March 28, 1939. L. E. PERRINE ET AL 2,151,987

REFRIGERATING APPARATUS

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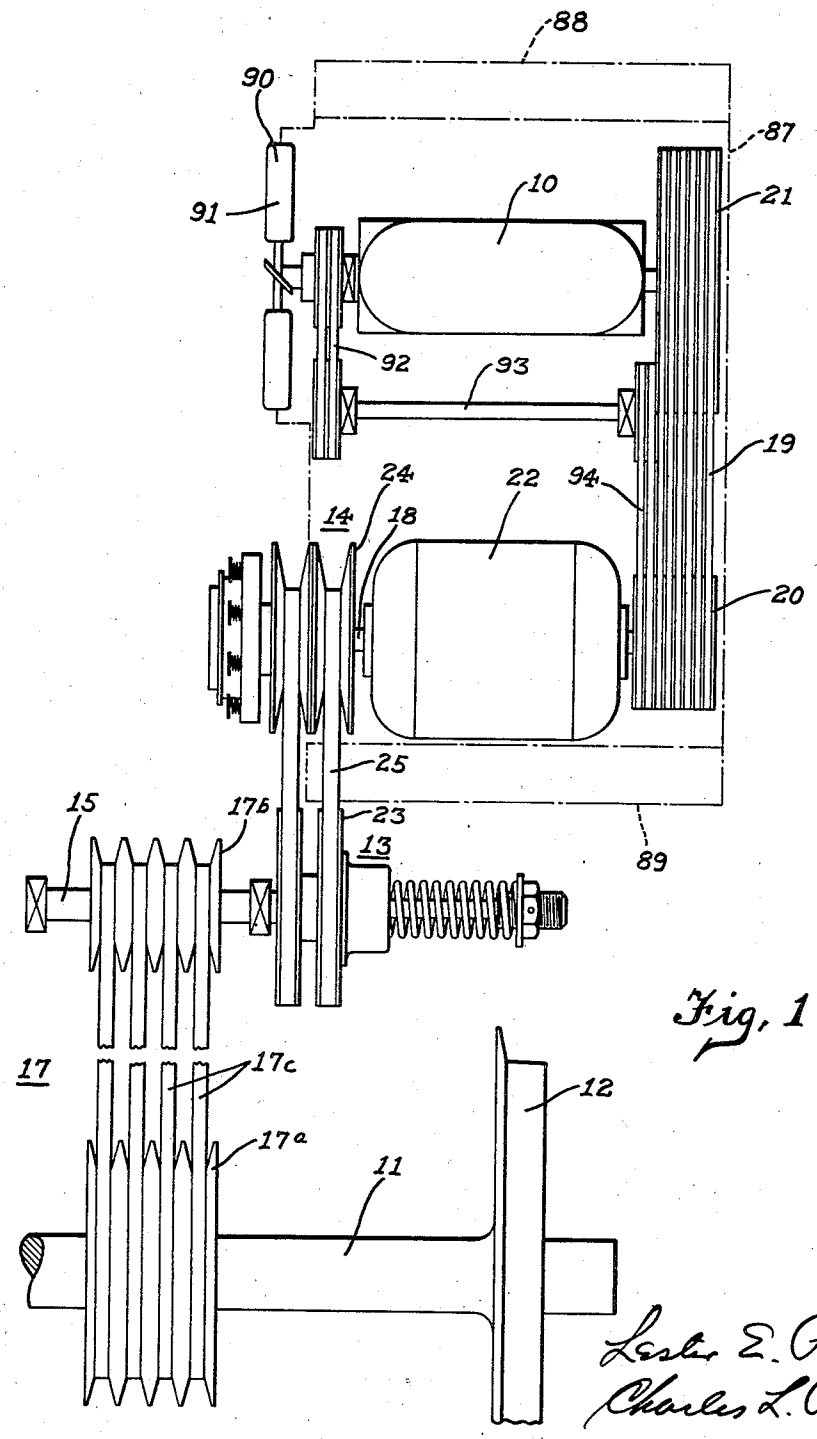


Fig. 1

Inventors
Lester E. Perrine,
Charles L. Paulus,
By Pierce Hardman & Pike
Attorneys

