June 28, 1966 W. W. WEBSTER 3,257,732

DRYING OF HONEYCOMB METAL STRUCTURES

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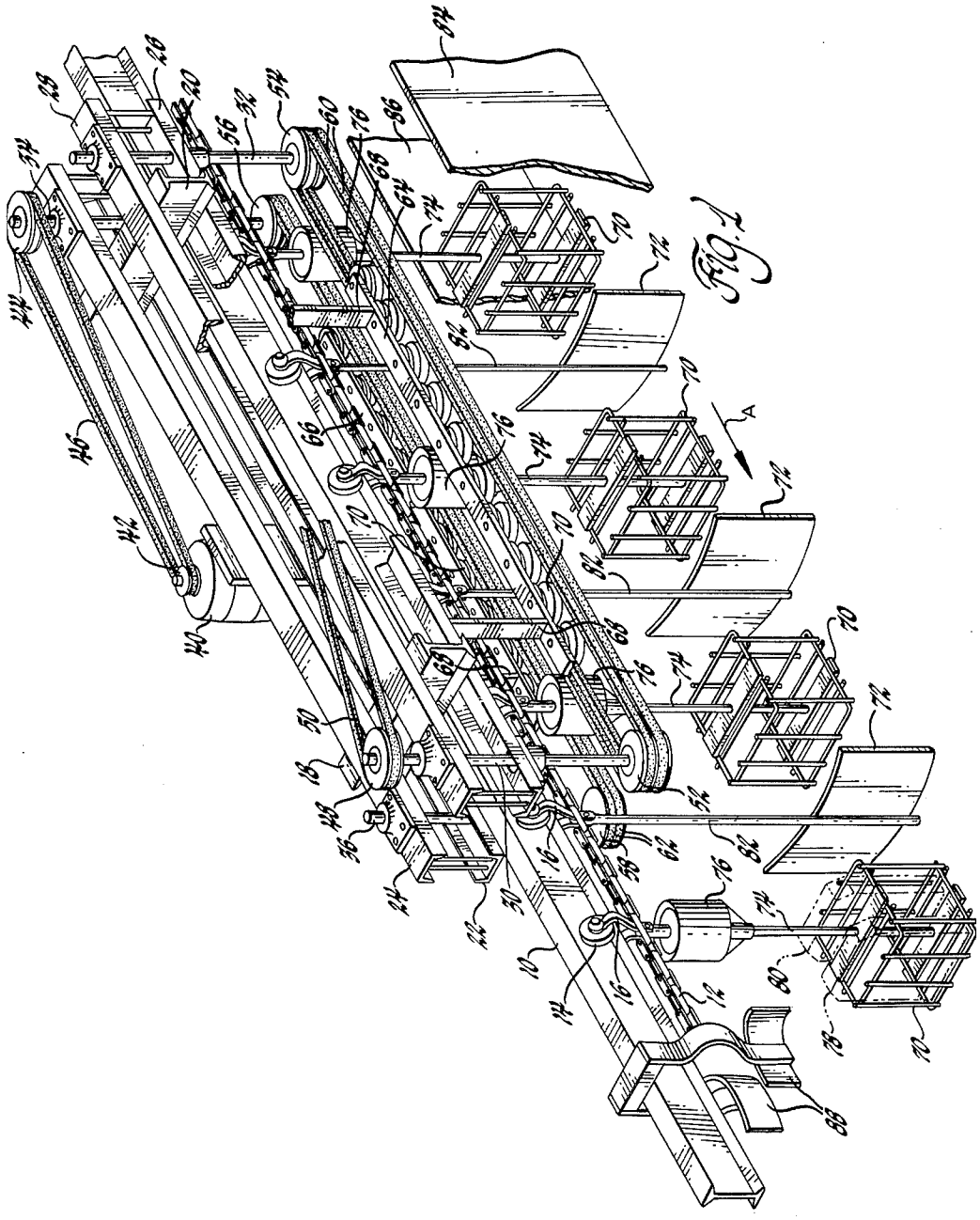


