May 19, 1942. J. K. DELANO 2,283,798

APPARATUS FOR ANNEALING WIRE

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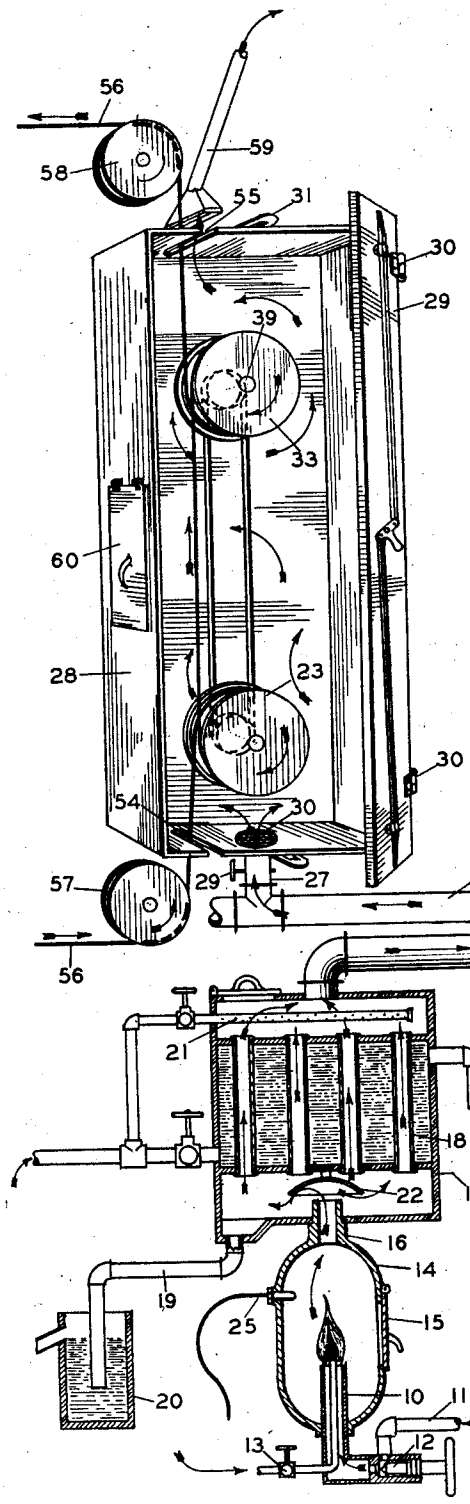


Fig.-1

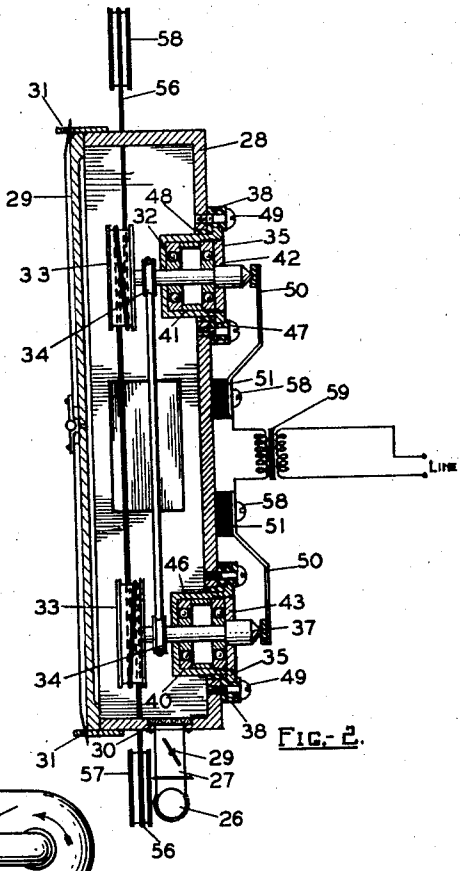


Fig.-2.

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APPARATUS FOR ANNEALING WIRE

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1 Claim. (Cl. 266—5)

My present invention relates to a novel apparatus for the prevention of oxides from forming upon wire during the annealing process. The invention is specially adapted for use in the annealing of copper wire which is to be insulated by coating with insulating varnish or other similar insulation. The device for carrying out the method may be installed in connection with a wire insulating machine, or in other machines where it is desired to anneal the wire. The invention is also suitable for use with wire drawing machines, to allow the wire to be drawn and annealed so it can be wound directly upon the spools so as to do away with the extra handling of the wire as practiced in the trade today.

When the annealing of the wire takes place in the open air, the temperature to which the wire is subjected is extremely critical, and if raised too high, a film of oxide forms giving the wire a false surface, upon which the insulating material will be coated. With the insulating material adhering to this false surface, when the wire is stretched or twisted, a cracking or flaking of the false surface will take place, resulting in the breaking of the insulation at these places.

When copper wire is drawn to smaller sizes from the original rod, the number of times required to reduce its diameter before final size is reached causes the surface of the wire to appear in places, when viewed under a microscope, to resemble a tree with the bark flaking off. This is due to the surface being hardened by passing through the dies while the center or core of the wire remains soft, causing the hardened portion to have stresses which cause it to peel away from the parent core.

