April 13, 1965 **P. HALLER** **3,177,660**

PROPULSION APPARATUS

Filed Oct. 19, 1959 2 Sheets-Sheet 1

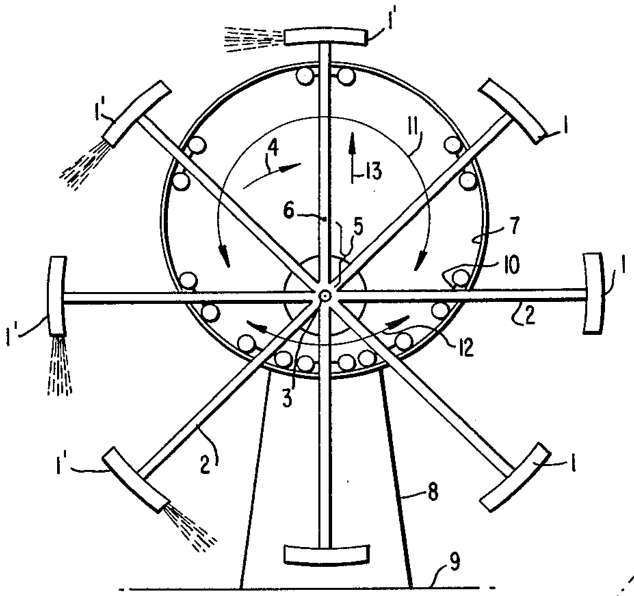

FIG. 1

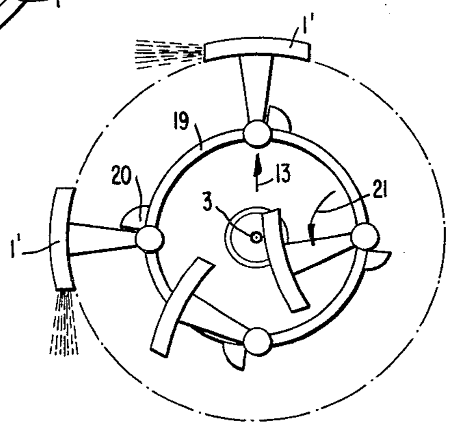

FIG. 3

FIG. 2

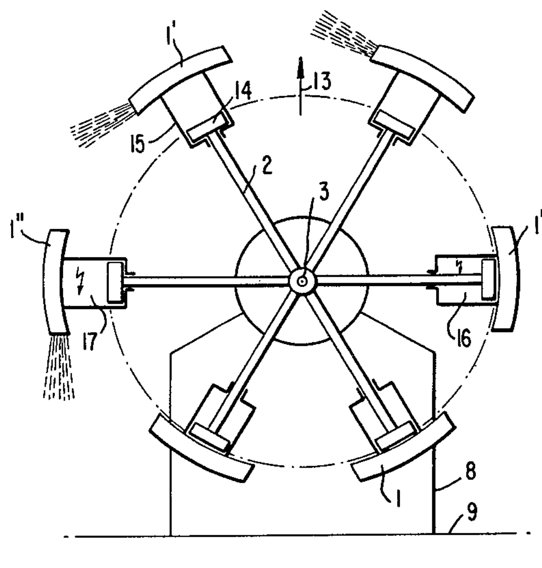

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FIG. 4

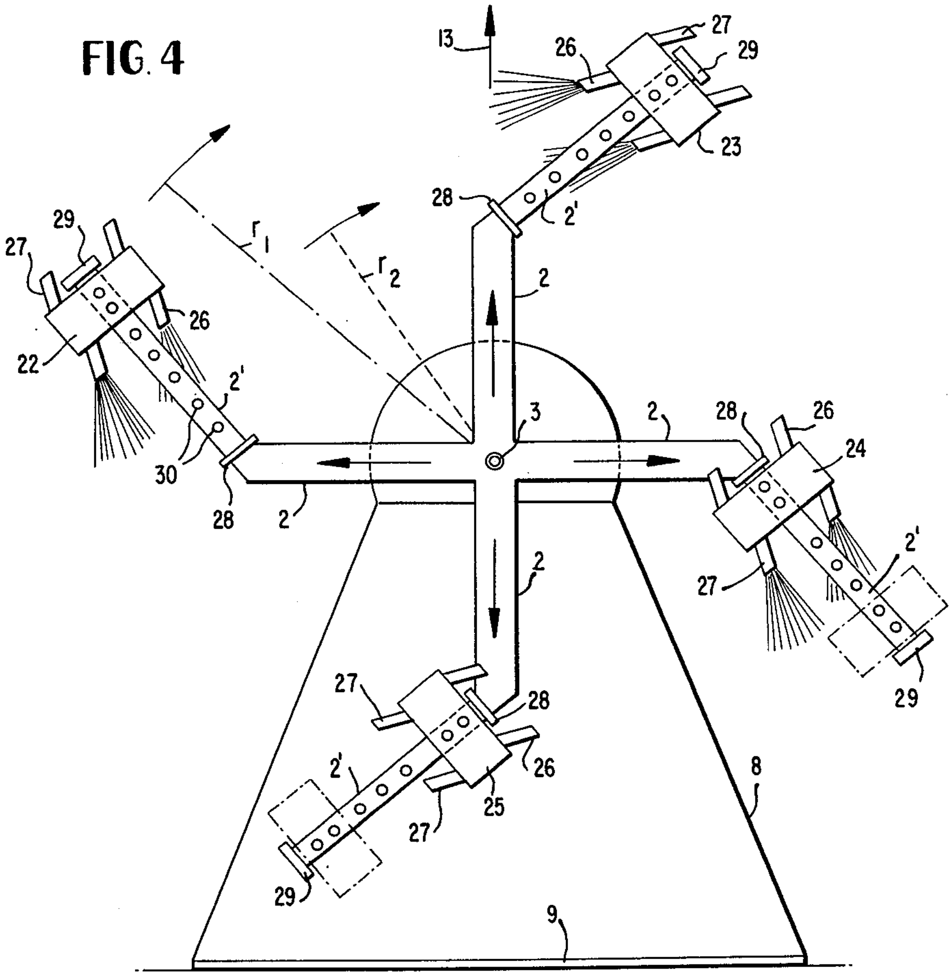
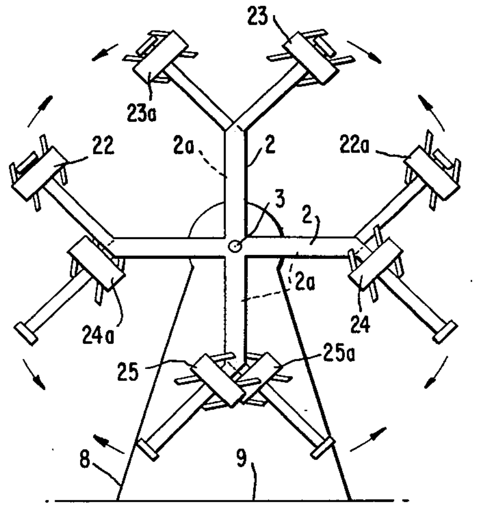


FIG. 5



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PROPULSION APPARATUS

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19 Claims. (Cl. 60—39.34)

The present invention relates to a propulsive apparatus, particularly for use in elevating and floating apparatus, including aircraft, and it is the principal object of the invention to provide such a propulsive apparatus which essentially consists of a plurality of rotating units, at least one of which is movable at a uniform angular velocity in such a manner along a continuous path, preferably extending in a circular, oval, eliptical or similar direction, that an unbalanced thrust is transmitted to the entire apparatus by movable thrust transmitting means having variable effective radii. The jet units produce all of the reactive forces constituting the unbalanced thrust present in the disclosed apparatus.

