **20** is not required to be passed down into the water **48** contained in tank **46**. In place of such a structure, the tank **46** is provided with a series of holes **50** along one side and a series of holes **52** along its other side. Holes **50** and **52** are positioned on lines that are parallel to one another and at the same level. Furthermore, these holes are positioned just below the surface of water **48**. Accordingly, as the newly coated wires **20** pass through the water bath **48** in tank **46**, they are maintained in a horizontal position. This prevents the newly applied coating from running along the surface of the wire and forming a nonunifrom coat. Holes **50** and **52** are only slightly larger than required to pass the wire. However, to compensate for the water leakage that will still occur, gutters **54** and **56** are provided beneath each row of holes to collect the water and suitable refilling means (not shown) are provided for replenishing the water supply.

It will be apparent that a number of advantages are achieved by this invention. The metallic die which, unlike wire drawing dies has a long bore, is highly novel in and of itself. The die is positioned over the molten metal tank so that it forces any splinters and excess globules of coating material off the wire surface and allows them to drop back into the metal tank. Furthermore, the die being relatively massive, it provides an effective heat sink. For this reason its temperature does not increase rapidly and it is relatively insensitive to even large variations in metal temperature. For example, if the machine illustrated in this application were to stop for any reason, the length of wire between the surface of metal bath **12** and die **30** would not be lost to scrap as in the prior art. The congealed metallic coating could be easily restored to a liquid state, for example, by means of a torch or by a ladle of hot metal poured over the wire. Furthermore, this may be done without affecting the operation of die **30**. Wire travel could then be resumed without formation of imperfectly coated wire.

A variation of the rotating die of this invention is illustrated in FIG. 5. In this illustration the wire **20** is shown as passing through two sets of rotating dies. The first die **58** is constructed in a similar fashion to that previously described except that at least a portion of its wire bearing surface is threaded as at **60**. After passing through this threaded die the wire passes through the standard die **30**, such as previously described. The die illustrated in FIG. 5 is of particular advantage in coating very large wire. The threaded die performs two valuable functions. First, it serves to assist in advancing the wire **20** through the two dies. Secondly the threads **60** act as a reservoir for excess molten metal. The threads continually collect and redistribute molten metal along the surface of wire **20** so that a much smoother and more uniform coating is thereby achieved. In addition, if the molten metal is unusually "dirty," the rotation of die **58** may be reversed in opposition to the advance of wire **20**. This has the effect of speeding up the wiping action, returning inclusions to the bath at a greater rate. The threads, of course, do not cut into the surface of wire **20**.

Many variations and modifications of this invention will be apparent to those skilled in the art. For these reasons the foregoing description is to be construed as illustrative only rather than limiting. This invention is limited only, the scope of the following claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of applying a metallic coating to a wire which comprises: immersing said wire in a molten metal bath to deposit a molten metal coating thereon; smoothing said coating by passing the coated wire through a metallic die having a continuous rigid wire-engaging bearing surface therethrough having a length at least five times the diameter of said wire; rotating said metallic die to smooth said metal coating; passing the coated wire through a cooling liquid rinse; maintaining said wire in a substantially horizontal plane within said rinse; and removing the smooth coated rinsed wire therefrom.

2. The method of applying a metallic coating to a wire which comprises: immersing said wire in a molten metal bath to deposit a molten metal coating thereon; passing the coated wire through a metallic die having a continuous rigid wire bearing surface having a length at least five times the diameter of said wire; rotating said metallic die to smooth said metal coating; and removing the smooth coated wire therefrom.

3. The method of applying a metallic coating to a wire which comprises: immersing said wire in a molten metal bath to deposit a molten metal coating thereon; smoothing said coating by passing the coated wire through a metallic die having a continuous rigid wire-engaging bearing surface therethrough, the length of said bearing surface being at least five times the diameter of said wire; passing the coated wire through a cooling liquid rinse; maintaining said wire in a substantially horizontal plane within said rinse; and removing the smooth coated rinsed wire therefrom.

4. Apparatus for applying a metallic coating to a wire strand which comprises: means for applying a molten metal coating to said strand; die means comprising a rigid metallic body defining an elongated wire-smoothing passage therethrough, said passage having an internal diameter substantially equal to the diameter of the finished coated wire and a length at least five times its diameter; and means for passing said wire strand through said passage to smooth said metal coating.

5. Apparatus for coating a wire strand which comprises: means for applying a molten metal coating to said strand; die means comprising a rigid metallic body defining an elongated wire smoothing passage therethrough, said passage having a length at least five times its diameter; means for passing said wire strand through said passage to smooth said metal coating; and means for rotating said die means about substantially the longitudinal axis of said passage.

6. In apparatus for wiping excess coating material from a wire as it passes from a bath of melted metal, rotatable mounting means defining a mounting opening therethrough; a hollow shaft in alignment with said opening and supporting said mounting means; rigid metallic die means positioned in said opening and defining therethrough an elongated wire-smoothing passage having a length at least five times its diameter; means for passing the wire as it issues from the bath through said passage and said hollow shaft; and drive means for rotating said mounting means and die means about said wire in a plane normal to the longitudinal axis of the wire passing through said passage.

7. Apparatus for coating a wire with metal which comprises: a bath of melted metal; rotatable mounting means

defining a mounting opening therethrough a hollow shaft in alignment with said opening and supporting said mounting means; rigid metallic die means positioned in said open ing and defining therethrough an elongated wire-smoothing passage having a length at least five times its diameter; means for passing the wire as it issues from the bath through said passage and said hollow shaft; drive means for rotating said mounting means and die means about said wire in a plane normal to the longitudinal axis of the wire passing through said passage; and water-filled cooling tank means adapted to receive said wire and including a first wall defining a wire receiving opening below the normal water surface and a second wall defining a wire discharging opening, said receiving and discharging openings being positioned at substantially the same level.

8. In apparatus for wiping excess coating material from a wire as it passes from a bath of melted metal, the improvement which comprises: rotatable mounting means defining a mounting therethrough; a hollow shaft in alignment with said opening and supporting said mounting means; metallic die means positioned in said opening and defining an elongated passage, at least a portion of said passage comprising a thread encircling said wire; means for passing the wire as it issues from the bath through said passage and said hollow shaft; and drive means for rotating said mounting means and die means about said wire in a plane normal to the longitudinal axis of the wire passing through said passage.

9. In apparatus for wiping excess coating material from a wire as it passes from a bath of melted metal, the improvement which comprises: first rotatable mounting means defining a first mounting opening therethrough; a first hollow shaft in alignment with said first opening and supporting said first mounting means; first metallic die means positioned in said first opening and defining an elongated first passage, at least a portion of said first passage comprising a thread encircling said wire; second rotatable mounting means defining a second mounting opening therethrough; a second hollow shaft in alignment with said second opening and supporting said second mounting means; second metallic die means positioned in said second opening and defining an elongated wire smoothing second passage; means for passing the wire as it issues from the bath sequentially through said first passage, first shaft, second passage, and second shaft; and drive means for rotating each of said first and second mounting means and first and second die means about said wire in a plane normal to the longitudinal axis of the wire passing through said passage.

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