Nov. 9, 1965 I. G. HALL ETAL 3,216,486

ROTARY HEAT EXCHANGER

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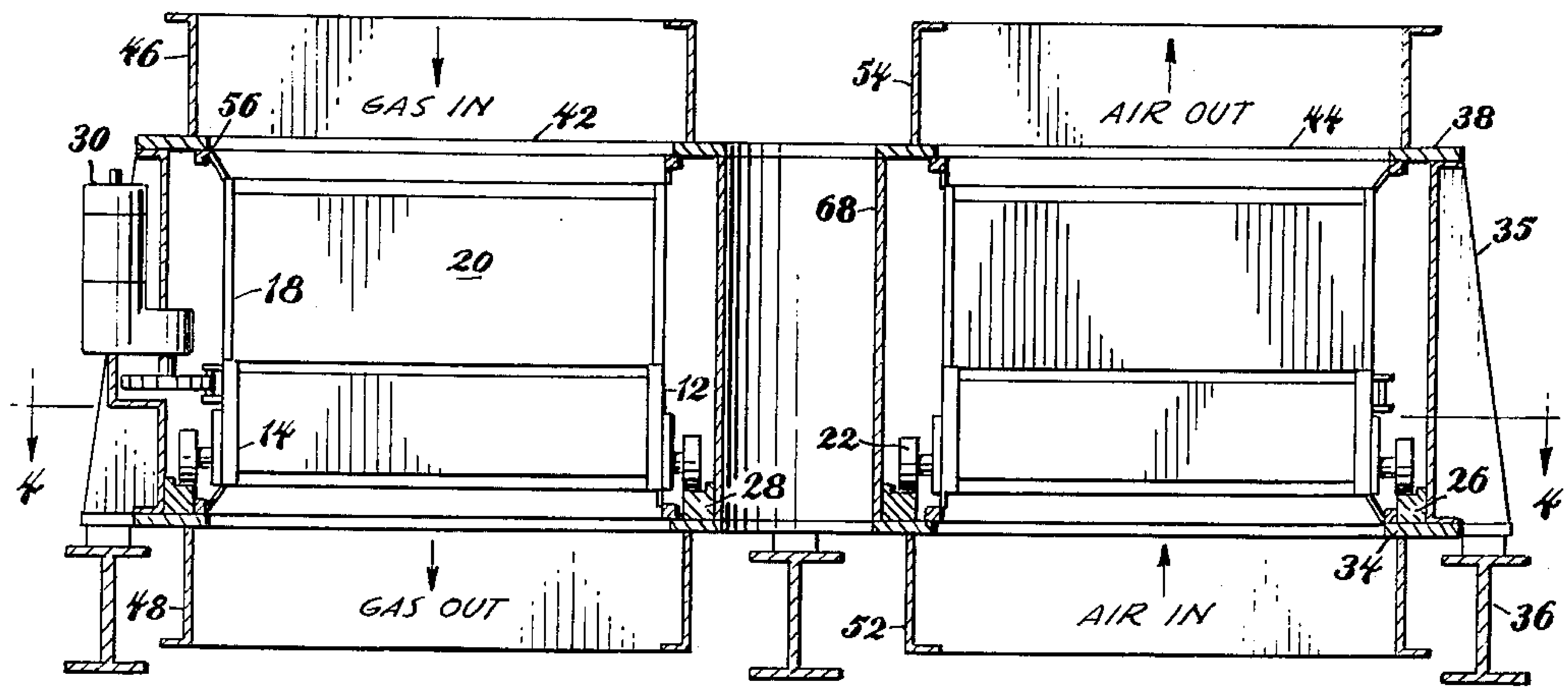

