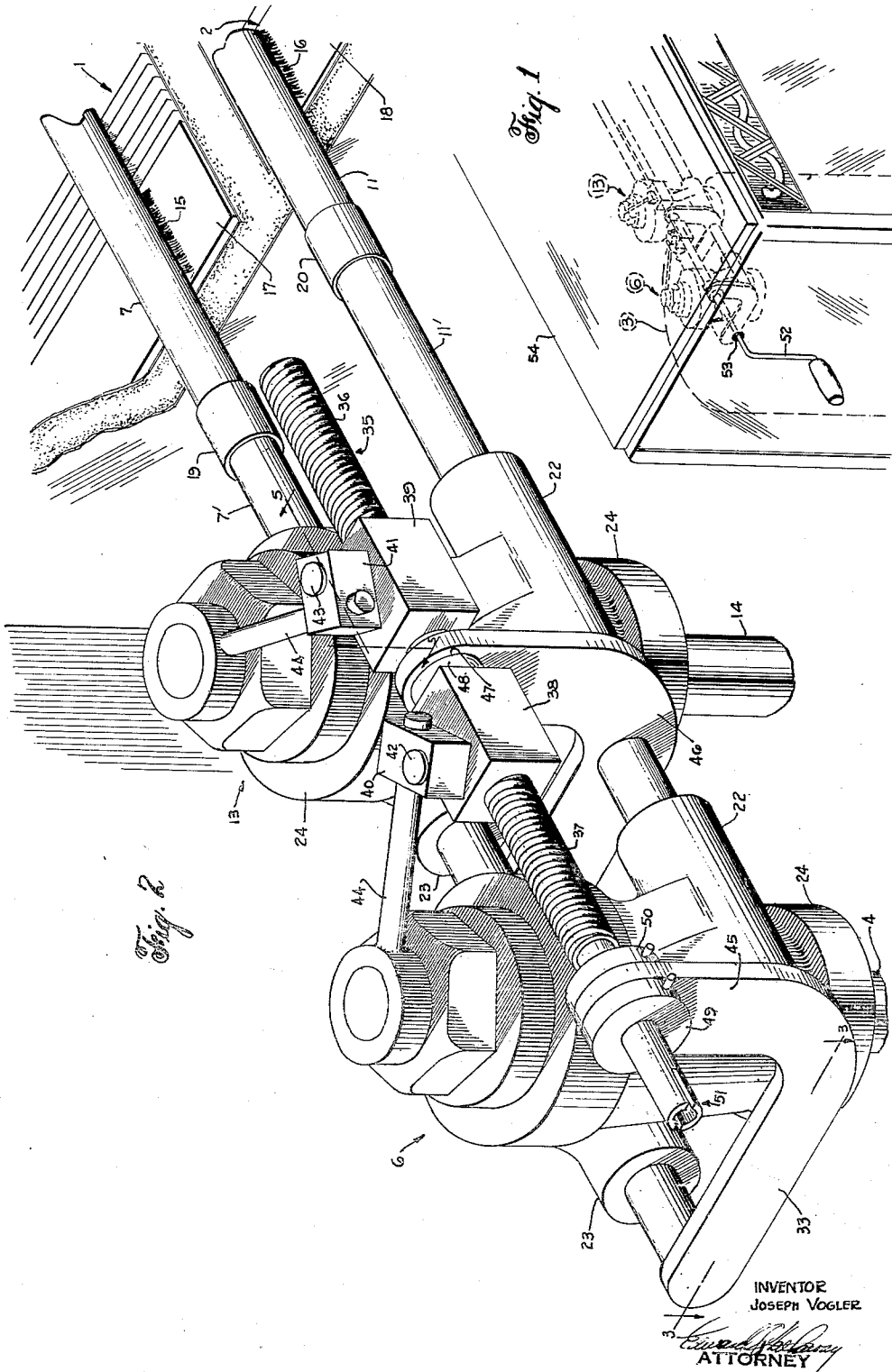


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MEANS FOR INTERCHANGING THE FUNCTIONS OF
COMPLEMENTARY HEAT EXCHANGE ELEMENTS
Filed May 31, 1933

