

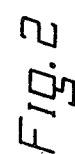
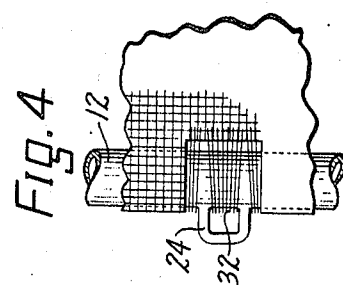
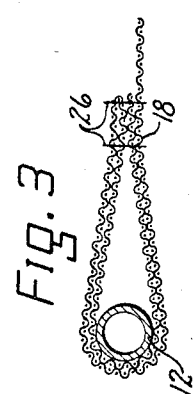
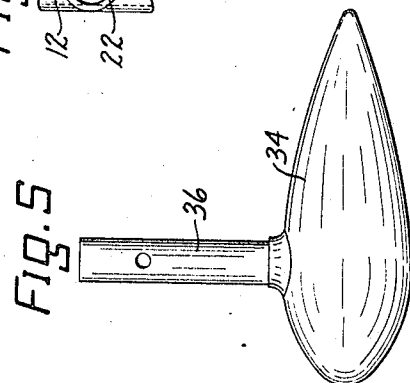
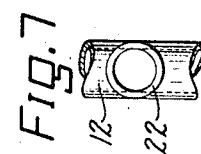
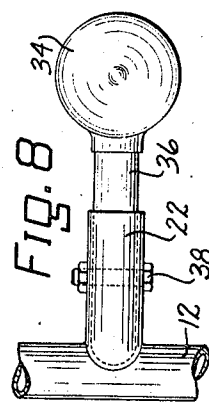
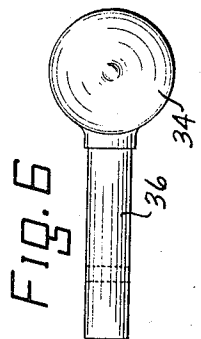
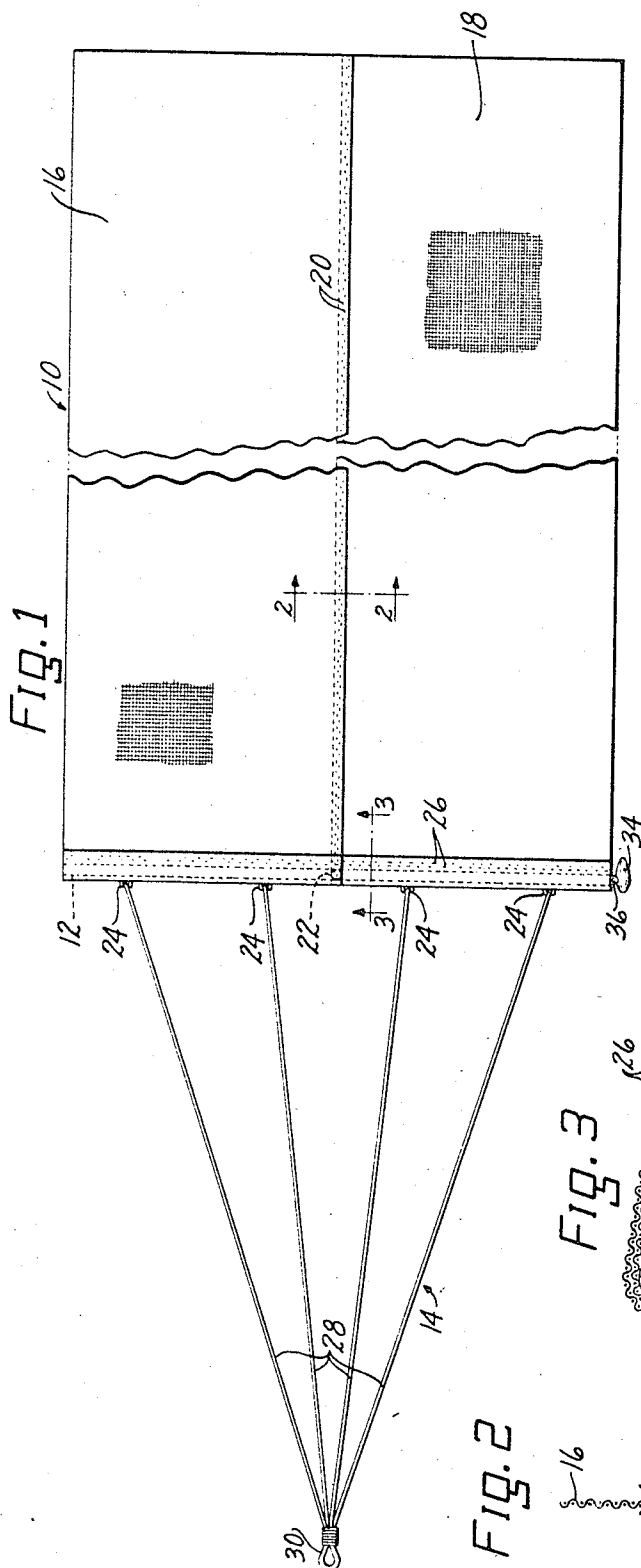
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F. G. MANSON

