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STREAMING OF VISIBILITY ENHANCERS
FROM AIRCRAFT TOWED TARGETS

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5 The present invention relates to the streaming of a visibility enhancer from a target towed behind an aircraft.

In particular, the present invention discloses a method and apparatus by means of which the visibility enhancer can be deployed at a time which is delayed until after the deployment of the target. This has the desirable effect of substantially reducing the vibration, drag and/or other forms of mechanical shock.

10 Background Art

In military applications, a visibility enhancer normally takes the form of a towed banner such as a strip of fabric approximately 10 metres in length which is deployed or streamed behind a towed target for the purpose of target practice. The target itself is towed behind an aircraft by means of a towing cable which is usually
15 several kilometres in length. The purpose of the visibility enhancer is that it enables the target to be seen and forms the object at which the practice fire is directed. The accuracy of the practice fire is determined by various means, the most simple of which is the counting of holes shot in the target enhancer after the target enhancer has been recovered following the conclusion of the target practice.

20 The towed target is connected to one end of the lengthy cable, the other end of which is connected to the towing aircraft by means of a winch and winch cradle installed on the towing aircraft. In order to deploy the target, the winch is released. Thus the cable on the winch is unwound as the drag experienced by the released target draws the cable from the winch. As a consequence, the towing cable and its release
25 mechanism are subjected to substantial stress due to the various mechanical forces of vibration, drag and other forms of mechanical shock which are applied throughout the system.

Essentially simultaneously with the release of the towed target from the winch cradle, the retaining mechanism for the visibility enhancer has hitherto been released
30 via the same release switch, so that the visibility enhancer is streamed from the towed target within a split second of the release of the target itself. Thus the visibility enhancer is streamed out behind the target as the target is being deployed. The shock of extension and drag of the visibility enhancer therefore also act on the towing cable and the release mechanism. The combined stress created by the target and the visibility
35 enhancer are liable to damage the towing cable. This can lead to severing or breaking of the towing cable during subsequent target presentation missions with possible loss of the towed target and visibility enhancer.

At the conclusion of the mission the target and enhancer are wound back to the aircraft prior to landing.



Object of the Invention

The aim of the present invention is to avoid, as much as possible, damage to such towing cables and related equipment by the reduction of the amount of shock experienced by the cable as a result of deployment of a visibility enhancer.

5 Summary of the Invention

In accordance with the first aspect of the present invention there is disclosed a method of deploying a visibility enhancer for a target towed behind an aircraft in flight, said method comprising the steps of:

- (1) storing the visibility enhancer together with the body of said target,
- 10 (2) deploying at a first time said target body from said aircraft whilst maintaining said visibility enhancer together with said target body, and
- (3) at a second time, delayed from said first time, deploying said visibility enhancer.

In accordance with the second aspect of the present invention there is disclosed
15 apparatus for deploying a visibility enhancer from a target towed behind an aircraft in flight, said aircraft having a towing cable having one end connected to said aircraft and the other end connected to said target, and a cable release mechanism operable in flight to unwind said cable and thereby deploy said target behind said aircraft, wherein said target includes an elongate target visibility enhancer means having one end connected to
20 said target and being stored together with a target body, an enhancer release mechanism to permit release of said enhancer whereby the other end of said enhancer streams from said target, and a timer means activatable by said cable release mechanism and connected to said enhancer release mechanism to delay operation of same until after a predetermined period following operation of said cable release mechanism.

25 It will be apparent to those skilled in the art that in contrast with the prior art where the visibility enhancer retaining mechanism is immediately unlocked at the same time as the towed target commences its release from the winch cradle, in accordance with the preferred embodiment of the present invention a time delay is included so that the retaining mechanism for the visibility enhancer is not unlocked until the end of the
30 period of deceleration experienced by the aircraft as a result of the release of the towed target. In this way the effect of the shock of the extension and drag of the visibility enhancer is then felt only on the extended towing cable. As a result, the possibility of damage to the release mechanisms and/or the towing cable itself is substantially reduced.

35 Brief Description of the Drawings

The preferred embodiment of the present invention will now be described with reference to the drawings in which:

Fig. 1 is a side elevational view of an aircraft in flight having a target pod secured to the underside of a wing;



Fig. 2 is a view similar to Fig. 1 but showing the target pod deployed by means of a towing cable;

Fig. 3 is a view similar to Fig. 2 but showing the deployment of the visibility enhancer;

5 Fig. 4 is a schematic block diagram illustrating the preferred arrangement of the time delay mechanism; and

Fig. 5 is a detailed circuit diagram of the time delay arrangement.

Detailed Description

As seen in Fig. 1, an aircraft 1 includes a target housing or pod 2 secured to the underside of the wing structure 3. A winch mechanism 4 is also located on the underside of the wing structure 3.

