July 5, 1966 C. J. DANIELS ETAL 3,259,213

FRICTION AND HYDRAULIC BRAKE FOR ARRESTING GEAR MEANS

Filed Oct. 9, 1964 3 Sheets-Sheet 1

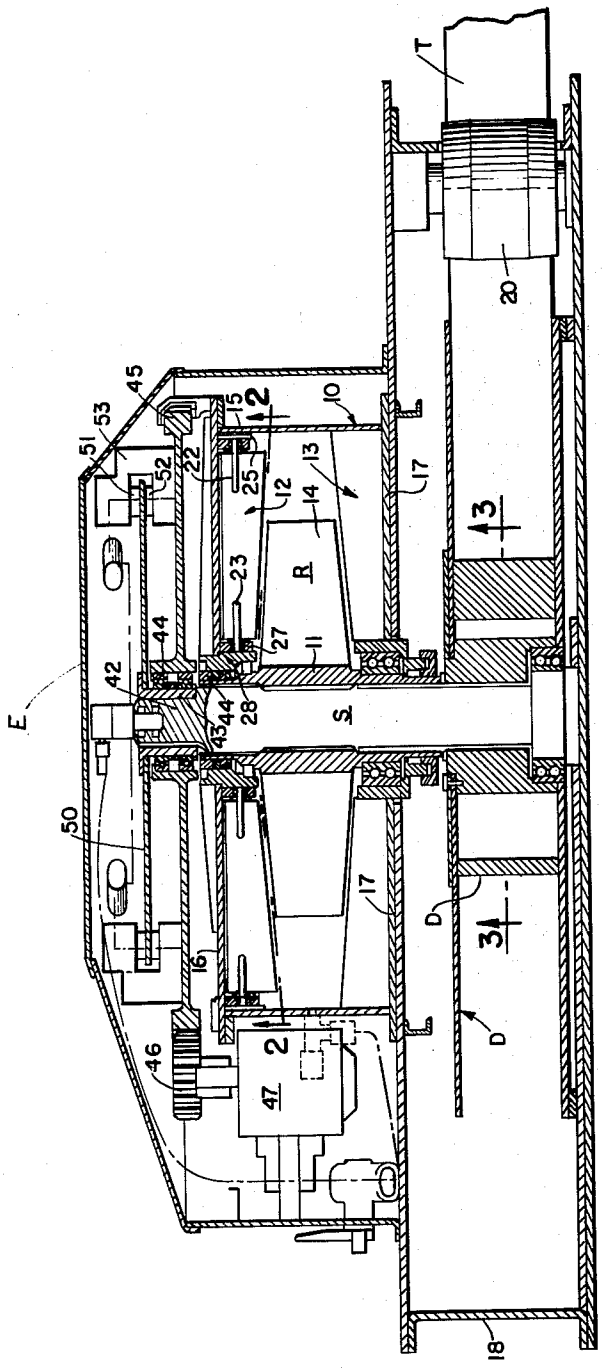


FIG. 1.

