April 21, 1964 L. E. MATTHEWS 3,129,559

SELF-SUSTAINING MOMENTUM MOTOR

Filed Dec. 22, 1961 2 Sheets-Sheet 1

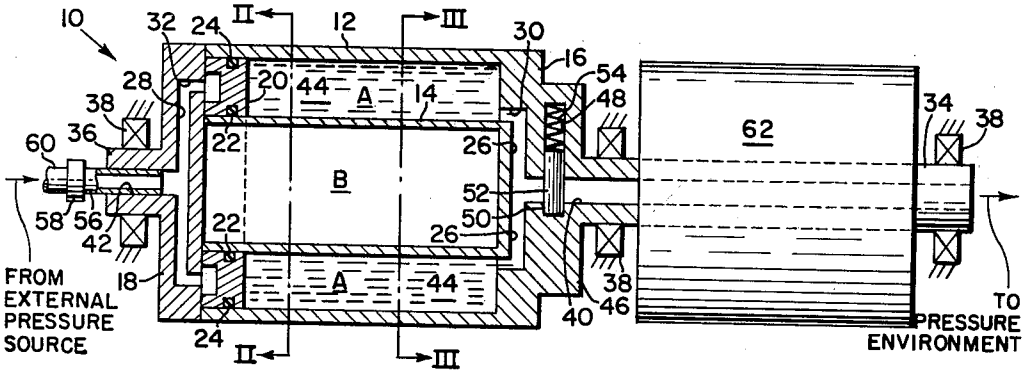


Fig. 1

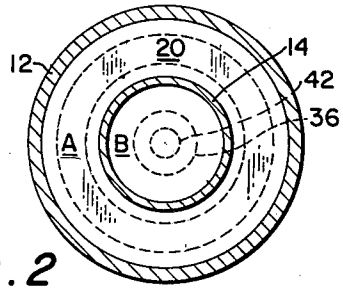


Fig. 2

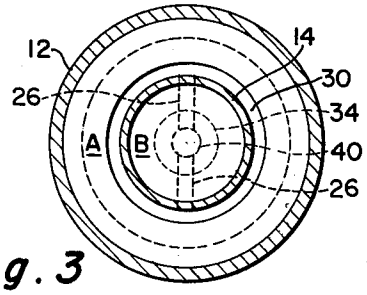


Fig. 3

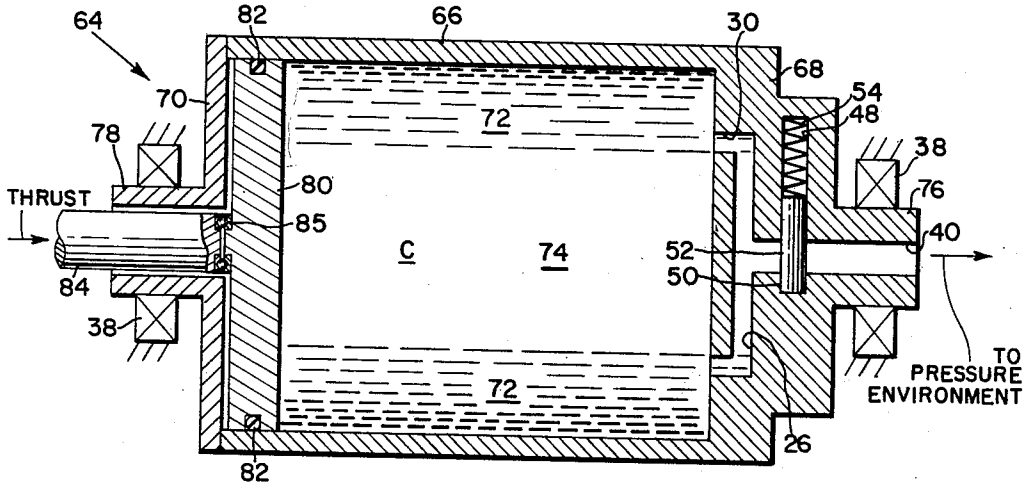


Fig. 4

INVENTOR.
LYLE E. MATTHEWS
BY Erwin F. Johnston
George J. Rubens
ATTORNEYS

April 21, 1964 L. E. MATTHEWS 3,129,559

SELF-SUSTAINING MOMENTUM MOTOR

Filed Dec. 22, 1961

2 Sheets-Sheet 2

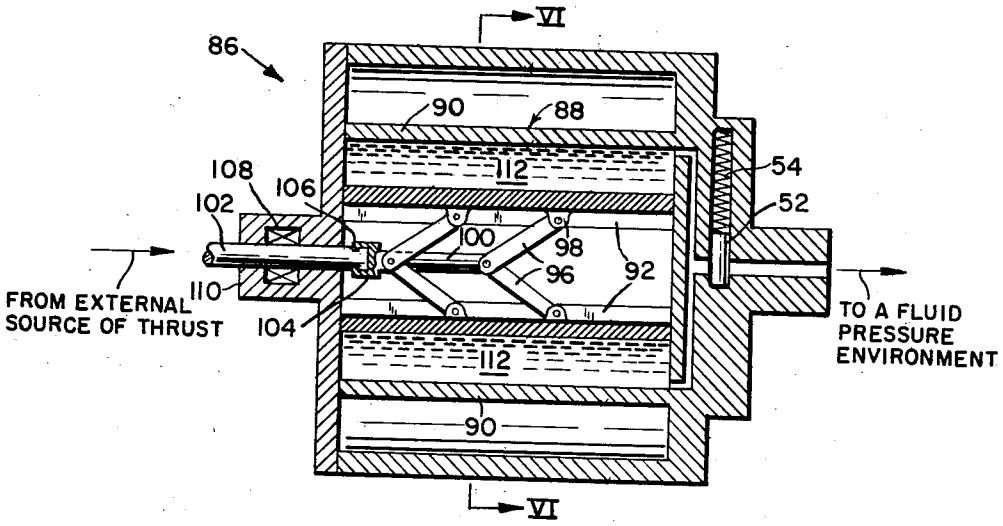


Fig. 5

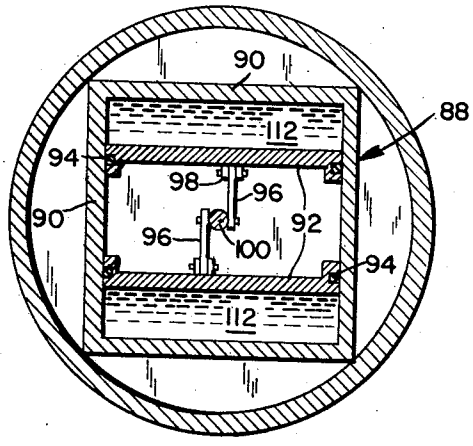


Fig. 6

INVENTOR
LYLE E. MATTHEWS

BY Erwin F. Johnston
George E. Rubens
ATTORNEYS

United States Patent Office 3,129,559 Patented Apr. 21, 1964

3,129,559

SELF-SUSTAINING MOMENTUM MOTOR

Lyle E. Matthews, 3412 Minna St., Oxnard, Calif.

Filed Dec. 22, 1961, Ser. No. 161,747
14 Claims. (Cl. 60—1)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates generally to improvements in self-sustaining motors and the like and more particularly to new and improved self-sustaining motors wherein a constant force or pressure can be applied to a liquid within the motor to exhaust the liquid and maintain the container at a constant angular velocity and/or a purely mechanical means can be employed to drive the fluid from the container.

