United States Patent

Robinson

[15] **3,707,282**

[45] **Dec. 26, 1972**

[54] PLANETARY AMUSEMENT RIDE

[72] Inventor: **Ralph G. Robinson,** Tempe, Ariz.

[73] Assignee: **Le Roy A. Anderson,** Scottsdale, Ariz. ; a part interest

[22] Filed: **Feb. 5, 1970**

[21] Appl. No.: **8,925**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 720,756, April 12, 1968, abandoned.

[52] **U.S. Cl.**.....**272/36,** 272/38

[51] **Int. Cl.**.....**A63g 1/08,** A63g 27/04

[58] **Field of Search**.....272/29, 36, 38, 49, 30, 6, 272/28, 37; 244/17.23

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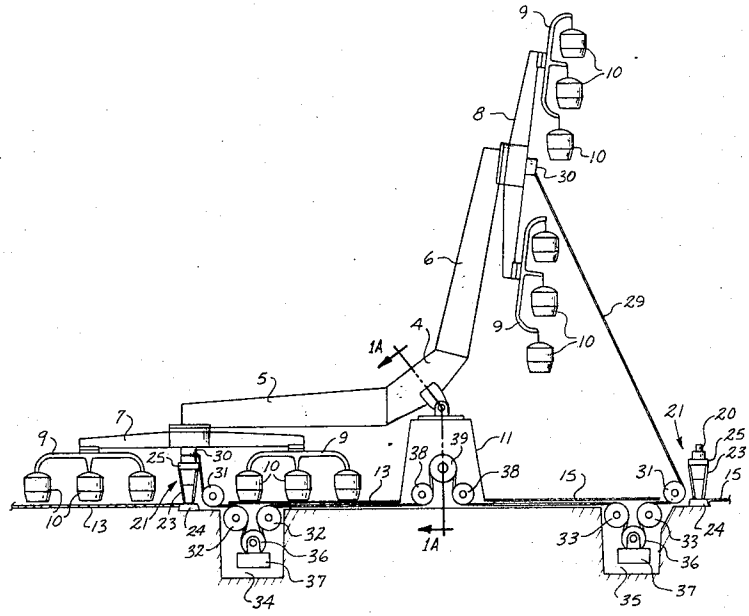
Primary Examiner—Anton O. Oechsle
Assistant Examiner—Arnold W. Kramer
Attorney—Edwin M. Thomas

[57] **ABSTRACT**

An amusement ride is described of duplex structure having a pair of main rotatable wheels or spiders which carry rotatable subwheels or spiders. The subwheels in turn carry passenger capsules or compartments. Two main arms which carry the main wheels are at obtuse angles to each other and are joined to form a rigid structure which is pivoted on a solid base for rocking in a vertical plane. The arms are rocked by cable and winch drum arrangement or by hydraulic piston mechanism. The main wheels or spiders are driven in rotation by hydraulic or electric motors; the subwheels can be rotated dependently or independently by the same or separate prime mover means. One set of wheels can be loaded and/or operated like a merry-go-round while the other set is high in the air analogous to a Ferris wheel.

3 Claims, 19 Drawing Figures



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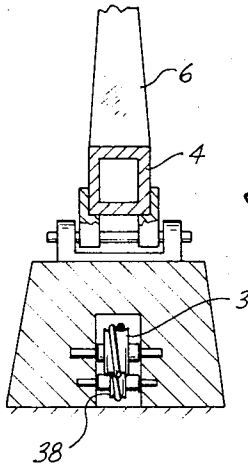