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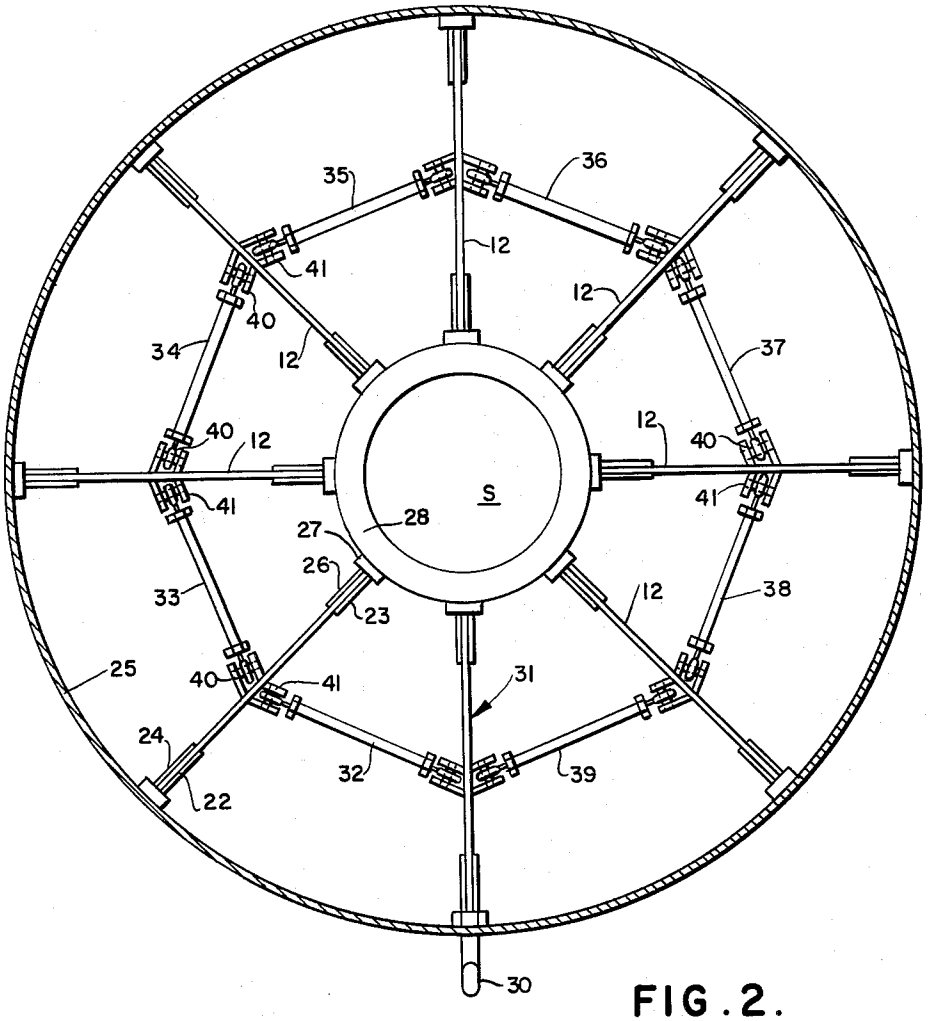


FIG. 2.

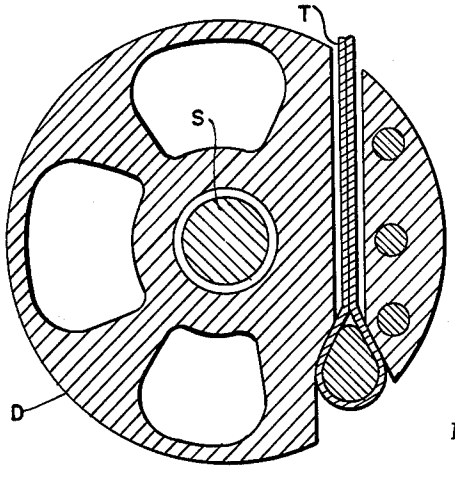


FIG. 3.