These flakes, splinters, or projections are extremely minute but are a source of trouble in producing a good dielectric coating as they frequently project from the wire, and when the coating is dry, the flakes or splinters will be protruding through the insulation, thus producing a puncture in the film of insulation.

It is the usual practice to endeavor to clean the wire before insulating by passing the wire through dry sand or felt to scrape these particles from the wire. Unless the felt or sand is being continually renewed, the accumulated copper dust will aggravate instead of remedying the condition.

Another source of poor insulation is caused by the lubricating greases or soaps used in the drawing dies. These cling to the wire and carbonize during the annealing and afford poor adhesion and bad dielectric.

An object of my invention is to cause any oxides or tarnish, on the surface of the wire being annealed, to be reduced so the surface of the wire is clean and bright; and foreign matter being thrown off the wire due to its flexing and speed of travel through the annealing process.

Another object of my invention is to provide an apparatus for preventing the forming of oxides during the annealing process.

Another object of my invention is to provide an apparatus for annealing, whereby the wire being annealed is kept in rapid motion and surrounded by an atmosphere of inert or reducing gas while it is being heated, to prevent oxidation.

With these and other objects in view, my invention consists in certain novel construction and combination of parts as will hereinafter be fully described and claimed and further illustrated in the accompanying drawing which forms a part hereof, and in which like figures of reference refer to corresponding parts in all of the views, and it is understood that slight changes may be made without departing from the spirit of the invention.

In the drawing:

Figure 1 is a schematic view of the apparatus for generating the inert or reducing gas, and the housing for annealing the wire.

Figure 2 is a sectional side view of the annealing housing.

Referring to the drawing:

It is understood that the device is to be mounted in or adjacent a suitable wire machine having means for imparting movement or travel to the wire to carry it through the device, and as the construction and operation of such machines is well known in the art, it is unnecessary herein to describe the means for imparting movement or travel to the wire.

The device comprises a burner 10 with means for connecting it to a gas supply 11, such as "city gas" with a valve 12 for controlling its flow and a valve 13 to control the air required to produce an "air deficient flame." To retain this generated gas or the products of combustion and prevent the addition of any outside air, the burner 10 is enclosed in a housing 14 provided with a weighted air-tight door 15 and a pipe 16 for taking away the inert gas thus generated. The door 15 provides an opening through which the burner 10 may be ignited, and also acts as a safety valve to relieve any inside pressure due to any undue expansion of the gas and air.

A standard thermostat 25 is also enclosed in the housing 14 and connected by a magnetic sole-

noid or other suitable device to close the gas valve if the flame should be extinguished. This is not shown as it is common in the art.

From the housing 14, the gas is carried by the pipe 16 to a water cooled condenser 17 where the inert gas is cooled by the water tubes 18 to remove the water vapor of combustion from the gas. This water vapor is condensed on the tubes 18 and settles to the bottom of the condenser 17 where it is carried off by the pipe 19 to the water trap 20 to prevent any gas from escaping or air from entering the condenser 17.

For any soot or combustion products which is being carried by the inert or burnt gas will be deposited upon the tubes 18 so I have provided a sprinkler pipe 21 in the top of the condenser 17 by which the tubes 18 may be washed to remove any residue which may cling thereon and also may be used if desired to wash the inert gas, although the scrubbing or cleaning of the gas can be done in a separate compartment. To prevent this washing water or the condensed water vapor from entering the housing 14, a hood 22 is suspended over the inlet pipe 16.

From the condenser 17 the gas is carried by the pipes 23 to a suction blower 24, driven by a suitable motor not shown, at a speed fast enough to carry away as generated the inert gas, but not fast enough to break the water seal in the trap 20, and at the same time fast enough to cause air for combustion to be drawn in at the mixing valve 13.

From the outlet of the blower 24 and by the pipes 26 and 27 the generated gas is delivered to the annealing devices 28, of which only one is shown, through the control valves 29 and wire gauze 30 preventing any possible explosion in the annealing device 28 from flashing back into the supply line.

The annealing device 28 comprises a rectangular box of cast iron, or other suitable material, equipped with a door 29 swung upon the hinges 30, so as to permit the door 29 to be closed and tightly held in place by the catches 31 thus providing an air-tight door.

Centrally located in the back of the housing 28 and adjacent each end are two holes 48 through which the insulating bushings 47 extend. Through these bushings 47 are inserted metal tubes 46 formed with a flange 38 on their outer ends and shoulders 32 on the opposite ends. This tube 47 is held in place by the screws 49 through the flange 38 and insulating bushing 47 to the housing 28, thus insulating the tube 46 from the housing 28.

The tube 46 is threaded adjacent its flanged end to receive the lock nut 35 which locks the bearing assembly in place. This bearing assembly consists of a shaft 39 formed with a shoulder 36 midway of the shaft and one end pointed or rounded 37. Abutting this shoulder 36 is a roller bearing 40, a spacer 41, and another roller bearing 42; the whole assembly held against the shoulder 36 by the lock nut 43.