There is a need for a light and simple device which will supply a substantially constant frequency power source for a period of time. Heretofore, batteries, electric motors, gas engines, etc. have been employed for providing this required power. However, these devices present a weight problem and are often overly complex for their intended function. It is a common requirement in missile work for an electric generator to operate at a substantially constant speed over a short period of time such as for a predetermined period of time after the launch of a missile. Further, there is a requirement for such a device for driving a gyro at a constant speed. The present invention accomplishes this by rotating a container and at least one fluid at an angular velocity which is at or higher than the desired sustaining velocity of the container. The container has at least one channel for directing the liquid inwardly toward the container's axis of rotation to some outside pressure environment. After the container is brought up to a particular rotational speed and then allowed to rotate free from any external power source a mechanical means is employed to apply a pressure greater than that in the environment to the fluid so as to overcome the centrifugal force on the fluid and cause the fluid to be discharged through the channel. This results in a release of kinetic energy to the container as a whole, this release maintaining a substantially constant angular velocity of the container until the fluid is completely discharged. The means for applying the pressure to the fluid can be any mechanical apparatus such as a piston or pistons.

The invention herein as shown in the embodiments of FIGS. 1 and 4 is an improvement over the embodiment described in an application Serial No. 98,993 filed March 28, 1961 for "Self Sustaining Momentum Motor" in that a constant pressure or thrust can be applied to the liquid to be exhausted to maintain a constant velocity of the embodiments whereas in the embodiment of the former filed application an increasing gas pressure had to be applied inside the container to maintain the container at a constant angular velocity. Accordingly, the embodiments of FIGS. 1 and 4 do not require a special apparatus for varying the pressure or thrust necessary to exhaust the liquid. A further improvement of the embodiments of FIGS. 1 and 4 is that the conduit for discharging the liquid can be made shorter since the conduit need open into the container only at the inner side of the column of liquid, thus cutting the loss of energy due to friction. Another improvement of all the embodiments of the present invention is that they can all be operated by a purely mechanical means operating on the piston or pistons such as a rod acting thereon, the rod being actuated by some driving force.

Accordingly an object of the present invention is to

provide a device which utilizes the conservation of momentum principles for imparting angular momentum from a fluid to a rotatable object.

Another object is to provide an improved momentum motor in which a constant pressure or force can be utilized to exhaust a liquid therefrom to maintain the motor at a constant angular velocity.

A further object is to provide a self-sustaining motor in which the fluid therein can be forced therefrom by a purely mechanical means.

Still another object is to provide a self-sustaining motor which is simple of construction and reliable in operation.

Yet another object is to provide a self-sustaining motor which can be operated with a single fluid.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a side view shown partly in cross-section of a preferred embodiment of the invention;

FIG. 2 is a view taken along line II—II of FIG. 1 with the device shown in full;

FIG. 3 is a cross-sectional view taken along line III—III of FIG. 1 with the device shown in full;

FIG. 4 is a side view shown partly in cross-section of another embodiment of the invention in a rotating state;

FIG. 5 is a side view shown partly in cross-section of a further embodiment of the invention; and

FIG. 6 is a cross-sectional view taken along line VI—VI of FIG. 5 with the device shown in full.

Referring now to the drawings wherein like reference numerals designate like or corresponding parts throughout the several views there is shown in FIGS. 1 and 2 a preferred embodiment of the invention which is a container **10** having an outer shell **12**, an inner shell **14** spaced from the outer shell **12**, a forward end plate **16** and an after end plate **18** so as to divide the container into an outer-annular portion A and an inner-cylindrical portion B, each of these portions being sealed from one another. Located within the portion A is an annular piston **20** which is slidable across the inner and outer shells **14** and **12** and which is sealed with respect thereto by an inner O-ring **22** and an outer O-ring **24**.

The forward end plate **16** is provided with radially directed exhaust passage **26** and the after end plate **18** is provided with an annular radially directed intake passage **28**, these passages communicating with annular axially directed passages **30** and **32** so as to open into portion A. Integral with the forward and after end plates **16** and **18** are hollow shafts **34** and **36**, respectively, these shafts being rotatably supported by bearings **38**. The hollow shafts **34** and **36** each have axial passages **40** and **42**, respectively, the passage **40** communicating with portion A via passages **26** and **30** and passage **42** communicating with portion A via passages **28** and **32**. Disposed within the portion A between the piston **20** and the annular axial passage **30** is a fluid such as a liquid **44**.