2,073,891

3 Sheets-Sheet 1

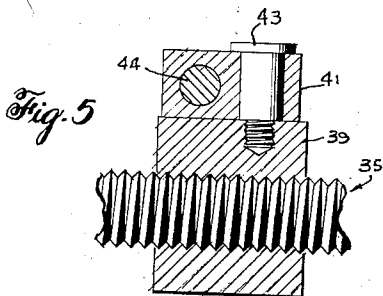
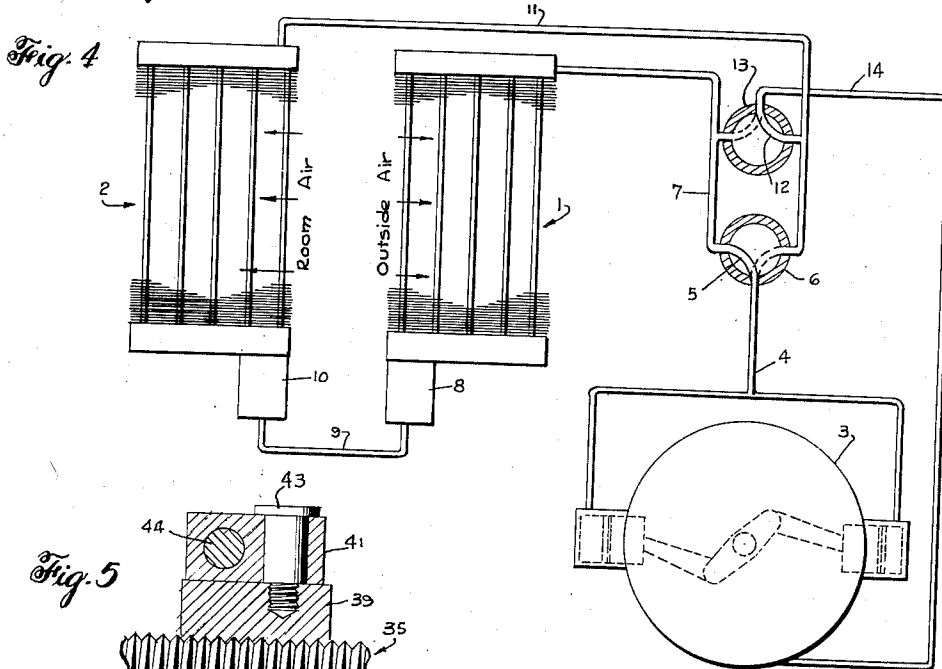
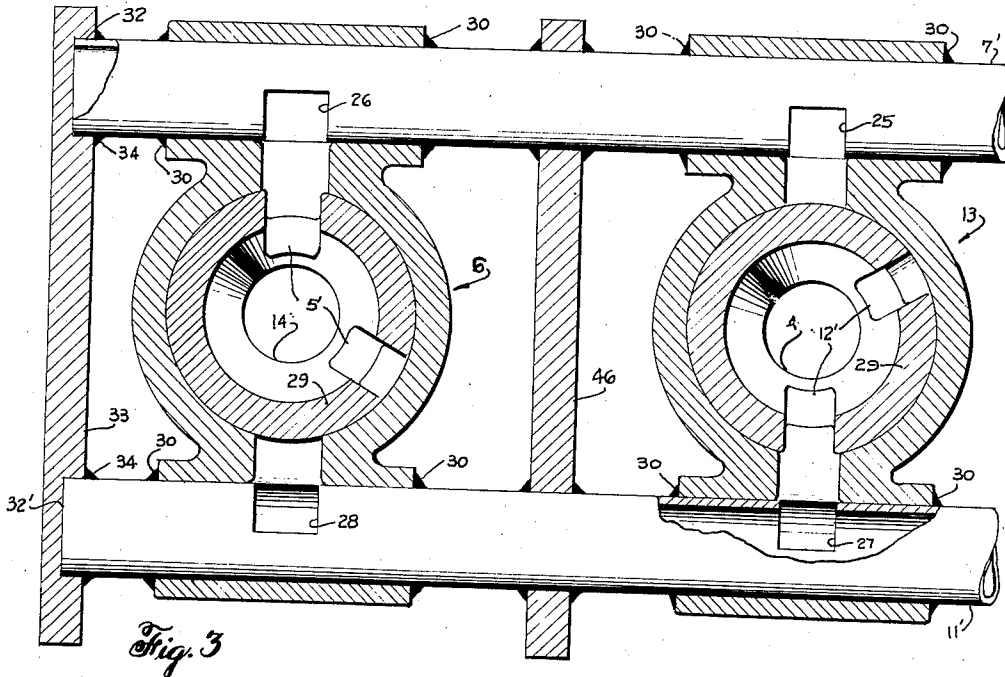


