March 28, 1961 R. B. COTTON ET AL 2,977,074

OVER-RUN SPRING TYPE BARRIERS

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Fig. 1.

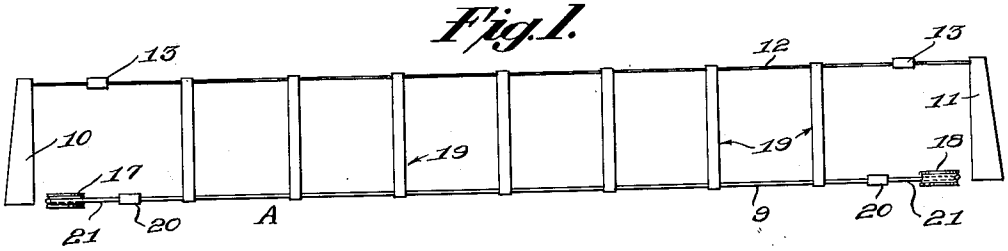


Fig. 4. Fig. 5.

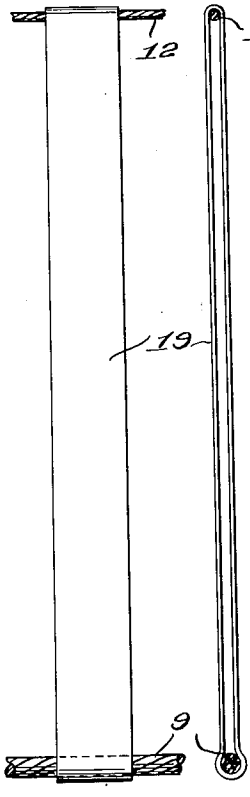


Fig. 6.

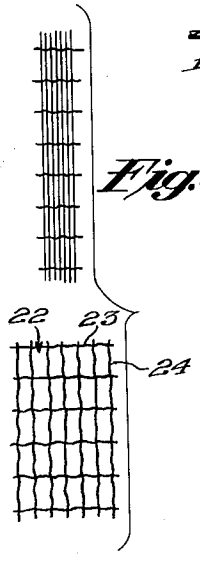
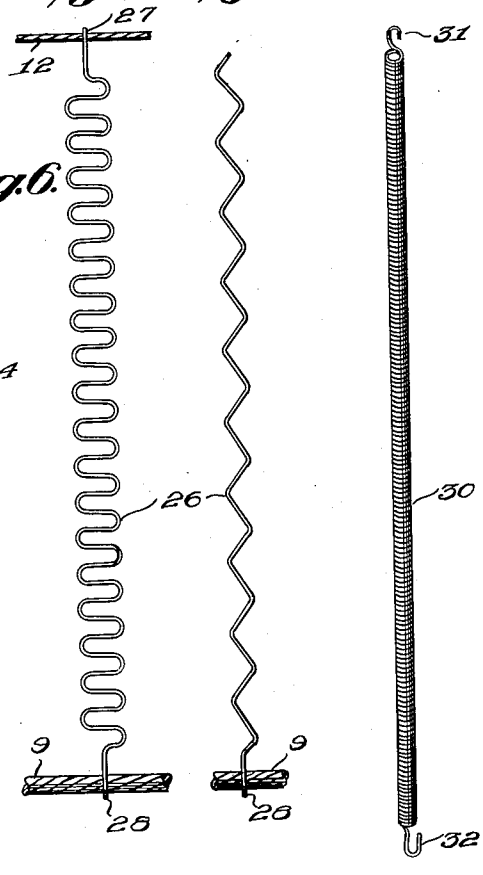


Fig. 7. Fig. 8. Fig 9.