March 28, 1939. L. E. PERRINE ET AL 2,151,987

REFRIGERATING APPARATUS

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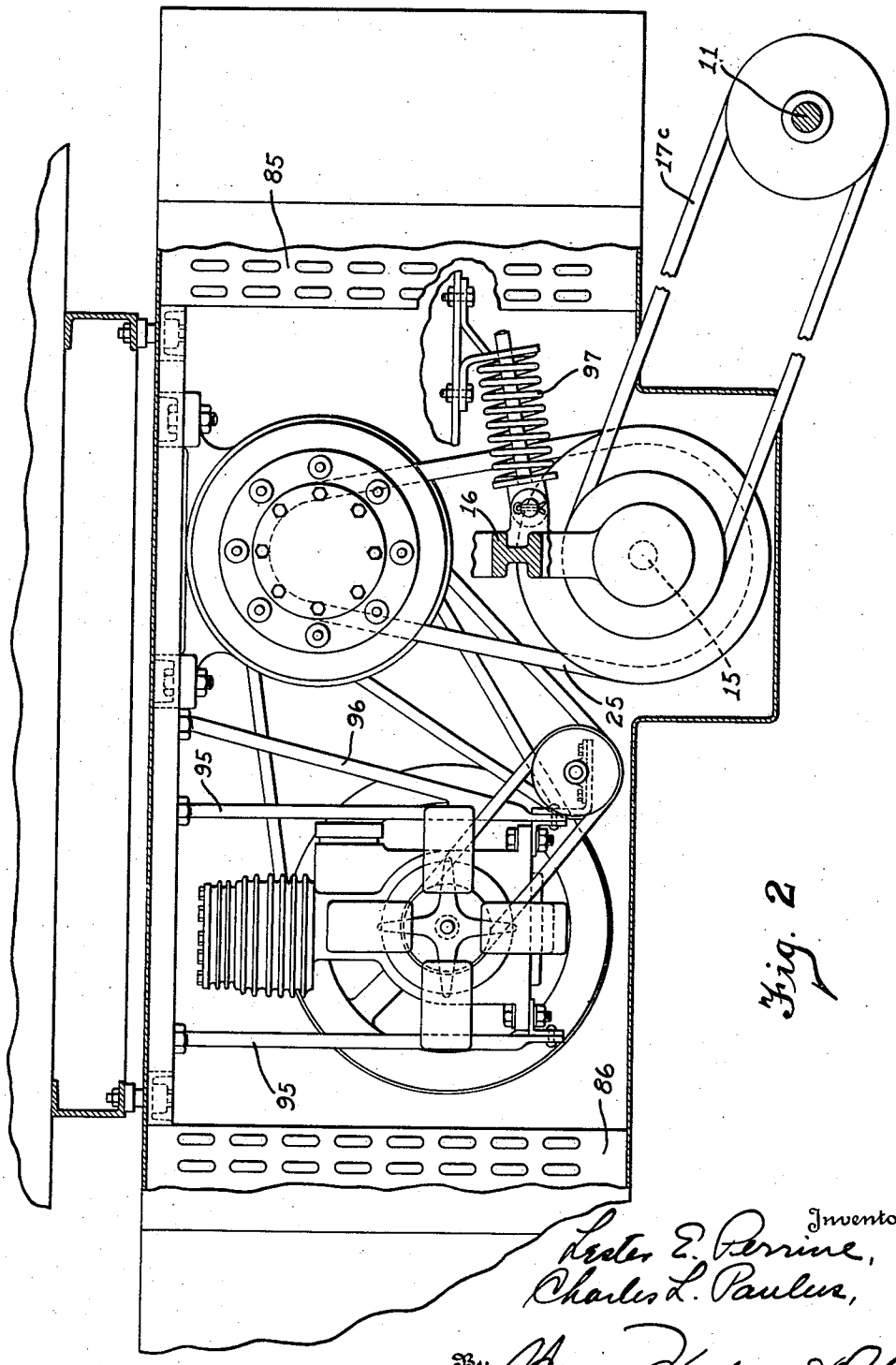


Fig. 2

Inventors
Lester E. Perrine,
Charles L. Paulus,
By Spencer Hardway & Fisher
Attorneys

March 28, 1939. L. E. PERRINE ET AL 2,151,987

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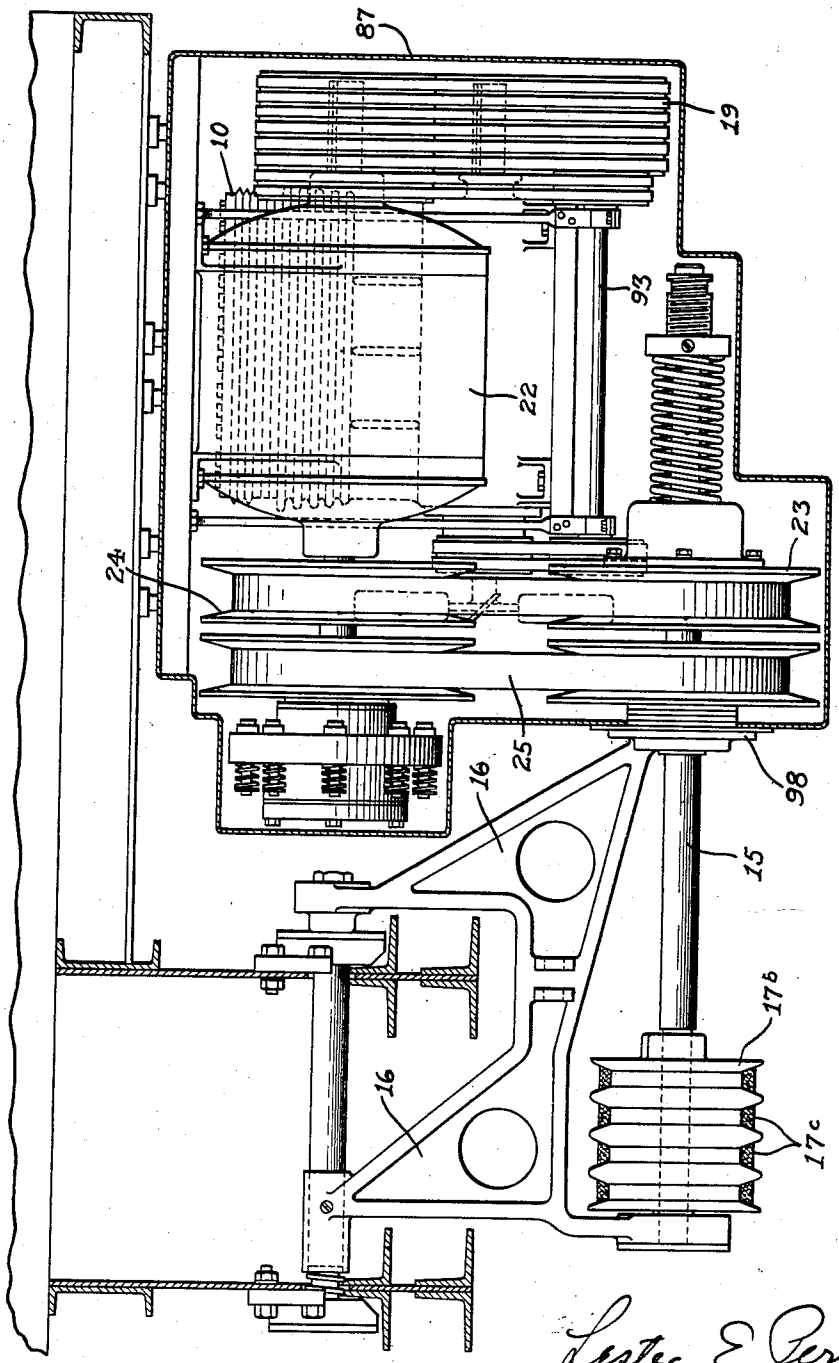


