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PROCESS FOR PRODUCING AN INSULATING COATING ON ARTICLES CONTAINING ALUMINUM

Filed March 15, 1928

Fig. 1.

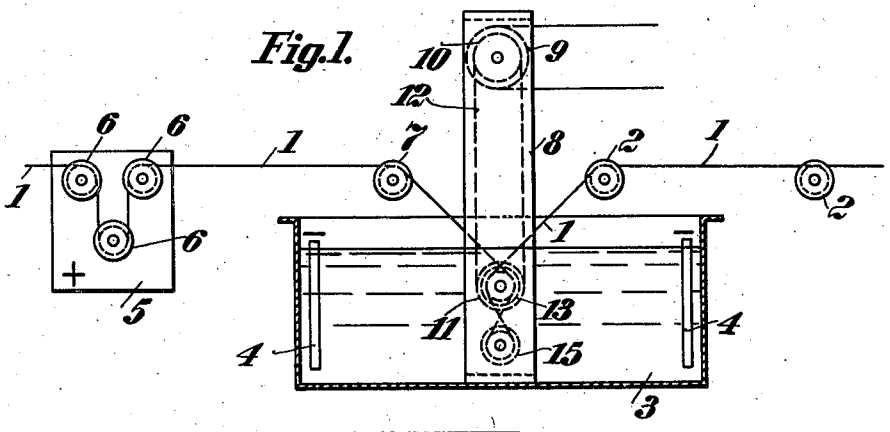
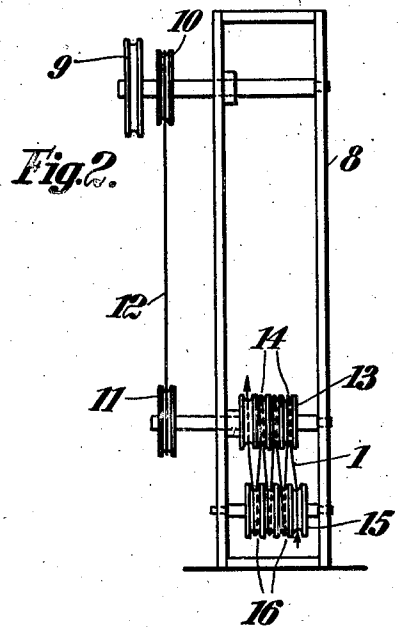


Fig. 2.



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UNITED STATES PATENT OFFICE

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PROCESS FOR PRODUCING AN INSULATING COATING ON ARTICLES CONTAINING ALUMINUM

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It is generally known that aluminum and aluminum-alloys are coated, when exposed to the air, with a thin oxide layer which, for certain purposes, is sufficient as electric insulation. For other purposes the thin oxide coating produced in this manner is however not sufficient as insulation, and in such cases it is necessary to provide a thicker insulating layer on the aluminum or aluminum alloys. This is done, in a manner known per se, by producing either by electrolytic process or by the action of suitable chemical fluids solidly adhering coatings or precipitates of aluminum oxide or other aluminum combinations on the metallic surfaces. It is for instance possible to produce the insulating layer on the metallic surface by treating the article with oxidizing liquids, gases or vapours. The aluminum or the like might further eventually be provided with covers of another type having an insulating effect.

In the use of such covers and coatings exists however under certain conditions a difficultly in so far, as the insulating covers of aluminum oxide or the like produced in this manner are brittle, and break or peel consequently easily when flexible articles, as wires, bands, thin plates and the like having these covers, are being bent; or the brittle coatings might even cause the breaking of thin wires, bands or sheet metal plates.

It has been found that this inconvenience can be avoided by submitting the articles to be fitted with the insulating covers to a mechanical treatment while they are being treated with the fluid (liquids, gases or the like) designed to produce the coating or precipitate. This mechanical treatment effects a kneading of the coating during its formation and can consist for instance in continuous or intermittent hammering, beating, rubbing or to and fro bending of the flexible metal articles in such a manner, that the insulating cover forming on the same is produced during this treatment. This cover has then the desired elasticity and will neither break nor peel at the bending of the metal articles. The cover which has been formed can serve, owing to its elasticity and great resisting capability, with advantage also as protecting layer against other influences than electric, coming from the outer side.

The new process may be carried out in a simple manner, for instance in that the wires or bands of aluminum or aluminum alloys, which for example are treated as anode in an electrolytic bath, are guided through the bath over pins or rollers arranged alternately in different positions, so that the wire or the band conducted over the same adopts a serpentine or zig-zag shape. The wire or the band is therefore, when passing through the electrolytic bath, alternately bent to and fro and thus submitted to the mechanical kneading treatment during the formation of the oxide layer and in accordance with the present invention. For the electrolytic bath, bases or solutions of salts can be used, which have an oxidizing effect; solutions of organic acids as oxalic acid or the like or inorganic acids as chromic acid or nitric acid are preferably used as bath-liquid. In a quite similar manner the mechanical treatment can be carried out also when the formation of the oxide layer or the like has to be produced by the action of gases or vapours on the metallic surface. Other means for bending to and fro and for other mechanical treatment of the wires, bands and sheet metal plates during the formation of the insulating layer may evidently be used also.

When the process is carried out in such a manner that the wire or the like is conducted in the medium producing the coating over rotatably mounted rollers, the arrangement may be made so that a rotatably mounted body of regular or irregular shape, having a spiral groove, serves as guiding for the wire or the like so that on one and the same roller several different bendings are given to one wire. The arrangement is preferably made so that several rollers are provided, and the wire is conducted several times around the same. The desired to- and fro-bending is specially favoured when at least one of the rollers rotates in a direction opposite to the direction of rotation of the other rollers. This might be obtained for example by juxtaposing an odd number of rollers over which the wire or the like is conducted in serpentine

shape, so that the 2nd, 4th, 6th roller and so forth turn in opposite direction as the 1st, 3rd, 5th and so forth. The same result may be obtained by providing a number of rollers, between which the metal wires, strips, bands or plates pass in such a manner that their paths cross one another. In this manner a specially good milling or kneading of the coating is obtained, as the bending of the same is carried out alternately in opposite directions. The rollers or cylinders may further have a roughened, irregular or undulated surface, for instance teeth, so that the wire or the like is not only bent several times but also submitted on the surface to a mechanical treatment.