Fig. 1A

Fig. 1

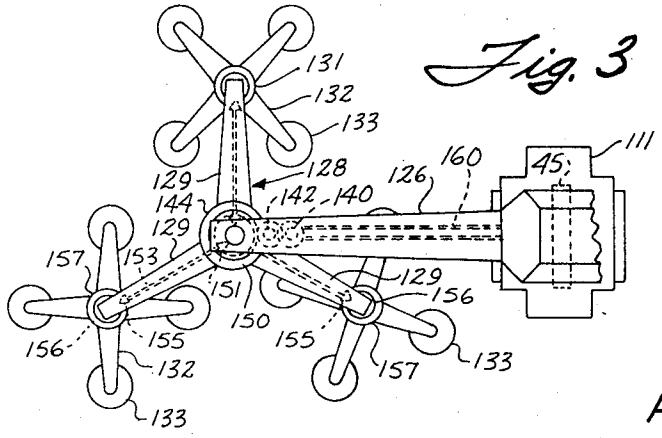


Fig. 3

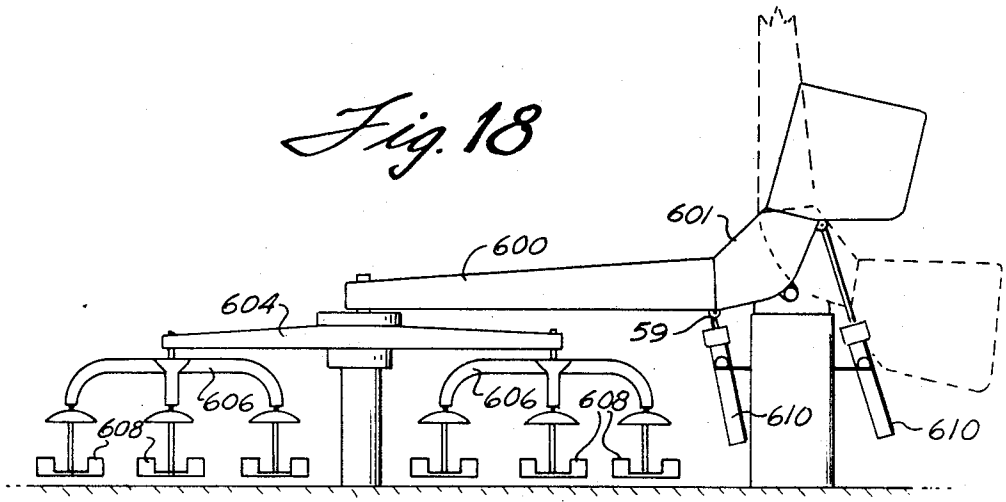
INVENTOR

RALPH G. ROBINSON

BY Edwin M. Thomas

ATTORNEY

Fig. 18



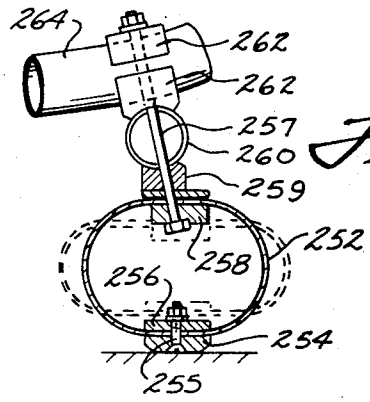
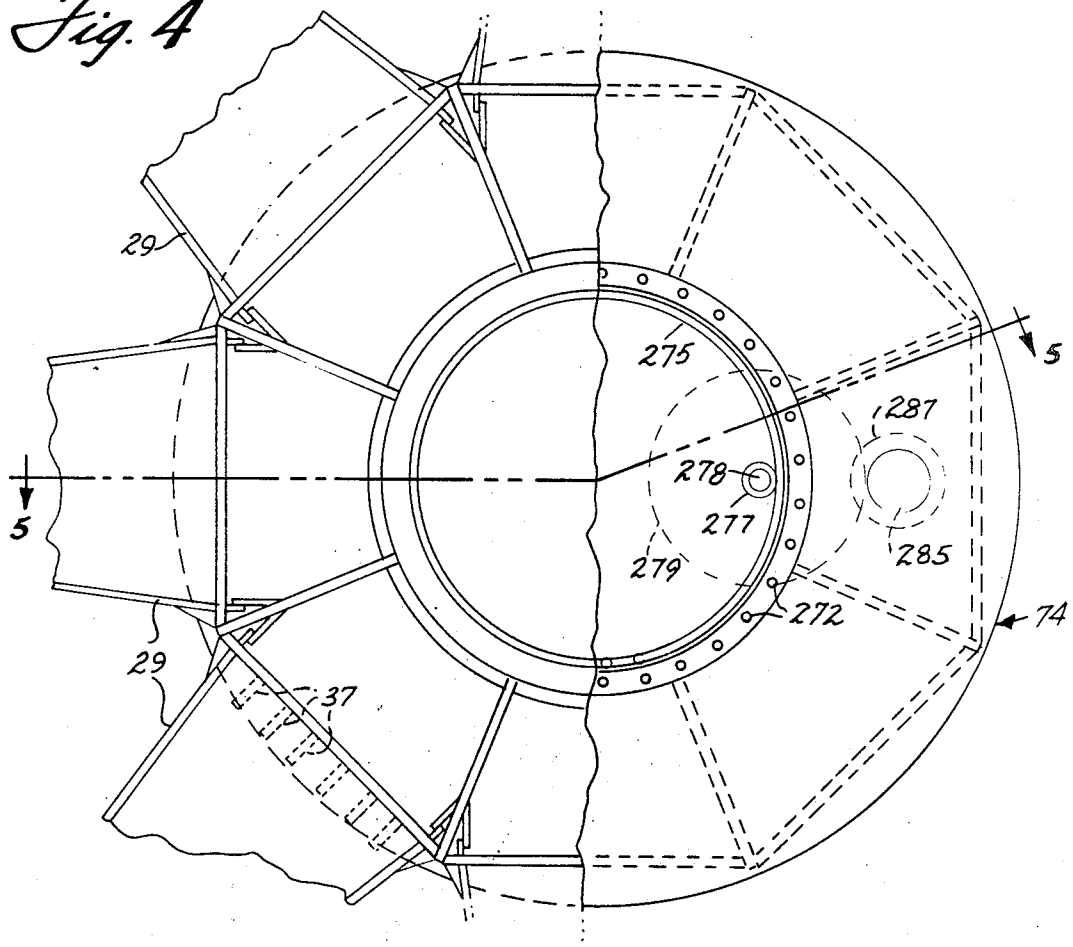


Fig. 12

Fig. 2

Fig. 4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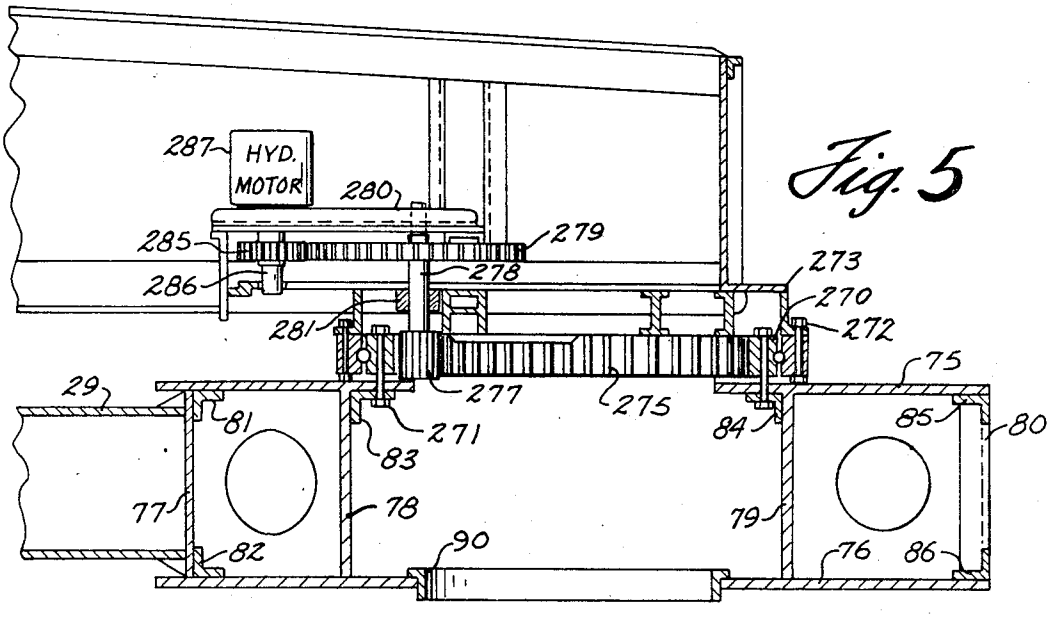
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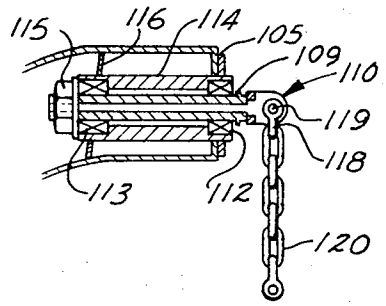
Fig. 5