Fig. 1

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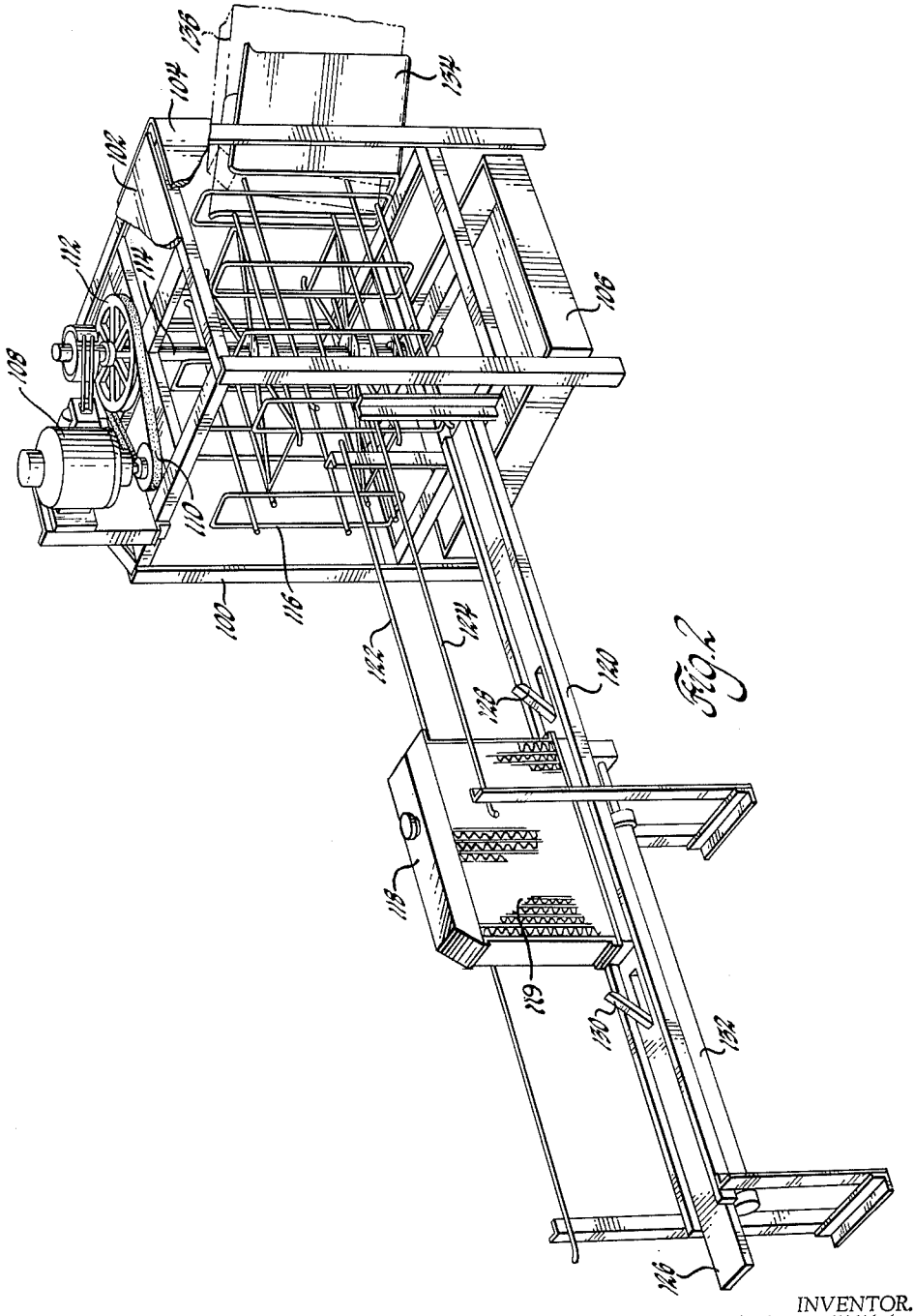


Fig. 2

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DRYING OF HONEYCOMB METAL STRUCTURES

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1 Claim. (Cl. 34—8)

This invention relates to the drying of honeycomb metal structures and more particularly to the removal of entrapped liquid or the drying of ambient exposed but intricately arranged surfaces of structures such as heat exchangers of the types including cores of integrated tubes and thin metal work.

In the manufacture of automobile radiator cores having parallel air passages extending through them it has been customary to dry the air contacting surfaces of the metal parts including the tubes and thin metal air centers separating the tubes, this drying being necessary as a preliminary to painting. Testing of the radiators for leaks by immersing them in water results in the crevices and pockets of the cores being surprisingly full of water—that is—outside the tubes. Not only water but any treating liquid used in the manufacture of the radiators should generally be removed and for reasons dependent upon the particular situation. One way to dry metallic honeycomb structures which has been the customary procedure in at least one large manufacturing plant is to subject such structures to hot and cold air blasts and then to pass the partially dry structures through an infrared drying tunnel. The air blasts alone are not adequate as liquid droplets merely run to the lee or sheltered spots on the radiators such as behind the tubes. The drying tunnel serves as supplement means to insure removal of the droplets effectively but the time needed, the equipment and space requirements, and the expense involved in this manner of operation are highly objectionable factors.

