United States Patent

[11] 3,620,489

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Wilmington, Del.

[54] **RUNWAY SHEAVE ASSEMBLY FOR AIRCRAFT-ARRESTING GEAR**
24 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** ..... **244/110 C**
[51] **Int. Cl.** **B64f 1/00**
[50] **Field of Search** 244/110, 63

[56] **References Cited**

UNITED STATES PATENTS

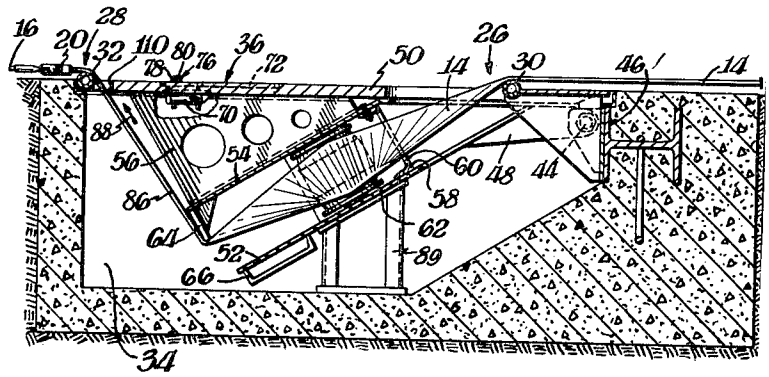
3,182,935	5/1965	Wischhoefer	244/110 A

FOREIGN PATENTS

916,588	1/1963	Great Britain	244/110

Primary Examiner—Milton Buchler
Assistant Examiner—Paul E. Sauberer
Attorney—Connolly and Hutz

ABSTRACT: The runway sheaves of an aircraft-arresting gear are mounted at the bottom of a hinged cover assembly and received within a pit prior to activation. The linear payout element is deflected into a deep bend under the closed cover assembly by a knee element. The cover assembly is locked down by shear pins. The strong tensioning of the linear payout element during the initial phase of arrestment breaks the shear pins and raises the cover assembly. The cover assembly is then latched in a raised position to maintain the sheave and payout element elevated above ground level and facilitate their action during arrestment of the aircraft. Fairleads and slots smoothly guide the linear payout element under and through the cover assembly, which is efficiently fabricated from a cover plate and a lower plate disposed at an acute angle beneath it. The sheaves are mounted between an inner plate spaced above and parallel to the lower plate and the knee element extends downwardly from the edge of the inner plate remote from the hinge. The cover assembly is of truncated V-shape in plan with its narrow end adjacent the runway and a hinge at its wider opposite end. The cover and inner plates are spaced apart by angular channels disposed parallel to the sides of the assembly and a slotted cross channel is secured between the inner and lower plates. A striker bar for the latch is conveniently made from the extended web of a lateral channel mounted beneath the narrower end of the assemblies. The latches and shear pin retainers are mounted on catch plates secured to the pit adjacent the narrow end of the cover assembly.



