Feb. 18, 1930. R. H. KIENLE 1,747,940

METHOD OF ENAMELING WIRE

Filed March 30, 1923

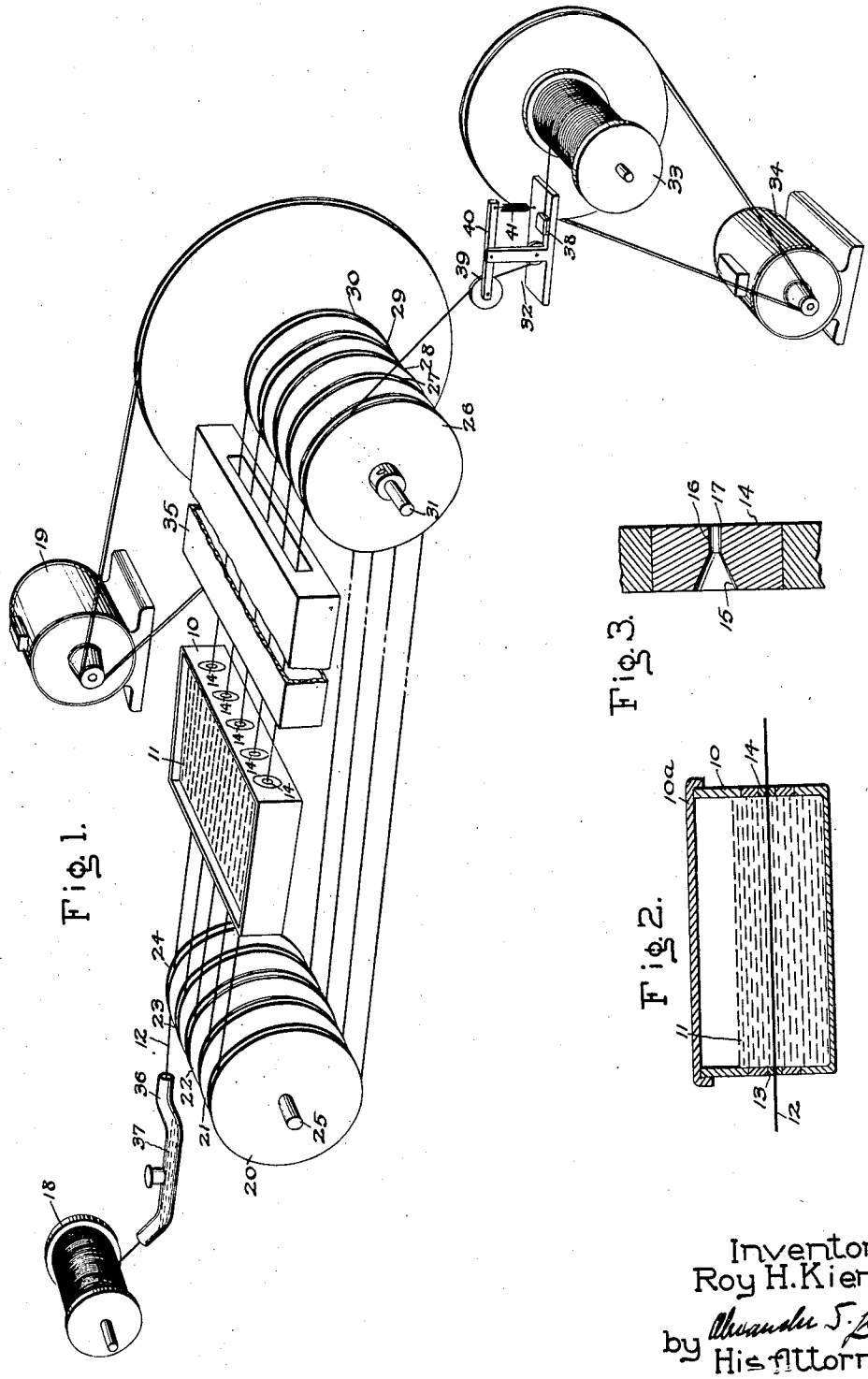


Fig. 1.

Fig. 3.

Fig. 2.

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Patented Feb. 18, 1930 1,747,940

UNITED STATES PATENT OFFICE

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METHOD OF ENAMELING WIRE

Application filed March 30, 1923. Serial No. 628,909.

My invention relates to the art of enameling wire and has for its object the provision of means and method whereby electric conductors, particularly the smaller sizes of wire, may be enameled at comparatively high speed.