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OVER-RUN SPRING TYPE BARRIERS

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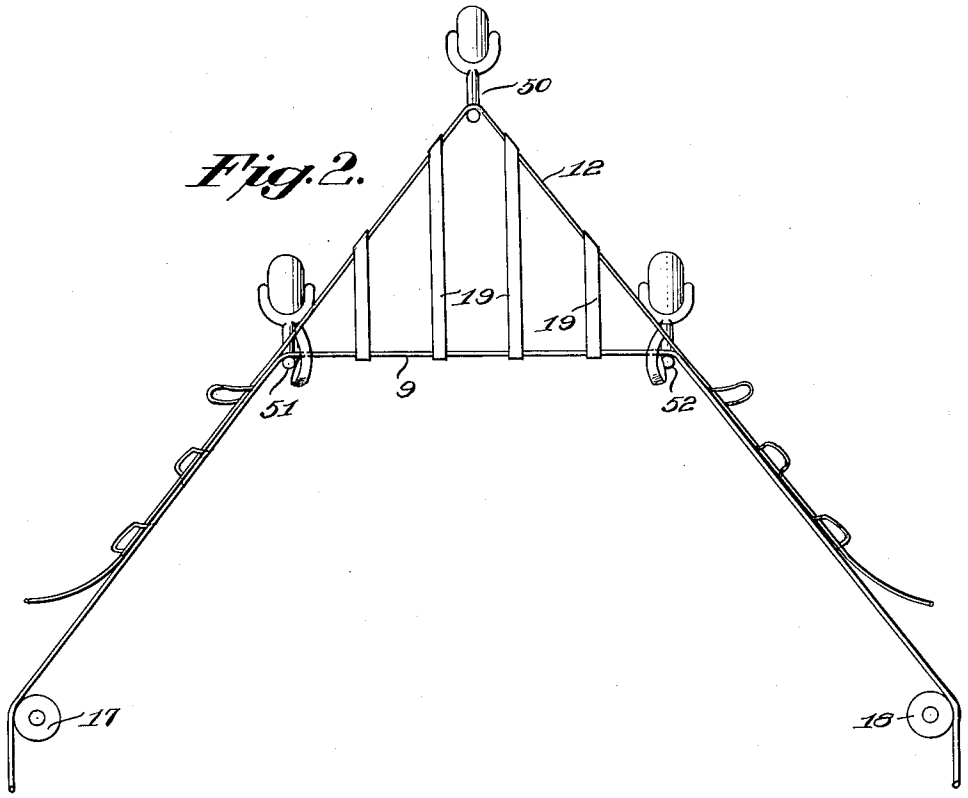

Fig. 2.

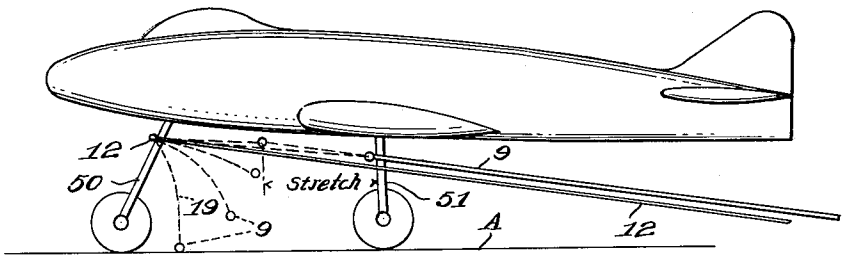

Fig. 3.

