July 18, 1939. J. KARMAZIN 2,166,109

METHOD OF MAKING TUBING FOR REFRIGERATING APPARATUS

Filed June 11, 1936 2 Sheets-Sheet 1

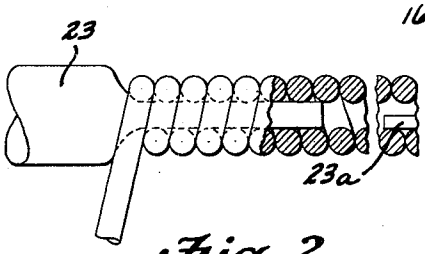


Fig. 2

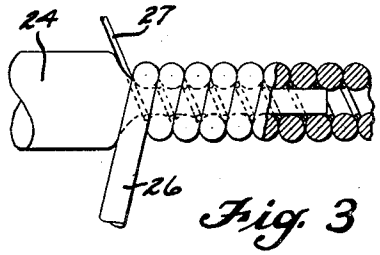


Fig. 3

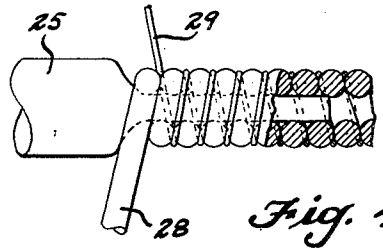


Fig. 4

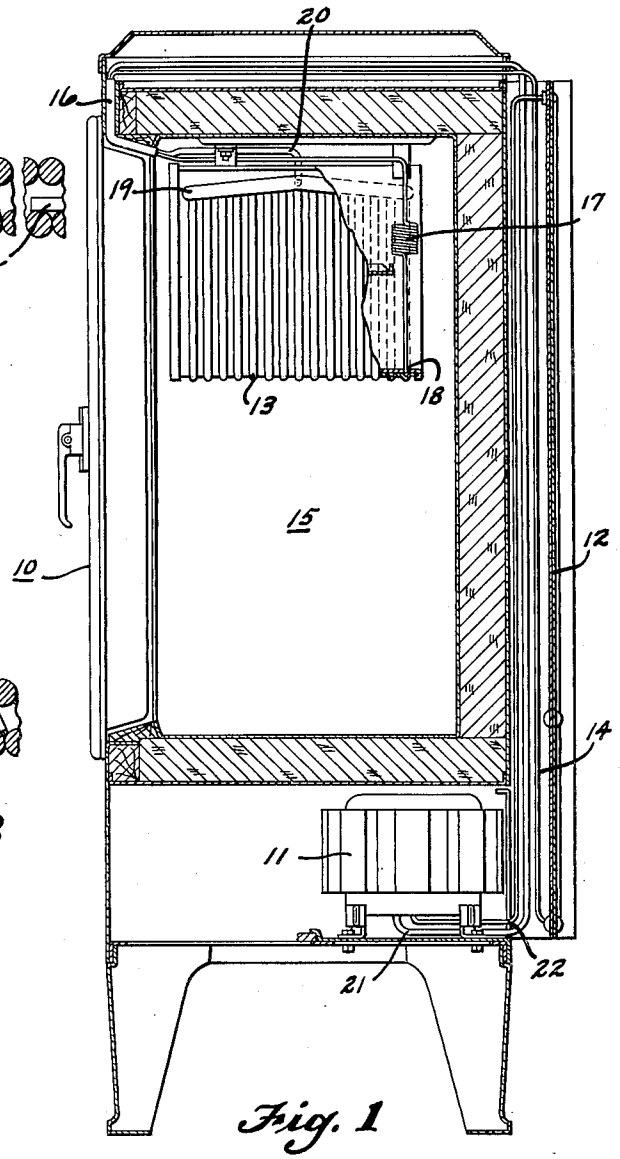


Fig. 1

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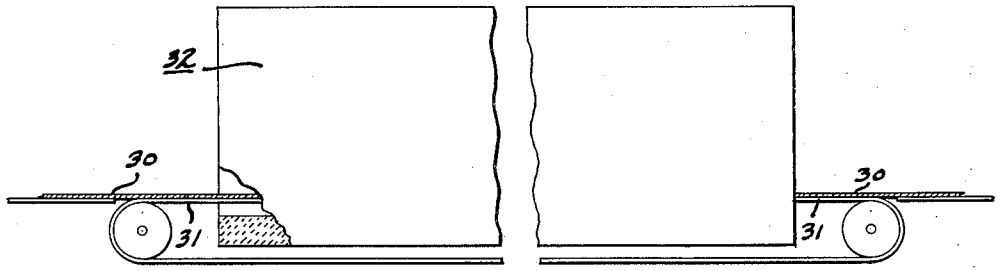