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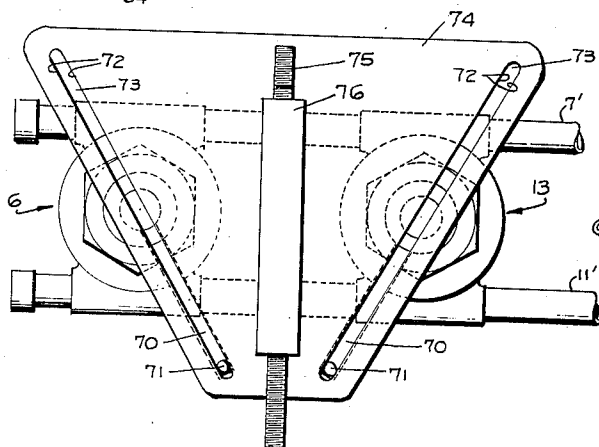
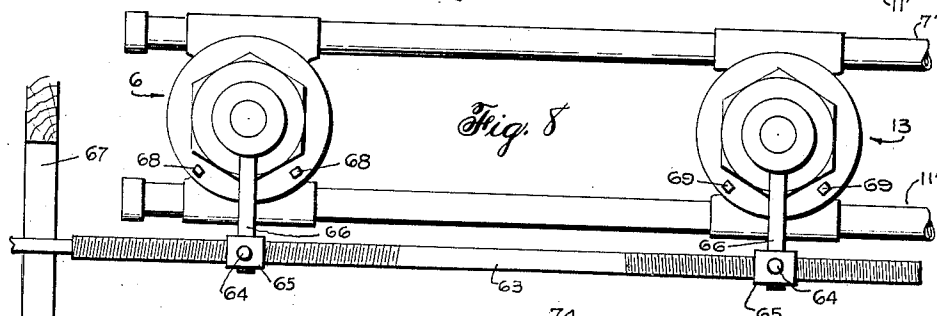
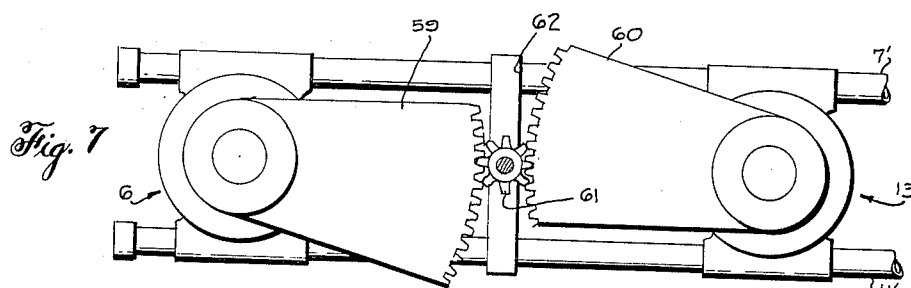
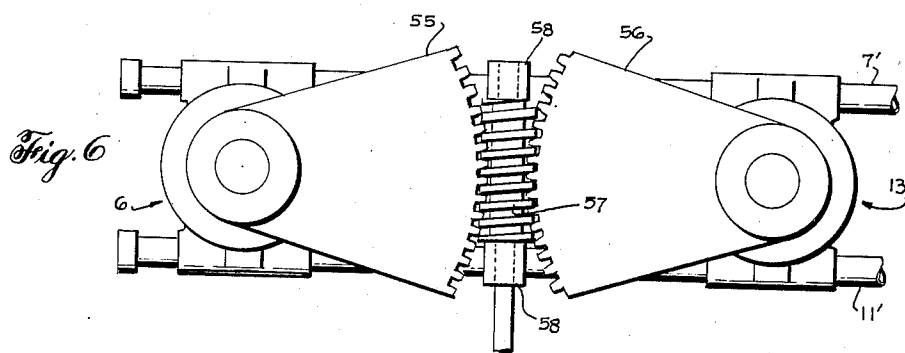
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,073,891