Fig. 11



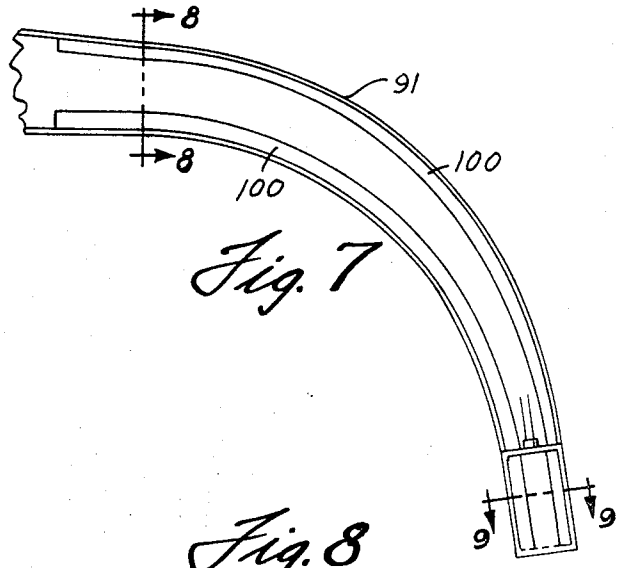


Fig. 7

Fig. 8

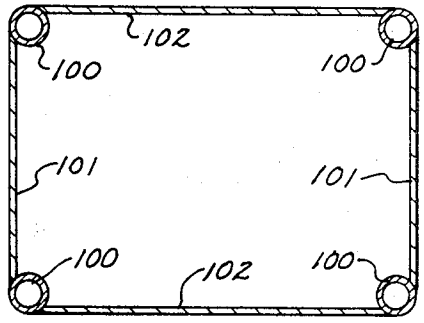


Fig. 6

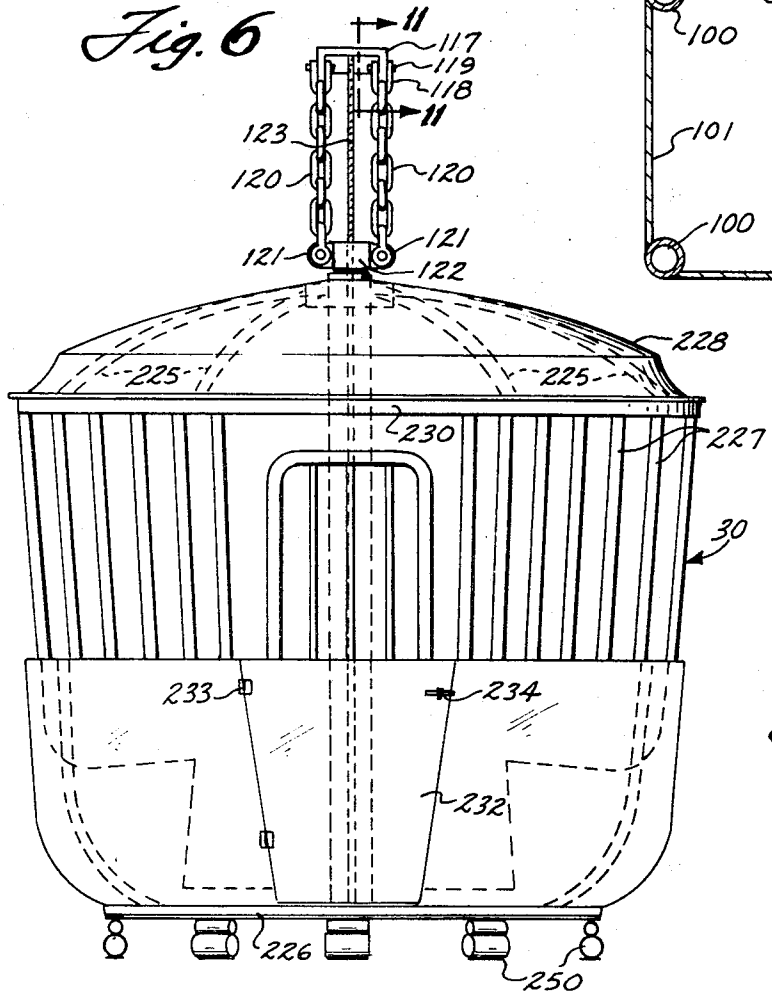


Fig. 9

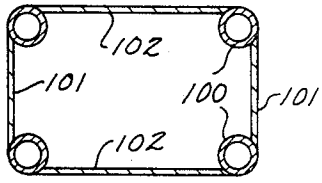


Fig. 10

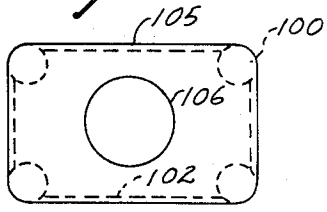


Fig. 16

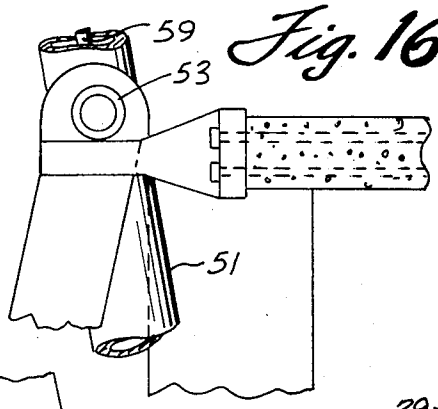
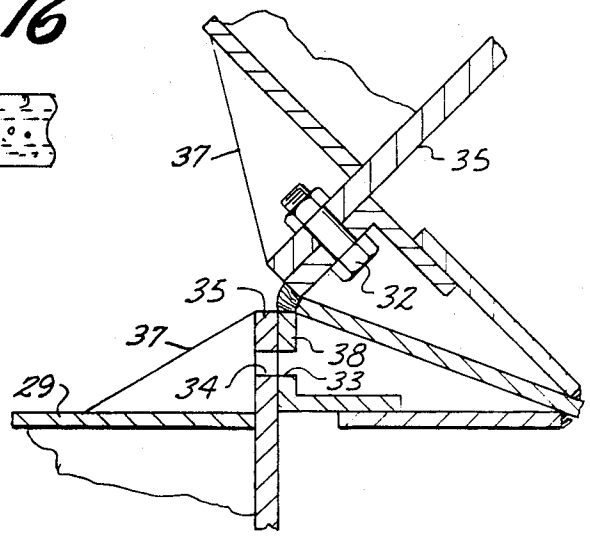


