Feb. 10, 1953 S. M. SCHWELLER 2,627,652

METHOD OF MAKING AN ELEMENT HAVING A FIN

Filed Sept. 29, 1949 2 SHEETS—SHEET 1

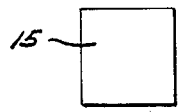

Fig. 1

Fig. 2

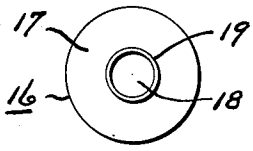

Fig. 3

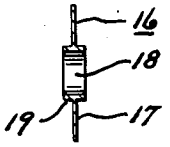

Fig. 4

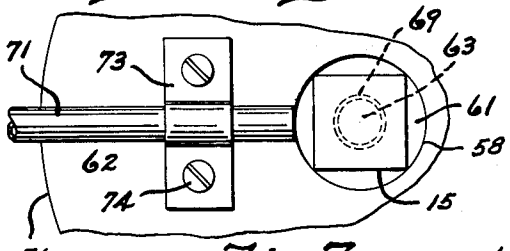

Fig. 7

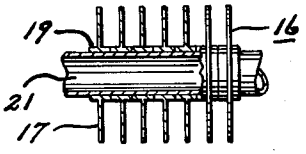

Fig. 5

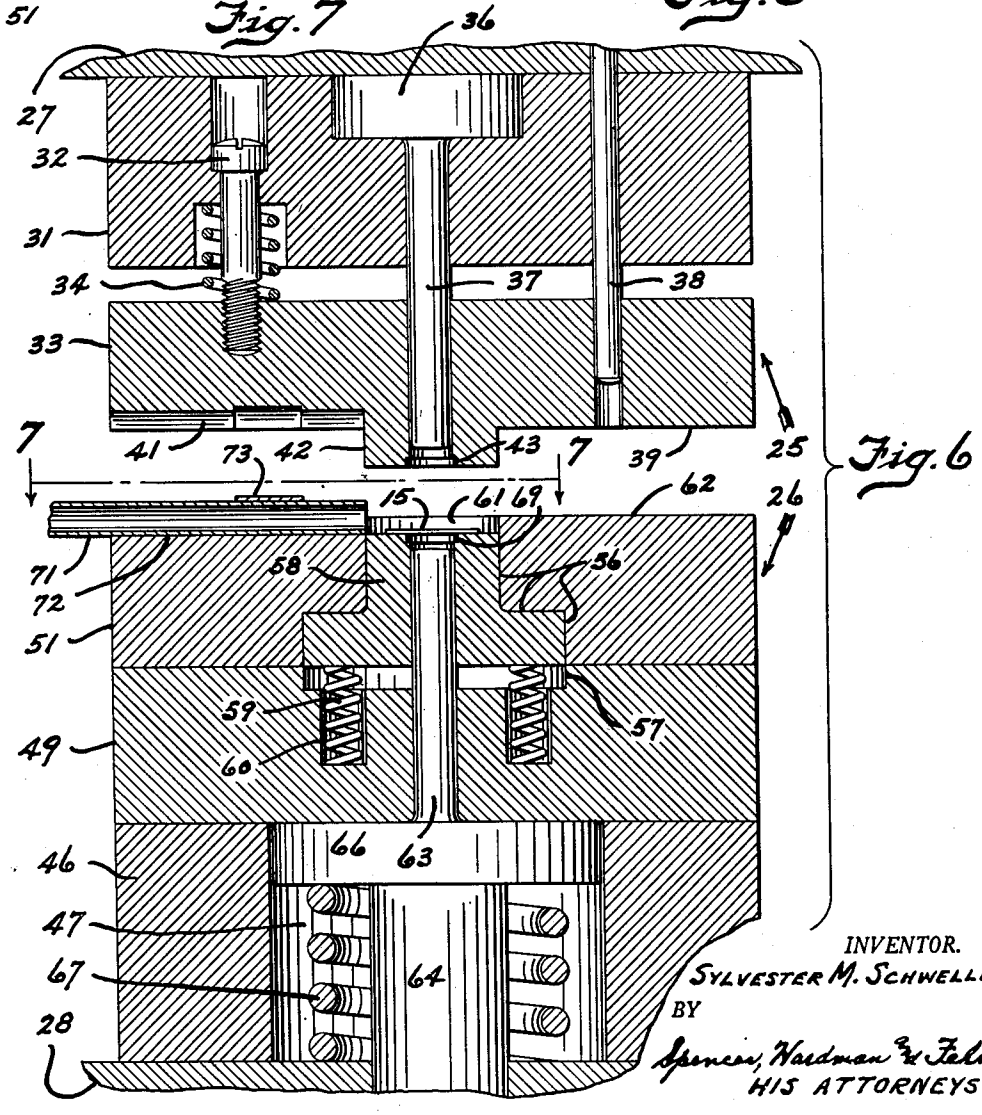

Fig. 6

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METHOD OF MAKING AN ELEMENT HAVING A FIN