Fig. 1

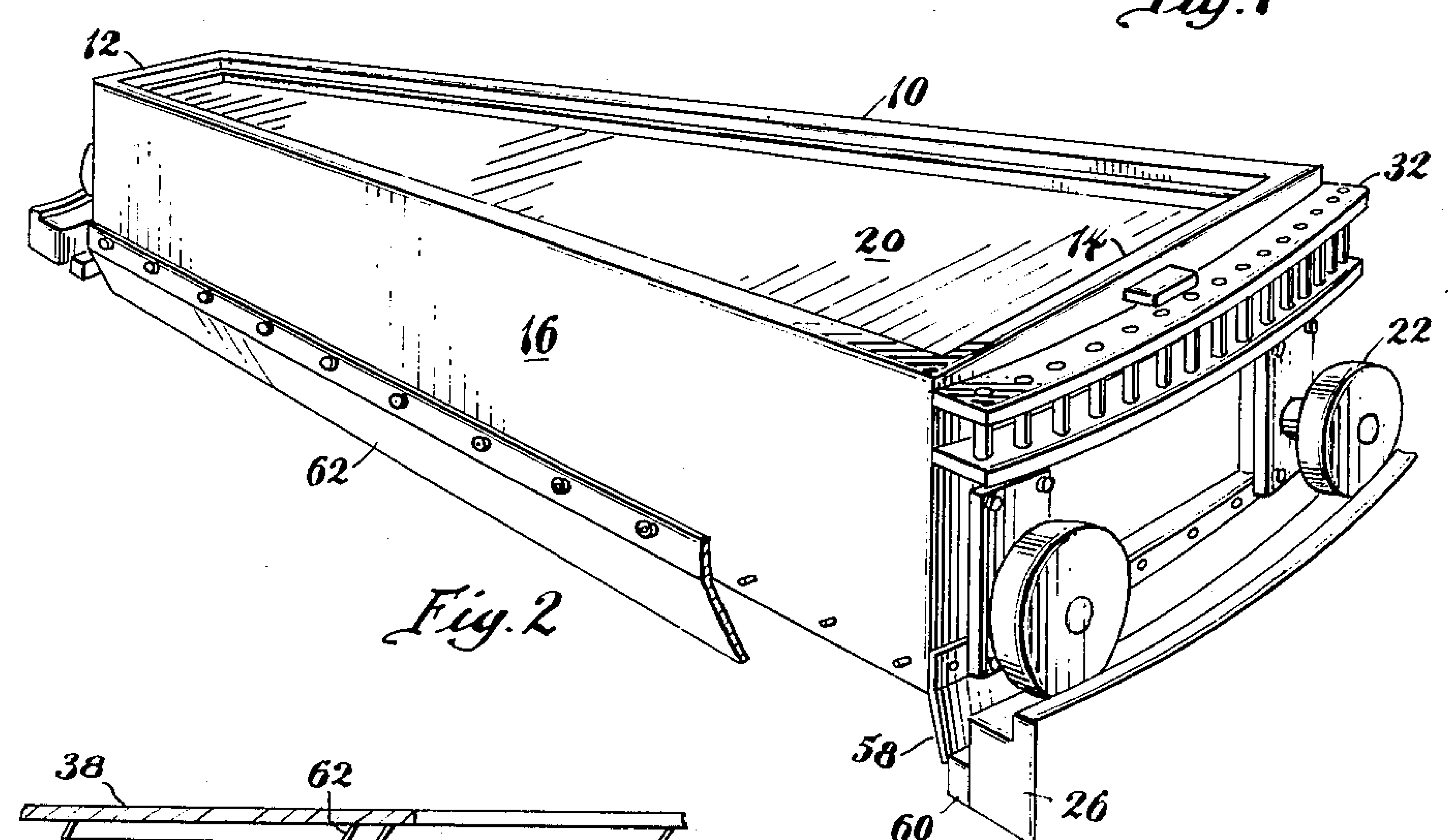

Fig. 2

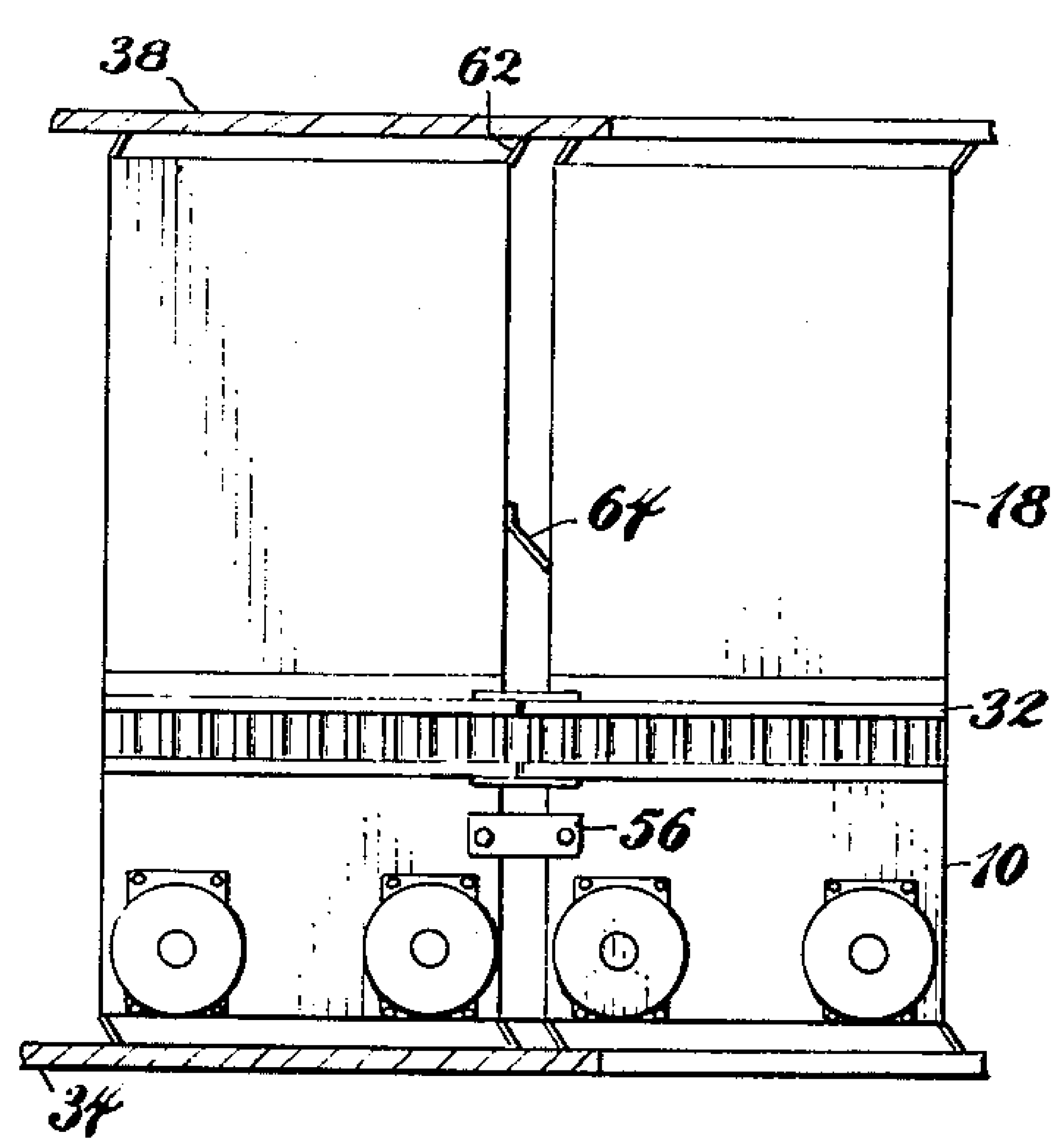

Fig. 3

INVENTOR.
Irvin G. Hall
BY Norman Casagrande
Wayne Lang
AGENT

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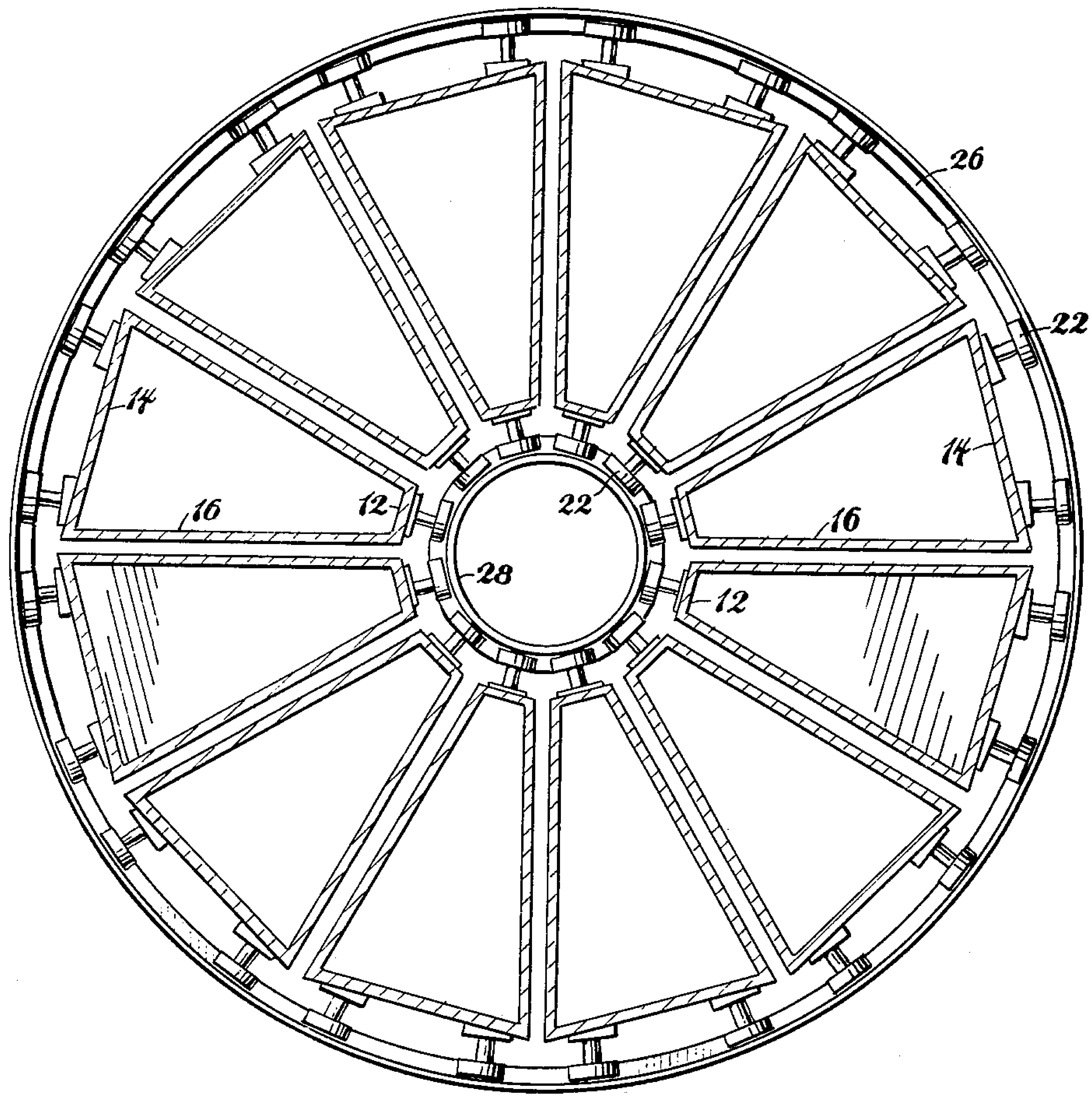

Fig. 4

INVENTOR
Irvin G. Hall
Norman Casagrande
By
Wayne Lang
AGENT

United States Patent Office

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ROTARY HEAT EXCHANGER

Irvin G. Hall, Friendship, and Norman Casagrande, Wellsville, N.Y., assignors, by mesne assignments, to The Air Preheater Company, Inc., a corporation of Delaware

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6 Claims. (Cl. 165—8)

The present invention relates generally to heat exchange apparatus and particularly to an improved arrangement that permits the use of large capacity equipment not generally considered feasible because of various size limitations.

In rotary regenerative heat exchange apparatus of the type herein defined, a cylindrical rotor having a number of compartments containing a mass of heat absorbent material is first exposed to a stream of heating gas, and then as the rotor is rotated about its axis, the compartments of heat absorbent material are exposed to a stream of cool air or other fluid to be heated whereby heat from the hot gas may be transferred to the cooler air through the intermediary of the heat absorbent material. The rotor is usually surrounded by a housing having openings at either end for ducts that provide for the flow of the heating fluid and the fluid to be heated.