A further object of the invention consists in providing a propulsive apparatus of the type as above described which consists of a plurality of reaction-propulsion jet units which are adapted to carry out a rotary movement about a common axis in one direction, and preferably of an equal number of similar jet units which are adapted to carry out a rotary movement about the same axis but in the opposite direction, and which further consists of control means for operating each jet unit only if it produces a thrust in the upward direction.

Another object of the invention consists in providing several rotating jet propulsion units for preventing a rotary movement of the entire propulsive apparatus.

Another feature of the invention consists in mounting the jet propulsion units in a star-shaped arrangement on arms extending radially to the axis of rotation.

A further object of the invention is to provide a cylindrical runway having a central axis extending parallel to and above the axis of rotation of the jet propulsion units and to provide within this runway a plurality of rolling weights which are movable along this runway by the arms on which the jet propulsion units are mounted.

Another object of the invention consists in designing the jet propulsion units so as to be movable in a radial direction so that their radial distance from the axis of rotation may be increased from a common basic diameter during their operation.

It is another object of the invention to provide the ends of the arms carrying the jet propulsion units with stationary pistons which are slidable within cylinders which are connected to and support the jet propulsion units, and to provide means for carrying out a combustion process alternately below these pistons or above the same in a manner similar to the combustion in an internal combustion engine.

The present invention further provides means for injecting additional fuel into the jet propulsion units when the latter develop a thrust in the upward direction.

According to the invention it is also possible to provide electromagnetic means for controlling the distance between the jet propulsion units and the axis of rotation. The arms carrying the jet propulsion units may also be mounted on a supporting ring which is disposed symmetrically to the axis of rotation and so as to be pivotable about parallel axes and to be locked in a fixed position so that the jet propulsion units which are in operation may be locked in a position in which they project radially outwardly, while the propulsion units

which are not in operation are locked in a position in which they are partly or fully pivoted inwardly relative to the axis of rotation. The inward pivotal movement of the inoperative propulsion units may be carried out either in the direction of their rotation or in the opposite direction. The forward pivotal movement may be produced by utilizing the jet reaction and the latter may also be controlled so as to act in the opposite direction and to pivot the individual propulsion units toward the rear. The pivotal movement of the propulsion units may also be effected by mechanical means, for example, by positively turning the arms carrying the propulsion units toward the rear. By providing suitable stop members which are preferably adapted to be inserted into and withdrawn from the path of travel of each propulsion unit about its own axis on the supporting ring it is also very easily possible to arrest each unit in the outwardly or inwardly pivoted position.

A further improvement according to the invention consists in connecting the rotating jet units by suitable guiding means with a rigid system which rotates at a constant angular velocity, and in shifting them relative to the rigid system within a plane extending vertically to the axis of rotation by means of the thrust produced by the jet nozzles or by means of the centrifugal force produced by the rotation of the jet units, or by a combination of the thrust and the centrifugal force.

The present invention further provides that these thrust nozzles are preferably mounted on the inner and outer sides of the rotating units, and it also provides suitable means for locking the shiftable rotating units in their two end positions which are disposed at different distances from the center of rotation, or at least in the inner end positions.

The guiding means for the shiftable rotating units may further extend in a radial direction on the rigid system or be disposed at an angle to the radii of the rigid system, preferably in such a manner that the outer ends of the guide means point in the direction of rotation. These guide means may also be of a curved shape, and their outer ends should preferably point likewise in the direction of rotation.

These and other objects, features, and advantages of the present invention will also appear from the following detailed description thereof, particularly when the same is read with reference to the accompanying drawings, in which—

FIGURES 1 to 4 illustrate diagrammatically four different embodiments of the invention, and

FIGURE 5 illustrates diametrically a modified embodiment of FIGURE 4.