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AERIAL TRAILER

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AERIAL TRAILER

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17 Claims. (Cl. 273—105.3)

This invention relates to aerial trailers for use in towing behind an airplane as a target and which may be used for other purposes, such as advertising.

Heretofore, aerial trailers for tow targets have generally been made of a sleeve type construction. This type of target has been subject to many objections, namely, the difficulty in getting the sleeve to open, the difficulty in arranging suitable means for towing the same, and the difficulty in getting the target to ride smoothly and without flutter or lateral motion.

Trailers of flag type construction have often been used both for advertising purposes and for tow targets, but these devices have heretofore been made of a closely-woven fabric and with a rigid frame, or with a plurality of rigid elements, in order to maintain their shape and, because of such construction, were not suitable for towing at the high speeds of modern military aircraft. It has also been a common expedient with this type of target, to attach small cone-like sleeves at the rear end, and sometimes at the front end, in order to provide stability. Such construction further complicates the design and adds to the drag.

It is well known that any flag arrangement of flexible material tends to wave upon rapid movement through the air. This waving motion, or flutter, increases the flat plate area of the trailer in the direction of motion, to the extent of the width between the opposite crests of the waves, and in this manner increases the drag of the target. This tendency of a flag to wave is amplified by the reaction of the moving air to the flat plate area thus produced by a tightly woven material, so that the natural tendency to wave is soon multiplied into oscillations of destructive proportions. It necessarily follows that if the drag is increased, then either the speed of the aircraft towing the target is cut down, or the size of the target must be reduced in order to permit the desired speed, either of which are undesirable limitations, to say nothing of the undesirable characteristics of the target as such.

It is also well known that the flutter of aerial trailers of fabric construction increases as the speed at which they are towed increases. Consequently, when trailers of the flag type construction made of fabric have been used for tow targets at appreciable speeds, such as are practical for target practice in military aircraft combat, the flutter, or tendency of the cloth to oscillate, increases to such an extent that the target is very unstable in flight, thus making an unsatisfactory target, and also soon disintegrates under the ex-

treme forces to which it is subjected by the flutter.

A further objection to the flag type style of trailer heretofore used has been the fact that it required the use of rigid elements to maintain its shape. These rigid elements add extra weight and flat plate resistance to the trailer, thus increasing its drag, and also increasing its tendency to flutter, with consequent disintegration.

On the other hand, an aerial trailer of the flag type has inherent advantages over a trailer of the sleeve type if the problems of flutter and lack of stability can be overcome, inasmuch as there is less drag in proportion to the effective area for a target of the flag type construction than for a target of the sleeve type construction.

It is therefore an object of this invention to provide a novel trailer of the flag type that is made of semi-flexible mesh material and which, by virtue of such construction, is free from the above-described difficulties and objections.

It is another object of this invention, by virtue of the use of such mesh material, to eliminate the provision of a hem at the trailing edge, thus further reducing the cost of construction and the amount of drag.

It is still another object of this invention, by virtue of the semi-rigid nature of the mesh material used in the construction of the trailer, to obtain the natural spread of the flag to its full dimensions without the usual frame elements.

It is yet another object of this invention to provide a novel means for determining the attitude in flight which the trailer shall assume; that is, whether it will fly in a vertical or horizontal plane.