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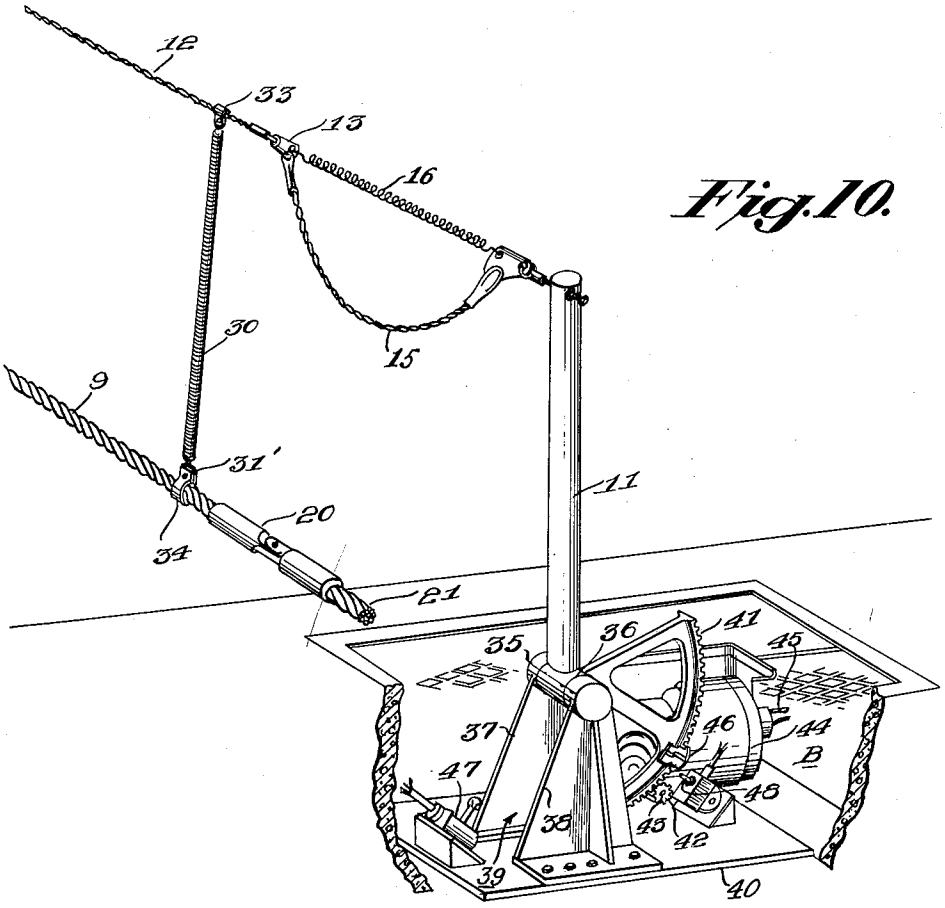

Fig. 10.

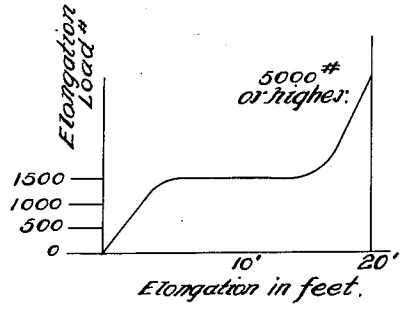

Fig. 11.

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OVER-RUN SPRING TYPE BARRIERS

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2 Claims. (Cl. 244—110)

The present invention relates to arresting means and more particularly to overrun barriers for use on or adjacent aircraft runways.

It is important for safety reasons to provide some means to instantly raise an arrest cable during the initial contact period of arrestment of an aircraft, but in a manner such that the nose wheel strut will not be engaged by the arrest cable to thereby cause nose over and resulting disastrous landings. Prior arrangements of overrun barriers have been developed with some success using horizontal upper and lower cables and connecting nylon stringers or webs, but the lifting action transmitted to the lower arrest cable from the upper nose wheel cable through the flexible nylon stringers is not retrogressive, that is, the forward pull on the nylon stringers by the nose wheel strut or other leading aircraft part, while it raises or lifts the lower arrest cable, it does not provide a positive rearwardly directed force counter to the direction of arrestment in a direction back of the nose wheel toward the main portion of the landing gear, but instead provides a non-retrogressive pull, that is, a forward and upward pull in the direction of arrestment in a direction away from the main landing gear, which may at certain speeds and arresting weights with certain forms of landing gear not cause a lift elevation back of the nose wheel sufficiently high for a safe complete engagement with the main part of the landing gear.

Accordingly, it is an object of the present invention to provide novel means adapted to transmit a retrogressive or rearward and upward instant boosting force to the lower arrest cable upon contact of the nose wheel with the upper actuator cable, such instant retrogressive action or rearward and upward instant boosting force causing an accelerated movement of the arrest cable to a height sufficient for a complete and safe main gear engagement at high arrest speeds.

A further object of this invention is to provide a novel mechanical retrogressive lifting arrangement for an arrest cable, whereby aircraft having many different forms of landing gear may be efficiently and safely arrested.