Referring first to FIGURE 1 of the drawings, the propulsive apparatus shown therein essentially consists of a plurality of reaction-propulsion jet units **1** and **1'** which supply all of the reactive forces and are mounted on radially extending arms **2** at equal radial distances from their common axis of rotation **3** about which they are rotatable in the direction as shown by the arrow **4**. This axis of rotation **3** of jet units **1** and **1'** is disposed parallel to, and at a distance **5** from the central axis **6** of a stationary housing forming a cylindrical runway **7** which is mounted on a frame **8** with a base **9**. Runway **7** is preferably formed of two cylindrical parts which are separated by a slot within which arms **2** are able to run freely about the axis **3**. Each arm **2** is loosely connected to at least one pair of rollers **10** forming weights which are adapted to roll along runway **7** on arms **2** and to slide along these arms when they are rotating about axis **3**. The individual jet units **1** and **1'** are supplied by suitable control means, not shown, with jet fuel which is passed through the hollow arms **2**. These control means are adapted to operate the jet units only at those times when the latter produce a thrust in the upward direction. Thus, as shown in FIGURE 1, the jet units which are in operation are those marked **1'**. When arms **2** rotate about the axis **3**, they take along the rollers **10** which are pressed upon runway **7** by the centrifugal force. Due to the rotation, rollers **10** run within the sector **11** at a greater speed and under a greater centrifugal force than rollers **10** run within sector **12**. The difference in centrifugal forces effectively transmits to the entire apparatus the unbalanced forces from jet units **1'**. This transmission of thrust from jet units **1'** to the relatively stationary assembly results in a lift in the direction as shown by arrow **13** which relieves the load upon base **9**.

The function of the force transmitting means such as rollers **10** may be described as follows. It is known in connection with rotating jet units wherein the jets are actuated only through an arc of their path that difficulties exist in transmitting the thrust of the jets to the vehicle and in opposing and preventing the tendency for the jets to run away or undergo uncontrolled rotary acceleration which would lead to distruction of the apparatus. The rollers **10** having different centrifugal force within sector **11** as compared to the centrifugal force within sector **12** are effective in a sense to brake the rotation of the jet units and to transmit the unbalanced force thereof to the entire system since the forces required to vary the centrifugal force of rollers **10** is supplied by jet units **1'**.

Instead of making the runway **7** of a cylindrical shape, it may also be given an oval shape.

In order to prevent vibrations, it is furthermore possible to provide additional jet units on arms which are also rotatable about the axis **3** but in the opposite direction to jet units **1** and **1'**.

In the modification of the invention as illustrated in FIGURE 2, the jet units **1** are mounted on arms **2** which are disposed in a star-shaped arrangement about the axis of rotation **3**. Each arm **2** carries on its free end a piston **14** which is slidable within a cylinder **15** which is rigidly secured to one of the jet units **1**. Suitable control means, not shown are further provided to supply cylinders **15** from the central axis **3** with fuel and to ignite the fuel either within cylinder chambers **16** or **17**. If, for example, the fuel is ignited in cylinder chambers **16**, cylinders **15** with jet units **1** thereon will assume the position **1'**, while at an ignition in cylinder chambers **17**, they will assume the position **1''**. The fuel supply and control means are also designed to supply jet units **1** with additional fuel when they are in the position **1''** so as to increase the lift and the speed of rotation. Cylinders **15** are preferably locked by suitable means for a short time when they are in their inward position **1'**, and these locking means are then released automatically when an ignition occurs in cylinder chamber **17**. These locking means and the ignition may be controlled, for example, electrically by means of stationary contact rings and brushes on arms **2**.

The greater centrifugal force acting upon those jet units **1** which are disposed substantially above the axis **3** as compared to the centrifugal force of the units disposed below axis **3** is effective to absorb the thrust of the jets and to prevent uncontrolled rotary acceleration thereof substantially as explained previously in connection with the embodiment of FIGURE 1.

Instead of producing the movement of jet units **1** in the radial direction by means of internal combustion, it is, of course, also possible to do this by electro-magnetic means.

In order to overcome vibrations, a second set of jet units running in the opposite direction to jet units **1** and **1'** about the axis **3** may also be provided similarly as described with respect to FIGURE 1.