The rotor is usually supported for rotation by a central support bearing that is carried by beams at the top or bottom of the rotor, and it is driven about its axis by a driving means acting at its periphery or at its axis of rotation so that all portions of the rotor may be traversed alternately by the heating fluid and the fluid to be heated.

Arrangements as this have been generally satisfactory for heat exchangers of the size and type used heretofore; however, applications for heat exchangers having an over-all size and mass far exceeding anything in current use have been designed and proposed for future installation. Inasmuch as the size of heat exchangers being proposed is approaching a size limit as determined by the availability of components such as bearing means suitable for supporting for rotation a massive rotor that exceeds the limits of size and mass of anything heretofore considered, new arrangements for rotor support must be devised before the development of such apparatus may keep pace with the development of related equipment.

As a further consideration, heat exchange equipment of this type is usually shipped from manufacturing plant to erection site in an assembled or semi-assembled state and as such is limited in size by generally available shipping facilities. It is therefore an object of this invention to produce a rotor design which permits the rotor to be divided into relatively small basic units for shipping, and then readily reconstructed at its final destination for ultimate use.

The invention will be more clearly understood upon consideration of the following detailed description of an illustrative embodiment thereof when read in conjunction with the accompanying drawings in which:

FIGURE 1 is a sectional elevation of a rotary regenerative heat exchanger constructed and arranged according to the invention.

FIGURE 2 is a perspective view of a basic element compartment.

FIGURE 3 is a partial side view of the rotor showing the linkage relationship between adjacent compartments.

FIGURE 4 is a sectional view of the rotor as seen from line 4—4 of FIGURE 1.

In the drawings the numeral **10** designates a trapezoidal or sector shaped housing of a compartment module that comprises the basic structural component of the apparatus herein defined. A series of such compartments **10** arranged in lateral juxtaposition together provide a composite substantially annular rotor having an inner

wall **12** and an outer wall **14** joined together by radial walls **16**. The walls of each compartment module **10** are comprised of relatively heavy, strong material capable of supporting thereon a similar series of upper compartments **18** having the same outside dimensions but being formed of comparatively light gauge material as a weight conservation measure. The upper compartments **18** are secured to the foundation compartments **10** after assembly by means such as welding whereby they serve together as a composite compartment. The composite compartments are adapted to receive sheets or blocks of heat absorbent material **20** to which hot gases may transmit heat and which in turn may transmit the absorbed heat to cooler air or other fluid flowing in contact therewith.

Each composite element compartment is provided with a plurality of trucks **22** mounted on outer wall **14**, and at least one truck **22** mounted on inner wall **12** capable of independently supporting the compartment on annular track means **26** and **28** aligned therewith. The trucks may be simple wheels or rollers but they must be sufficiently strong to support the mass of the compartment and its load of heat absorbent element. Supporting means for the trucks **22** preferably include anti-friction bearings of a suitable type that substantially reduce the force required of drive means **30** to move the assembly about its axis.

Both outer and inner annular tracks **26** and **28** may be positioned at the lower part of the rotor on the inner surface of end plate **34** which is carried by the support structure **36**. A number of vertical risers or supports **35** spaced about the outer periphery of the rotor support the outer rim of an upper end plate **38** while a tubular support **68** centrally positioned within the annular rotor provides a fixed support for the central portion of the upper end plate. Both end plates **34** and **38** are apertured at **42** and **44** and connected to inlet and outlet ducts **46** and **48** for the hot gas and inlet and outlet ducts **52** and **54** for the air in order that the hot gas and cooler air may be simultaneously directed through the flow passageways of the heat absorbent material carried by the rotor.

Each sectorial compartment **10** is pivotally linked to each adjacent compartment by a linkage arrangement **56** which is adapted to permit limited axial movement of each compartment independent of other compartments adjacent thereto. This arrangement holds the compartments at a fixed lateral spacing while permitting each compartment to at all times rest directly upon the subjacent portion of the annular tracks **26** and **28**.

An annular driving rack extending completely around the rotor is adapted to intermesh with a pinion gear on driving means **30** to move the rotor about its axis. The driving rack is comprised of a plurality of arcuate sections **32** each of which is firmly secured to the outer wall of each compartment **10**.