As seen in Fig. 2, the target pod 2 can be deployed by operation of a release mechanism from within the aircraft 1 which enables a cable 5 to be drawn out from the winch mechanism 4 because of the drag experienced by the released target pod 2.

15 Fig. 3 illustrates the position a short, but very important, time later. At the time illustrated in Fig. 3 a visibility enhancer in the form of a fabric banner 7 has been unfurled or deployed from the rear of the target pod 2 so as to substantially enhance the visibility of the target.

It will be appreciated by those skilled in the art that Figs. 1-3 are not drawn exactly to scale in that the longitudinal dimension of the target pod 2 is approximately 1 or 2 metres, the longitudinal dimension of the banner 7 is approximately 10 metres and the longitudinal extent of the cable 5 is normally several kilometres, preferably 2 to 7 kms.

In the prior art the target pod 2 and banner 7 are released substantially simultaneously so that the shock of the extension and the drag caused by both the pod 2 and the visibility enhancer, or banner 7 act essentially simultaneously on the cable 5 and its associated winch mechanism 4.

In order to reduce the severity of this mechanical stress, a delay mechanism illustrated in block diagram form in Fig. 4 is provided within the target pod 2.

30 As in the prior art, the target pod 2 contains various forms of electronic equipment, such as telemetry equipment and telecommand systems for counting the hits recorded on the special textile material of the banner 7. Further, this equipment also enables data transfer to ground so as to provide information to persons on the ground as to the success of the target practice.

35 As seen in Fig. 4, a release switch 11 is provided which is operable in order to release the target pod 2. The signal generated by the release switch 11 is conducted to a time delay circuit 12 which is powered from a battery 13 contained within the target pod 2. The time delay circuit 12 operates a relay or equivalent switch 14 which in turn ignites a squib represented by the resistor 15. This results in deployment of the banner



7 in substantially conventional fashion. Thus the effect of the circuit of Fig. 4 is to result in a time delay between the operation of the release switch 11 and the activation of the squib, whereas in the prior art this operation and activation are essentially simultaneous.

5 Fig. 5 is a detailed circuit diagram illustrating the preferred implementation of the time delay circuit illustrated in block diagram form in Fig. 4. In Fig. 5, IC1 is a power supply regulation integrated circuit. The integrated circuit IC2 is an RC oscillator and integrated divider preferably of the type manufactured by EXAR (of the USA). This is the time controlling component. The oscillator frequency is set with a
10 combination of resistor R5 and capacitor C3 so that the oscillator frequency (6.4 Hz) which is divided by 16 appears at pin 5. The result is a step frequency of 0.4 Hz which corresponds to a basic delay time increment of $T = 2.5$ seconds.

The outputs of integrated circuit IC2 are able to be programmed by means of a hex switch S1. If all outputs are programmed to provide low active outputs, then the
15 NAND gates (realised by means of integrated circuit IC3) result in output transistor T2 being switched via the driving transistor T1. As a consequence, the squib resistor 15 receives a substantial current and is thus ignited.

The resistor R11 in the collector circuit of the transistor T2 is used to limit the current through the squib resistor R15 to 1 Amp at a temperature of -20°C . The output
20 $f/2$ which appears at pin 2 of IC2 switches to low when the elapsed time after ignition is 312.5 milliseconds. At that time the squib current is turned off and the integrated circuit IC2 is switched to a stand-by state. In the above described arrangement which switches through the battery voltage, the whole circuit is activated on operation of the release switch.

25 Commercially available 9 volt primary batteries can be used for the power supply, however, with a suitable adjustment to the value of the current limiting resistance R11, just a single battery can be used if desired. However, with only the single battery the minimum operating temperature is limited to approximately 0°C .

The above described arrangement in Fig. 5 has the following specifications.
30 The ignition current through the squib resistor 15 is greater than or equal to 1 Amp;
The ignition period is greater than or equal to 100 milliseconds;
The ignition resistance is greater than or equal to 1 Ohm;
The delay time dT is adjustable between 0 and 37.5 seconds and is able to be stepped or adjusted in 2.5 second intervals;
35 The preferred delay period is between 20 and 35 seconds;
The accuracy of the delay time is better than 1%; and
The operating temperature range is from -20 to $+70^{\circ}\text{C}$.

The foregoing describes only one embodiment of the present invention and modifications, obvious to those skilled in the art, can be made thereto without departing

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from the scope of the present invention. For example, a mechanical timer can be used rather than the electrical timer illustrated in the preferred embodiment.



