Dec. 2, 1969 C. L. E. MARCHERON 3,481,565

AIRCRAFT ARRESTING GEAR

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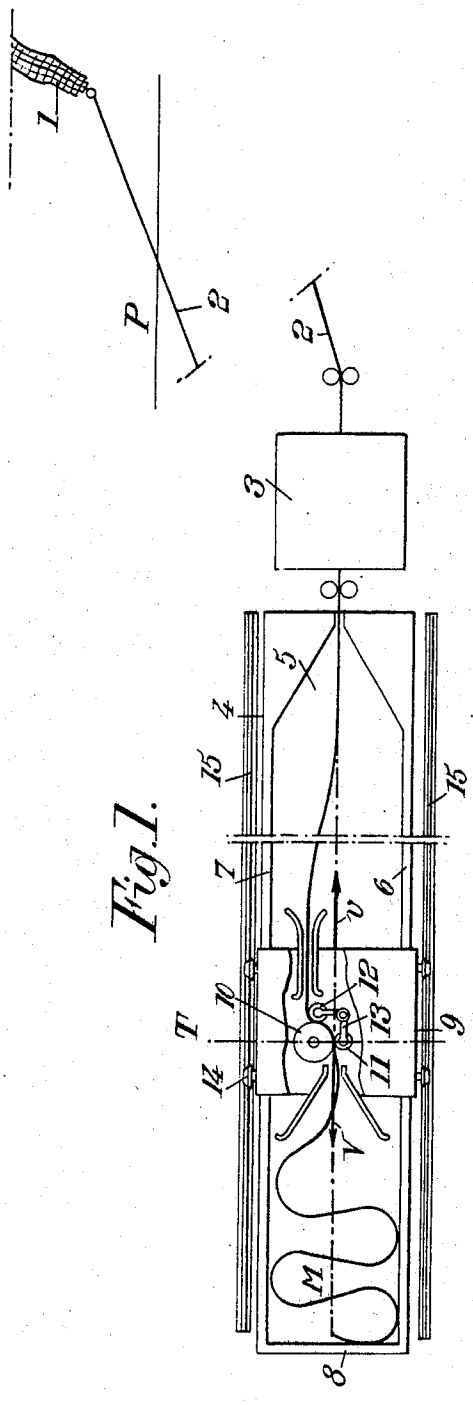


Fig. 1.

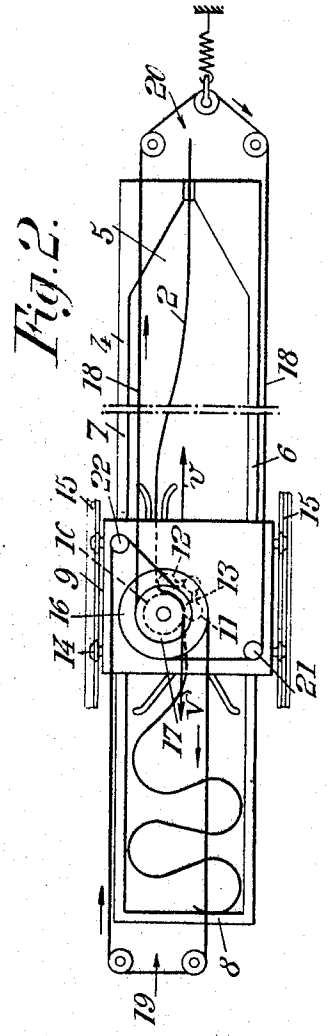


Fig. 2.