With the usual process of enameling wire in which the wire is simply drawn through the enamel and then suitably dried, the speed at which a smooth, even coat can be applied is limited. For example, with a wire having a diameter of .003 inches, the maximum enameling speed with this method is approximately 30 feet a minute. If this speed is exceeded the enamel is not evenly applied and takes the form of drops or globules spaced at intervals on the wire with little or no enamel between. This phenomena is known as beading, and is due to the action of a number of forces, among which may be mentioned the adhesive property and surface tension of the enamel. Felt wipers have been used to prevent this beading action at high speed, their function being to remove the excess enamel. A great disadvantage of such wipers is that they must be continually watched and replaced as soon as they become saturated with enamel, otherwise beading results.

In carrying out my invention, I provide a wiper which operates continuously to prevent beading at high speeds whereby the speed at which the wire can be enameled is limited only by the mechanical characteristics of the apparatus and the wire, for example, the speed at which the enamel can be dried and the allowable tension which may be applied to the wire.

For a more complete understanding of my invention, reference should be had to the accompanying drawing in which Fig. 1 is a perspective view showing in somewhat diagrammatic form apparatus for enameling wire embodying my invention; Fig. 2 is a section view showing the wire passing through the bath of enamel; while Fig. 3 is an enlarged section view showing the wiper for removing the excess enamel.

Referring to the drawing, the apparatus for enameling wire in one form of my invention comprises a suitable container 10 for the bath of enamel 11. The wire 12, which is to be enameled, is passed through suitable oppositely disposed pairs of submerged dies 13 and 14 (Fig. 2), mounted in opposite walls of the receptacle 10, back and forth transversely through the bath of enamel whereby the coating of enamel is applied in a number of layers. The number of applications or layers of the enamel applied depends on the thickness of the final coat desired, and the dies 13 and 14 are suitably graduated in size as the diameter of the wire increases with each application.

The dies 13 (Fig. 2) are of the usual form, the orifices of the aperture of each die having bevelled or rounded edges. These dies fit the wire 12 tightly enough to prevent leakage of the enamel from the container 10. The dies 14 are of special form and are made of a suitable hard wear resisting material, such as agate, sapphire or diamond. These dies act not only to prevent the enamel from escaping around the wire, but also act as wipers to remove the excess enamel. The aperture of each is formed at its inner orifice with an enlarged portion 15 which tapers gradually to a comparatively short cylindrical portion 16 leading to the outer orifice 17. This cylindrical portion acts as a wearing surface and also acts as a wiper. The diameter of the portion 16 is somewhat larger than the diameter of the wire 12 which is being enameled. This diameter depends somewhat on the nature of the enamel used and its specific gravity. The outer orifice 17 leading into the cylindrical portion 16 has a substantially square edge, this edge being smoothed off very slightly just enough to prevent scraping of the previously applied layers of enamel as the wire is drawn therethrough. The dies 14 may be conveniently constructed by boring the tapered portion 15 of the aperture from the inside and then boring the cylindrical portion 16 from the outside after which the edge of the outer orifice is smoothed as previously described.

The function of each die 14 is to remove the excess enamel as the wire emerges from the bath of enamel and its action is so efficient that the enamel will be applied smoothly and

evenly, practically regardless of the speed of the wire. If a die, similar in shape to the dies 13, that is, having the edges of its orifices beveled or rounded off, were used, small quantities of the enamel would collect in the bevelled outer orifice around the wire which in time would be carried off by the wire in the form of drops or globules whereby beading would result. When the edge of the outer orifice is square, however, there is no chance for the enamel to collect around the wire and therefore, no beading will occur.

The level of the enamel in the container 10 is maintained above the dies, particularly above the dies 14 to prevent exposing the wire to the collection of particles of dust and lint after it has been passed through the enamel and before it reaches the wiper die as would occur were the wiper die mounted, for example, above the container. Any such particles of dirt or lint tend to clog up the wiper die and thus decrease its effectiveness. A cover 10[a] is provided for the container as a protection for the enamel.