Fig. 13



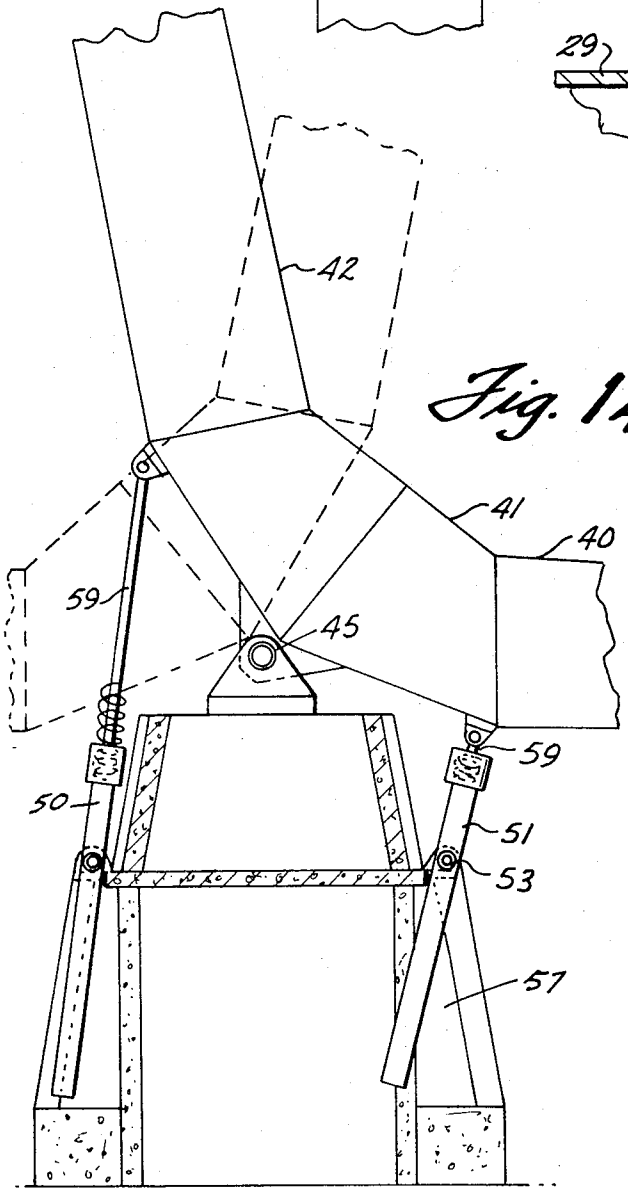


Fig. 14

Fig. 15

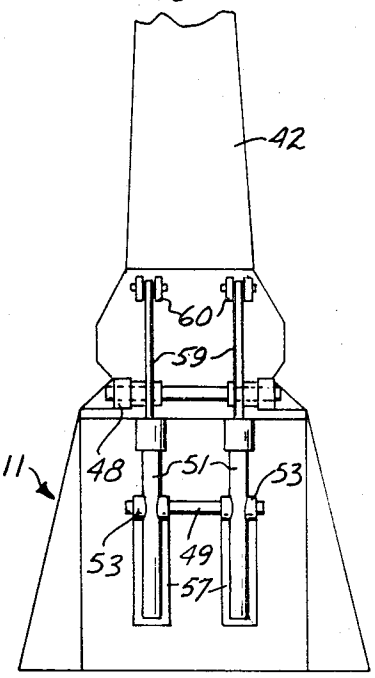
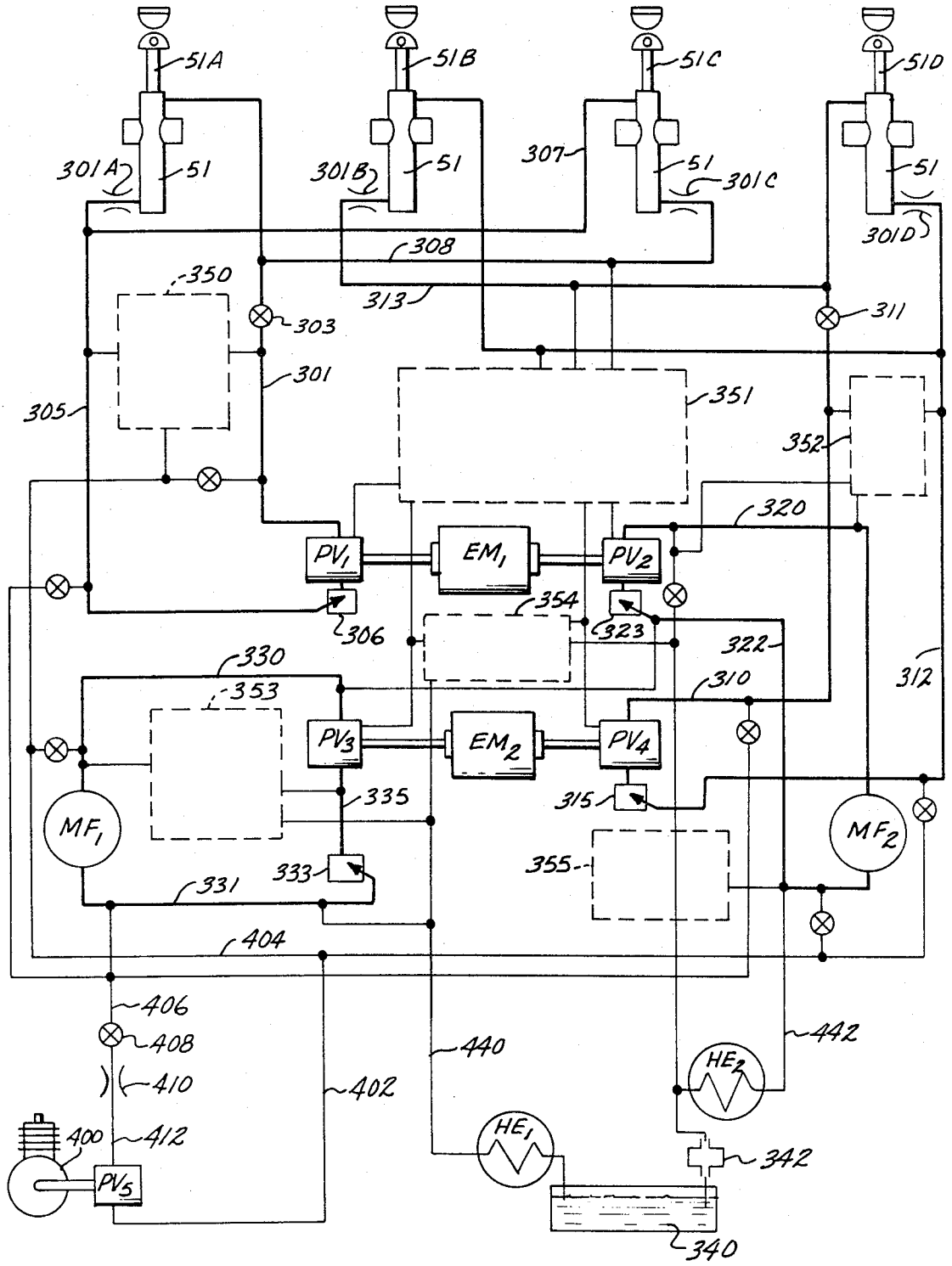


Fig. 17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PLANETARY AMUSEMENT RIDE

This application is a continuation-in-part of application Ser. No. 720,756, filed Apr. 12, 1968, and now abandoned.

BACKGROUND AND PRIOR ART

The present invention is an improvement over that described in U.S. Pat. No. 3,243,184, which describes a combination merry-go-round and Ferris wheel, wherein one wheel may be laid substantially horizontal while the other is in more or less a vertical position and in rotation like a Ferris wheel.

A great disadvantage of most prior art Ferris wheels is that each capsule or carriage must be grounded for unloading or reloading and then moved step by step to successive stopping positions; the next carriage then is grounded in turn, unloaded and reloaded, and moved to the next position, etc. For a wheel with multiple carriages or passenger compartments, this means that as many stops and loading and unloading operations must be carried out as there are carriages or compartments on the wheel. These operations involve a great deal of stoppage time with patrons queuing up, etc., greatly decreasing the profitability of such a ride, particularly where large crowds of people are available to be carried.

It is known in the art to lift a loaded wheel off the ground, as in Winton U.S. Pat. No. 3,459,422, and to tilt the wheel to non-horizontal positions during rotation. As set forth in the U.S. Pat. No. 3,243,184, mentioned above, a ride of analogous type to the present invention has been designed which has two angularly divergent main supporting arms, each carrying a simple main wheel or spider. Each wheel or spider carries a plurality of suspended passenger compartments or capsules, each of which can contain a group of passengers. One wheel is high in the air while the other is on or near the ground. A typical arrangement is to have eight to twelve capsules or carriages on each wheel; each capsule can carry six to eight persons. While one wheel is being unloaded and reloaded, the other can be up in the air and operating. Rotation of either wheel can be started while it is in horizontal position at or just above the ground. This can more than double the capacity of the device. The passengers are given an additional thrill and an exhilarating experience as the rotating wheels move from horizontal to vertical positions. It will be understood that the terms "horizontal" and "vertical" as used here, are relative. True horizontal and vertical need not actually be used for the major operating periods in some cases. Normally, the lowered wheel stops rotating and is loaded in a horizontal position while resting on or just above a stanchion or platform. There the patrons can get into and out of all the capsules with relative ease; all capsules on the "down" wheel can be loaded or unloaded simultaneously. After reloading, the main arms can be operated to raise the newly loaded wheel to a more or less vertical position for rotation while the other wheel is lowered. Preferably, the wheel begins rotation as it lifts; the plane of the wheel passes through various angular positions until the vertical or high operating position is reached. The individual capsules are suspended from the wheel in such a way that they hang freely in all wheel positions. The passengers thus are able to sit upright, regardless of the particular momentary position of the wheel.