On the opposite ends of the shafts 39 are secured the two sets of sheave wheels 33 and 34. The outer set 33 having the wire to be annealed strung around them; and the inner set 34 connected by a drive belt composed of insulating material such as canvas, cloth, leather, rubber or some other suitable material. When the wire 56 is pulled from the upper sheave wheel 33, the lower sheave wheel will be turned by the insulating belt so as to take any strain or pull from the wire 56 while it is hot, thus preventing the wire from stretching.

The pointed ends of the shafts 39 projecting through the housing 28 are electrically connected by flat springs 58 to the back of the housing 28. By extending one of the shafts 39 the sheave wheels 33 and 34 may be driven by some suitable source of power.

A narrow slot 54 in the base of the housing 28 has been provided to allow the wire 56 to enter from the spool 57 and a similar narrow slot 55 provided in the top to allow the wire 56 to leave to the spool 58.

Above the housing 28 is placed a hood or flue 59 for connection to a suitable chimney for catching and removing any gas escaping from the slot 55 to prevent the entrance of any gas into the surrounding room. The slight gas pressure in the housing will prevent any air from entering by the slots 54 and 55.

A weighted air-tight door 60 secured upon the side of the housing 28 provides a safety valve by which any undue pressure will escape if a combustion should take place within the housing.

In the operation of the device; I take ordinary "city gas", although it is possible to burn charcoal, coal, petroleum or its various distillations, and burn it under similar conditions in a tightly enclosed chamber, as chamber 14, resulting in an inert reducing gas. This gas is drawn by the blower 24 through a water cooled condenser 17 which chills the gases and causes the water of combustion to separate from the gas and is carried off by the waste drain 19 through the trap 20 which prevents any escape of the gas or the entrance of air.

This burnt or inert gas propelled by the same blower 24 and piping 23 and 26 is now supplied to the annealing devices 28 through the valves 29 and mesh screen 30.

The secondary of a transformer 59, whose primary is connected to a source of power, is connected to the screws 58 in such a manner that when the current is turned on and the wire 56 is around the sheaves 33, a closed circuit will be made through the wire 56 which will result in the temperature of the wire 56 being raised to any temperature desired in proportion to the amount of current delivered. So by a suitable rheostat, not shown, for raising or lowering the current of the transformer, the temperature of the wire 56 will also be raised or lowered.

The wire 56 will then be raised to annealing temperature in the presence of the inert gases and as soon as it leaves the electrical current between the two sheave wheels 33 and 34 the wire will commence to cool, and the housing 28 may be extended, if required, to allow the cooling of the wire 56 in the presence of the inert gas.

Copper wire that is black from age, or badly tarnished, will, when run through this device be just as clean and bright again as though it were just newly drawn or bright acid dipped.

The heating of the oxidized wire in the reducing or inert gas appears to cause the oxide to change over to metallic copper again and combine with the parent copper. This change also seems to occur with the copper particles or splinters which are present on the wire; they appear to be re-fused into the base metal as through the copper has been remelted, which is not possible as the annealing temperature is not even red heat.

The travel of the wire at high speed around the pulleys 33 and 34 of the annealing device, and the expansion and contraction of the wire under heating and cooling, causes any carbonized soap or inert matter to leave the surface of the wire and accumulate at the bottom of the enclosing box 28 where it can be periodically cleaned out; instead of being carbonized on the wire and unable to leave it, which would be the case if the wire were spooled and then annealed.

The products of the burner flame have been referred to as an inert or reducing gas in the specification; no doubt the gas is composed of a combination of combustion gases such as CO, CO_2, and H, and also other products of incomplete combustion. The important part in producing the best results appears to have enough flame to cover the air inlet at the point of combustion so all the air must pass through the flame, and that just enough air be admitted to support combustion so that it burns with a dark center and yellow edges.

The relief doors 15 and 60 in the burner housing 14 and annealing box 28 are provided, in case the raw gas should get into the system and be ignited. This condition might arise should the flame become extinguished.

With the above process the wire is dead soft annealed without oxides. Any oxides formed previously or during annealing are reduced and all foreign matter adhering to the wire is removed. By the employment of the insulated belt, the wire is not stretched, thus resulting in a perfectly clean, bright, annealed wire ready for enameling and requiring no further scouring or cleaning.

Having thus described my invention, what I claim is new and desire to secure by Letters Patent is:

Apparatus for annealing fine wire subject to stretching comprising a driving pulley and a driven pulley, said pulleys being mounted in spaced relation in a housing and electrically insulated therefrom for rotation with a driving shaft and a driven shaft, respectively, said pulleys being adapted to carry and continuously advance a continuous strand of wire which during operation of the apparatus is continuously supplied to the driven pulley and continuously withdrawn from the driving pulley and makes at least one complete pass around each pulley; means to apply electrical heating current to the wire between the pulleys; and mechanical means connecting the driving shaft with the driven shaft and electrically insulated from said shafts to rotate the driven shaft from the driving shaft and at the same speed as the driving shaft; whereby the increments of wire which during operation of the apparatus are advanced in a heated condition from the driven pulley to the driving pulley are substantially relieved of tension.

JAMES K. DELANO.