In the further embodiment of the invention as illustrated in FIGURE 3, the jet units **1** are rigidly secured to arms **2** and each of them together with its arm **2** is pivotable to a certain extent about an axis **18** on an annular supporting member **19** which is, in turn, rotatable about a central axis **3**. Supporting member **19** is provided with suitable stop members **20** for arresting the individual arms **2** in a radial position relative to the central axis **3** when the respective jet unit **1** is in operation and for also arresting them in the inwardly turned position when the jet units are not in operation. Additional means, not shown, may also be provided whereby the inoperative jet units **1** with their arms **2** are pivoted inwardly toward the center of rotation **3** in a counterclockwise rotation as shown by arrow **21**. The pivotal movement of the jet units **1** from their radially extended position to the inward position and vice versa may also be effected in a clockwise direction by the jet propulsion of the respective units **1** themselves. In this event, stop members **19** may be movable into and out of the path of travel of arms **2** so as to stop and release the same, and the operation of these stop members **19** may be effected by the same or similar control means as mentioned with reference to FIGURE 1 for effecting the supply and ignition of the fuel of jet units **1**.

Due to the propelling force of the radially extended jet units **1**, a strong lift will be produced in the direction of arrow **13**.

In order to prevent undue vibrations of the entire apparatus, it is also possible, similarly as described with reference to FIGURE 1, to provide a second set of jet units which are rotatable about axis **3** in the opposite direction to jet units **1**.

In the further embodiment of the invention as illustrated in FIGURE 4, each jet unit **22** to **25** is provided with a plurality of jet nozzles **26** and **27** which extend in the inward and outward directions, respectively, and each unit is slidable inwardly or outwardly under the action of the respective nozzles along an outer arm **2'** which forms an extension of one of the arms **2** which are rigidly secured to each other and thus form a rigid system which is intended to be rotated at a constant angular velocity about the central axis **3**.

The limits of the inward and outward movements of each unit **1** to **4** along arms **2'** are determined by stop members **28** and **29**, and suitable means, not shown, may be provided for temporarily locking each unit in the two end positions but at least in the inner end position. These locking means and their control means may be of a type similar to those as described with reference to FIGURE 2.

As illustrated in FIGURE 4, the outer arms **2'** are preferably bent or curved relative to the radially extending arms **2** so as to point with their outer ends in the direction of rotation, that is, in the embodiment as illustrated, in the clockwise direction.

The two sets of jet nozzles **26** and **27** of each jet unit **22** to **25** may be supplied with fuel, for example, through the hollow arms **2** and **2'** which are connected by pressure valves **30** with the respective jet unit so as to supply the fuel thereto at the different positions during its movement along arm **2'**.

The operation of the apparatus according to FIGURE 4 will now be illustrated by a description of the movements of one of the jet units **22** to **25** during one revolution about the central axis **3**.

While the jet unit is located within the lower half of its rotary movement about the axis **3**, it is locked at its inner position in engagement with the inner stop member **28**, as shown, for example, by jet unit **25**. This unit **25** then moves along a circular trajectory with a radius r_2, in which the effective centrifugal force and the angular momentum are relatively small. When the unit during its further rotation about axis **3** has moved approximately to the level of this axis, the locking means are automatically released so that, when jet nozzles **26** are then operated, the jet unit will be shifted outwardly along arm **2'** until it engages with stop member **29**. This shifting movement of jet unit 25, which rotates at the same time about axis 3, is effected by the outward thrust which is produced by a combination of the jet reaction of the inner jet nozzles 26 with the centrifugal force acting upon unit 25. The rotating unit will then be in the position as shown by unit 22, in which it has attained such an acceleration by the thrust caused by nozzles 26 that its velocity is exactly equal to the peripheral speed along a trajectory with a radius r_1 when the angular velocity of the rigid system formed by arms 2 remains uniform. The jet unit then continues to rotate along the circular trajectory with the radius r_1 until, after passing beyond its highest position, it again arrives approximately at the level of axis 3. During this preceding sector of the rotation, the angular momentum and the centrifugal force are very great. By the operation of jet nozzles 27, the rotating unit is then again retracted from its position on stop member 29 to its inner trajectory with the radius r_2. The thrust of nozzles 27 then acts in the direction opposite to the movement produced by the centrifugal force and thereby retards the velocity of the jet unit to such an extent that, at the end of this sector of the rotation, it again corresponds exactly to the peripheral speed along the circular path with the radius r_2. The jet unit is then again locked in this position and continues to rotate along the trajectory with the radius r_2 in the manner as previously described, during which time the angular momentum and the centrifugal force are again reduced.