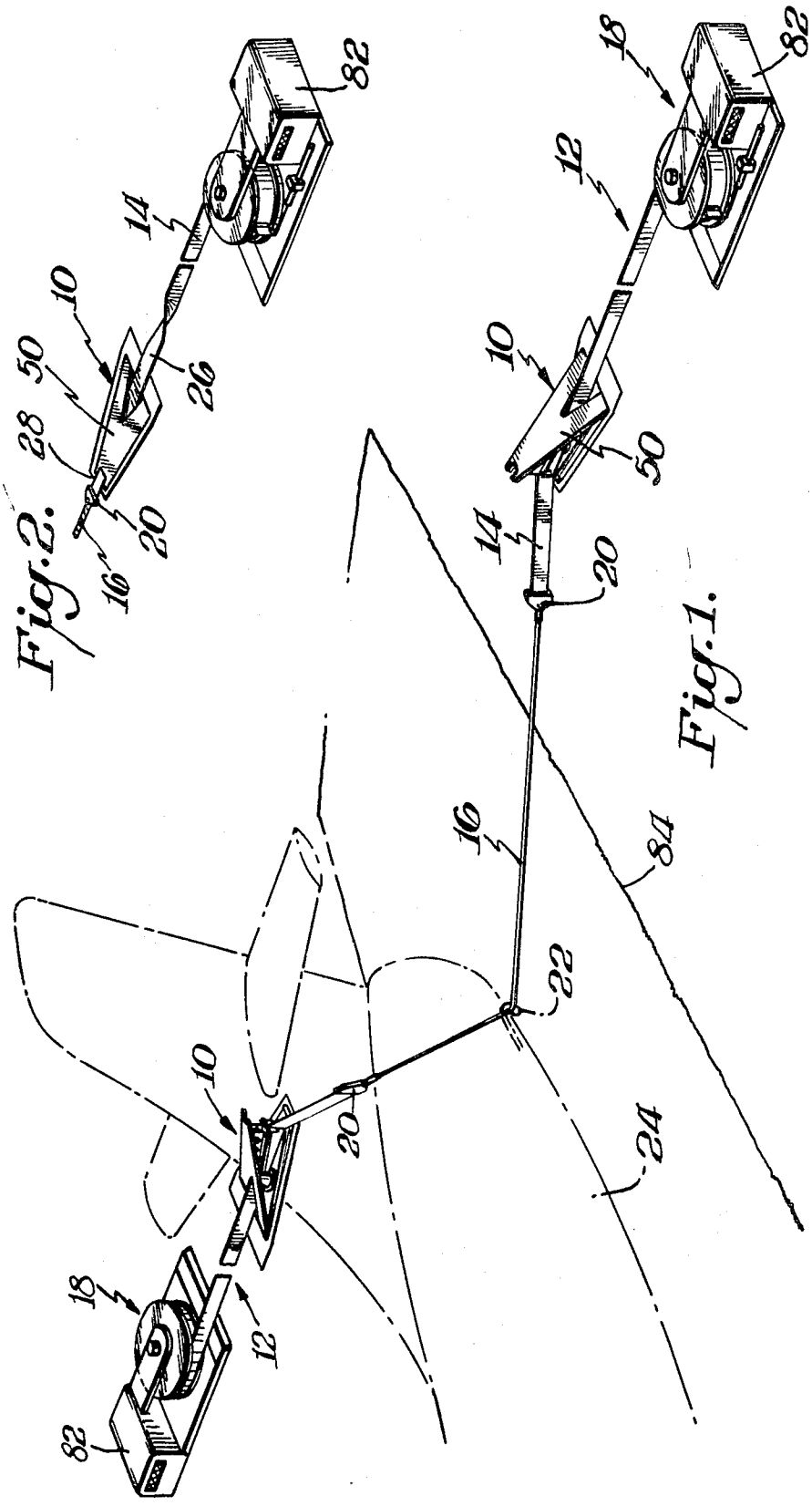

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Fig. 2.
18
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Fig. 1.
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Fig. 3.