The present invention includes several improvements over that described in U.S. Pat. No. 3,243,184. In one embodiment, fluid operated means are employed and in another drum and cable means are used for raising and lowering the supporting arms and the respective main wheels from horizontal to vertical position and vice versa. Better control and superior leverage can be obtained with these means than with gearing, as in the patent. Also, simpler mountings can be used. The apparatus must be accident proof as far as possible. In one embodiment hereof self-throttling fluid parts are used for limiting and controlling the rates at which the wheels can be raised and lowered. Critical hydraulic lines are equipped with built-in safety mechanisms which cannot readily be disabled and which are operative, even if there should be an operating failure in the hydraulic system or of the controls which operate it.

One important aspect of the present invention is its arrangement of "wheels within wheels"; that is, subwheels are mounted on arms of a main wheel or spider. With this arrangement a group of capsules is carried on each subwheel and each subwheel may have its own individual motion, thus giving a compound operation to the cycle. With this arrangement, the various capsules on the arms of the subwheels may approach the ground, or seem to approach it, with very high rates of speed on the double descending side of the cycle, or they may appear to stand relatively still in other portions of the cycle. At other times there will be acceleration or deceleration. There are thus exciting phases in the cycle which add greatly to the thrill of the ride without increasing its hazards. Where the latter system is used, the mechanism for rotating the subwheels on the spokes of the main wheel or spider are relatively simple, comprising either simple radially extending driven shafts operated from the power which rotates the main wheel around its own axis or by individual hydraulic motors taking motive power from the main prime movers. Individual electrical motors may be used.

The system of the present invention, in one form, also involves use of programming mechanism. By means of valves and fluid operated control devices, this mechanism takes over the normal operation of the equipment. While one arm and its main wheel is operating in the high or "vertical" position, the other wheel is in loading position and is kept there automatically until all its capsules are loaded and their doors closed. Only after the doors on the down wheel are finally closed, can the operator start up this side of the mechanism. When he moves a switch to start the cycle, the programming mechanism takes over. Meanwhile, the other wheel can still be in operation with its passengers receiving maximum ride for their money. Rotation of both wheels can take place in changing planes during large part of the cycle.

For cable operation, a reversible winch, suitably power driven, is used to wind up cable attached to one arm and to take up cable attached to the other arm.

For hydraulic operation a plurality of pumps and main prime mover units, preferably electrically driven, are provided to pump the hydraulic fluid, thereby to raise and lower the respective arms from loading to operating positions and vice versa. With two prime movers, one may become inoperative and the ap-

paratus can still be operated in more or less normal fashion. A pair of raising and lowering piston-cylinder units are provided, one on each side of the axis or pivot axle on which the branched arm unit is mounted at its juncture. In normal operation a pair of cylinders are attached on each side and the hydraulic lines serving them are so interconnected that the push-pull relation is applied to both sets of operators. In this manner the arms may be raised and lowered with maximum speed, with minimum friction because distortion is minimized, and with complete safety because of the throttling devices which restrict the flow of fluid from the operating cylinders.

Each prime mover also can drive a separate pump for operating a fluid motor which rotates the appropriate wheel about its own axis. Whether such axis is in horizontal or loading position, in upright normal operating position, or in between, the fluid pump thus supplies the driving fluid under pressure. Controls are arranged so that either wheel can be rotated or stopped from rotation at any desired point in the cycle. Normally, one prime mover supplies power to rotate one wheel and the other drives the other wheel, but interconnection makes it possible to put either or both wheels in rotation under the drive of either prime mover.

As an additional safety factor, a separate combustion engine driven prime mover which drives a small hydraulic pump is included to operate the main elevator pistons to raise or lower the equipment into appropriate positions. Thus, in case of electric power failure passengers may be safely brought to the ground and unloaded without difficulty.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a side elevational view of one form of the apparatus.

FIG. 1A is a fragmentary vertical section taken on line 1A—1A of FIG. 1.

FIG. 2 is a side view of a modified form, employing a hydraulic lift system.

FIG. 3 is a top view of part of the apparatus of FIG. 2.

FIG. 4 is a plan view on an enlarged scale of one of the main hubs or spool of a main wheel, taken substantially on the line 4—4 of FIG. 2.

FIG. 5 is a vertical sectional view of the apparatus of FIG. 4 and some parts associated therewith, taken substantially along line 5—5 of FIG. 4.

FIG. 6 is a side view of one of the capsules or carriages in which passengers ride, showing general structure and some supporting and landing elements.

FIG. 7 is a side view of the outer end portion of one of the main supporting arms.

FIG. 8 is a cross-sectional view of the arm of FIG. 7 on larger scale, taken substantially on the line 8—8 of said figure.

FIG. 9 is a transverse sectional view taken substantially along the line 9—9 of FIG. 7.

FIG. 10 is an end view of the outer tip of the arm as seen at the bottom outer end of FIG. 7.

FIG. 11 is a detail sectional view of a suspension means taken substantially along the line 11—11 of FIG. 6.

FIG. 12 is an enlarged detail, partly in section, of one of the landing shoes, shown in FIG. 6.

FIG. 13 is a detailed structural view in section showing the manner in which the arms of a main wheel are attached to its hub.

FIG. 14 is a fragmentary view showing a pivotal rocking arrangement for swinging the main arm structure on its base.

FIG. 15 is a side view of the structure of FIG. 13.

FIG. 16 is a detail view, partly in section, showing the mounting of rocker operating cylinders on the base.

FIG. 17 is a schematic diagram of the fluid operating and programming assembly.

FIG. 18 is a side view of another modification.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring first to FIG. 1, the apparatus comprises a solid base structure 11 having landing pads or paved areas 13 and 15 on either side. Each pad is equipped with a stanchion 21 comprised of a supporting ring 22 and upstanding posts 23 on base 24. Each stanchion is adapted to support the center of a main wheel or spider 7 or 8, when in its lowered position. A dash-pot 20, preferably of hydraulic type, is mounted in each stanchion to absorb any shock when a main wheel makes contact. As seen in FIG. 1, the branded arm 4 support comprises two strong main arms 5 and 6 fabricated of metal for adequate strength and hollow in cross-section for reduced weight. These arms are angularly divergent and pivotally mounted at their juncture. Each arm carries a rotatable main wheel or spider 7, 8. Each wheel or spider carries two or more sub-wheels 9 and each sub-wheel carries a plurality of capsules 10. Each capsule is capable of carrying four or more, usually about six to eight passengers.