Fig. 5

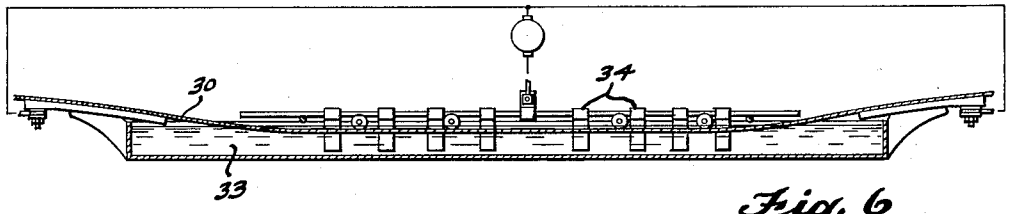


Fig. 6

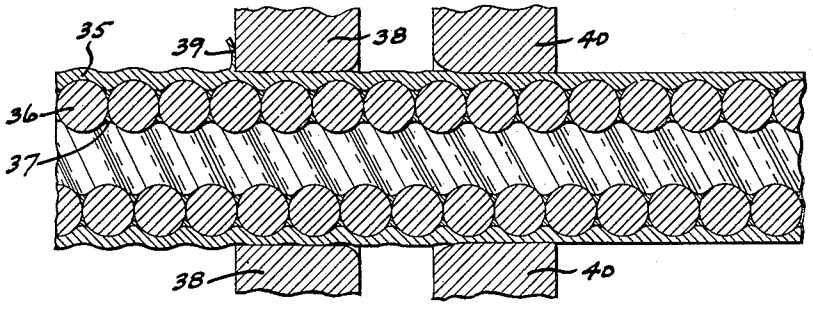


Fig. 7

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2,166,109

METHOD OF MAKING TUBING FOR REFRIGERATING APPARATUS

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Application June 11, 1936, Serial No. 84,710

4 Claims. (Cl. 29—157.3)

This invention relates to refrigerating apparatus and to the manufacture of tubing adapted to be used in refrigerating apparatus or in other places.

An object of this invention is to provide an improvement in refrigeration which includes a relatively long and small diameter tube with inner corrugations which is adapted to interpose the necessary restriction between the high side and the low side of the refrigerating system.

Another object of this invention is to provide an improved tube.

Another object of this invention is to provide an improved method of manufacturing tubing.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic representation of a refrigerating apparatus with which my tubing may be used;

Fig. 2 is a diagrammatic representation, partly in cross-section, of a step in the manufacture of the tubing;

Fig. 3 is a view similar to Fig. 2, but showing a slightly different step in the manufacture of tubing;

Fig. 4 is a view, somewhat similar to Fig. 3, but showing a modified form;

Fig. 5 is a diagrammatic representation of a brazing furnace, having a reducing atmosphere, in which the tubing is brazed;

Fig. 6 is a diagrammatic representation of an apparatus in which the tubing is provided with a protective coating by electro-deposition; and

Fig. 7 is a diagrammatic representation of the compressing step for the protective coating of the tubing.

Tubing manufactured in accordance with this invention is particularly useful when used in connection with refrigerating apparatus. Heretofore restrictor tubes of small diameter have been interposed between the high side and low side of a refrigerating system. However, great difficulty has been encountered because it is very difficult to manufacture tubing of such small diameter in large quantities with the uniformity and precision required. This precision is necessary because the compressor generally operates at a constant speed while the condenser is subjected to wide variations of room temperature. This produces wide variations in pressure on the restrictor, and it is therefore necessary to have the tube of proper dimensions, and to insure that these dimensions are properly duplicated in quantity production. In ordinary household refrigerators, it has been found that where a tube of about .035 inch internal diameter and 10 to 14 feet in length is provided, a very satisfactory balance is obtained in the operation of the refrigerating system throughout a wide variation in room temperature. Such tubing has heretofore been extremely difficult to manufacture in large quantities with assurance that proper uniformity in size can be maintained.

In accordance with this invention, however, tubing may be manufactured in large quantities with satisfactory uniformity of duplication. This is accomplished by forming a tube from a wire, preferably of ferrous materal, such as steel, wound in the form of a spiral with the loops of the spiral tightly touching each other. Bonding material is placed with the tube. The tube is then passed through a brazing furnace having a reducing atmosphere, where the bonding material is uniformly distributed along the loops and brazes them together. Thereafter the tube is provided with a protective coating so that the tube may be used in damp places without danger of rusting.

Without intending to limit the scope of this invention, preferred forms of the manufacture and use of the tubing are illustrated, so that the invention may be practiced by those skilled in the art.

The tubing may be used with a refrigerating apparatus, such as is shown in Fig. 1. The refrigerating apparatus may comprise a cabinet 10 to be refrigerated. The refrigerating system may include a high side having a motor compressor unit 11 and a condenser 12. The unit 11 may include a constant speed electric motor and a compressor driven thereby. The system may also include a low side, in the form of an evaporator 13. A restrictor tube is interposed between the high side and low side. It extends from the lower end of the condenser 12, as indicated at 14, and passes into the compartment 15 of the cabinet, as indicated at 16. Any excess length in the tube may be taken up by spirally winding the tube, as indicated at 17, from whence it discharges into the evaporator at 18. The evaporated refrigerant is collected in headers 19 and returned through the tube 20, to the motor-compressor unit 11. The tube 20 may be in thermal contact with the tube 14 through a portion of its length, so that the heat exchange may take place between the liquefied refrigerant and the evaporated refrigerant.