MEANS FOR INTERCHANGING THE FUNCTIONS OF COMPLEMENTARY HEAT EXCHANGE ELEMENTS

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Application May 31, 1933, Serial No. 673,733

6 Claims. (Cl. 277-19)

This invention relates generally to air conditioning apparatus of the type utilizing complementary heat exchange elements in a refrigerating system and more particularly to improved means for interchanging the functions of said elements whereby the refrigerating system may be employed for either heating or cooling the air of homes, offices or rooms used for various purposes.

10 It is well-known that a condenser of a refrigerating system gives off a quantity of heat depending upon the amount of heat extracted from the air or other medium which is circulated over the evaporator and that the evaporator cools
15 this medium in extracting heat therefrom. Hence it is seen that room air may be cooled or heated depending upon whether the heat exchange element, over which the room air flows, is serving as a condenser or evaporator, it being
20 understood that the heat exchange elements have preferably a fixed physical relation to each other and that room air flows over one of said elements and that preferably outside air flows over the other. To change the air conditioning
25 apparatus from a room cooler to a heater or vice versa merely requires that the direction of flow of the refrigerant through the heat exchange elements be reversed thereby interchanging the condenser and evaporator functions of the heat
30 exchange elements.

35 It is one object of my invention to utilize the foregoing principles and mode of operation by providing improved means for interchanging the evaporator and condenser functions of the heat exchange elements. A further object is to accomplish the interchanging operation by employing
40 preferably a plurality of valves and improved operating means therefor. Another object in this respect is to so arrange and control the valves that they may be very tightly sealed and held to their seat at all times to minimize or prevent leakage of refrigerant while at the same time permitting the valves to be easily and positively operated without imposing undue strains
45 upon the operating mechanism or its supporting structure.

50 Another object is to provide an improved valve arrangement and operating means whereby the operating forces are preferably self-contained, thus allowing the tightly sealed and held valves to be moved without abnormal strains being transmitted to the supporting structure.

55 A further object is to provide an improved supporting arrangement for the valve or valves with respect to the heat exchange elements and also to provide improved means for connecting the high and low pressure refrigerant pipes to the valves whereby a simple and effective communication is made between the pipes and valves.

60 Other objects and advantages will be more ap-

parent to those skilled in the art from the following description of the accompanying drawings in which:

Fig. 1 is a partial perspective of an air conditioning room unit embodying my invention;

Fig. 2 is a perspective of the valve mechanism and operating means therefor and also showing the supporting relation thereof with respect to the heat exchange elements;

Fig. 3 is a horizontal section through the valves taken at the level of the high and low pressure pipes;

Fig. 4 is a diagrammatic outline of a compressor-condenser-expander circuit with interchanging valves therein;

Fig. 5 is an enlarged longitudinally vertical section through one of the adjusting nuts and screws with a valve arm attached thereto;

Fig. 6 is a plan view of a modified arrangement employing a worm and worm sectors for operating the valves;

Fig. 7 is a plan view of a modified form of valve actuating means employing rack and pinion;

Fig. 8 is a further modification employing a screw similar to the preferred form but with a modified form of attachment of the valve arms to the screw;

Fig. 9 is a plan view of a further modification employing cam actuating means.