As shown in the drawing, the wire 12 is drawn from a supply spool 18 by means of an electric motor 19 and passed back and forth through the receptacle 10 through the pairs of dies 13 and 14, five pairs of dies being shown, whereby the wire is given five successive layers of enamel. The wire is guided back and forth from the pair of dies to the next by means of a set of pulleys 20 to 24 inclusive, mounted on a shaft 25 adjacent the left hand side of the receptacle 10 and a similar set of pulleys 26 to 30 inclusive mounted on a shaft 31 situated on the oposite side of receptacle 10 a short distance therefrom. Shaft 31 is driven by the motor 19, pulley 26 being secured to the shaft 31 and forming the tractive element, pulleys 27 to 30 inclusive being mounted loosely on the shaft which acts as a bearing for them. Pulleys 20 to 24 are likewise loosely mounted on shaft 25 which acts as a bearing. Pulleys 20 to 24 inclusive and 27 to 30 inclusive are held in definite axial positions in their respective shafts by suitable spacing members. The wire is given a turn around pulley 26 which acts in effect like a capstan to exert a tension on the wire thus pulling it from reel 18 through the apparatus. Following the course of the wire from reel 18, it will be observed that it passes first over the guide pulley 24 and then through the enamel bath via the first pair of dies, downward over the guide pulley 30, back underneath receptacle 10 and upward over guide pulley 23, thence again through the enamel bath, downward over guide pulley 29, back underneath the receptacle 10 and upward over guide pulley 22, again through the enamel bath, and downward over guide pulley 28, back underneath receptacle 10 and upward over guide pulley 21 again through the bath and downward over guide pulley 27, back underneath the receptacle 10 and upward over guide pulley 20 and again through the enamel bath to the pulley 26. From pulley 26 the wire, which has now a coating of enamel, passes through a suitable tensioning device 32 and is then wound up on a reel, or spool 33, driven by an electric motor 34.

After emerging from the enamel bath, the wire in each instance passes through a suitable drying oven 35 which may be heated in any suitable manner, but preferably by electricity. This heater is situated between the receptacle 10 and the guide pulleys 26 to 30 inclusive so that the enamel is immediately dried after the wire emerges from the bath.

Before being passed through the bath of enamel, the wire is first passed through a suitable container 36 filled with cleaning bath 37 made of a suitable compound such as a mixture of alcohol and acetic acid which removes all grease and copper oxide, thoroughly cleaning the wire.

A suitable slip connection or coupling (not shown) is provided in the driving connection of motor 34 whereby a substantially constant winding tension is exerted by the motor on the wire as it is wound up on spool 34 regardless of the change in diameter of the spool as the wire is wound on. When the wire is first wound on the spool little or no slip takes place between the spool and the motor but as the spool is filled this slip increases, in a well known manner, in proportion to the increased diameter of the spool. The tensioning device 32 is provided to apply the proper winding tension in winding the wire on spool 33. It comprises clamping plates 38 preferably made of felt, between which the wire is drawn after passing over an idler pulley 39 which is secured on the end of an arm 40. This arm 40 is biased upward by means of a spring 41 whereby slack is taken up between pulley 26 and the clamping plates 38.

In the operation of the enameling apparatus the wire is first passed by hand from the spool 18 through the apparatus and suitably fixed to the empty spool 33. The enlarged tapered orifices 15 of the dies 14 facilitates the threading of the wire therethrough. A suitable cleaning solution is then poured in the receptable 36 and the enamel 11 poured in receptacle 10 after which motors 19 and 34 are started up and the enameling process takes place automatically. Previous to the starting of the apparatus, the drying oven is brought up to the desired temperature and is maintained at this temperature throughout the enameling operation.

With this apparatus it is possible to use an enamel having a comparatively high specific gravity so that the gravity of the enamel is not subject to any appreciable change due to the escape of vapors in the air. Periodic testing of the enamel and thinning to main-

tain its gravity substantially constant is therefore unnecessary. In fact, the only attention to the enamel required is to replenish the supply as it is used.

While I have described my invention as embodied in concrete form and as operating in a specific manner in accordance with the provisions of the patent statutes, it should be understood that I do not limit my invention thereto, since various modifications thereof will suggest themselves to those skilled in the art without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

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

1. The method of enameling bare wire which consists in drawing the wire at a high speed through a bath of enamel and then through a wiper provided with an outer orifice having a square edge.

2. The method of applying a coating of enamel to a wire which consists in drawing the wire at a high speed through a bath of enamel and then through a die provided with an abruptly terminating forming surface.

3. The method of applying a coating of enamel to a wire which consists in drawing the wire at a high speed through a bath of enamel and then through a hard, wear-resistant die provided with an outer sharply defined orifice.

4. The method of applying a coating of enamel to a wire which consists in drawing the wire at a high speed through a bath of enamel and then through a die provided with an orifice having an edge square in cross sectional planes passing longitudinally through the opening in the die, whereby a uniform coating on the wire is obtained.

5. The method of enameling wire which consists in drawing the wire at a high speed through a bath of enamel and then through a die provided with a round orifice having an edge square in cross-sectional planes passing longitudinally through the opening in the die whereby a uniform coating on the wire is obtained.

In witness whereof, I have hereunto set my hand this 29th day of March, 1923.

ROY H. KIENLE.