An object of the present invention is to provide an improved method of removing liquid from ambient exposed, or air contacting surfaces of honeycomb structures such as heat exchangers of the automobile radiator or oil cooler types with a minimum expenditure of time and financial investment accompanied with a reliable thoroughness insofar as liquid removal is concerned.

To this end, a feature of the present invention is a method of removing liquid deposited in a metallic honeycomb structure having parallel air passages extending therethrough which comprises arranging the structures with dynamic balance about an axis, rotating the structure about that axis thereby centrifugally forcing the liquid outwardly from that axis and along the air passages and collecting that liquid in a zone separated from the structure. Another feature of the invention is the arranging of multiple units in a rotatable framework in balanced relation about the axis of the framework and rotating the framework within an enclosure whereby liquid deposited on the ambient exposed or normally air contacting surfaces of the units is removed from the latter along through-passages therein.

These and other important features of the invention will now be described in detail in the specification and then pointed out more particularly in the appended claim.

In the drawings:

FIGURE 1 is a perspective view of a portion of a continuous chain conveyor system developed for carrying out the method of the present invention and showing heat exchangers such as automobile radiators properly positioned with respect to their axes of rotation;

FIGURE 2 is a perspective view of one form of a stationary axis centrifugal apparatus which is suitable in performing the method of the present invention.

In FIGURE 1 is depicted a portion of a conveyor system which comprises an I-beam 10 along which a conveyor chain 12 is arranged to operate. Wheels 14 are connected by means of yokes 16 to the chain in a manner which is conventional. The I-beam 10 is supported by cross beams 18 and 20 and these in turn support four channel bars 22, 24, 26 and 28. The channel bars 22 and 24 are in spaced but in facing relation with the beams 18 and 20 interposed and clamped between them. The same is true with the channel bars 26 and 28 but the latter are on the other side of the channel bar 10. Two pulley shafts 30 and 32 are vertically supported and journalled on the channel bars 26 and 28. Two identical pulley shafts 34 and 36 are similarly arranged with respect to the channel bars 22 and 24. The pulley shaft 34 is arranged to be driven by a motor 40 through pulleys 42 and 44 which are connected by a belt 46. A similar arrangement is used with respect to the pulley shaft 30 although the required motor is not shown in the drawing but it will be understood that a pulley 48 is keyed to the shaft 30 and a belt 50 is used therewith in the same manner as is the case with respect to the belt 46.

The lower ends of the shafts 30 and 32 are fitted with pulleys 52 and 54 respectively and the shafts 34 and 36 are fitted with pulleys 56 and 58 respectively. Belts 60 are used to connect the two pulleys 52 and 54 and belts 62 are used to connect the pulleys 56 and 58. With this arrangement, the runs of the belts 60 and 62 are parallel and in the same horizontal plane a short distance below the chain 12.

Horizontal guide bars 64 and 66 are suspended beneath the channel bars 26 and 22 respectively and by vertical strap members 68. The bars 64 and 66 in turn support guide rolls 70 which are so placed as to serve as backing members for the adjacent parallel runs of the belts 60 and 62.

Baskets 70 and arcuate deflectors 72 are alternately arranged along the conveyor chain 12. Each basket 70 is hung by a rod 74 from a yoke 16 and the rod is fitted with a driving drum 76 of a diameter snugly to fit between the adjacent runs of the belts 60 and 62. Each drum 76 includes an end thrust bearing to permit the drum and rod 74 to rotate. Each basket is composed of a frame for retaining two heat exchangers such as indicated at 78 and 80 in dot and dash lines. The frame holds the two exchangers in dynamic balance about the axis of the basket. Each deflector 72 forms a shield between baskets or frames 72 and is nonrotatively supported by a rod 82 from a yoke 16. Side plates 84 and 86 are spaced from and extend along opposite sides of the series of baskets 70 and deflectors 72.