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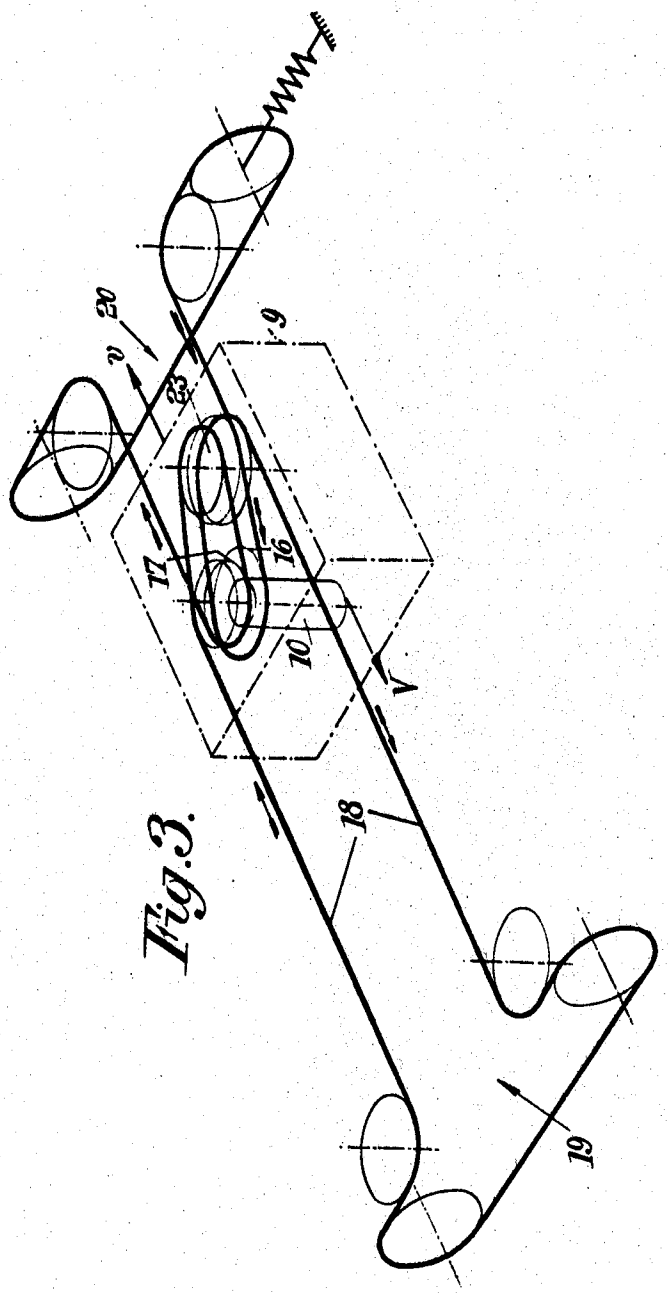


Fig. 3.

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AIRCRAFT ARRESTING GEAR

Claude Louis Edouard Marcheron, Montrouge, France, assignor to Societe d'Exploitation des Materiels Hispano-Suiza, Bois-Colombes, France

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Int. Cl. B64f 1/02
U.S. Cl. 244—110 8 Claims

ABSTRACT OF THE DISCLOSURE

The arresting gear comprises an artificial obstacle held by a holding strap which is braked by a braking device. Folding means are provided for folding the strap, upstream of the braking device, in an elongated magazine having two lateral walls and an end wall. These folding means comprise a carriage adapted to deliver the strap towards this end wall with a particular distribution speed, and the carriage is moved away from this end wall with a recoil speed less than the distribution speed.

The present invention relates to aircraft arresting gear comprising an artificial obstacle secured to at least one holding strap—that is to say a flexible bend having a thickness substantially smaller than its width—subjected to the action of a braking device. The holding strap has characteristics of flexibility in the longitudinal direction and characteristics of rigidity in the transverse direction so that it can be folded in a systematic manner along practically all of its part situated upstream of the braking device, this folded part of the strap being called hereafter "upstream part." The upstream part rests by its lower edge on a plane support, which permits the progressive unfolding of this upstream part before it passes into the braking device. The invention concerns more particularly, but not exclusively, aircraft arresting gears for arresting, at the end of the runway, aircraft in difficulty, such apparatus being called hereafter "barrier arresting gear for aviation runways."

It is known that such a strap can be folded in a natural manner in a configuration having the form of successive loops more or less close together, without any internal stresses in the strap which would tend to render the upstream part of the strap unstable, such an instability risking premature unfolding.

An object of the present invention is to provide improved apparatus of this type which responds better than in the past to the various considerations of practice, and another object of the invention is to take advantage of the property of straps mentioned hereabove in order to construct means for folding the upstream part of the strap.

It has already been proposed in aircraft arresting gears of the type mentioned above to provide an elongated box for housing the upstream part of the strap, this box being called hereafter "magazine." The magazine was of parallelepiped shape and was disposed horizontally (approximatively at least), and its bottom constituted the plane support on which the lower edge of the upstream part rested. The separation of the two lateral walls of this mechanism corresponded to the width of the upstream part, and the magazine was provided, at one of its ends, with a plate forming a stop.

The principal feature of the present invention is characterized by the fact that the means for folding the strap in such a magazine comprise a distributor carriage adapted to deliver the strap with a speed V, called "distribution speed," in the direction of the stop plate and in the median longitudinal plane of the magazine (approximately at least), the distributor carriage being subjected to the action of a motor mechanism adapted to impose a recoil movement on the distributor carriage moving this distributor carriage away from the stop plate with a speed v, called "recoil speed," lower than the distribution speed V, whereby the strap is folded in the magazine according to a configuration having the form of successive loops bearing alternately on one and the other of the two lateral walls, the spacing of the loops depending on the ratio between the distribution speed V and the recoil speed v.