Fig. 3

Inventors
Lester E. Perrine,
Charles L. Paulux,

By Bauer, Friedman & Hahn
Attorneys

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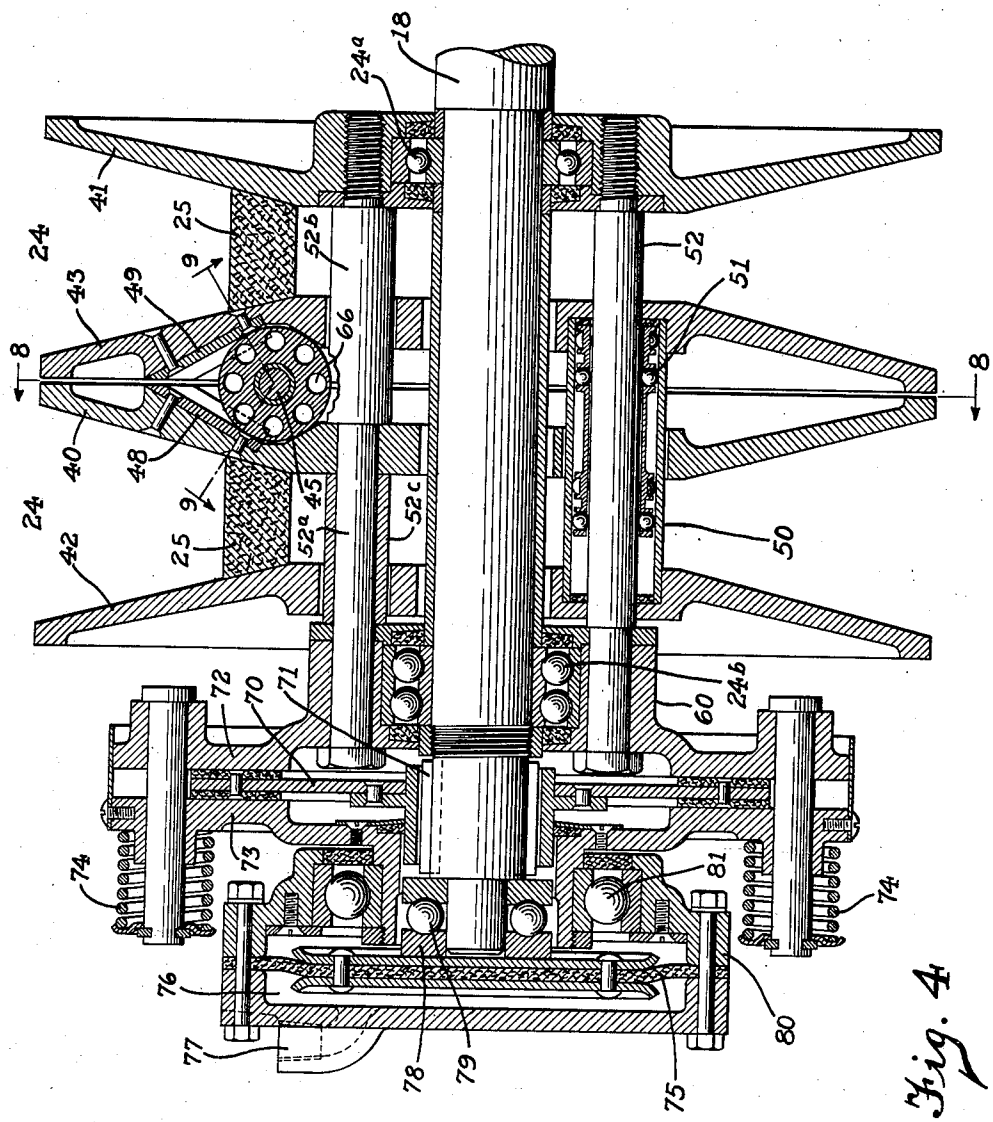