The base or arm support 4, of FIG. 1, is a strong composite hollow structure. As shown in FIG. 14 it can be made up of outer plates 40, 41, 42, etc., internally braced with corner members. Transverse and diagonal bracing members may be added to provide requisite strength. Where the two arm members 5 and 6 are joined, the parts include brackets or plates 44, secured outside, as in FIG. 1, or inside as in FIG. 14. These are formed with or secured to bearing sleeves sized to receive a horizontal pivot shaft 45. The sleeves are mounted in fixed bearings 47 having appropriate brackets 48, 49 secured on top of the base member 11 and securely fastened thereto so that wind storms or other strong forces cannot loosen or dislodge the machine from the base.

The embodiment of FIGS. 1, 1A, includes an operating cable 29 attached to a swiveling block 30 at the hub of each main wheel 7 or 8. Cable 29 passes under anchored pulleys 31. The latter are firmly secured to a foundation element near the center of each paved area 13 or 15. From pulleys 31, the cable passes over a pair of guide pulleys 32 or 33, near each stanchion 21. These pulleys are supported firmly on shafts mounted in the walls of counterweight pits 34 or 35. Between each pair of guide pulleys the cable passes under a hanging pulley 36 mounted in an upstanding yoke connected to a counterweight 37. The cable 29 passes under platforms 13 and 15 and under guide pulleys 38 mounted in base 11. Thence it is wound a number of turns around a winch drum 39. The latter is equipped with a conventional drive motor and gear reduction box, and can be driven in either direction. Clockwise

rotation of the drum, as seen in FIG. 1, pulls down the right arm 6 while cable 29 is paid out to the left, permitting arm 5 to rise.

The counterweights are of adequate size to keep the cable 29 tight at all times. They can rise or fall sufficiently to accommodate differences in total cable path length as the arms are moved to various positions. They also keep the cable under sufficient tension that there is no loosening or slippage around the winch or drum 39.

The modification of FIG. 2 is operated by hydraulic mechanism. In FIGS. 14, 15 and 16, the apparatus for rocking the main arms to their respective raised and lowered position is shown in greater detail. On each side of base 11, FIG. 14, are a pair of hydraulic cylinders 50, 51 individually mounted in trunnions 53. These trunnions are pivoted to the base structure at 49. The base is channeled at 57 so that the pistons may pivot about their trunnions as required to accommodate the connection of their outwardly, upwardly extending piston rods 59 to ears or brackets 60, secured to the respective arms 40 and 42 which correspond to arms 6 and 5 of FIG. 1.

A pair of cylinders is mounted on each side of pivot shaft 45 so that two piston rods 59 lift up on one of the arms while the other two pull down on the opposite arm.

As explained further below, the pistons are arranged or paired in another respect so that one of the pistons at the left, FIG. 14, and one of those at the right, e.g. are operated simultaneously by a single primary pump or source of fluid pressure, as further explained below. The other cylinders are operated simultaneously but by separate fluid pump means driven by a separate prime mover. This arrangement is used in order that failure of either prime mover will not interrupt operation of the equipment. The equipment operates more easily when both pumps or prime movers are in normal operation, but it can be operated quite satisfactorily by only one driver when necessary.

As in FIG. 1, the main wheels in FIG. 2 support and drive secondary or subwheels or spiders. In FIGS. 2 and 3, the support arms 125 and 126, which are generally similar to arms 5 and 6 of FIG. 1, are pivoted on a base 111. These arms carry main wheels or spiders 127 and 128. Each of these is shown as having three radial arms, although, of course, it may have two or four, or a greater number if desired. Each arm 129 of a main wheel carries at its outer end a sub-wheel or sub-spider 131, having a plurality of arms or spokes 132, each of which carries a capsule or carriage 133. These capsules, as shown in FIG. 2, may be of a relatively simple type carrying about four persons, or they may be the enclosed cage type shown at 10 in FIG. 1. See FIG. 6, also. The capsules or carriers are constructed so as to hold the passengers safely, suitable retaining bars, not shown in detail, being provided.

Main wheels or spiders 127, 128 of FIGS. 2 and 3, are driven in rotation about their axes by suitable fluid motor means e.g., hydraulic. In FIG. 3, such a hydraulic motor is shown at 140; it drives speed-reducing gearing 142 which drives the main hub or spool 144 to which the several arms 129 are attached. A large stationary ring gear 150 meshes with bevel gears 151 mounted on the inner ends of radially extending rotatable shafts 153; these are appropriately journaled in bearings on or under the arms 129. At the outer ends each of these rotatable shafts carries a bevel gear 155 which drives an annular gear or rack 156 attached to the hub 157 of the sub-wheel assembly 131. As fluid motor 140 rotates a main wheel or spider, movement of bevel gears 151 around fixed gear 150 rotates the sub-wheels or spiders at an appropriate rate. Rotation rates may be selected by appropriate relationships between the various gearing elements.

Hydraulic lines 160, which supply driving fluid to motor 140, are led through main arms 125, 126, or under them, from hydraulic fluid pump sources. These pumps may be mounted either in the base rocker portion 165 of the arm, FIG. 2, or may be mounted in base 111 and connected by appropriate flexible connections to accommodate rocking of the main arms.

The arrangement is such that at least one main pump supplies driving fluid under appropriate pressure to operate the piston-cylinder assemblies 181, 182, FIG. 2. These correspond in general to the cylinders 50, 51 of FIG. 14. Simultaneously, the same or a different prime mover supplies fluid for lines 160 which drive the main wheels in rotation. The interrelationship between these parts is described hereinafter.

Each of the main wheels 7, 8, FIG. 1, or 127, 128, FIGS. 2 and 3, is built on a base hub or spool unit 74. The later is shown in detail in FIGS. 4 and 5. Each hub comprises an upper circular plate 75 and a lower circular plate 76. Vertical plate members 77, 78, 79, and 80 are welded or riveted between plates 75, 76, with suitable bracing such as angle members 81, 82, 83, 84, 85, 86, FIG. 5. Plate 76 has a circular opening in which is mounted a suitably insulated slip ring 90 to feed electric current to the carriages or capsules for illumination and controls therein. Spider arms 91, FIG. 1, are of hollow construction with appropriate internal bracing as in the construction of the main arms. An outer terminal portion of an arm 91 is shown in FIG. 7. The construction preferred includes tubular corner members 100, side plates 101, top and bottom plates 102 and appropriate diagonal and other bracing elements. At the point where curvature of the arm begins, FIG. 7, the arms are larger, tapering toward their ends.

The end of each arm 91 is closed by a plate 105, FIG. 11, having an opening 106 through which a swivel device 110 is mounted. The swivel consists of a hollow tubular member 109 mounted in bearings 112, 113 which are mounted in an outer sleeve member 114. A nut 115 keeps the parts in place and the sleeve is supported in the end plate 105 and another transverse member 116. At its outer end the tubular member 109, which is in the shape of a short angular bar, 117, supports a pair of clevises 118 on pivot pins 119. A pair of short chains 120, suspended from the clevises, attach to ears 121 of a post 122 projecting from the top of the capsule. A safety cable 123 is fastened to the post 122 and to the member 117 so that if a chain should break or become disconnected, the cable would still support the capsule safely. Appropriate flexible or slip-ringed electric lines, not shown, supply current to each capsule through the swivel arrangement.