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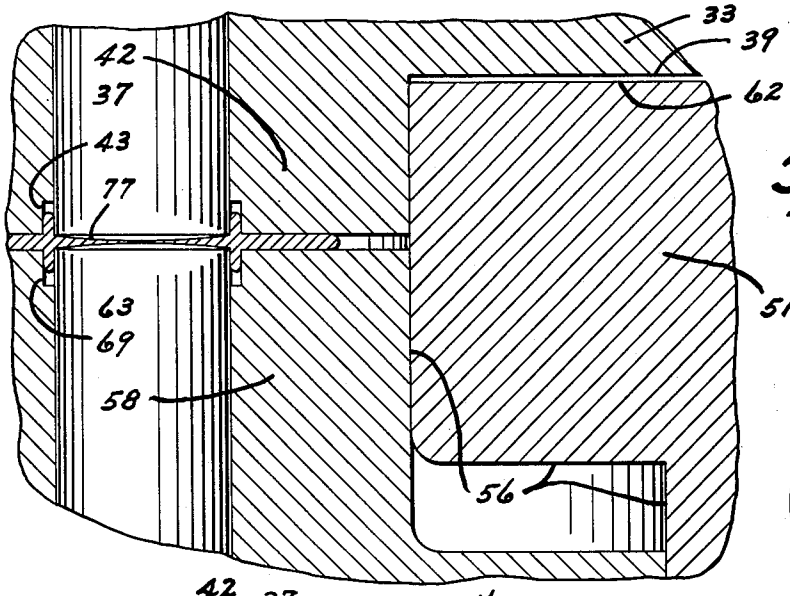

Fig. 8

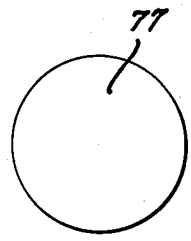

Fig. 10

Fig. 11

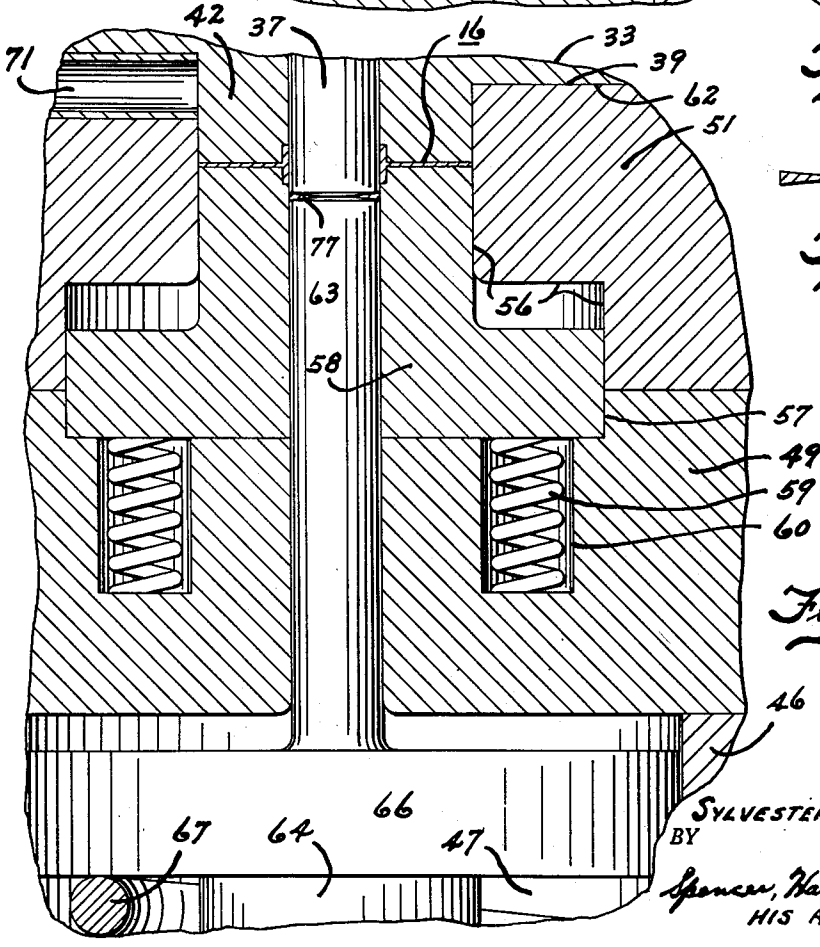

Fig. 9

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UNITED STATES PATENT OFFICE

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METHOD OF MAKING AN ELEMENT HAVING A FIN