With these and incidental objects in view, the invention includes certain novel features of construction and combinations of parts, the essential elements of which are set forth in appended claims and the preferred forms and embodiments of which are hereinafter described with reference to the drawing which accompanies and forms a part of this specification and in which like reference numerals refer to like parts.

Figure 1 is a side elevation view.

Figure 2 is a section view taken on the line 2—2 of Figure 1.

Figure 3 is a section view taken on the line 3—3 of Figure 1.

Figure 4 is a fragmentary view showing that portion of the trailer which includes the securing means or cable retainers.

Figure 5 is a side elevation view of the positioning device.

Figure 6 is an end elevation view of Figure 5. Figure 7 is a fragmentary view of that portion of the spreader bar which is adapted to receive the positioning device.

Figure 8 is an end elevation of Figure 7 with the positioning device attached.

Figures 2 to 8 inclusive are like-scale enlargements of portions of Figure 1.

Referring to the drawing, the invention, as illustrated, comprises a rectangularly shaped portion 10, tow and spreader bar 12, and a hitch means 14.

The rectangular portion 10 may be made of a single piece of a semi-rigid material, or of a plurality of such pieces, depending on the convenience in manufacture and the dimensions of material available. While various types of mesh material may be used, it has been found that the greatest advantages are to be obtained by using a wire mesh of basket weave construction, made of .010" steel wire. The mesh may be of any suitable size, but preferably is in the range from 8 x 8 to 12 x 12 mesh per inch, with perhaps the best results being obtained from a 10 x 10 mesh which will provide the desired appearance of opacity in flight and at the same time offer a limited resistance to the passing of air there-through. When more than one piece of the mesh material is used, as illustrated in Figure 1, a suitable method of joining the pieces 16, 18 is as shown in Figure 2. The two pieces are overlapped and the edges are selvaged. The overlapped portions are then stitched with suitable thread or wire 20. In practice, a 3-cord linen thread has been used, making about five stitches to the inch.

A preferred size of the trailer for tow target purposes for use in towing behind airplanes capable of developing a speed of 300 miles per hour is 9' x 40'.

A spreader and tow bar 12 of metal tubing or other suitable material is secured to the leading edge of the rectangular portion. For a trailer of the above dimensions, a 1" steel tube has been used. Intermediate the ends of the tube is rigidly attached, as by welding, a short tube extension 22 of the same inside diameter as that of the tow bar, for the attachment of a positioning member hereinafter described. The point of attachment of the tube extension will be dependent upon the attitude in flight which it is desired that the trailer shall assume; that is, the angle of incidence of the plane of the trailer with the earth will vary from 0° to 90° as the point of location of the extension tube is varied from the middle of the bar to one or the other ends. At 90° from the extension tube there is rigidly attached to the bar 12, as by welding, a plurality of U-shaped hitch rings, or eyes, 24.

The wire mesh may be secured to the spreader bar in any suitable manner, but is preferably attached by first doubling the leading end of the material and then lapping the doubled portion over the tow bar, as shown in Figure 3, thus providing a hem section having four thicknesses of the material. The rear end of this section is stitched in the same manner as described in connection with the stitching in Figure 2. The stitching 26 is preferably placed a few inches behind the spreader bar, thus providing a loose hem portion at the forward end of the target in which the spreader bar is disposed. The mesh material is spread or cut at the places where the cable eyes 24 are located, in order to allow the same to protrude.

The hitch 24, as illustrated, comprises a plurality of cables 28, one being attached to each of the eyes 24. The cables are tied together at the front end to form a loop 30 for attachment to the tow cable (not shown). The cables 28 are of such length and are joined together in such a manner that the loop 30 is directly in line with the center axis of the target, and are arranged so as to pull the target with the tow bar perpendicular to this axis with an equal tension on each cable. While any suitable material may be used for the cables, a $\frac{3}{8}$ " manila rope is preferred for use with a target of the above-said dimensions.

After the ropes 28 have been secured to the eyes 24, in the event that the wire mesh had been cut to allow the eyes to protrude, the cut portions are secured to the tubing by the use of copper wire 32. The copper wire is preferably passed by continuous turns through the wire mesh material and through the eyes 24 as shown in Figure 4, suitably fastening the ends, thereby securing the mesh material to the bar at the said eyes. If the wire mesh were spread to accommodate the eyes, a reinforcing wire is also used in a similar manner.