Each capsule is made up as shown in FIG. 6, of a framework of main tubular members 225 curved to form the necessary enclosure and secured to a bottom plate member 226. This type of capsule is shown in

FIG. 1 at 10. Vertical bars 227, fitted in between the main frame members 225, complete the structure. A roof member 228 of light sheet material such as fiber glass is supported on the upper framework of the capsule. A band 230 surrounds the upper parts of the bars. A door 232, hinged at 233, has an appropriate latch 234 to hold it closed. Electric contact and control elements of conventional types, not shown, are provided to signal when the doors are closed and to prevent operation of the equipment if the doors are not properly closed.

With the mounting just described, the capsules are arranged to swing quite freely in the air. The dual chain support prevents undue twisting, although the capsules always may rotate through small angles. The force of gravity prevents excessive winding or twisting of individual capsules while they are suspended above ground. Curvature of the arms permits the capsules to swing clear in all positions of the main arms.

When a main arm is lowered to bring passengers to the ground, the central hub member of a main wheel 7, 8, FIG. 1, or 127, 128, FIG. 2, is brought to rest on a stanchion 21, FIG. 1 or 121, FIG. 2. In this position the capsules are arranged to contact the ground through resilient shoe elements 250, which act as drags and shock absorbers. As shown in FIG. 12, each drag consists of a flexible rubber tube 252 made of reinforced rubber tubing, or the like, of such thickness and stiffness as to flatten only part way when supporting the weight of the capsule 30. Each tube 252 has a metal shoe element 254 clamped on the bottom by a bolt 255 extending through plate element 256 inside the tube. Each drag or shoe unit is attached by a bolt 257 to a tubular frame element 264 at the bottom of the capsule. This bolt extends through an inner bracket 258, an outer bracket 259 and a rigid tube element 260 and through tube clamping pieces 261 and 262. When a capsule 10 or 31 approaches the ground, usually swinging somewhat, these devices contact the ground on one side or another and drag the carriage gently to a stop. Further lowering of the capsule settles all the drag members 250 on the ground, stably positioning the capsule for loading and unloading.

Referring again to FIGS. 4 and 5, the upper plate 75 of each hub 74 is secured to an inner race 270 of a large annular ball bearing assembly. Bolts 271 pass through the race and are secured to the angular elements 83 inside the spool and bolts 272 secure the outer race member to a frame element 273 of a main arm. Secured inside the inner race is an internal gear ring 275 which is driven by a spur gear 277 on the lower end of a rotatable shaft 278. A large driven gear 279 is attached to shaft 278, the shaft being journaled in an upper plate 280 and a lower bearing 281 secured to frame 273.

Gear 279 is driven by a spur gear 285 on the shaft 286 of a motor 287. The latter preferably is driven by hydraulic liquid from one of the prime mover pumps mentioned above. The connections to the hydraulic motor are not shown in detail, being obvious to those skilled in the art. However, an electric motor may be used, as will be obvious. FIG. 17 shows means by which hydraulic fluid under appropriate pressure is fed at appropriate flow rates to a motor MF_1 or MF_2, equivalent to motor 287, to rotate the gear 285. Thus the gearing described drives the spool or hub 74 about its axis, which is vertical as seen in FIG. 5. The direction of this axis varies, of course, as the position of the main supporting arms changes.

The drive system of FIG. 17 and the programming system by which the mechanism is operated through its various cycles will now be explained. The four cylinders 50 or 51 are indicated at 51 in FIG. 17. These rock the main arm assembly about its pivot. Two of these are at the left and two at the right; see also FIGS. 14 and 15. Prime movers such as powerful electric motors EM_1 and EM_2 each drive a pair of fluid pumps. Motor EM_1 is shown as driving pumps PV_1 and PV_2, whereas motor EM_2 is shown as driving pumps PV_3 and PV_4.

Pump PV_1 supplies fluid through a heavy output line 301 to a piston 51A ready for retract movement and at the same time pumps fluid to extend a piston 51C on the other side of the pivot. The return lines from both of these cylinders contain restrictive orifices shown at 301A and 301C, respectively. These limit the speed at which the main arms can move, even if one of the hydraulic lines should break or be inoperative. Similar orifices 301B and 301D are shown in the return lines from the other main operating cylinders.

A valve 303 is provided for cutting off the flow of fluid in line 301. Alternative connections may be used in some cases, as will be explained later.

In a typical operation, pump PV_1 forces fluid through the line to retract piston 51A and to extend piston 51C, thus pulling one main arm, such as 126, FIG. 2, downwardly and lifting the other arm 125. Fluid from the first cylinder returns through the restrictive orifice 301A into return line 305, which passes through a control device 306 to the opposite side of the pump PV_1. At the same time driving fluid from 301 is led through line 308 to the bottom of the cylinder operating piston 51C and returns from operating piston 51C through line 307, which connects to line 305.

The second prime mover EM_2 drives a pump PV_4 whose output is fed through a control 315 and a line 312 assuming valve 311 in return line 310 is open, to force outward the piston 51D while forcing inwardly the piston 51B. That is, fluid passes from pump PV_1 through line 301 while PV_4 pumps through line 312. On reversal, liquid flows out of pump PV_4 through line 310 and flows out of pump PV_1 through line 305 and controller 306.

The motor EM_1, in addition to providing operating power for two of the cylinders which raise and lower the main arms, also drives a second pump PV_2. The latter supplies operating fluid through a line 320 to a fluid motor MF_2, which is motor 287 of FIG. 5, and rotates one of the main wheels or spiders in the manner already described. Return fluid from this motor flows through line 322 to controller 323 and thence back into the pump PV_2.

Similarly, motor EM_2 drives a pump PV_3 which supplies fluid through line 330 to drive the motor MF_1 (like 287) in the other main wheel. The fluid is returned through line 331 under control of the controller device 333. From thence it returns to the pump through line 335.

Cooling means to prevent overheating of the working fluid comprises a pair of heat exchangers HE_1 and HE_2, shown at the bottom of FIG. 17. By suitable valving,

not shown, the fluid or part of it may flow continuously or be diverted to the heat exchangers and thence into a sump or reservoir **340** from which it may be withdrawn through a filter **342** and returned to the appropriate lines for recycling.

The operations driven by the fluid system are under program control. Where the machine is electrically driven, as in FIG. **1**, or where the wheels or sub-wheels have their own electric motors, as they may have, the same general types of control are provided. The mechanism by which the various parts are started and stopped, bypassed, etc., form no part of the present invention, but these involve programming control elements, shown diagrammatically only at **350**, **351**, **352**, **353**, **354**, and **355**. The arrangement is such that, in ordinary operation, suitable hydraulic lines will be opened to flow the operating fluid into the appropriate cylinders **51** or out of the, as the case may be. The large rocker arms are thus moved about their pivot **45** until one of the wheels is in horizontal or landing position with its carriages or capsules resting firmly on a platform where loading and unloading takes place. The timing of the cycle permits adequate time for loading and unloading one side while the other is operating high in the air.