Since the effort required for shifting nozzle units 22 to 25, and for thereby changing the angular momentum is supplied by the thrust of the jet nozzles, this portion of the thrust is effectively absorbed within the system. This thrust is effective in the outward direction, that is, if the apparatus is operated as above described, in the upward direction, as indicated by the arrow 13. For driving the rigid system which is formed by arms 2', 2 and revolves at a constant angular velocity, it is possible either to apply a motor, not shown, which acts upon the shaft with the axis 3 on which the arms are mounted, or to utilize the thrust of the nozzles 26 when the jet units are in their respective outer end positions. Although the jet units may be locked also in these outer end positions, such locking means may be omitted since the thrust nozzles 26 together with the centrifugal force will maintain the jet units in this position. If the outer arms 2' are properly designed, the jet units may also be moved from their inner to their outer end positions merely by the action of the centrifugal force and without any contribution by jet nozzles 26 which may then be used merely for producing the lift, and possibly also the propulsion, along the trajectory r_1.

If the rigid system formed by arms 2, 2' is driven by a motor, as above described, the jet nozzles 26 and 27 may be required only for shifting the nozzle units 22 to 25 back and forth along arms 2', and their operation may be stopped as soon as the respective unit has been locked in its inner or outer end position. If arms 2' are properly designed to permit the nozzle units to be driven outwardly merely by the centrifugal force, operation of the inner nozzles 26 for this purpose may also be omitted. Of course, the rigid system may also be driven by a combination of a motor with the thrust produced by the nozzle units.

As previously described with reference to FIGURES 1 to 3, the vibrations and other undesirable components of the outwardly effective forces may also be neutralized by coupling two apparatus of the type as shown in FIGURE 4 which are rotatable in opposite directions. FIGURE 5 illustrates a modified embodiment of FIGURE 4 in which two apparatus are disposed axially behind one another and are coupled with each other by any conventional means. The same reference numerals again designate the same parts, the suffix *a* being used with corresponding reference numerals to designate corresponding parts of the second apparatus.

Although my invention has been illustrated and described with reference to the preferred embodiments thereof, I wish to have it understood that it is in no way limited to the details of such embodiments, but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed my invention, what I claim is:

1. A propulsive apparatus, comprising:
   rotating means rotataing about an axis of rotation including a plurality of movable mass means which change their radial distance from said axis of rotation during rotation of said rotating means,
   said rotating means also including a plurality of jet units,
   means to activate said jet units to provide a thrust only during a part of their rotation,
   and further means to vary the distance between said mass means and said axis of rotation during rotation of said rotating means.

2. A propulsive apparatus as defined in claim 1, which comprises an equal number of said jet units rotating about said axis in opposite directions, and said activating means including means for driving each of said jet units only when a respective unit develops a thrust in the upward direction.

3. A propulsive apparatus as defined in claim 1, in which said jet units comprise a plurality of reaction-propulsion jet units disposed in a star-shaped arrangement, and a plurality of arms, each jet unit being mounted on a respective arm, the arms of all of said jet units extending radially from said axis.

4. A propulsive apparatus as defined in claim 3, wherein said further means includes a cylindrical stationary runway having a central axis parallel to and above said axis of rotation of said jet unit, and wherein said mass means include a plurality of rolling weight members within said runway, said weight members being loosely connected to said arms and adapted to be taken along by said arms to roll along said runway about the axis thereof.