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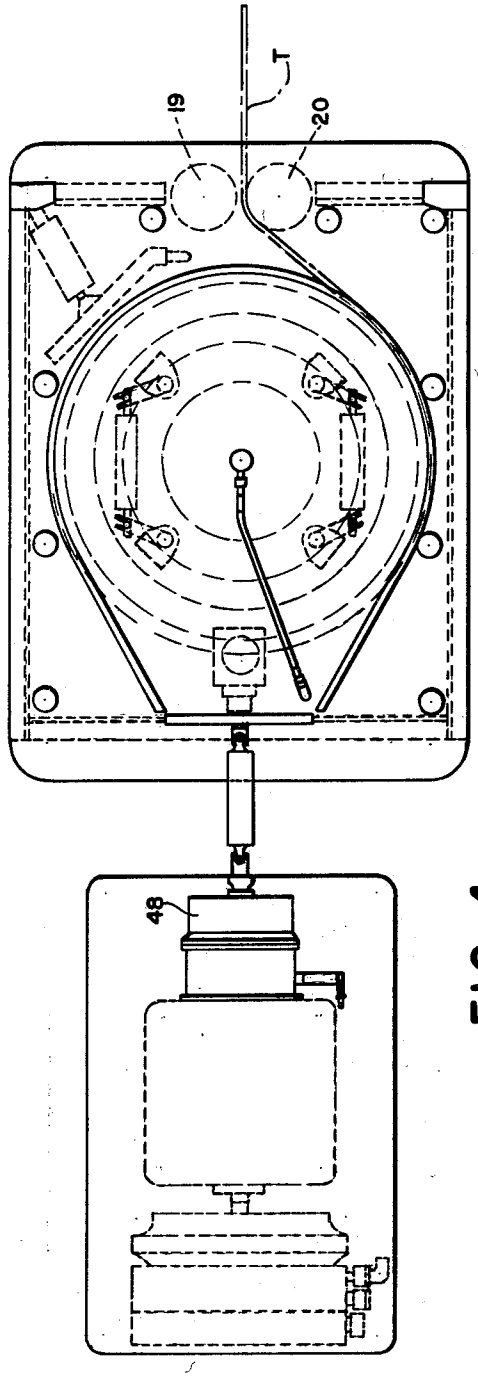


FIG. 4.

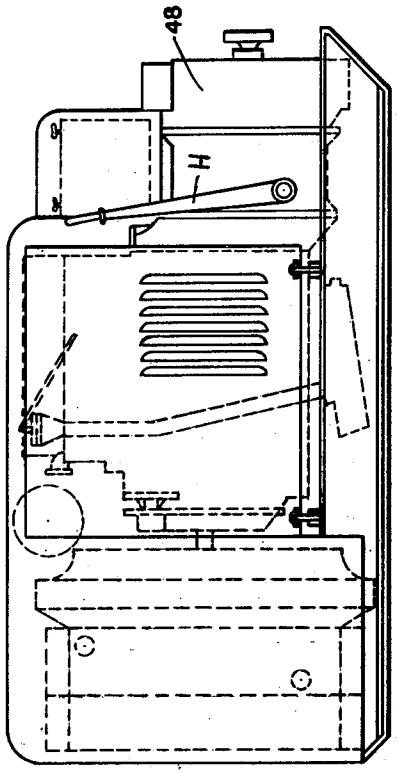


FIG. 5.

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3,259,213

FRICTION AND HYDRAULIC BRAKE FOR ARRESTING GEAR MEANS

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3 Claims. (Cl. 188—86)

The present invention relates generally to rotary energy absorber units for aircraft arrestment. More particularly the invention relates to means to control torque and braking effect for rotary energy absorber units of a type having a rotor with radial paddle blades mounted on a shaft vertically with respect to a cable or tape storage drum, said rotor being confined in a liquid filled housing so the said rotor blades are immersed in the liquid confined in the housing.

An object of this invention is to vary the turbulent fluid flow path produced by the rotor paddle blades in the liquid housing adjacent cooperating stator vanes mounted in the respective top and bottom housing walls as the rotor and the tape storage drum are rotated by the tape runout from the storage drum.

Another object is to provide actuator means for diverting the rotor generated flow path of liquid in the housing by angularly displacing the stator vanes in the liquid housing with respect to the rotor paddle blades.

Another object is to further control tape runout by additive friction braking, if desired.

A further object is to provide novel movable means in a liquid filled housing and means for moving said movable means to divert the flow path of fluid set up by the rotation of a paddle-like rotor in the housing, whereby the over-all drag coefficient of the rotor in the housing liquid is controllable.

Still another object is to provide a master movable stator vane and link connected slave vanes in a liquid filled housing with a paddle wheel therein having paddle blades adjacent the vanes and operating means for moving said master stator vane to impart following movements to various angular positions of each slave vane in the paddle wheel generated flow path of the liquid in the housing.