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Application September 29, 1949, Serial No. 118,487

1 Claim. (Cl. 29—157.3)

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This invention relates to refrigeration and particularly to heat exchangers employed in refrigerating systems.

An object of my invention is to provide an improved and lower cost heat transfer device or heat exchanger.

Another object of my invention is to provide a low cost fin element adapted to be mounted on a fluid conduit of a heat exchanger and an improved method of fabricating the fin.

A still further object of my invention is to provide an improved method of making a fin element from thin sheet metal stock and to provide the fin element with a collar portion adapted to embrace a conduit of a heat exchanger.

A more specific object of my invention is to fabricate a fin element from a substantially square piece of malleable sheet metal by causing the metal to flow and form a thin circular-shaped fin portion and an integral central collar portion extending outwardly beyond each side thereof to provide means for spacing the fins of the elements from one another on a conduit of a heat exchanger.

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 view of a square piece of sheet metal to be formed into fin element in accordance with my method;

Fig. 2 is an end view of the metal piece shown in Fig. 1;

Fig. 3 is a side view of a fin element made in accordance with my present method;

Fig. 4 is a sectional view of the fin element shown in Fig. 3;

Fig. 5 is a side view partly in section of a finned conduit of a heat exchanger;

Fig. 6 is a vertical sectional view of a two-part die employed in the present method, showing the metal piece disposed in a cavity of one part of the die;

Fig. 7 is a fragmentary view of a part of the die taken on the line 7—7 of Fig. 6;

Fig. 8 is an enlarged fragmentary vertical sectional view of the die showing the metal of the metal piece flowing into a confined space within the die;

Fig. 9 is an enlarged fragmentary vertical sectional view of the die showing the metal of the metal piece flown into the desired shape to form a fin element of the present disclosure;

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Fig. 10 is an enlarged view of a thin disc-like portion removed from the metal piece in accordance with the present method; and

Fig. 11 is a sectional view of the disc-like portion shown in Fig. 10.

Referring to the drawings, for illustrating my invention, I have shown in Fig. 1 thereof a rectangular or square-shaped piece 15 of aluminum which may be cut from sheets or ribbon-like rolls of thin aluminum. The piece 15 may be substantially pure aluminum known to the trade as Commercial Aluminum and consisting of .2% copper; 1.0% iron and silicon; .05% manganese; .10% zinc; .05% each of the alloys and the remainder pure aluminum. This metal in addition to being of high heat conductivity, suitable for use in heat transfer devices and of low cost, is also readily malleable and suitable to be worked or deformed under pressure. The metal piece 15 (see Fig. 2) is approximately $\frac{1}{32}$'' in thickness.

A fin element 16 produced by deforming piece 15 in the manner or by the method hereinafter described is shown in Figs. 3 and 4, and includes a circular fin portion 17, having a central hole 18 therein bounded by a collar 19 which projects outwardly from each side of the fin portion 17. The fin portion 17 of element 16 is preferably, although not necessarily, tapered by being thicker adjacent collar 19 than at its outer edge. A plurality of the fin elements 16 are strung or mounted on a conduit 21 (see Fig. 5) of a heat transfer device, or heat exchanger such, for example, as a condenser or evaporator employed in refrigerating and the like systems. Fin elements 16 may be secured in intimate thermal contact with the wall of conduit 21, for increasing the heat transfer surface thereof, in any suitable or conventional manner. The fin portion 17 of element 16 extends outwardly from the collar 19 intermediate its ends and the collar 19 is of utmost importance since it provides a large area to pick up heat from the wall of condenser conduit 21 and also serves to space the fin portions 17 of elements 16 from one another. The spacing collar 19 furthermore eliminates the use of expensive rack or rack-like tools or dies, for spacing fin elements on a conduit prior to or at the time fin elements are bonded or secured thereto.