In the illustrated embodiments of the invention, which are shown herein merely for the purpose of disclosing certain specific forms among others that the invention might take, I employ any suitable refrigerating system having complementary heat exchange elements with a fixed physical relation between them and with fixed paths for the flow of room air and outside air over the respective elements. It will be understood that my invention is particularly applicable to a self-contained air conditioning room unit such as shown in Galson application, filed December 24, 1932, Serial No. 648,772, and it is to be considered that the invention herein is applied to a unit of the Galson type wherein one heat exchange element generally indicated at 1 has outside air circulated thereover while room air is circulated over the other heat exchange element generally indicated at 2, see Figs. 2 and 4, these being connected to a suitable compressor.

For purposes of clarity, my improved interchanging means and associated features will be described as though the unit were operating as a room cooler wherein, as shown in Fig. 4, suitable refrigerant is compressed in a compressor 3 and discharged through pipes 4 of the high side and thence through a passage 5 of an interchanging valve 6 to pipe 7 which connects to condenser 1 over which outside air is circulated to effect condensation of refrigerant. The liquid refrigerant then flows preferably through a

double trap or expansion valve system as shown in Neeson application, filed January 25, 1933, Serial No. 653,466, wherein one trap or expansion valve 8 which is inoperative during the cooling function of the unit allows liquid to flow freely through pipe 9 and an operative trap or expansion valve 10 to the evaporator 2 which preferably is of the flooded type and over which room air is circulated. Low pressure refrigerant gas evaporated in evaporator 2 is discharged through the low pressure or suction pipe 11 and thence through port 12 of a second interchange valve 13. The gas then flows through the pipe 14 to the intake of compressor 3.

To cause this system to heat the room air, it is only necessary to rotate valves 6 and 13 until their respective ports 5 and 12 are in the dotted line position as shown in Fig. 4 in which event the compressor discharge pipe 4 communicates with pipe 11 and heat exchange element 2, thereby causing the latter to serve as a condenser over which the room air flows to condense a refrigerant and in so doing to heat the air. The condensed refrigerant then flows through trap 10 which now becomes inoperative by virtue of the liquid flowing in a direction opposite to that of the cooling cycle and continues through pipe 9 and trap 8, which now becomes operative to permit flow of only refrigerant liquid but to prevent substantial flow of gaseous refrigerant. The refrigerant then continues through heat exchange element 1 now serving as an evaporator and over which outside air flows thereby permitting extraction of heat from the outside air to evaporate the liquid refrigerant, the extracted heat being carried in the gaseous refrigerant through pipe 7 to valve passage 12 and pipe 14 to the suction side of the compressor which compresses the gas to permit the condenser operation and repeat the above cycle.

It is of the utmost importance that leakage of refrigerant be prevented or reduced to the smallest possible minimum and to accomplish this with valves of simple form, it is usually necessary that such valves be tightly sealed and held in their seat. However, it is equally necessary that such valves shall be easily and positively operated to effect their operation and also to have the valves supported in a relatively simple and economical manner so as to avoid expensive and complicated constructions.

To accomplish the foregoing results, the pipes 7 and 11, connected respectively to the heat exchange elements 1 and 2, are brought out laterally from said elements and preferably over the top thereof as shown in Fig. 2, these pipes if desired being welded as at 15 and 16 or otherwise suitably secured to the headers 17 and 18 of the heat exchange elements. The pipes 7 and 11 may be continued as single pieces or if desired suitable joints 19 and 20 may connect the continued portions 7' and 11' of the pipes 7 and 11. Said continued portions are preferably substantially parallel which is also preferably the case with pipes 7 and 11, although any of these pipes may assume any particular curvature in leading to or from the joints 19 and 20. The provision of joints 19 and 20 also permits the valve mechanism, to be described presently, to be made as a unit and to be assembled with or removed from the heat elements while they remain in a fixed position within the cooler unit, these joints being preferably telescopic soldered connections.