Other features of the present invention will become obvious from the following specific description, given merely by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 is a schematic view from above of an aircraft arresting gear arranged according to the invention;

FIGURE 2 is a partial schematic view from above of a particular embodiment of the arresting gear represented in FIGURE 1; and

FIGURE 3 is a schematic view in perspective illustrating a variation of the arresting gear represented in FIGURE 2.

Dealing first of all with the arresting barrier **1** proper, to be used in this arresting gear, this barrier **1** can be formed in any appropriate manner, for example by using a cable or better still, as shown in FIG. 1, a net.

In any case, when an aircraft engages the arresting barrier **1**, this barrier pulls at least one strap **2** subjected to the action of a braking device **3**, mounted at a fixed post and preferably actuated hydraulically. The strap **2** comprises a flexible band having a thickness substantially smaller than its width, and having in addition characteristics of flexibility in the longitudinal direction and characteristics of rigidity in the transverse direction. Generally two such straps are provided, these straps being secured respectively to the two ends of the arresting barrier **1**, these two straps being symmetrically disposed about the axis of symmetry of the aviation runway P in question. (In FIGURE 1 only one of these two straps **2** has been shown, because this symmetrical arrangement renders it superfluous to show the other strap.)

This strap **2** can then be folded in a systematic manner at its upstream part and it then rests by its lower edge, on a plane support. Such a folded configuration permits the progressive unfolding of the strap **2** before it passes into the braking device **3**.

In order to house the upstream part of the belt **2**, a magazine **4** of parallelepiped shape is provided, this magazine being disposed horizontally (approximately at least). The bottom **5** of the magazine forms the plane support on which the lower edge of the upstream part rests. The spacing of the two lateral walls **6** and **7** of this magazine **4** correspond to the width of the upstream part. The magazine **4** is provided, at one of its ends, with a stop plate **8**.

In accordance with the principal feature of the invention, the means for folding the strap **2** in the magazine **4** comprise a distributor carriage **9** adapted to deliver the band **2** with a distribution speed V in the direction of the stop plate **8** and in the longitudinal median plane M of the magazine **4** (approximately at least), the distributor carriage **9** being subjected to the action of a motor mechanism adapted to impose on it a recoil movement moving it away from said stop plate **8** with a recoil speed v lower than the distribution speed V.

It can then be seen that the strap **2** will be folded in the magazine **4** in a configuration having the form of successive loops bearing alternately on one and the other of the two lateral walls **6** and **7**, and the separation of these successive loops will depend on the ratio k between the distribution speed V and the recoil speed v.

Thus, a configuration in the form of successive loops which are either contiguous or not can be obtained according to the value of the ratio k. In the case in which the successive loops are not contiguous, it is even possible to compress the folded part of the strap, taking into account the characteristics of flexibility in the longitudinal direction of the strap in question.

Before examining in more detail other features of the invention, it is appropriate to indicate that the strap **2** that is to be folded in the magazine **4** can be either unfolded along practically all its length, which is the case after each engagement of an aircraft in the barrier **1** (case shown in FIGURE 1), or disposed in a reserve, for example in the form of one or several rolls, this reserve being then carried by the distributor carriage for example (case not shown).

As shown in FIGURE 1, the distributor carriage **9** is advantageously provided with a roller distribution apparatus arranged so that, under the action of a motor of an appropriate type, this distributor apparatus delivers the strap **2** at a distribution speed V.

Such a distribution apparatus then comprises, a driving roller **10**, driven by the motor of the apparatus, the axial dimension of this roller **10** being preferably at least equal to the height of the strap **2**, and a pressure roller **11** advantageously disposed in the same transverse plane T as the driving roller **10**, the strap **2** being nipped between these two rollers **10** and **11**, the axial dimention of the pressure roller **11** being also preferably at least equal to the height of the strap **2**.

This distribution apparatus is completed by a feeler roller **12**, of the same axial dimension as the driving and pressure rollers **10** and **11**, mounted at one of the ends of a pivotable bell crank lever **13** whose other end carries the pressure roller **11**. The form of this pivotable bell crank lever **13** is such that, on the one hand, the strap **2** is maintained in contact with the driving roller **10** on a sector of large angular extent (for example 90°), and on the other hand, the pressure force exerted by the pressure roller **11** on the strap **2** is greater as the force necessary to bring back towards the distributor carriage **9** the unfolded fraction of the strap is greater, i.e. as the reaction of the unfolded fraction of the strap **2** on the feeler roller **12** is greater, thereby pivoting the bell crank lever **13** harder and urging the pressure roller **11** harder against the driving roller **10**.