While the rotor support means have been disclosed as being positioned adjacent the lower edge of the rotor, it should be clearly understood that such support means could be readily installed at other axially displaced positions around the periphery of the rotor. Moreover, the particular type of anti-friction trucks carried by the rotor are not necessarily limited to the type disclosed in the drawing. It is thus intended that all matter included in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative only and not in a limiting sense.

We claim:

1. A regenerative heat exchanger having a rotor comprising a plurality of independent open ended compartments arranged side-by-side in an endless assembly around a vertical axis, a mass of heat absorbent material carried by each compartment of the rotor, fixed support means independent from the rotor assembly subjacent the base thereof, anti-friction support means carried by each compartment of the rotor adapted to engage the fixed support means to provide a support for the rotor, linkage means pivotal about an axis normal to that of the rotor connecting each compartment of the rotor to the compartments adjacent thereto, inlet and outlet ducts for a heating fluid and a fluid to be heated arranged to confront opposite ends of the rotor, and means for rotating the compartments of the rotor over their fixed support means whereby each part of the rotor is alternately aligned with the ducts for the heating fluid and the fluid to be heated.

2. A regenerative heat exchange apparatus having a rotor comprising a plurality of independent open ended compartments arranged similarly side-by-side in an endless assembly around a vertical axis, linkage means pivotal about a horizontal axis pivotally linking each compartment to other compartments adjacent thereto, a mass of heat absorbent material carried by each compartment of the rotor, support tracks independently mounted subjacent laterally spaced edges of the compartment assembly, support means mounted on each compartment of said assembly to engage the support tracks and be supported thereby, inlet and outlet ducts for a heating fluid and a fluid to be heated arranged to confront opposite ends of the rotor, an arcuate drive rack similarly affixed to each compartment of the rotor so as to collectively provide a drive rack extending around the rotor, and driving means cooperating with said drive rack adapted to advance the rotor over said support tracks whereby each part of the rotor is alternately aligned with the ducts for the heating fluid and the fluid to be heated.

3. Rotary apparatus having a plurality of independent open-ended compartments of substantially trapezoidal configuration arranged in series around a vertical axis with their oblique walls in juxtaposition and their parallel walls arranged end to end to form a substantially annular rotor with composite inner and outer walls, linkage means pivotal about a horizontal axis linking each compartment to other compartments adjacent thereto, inlet and outlet ducts at opposite ends of the rotor arranged to direct a heating fluid and a fluid to be heated through spaced parts of the rotor, plate means confronting ends of the rotor intermediate said spaced ducts to limit fluid flow thereto, a mass of heat absorbent material carried by the compartments of said rotor, independent support means positioned radially outside said annular rotor, anti-friction support means carried by the inner and outer walls engaging said independent support means, and means for rotating the rotor about its axis to alternately align each part of the rotor with the ducts for the heating fluid and the fluid to be heated.

4. Rotary apparatus of a type having a plurality of open ended compartments arranged in a mutually adjacent relationship about a vertical axis to provide a substantially annular rotor with inner and outer composite walls formed by the spaced walls of the compartments, linkage means pivotally connecting each compartment to other compartments adjacent thereto, inlet and outlet ducts at opposite ends of the rotor adapted and arranged to direct a heating fluid and a fluid to be heated through spaced parts of the rotor, a mass of heat absorbent material carried by each compartment of the rotor, fixed annular support means positioned subjacent the outer and the inner composite walls, anti-friction support means axially aligned with the fixed annular support means and carried by radially spaced inner and outer walls of each compartment adapted to engage the annular support means to support the rotor, sealing means bridging the space between adjacent compartment walls to preclude the flow of fluid therethrough, and means for rotating the rotor about its axis to alternately align each part of the rotor with the ducts for the heating fluid and the fluid to be heated.

5. Rotary apparatus as defined in claim **4** wherein each compartment of the rotor is provided with a plurality of anti-friction support means on its radially outer wall and a single similar support on its radially inner wall to engage the fixed annular support and provide stability of support to each compartment.

6. Rotary apparatus as defined in claim **4** wherein said linkage means is pivotally secured to the radially outer wall of each compartment.

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CHARLES SUKALO, *Primary Examiner.*