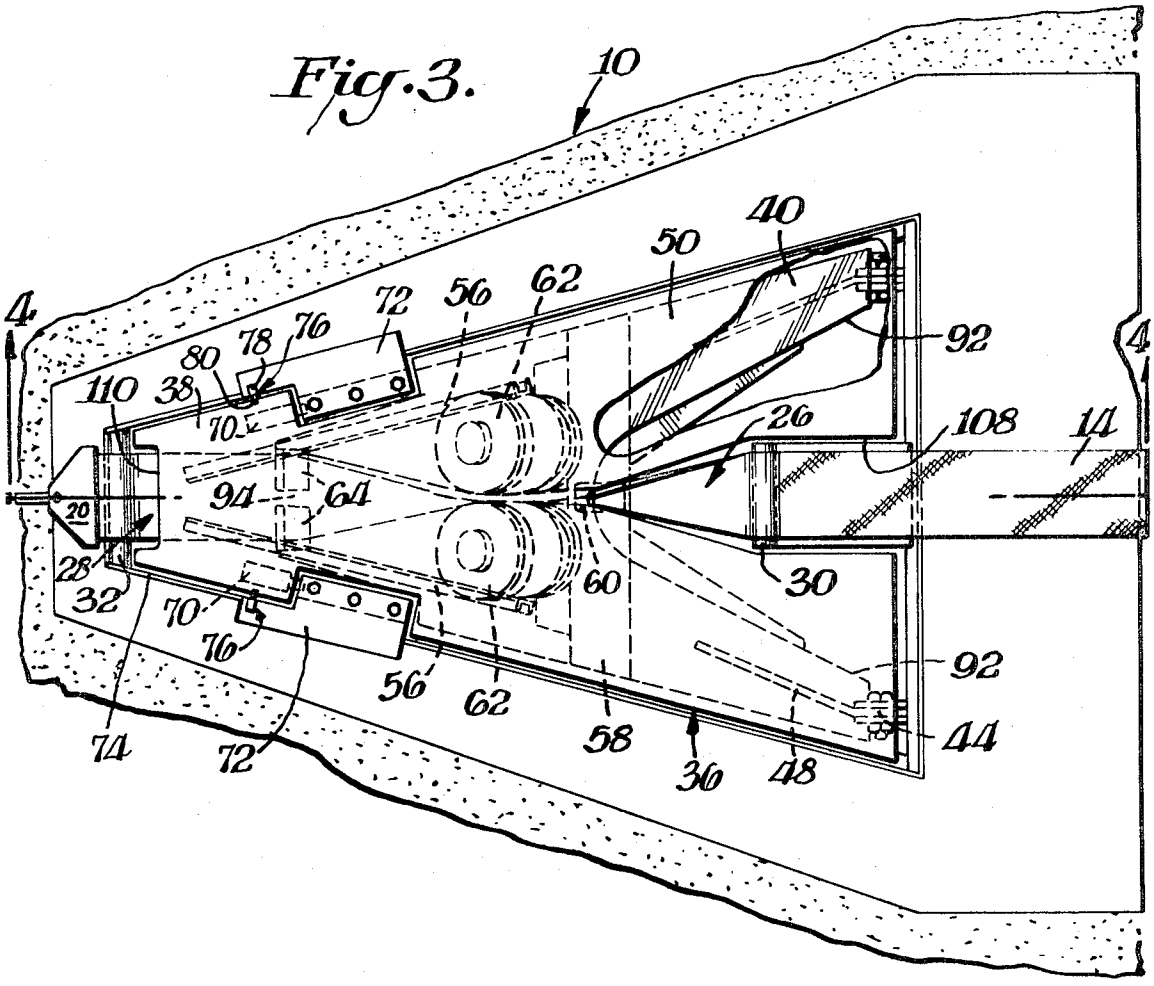
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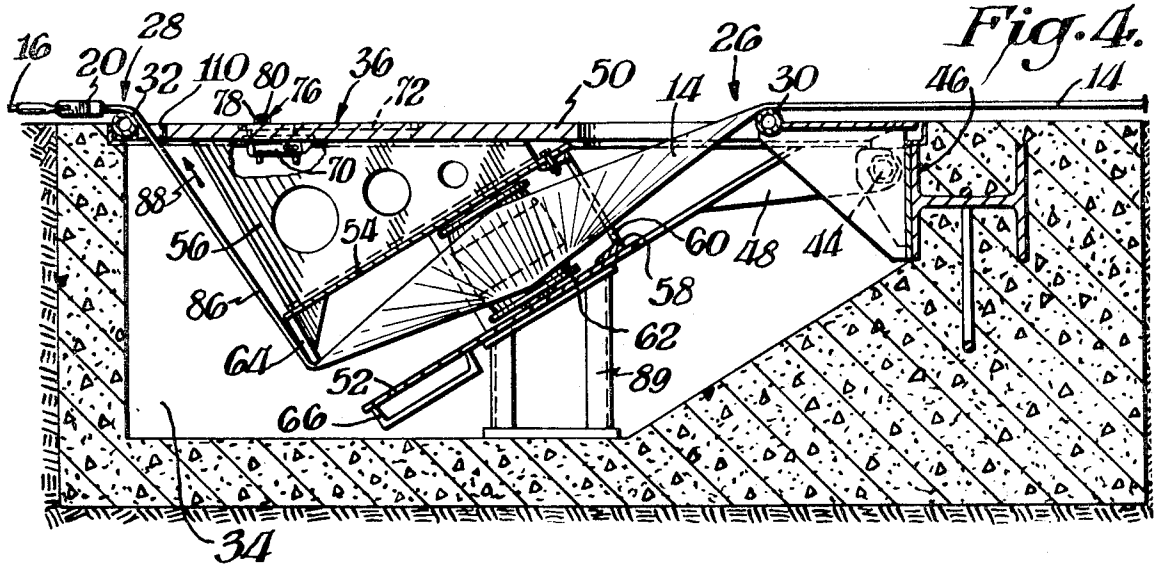
Fig. 4.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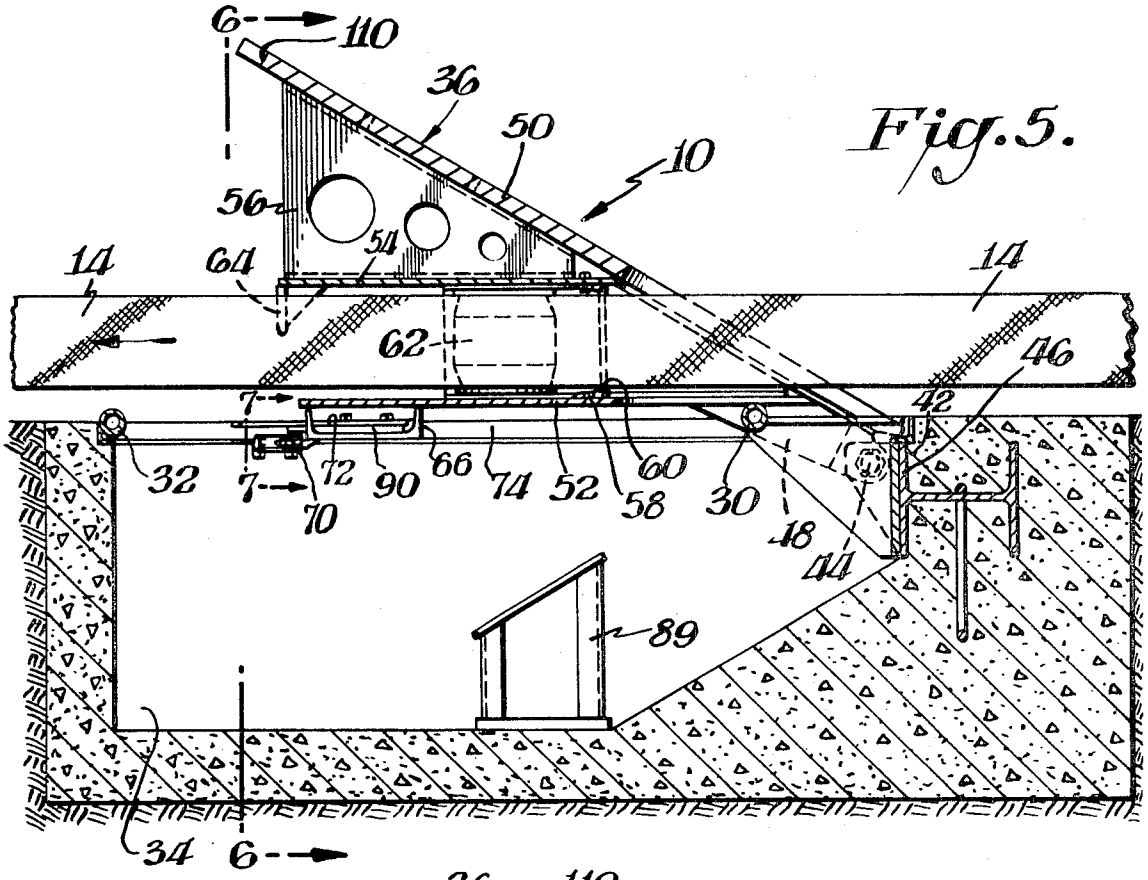


Fig. 5.