As for the motor mechanism for imposing on the distributor carriage **9** a recoil movement moving the carriage away from the stop plate **8** with a recoil speed v, it can be formed in any appropriate manner on the condition that the recoil speed v is less than the distribution speed V, the ratio k between the distribution speed V and the recoil speed v being preferably constant if it is desired that the folding of the strap **2** in the magazine **4** is effected in a regular manner, that is to say according to a configuration in the form of successive loops whose separation is constant.

Thus this motor mechanism can be carried by the distributor carriage **9** which is then provided with wheels **14** guided by rails **15**, at least one of these wheels **14** being a driving wheel. A synchronization device connects this motor mechanism to the motor for driving the driving roller **10**.

Alternatively, a single motor can be provided, carried by the distributor carriage **9** equipped with its wheels **14**, this single motor assuring, by the intermediary of a motion transmission device, on the one hand, the driving of the driving roller **10** and on the other hand the recoil movement of the distributor carriage **9**.

Although the embodiment described above can be used, it seems preferable, to avoid having a distributor carriage **9** which is too cumbersome, to use the embodiment illustrated in FIGURE 2 in which the same reference characters designate the same members as in FIGURE 1.

According to this embodiment, the motor mechanism assuring the recoil movement of the distributor carriage **9** comprises a distance transmission having an endless tie, and the motor mechanism is arranged to drive the driving roller **10** as well.

For this purpose, as shown in FIGURE 2, two pulleys of different diameters, namely a first pulley **16** of diameter D_1 and a second pulley **17** of diameter D_2 smaller than the diameter D_1, are angularly fixed to the shaft of the driving roller **10** (or to a shaft driving the driving roller **10**). The pulley **16** will be called hereafter "large pulley," and the pulley **17** will be called "small pulley."

A distance transmission is then provided comprising principally an endless tie **18** (cable, chain, etc.) traveling under the action of driving means between two groups of pulleys **19** and **20** situated respectively at the two ends of the magazine **4**. The endless tie **18** co-operates without sliding with the large pulley **16** and the small pulley **17**, the strand of this endless tie traveling in the direction of the distribution speed V of the strap **2** co-operating with the large pulley **16**, whereas the strand of this endless tie **18** traveling in the direction of the recoil speed v of the distribution carriage **9** co-operates with the small pulley **17**.

Under these conditions, if the unit formed of the driving roller **10**, the large pulley **16** and the small pulley **17** turns through an angle α, the advance x_1, with respect to the distributor carriage **9**, of the strand of the endless tie **18** co-operating with the large pulley **16** will be:

$$x_1 = \frac{1}{2}\alpha D_1$$

and the recoil x_2, with respect to the distributor carriage **9**, of the strand of the endless tie **18** co-operating with the small pulley **17** will be:

$$x_2 = \frac{1}{2}\alpha D_2$$

The distributor carriage **9** will then have completed a recoil movement whose value X is equal to the algebraic mean:

$$\frac{x_1 + (-x_2)}{2}$$

namely:

$$X = \frac{1}{2}(x_1 - x_2) = \frac{\alpha(D_1 - D_2)}{4}$$

If d designates the diameter of the driving roller **10**, the length x of the strap delivered by a rotation of the above mentioned unit through the angle α will be:

$$x = \frac{1}{2}\alpha d$$

The ratio k between the distribution speed V and the recoil speed v is then equal to

$$\frac{V}{v} = \frac{x}{X} = k$$

namely:

$$k = \frac{x}{X} = \frac{\alpha d/2}{\alpha(D_1 - D_2)/4} = \frac{2d}{D_1 - D_2}$$

The driving means actuating the endless tie **18** can be formed by an appropriate motor driving one or more pulleys of the two groups of pulleys **19** and/or **20**. As shown in FIGURE 2, one or more of these pulleys can assure the tension of the endless tie **18**.

In order to increase the sector of contact between the endless tie **18**, the large pulley **16** and the small pulley **17**, two idler pulleys **21** and **22** are mounted freely on the distributor carriage **9** and co-operate respectively, with the strand of the endless tie **18** traveling in the direction of the distribution speed V, and with the strand

of the endless tie **18** traveling in the direction of the recoil speed *v*.