Fig. 4

Inventors
Lester E. Perrine
Charles L. Paulus,

By Brown Hardman & Keller
Attorneys

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REFRIGERATING APPARATUS

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Fig. 5

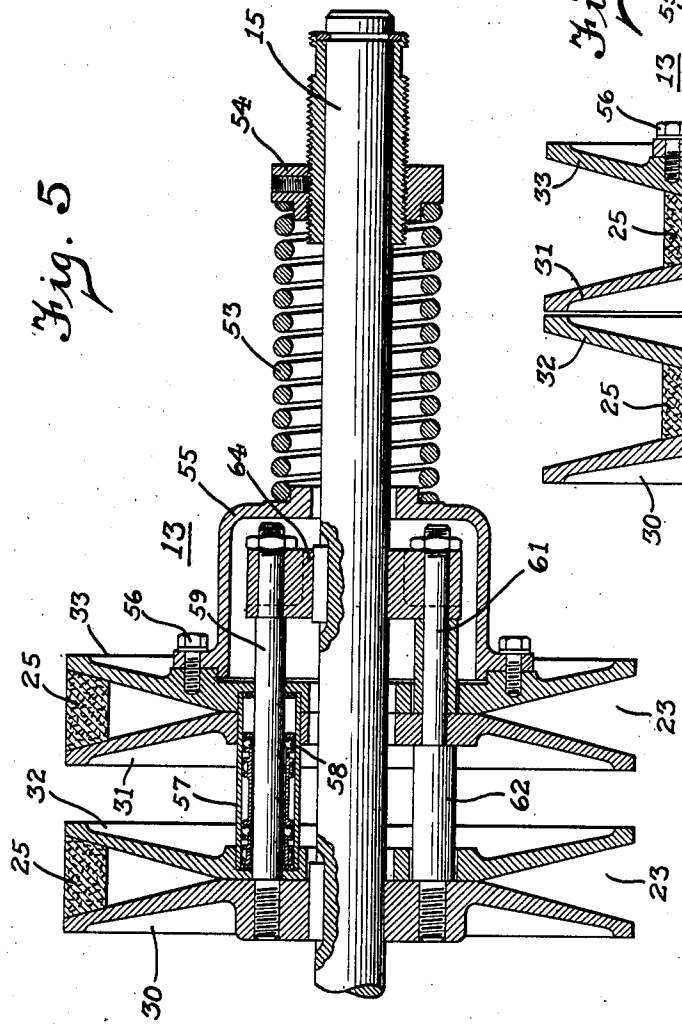
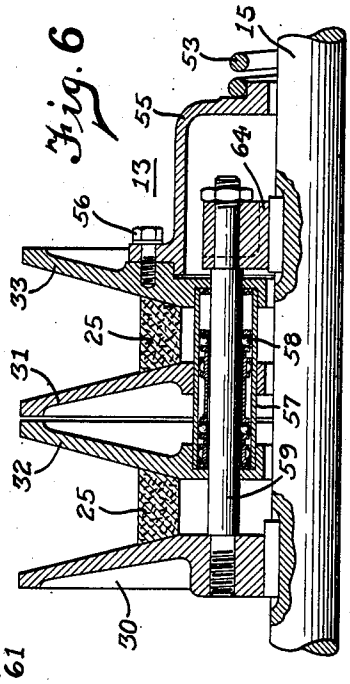


Fig. 6



Inventors
Lester E. Perrine,
Charles L. Paules.
By Duncan Hardman & Pike
Attorneys

March 28, 1939. L. E. PERRINE ET AL 2,151,987

REFRIGERATING APPARATUS

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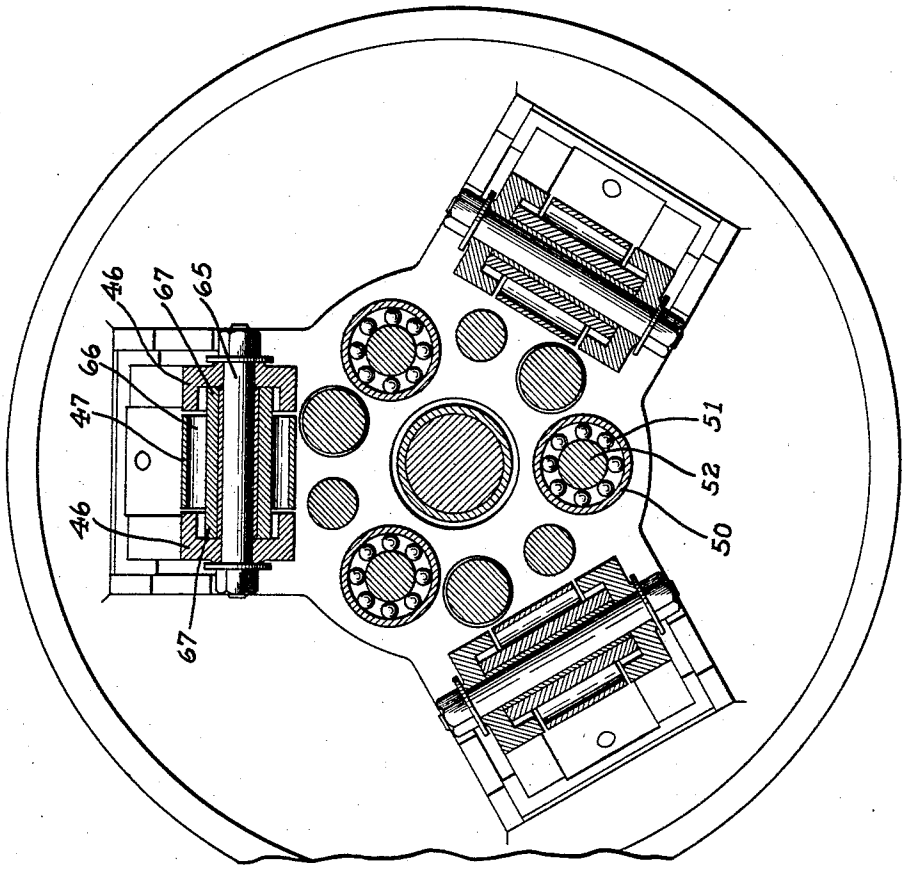