The continual bending of thick wires requires much power and causes a strong friction on the rollers and in the roller bearings. The same is the case for thin wires, when a greater number of bending points or rollers are provided. When therefore metals are to be treated which possess only a low tensile resistance or a considerable dilatation or expansion, it is advisable to reduce the tensile stress as much as possible and to drive at least some of the guide rollers with that speed at which the wire or the like has to be conducted through the oxidizing medium. In certain cases all guide rollers for the wire and this wire itself may be conducted at similar speed, i. e. driven from one single outer driving mechanism, whereby a complete relieving of tension is obtained for the wire or the like. The guide rollers or their driving means may be preferably arranged on one or several movable supports to be inserted into the bath or the like in order to save room and to facilitate attendance. The arrangement may be further made, that several wires or bands are simultaneously treated in the same bath.

An embodiment of an apparatus for carrying out the invention is diagrammatically illustrated in the accompanying drawings, and by way of example an electrolytic oxidation-apparatus with continuous current is selected. The apparatus may however work with alternating current.

Fig. 1 shows the bath with the apparatus and the means for feeding and delivering the wire.

Fig. 2 shows the supporting frame carrying the bending device and the driving means.

The wire or metal band 1 to be oxidized or coated is supplied from the left over tensioning- and guiding-rollers 6 and 7 into the bath 3 and delivered from the bath over pulleys 2 to the winding-up device. The metal rollers or pulleys 6 are mounted on an electricity conducting plate 5 or the like, which forms the one pole and at continuous current the positive electrode, so that the bare wire becomes positive by touching this current supply. In the bath 3 plates 4 or the like are immersed which are connected to the other pole of the source of current. The bending to and fro of the wire 1 takes place, according to the invention, on two disks or rollers 13, 15 rotatably mounted in a supporting frame 8. Each roller 13, 15 has several guide grooves 14, 16 respectively, so that the wire is wound several times around the rollers and conducted in these guide grooves. The grooves of the one roller are slightly staggered or set off with regard to those of the other roller. Instead of using one roller with several parallel annular grooves, a number of rollers might be used having each only one guide groove and the individual rollers may be mutually movable in a certain limit. The wire is conducted so that it crosses between the two rollers 13 and 15, the bending direction of the wire being reversed each time at the transition from one roller to the other. In order to relieve the wire of the tension as much as possible, the roller 13 is driven from the outer side. With this object in view a driving pulley 9 is mounted on the frame 8, which carries the rollers 13 and 15, on the outer side of the same, and connected by a chain or rope drive 10, 11 to the axle of the roller 13, said pulley 9 being driven in a suitable manner, for instance from a motor. Other guide rollers, for instance those 15, 6, 7, or 2, may also be driven in a similar manner. The reel or winding up device for the finished wire and eventually also the drum from which the bare wire comes, may be driven at the same speed so that the wire is relieved of any tension, even when it is bent to and fro in a great number of windings. Instead of arranging the guide rollers 13, 15 as shown the one above the other in an upright frame 8 on horizontal axles, a horizontal frame may be used in which the rollers are journalled the one at the side of the other on vertical axles. The upright or vertical frame has the advantage that the points at which the wire to be treated enters into and comes out from the bath are situated in the surface of the bath. Several wires may be located at the same time in the same bath, when several bending and guiding devices are arranged, which may all be driven from the same point.

Having now particularly described and ascertained the nature of my said invention, I declare that what I claim is:

1. The method of subjecting flexible articles of metal containing aluminum to a treatment with an oxidizing agent and simultaneously to a kneading process until the oxide coating formed is rendered flexible.

2. Method to provide on flexible articles of metal containing aluminum a solidly adhering elastic cover, consisting in that the articles are treated with a fluid designed to produce a coating layer on the surface of the articles and are bent to and fro during the treat-

ment with the fluid simultaneously compressing, rubbing and kneading the entire surface of the said layer until the coating layer is rendered flexible.

3. Method to provide on flexible articles of metal containing aluminum a solidly adhering elastic cover, consisting in that the articles are treated with the fluid designed to produce a coating layer on the surface of the articles and are conducted over rotatable rollers adapted to bend the articles alternately to and fro in the medium producing the coating and simultaneously knead the entire surface of the coating layer.

4. Method to provide on flexible articles of metal containing aluminum a solidly adhering elastic cover, consisting in that the articles are treated with a fluid designed to produce a coating layer on the surface of the articles and are conducted over rotatable rollers adapted to bend the articles alternately to and fro in the medium producing the coating and to thoroughly knead the entire surface of the coating formed, at least one of the said rollers being positively driven.

5. A process of improving coverings of aluminum oxide formed on the surface of a metallic article which contains aluminum consisting in subjecting the article during the formation of the said covering to a mechanical treatment by which its entire surface undergoes tensile and compressive stresses.

6. Method to provide on flexible articles of metal containing aluminum a solidly adhering elastic cover, consisting in that the articles are treated with a fluid designed to produce a coating layer on the surface of the articles and said coating layer is submitted during its formation to a mechanical treatment, adapted to thoroughly compress and rub said layer until it is rendered flexible.

In testimony whereof I have hereunto set my hand.

ERNST WOLFGANG KÜTTNER.