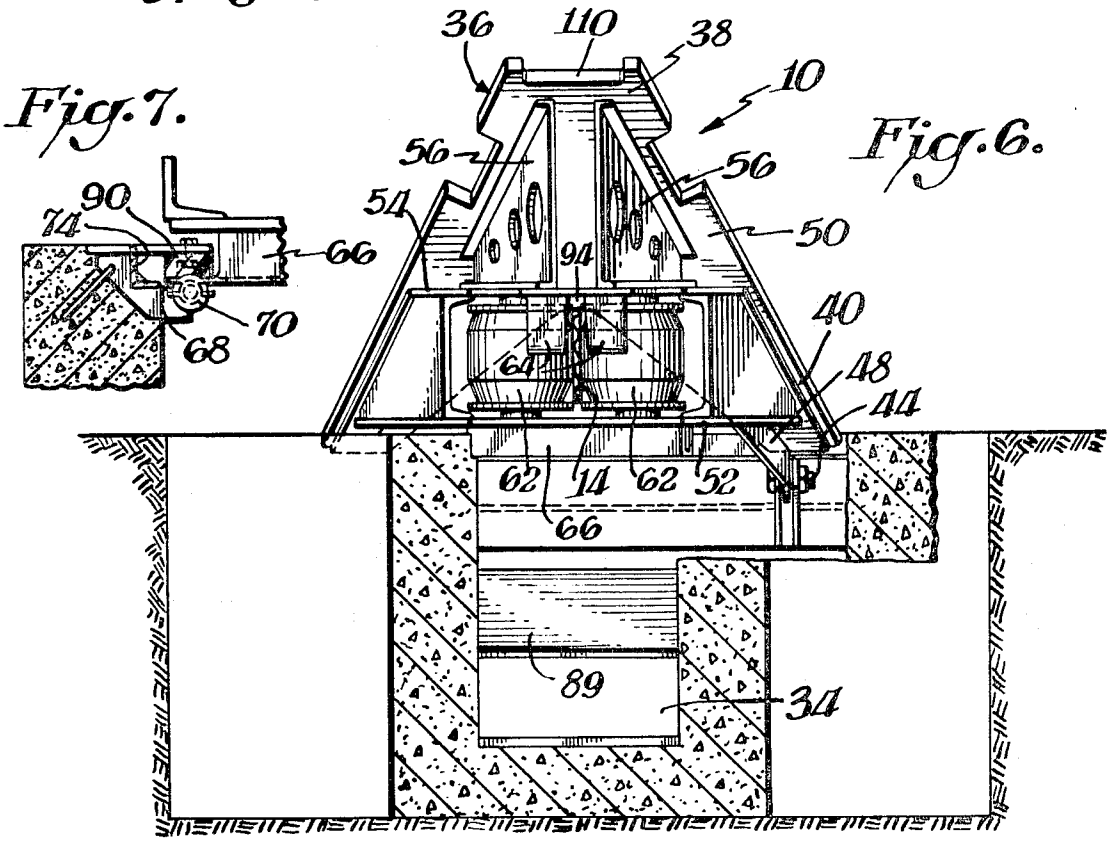


Fig. 7.

Fig. 6.

Fig. 8.

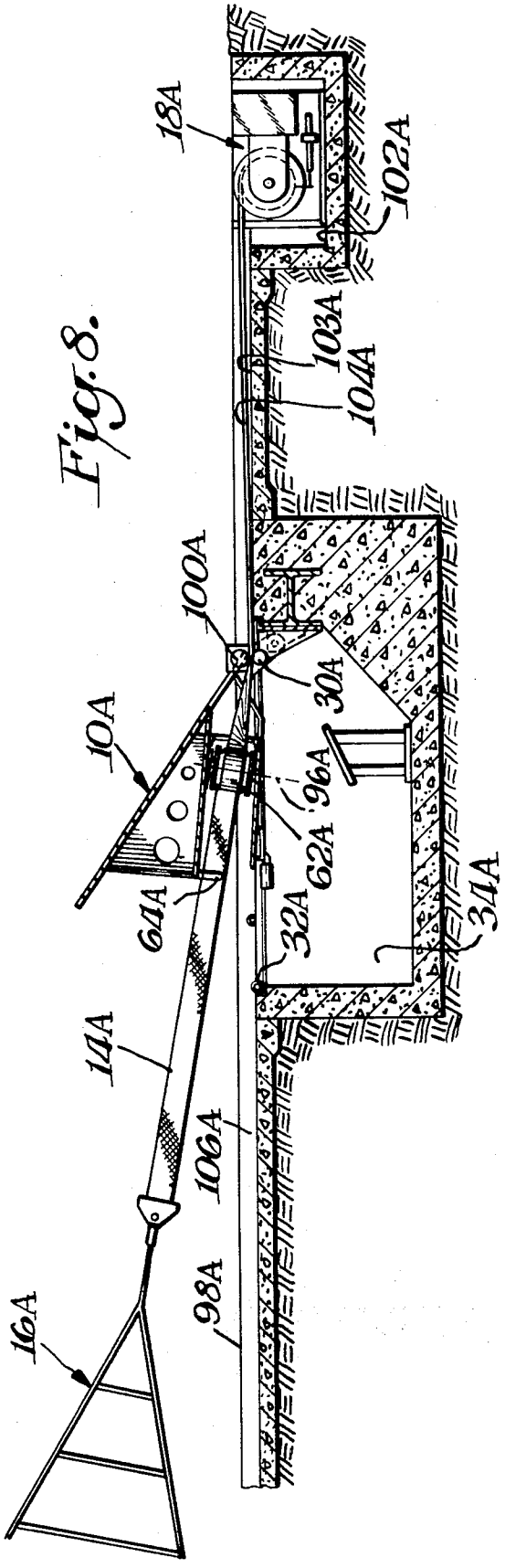
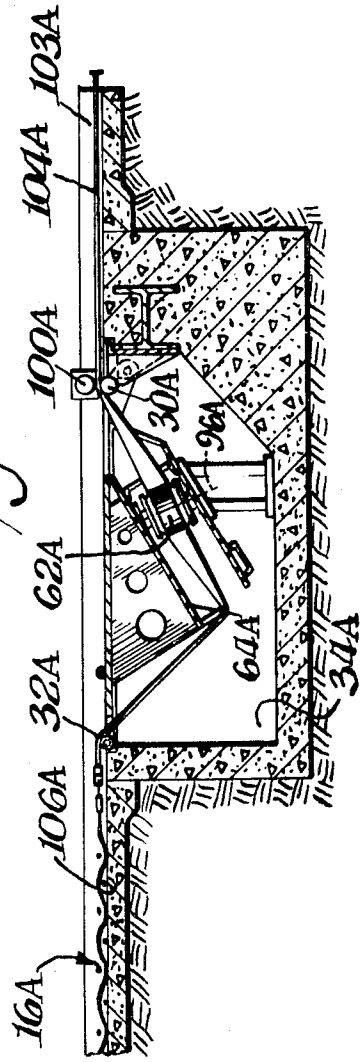