I have illustrated only the die parts employed to carry out the method of fabricating fin elements as hereinafter described, since the construction and operation of punch or pressing machines utilized to move the die parts relative to one another are conventional and well known. In Fig. 6 of the drawings I show a die compris-

ing an upper part and a lower part generally represented by the arrows and reference characters 25 and 26 respectively. These parts are secured to relatively movable members 27 and 28 respectively of a punch or pressing machine. The punch or press moves the upper member 27 downwardly so as to bring the die parts 25 and 26 into cooperative relation with one another. Upper die member 25 comprises a plate 31 rigidly mounted upon the upper member 27 and a plurality of screws 32 in plate 31 are threaded into another plate or die element 33 carried by and movable relative to plate 31. A spring 34 surrounds each screw 32 for a purpose to be hereinafter described. The mounting of plate 31 to member 27 locks an element comprising a head 36 and a plunger 37 thereto. The plunger 37 extends through plate 31 into a hole provided in plate 33 and is adapted to project beyond the plate 33 when this plate is moved a predetermined distance relative to plate 31. A plurality of dowel pins or the like 33 may be employed in addition to the screws 32 for guiding the movement of plate 33 relative to plate 31. The lower face 39 of plate 33 is provided with a cut-out portion or groove 41 and has a circular boss 42 projecting therefrom for a purpose to be hereinafter described. The hole in plate 33 in which plunger 37 moves is provided at its lower end with an enlarged portion or counterbore 43 to be presently described.

Lower die part 26 comprises a base 46, secured to member 28 and having a large hole 47 therein, a plate 49 resting on top of base 46 and another plate 51 supported upon plate 49. Both plates 49 and 51 and base 46 are rigidly secured to one another and to member 28 by suitable bolts and screws (not shown) which pass through the plates and base and are threaded or anchored in the member 28. Top plate 51 of die part 26 is bored out as at 56 and intermediate plate 49 is bored out as at 57 for the reception of a shouldered movable element 58. A plurality of springs 59, located in counterbores 60 provided in plate 49, normally hold the movable element 58 in its upper position as shown in Fig. 6 of the drawings, with its top surface spaced below the top surface 62 of die plate 56 so as to provide a circular cavity 61 in the face surface of this die plate for a purpose to be presently described. The element 58 is provided with a hole, centrally thereof, corresponding to and aligned with a central hole provided in intermediate plate 49, for the reception of a plunger 63 of a shaft member 64 which is movable relative to plates 49 and 51 and base 46 of die part 26. Shaft member 64 has an enlarged shouldered portion 66 thereon which moves along and is guided by the wall surface of hole 47. A strong spring 67 is interposed between the shouldered portion 68 of shaft 64 and the face of member 28 to normally force shaft 64, its shouldered portion 66 and its plunger portion 63 upwardly into the position shown in Fig. 6 of the drawings. The upper end of the hole in element 58 is provided with an enlarged portion or counterbore 69 so as to match or correspond to the counterbore 43 in the plunger hole of lower plate 33 in the die part 25. A tube 71 fits in a groove 72 provided in the face 62 of plate 51 of lower die part 26 and is rigidly held in place on die part 26 by a metal strap 73 and screws 74 (see Fig. 7). One end of the tube 71 terminates adjacent the wall of cavity 61 in die part 26 and its other end is connected to a source of supply of air under pressure for a purpose to be hereinafter described. The elements of die parts 25 and 26 are normally held in the position shown in Fig. 6 of the drawings with the faces 39 and 62 respectively thereof spaced from one another a suitable distance to permit access by the operator of the punch press to the die cavity 61.