The above and other objects and advantages of the present invention will appear more fully hereinafter from a consideraiton of the detailed description which follows, taken with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of this invention.

In the drawings, wherein like reference characters refer to like parts throughout the several views:

FIGURE 1 is a cross section view of an embodiment of the invention showing a rotary energy absorber unit including a tape storage drum in side elevation and a tape retrieve drive for rewinding the tape drum after tape payout action with an illustration of an upper group of novelly pivoted stator vanes and novel controlling means for angularly moving said vanes;

FIGURE 2 is a cross section view, taken on section line 2—2 of FIGURE 1 showing the pivoted stator vanes of the unit in end elevation in solid vertical erect position and showing the pivot pins of the said vanes;

FIGURE 3 is a view taken between the arrows on line 3—3 of FIGURE 1;

FIGURE 4 is a top plan view of the complete unit including the arresting portion of the absorber and the retriever unit connected therewith for rewinding the tape in the storage drum and also of an auxiliary friction brake system.

FIGURE 5 is a side view in elevation of the retriever power unit.

Generally, throughout the following description of the structural features of each rotary energy absorber device comprises a liquid filled housing **10** enclosing a rotor R formed like a paddle wheel, said rotor being mounted on a shaft S which shaft extends centrally through the housing and extends through a bearing in the lower housing wall from the housing **10** into a space below the housing. On this first extended portion of the shaft S below the housing bottom wall is mounted a tape storage drum D which is arranged on the first shaft extension to rotate the rotor when it is rotated by the runout or payout of tape T from the drum D therein. The rotor or paddle wheel R is rotatable with respect to upper and lower groups of stator vanes **12** and **13** respectively, in the fluid filled housing **10**. The torque and drag effect of the rotor R is regulated by the extent of the radius of the coil of the tape T from the core of the storage drum D as it pays out and is further controlled by the angular position of the upper stator vanes **12** with respect to the radial rotor blades or paddles **14** whcih are rotatable in the liquid in the housing **10**.

Referring in detail to the drawings with particular reference to the embodiment depicted in FIGURES 1 and 4, there is shown an energy absorber formed from a cylinder **15** with the top and bottom rims thereof sealed off and closed by top and bottom plates **16** and **17**, such plates on their inner surfaces supporting the stator vanes **12** and **13**. The assembled housing is supported in an elevated position on a frame structure **18** in which the tape storage drum D is key mounted on shaft S and from which the nylon tape T pays out over a pair of spaced sheaves **19** and **20** mounted in said frame. The frame **18** may be suitably anchored to the ground by anchors, not shown, at each respective corner of the support frame **18**.

Lower stator vanes **13** are on a radial axis and are formed from the bottom plate **17** and upper stator vanes **12** are pivoted on a radial axis adjacent to the inner opposed face of top plate **16** of the housing **10**. These radial pivot axes comprise pivot pins **22** and **23** for the respective upper group of each of the stator vanes **12**, see FIGURE 2.

Each of the respective upper vane pins are turnable in bearing sockets, such as **24** in an annular ring or shroud **25** and in radially opposite bearing sockets **26** mounted on the exterior of the annular ring **27** around outer bearing race **28**.

The radially arranged upper stator pivot pins permit angular movement to be imparted to the respective upper stator vanes **12** from vertical position to angular positions therefrom; see FIGURE 2.

The operating means for imparting angular motion simultaneously to the respective upper stator vanes comprises a handle **30** extending exterior of the housing **10**. This handle may be keyed to or may be a fixed part of a master vane **31** of the upper vane group and each other vane **12** is connected by slave linkage members **32, 33, 34, 35, 36, 37, 38** and **39**. These slave links have eyelet ends at each end and are pivotally connected by transverse pins **40** to bifurcated brackets **41** on each opposite side of each upper stator vane, see FIGURE 2.