Integral with the hollow shaft **34** is an annular hub **46** having an upper tubular recess **48** and a lower tubular recess **50**. A cylindrical pin **52** is slidably mounted within the recesses **48** and **50** with a compression spring **54** biasing the pin **52** toward the lower recess **50** so as to close off the portion A from a pressure environment outside of the container **10** when the pin blocks the axial passage **40**. The centroid of the mass of the pin **52** is to be off-set from the longitudinal axis of the container in a direction away from the lower recess **50** so that upon rotation of the container the pin will be thrown radially outwardly so as to open the passage **40**. The mass of the pin, the location of its centroid, the sliding friction thereon and the strength of the spring are to be considered in design-

ing the pin so that it will open channel 40 when the container is rotated at a predetermined angular velocity and close the passage 40 at velocities therebelow. Since the center of gravity of the pin will be offset from the axis of rotation it may be desirable to add a counterweight to the shaft 34 to balance the apparatus when it is in a rotating condition.

Inserted within the passage 42 is a tube 56 which opens into portion A via the passages 28 and 32. A rotating coupling 58 joins the tube 56 with another tube 60, the tube 60 being connected to an external pressure source (not shown). The external pressure source could of course be internal within the container and could be provided by a pressurized fluid or by a gas-generating means. The hollow shaft 34 also acts as a shaft for a motor generator 62, the motor generator being capable of driving the container 10 as a motor in an initial phase of the operation of the embodiment and then being driven by the container 10 as a generator in another phase of the embodiment.

By applying a constant force on the liquid to exhaust it inwardly the container can be maintained at some constant angular velocity. This force (F) is the force exerted upon the liquid 44 by the piston 20 and is substantially equal to

$$\frac{\pi\rho\omega^2}{4}(R_o^4 - R_i^4)$$

where

ρ is the mass per unit volume of the liquid,

ω is the desired sustaining angular velocity of the container, this velocity being greater than the predetermined velocity at which the pin 52 opens the passage 40,

R_o is the outer radius of the portion A and

R_i is the inner radius of the portion A.

Then the pressure of the external pressure source should be constant and equal to the force (F) divided by the area of the piston 20 upon which this pressure acts. Accordingly, when the container tends to fall below the sustaining angular velocity the pressure on the liquid 44 will cause the liquid to be discharged inwardly through the passages 30, 26 and 40 so as to give up kinetic energy and maintain the container at the sustaining angular velocity. The predetermined velocity at which the pin 52 opens the passage 40 is to be appreciably below the desired sustaining velocity in the preferred embodiment, however, the invention would work with the pin opening the passage just before the sustaining velocity is reached. Of course, the pressure upon the liquid 44 by the piston 20 is to be maintained by sufficient external pressure into tube 60. It is to be noted that the passage 30 opens into portion A at an inner side thereof so as to shorten the passage 26 as much as possible. By keeping passage 26 short the friction upon exhausting the liquid through the passage 26 will be kept to a minimum, thus enabling the preferred embodiment to be more efficient during its operation.

Another embodiment, shown in FIG. 4, includes a container 64 having a cylindrical shell 66, a forward end plate 68 and an after end plate 70 so as to define an inner space C. Disposed within the space C is a fluid such as a liquid 72 and another fluid less dense than the liquid 72 such as a gas 74, however, for this embodiment it would also be feasible to fill the entire space C with the liquid 72. Integral with the end plates 68 and 70 are hollow shafts 76 and 78, respectively. Also disposed in space C is a circular piston 80 which has an O-ring 82 for sealing the piston 80 with the annular shell 66. A non-rotating piston rod 84 is journaled into the hollow shaft 78 with a clearance and is connected to the piston 80 by a thrust bearing 85 and at its left end is connected to a mechanism (not shown) for delivering a constant force to the piston rod. The remainder of the embodiment shown in FIG. 4 is the same as the embodiment shown in FIG. 1 including the motor generator which has been omitted from FIG. 4.