Another object is to provide a simple, all steel barrier including an arresting cable with an operatively connected nose wheel actuated arresting cable lifting means adapted to raise the arresting cable retrogressively upward, to thereby positively engage the under side of the fuselage of an aircraft being arrested in back of the nose wheel.

A further object is to provide elongatable metal spring devices connected to the arrest cable and to an upper stanchion supported nose wheel engageable cable adapted to retrogressively elevate the arrest cable during nose wheel engagement of a landing aircraft with said upper cable as said stringers are elongated by the forward motion of the aircraft in proportion to the weight and speed of the aircraft.

With the foregoing and other objects in view, the present invention consists of certain novel features of construction, combination and arrangement of parts, as

will now be more fully described and particularly summarized in the appended claims.

In the drawings, wherein like parts are given like reference numerals and are thus identified throughout the following description:

Figure 1 is a front view of an overrun barrier in erect position constructed according to one embodiment of the present invention;

Figure 2 is a schematic plan view of the barrier extended as it appears following an arresting engagement with the landing gear of an aircraft;

Figure 3 is a diagrammatic illustration of the retrogressive movement of the arrest cable of the overrun barrier with respect to the nose wheel strut and the main landing gear portions of an engaging aircraft;

Figure 4 is a front elevational view of one form of stringer device adapted to provide the retrogressive lifting energy to the arrest cable;

Figure 5 is a side edge elevational view of the device of Figure 4;

Figure 6 is an illustration of the steel webbing of Figure 4 showing its structure prior to elongation and after elongation;

Figure 7 is a front elevational view of a second form of lifting means;

Figure 8 is a partial front elevational view of said second form of lifting means in elongated form;

Figure 9 is a perspective view of a third form of arrest cable lift means;

Figure 10 is a general perspective view of one form of stanchion and the connections to the overrun barrier actuating cable;

Figure 11 is a graphic illustration of the resulting curve for a specific elongation load in feet.

Referring first to the general construction of the present overrun barrier as illustrated in Figure 1, the same comprises a lower arrest cable **9** and an upper actuator cable **12** positioned between spaced stanchions **10** and **11** with the actuator cable **12** stretched between the stanchions from connection with each respective top end of each stanchion. These connections include shear links **13** and also restrainer cables **15** and tensioning springs **16** for each stanchion connection, see Figure 10. Thus the actuator cable **12** is held taut between the upper ends of the spaced stanchions. The stanchions **10** and **11** may be raised and lowered with respect to the landing surface A and the arresting cable **9** as will hereinafter be described.

The arrest cable **9** is reeved at each end around spaced runway pendant sheaves **17** and **18** on each side of the runway or landing surface A and connected by a coupler **20** at each end to the purchase cable **21**, see Figure **10**, of any suitable type of energy absorber, not shown. For example, an energy absorber, such as described and illustrated in Patent Number 2,731,219, issued January 17, 1956, and assigned to the present assignee, may be used.

Novel arresting cable lifting means **19** are mounted at spaced apart intervals along the arrest cable **9** and the actuator cable **12**. Such lifting means may be made of spring steel strip or wire in various formations, such as illustrated in Figures 4, 5, 6, 7, 8 and 9, each to be referred to in detail as the description proceeds. For example, the first form of Figures 4, 5 and 6 shows a novel elongatable woven web **22** formed from a plurality of plaited or corrugated weft and woof steel wires **23** and **24**, respectively. These webs **22** are woven in a circle, to thereby provide a continuous loop adapted to be strung on the upper actuator cable **12** and the lower arresting cable **9** of the barrier and when subjected to load will elongate and change from wide to narrow formation as illustrated in Figure 6.

A second form of steel spring arrest cable lifting means

is illustrated in Figures 7 and 8 and comprises a serpentine flat spring 26 either formed or provided with a coupling 27 and 28, respectively, at each end for securing the same to the actuator cable 12 and the arrest cable 9. In Figure 8 the spring is shown elongated as it appears after an arrest of an aircraft.

A third form of steel spring arrest cable lifting means is illustrated in Figures 9 and 10 and comprises a coil of steel spring wire 30. Each end of the coil is formed with a securing means, such as hooks 31 and 32 which engage in eyelets 31' of cable clamps 33 and 34, respectively, for the cables 12 and 9.

