April 6, 1937. W. G. WINKLER ET AL 2,075,921

TREATMENT OF RESTRICTED FLOW TUBING AND APPARATUS THEREFOR

Filed Jan. 15, 1935 2 Sheets-Sheet 1

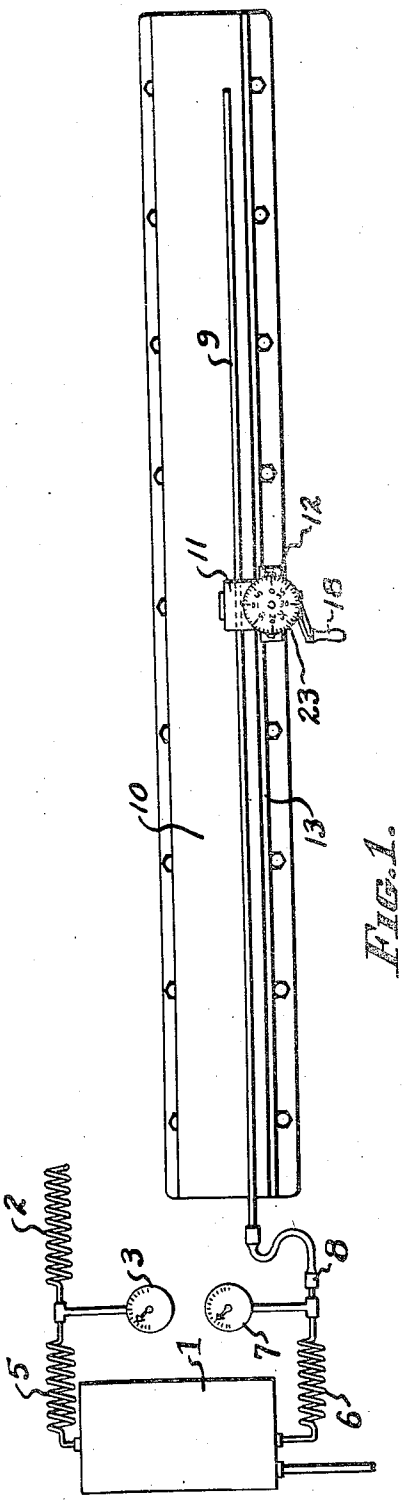



FIG. 1.

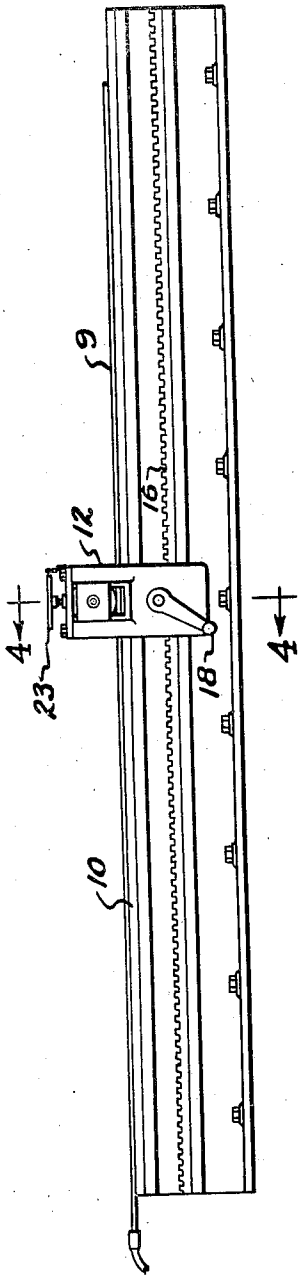



FIG. 2.

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FIG. 4.