When a loading operation on one side is completed, the capsule doors are closed and the operator activates a lift switch. The lift motors then operate to raise the newly loaded wheel and to lower the other, whose ride is being completed. With hydraulic operation, control devices **350**, **351**, etc., control the flow of fluid and also time its starting and stopping appropriately. For electric operation, they act in similar fashion to drive reversible lift motors in appropriate direction and to operate wheel-rotating motors at appropriate speed, etc. Thus, the newly loaded wheel **8** or **128** leaves the ground and starts rotating. The sub-wheels may be and preferably are driven through gearing from the main wheel but they may be driven individually by electric motors, if desired. The driving operation rotates the main wheel as it goes to the vertical position and the sub-wheels may start at the same time or later. These continue rotation after the operation of the lifting cylinders or pistons has ceased. For a prescribed cycle of time, 2 or 3 minutes for example, rotational operation continues while the other main wheel **7** or **127** is being unloaded and reloaded. When the cycle is finished, automatic control mechanism again lowers arm **6** or **126** with wheel **8** or **128**, with its sub-wheels, etc., into contact with the stanchion **21** or **121**. The other arm is then raised to its vertical or approximately vertical position, etc.

In case the operator has not succeeded in closing the doors, or in case of any other abnormality, safety switches and controls prevent resumption of operation until the obstacle is cleared. The safety control mechanism is not shown, being obvious to those skilled in the art.

For hydraulic operation, the arrangement of lift cylinders in pairs side by side, as in FIG. **15**, gives a smooth, stable operation to the lifting and lowering of the respective wheels when both prime movers are operating, as is preferred. It is quite possible, however, to use only one cylinder pulling on one side and another pushing on the other side to raise and lower the arm and wheel assembly, making use of only one of the fluid supply pumps PV_1 for example. In normal operation both main pumps are used.

In order to provide for emergencies such as an electric power failure, an auxiliary or emergency power unit is provided. Hence, passengers will not be stranded high in the air in case of such power failure. FIG. **17** shows one embodiment for the hydraulic drive in the form of a separately powered motor, such as a gasoline or diesel engine **400** connected to drive an auxiliary pump PV_5. The latter is adapted to to supply pressured fluid through appropriate valve and line connections to the several cylinders **51** and to rotary drive motors MF_1 and MF_2. The output of the pump PV_5 is led through a line **402** to line **404** which connects through suitable valves to the respective motors and cylinders. The operating fluid is returned through a line **406** under control of a valve **408** and through a restricted flow throttling device **410**, to prevent excessive or dangerous operating speeds, and then through return line **412** back to the pump PV_5. Regardless of the load on an arm which may be up in the air, throttling device **410** is a further safety limit device in addition to the throttling devices **301A**, **301B**, etc., previously explained. The restricted orifices **301A**, etc., at the cylinders may actually be incorporated in the structure of the cylinders themselves, if desired, or at their inlets or outlets, as the case may be. Hence, the rupture of one or more hydraulic lines does not endanger the lives or safety of passengers in the equipment, whether high in the air or near the ground. In addition, coil spring shock absorbers **501**, **502**, are provided around piston rods **59** and serve both to help lift the arms in starting up and to act as emergency shock absorbers. Sleeves **505** secured to the top of each cylinder **51** contain these springs suitable precompressed and restrained, as will be obvious to those skilled in the art. The whole apparatus can be operated, if necessary, at least at low speed, by the auxiliary power equipment.

Similar or analogous controls and safety devices can be used where the various parts are driven by electrical and mechanical means. The hydraulic drive often can be built with greater safety than gear arrangements. Hydraulic power can assure smooth operation without binding with the paired operation of the hydraulic rocking cylinders described above. However, the cable operation of FIG. **1** has advantages of simplicity and the cables can be attached farther from the pivot to control the arms effectively and without requiring excessive power at the winch **29**. Means for driving the latter in either direction are known to those skilled in the art.

FIG. **18** shows a modification, i.e. simplified system wherein one arm is replaced with a counterweight **602**. The single arm **600**, in such a first stage unit, is attached to a base rocker **601**. The general arrangement is similar to FIG. **2**. Main wheel **604** on the outer end of arm **600** has sub-wheels **606** each carrying passenger capsules **608**. A pair of hydraulic cylinders **610** operates in push-pull relationship like the arrangement described above to raise and lower the arm **600**. Such a unit can be installed with a single arm and expanded later, when the traffic justifies expansion, by replacing the counterweight **602** by another arm and wheel assembly, as will be obvious.

FIG. 13 shows in detail how the main wheel or spider arms including elements 29 are detachably secured to the rocker or middle arm part 41 by bolts 32 passing through holes 33, 34 formed in flanges 38 and 35 in the respective parts. A series of triangular reinforcing web elements 37 are welded to the top, bottom and side plates of arm members 29. See also FIGS. 4 and 5. Similarly, the parts shown in FIGS. 1, 2 and 18 may be secured by bolts or by welding. Bolts permit disassembly for shipment, etc. The main arms 25, 26, FIG. 1, or 125, 126, FIG. 2, or 600, FIG. 18, may be made up of single piece or two piece welded tubing, of round or oval cross-section, rather than of rectangular, if desired. Likewise, the arms of the spiders or wheels may be made of tubing rather than of welded plate construction.

The "wheels within wheels" arrangement gives a new sensation and thrill to riders that cannot be duplicated in the conventional Ferris wheel. Also, the rocking duplex arm and wheel structure increases loading efficiency and gives capacity for accommodating larger numbers of customers. This is of great importance where space and time are at a premium. Obviously, the arrangements of the various parts, the timing of cycles, and the particular driving and control means can be varied to suit any particular requirement or installation.

Various modifications and changes may be made in addition to those already described, within the purpose and spirit of the invention.

What is claimed is:

1. Amusement apparatus of the character described which comprises, in combination, a rigid unitary bifurcate arm structure having a pair of joined divergent main arms pivoted at their juncture to a base on a horizontal axis for pivotal movement in a substantially vertical plane, the arms being so arranged angularly with respect to each other that when one arm is in a low and substantially horizontal loading position, the other is in a high and substantially vertical operating position; power means operatively connected between said rigid unitary bifurcate arm structure and said base for causing the pivotal rocking movement of said bifuracate arm about said axis; a main spider rotatably mounted on the free end of each arm, so that either main spider is rotatable substantially in a vertical plane when its arm is in the high position and rotatable in a horizontal plane when its arm is in the low position; a plurality of rotatable subspiders, each subspider rotatably mounted on a respective free end of said main spiders, each subspider being rotatable in a substantially vertical plane when its associated arm and main spider are in the high position and in a horizontal plane when its associated arm and main spider are in the low position; passenger capsules carried by and hanging dependent from each of said sub-spiders and means for driving said main spiders and said sub-spiders independently in rotation in either said high or low position.

2. Apparatus according to claim 1 in which the power means causing the main arms to move about their pivot between high and low positions comprises a pair of hydraulic cylinders operating between the base and each arm, and including means for supplying hydraulic fluid to one pair of cylinders for pushing and simultaneously supplying hydraulic fluid to said other pair for pulling, for coordinated movement of said main spiders and sub-spiders between high and low positions.

3. Combination according to claim 1 in which the power means comprises cable and winch means anchored to said base and connected to said rigid unitary bifurcate arm structure to move said arm structure between loading and operating position and to sustain it in operating position.

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