5. A propulsive apparatus as defined in claim 3, wherein said further means includes means for moving each of said jet units in a radial direction so as to increase its distance from a common basic diameter relative to said axis when said jet unit is in operation.

6. A propulsive apparatus as defined in claim 5, in which said means for moving each of said jet units comprise a plurality of pistons, each of said pistons being rigidly secured to one of said arms, a plurality of cylinders, each of said cylinders being secured to one of said jet units, and means for supplying a fuel to said cylinders and for alternately exploding said fuel at the opposite sides of said pistons.

7. A propulsive apparatus as defined in claim 5, further comprising means for injecting additional fuel into each of said jet units when said unit develops a thrust in the upward direction.

8. A propulsive apparatus as defined in claim 1, in which each of said jet propulsion units is mounted at one end of an arm, further comprising an annular supporting member centrally rotatable about said axis of rotation, the other end of each arm being mounted on said supporting member in a symmetrical arrangement relative to said first-mentioned axis of rotation and so as to be rotatable about a second axis parallel to said first-mentioned axis of rotation, and means for locking the arms of said jet units which are in operation in a radially extending position relative to said first-mentioned axis of rotation and for locking the arms of said jet units which are not in operation in a position in which they are at least partly turned in a direction toward said first-mentioned axis of rotation.

9. A propulsive apparatus as defined in claim 8, further comprising means for pivoting each of said arms with one of said jet units thereon in a direction opposite to the direction of rotation of said annular supporting member about said first-mentioned axis of rotation.

10. A propulsive apparatus as defined in claim 8, further comprising means for pivoting each of said arms with one of said jet units thereon in the same direction as the direction of rotation of said annular supporting member about said first-mentioned axis of rotation.

11. A propulsive apparatus as defined in claim 10, in which said locking means are adapted to be inserted into and withdrawn from the path of travel of each of said arms to lock and unlock said arm.

12. A propulsive apparatus as defined in claim 11, in which the pivoting movement of said arms is produced by said jet units while rotating on said annular supporting member about said first-mentioned axis of rotation and when said locking means are withdrawn from said path of travel of the respective arm.

13. A propulsive apparatus as defined in claim 1, in which said rotating means further include a rigid system adapted to rotate at a constant angular velocity about said axis and having guide means thereon for supporting said jet units, said mass means being unitary with said jet units, said jet units comprising jet nozzles for shifting said units relative to said rigid system along said guide means within a plane extending perpendicularly to said axis.

14. A propulsive apparatus as defined in claim 13, in which each of said units has at least one jet nozzle extending toward the outside thereof and at least one jet nozzle extending toward the inside thereof for shifting said unit along said guide means from an outer position to an inner position and vice versa.

15. A propulsive apparatus as defined in claim 13, further comprising means for locking each of said units at least in an inwardly shifted position on said guide means.

16. A propulsive apparatus as defined in claim 13, in

which said guide means for each of said rotating units extend in a radial direction of said rigid rotating system.

17. A propulsive apparatus as defined in claim 13, in which said guide means for each of said rotating units extend at an angle to the radius of said rigid system so that the outer ends of said guide means extend in the direction of rotation of said units.

18. A propulsive apparatus as defined in claim 13, in which said guide means for each of said rotating units are curved relative to said rigid system so that the outer ends of said guide means extend in the direction of rotation of said units.

19. A propulsive apparatus as defined in claim 1, further comprising a rigid system adapted to rotate at a constant angular velocity about said axis and having guide means thereon for supporting said jet units, said mass means being unitary with said jet units, said jet units comprising jet nozzles, at least one of said nozzles on each of said units extending toward the outside thereof and being adapted to shift said unit along said guide means toward an inner position, each of said units being adapted to slide from said inner position to an outer position under the action of the centrifugal force produced by the rotation of said units about said axis.

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