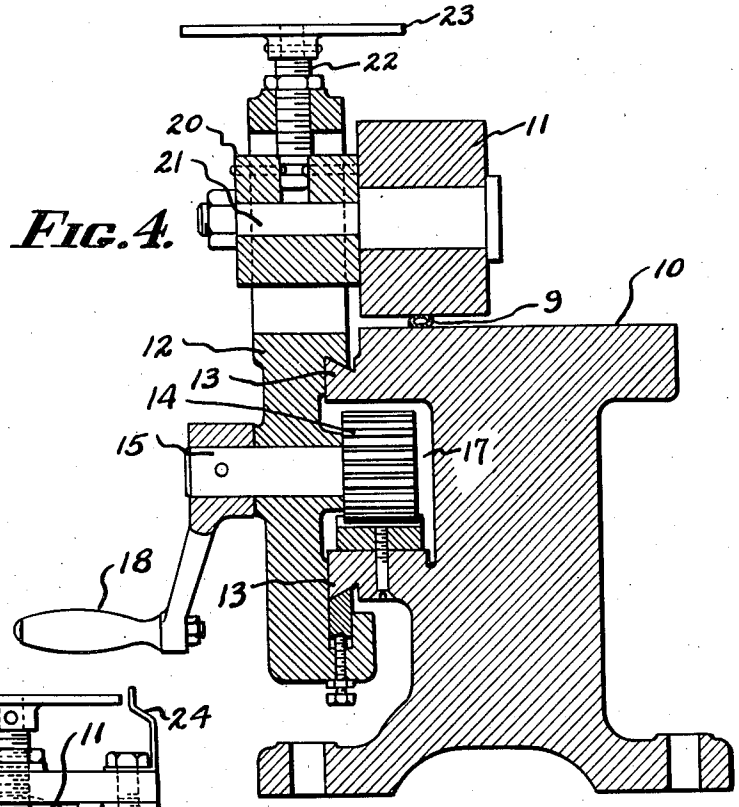
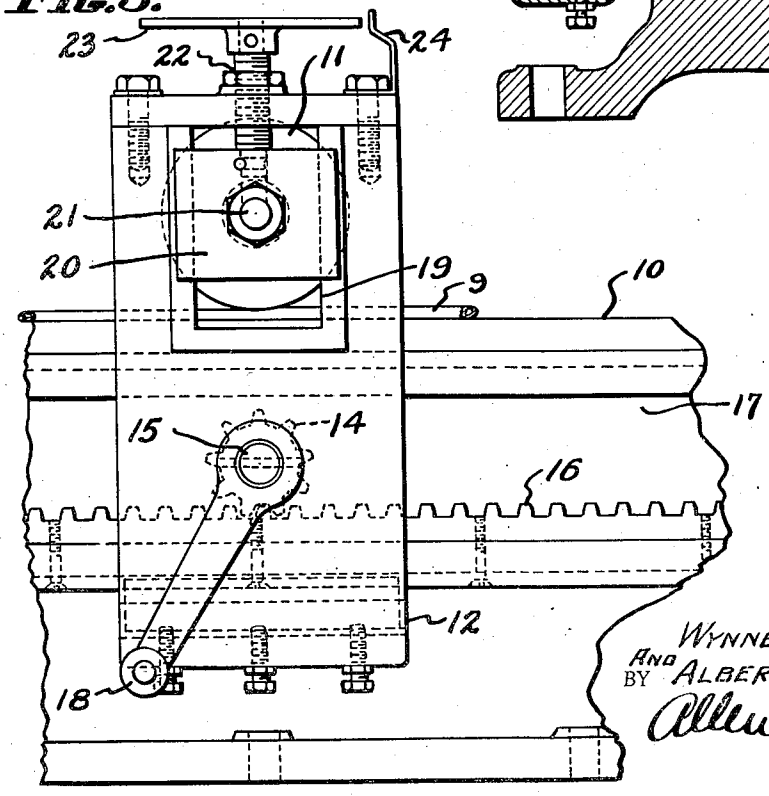



FIG. 3.




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Patented Apr. 6, 1937

2,075,921

# UNITED STATES PATENT OFFICE

2,075,921

## TREATMENT OF RESTRICTED FLOW TUBING AND APPARATUS THEREFOR

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Application January 15, 1935, Serial No. 1,920

9 Claims. (Cl. 153—2)

Our invention relates to a treatment for the standardization or controlled variation of restricted flow tubing, and an apparatus for carrying on such treatment. Our invention will have utility wherever restricted flow tubing must be brought to quite close tolerances; but we shall describe our invention in connection with one particular exemplary, but not limiting, use therefor.

In the use of restricted flow devices, such as so-called capillary tubes in domestic refrigerators, where the capillary tube is used as the means for feeding liquefied refrigerant into the evaporator of the mechanical system, the proper functioning of the apparatus depends, among other factors, upon a nice proportioning of the capacities of the various instrumentalities in the system. By way of example, assuming that the capillary tube always receives a supply of liquefied refrigerant from the condenser, it will be clear that the capacity of the evaporator must be such as to be capable of receiving a continuous flow of the refrigerant without marked changes of pressure in the evaporator occurring solely from such flow. The evaporator must in fact be neither too large in capacity, nor too small, and assuming that the other elements of the system are of proper kind and capacity, and function properly, the capacity of the evaporator must be quite closely proportioned to the feeding capacity of the particular restricted flow device employed. In commercial practice of course the evaporators are made up in standard units of a given size and capacity, and it is not practicable to modify them to make them conform to variations in the capacity of the restricted flow devices. Clearly, therefore, the restricted flow devices must be brought to a given capacity within very narrow tolerances. The ordinary manufacturing tolerances are too wide to give consistently good results. As a consequence, it has been necessary to take the tubes as manufactured and test each one of them, discarding all but those which had the correct capacity. This represents a wastage so far as the manufacturer of tubing is concerned, and the purchaser of such tubing has had to pay a very much larger price for selected tubing than he would have had to pay for the ordinary product of the mill.