It will thus be seen that a trailer of the flag type construction has been provided, made of a semi-flexible mesh material which will assume its full dimensional shape in flight without the use of the conventional rigid frame elements. By virtue of such construction, sufficient rigidity is provided that the tendency to flutter is practically eliminated. Since there is no substantial flat plate area set up by the natural tendency to wave, of a flag made of this material, the oscillations as amplified by the reaction of the moving air to the flat plate area of a flag of tightly-woven material do not occur. This improved trailer rides very smoothly in flight, is free from deleterious flutter, and creates a minimum of drag resistance, while providing sufficient effective area for military purposes. Furthermore, the drag produced by such a trailer is reduced so that, and the natural strength of the material is such that, no hem is necessary at the trailing edge to prevent fraying.

In the event this invention is to be used in target practice in which different combat groups engage, using bullets or projectiles marked with a designating paint for each different group, the wire mesh tail portion should preferably have the individual wires covered with a contrasting colored, flexible, adhesive covering in order that the different paint colors with which the bullets or projectiles from the different firing sources are marked, will be registered thereon so as to determine the scores of the different firing sources. The most common method of accomplishing this is to weave the mesh of wire covered with a cotton yarn. However, any suitable method of providing a flexible covering capable of being colored white may be used, such, for instance, as spraying with a white rubber solution.

A positioning means 34 for determining the flight attitude is provided in the form of a streamlined weight of tear-drop design, having a laterally extending rod or tube 36 to serve as a securing means. The laterally extending tube 36 is of a diameter corresponding to the inside diameter of the tow bar tube, and is designed to be inserted in the open lower end of said tow bar when it is desired to have the trailer assume a vertical attitude in flight. If it is desired to tow the trailer in a horizontal attitude, the extension 36 of the positioning member is inserted in the short

T tube 22 which should extend sufficiently to lower the positioning member below the center of gravity of the trailer in horizontal position, and thus dynamic balancing of the target, which would result in rotation thereof, is prevented. The positioning member may be held in place by any suitable means and, as shown, is secured by means of a bolt and nut 38 passed through registering openings in the tow bar and the extension of the positioning member. In the preferred embodiment, the positioning member weighs about 5 pounds and is about 8 inches long and 2½ inches in diameter at its most bulbous part. It will be seen that by the use of such a positioning member, the flight attitude of the aerial trailer can be controlled with a minimum of additional drag so as to present the greatest effective area to the source of firing.

The trailer as above described is packed for storage in the airplane by rolling it, beginning with the trailing edge and ending with the spreader bar on the outside. The hitch cables are tucked in before completing the roll, allowing the loop to extend from one end. Thus, the trailer when folded or packed is in the form of a small elongated roll and is easily deployed from the airplane through a small opening in the aircraft. The trailer will unfold naturally with a minimum of shock force.

While the mechanism and construction herein shown and described is admirably adapted to fulfill the objects primarily stated, it is to be understood that it is not intended to confine the invention to the forms or embodiments herein disclosed, for it is susceptible of embodiment in various forms all coming within the scope of the claims which follow.

I claim:

1. An aerial trailer of the flag type adapted to be towed by aircraft having a main body portion formed of wire mesh material with the leading edge thereof doubled and secured to itself to form a loop extending transversely of said main body portion, said wire mesh material being sufficiently rigid to resist the forces causing flutter in the main body portion when the trailer is towed and having a mesh of a size small enough to cause the material to appear substantially opaque at the distance intended for use, and of a size large enough to offer little resistance to the passage of air through the material if the main body portion should flutter; a rigid member disposed in said loop portion, said member having a plurality of eyes attached thereto for receiving the ends of a corresponding number of hitch cables.

2. In an aerial trailer as described in claim 1, said cables being joined at the fore ends into a loop.

3. In an aerial display device adapted to be towed by aircraft, the combination of a flag-type body portion constructed of a semi-rigid open-mesh material, which material is rigid enough to be self-supporting in flight and also resistant to the forces causing flutter when the device is towed, yet is flexible enough to be formed into a compact package for storage purposes and which material has a mesh of a size small enough to cause said body portion to appear substantially opaque at the distance intended for use and of a size large enough to offer little resistance to the passage of air therethrough should flutter occur; a tubular towing member secured to the leading edge of the body portion; and means to connect the tubular towing member to an aircraft.