CLAIMS

1. A method of deploying a visibility enhancer for a target towed behind an aircraft in flight,

said method comprising the steps of:

- (1) storing the visibility enhancer together with the body of said target,
- (2) deploying at a first time said target body from said aircraft whilst maintaining said visibility enhancer together with said target body, and
- (3) at a second time, delayed from said first time, deploying said visibility enhancer.

2. The method as claimed in claim 1 wherein the delay time between said first and second times is substantially equal to the period of time during which the aircraft decelerates following deployment of the target body.

3. The method as claimed in claim 1 or 2 wherein the delay time is adjustable.

4. The method as claimed in claim 3 wherein the adjustment of delay time is within the range of from 2.5 seconds to 35 seconds.

5. A method of deploying a visibility enhancer from a target towed behind an aircraft in flight, said method being substantially as herein described with reference to the accompanying drawings.

6. Apparatus for deploying a visibility enhancer from a target towed behind an aircraft in flight, said aircraft having a towing cable having one end connected to said aircraft and the other end connected to said target, and a cable release mechanism operable in flight to unwind said cable and thereby deploy said target behind said aircraft, wherein said target includes an elongate target visibility enhancer means having one end connected to said target and being stored together with a target body, an enhancer release mechanism to permit release of said enhancer whereby the other end of said enhancer streams from said target, and a timer means activatable by said cable release mechanism and connected to said enhancer release mechanism to delay operation of same until after a predetermined period following operation of said cable release mechanism.

7. Apparatus as claimed in claim 6 wherein said timer means includes means to vary the length of said predetermined period.

8. Apparatus as claimed in claim 6 or 7 wherein said timer means is electronic and includes a self contained power supply.

9. Apparatus as claimed in any one of claims 6-8 wherein said enhancer comprises a strip of fabric and said target body comprises a pod releasably connected to the underside of a wing of said aircraft.

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10. Apparatus for deploying a visibility enhancer from a target towed behind an aircraft in flight, said apparatus being substantially as herein described with reference to the accompanying drawings.

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STREAMING OF VISIBILITY ENHANCERS
FROM AIRCRAFT TOWED TARGETS

ABSTRACT

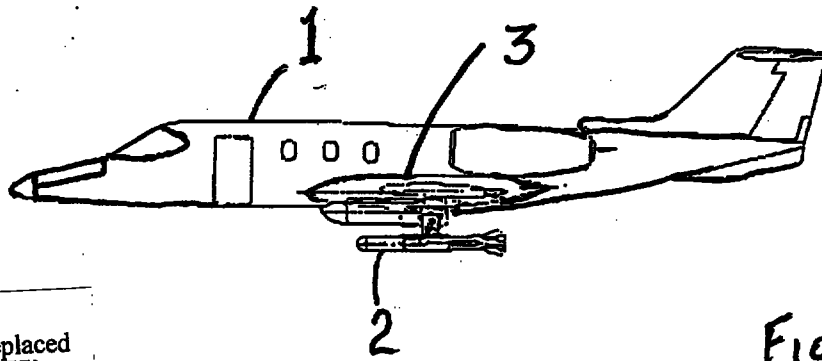
5 The present invention discloses a method of, and apparatus for, deploying a fabric banner (7) as a target enhancer from a target pod (2) towed by a cable (5) from an aircraft (1) in flight. In order to lessen the mechanical shock on the cable (5) and its associated equipment (4), the target pod (2) is first deployed. After a delay time (20-35 seconds) a time delay circuit (11) then deploys the banner.