The refrigerant compressed by the unit 11 is discharged into the upper part of the condenser 12 through the tube 22.

It is apparent that a large portion of the restrictor tube is located where it is subjected to an atmosphere having frequent changes in relative humidity and temperature, which changes tend to promote rusting of tubing made out of ferrous material. According to one feature of this invention, such rusting is prevented.

As will be apparent from the further description of my invention, the restrictor tube has an internal spiral or corrugated construction. This imposes a restriction on the refrigerant which promotes uniform flow of refrigerant, probably because of the eddies produced by the corrugated construction.

In manufacturing my tubing, a strip or wire of ferrous material, such as steel, is spirally wound on the rotating mandrel 23 of Fig. 2, 24 of Fig. 3 or 25 of Fig. 4. This produces a spring with loops tending to remain in contact with each other, the mandrel being a portion of the well-known spring coil machine. The tubing produced, as indicated in Fig. 2, may be brazed by inserting a copper wire 23*a* longitudinally into the tube. In the modification shown in Fig. 3, the strip or wire 26 of ferrous material is wound on the rotating mandrel 24. Simultaneously, a wire 27 of cuprous material is wound with the strip 26 so that the cuprous wire is placed inside of the tube along the spiral channel between the loops of the spiral. The tension on the wires, while winding them on the mandrels shown in Figs. 2, 3 and 4, is such as to cause the loops of the spring to contract tightly against each other. In the modification shown in Fig. 4, the steel strip or wire 28 is spirally wound on the rotating mandrel 26 and simultaneously therewith the cuprous wire 29 is wound on the outer channel between the loops of the ferrous wire. If desired, a copper wire may be placed inside and another copper wire outside the steel wire on the same tube.

After tubing has been produced as indicated in Figs. 2, 3 and 4, the tubing is passed through a brazing zone diagrammatically indicated in Fig. 5. Such tubing is indicated at 30, being carried by a conveyor 31 through the brazing furnace 32, in which a reducing atmosphere, such as hydrogen, is maintained. In this furnace, the tubing is heated to a temperature sufficiently high to cause the copper to braze the adjacent loops of the tube. The tubing is then cooled, preferably while still in the reducing atmosphere.

The tubing is passed through the brazing zone in a horizontal position. Particularly with respect to Figs. 2 and 3, it is to be noted that the copper material is automatically distributed along the inner ridges formed by contiguous loops of the spring-like tube, and that the cuprous material is thus prevented from running together into puddles while in a melted condition, thus insuring automatic and even distribution of the bonding material throughout the length of the tube. The copper flows upwardly between the loops by capillary attraction.

After the tube has been brazed, a protective coating is provided. This is preferably accomplished by electro-deposition, in the manner shown in Fig. 6. The tubing 30 is passed through an electrolytic bath 33 in which electrodes 34 are immersed. The electrodes are distributed to promote a substantially even electro-deposition on the tube. In Fig. 7, at the left end, the tubing is shown as it leaves the electrolytic bath. The ferrous wire or strip is indicated at 36, the cuprous bonding material is indicated at 37 while the electro-deposited material is indicated at 35. After leaving the electrolytic bath, the bonding material is preferably compressed to remove its porous nature. If the electrolytic bath produces a sufficiently ductile copper coating, the tube need not be preliminarily annealed, and the copper compressing step may follow immediately. However, if the electrolytic bath is of a nature to produce a brittle copper coating, the tube is annealed, before the copper is compressed, in any suitable annealing furnace at a temperature sufficiently high to transform the copper from its brittle state to a ductile state, the temperature being sufficiently low not to produce any further brazing.

If desired, the copper coating 35 is preliminarily shaved by a die 38 to remove any excess copper material, such excess material being removed at 39. Thereafter, the tubing is passed through the compressing die, as indicated at 40, where the cuprous material is compressed to close its pores. The compressing operation, however, is preferably not sufficient to change the diameter of the steel tubing, but only sufficient to compress the copper. It is to be understood, however, that the steel portion of the tubing may also be compressed, if desired, so that a drawing operation is thus performed not only on the copper but also on the steel.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A method of manufacturing tubing for refrigerating apparatus or the like which includes spirally winding metal wire into the form of a spring, placing bonding material with the spring, heating the same to bond the individual loops of the spring together, electro-depositing a protecting coating on the tube, and compressing the electro-deposited material.

2. The method of manufacturing tubing for refrigerating apparatus or the like which includes forming a strip of ferrous material into a tube, bonding portions of said strip to each other with a cuprous substance in a reducing atmosphere, electro-depositing a coating on said tube, and compressing the electro-deposited material.

3. The method of manufacturing tubing for refrigerating apparatus or the like which comprises winding a first cylindrical wire to form a tube having loops on a mandrel, simultaneously winding a second wire of bonding material on the outside of said tube in the recess formed between said loops, said wire being of such a diameter so as to fit within said recess and heating said tube to bond said loops.

4. The method of manufacturing tubing for refrigerating apparatus or the like which comprises winding a first wire to form a tube having loops on a mandrel, simultaneously winding a second wire of bonding material between said loops inside said tube, and heating said tube to bond said loops.

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