4. An aerial display device adapted to be towed

by an aircraft, comprising a tubular towing member and a body portion made of semi-rigid open-mesh material and having one end of said body portion folded upon itself and then looped around said tubular towing member and stitched in place and said material of said body portion being sufficiently rigid to resist the forces causing flutter in the body portion when the flag is towed and having a mesh of a size small enough to cause the material to appear substantially opaque at distances which the device is intended to be used and of a size large enough to allow the passage of air through the material when flutter does occur; and a harness supported by said towing member for connecting the device to said aircraft.

5. In a display device adapted to be towed by aircraft, the combination of a body portion; a towing member secured to the leading edge of the body portion; a weight element; means for fastening said element rigidly in various positions on the towing member below the center of gravity thereof in flight for determining the position of the display device in flight; and means to connect the towing member to an aircraft.

6. In an aerial trailer of the flag type having a rigid tube at the fore end thereof serving as a spreader bar, a short tube attached intermediate the ends of said bar and extending transversely of the plane of said trailer, a detachable mass adapted to be received and secured in the ends of said spreader bar or in said transversely extending tube for determining the flight attitude of said trailer, said detachable mass being below the center of gravity of said trailer in flight.

7. In an aerial trailer of the flag type having a rigid member at the leading edge of the flag portion thereof, a positioning member for determining the flight attitude of said trailer, and means for rigidly fastening the positioning member to said rigid member below the center of gravity of said trailer in flight.

8. An aerial trailer of the flag type for use as a tow target having the target portion thereof made of a mesh woven of wire covered with an adhesive, flexible material.

9. An aerial trailer of the flag type for use as a tow target having the target portion thereof made of open mesh material, which material is semi-rigid in order to resist and dampen the forces causing flutter when the target is towed, and has a mesh size small enough to cause the material to appear substantially opaque when the target is towed, but large enough to allow air to pass therethrough without increasing the drag of the target if the target should flutter.

10. An aerial trailer of the flag type for use as a tow target, having the target portion made up of woven open mesh wire material, said wire being semi-rigid so that the material formed therefrom will resist and dampen the forces causing flutter in the target when the target is towed at high speeds, and said mesh being small enough to render the target visible when in use, but large enough to allow air to pass therethrough if flutter does occur.

11. An aerial trailer of the flag type adapted to be towed by an aircraft or other vehicle and having a planar flag portion made of wire mesh material, said wire being semi-rigid so that the material formed therefrom will retain its planar condition and will resist and dampen any forces which cause flutter and distortion from its planar condition when the flag is being towed.

12. An aerial trailer adapted to be towed at high speeds by an aircraft or other vehicle com-

prising a main body portion made of semi-rigid open mesh material, which material is characterized by being sufficiently rigid to resist the forces causing flutter when the trailer is towed at high speeds and having a mesh of size sufficiently small to cause said material to be substantially opaque at the distance intended for use and of a size large enough to offer little resistance to the passage of air therethrough if the main body portion should flutter, a rigid member at the leading edge of said main body portion, and means for attaching said trailer to said aircraft or other vehicle.

13. A planar type of target adapted to be towed at relatively high speeds by an aircraft or other vehicle, said target being made of semi-rigid mesh material having the characteristics of rigidity to resist transverse displacement caused by flutter when the target is towed at high speeds and porosity to allow the passage

of air therethrough to reduce drag if transverse displacement does occur.

14. An aerial trailer of the flag type for use as a tow target having the target portion thereof made of semi-rigid mesh material of a mesh size in the range of 8 x 8 to 12 x 12 mesh per inch.

15. An aerial trailer having the body portion made of a coated wire mesh material of a mesh size in the approximate range of 8 x 8 to 12 x 12 mesh per inch.

16. An aerial trailer of the flag type for use as a tow target having the target portion thereof made of a mesh woven of wire covered with an organic material.

17. An aerial trailer of the flag type for use as a tow target having the target portion thereof made of a mesh woven of wire covered with cotton yarn.

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