The stanchions 10 and 11 are rockably journalled on a bearing 35 by means of a bearing sleeve 36 formed at the end of each stanchion. The bearing 35 is supported between the arms 37 and 38 of a standard 39 supported on the bottom 40 of a pit B. Connected to the bearing sleeve 36 is a driven segment gear 41 in mesh with a drive pinion gear 42 on the armature shaft 43 of a motor 44. The operating element for the motor includes a starter switch connected to leads 45 and spaced apart limit cut-off switches 47 and 48 controlled by a contact cam 46 carried by the segment gear 41. These switches serve to cut the motor circuit in the raised position of the stanchions and in the lowered position of the stanchions as can readily be determined from Figure 10 of the drawings.

The operation of the device is believed to be clear from the foregoing descriptions of the several forms which all perform in a similar manner as generally illustrated in Figures 2 and 3. For example, when the actuating cable 12 of the barrier is engaged by an airplane nose wheel strut 50 the shear links 13 are broken and the upper cable 12 transmits a load to the steel lifting means, such as the vertically positioned steel webbing stringers 19, the serpentine flat springs 26 or the coil springs 30 of the several forms. When a high speed picture film is taken of this action of the vertical lifters, it shows that the vertical lines or lifters will tend to follow the original vertical path and the aircraft developed elongation load will cause the transmitting force of the elongating lifters to retrogressively raise or lift up the arrest cable 9 and engage the under side of the fuselage in back of the nose wheel, see Figures 2 and 3, for engagement with the main landing gear struts 51 and 52.

An example of the elongation load is graphically illustrated in Figure 11, wherein the vertical side of the graph is marked off in pounds and the base line of the graph in feet.

Without further description it is believed that the present invention is clearly understandable to others authorized to practice the same. While only three embodiments of the invention are described and illustrated in detail, it is to be expressly understood that other combinations, modifications and arrangements of the parts

which will now probably occur to others skilled in the art are to be considered a part hereof. To determine the scope of the present invention, reference should be had to the appended claims.

What is claimed is:

1. An over-run barrier comprising a horizontally disposed arresting cable and a horizontally disposed actuating cable normally disposed vertically above said arresting cable in substantially parallel relation thereto, said arresting cable being normally disposed in engagement with a runway and having its opposite ends engaged with energy absorbing means, a normally vertical stanchion disposed adjacent each side of the runway, said actuating cable having its opposite ends releasably connected to said stanchions, and elongatable endless bands of woven metallic corrugated wire extending around the arresting cable and the actuating cable, and said endless bands being equally spaced lengthwise of the barrier, whereby said actuating cable upon being engaged by the forward strut of an aircraft is released from said stanchions and upon continued movement of said aircraft transmits load to said bands and causes same to elongate and therewith lift said arresting cable retrogressively into the path of the main landing gear of the aircraft.

2. An overrun barrier comprising an arresting cable normally engaged with a runway and whose opposite ends are each engaged with an energy absorber, an actuator cable disposed vertically above said arresting cable, a normally vertical stanchion disposed adjacent each side of the runway, releasable connections between said actuator cable and said stanchions, and extensible metallic means connecting said actuator cable to said arresting cable, whereby said actuator cable when engaged by the forward strut of an aircraft transmits load to said means and causes same to extend and lift said arresting cable retrogressively into the path of the main landing gear of the aircraft, said extensible metallic means comprising endless bands of metallic corrugated woven wire which are looped around said arresting cable and said actuator cable in spaced relation longitudinally thereof, said bands being held taut by suitable tension means operatively associated with the actuator cable.

References Cited in the file of this patent

UNITED STATES PATENTS

1,315,320	Mesurier	Sept. 9, 1919
2,026,007	White	Dec. 31, 1935
2,440,574	Cotton	Apr. 27, 1948
2,450,328	Cotton	Sept. 28, 1948
2,465,936	Schultz	Mar. 29, 1949
2,578,958	Finters	Dec. 18, 1951
2,694,852	Rogers	Nov. 23, 1954
2,731,219	Cotton et al.	Jan. 17, 1956