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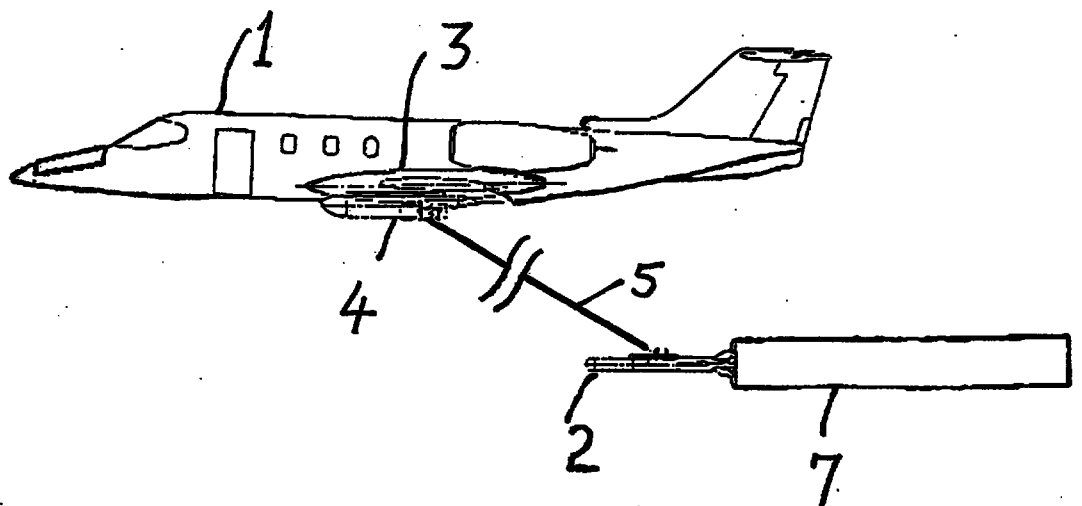
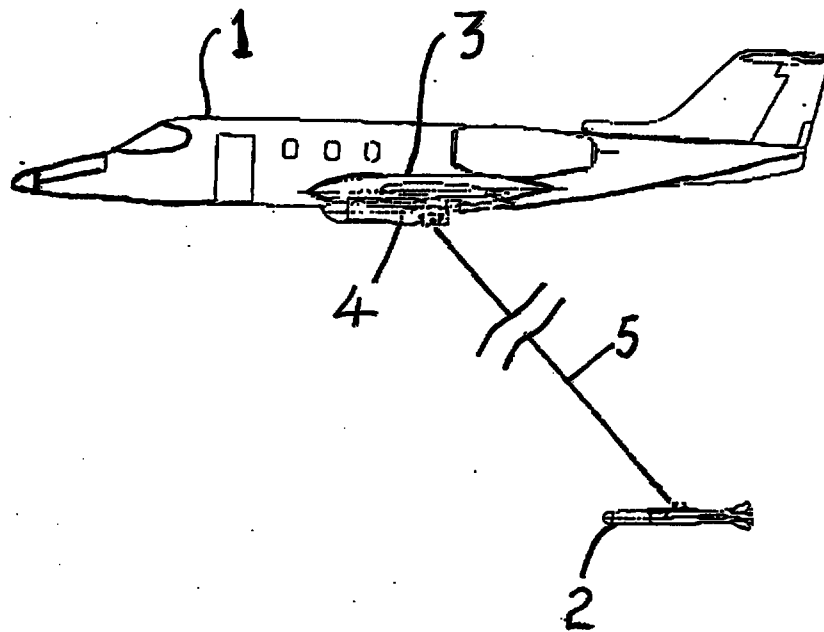
Fig. 3

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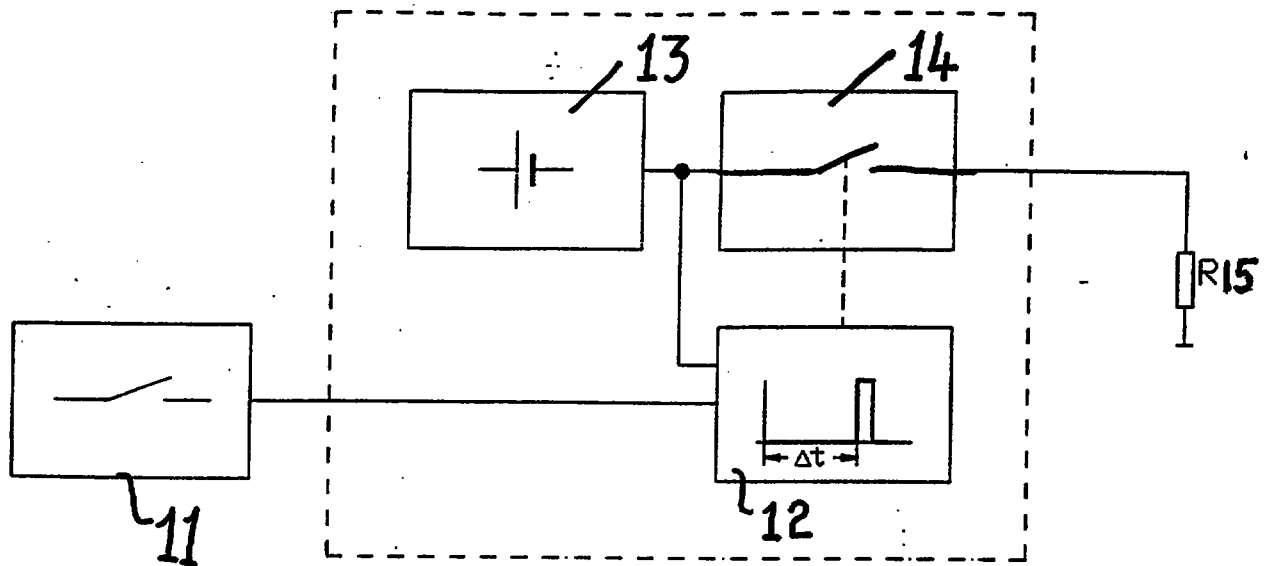