There has hitherto been no suggestion leading to a solution of this selection problem. Theoretically in a small bore tube, the function of which is to interpose substantial resistance to the passage of fluid, variations in bore could be taken care of by variations in length. It will be clear, however, that this could not be done without considerable wastage of material, since the bore varies from point to point in the tube, and since it is not possible to predict within narrow enough tolerances the average effective bore of any given length of tubing.

It is an object of our invention to provide a means whereby standard lengths of tubing may be taken and tested, and if they are found to depart from the permissible tolerances, treated so as to bring them within said tolerances. It is an object of our invention to provide a way of further restricting the bore of a tube which has too high an effective capacity, and of doing this in a controlled manner and to exactly the extent desired, to bring the capacity of the tubing within the required tolerances. In this way we are enabled to use and to treat for use tubing which is cheaper both because it need not bear the cost of selection, and also because it may be made to very much wider upper tolerances, and these results likewise constitute objects of our invention.

These and other objects of our invention which will be set forth hereinafter, or will be apparent to one skilled in the art upon reading these specifications, we accomplish by that certain construction and arrangement of parts, and by those certain process steps of which we shall now describe the aforesaid exemplary embodiment.

Reference is had to the drawings:—

Figure 1 is a plan view of the treatment device showing in a semi-diagrammatic way the testing and control mechanism.

Fig. 2 is an elevational view of the treatment device.

Fig. 3 is an enlarged view of the rolling mechanism.

Fig. 4 is a sectional view taken along the lines 4, 4 of Fig. 1.

Briefly, in the practice of our invention, we control the effective internal diameter of a restricted flow tubing by slightly flattening the tubing a controlled amount, while testing the tubing to determine its capacity as so flattened. We have found it readily possible to do this because in tubing manufactured for refrigerator use a flattening of as much as .020 inch has been made without any impairment of the tubing, and without any seam-cracking. This is not given as the limit of the flattening which may be attempted, but as illustrative of the largest degree of flattening which we have found necessary in any selected tubing having the ordinary manufacturing tolerances. Control is had both by the degree

of flattening and by the extent of it, as measured along the length of the tubing.

In the practice of our invention we ordinarily set up a testing apparatus which comprises a cylinder of fluid under known pressure, a restricted flow device known to be correct in capacity, together with a pressure gauge to give an indication of that capacity. We likewise set up a second pressure gauge connected to the tubing which is to be treated, and we stretch this tubing out upon a long table. Assuming that the tests on the last mentioned tubing show too high a capacity, the tubing is then progressively flattened, as will hereinafter be described, until its capacity is correct. Whereupon another tube may be treated.

An exemplary apparatus is shown in the figures, where in Fig. 1 a tank 1 is maintained under a known fluid pressure, say, 200 lbs. of air. A standard restricted flow tubing is indicated at 2, connected with a pressure gauge 3. Preferably there will be between this pressure gauge and the tank 1 a restricted flow device of known capacity 5. The unconnected end of the standard capillary tube is left open, and the gauge 3 will give an indication of the back pressure produced by the restrictive effect of the device 2. For testing the tube to be treated, we provide a restrictive device 6 of the same capacity as the device 5, and a gauge 7 similar to the gauge 3. A standard coupling is shown at 8, and the capillary tube under treatment is indicated at 9, and is connected to this coupling. The tube 9 is stretched out upon a long table 10, a marginal portion of which forms one of the co-operating rolling surfaces therefor. A roll 11, mounted in a traveling housing 12, is arranged to be passed along the table. Reference to Figs. 3 and 4 will show the housing or standard member 12 mounted as, for example, by keys 13 operating in keyways along the edge of the table, so that the member 12 can slide therealong. The motion of the member 12 is controlled by a pinion 14 attached to a shaft 15 passing through the standard 12. The pinion 14 meshes with the teeth of a rack 16 in a cut-out portion 17 of the table edge. A crank 18 is attached to the shaft 15 so that it may be rotated.

The standard member 12 has a cut out portion 19, the sides of which form guides for the sliding movement of a bearing member 20. The roll 11 may be mounted on a shaft 21, journaled in the bearing member 20, and a screw-down device is indicated at 22, preferably having a micrometer adjustment dial 23, operating in conjunction with a pointer member 24 to indicate its position. It will be clear that the pressure of the roller 11 against the tube 9 can be varied by means of the screw-down 22, and the flattening effect gauged by means of the micrometer 23. It will further be clear that the whole flattening fixture may be moved longitudinally of the table edge by means of the crank 18. In many instances it will not be necessary to flatten a tube throughout its entire length; in other instances it may be necessary to roll the tube more than once in order to secure the desired total flattening effect. In any event, however, it is our practice to flatten a tubing in such a way that a few inches of unflattened tubing are left at either end of the restricted flow device so that the ordinary connections may be made thereto when the tube is placed in a refrigerator for use.