Fig. 8

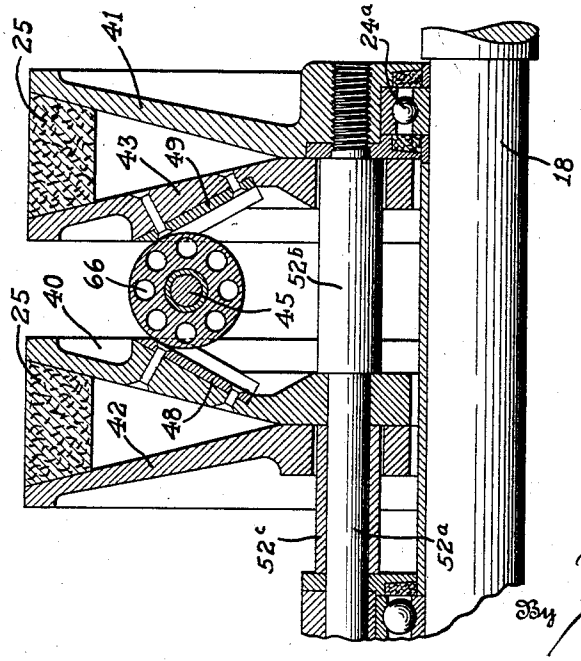


Fig. 7

Inventors
Lester E. Perrine,
Charles L. Paulus,
By Spencer, Hardman & Fehr
Attorneys

March 28, 1939. L. E. PERRINE ET AL 2,151,987

REFRIGERATING APPARATUS

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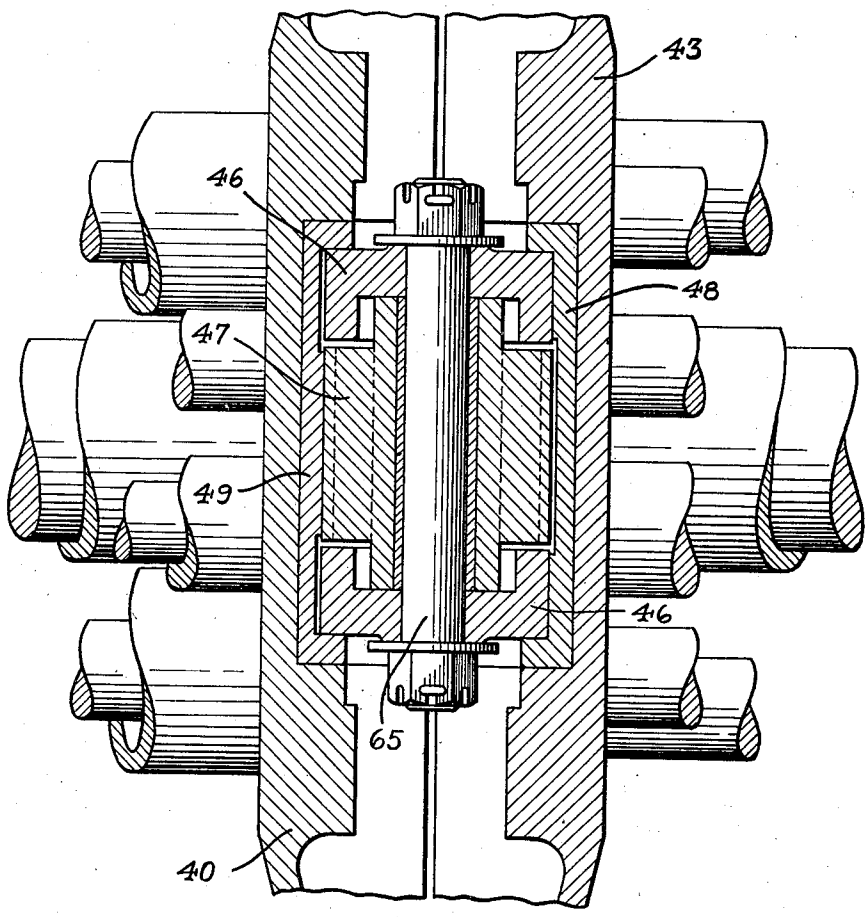


Fig. 9

Inventors
Lester E. Perrine,
Charles L. Paulus,
By Spencer Hardman & Fehr
Attorneys

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UNITED STATES PATENT OFFICE

2,151,987

REFRIGERATING APPARATUS

Lester E. Perrine, Detroit, Mich., and Charles L. Paulus, Dayton, Ohio, assignors to General Motors Corporation, a corporation of Delaware

Application September 1, 1934, Serial No. 742,490

9 Claims. (Cl. 74—230.17)

This invention relates to refrigeration and more particularly to refrigerating apparatus for conditioning air in vehicles and the like.