Fig. 4

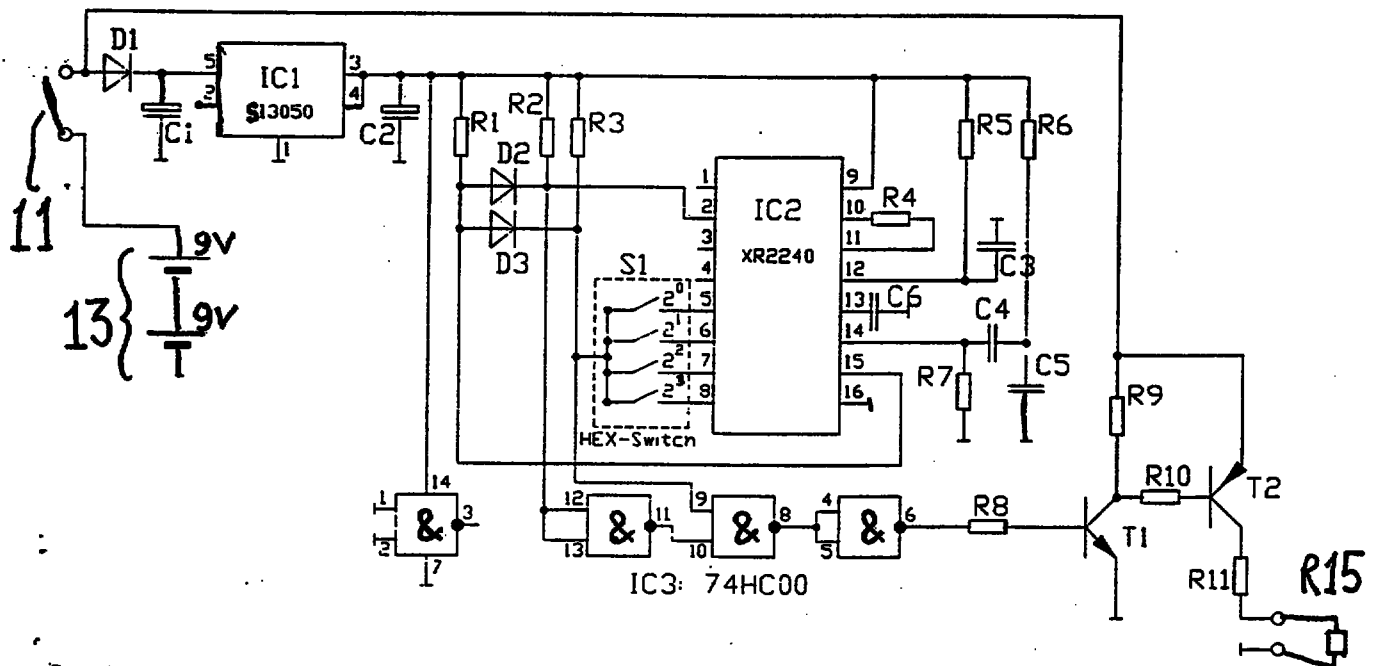


Fig. 5

STREAMING OF VISIBILITY ENHANCERS FROM AIRCRAFT TOWED TARGETS

The present invention relates to the streaming of a visibility enhancer from a target towed behind an aircraft.

In particular, the present invention discloses a method and apparatus by means of which the visibility enhancer can be deployed at a time which is delayed until after the deployment of the target. This has the desirable effect of substantially reducing the vibration, drag and/or other forms of mechanical shock.

Background Art

In military applications, a visibility enhancer normally takes the form of a towed banner such as a strip of fabric approximately 10 metres in length which is deployed or streamed behind a towed target for the purpose of target practice. The target itself is towed behind an aircraft by means of a towing cable which is usually several kilometres in length. The purpose of the visibility enhancer is that it enables the target to be seen and forms the object at which the practice fire is directed. The accuracy of the practice fire is determined by various means, the most simple of which is the counting of holes shot in the target enhancer after the target enhancer has been recovered following the conclusion of the target practice.

The towed target is connected to one end of the lengthy cable, the other end of which is connected to the towing aircraft by means of a winch and winch cradle installed on the towing aircraft. In order to deploy the target, the winch is released. Thus the cable on the winch is unwound as the drag experienced by the released target draws the cable from the winch. As a consequence, the towing cable and its release mechanism are subjected to substantial stress due to the various mechanical forces of vibration, drag and other forms of mechanical shock which are applied throughout the system.