The valve unit consists in having pipes 7' and 11' extend preferably entirely through lugs 22

and 23 formed on opposite sides of the valve casing 24. Inasmuch as the two valves 6 and 13 are identical in construction, the description of one will suffice for both and similar parts are accordingly given the same reference numbers. The pipe 7' is provided with cut-out portions 25 and 26 and pipe 11' with cut-out portions 27 and 28 communicating with suitable ports in the valve bodies which in turn communicate with the hollow interior of a suitable rotatable plug valve 29 as through passages 5' and 12'. The pipes 4 and 14 connected directly to the compressor as shown in Fig. 4 are in the actual embodiment of Fig. 2 connected preferably at the lower portion of the valve casing herein specifically shown as extending axially from the bottom of the valve.

The valve lugs 22 and 23 are welded or soldered as at 30 to pipes 11' and 7' or are otherwise suitably secured thereto, while the ends of the pipes are closed in a relatively simple and effective manner by the provision of an end brace 33 having recesses 32 and 32' into which said pipes extend to be secured by welding or soldering 34.

To cause the valve operating forces to be self-contained within the valve and also to permit a high degree of ease of operation, there is provided a screw actuating shaft generally indicated at 35 having right and left hand threads 36 and 37 upon which nuts 38 and 39 are threadedly mounted. Blocks 40 and 41 are secured to nuts 38 and 39 by pivot pins 42 and 43 while valve operating handles 44, preferably round in cross-section, have slidable engagement with the pivot blocks 40 and 41 through suitable holes therein.

To simply and adequately support the actuating shaft 35, the end member 33 has a turned-up portion 45 while an intermediate bracket 46 is secured to the pipes 7' and 11' in the manner shown in Fig. 3 and also has a turned-up portion provided with a hole 47 in which an enlarged hub 48 on screw shaft 35 is journaled. Hub 48 and bore 47 preferably do not have any side flange. The bearing flange 46 thus provides preferably only a radial support for the screw shaft although the outer end of the shaft which passes through support 45 may be provided with removable nuts or collars 49 and 50 to take up any temporary tendency of axial displacement of the screw. The end of the screw shaft may be provided with any suitable removable crank connecting means herein specifically shown as a socket and slot generally indicated at 51 with which a crank 52 may be removably connected by insertion through a suitable opening 53 in the end of the room unit cabinet 54 which encloses the entire unit.

The interchanging valve mechanism as shown in Fig. 1 is preferably disposed at one end of the unit above the compressor 3 from which the heat exchange elements extend longitudinally toward the other end of the unit. Hence it is seen that the interchanging valves are rendered accessible not only to the hand crank 52 but also to the compressor discharge and suction pipes while the heat exchange elements are arranged to permit their pipes 7 and 11 to adequately support the interchanging valve unit, all of which effects a most desirable arrangement both from the standpoint of manufacture, inspection and repair as well as convenience of operation.

Operation.—The operation of the refrigerating system when used either for cooling or heating has been previously described but the following

is the operation of the valve mechanism for interchanging the functions of the condenser and evaporator. It will be noted from Fig. 2 that the valves 6 and 13 have their operating arms or handles 44 angularly related to each other while the ports 5' and 12' of the valves 6 and 13 are arranged whereby the valve arms are moved inwardly toward each other to effect one mode of operation and outwardly away from each other to effect the other mode of operation such as heating or cooling. To effect this valve movement, it is only necessary to insert the crank 52 within the pin and slot 51 of the actuating screw 35 so that upon rotation thereof the nuts 39 and 39 will be moved toward or away from each other due to the right and left hand threads 36 and 37. This mode of operation insures that the relatively large forces necessary to turn the valves will be equal and opposite and hence substantially self-contained so that no large supporting members or bearings are necessary. Any unequal forces that might occur will be suitably taken care of by the intermediate bracket 46 or end bracket 45. It is also seen that my improved arrangement permits interchanging valves 6 and 13 to be assembled as a unit, including pipes 7' and 11', brackets 45 and 46 and the valve operating mechanism such as the screw 35, the nuts and pivot blocks therefor together with the associated mechanism as above described and shown.