The belts 60 and 62 are so rotated that their inner or adjacent parallel runs travel in opposite directions and in speeds causing the drums 76 to rotate as the chain 12 brings the latter between the belts. The speed of belts 60 plus the speed of the chain 12 is made equal to the speed of the belts 62 minus the chain speed. The baskets or frames 70 are consecutively loaded from their tops with exchangers to be dried and as the loaded frames 70 bodily move in the direction of the arrow A and their drums 76 are engaged by the belts 60 and 62, water is thrown along and from conventional air passages of the heat exchangers by centrifugal force and is deflected by the shields 72 and the side walls 84 and 86 to a collector (not shown) below. If a liquid other than water is discarded from the exchangers, the process permits its collection facilitating subsequent salvage and treatment of that liquid if advantageous. After the centrifugal treatment zone determined by the belts 60 and 62 has been traversed, each frame 70 stops rotating by action of a brake such as the cooperating friction plates 88 and the dry heat exchangers may be quickly replaced by wet units or the conveyor may be such as to go through other

treatment zones before again passing through the drying zone.

FIGURE 2 shows a type of apparatus in which a basket or frame rotatable on a fixed axis may be used to carry out the present invention. This apparatus comprises an angle bar frame **100** which may be enclosed on its top and sides by plate material such as partially shown at **102** and **104**. The bottom of the frame is left open and space is provided beneath the frame for an open box or collector **106**. A motor **108** is mounted on top of the frame **100** and is arranged to drive a belt **110** and a pulley **112**. The latter is fixed to a shaft **114** suitably journaled in the frame **100** centrally to support a basket or frame **116**. The latter is made of steel rods in such a way as to form baskets on opposite sides of the shaft **114** for holding heat exchangers such as the automobile radiator depicted at **118** as having a core **119** with through air passages. A work handling platform is shown at **120** in the form of a guideway over which the heat exchangers may be consecutively propelled for insertion into the frame **116** between drying operations. Guide rails or rods **122** and **124** are suitably retained above the support table **120** as shown in the drawing. A reciprocating plate **126** is mounted in the table **120** and has resiliently mounted fingers **128** and **130** such as are conventionally employed in conveyor systems for urging loads in one direction. A hydraulic power cylinder **132** is provided to actuate the plate **126** when the frame **116** is to be loaded with heat exchangers. The side of the frame **100** opposite the work loading table **120** is provided with a chute **134** which is inclined downwardly to facilitate discharge of the dry heat exchangers. A portion of an exchanger **136** is shown in dot and dash lines and in a position of discharge within the chute **134**.

In the operation of the apparatus of FIGURE 2, the frame **116** is held stationary until a heat exchanger has been fed from the platform **120** into the frame **116** and to one side of the shaft **114**. It will be understood that the conventional through air passages of the heat exchanger core will then be extending away or outwardly from the shaft **114**. The frame **116** is then rotated 180 degrees by hand or otherwise indexed and the other side or pocket of the frame **116** is loaded with another heat exchanger. The changing of one wet exchanger into the basket **116** may conveniently sevre as a means for discharging a dry heat exchanger as will be understood. With the frame **116** properly loaded and in balance, the motor **108** is then driven rapidly to rotate the frame with the result that any water or liquid on the heat exchangers

in the basket is centrifugally thrown off and gathered in the container **106**. After a surprisingly short time the heat exchangers in the basket become dry and rotation is terminated and the heat exchangers are replaced by two wet exchangers for the next drying operation.

The centrifugal drying of clothes is a common procedure and has been practiced for many years but automobile radiators are awkward to handle and are unyielding and engineers have heretofore considered them as objects not amenable to the treatment herein taught as eminently practical and more satisfactory than the application of forced air jets or heat. It has been found that with an approximate five-foot diameter for a rotatable cage or frame holding two automobile radiators that a rotational speed of about 400 r.p.m. for about fifteen seconds and without the application of heat or air jets is adequate to remove water to such an extent that the radiators may immediately be painted.

I claim:

A method of removing liquid from ambient exposed surfaces of thin easily distortionable metallic walls of the core of a heat exchanger having generally parallel air passages therethrough, said method including providing an open framework rotatable on a axis, placing said heat exchanger while wet with liquid in said framework to restrain movement of said heat exchanger away from said axis and with said parallel passages directed away from said axis, rotating said framework and heat exchanger about said axis under balanced conditions thereby causing said liquid to move along said surfaces away from said axis by centrifugal action, and removing said heat exchanger from said framework in substantially dry condition.

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