Essentially simultaneously with the release of the towed target from the winch cradle, the retaining mechanism for the visibility enhancer has hitherto been released via the same release switch, so that the visibility enhancer is streamed from the towed target within a split second of the release of the target itself. Thus the visibility enhancer is streamed out behind the target as the target is being deployed. The shock of extension and drag of the visibility enhancer therefore also act on the towing cable and the release mechanism. The combined stress created by the target and the visibility enhancer are liable to damage the towing cable. This can lead to severing or breaking of the towing cable during subsequent target presentation missions with possible loss of the towed target and visibility enhancer.

At the conclusion of the mission the target and enhancer are wound back to the aircraft prior to landing.

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Object of the Invention

The aim of the present invention is to avoid, as much as possible, damage to such towing cables and related equipment by the reduction of the amount of shock experienced by the cable as a result of deployment of a visibility enhancer.

Summary of the Invention

In accordance with the first aspect of the present invention there is disclosed a method of deploying a visibility enhancer for a target towed behind an aircraft in flight,

said method comprising the steps of:

- (1) storing the visibility enhancer together with the body of said target,
- (2) deploying at a first time said target body from said aircraft whilst maintaining said visibility enhancer together with said target body, and
- (3) at a second time, delayed from said first time, deploying said visibility enhancer.

In accordance with the second aspect of the present invention there is disclosed apparatus for deploying a visibility enhancer from a target towed behind an aircraft in flight, said aircraft having a towing cable having one end connected to said aircraft and the other end connected to said target, and a cable release mechanism operable in flight to unwind said cable and thereby deploy said target behind said aircraft, wherein said target includes an elongate target visibility enhancer means having one end connected to said target and being stored together with a target body, an enhancer release mechanism to permit release of said enhancer whereby the other end of said enhancer streams from said target, and a timer means activatable by said cable release mechanism and connected to said enhancer release mechanism to delay operation of same until after a predetermined period following operation of said cable release mechanism.

It will be apparent to those skilled in the art that in contrast with the prior art where the visibility enhancer retaining mechanism is immediately unlocked at the same time as the towed target commences its release from the winch cradle, in accordance with the preferred embodiment of the present invention a time delay is included so that the retaining mechanism for the visibility enhancer is not unlocked until the end of the period of deceleration experienced by the aircraft as a result of the release of the towed target. In this way the effect of the shock of the extension and drag of the visibility enhancer is then felt only on the extended towing cable. As a result, the possibility of damage to the release mechanisms and/or the towing cable itself is substantially reduced.

Brief Description of the Drawings

The preferred embodiment of the present invention will now be described with reference to the drawings in which:

Fig. 1 is a side elevational view of an aircraft in flight having a target pod secured to the underside of a wing;

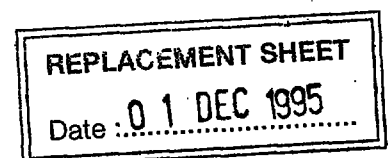


Fig. 2 is a view similar to Fig. 1 but showing the target pod deployed by means of a towing cable;

Fig. 3 is a view similar to Fig. 2 but showing the deployment of the visibility enhancer;

Fig. 4 is a schematic block diagram illustrating the preferred arrangement of the time delay mechanism; and

Fig. 5 is a detailed circuit diagram of the time delay arrangement.

Detailed Description

As seen in Fig. 1, an aircraft 1 includes a target housing or pod 2 secured to the underside of the wing structure 3. A winch mechanism 4 is also located on the underside of the wing structure 3.

As seen in Fig. 2, the target pod 2 can be deployed by operation of a release mechanism from within the aircraft 1 which enables a cable 5 to be drawn out from the winch mechanism 4 because of the drag experienced by the released target pod 2.

Fig. 3 illustrates the position a short, but very important, time later. At the time illustrated in Fig. 3 a visibility enhancer in the form of a fabric banner 7 has been unfurled or deployed from the rear of the target pod 2 so as to substantially enhance the visibility of the target.

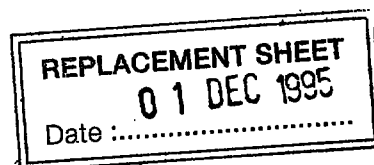
It will be appreciated by those skilled in the art that Figs. 1-3 are not drawn exactly to scale in that the longitudinal dimension of the target pod 2 is approximately 1 or 2 metres, the longitudinal dimension of the banner 7 is approximately 10 metres and the longitudinal extent of the cable 5 is normally several kilometres, preferably 2 to 7 kms.

In the prior art the target pod 2 and banner 7 are released substantially simultaneously so that the shock of the extension and the drag caused by both the pod 2 and the visibility enhancer, or banner 7 act essentially simultaneously on the cable 5 and its associated winch mechanism 4.