18A
102A
103A
104A
100A
10A
30A
96A
62A
64A
32A
34A
14A
106A
98A
16A

Fig. 9.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RUNWAY SHEAVE ASSEMBLY FOR AIRCRAFT-ARRESTING GEAR

BACKGROUND OF THE INVENTION

This invention relates to a pit-mounted runway sheave assembly for an aircraft arresting gear and it more particularly relates to an automatically raised device. Sheave assemblies are mounted alongside airport runway to guide and restrain the linear payout element of aircraft-arresting gear during an arrestment. Intermediate cross runway elements are bidirectional and require a pair of sheaves, whereas terminal runway units are unidirectional and only require a single sheave. Since the sheaves are mounted close to or on the edge of the runway, they must not create an above-ground obstruction in the path of aircraft or personnel. U.S. Pat. No. 3,182,935 shows an arrangement for holding a runway sheave assembly down in a depression until the aircraft-arresting gear is actuated. It utilizes a lifting motor, thus complicating the device and its control and making it subject to malfunction.

An object of this invention is to provide a pit-mounted runway sheave assembly which is simple, rugged and dependable in operation.

SUMMARY

The sheave or pair of sheaves are mounted beneath a hinged cover assembly disposed within a pit prior to activation. The linear payout element is deflected into a deep bend under the cover assembly by a knee element in line with the sheave. The cover assembly is releasably locked in a closed position to permit the payout element to be pretensioned a predetermined amount without raising the cover assembly. The substantially deep bend creates an upwardly directed component of force in response to tensioning of the payout element, which is sufficient during the initial phase of arrestment to exceed the predetermined upward force for releasing the lock. This quickly elevates the cover assembly in response to the resultantly strong tensioning of the payout element. A latch holds the cover assembly and its sheave and payout element elevated above ground level during arrestment of the aircraft to facilitate their action. The payout element on both sides of the sheave assembly may be disposed above ground level and fairleads and suitable slots are provided for smoothly guiding the payout element under and through the cover assembly.

The cover assembly is efficiently fabricated from a cover plate and a lower plate disposed at an acute angle below it and which are connected adjacent the hinge. The sheave is mounted between an inner plate spaced above and parallel to the lower plate, and the knee element extends downwardly from the edge of the inner plate remote from the hinge. An advantageous form of cover assembly is a truncated V-shape in plan with its narrow end adjacent the runway and its hinge at the wider opposite end. The cover and inner plates are spaced apart by angular channels disposed parallel to the sides of the assembly, and a slotted cross channel is secured between the inner and lower plates. A striker bar for the latch is conveniently comprised of the extended web of a lateral channel mounted beneath the narrower end of the cover assembly, which engages the latches on catch plates secured to the walls of the pit. These catch plates may also include shear pin retainers for locking the cover assembly down in the closed position.

BRIEF DESCRIPTION OF THE DRAWING

Novel features and advantages of the present invention will become apparent to one skilled in the art from a reading of the following description in conjunction with the accompanying drawing wherein similar reference characters refer to similar parts and in which:

FIG. 1 is a three-dimensional pictorial view of an embodiment of this invention in the raised position during an arrestment of a landing aircraft;

FIG. 2 is a partial three-dimensional view of the embodiment shown in FIG. 1 in the closed lowered position;

FIG. 3 is a plan view partially broken away of the embodiment shown in FIGS. 1 and 2;

FIG. 4 is a cross-sectional view taken through FIG. 3 along the line 4—4;

FIG. 5 is a cross-sectional view in elevation of the embodiment shown in FIGS. 1, 3 and 4 in the raised position;

FIG. 6 is a cross-sectional view taken through FIG. 5 along the line 6—6;

FIG. 7 is a cross-sectional view taken through FIG. 5 along the line 7—7;

FIG. 8 is a cross-sectional view of another embodiment of this invention in the raised activated position; and

FIG. 9 is a cross-sectional view in elevation of the embodiment shown in FIG. 8 in the closed lowered position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1 is shown a pair of pit-mounted runway sheave assemblies **10** for an aircraft-arresting gear **12** having a linear payout element **14** connecting a cross runway element **16** with energy absorber **18**. Cross runway pendant **16** is, for example, steel cable or a nylon rope as described in U.S. Pat. No. 3,456,908. Linear payout element **14** is, for example, nylon tape or steel cable as described in U.S. Pat. No. 3,467,347. Energy absorber **18** is, for example, of the type described in U.S. Pat. No. 3,172,625, which also describes a nylon tape suitable for use as linear payout element **14**. Tape **14** is connected to cross runway pendant **16** by connector **20**.