It is among the objects of this invention to provide a refrigerating apparatus which may be connected to rotating parts of the vehicle and which causes the refrigerating apparatus to be operated at proper speeds under varying speed conditions of the vehicle.

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 plan view, somewhat diagrammatic, of a portion of an apparatus embodying features of the invention with one of the shafts horizontally displaced to expose the same to view;

Fig. 2 is a vertical view of the apparatus shown in Fig. 1, but with two of the shafts shown in vertical alignment;

Fig. 3 is a view transverse to Fig. 2;

Fig. 4 is a cross-sectional view of the driven pulley portion of the variable ratio drive;

Fig. 5 is a cross-sectional view of the driving member of the variable ratio drive;

Fig. 6 is a view of a portion of the apparatus shown in Fig. 5, but in a different position;

Fig. 7 is a portion of the apparatus shown in Fig. 4 but in a different position;

Fig. 8 is a cross-sectional view taken substantially along the line 8—8 of Fig. 4; and

Fig. 9 is an enlarged cross-sectional view taken along the line 9—9 of Fig. 4.

In practicing this invention, a vehicle is provided with a variable ratio drive by which an apparatus, such as a compressor 10 of an air conditioning system, is driven at desired or permissible speeds notwithstanding the variations in the speed of travel of the vehicle. Preferably the variable ratio drive is interposed between the compressor and some rotating part of the vehicle which rotates in direct proportion to the speed of the vehicle. For example, the rotating part may be an axle 11 which carries a wheel 12 of the vehicle. The axle 11 actuates the driver portion 13 of the variable ratio drive which in turn drives the driven portion 14 of the variable ratio drive from whence the power is transmitted by suitable instrumentalities to the compressor 10.

When this invention is applied to a railway car or the like, the axle 11 is preferably caused to drive a jack-shaft 15 floatingly mounted on the vehicle by means of hangers 16. The drive between the axle 11 and the shaft 15 preferably takes the form of the belt drive 17 which drives the jack-shaft 15 at a greater rotational speed than the axle 11. The drive 17 may be of the multiple V-belt type as shown having pulleys 17a and 17b on which the belts 17c operate.

The driven portion 14 of the variable speed drive may be mounted on a shaft 18 which in turn drives the compressor 10 through the medium of belts 19 interposed between the pulley 20 of the shaft 18 and the pulley 21 of the compressor 10. If desired, the shaft 18 may form a portion of the dynamo electric machine 22 hereinafter more fully described.

The variable ratio drive preferably includes frictionally connected rotating parts having variable effective power transmitting diameters and is provided with means for automatically varying these diameters to compensate for variations in the speed of travel of the vehicle. These frictionally connected rotating parts preferably take the form of one or more driving pulleys 23 and one or more driven pulleys 24 between which are placed one or more belts 25. One or more of the pulleys is provided with relatively movable flanges, the relative movement of which varies the effective belt diameter of the pulley or pulleys and thus varies the speed ratio between the axle 11 and the compressor 10.

In the preferred embodiment, the driving member 13 includes a pair of pulleys 23 each of which is provided with an axially fixed pair of cone-shaped flanges 30 and 31 and a pair of axially movable cone-shaped flanges 32 and 33. The flanges 30 and 31 are directed in one axial direction and the flanges 32 and 33 are directed in the opposite axial direction thus to form the V-pulleys 23. Means are provided for automatically moving at least one of the pairs of flanges, such as flanges 32 and 33, in a manner to be more fully described in order to vary the effective belt drive diameter. This variation in diameter causes the belts 17 to ride far out on the pulley as shown in Fig. 5 or nearer towards the center as shown in Fig. 6.

The driven portion of the variable drive 14 (shown more in detail in Figs. 4, 7, 8 and 9) is preferably also provided with a pair of pulleys 24. These pulleys are formed by relatively movable conical-shaped flanges somewhat similar to the driving member 13. Thus axially fixed flanges 40 and 41 are directed in the same general axial direction while the movable flanges 42 and 43 are directed in the opposite axial direction to form V-shaped grooves or pulleys. Here also

automatic means are provided for causing relative movement between these flanges thus to cause the belts **25** to move axially inwardly or outwardly to vary the effective belt diameter.

The means for automatically varying the effective belt diameters of the pulleys preferably is speed responsive in character. Thus one or more centrifugal devices **45** are placed on either the driving member or the driven member to vary these diameters. In the preferred form, a plurality of centrifugal devices or rollers **45** are placed on the driven member **14**. These centrifugal devices take the form of roller-like weights having independently movable frictional contact surfaces **46** and **47** which engage the slanting surfaces **48** and **49**. When the centrifugal devices **45** fly outwardly they spread the flanges **40** and **43** apart as indicated in Fig. 7, thus moving flanges **43** and **42** to the position shown in Fig. 7 to vary the effective belt driving diameter.

The flanges **42** and **43** are tied together by means of sleeves **50** which are secured to these flanges and which ride on antifrictional devices **51** on the bolts **52** which are supported between the flanges **41** and the hub **60**. The fixed flanges **40** and **41** are maintained in their fixed spaced positions by bolts **52***a* having enlarged portions **52***b* which together with the sleeves **52***c* lock the flanges **40** and **41** in their fixed relation. The entire pulley structure is locked to the hub **60** and is floatingly mounted on the shaft **18** by ball bearings **24***a* and **24***b*.