In order to reduce the severity of this mechanical stress, a delay mechanism illustrated in block diagram form in Fig. 4 is provided within the target pod 2.

As in the prior art, the target pod 2 contains various forms of electronic equipment, such as telemetry equipment and telecommand systems for counting the hits recorded on the special textile material of the banner 7. Further, this equipment also enables data transfer to ground so as to provide information to persons on the ground as to the success of the target practice.

As seen in Fig. 4, a release switch 11 is provided which is operable in order to release the target pod 2. The signal generated by the release switch 11 is conducted to a time delay circuit 12 which is powered from a battery 13 contained within the target pod 2. The time delay circuit 12 operates a relay or equivalent switch 14 which in turn ignites a squib represented by the resistor 15. This results in deployment of the banner 7 in substantially



conventional fashion. Thus the effect of the circuit of Fig. 4 is to result in a time delay between the operation of the release switch 11 and the activation of the squib, whereas in the prior art this operation and activation are essentially simultaneous.

Fig. 5 is a detailed circuit diagram illustrating the preferred implementation of the time delay circuit illustrated in block diagram form in Fig. 4. In Fig. 5, IC1 is a power supply regulation integrated circuit. The integrated circuit IC2 is an RC oscillator and integrated divider preferably of the type manufactured by EXAR (of the USA). This is the time controlling component. The oscillator frequency is set with a combination of resistor R5 and capacitor C3 so that the oscillator frequency (6.4 Hz) which is divided by 16 appears at pin 5. The result is a step frequency of 0.4 Hz which corresponds to a basic delay time increment of $T = 2.5$ seconds.

The outputs of integrated circuit IC2 are able to be programmed by means of a hex switch S1. If all outputs are programmed to provide low active outputs, then the NAND gates (realised by means of integrated circuit IC3) result in output transistor T2 being switched via the driving transistor T1. As a consequence, the squib resistor 15 receives a substantial current and is thus ignited.

The resistor R11 in the collector circuit of the transistor T2 is used to limit the current through the squib resistor R15 to 1 Amp at a temperature of -20°C . The output f/2 which appears at pin 2 of IC2 switches to low when the elapsed time after ignition is 312.5 milliseconds. At that time the squib current is turned off and the integrated circuit IC2 is switched to a stand-by state. In the above described arrangement which switches through the battery voltage, the whole circuit is activated on operation of the release switch.

Commercially available 9 volt primary batteries can be used for the power supply, however, with a suitable adjustment to the value of the current limiting resistance R11, just a single battery can be used if desired. However, with only the single battery the minimum operating temperature is limited to approximately 0°C .

The above described arrangement in Fig. 5 has the following specifications. The ignition current through the squib resistor 15 is greater than or equal to 1 Amp; The ignition period is greater than or equal to 100 milliseconds;

The ignition resistance is greater than or equal to 1 Ohm;

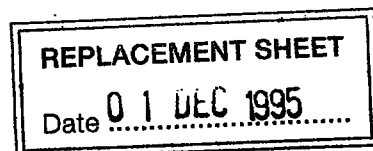
The delay time dT is adjustable between 0 and 37.5 seconds and is able to be stepped or adjusted in 2.5 second intervals;

The preferred delay period is between 20 and 35 seconds;

The accuracy of the delay time is better than 1%; and

The operating temperature range is from -20 to $+70^{\circ}\text{C}$.

The foregoing describes only one embodiment of the present invention and modifications, obvious to those skilled in the art, can be made thereto without departing from



the scope of the present invention. For example, a mechanical timer can be used rather than the electrical timer illustrated in the preferred embodiment.

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CLAIMS

1. A method of deploying a visibility enhancer for a target towed behind an aircraft in flight,

said method comprising the steps of:

- (1) storing the visibility enhancer together with the body of said target,
- (2) deploying at a first time said target body from said aircraft whilst maintaining said visibility enhancer together with said target body, and
- (3) at a second time, delayed from said first time, deploying said visibility enhancer.

2. The method as claimed in claim 1 wherein the delay time between said first and second times is substantially equal to the period of time during which the aircraft decelerates following deployment of the target body.

3. The method as claimed in claim 1 or 2 wherein the delay time is adjustable.

4. The method as claimed in claim 3 wherein the adjustment of delay time is within the range of from 2.5 seconds to 35 seconds.

5. A method of deploying a visibility enhancer from a target towed behind an aircraft in flight, said method being substantially as herein described with reference to the accompanying drawings.