Hook **22** on aircraft **24** engages pendant **16** during the arrestment shown in FIG. 1. Hook **22** is, for example, of the type shown in U.S. Pat. No. 2,989,272. This arrestment raises sheave assembly **10** from the closed lower position shown in FIG. 2 to the raised position shown in FIG. 1 as later described in detail.

FIGS. 3 and 4 show sheave assembly **10** in the lowered position in which the portions of tape **14** at the entrance end **26** and exit end **28** are disposed flat to the ground in contact with entrance fair-lead **30** and exit fair-lead **32** mounted at the corresponding edges of pit **34** through slots **108** and **110**. The sheave assembly is mainly comprised of a cover assembly **36** which is a truncated V-shape in plan with its narrower end **38** disposed adjacent the runway and its wider end **40** oppositely disposed and rotatably connected to the corresponding entrance wall **42** of pit **34** by hinge **44** secured to wall **42** by anchoring beam **46**. Hinge **44** includes a pair of hinge arms **48** connected to the wider end **40** of cover assembly **36**.

Cover assembly **36** includes a cover plate **50** and an angularly disposed lower plate **52**. An inner plate **54** is spaced below cover plate **50** by a pair of angular channels **56** disposed substantially parallel to the sides of the narrow end **38** of cover plate **50** as shown in FIG. 3. Inner plate **54** is spaced parallel and above lower plate **52** by slotted cross channel **58** having a central slot **60** to provide a path for tape **14**. A pair of sheaves **62** are rotatably mounted between inner plate **54** and lower plate **52** and tape **14** passes between them thus making sheave assembly **10** bidirectional in action. As shown in FIGS. **3** and **4**, the portion of tape **14** between entrance section **26** and sheaves **62** is twisted approximately 90°.

A knee element **64** is mounted below cover assembly **36** remote from hinge **44**. Tape **14** is thus deflected in a deep bend within pit **34** as shown in FIG. **4**. The portion of tape **14** between sheaves **62** and knee **64** is twisted in an additional 90° to make tape **14** twist approximately 180° from entrance fair-lead **30** to knee **64** and exit fair-lead **32**.

Striker channel **66** is mounted under the end of lower plate **52** remote from hinge **44**. It includes web extensions **68** shown in FIG. **7** which engage latches **70** secured to catch plates **72** mounted at the narrow end of pit **34** and connected to frame **74** about the perimeter of pit **34**. The action of latches **70** is later described in detail in conjunction with FIGS. **5** and **6**. A pair of releasable locks provided by shear pin assemblies **76** connects the narrow end **38** of cover plate **50** to catch plates **72** to releasably lock it in a closed position. This permits tape

14 to be pretensioned a predetermined amount without raising cover assembly 10. Shearable assemblies 76 include shear pin retainers 78, catch plates 72 and shear pins 80 which engage over the narrow end of cover plate 50. The rewind motor 82 in energy absorber 18 is actuated to pretension tape 14, for example, about 1,500 lbs. to hold cross runway pendant 16 straight across runway 84 in position for engaging landing aircraft 24. Shear pins 80 are designed to hold cover assembly 36 in the closed position against this pretensioning load.

FIGS. 5–7 show the condition of sheave assembly 10 in the raised position of FIG. 1. The substantially deep bend of tape 14 shown in FIG. 4 below cover assembly 36 creates an upwardly directed component of force along tape section 86 between knee 64 and exit fair-lead 32. This upwardly directed component of force designated by arrow 88 is sufficient during the initial phase of arrestment shown in FIG. 1 to exceed the breaking strength of shear pins 80 and thus raise cover assembly 36 in response to the resultantly strong tensioning of tape 14 by the initial shock of engagement of aircraft 24 with pendant 16. This strong shock forcibly rotates cover assembly 36 upwardly from pedestal 89 at the bottom of pit 34 into the raised position shown in FIGS. 5–7. Web extensions 68 of striker channel 66 engage latch 70 to hold cover assembly 36 in the raised position. This positions sheaves 62 above the ground to allow tape 14 to untwist and assume the substantial vertical untwisted condition shown in FIGS. 1, 5 and 6 to facilitate its smooth arresting action. The upward movement of web extension 68 is smoothly buffed by resilient pads 90 beneath catch plates 72.

Additional structural features of sheave assembly 10 include frame 74 within which cover plate 50 nests in the lowered position shown in FIGS. 2–4 to allow it to smoothly traverse aircraft wheels over it. Inner plate 54 also includes a pair of lateral extensions 92 secured under the hinged portion of cover plate 50. FIG. 6 shows vertical slot 94 in knee 64. It provides a path for tape 24 when cover assembly 36 is in the raised position shown in FIGS. 5 and 6.