When proceeding empirically to flatten a tube, and using the set-up shown in Figure 1, let it be supposed that the gauge 7 shows less back pressure than the gauge 3, indicating that the bore of the tube 9 is too large. We start with the flattening fixture on the standard 12 at the left hand end of the table, and adjusting the screw-down of the roll 11 so as to flatten the tube slightly, we rotate the handle 18 so as to cause the flattening fixture to travel toward the right hand end of the table, thus progressively flattening the tube. During the traveling of the flattening fixture, we observe the gauge 7, and as soon as this gauge reads the same as the gauge 3, we stop the motion of the flattening fixture and remove the tubing 9, which has now been finished. If the desired back pressure is not attained during the entire transit of the flattening fixture, we tighten the screw-down again and cause the flattening fixture again to traverse the length of the tube, repeating this operation as many times as may be desired to secure the necessary effect.

With some experience in the treatment of tubing in accordance with our invention, it will not usually be necessary to proceed empirically. With tubing made to ordinary manufacturing tolerances, a given back pressure will usually indicate a treatment for a given length of the tubing with a given and predetermined screw-down. This is the reason why we have provided the micrometer setting for the roll, and it will likewise be competent to mark off the table 10 with a scale in inches, or other convenient units of length, to indicate the travel of the flattening fixture. When this is done, the tubing may be treated very rapidly to bring it nearly to the required restriction, and the gauges 3 and 7 observed only during the final stages of the treatment.

By the use of this apparatus and process, we have found it possible not only to purchase unselected tubing on a more economical basis, but to bring all of our tubing to an accurate standard, which is much more nearly exact than it was possible to attain even with selected tubing in commercial operation.

Modifications may be made in our invention without departing from the spirit thereof.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is:—

1. A method of treating restricted flow tubing of over capacity, which comprises connecting a desired length of said tubing to a source of fluid pressure and restricting the bore thereof to bring it to the required capacity by flattening said tubing.

2. A method of treating restricted flow tubing of over capacity, which comprises connecting a desired length of said tubing to a source of fluid pressure and restricting the bore thereof to bring it to the required capacity by flattening said tubing by progressively rolling said tube in the direction of its length.

3. A method of treating restricted flow tubing of over capacity, which comprises connecting a desired length of said tubing to a source of fluid pressure and restricting the bore thereof to bring it to the required capacity by flattening said tubing by progressively rolling said tube in the direction of its length, while leaving an unrolled portion thereof at each end.

4. A method of treating restricted flow tubing of over capacity which comprises connecting a desired length of said tubing to a source of fluid pressure, and progressively rolling said

tubing so as to flatten it, ceasing said rolling when said tube shows the desired restrictive effect.

5. A method of treating over capacity, restricted flow tubing, which comprises arranging a comparative test of a known sample of tubing, placing the tubing to be treated under test by connecting it to a source of fluid pressure, and progressively flattening the tubing under test until it shows the same value as the known sample.

6. In a device for treating capillary tubing, a table of a length comparable to the desired length of tubing, a standard member arranged for longitudinal travel along the table edge, a roll rotatably mounted in said standard member and having a movement toward and away from said table top, and means for adjusting the position of said roll with reference to said table top, said means comprising an indicating micrometer adjustment.

7. In a device for treating capillary tubing, a table of a length comparable to the desired length of tubing, a standard member arranged for longitudinal travel along the table edge, a roll rotatably mounted in said standard member and having a movement toward and away from said table top, means for adjusting the position of said roll with reference to said table top, said means comprising an indicating micrometer adjustment, means for moving said standard along said table edge, said means comprising a rack in association with said table edge and a pinion in association with said standard, and means for rotating said pinion.

8. In a device for the purpose described, a source of fluid pressure, a standard restricted flow device connected therewith, a gauge for indicating the effective capacity of said standard restricted flow device, a restricted flow device to be treated, means for connecting said last mentioned restricted flow device to said source of fluid pressure, a gauge to indicate the effective capacity thereof, and means for treating said last mentioned restricted flow device to vary its effective capacity.

9. In a device for the purpose described, a source of fluid pressure, a standard restricted flow device connected therewith, a gauge for indicating the effective capacity of said standard restricted flow device, a restricted flow device to be treated, means for connecting said last mentioned restricted flow device to said source of fluid pressure, a gauge to indicate the effective capacity thereof, means for treating said last mentioned restricted flow device to vary its effective capacity, said means comprising a rolling mechanism, and means for causing said mechanism to flatten said tube progressively in the direction of its length.

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