When the belts **17** move outwardly from the position shown in Fig. 4 to the position shown in Fig. 7 the tension on the belts causes them to move inwardly on the driving member **13** from the position shown in Fig. 5 to the position shown in Fig. 6. Automatic means are provided for accomplishing this latter movement of the belt, and this automatic means preferably takes the form of a tensioning device or belt take-up now more fully described. A helical spring **53** is adjustably held by the nut **54** against a housing **55**. This housing **55** is connected to the movable flange **33** by bolts **56**, while the movable flange **33** is tied to the movable flange **32** by the sleeves **57** which ride on any antifrictional device **58** carried on the bolts **59**. The auxiliary fixed flange **30** is tied to the fixed flange **31** by means of bolts **61** having enlarged portions **62** and sleeves **63** cooperating with a sleeve **64** keyed to the shaft **15**. The bolts **59** and **61** are supported on the flange **30** which is also keyed on the shaft **15**. Thus as the housing **55** is urged axially against the movable flanges **32** and **33** by the spring **53**, the flanges **32** and **33** are permitted to move in response to varying tensions of the belt. By adjustment of the nut **54** the spring tension may be balanced with the force created by the centrifugal device **45** to obtain the desired variable ratio. The adjustment may be carried to such an extent that the shaft **18** is driven at a substantially constant speed regardless of variations in the car speed between any desired speed limits. It is to be understood, however, that the adjustment need not be carried further than to maintain the speed of shaft **18** between permissible limits rather than at a substantially constant speed.

The detailed construction of the centrifugal weights **45** will be more readily understood by reference to Figs. 4, 7, 8 and 9. Each of the weights **45** is a roller-like construction mounted on bolts **65** with antifriction devices **46** riding loosely on the bolts **65**. The devices **46** are spaced by the antifriction device **47** which is formed by a cylindrical member having a plurality of holes **66** bored therein, this cylinder having smaller cylindrical protrusions **67** extending into the cup-like formations of the devices **46**. One of the pulley flanges, such as flange **40**, is provided with a stepped surface **49** adapted to cooperate with the antifriction device **47** while the flange **43** is provided with stepped surfaces **48** adapted to cooperate with the antifriction devices **46** of the centrifugal weight **45**. Thus the device **47** rolls on surface **49** in one direction while the devices **46** roll on the surface **48** in the other direction. This permits the centrifugal weights **45** to move radially inwardly or outwardly with very little resistance due to friction against the pulley flanges.

Clutch means are provided permitting the compressor to be declutched from the axle **11** when the car is standing still or is running at speeds too low or too fast which are beyond the range of operation of the ratio changing device. In the preferred form, the clutch means cooperates with a flange **73** to clutch the edge of the disc **70**. When the flanges **72** and **73** are brought together by the springs **74**, the pulleys **24** are clutched to the shaft **18**. When the flanges **72** and **73** are spread apart, the pulleys **24** are declutched from the shaft **18**. This clutching and declutching operation thus affects the drive in the shaft **11** and the compressor **10**.

Pneumatic means are provided for actuating the clutch means. Thus a diaphragm **75** is provided at one edge of the chamber **76** which is connected by the opening **77** with the air brake system. When pneumatic pressure is introduced into the chamber **76**, the diaphragm **75** is pressed against the ring **78** which ring rides against the ball bearing **79**. The reaction thus produced moves the casing **80** towards the left in Fig. 4 and this in turn carries the thrust bearing **81** in the same direction and with it the flange structure **73** thus spreading apart the flanges **72** and **73**. When the pneumatic pressure is relieved in the chamber **76**, the springs **74** are permitted to clamp the clutch disc **70** between the flanges **72** and **73**. Suitable control means may be provided for controlling the flow of air into the chamber **76**.

The discharge from compressor **10**, such as compressed refrigerant, may enter condensers **85** and **86** which are mounted on the ends of a box structure **87** which is substantially air-tight except at the edges **88** and **89** and at the opening **90** where a fan **91** is placed. The fan **91** is of such a construction that when rotated in one direction it blows air inwardly into the box **87** through opening **90** and when it is rotated in an opposite direction it blows air outwardly from the box **87** through opening **90**. When the air is thus blown inwardly into the box, the air leaves through the condensers and is discharged into the atmosphere along the edges **88** and **89** thus cooling the condensers. When the air is blown outwardly by the fan, the air enters the box **87** through the condensers along the edges **88** and **89** and goes out through the opening **90**. The fan **91** may be driven by any suitable means such as by belts **92** driven from a shaft **93** which in turn is driven by belts **94** from the pulley **20**.

The compressor may be supported under the car in any suitable manner. Thus downwardly directed bolts **95** support the compressor **10** at the bottom thereof. Suitable brace bolts **96** prevent the compressor from swaying. The jack-shaft **15**,

which is swingingly mounted by the brackets 16 is urged away from the axle 11 by a spring 97 as will be readily understood. This provides for any necessary take-up in the belts 17c. By running the shaft 15 at a higher speed than the axle 11, it is possible to run the belts 25 at a relatively high speed and thus the size and number of the parts of the ratio transmitting device are reduced because of the relatively high speed of operation of the parts. The jack-shaft 15 extends through the housing 87 and the necessary opening therefor is sufficiently sealed by a sliding flange construction 98 so that the housing 87 is maintained substantially air-tight except at the edges 88 and 89 and opening 90.