In an alternative embodiment shown in FIGURE 3 (in which the same reference characters designate the same members as in FIGURE 2), also to increase the sector of contact between the endless tie **18**, the large pulley **16** and the small pulley **17**, a single idler pulley **23** can be freely mounted on the distributor carriage **9**. This idler pulley **23** is provided with three grooves, namely: two grooves co-operating with the strand of the endless tie **18** traveling in the direction of the distribution speed V, the diameter of each of these grooves being equal to the diameter D_1 of the large pulley **16**, and a groove co-operating with the strand of the endless tie **18** traveling in the direction of the recoil speed *v*, the diameter of this groove being equal to the diameter D_2 of the small pulley **17**.

Under these conditions, it is advantageous to provide the small pulley **17** with a supplementary groove intended to co-operate with the strand of the endless tie **18** traveling in the direction of the recoil speed *v*.

The invention thus provides aircraft arresting gear for aviation runways in which the means for folding the part of the strap situated upstream of the braking device are very simple, of sure operation, and permit of rapidly folding this upstream part.

Although various embodiments of the persent invention have been specifically described, the invention is not limited thereto, as there could be various modifications made without departing from the spirit or scope of the invention.

What I claim is:

1. In an arresting gear for vehicles running along the ground, comprising:

an artificial obstacle adapted to be engaged by a vehicle for arresting it,

at least one holding strap secured to said artificial obstacle, said strap having a thickness substantially smaller than its width, and having characteristics of flexibility in the longitudinal direction and characteristics of rigidity in the transverse direction whereby said strap can be folded in a systematic manner,

a braking device for said strap which passes through said braking device, said braking device being stationary with respect to the ground,

a magazine in the form of an elongated box for housing the portion of said strap that is upstream—with respect to the direction of translation of said holding strap when said vehicle is being arrested by said obstacle—of said braking device, said magazine having a substantially horizontal bottom on which said upstream portion of said strap can rest along its lower edge, and said magazine having two substantially parallel lateral walls and an end plate forming a stop;

the improvement which comprises folding means for folding said strap in said magazine, said folding means comprising:

a distributor carriage adapted to deliver said strap with a particular distribution speed in the direction of said end plate and along a plane which is substantially the longitudinal median plane of said magazine,

and a motor mechanism acting on said distributor carriage for moving said distributor carriage away from said end plate with a recoil speed which is less than said distribution speed, whereby to fold said strap in said magazine in the form of successive loops bearing alternately on one and on the other of said two lateral walls, the spacing between said successive loops being a function of the ratio between said distribution speed and said recoil speed.

2. Arresting gear according to claim **1**, in which said distributor carriage is provided with a roller distribution apparatus adapted to deliver the strap at said distribution speed.

3. Arresting gear according to claim **2**, in which said distribution apparatus comprises a driving roller whose axial dimension is at least equal to the height of the strap, and a pressure roller disposed in the same transverse plane as the driving roller, the strap being nipped between said driving roller and said pressure roller, the axial dimension of said pressure roller being at least equal to the height of the strap.

4. Arresting gear according to claim **3**, in which said distribution apparatus comprises in addition a feeler roller, of the same axial dimension as said driving and pressure rollers, mounted at one of the ends of a pivotable bell crank lever whose other end carries said pressure roller, the form of said pivotable bell crank lever being such that, on the one hand said strap is maintained in contact with said driving roller on a sector of considerable angular extent, and on the other hand the pressure exerted by said pressure roller on said strap is greater as the force necessary to bring back said strap is greater.

5. Arresting gear according to claim **3**, in which said motor mechanism is carried by said distributor carriage, and said distributor carriage is provided with wheels guided by rails, at least one of said wheels being a driving wheel, and a synchronization device being provided for connecting said motor mechanism to a motor driving said driving roller.

6. Arresting gear according to claim **3**, in which said distributor carriage carries a single motor adapted, by the intermediary of a motion transmission device, on the one hand to drive said driving roller, and on the other hand to produce the recoil movement of the distributor carriage, said distributor carriage being provided with wheels guided by rails, at least one of said wheels being a driving wheel.

7. Arresting gear according to claim **3**, in which said motor mechanism comprises a distance transmission acting by means of an endless tie, said motor mechanism being adapted to drive said driving roller.

8. Arresting gear according to claim **7**, in which said driving roller is rigid in rotation with two pulleys, of different diameter, namely a first pulley and a second pulley whose diameter is less than that of said first pulley, said distance transmission comprising principally an endless tie traveling under the action of motor means between two groups of pulleys situated respectively at the ends of said magazine, said endless tie being adapted to co-operate without sliding with said first pulley and with said second pulley, the strand of said endless tie traveling in the direction of the distribution speed co-operating with said first pulley, whereas the strand of said endless tie traveling in the direction of the recoil speed co-operates with said second pulley.

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MILTON BUCHLER, Primary Examiner

P. E. SAUBERER, Assistant Examiner

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