In the modification shown in Fig. 6 the valves 6 and 13 are supported on pipes 7' and 11' similarly to the preferred form except that the valve stems are each provided with worm sectors 55 and 56 actuated by a common worm gear 57 which is supported in suitable bearings 58 carried preferably by pipes 7' and 11'. Rotation of the worm will cause clockwise movement of one gear and counterclockwise movement of the other and the valve ports would be arranged to cooperate with such direction of movement to effect interchange of the evaporator and condenser functions.

In the modification shown in Fig. 7 the valves 6 and 13 are provided with spur gear sectors 59 and 60 commonly actuated by a pinion 61 whose shaft is suitably journaled in a bracket 62 carried by pipes 7' and 11'. Rotation of pinion 61 will effect rotation of the valves in the same direction whenever moved. It will also be noted that in either direction of movement, actuating forces between the gears will be substantially self-contained.

The modification of Fig. 8 is somewhat similar to the preferred form except that an actuating screw 63 is supported only by its pivotal connection 64 with nuts 65, there being no sliding connection between the valve arms 66 and the nuts. Rotation of the screw is provided with right and left hand threads so that rotation thereof will cause the valve arms to be moved toward or away from each other. As the arms are adjusted the screw will move laterally toward or away from the valves and to permit this movement while at the same time maintaining the operating crank in engagement with the screw, the cabinet is provided with an elongated slot 67 in which the screw can freely move. If for any reason one valve should become stuck so that the other valve would first move, it will be noted that upon completion of the movement of the free valve, the stem thereof will engage either one of stops 68 or 69 after which the entire operating force

will be applied to turn the stuck valve or the valve which offers the greatest resistance.

In Fig. 9 the valves 6 and 13 are supported and arranged in the manner of the preferred form except that the valve arms 70 have their outer ends bent up as at 71 to engage the cam surfaces 72 formed by slots 73 directed toward each other in a plate 74. This plate may be shifted transversely of the valves in any suitable manner, one specific form of which is to employ a screw 75 suitably anchored against longitudinal movement so that a nut 76 carried by plate 74 will be moved and thereby effect swinging of the valve arm 70.

From all of the foregoing disclosures it is seen that I have provided a relatively simple and economical and yet highly effective means for interchanging the functions of a condenser and evaporator and at the same time permit the valves to be tightly sealed and held to their seats to prevent leakage of refrigerant.

It will of course be understood by those skilled in the art that various changes may be made in the details of construction and arrangement of parts without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. In combination, a plurality of rotatable valves disposed with their axes substantially parallel, and means for simultaneously moving said valves relative to each other, including a screw disposed in a direction transverse to said axes and connected to each of said valves to provide self-contained and opposed operating forces.

2. In combination, a plurality of rotatable valves disposed with their axes substantially parallel, and means for simultaneously actuating said valves including a screw disposed in a direction transverse to said axes, arms secured to each of said valves, and pivotal connections between said arms and screw.

3. In combination, a plurality of rotatable valves disposed with their axes substantially parallel, and means for simultaneously actuating said valves including a screw disposed in a direction transverse to said axis, arms secured to each of said valves, and slidable connections between said arms and screw.

4. In combination, a plurality of rotatable valves disposed with their axes substantially parallel, and means for simultaneously actuating said valves including a screw disposed in a direction transverse to said axes and having left and right hand threaded portions, nuts on said threaded portions, and arms carried by said valves operatively connected to said nuts whereby upon rotation of said screw the valves are rotated in opposite directions.

5. In combination, pipes terminating in substantially parallel portions, and valves each supported on each of said parallel pipe portions, each of said pipes being arranged to have communication with each valve.

6. In combination, a plurality of valves each having on the correspondingly same side a lateral port terminating adjacent a pipe seat, and a pipe of substantially uniform cross-section received by said pipe seats and extending from one seat of one valve to the seat of the other of said valves, said pipe having lateral openings registering with said ports.

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