Operation of the apparatus, to carry out the method of making fin elements of the prescribed shape as herein disclosed, will now be described. The operator places one of the square metal pieces 15 in the circular cavity 61 of die part 26 so that the same rests on and is supported by movable element 58 (see Figs. 6 and 7). The operator then trips the press to cause the same to move upper die part 25 downwardly toward the lower stationary part 26 of the die. For a better understanding of the operation of the device it is desired to point out that the force exerted by spring 67 is much greater than the combined force exerted by springs 34 and 59 and that the force exerted by springs 34 is greater than the force exerted by springs 59. Movement of die part 25 downwardly into cooperative relation with die part 26 moves the face of boss 42 into the cavity 61 in die part 26 and into engagement with the metal piece 15 to thus clamp the piece 15 within a confined space in the die bounded by boss 42, movable element 58 and plate 51. Further downward movement of the die part 25 will cause boss 42 to move element 58, with metal piece 15 therebetween, downwardly to compress springs 59 whereupon the upper end of round plunger portion 63 of shaft 64 will engage a cylindrical center portion of the underside of metal piece 15. Continued downward movement of die part 25 will compress springs 34 and permit relative movement between the plates 31 and 33 whereupon the lower end of plunger 37 will move into alignment with the face of boss 42 and thereby engage a cylindrical center portion of the upper side of metal piece 15 corresponding to the central portion thereof engaged by plunger 63. It being understood that the face 39 of plate 33 and face 62 of plate 51 are still spaced a substantial distance from one another, after the above described movements have taken place, so as to permit additional downward movement of die part 25 relative to die part 26. Therefore additional downward movement of die part 25 causes plungers 37 and 63 to apply force to the cylindrical center portion of metal piece 15 to flow the metal thereof laterally or outwardly away from the central portion of piece 15 into those portions of the confined space in the die bounded by the face walls of boss 42, movable element 58, walls of bore 56 and walls of the counterbores 43 and 69 as shown in Fig. 8 of the drawings. It will be noted by reference to the enlarged view Fig. 8, that the ends of plungers 37 and 63 are slightly rounded and that the pressure exerted upon the piece 15 thereby causes substantially all of the metal to flow outwardly away from the plungers but for a thin disc-like portion 77 which in actual practice of the invention is approximately .008" in thickness at its outer edge. It should also be noted that the face 39 of plate 33 on die part 25 and the face 62 of plate 51 on die part 26 are still spaced from one another during the application of pressure, by the plungers, to the central portion of metal piece 15 to cause the metal thereof to flow so as to permit further additional downward movement of die part 25 and conse-

quently plunger 37 relative to die part 26. Thus further additional downward movement of die part 25, beyond that illustrated in Fig. 8, will cause plunger 37 and consequently plunger 63 to move down relative to other elements of the die and sever the disc-like part 77 from the piece 15 while at the same time applying pressure to the metal flowing from between the ends of plungers 37 and 63 to spread and fill the confined space between boss 42 and element 58 as shown in Fig. 9 of the drawings. The application of pressure to the metal flowing outwardly from the central portion of the piece 15 changes its form from a square shape to a circular shape. The further additional movement employed to fashion the piece 15 into the final shape thereof desired causes the shaft 64 in die part 26 to move against the force of spring 67 which spring therefore serves to cushion the final movement of the device. It is to be understood that in moving the face 39 of die part 25 into abutting relation with the face 62 of die part 26 the groove 41 in the face surface 39 serves to receive conduit 71 without damaging the same.

In Figs. 10 and 11 I have shown enlarged views of the small thin disc-like portion 77 which is severed from piece 15 and which represents all the waste metal involved in the present method of making the fin element 16. As before stated in actual practice the disc-like portion 77 is only approximately .008" thick at its edge and so thin in the center that the thickness thereof is incapable of being measured. In fact the flow of metal away from the central portion of piece 15 is frequently so rapid under the pressure applied thereto that a hole is formed in the disc 77.

After the fin element 16 has been formed by the method described the two-part die and elements thereof are returned to their normal position shown in Fig. 6. The member 27 is elevated to move die part 25 upwardly relative to die part 26 thereby withdrawing boss 42 from the cavity 61 and withdrawing plunger 37 from the collar portion 19 of fin element 16 in die part 26. This permits spring 67 to return plunger 63 to its normal position and springs 59 to move element 58 upwardly to its normal position. During the return of these elements to their normal position illustrated in Fig. 6 of the drawings, air under pressure is conducted through

the tube 71 and directed into the cavity 61 of die part 26 and this air forces the fin element 16 and disc-like portion 77 out of the die.

From the foregoing it should be apparent that I have provided a novel method of making a fin element with a minimum of waste. By my method the fin element may be fabricated from sheet or ribbon metal which is of low cost and provides a heat exchanger of high efficiency.

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, as may come within the scope of the claim which follows.

What is claimed is as follows:

The method of making an element having a fin portion with a central hole therein bounded by a collar projecting from both sides of the fin portion which consists in, placing a malleable piece of metal in a cavity in one part of a single die set adapted to have parts thereof moved into cooperative relation with one another to provide a confined space of appropriate configuration for fashioning the piece into the shape desired, moving one part of the die set toward the other part thereof to cause portions of the die set to engage and apply pressure to a center portion of the piece to flow all the metal of the piece but a thin part outwardly away from said center portion into other portions of the confined space, continuing movement of parts of the same single die set further toward one another to cause portions of the die set to sever the thin part from the piece, and simultaneously therewith causing parts of the die set to apply additional pressure to the flowing metal to spread and fill the confined space in the die set.

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