In operation of this arrangement, assuming the tape storage drum D on the first shaft extension of shaft S is being rotated by an aircraft being arrested to payout tape therefrom, the rotor R with its radial paddles **14** between the upper and lower stator vanes **12** and **13**, revolves and causes the fluid in the housing **10** to follow a turbulent flow path pattern. This flow path pattern, if desired, may be changed, to thereby effect the K factor of the unit by pivoting the upper stator vanes **12** on the

respective pivot pins **22** and **23** to various angular positions by using the handle **30** to angle the master vane **31**, as shown in FIGURE 2. Thus, variable control of rotor torque or braking effect of the rotary absorber unit may be obtained by diverting the liquid flow path in the housing **10** for effect of K, K being the over-all drag coefficient of the rotor R to control torque or braking effect.

With reference to FIGURE 1, the housing **10** is enclosed at the top in a dome or cover E. This dome or cover encloses a second shaft extension, that is, an extended stub end **42** of the shaft S, which stub or second shaft extension is formed to mount the inner race **43** of a roller bearing **44**. The bearing **44** journals a power driven gear **45** of suitable dimensions, for example, a gear with two hundred and eighty-eight teeth which mesh with a much smaller gear **46** to drive brake fluid pump **47**. Gear **46**, for example, may be formed with thirty-six teeth and control the engaging action of the brake shoes **51–52** on brake disk **50**.

A unit for driving the drum D in reverse direction for rewinding the tape T on the drum after each tape payout arrest operation is shown generally in FIGURE 5. A handle control H for a clutch **48** may be provided to disconnect the rotor shaft S during rewinding of the tape or to connect the clutch as required.

Also, under the cover E the disk **50** may be mounted on the stub end **42** of the second shaft extension the shaft S, so the disk revolves as the shaft S is turned by the tape runout from drum D during an arrest operation. This disk **50** is part of the auxiliary fluid actuated friction brake system and is rotatable between the vertically positioned shoes **51** and **52** of a hydraulic brake housing **53**. Such brake system may be similar to the brake system illustrated in FIGURES 1 and 2 of co-pending application, Serial No. 274,128, filed June 10, 1964, now Patent Number 3,172,626, likewise solely owned by the present assignee. However, the present invention is concerned primarily with control of rotor torque and resulting braking effect by stator vane angular movements and the friction brake system may or may not be used.

Thus, there are provided novel control means for programmed control of rotor torque and resulting braking effect of a rotary absorber unit of the type described, which control means are simple, economical and efficient in performance for the purpose intended.

Without further description it is believed that the advantages of the present invention over the prior art is apparent and while only one embodiment of the same is illustrated, it is to be expressly understood that the same is not limited thereto as various changes may be made in the combination and arrangement of the parts illustrated, as will now likely appear to others and those skilled in the art.

For a definition of the scope or limits of the invention, reference should be had to the appended claims.

What is claimed is:

1. In a hydraulic rotary arresting engine including

an enclosing casing and supporting base,

a liquid filled housing on said base in said casing,

a tape storage drum in the supporting base below the said housing,

a vertical shaft,

said drum being mounted on the lower portion of said shaft,

vertically spaced bearings mounted centrally of said housing and in said base vertically below said housing,

said vertical shaft being journalled to revolve in the respective vertically spaced bearings,

said shaft having

a first extension in said base secured to said tape drum,

a paddle wheel likewise secured to said first shaft extension in said housing,

angularly adjustable stator vanes vertically adjacent said paddle wheel journalled in means on the wall of said housing,

a second extension of said shaft projecting exteriorly of the top of said housing,

a disc secured to said second shaft extension and rotatable therewith above the housing,

a brake engageable with said disc,

vane control means for angularly moving said vanes, and

brake control means for operating said brake into engagement with said disc.

2. In a hydraulic rotary arresting engine as described in claim **1**, wherein one of said stator vanes is a master vane including linkage means connecting with said other stator vanes or slave vanes, said vane control means being operatively connected to said master vane, to thereby adjust each of said slave vanes in conformity with the angular position of said master vane.

3. In a hydraulic rotary arresting engine as described in claim **1**, wherein said brake means is a hydraulically operated friction brake with brake shoes engageable with said disc.

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