The constant force (F) or the thrust that is required to be exerted upon the piston 80 is equal to

$$\frac{\pi\rho\omega^2}{4}(R_o^4 + R_i^4)$$

where

ρ is the mass per unit volume of the liquid,

ω is the desired sustaining angular velocity of the container, this velocity being greater than the predetermined velocity at which the pin opens the passage to the pressure environment,

R_o is the outer radius of the liquid 72 and

R_i is the inner radius of the liquid 72.

Referring now to FIGS. 5 and 6 there is shown a further embodiment which includes a container 86 having an inner square compartment 88 formed by walls 90. A pair of pistons 92 having O-rings 94 are slidably disposed within the compartment so as to be movable with respect to the top and bottom walls 90. The pistons 93 are actuated toward and away from the top and bottom walls 90 by lever arms 96, each lever arm being pinned at one end to a hub 98 on a piston 92 and pinned at the other end to a rod 100. The rod 100 is driven along the axis of rotation of the container 86 by a stationary rod 102. The rod 102 can be driven along the axis by any suitable means (not shown) such as a motor which is geared to the rod 102 or by a weight attached to the rod 102 which is forced against the rod 102 by acceleration of a vehicle (not shown) on which the device is mounted. Since the rods 100 and 102 rotate with respect to one another a cupped bearing 104 is provided with an annular lip 106 to allow the rod 100 to be actuated in both directions and since the container rotates also with respect to the rod 102 bearings 108 are provided in a hollow shaft 110. Located within the spaces between each piston 92 and a corresponding wall 90 is a fluid such as mercury 112. The lever arms 96 have a length such that the pistons 92 can be driven to engagement with the top and bottom walls 90 so that substantially all of the liquid can be forced from the compartment 88. The remainder of this embodiment as well as the motor generator is essentially the same as that described for the preferred embodiment.

In the operation of the preferred embodiment the container 10 is rotated by the motor generator 62 to an angular velocity at or above the desired sustaining angular velocity, this velocity being above the predetermined angular velocity at which the pin 52 opens the passage 40. The liquid 44 as stated previously will be discharged from the container only at the sustaining angular velocity or some velocity below but substantially close thereto. When the container is rotated above the sustaining velocity the pressure on the liquid due to centrifugal force will be greater than the differential between the pressure exerted on the liquid by the piston 20 and the pressure of the pressure environment, thus preventing the liquid from traveling through the channels 30, 26 and 40. At velocities below the predetermined velocity the pin 52 will close the passage 40 preventing any discharge from the container 10 and at angular velocities of the container at or above the predetermined angular velocity the pin 52 will slide within the recesses 48 and 50 by centrifugal force so as to open passage 40. Assuming that the container is brought to an angular velocity above the sustaining velocity the centrifugal force on the liquid will retain the liquid within the portion A even though the differential pressure is acting on this liquid. However, when the container slows down to the sustaining angular velocity, the differential in pressure between the container and the pressure environment will overcome the centrifugal force to discharge the liquid through the passages 30, 26 and 40. When the liquid is discharged through the passages it will give up kinetic

energy to the over-all container in the same manner as kinetic energy is given up by a rotating skater when he pulls his arms from an outward position to an inward position. The liquid is discharged through the passage 40 into the lower pressure environment where it may be retained for further use. The container will be maintained at the sustaining angular velocity so long as some of the liquid is within the container. As soon as the liquid is completely discharged from the container, the container will then proceed to slow to a standing position by friction on the hollow shafts 34 and 36.

The operation of the embodiment shown in FIG. 4 is essentially the same as that for the preferred embodiment except that a circular piston 80 is employed rather than an annular piston and also there is no partition of the container in the embodiment of FIG. 4 but rather the container is entirely open inside. Accordingly, when the embodiment of FIG. 4 is in a static condition all of the fluid 72 due to the force of gravity will be resting to one side of the container and after being brought up to a particular angular velocity will be centrifugally forced out to an outer periphery within the container as shown in FIG. 4. As the container 64 slows down to or below the sustaining angular velocity the piston 80 will apply a pressure to the fluid so as to force it inwardly giving the same result as that described for the preferred embodiment. Maximum efficiency would be obtained with this embodiment by initially putting the gas 74 under a pressure equal to