FIGS. 8 and 9 show runway sheave assembly 10A which is adapted for use with a cross runway net 16A instead of cross runway pendant 16X. The axis of rotation 96A of sheaves 62A is thus inclined at an oblique angle to the ground 98A to incline tape 14A for direct connection to the end of net 16A. A restraining and deflecting roller 100A is mounted between roller 96A and energy absorber 18A to prevent tape 14A from being lifted above the line of action of sheave 62A during arrestment. Only one sheave 62A is provided because nets, such as 16A, are normally mounted at the terminal ends of the runway and only unidirectional action need be provided.

Another feature of runway sheave assembly 62A and its associated net 16A and energy absorber 18A is their complete underground installation. Energy absorber 18A is mounted in pit 102A and with a substantial horizontal axis of rotation to provide an untwisted section 104A of tape 14A from energy absorber 18A to horizontal roller 100A. Horizontal roller 100A cooperates with entrance fair-lead 30A to confine tape 14A between them.

As shown in FIG. 9, tape 14A from knee 64A is guided through covered trough 103A over entrance fair-lead 32A to net 16A which is stored in the unactivated condition within a cross runway trough 106A. A net installation of such type is, for example, described in U.S. Pat. No. 3,058,703. The entire installation is thus maintained below ground level and out of the path of personnel and aircraft prior to activation. This below ground installation is shown in conjunction with a terminal runway system, but is even more advantageous in an intermediate runway position, which is more subject to aircraft and personnel ground traffic. The canted position of sheave 62A shown in FIG. 8 provides a direct efficient line of action therebetween and prevents rubbing of the edge of 14A on flanges (not shown) which might be provided on sheave 62A. Such edge rubbing has been the source of extensive friction and wear.

OPERATION

Prior to actuation, sheave assembly 10 is in the lowered closed position shown in FIG. 2. The pretensioning of tape 14 causes portion 26 entering sheave assembly 10 and portion 28 leaving sheave assembly 10 to lie flat against the ground. This maintains cover plate 50 and runway pendant 16 in firm smooth contact with the ground to prevent them from interfering with personnel and aircraft traffic.

Landing aircraft 24 shown in FIG. 1 engages pendant 16 by hook 22 and exerts a strong tensioning force on pendant 16 and connected tape 14. The locking action of shear pins 80 first prevents cover assembly 36 from rising and holds it in a lowered position shown in FIGS. 2–4, until the breaking strength of shear pins 80 is exceeded. Then, a strong component of force illustrated by arrow 88 in FIG. 4 reacts upwardly against knee 64 which snaps cover assembly 36 up to the raised position shown in FIGS. 5 and 6. Tape 14 untwists from the 180° bend of the lowered position in FIGS. 2–4 to assume the vertical untwisted position of FIGS. 1, 5 and 6. Slot 94 in the center of knee 64 provides an unimpeded path for tape 14 in the activated position.

Bumper pads 90 smoothly arrest the upward movement of cover assembly 36 by stopping the upward movement of web extensions 68 on striker channel 66. Webs 68 also engage over latches 70 to hold cover assembly 36 in the raised position during arrestment and rewind.

After rewind, latches 70 are released to drop cover assemblies 36 back into pit 34 and onto pedestal 89. Cover plate 50 then nests within frame 74 to smoothly align itself with the ground. Tape 14 reassumes the twisted condition shown in FIGS. 2–4 and passes through cover plate 50 through entrance slot 108 and exit slot 110 in flat contact with entrance fair-lead 30 and exit fair-lead 32. Slot 60 in cross channel 58 provides the path for tape 14 to sheaves 62. Tape 14 passes under knee 64 before engaging exit fair-lead 32.

The action of sheave assembly 10A in FIGS. 8–9 is similar to that previously described with the exception of the use of single sheave 62A, the connection to net 16A, the advantageous inclination of sheave 62A and the complete below-ground installation of the system. Also as shown in FIGS. 8 and 9, no twist ever occurs in the portion 104A of tape 14A between energy absorber 18A and opposed deflecting roller 100A and fair-lead 30A.

I claim:

1. A pit-mounted runway sheave assembly for an aircraft arresting gear having a linear payout element connecting a cross runway element with an energy absorber comprising a cover assembly, horizontal hinge means connecting said cover assembly to a side of said pit to provide raising and closing movement thereof, a knee element mounted beneath said cover assembly remote from said hinge means and extending downwardly below it, rotatable sheave means mounted beneath said cover assembly between said knee element and said hinge means, said knee element being long enough to indent said linear payout element downwardly into a substantially deep bend into said pit, locking means which is releasable at a predetermined upward force securing said cover assembly to a wall of said pit when said cover assembly is down in the closed position whereby said linear payout element may be pretensioned a predetermined amount without raising said cover assembly, said substantially deep bend creating an upwardly directed component of force in response to tensioning of said payout element which is sufficient during the initial phase of arrestment to exceed said predetermined upward force for releasing said locking means whereby said cover assembly is allowed to rise in response to the resultantly strong tensioning of said payout element and latching means reacting between said cover assembly and a wall of said pit for holding said cover assembly in said raised position whereby said sheave means and said payout element are elevated above ground level during said arrestment to facilitate their action.

2. A runway sheave assembly as set forth in claim 1, wherein said linear payout element connected to each end of said runway sheave assembly is disposed above ground level, and fairleads are disposed at the entrance and exit edges of said pit whereby said linear payout element is smoothly guided into and out of said pit.