By properly calibrating the length and strength of the spring 53 as well as its adjustment by the nut 54, it is possible to coordinate its action with that of the centrifugal means 45 in such a manner that the driven part of the variable ratio drive rotates at a substantially constant speed while the car is travelling at variable speeds but within reasonable limits. The compressor 10 therefore operates at a substantially constant speed and produces refrigeration for the car at a constant rate while the car is travelling at all normal speeds.

When the car is standing still or is operating at an abnormally low or high speed, the compressor may be operated by the dynamo electric machine, which may be energized by battery or station current. During this type of operation, the compressor is declutched from the axle 11.

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, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A variable ratio drive including a compound pulley having a shaft, a pair of axially movable, relatively fixed flanges on said shaft, a pair of axially fixed flanges on said shaft, said flanges forming two V-shaped grooves on said pulley, a flange on one of said pairs cooperating with a flange on the other of said pairs to form diverging surfaces, a centrifugal weight between said diverging surfaces and acting to vary the width of said grooves, a plurality of rods around the shaft each supported by the shaft at two separated points, said relatively movable flanges being slidably mounted upon said rods.

2. A variable ratio drive including a driver pulley, a driven pulley, one of said pulleys having a pair of relatively movable flanges, centrifugal means for causing relative movement of said flanges including oppositely directed cone surfaces, a centrifugal weight between said surfaces having independently movable anti-friction devices in contact with said surfaces, a shaft means upon which one of said pulleys is rotatably mounted, and clutch means for connecting said shaft to said one pulley.

3. A variable ratio drive including a driving member, a driven member, a pair of belts between said members, a pair of conically shaped flanges axially fixed on one of said members directed in one direction, and a pair of conically shaped flanges axially fixed with respect to each other and movable on said last named member directed in the opposite direction forming a pair of V-shaped pulleys on said member for said belts, and speed responsive means for axially moving the axially movable pair of flanges to vary the effective belt diameter of said pulleys including centrifugal means on one of said members and spring means on the other of said members, and externally accessible adjusting means for adjusting the tension of said spring means.

4. A variable ratio drive including a driving member, a driven member, a pair of belts between said members, a pair of conically shaped flanges axially fixed on one of said members directed in one direction, and a pair of conically shaped flanges axially fixed with respect to each other and movable on said last named member directed in the opposite direction forming a pair of V-shaped pulleys on said member for said belts, and speed responsive means for axially moving the axially movable pair of flanges to vary the effective belt diameter of said pulleys, including centrifugal means on one of said members and spring means on the other of said members, one of said pulleys being rotatably mounted upon one of said members, and clutch means for connecting said rotatably mounted pulley to its member.

5. A variable ratio drive including a driving member, a driven member, a pair of belts between said members, a pair of conically shaped flanges on one of said members axially fixed with respect to each other directed in one direction and a pair of conically shaped flanges on said last named member axially fixed with respect to each other directed in the opposite direction forming a pair of V-shaped pulleys on said member for said belts, a flange of one pair having a surface outwardly converging with respect to a surface on a flange of the other pair, and speed responsive means for axially moving one of said pair of flanges to vary the effective belt diameter of said pulleys, said speed responsive means including a centrifugally movable structure between and acting on said outwardly converging surfaces, all of the flanges upon one of said members being rotatably mounted thereon, and clutch means for connecting said flanges to said one member.

6. A variable ratio drive including a compound pulley having a shaft, a pair of axially movable, relatively fixed flanges on said shaft, a pair of axially fixed flanges on said shaft, said flanges forming two V-shaped grooves on said pulley, a flange on one of said pairs cooperating with a flange on the other of said pairs to form diverging surfaces, a centrifugal weight between said diverging surfaces and acting to vary to width of said grooves, and clutch means for drivingly connecting and disconnecting said flanges to said shaft.

7. A variable ratio drive including a driving member, a driven member, a pair of belts between said members, a pair of conically shaped flanges axially fixed on one of said members directed in one direction, and a pair of conically shaped flanges axially fixed with respect to each other and movable on said last named member directed in the opposite direction forming a pair of V-shaped pulleys on said member for said belts, and speed responsive means for axially moving the axially movable pair of flanges to vary the effective belt diameter of said pulleys including centrifugal means on one of said members and spring means on the other of said members.

8. A variable ratio drive including a driving member, a driven member, a pair of belts between said members, a pair of conically shaped flanges on one of said members axially fixed with respect to each other directed in one direction and a pair of conically shaped flanges on said last named member axially fixed with respect to

each other directed in the opposite direction forming a pair of V-shaped pulleys on said member for said belts, a flange on one pair having a surface outwardly converging with respect to a surface on a flange of the other pair, and speed responsive means for axially moving one of said pair of flanges to vary the effective belt diameter of said pulleys, said speed responsive means including a centrifugally movable structure between and acting on said outwardly converging surfaces.

9. A variable ratio drive including a compound pulley having a shaft, a pair of axially movable, relatively fixed flanges on said shaft, a pair of axially fixed flanges on said shaft, said flanges forming two V-shaped grooves on said pulley, a flange on one of said pairs cooperating with a flange on the other of said pairs to form diverging surfaces, a centrifugal weight between said diverging surfaces and acting to vary the width of said grooves.

LESTER E. PERRINE.
CHARLES L. PAULUS.