$$\frac{\rho\omega^2 R_1^2}{2}$$

The operation of the device shown in FIGS. 5 and 6 is similar to that shown in the preferred embodiment except for the embodiment in FIGS. 5 and 6 a pair of pistons 94 move in a radial direction to discharge the fluid rather than moving in an axial direction as described for the preferred embodiment and the embodiment shown in FIG. 4. Accordingly, when the container 86 falls to the sustaining angular velocity or therebelow the pistons 92 move in a radial direction to force the liquid inwardly with respect to the container so as to maintain the angular velocity of the container in a similar fashion as described for the preferred embodiment.

It is now readily apparent that the present invention provides various embodiments which will sustain themselves at a sustaining angular velocity for a period of time. The invention eliminates the need of complicated power sources having undue weight where the requirement is merely to furnish a constant angular velocity over the specified period of time. By providing a purely mechanical means of discharging the fluid it is no longer necessary that more than one fluid be employed to accomplish this result.

Obviously many modifications and variations of the present invention are possible in light of the above teachings. For instance, in all embodiments the fluid which is to be discharged to the lower pressure environment could be discharged to an inner compartment within the container, the inner compartment acting as a lower pressure environment. This would reduce the efficiency of the device but would make it self-contained. In any of the embodiments the pressure environment could be an evacuated tank anywhere outside of the container. Of course, the valving arrangement could be constructed in many different ways. It is, therefore, to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. A momentum device comprising a container exposed to an exterior pressure environment, said container having an axis of rotation and adapted to contain a fluid, said container upon rotation being capable of rotating the fluid about said axis when the fluid is disposed within the container, said container having conduit means directed inwardly toward said axis of rotation for exhausting the fluid to said pressure environment and means including at least one member movable within said container and capable of being in direct contact with the fluid for applying a pressure thereto which is sufficient to force the fluid to flow inwardly through said conduit means toward said axis of rotation, whereby upon disposing fluid within the container and rotating the container and the fluid about the axis the inward flow of said fluid will give up kinetic energy to the container to maintain the container in a rotating state.

2. A momentum device comprising a container exposed to an exterior pressure environment, said container having an axis of rotation, a fluid inside said container which is capable of rotating with the container about said axis, said container having conduit means directed inwardly toward said axis of rotation for exhausting the fluid to said pressure environment and means including at least one member movable within said container in direct contact with the fluid for applying a pressure thereto which is sufficient to force the fluid to flow inwardly through said conduit means toward said axis of rotation, whereby upon rotating the container and the fluid about the axis the inward flow of said fluid will give up kinetic energy to the container to maintain the container in a rotating state.

3. A momentum device comprising a container having an axis of rotation, a fluid inside said container which is capable of rotating with the container about said axis, a pressure environment, means including at least one piston in direct contact with the fluid for applying a pressure to the fluid which is greater than the pressure of said environment, and said container having conduit means for exhausting the fluid from the container inwardly toward said axis of rotation to said pressure environment whereby upon rotating the container and the fluid about the axis the application of pressure by said pressure means on the fluid sufficient to force the fluid to exhaust inwardly toward said axis will cause the fluid to give up kinetic energy to the container to maintain the container in a rotating state.

4. A momentum device as claimed in claim 3 wherein the piston of said pressure means is movable axially with respect to said axis of rotation whereby a constant pressure can be applied to the fluid by the piston to maintain the container at a constant angular velocity.

5. A momentum device as claimed in claim 3 wherein the piston of said pressure means is movable in a direction normal with respect to said axis of rotation.

6. A momentum device comprising a container having an inner shell spaced from an outer shell with end plates enclosing the space between said shells, means for rotatably mounting the container about an axis which is aligned with the central axis of said inner shell, a pressure environment, a fluid within the space between the shells, a piston disposed within the space between the shells so as to substantially occupy a transverse cross-sectional portion of the space, said piston being in sliding sealing engagement with the shells and movable along the shells axially with respect to said axis and said container having conduit means for exhausting the fluid from the space between the shells inwardly toward said axis to said pressure environment whereby upon rotating the container and the fluid about the axis the application of a constant force on the piston to move the piston toward the conduit means will exert a constant pressure on the fluid causing the fluid to exhaust inwardly toward said axis giving up kinetic energy to the container to maintain the container at a constant angular velocity.