3. A runway sheave assembly as set forth in claim 1, wherein said cover assembly comprises a cover plate and a lower plate disposed at an acute angle relative to each other and connected adjacent said hinge means, an inner plate disposed between said cover and lower plates and substantially parallel and spaced from said lower plate, said sheave means being rotatably mounted between said inner and said lower plates, and said knee element extending downwardly from the edge of said inner plate remote from said hinge means.

4. A runway sheave assembly as set forth in claim 3, wherein the lower edge of said knee element is centrally slotted to receive said linear payout element.

5. A runway sheave assembly as set forth in claim 4, wherein said linear payout element comprises a linear tape disposed in contact with the lower edge of said knee element and the side of said sheave, said lower edge of said knee element being substantially horizontally disposed, and the side of said sheave means being substantially vertically disposed whereby said tape is twisted about 90° between said sheave means and said knee element.

6. A runway sheave assembly as set forth in claim 5, wherein said tape on both sides of said sheave assembly is disposed above the ground, entrance and exit fairleads are disposed at the entrance and exit edges of said pit for smoothly guiding said above ground portion of said tape which are substantially flat with said ground when said cover assembly is in the lowered position, and said tape being twisted through an additional 90° between said sheave means and said entrance fairlead.

7. A runway sheave assembly as set forth in claim 1, wherein said sheave means comprises a pair of sheaves and said linear payout element is disposed between said pair of sheaves to make said sheave assembly bidirectional in action.

8. A runway sheave assembly as set forth in claim 1, wherein said locking means comprises shearable means.

9. A runway sheave assembly as set forth in claim 1, wherein said latching means comprises a resilient latch mounted on said wall of said pit and a striker bar mounted upon a lower portion of said cover assembly for engaging said resilient latch.

10. A runway sheave assembly as set forth in claim 2, wherein slots are provided through said cover assembly adjacent said entrance and exit edges of said pit to provide a path for said linear payout element to said sheave means and said knee element.

11. A runway sheave assembly as set forth in claim 1, wherein a pedestal is provided in said pit to help support said cover assembly within said pit in said lowered position.

12. A runway sheave assembly as set forth in claim 3, wherein intermediate angular brace is disposed between said cover and said inner plate and a slotted cross brace is disposed between said inner and said lower plates.

13. A runway sheave assembly as set forth in claim 12, wherein said inner plate includes a pair of lateral extensions connected below said cover plate.

14. A runway sheave assembly as set forth in claim 1, wherein said cover assembly is substantially a truncated V-shape in plan having its narrower end disposed adjacent said runway and said hinge means disposed at its wider end.

15. A runway sheave assembly as set forth in claim 14, wherein said cover assembly comprises a cover plate and a lower plate disposed at an acute angle relative to each other and connected adjacent said hinge means, an inner plate disposed between said cover and lower plates and substantially parallel and spaced from said lower plate, said sheave means being rotatably mounted between said inner and said lower plates, and said knee element extending downwardly from the edge of said inner plate remote from said hinge means.

16. A runway sheave assembly as set forth in claim 15, wherein a pair of angular channel braces are mounted between said cover and said inner plates and substantially parallel to the sides of said truncated V-shaped cover assembly.

17. A runway sheave assembly as set forth in claim 16, wherein a cross brace comprising a centrally slotted channel is laterally secured between said inner and said lower plates, and said central slot providing a path for said linear payout element through said cover assembly.

18. A runway sheave assembly as set forth in claim 17, wherein the lower edge of said knee element is slotted to provide a path for said linear payout element.

19. A runway sheave assembly as set forth in claim 18, wherein said tape on both sides of said sheave assembly is disposed above the ground, entrance and exit fairleads are disposed at the entrance and exit edges of said pit for smoothly guiding said above-ground portions of said tape which are substantially flat with said ground when said cover assembly is in the lowered position, said tape being twisted about 90° between said sheave means and said knee element, said tape being twisted through an additional 90° between said sheave means and said entrance fair-lead and slots being disposed in the entrance and exit edges of said cover plate adjacent said fairleads to provide a path for said tape when said sheave assembly is in the closed position.

20. A runway sheave assembly as set forth in claim 19, wherein said sheave means comprises a pair of sheaves and said tape is disposed between said pair of sheaves.

21. A runway sheave assembly as set forth in claim 1, wherein said locking and latching means are mounted on a pair of catch plates mounted on the walls of said pit remote from said hinge means, said locking means comprising shear pin means and shear pin receiving means in said catch plates and on the upper portion of said cover assembly adjacent said plates when said assembly is in closed position and said latch means comprising latches mounted upon said catch plates and striker bars on a lower portion of said cover assembly for engaging said latches when said cover assembly is in said raised position.

22. A runway sheave assembly as set forth in claim 21, wherein said cover assembly is a truncated V-shape in plan and said catch plates are disposed adjacent the narrower end of said V-shaped assembly remote from said hinge means.

23. A runway sheave assembly as set forth in claim 1, wherein the axis of rotation of said sheave means is disposed at an oblique angle relative to the ground when said assembly is in the raised position whereby the line of action of said linear payout element is inclined to the ground to facilitate connection to an elevated cross runway element, and a substantially horizontally disposed restraining deflector is disposed above said linear payout element between said energy absorber and said sheave means for restraining upward movement of said linear payout element.

24. A runway sheave assembly as set forth in claim 23 wherein said energy absorber and said cross runway element are also disposed in pits connected to said pit for said cover assembly whereby the entire installation is disposed below the ground.

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