7. A momentum device as claimed in claim 6 wherein the inner and outer shells are cylindrical and concentrically spaced with respect to one another so that the space therebetween is annular, and further said piston also being annular.

8. A momentum device as claimed in claim 6 including means for actuating the piston toward said conduit means, said actuating means including another fluid under a pressure which operates on the piston on a side opposite a second side of the piston adjacent said first-mentioned fluid.

9. A momentum device as claimed in claim 6 wherein the conduit means opens into the space between the shells at a location which is substantially adjacent an outer wall of the inner shell whereby the length of travel of the fluid to the pressure environment is reduced, and means for closing the conduit means at velocities below a predetermined angular velocity of the container about the axis and opening the conduit means at velocities at or above the predetermined angular velocity.

10. A momentum device comprising a container having an inner cylindrical shell concentrically spaced from an outer cylindrical shell with end plates enclosing an annular space between said shells, means for rotatably mounting the container about an axis which is aligned with the central axis of said shells, a pressure environment located outside of said container, a fluid within the space between the shells, an annular piston disposed within the space between the shells and sealingly engaging an inner wall of the outer shell and an outer wall of the inner shell, said piston being slidable along the shells axially with respect to said axis, one of said end plates having an annular conduit opening into the annular space at a location which is substantially adjacent the outer wall of said inner shell and also opening outwardly from the container along said axis, conduit means joined to the last-mentioned end plate at the outward opening of the annular conduit for communicating the annular conduit with the pressure environment, means for closing the conduit means at velocities of the container below a predetermined angular velocity about the axis and opening the conduit means at velocities at or above the predetermined angular velocity, means for actuating the piston toward the annular conduit and said fluid being located between the piston and the annular conduit whereby upon rotating the container and the fluid about the axis at or above the predetermined velocity the application of a constant force on the piston sufficient to move the fluid inwardly toward the axis will cause the fluid to give up kinetic energy to the container thus maintaining the container at a constant angular velocity.

11. A momentum device comprising a container having a cylindrical shell enclosed by opposite-facing end plates, means for rotatably mounting the container about an axis which is aligned with the central axis of said shell, a pressure environment located outside of said container, a fluid within the container, a cylindrical piston disposed within the container having an outside wall which is in slidable sealing engagement with a periphery of an inside wall of the shell and which is movable along said axis and said container having conduit means for exhausting the fluid from the container inwardly toward said axis to said pressure environment whereby upon rotating the container and the fluid about the axis the application of a constant force on the piston sufficient to move the fluid inwardly toward said axis will cause the fluid to give up kinetic energy to the container to maintain the container at a constant angular velocity.

12. A momentum device as claimed in claim 11 wherein a gas is also disposed within said container and said fluid is a liquid.

13. A momentum device comprising a rectangular container, said container being rotatable about an axis, a pair of pistons disposed within the container with their walls in sliding sealing engagement with inner walls of the container, said pistons being movable outwardly from said axis, a fluid disposed within said container outward from said pistons, a pressure environment and said container having conduit means for exhausting the fluid inwardly toward said axis to said pressure environment whereby upon rotating the container and the fluid about the axis a movement of said pistons outwardly will exert a pressure on the fluid causing the fluid to exhaust inwardly toward the axis giving up kinetic energy to the container to maintain the container in a rotating state.

14. A momentum device as claimed in claim 13 including means for actuating said pistons, said actuating means including a rod along said axis and at least one lever pivoted to each piston and to said rod whereby upon moving the rod the levers will move the pistons.

References Cited in the file of this patent

UNITED STATES PATENTS

2,914,962 Schmidt ..... Dec. 1, 1959
3,014,341 Matthews ..... Dec. 26, 1961