6. Apparatus for deploying a visibility enhancer from a target towed behind an aircraft in flight, said aircraft having a towing cable having one end connected to said aircraft and the other end connected to said target, and a cable release mechanism operable in flight to unwind said cable and thereby deploy said target behind said aircraft, wherein said target includes an elongate target visibility enhancer means having one end connected to said target and being stored together with a target body, an enhancer release mechanism to permit release of said enhancer whereby the other end of said enhancer streams from said target, and a timer means activatable by said cable release mechanism and connected to said enhancer release mechanism to delay operation of same until after a predetermined period following operation of said cable release mechanism.

7. Apparatus as claimed in claim 6 wherein said timer means includes means to vary the length of said predetermined period.

8. Apparatus as claimed in claim 6 or 7 wherein said timer means is electronic and includes a self contained power supply.

9. Apparatus as claimed in any one of claims 6-8 wherein said enhancer comprises a strip of fabric and said target body comprises a pod releasably connected to the underside of a wing of said aircraft.

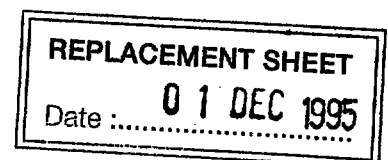
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10. Apparatus for deploying a visibility enhancer from a target towed behind an aircraft in flight, said apparatus being substantially as herein described with reference to the accompanying drawings.



STREAMING OF VISIBILITY ENHANCERS
FROM AIRCRAFT TOWED TARGETS

ABSTRACT

The present invention discloses a method of, and apparatus for, deploying a fabric banner (7) as a target enhancer from a target pod (2) towed by a cable (5) from an aircraft (1) in flight. In order to lessen the mechanical shock on the cable (5) and its associated equipment (4), the target pod (2) is first deployed. After a delay time (20-35 seconds) a time delay circuit (11) then deploys the banner.

Fig. 3

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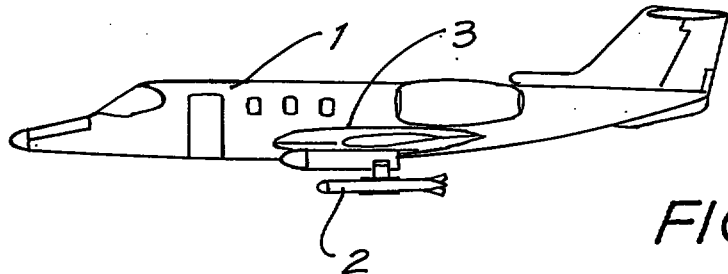


FIG. 1

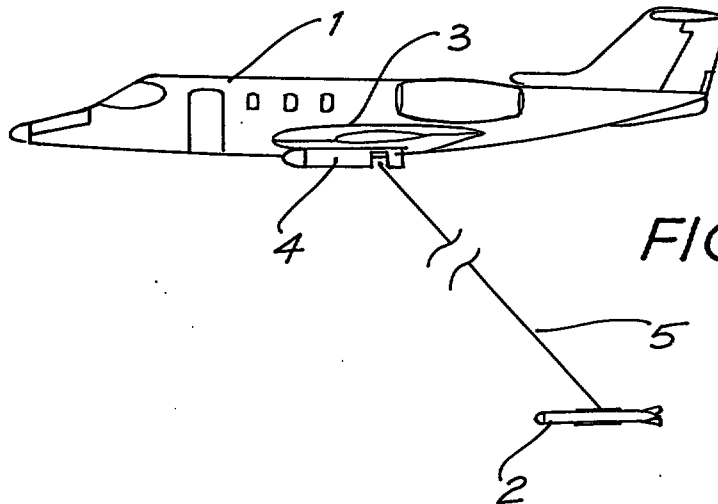


FIG. 2

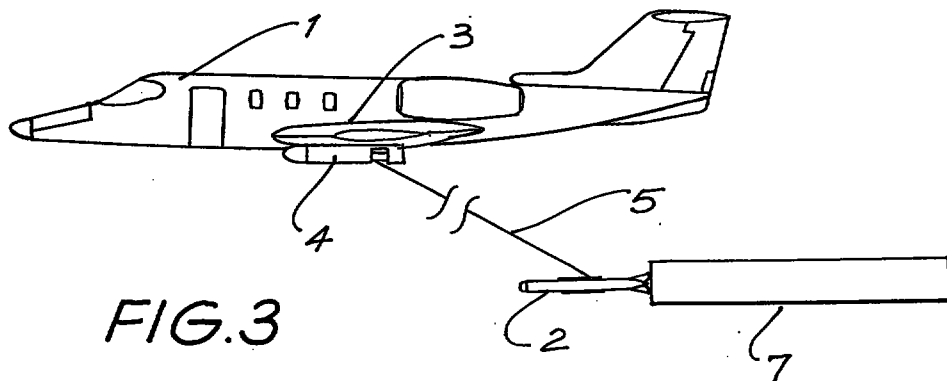


FIG. 3

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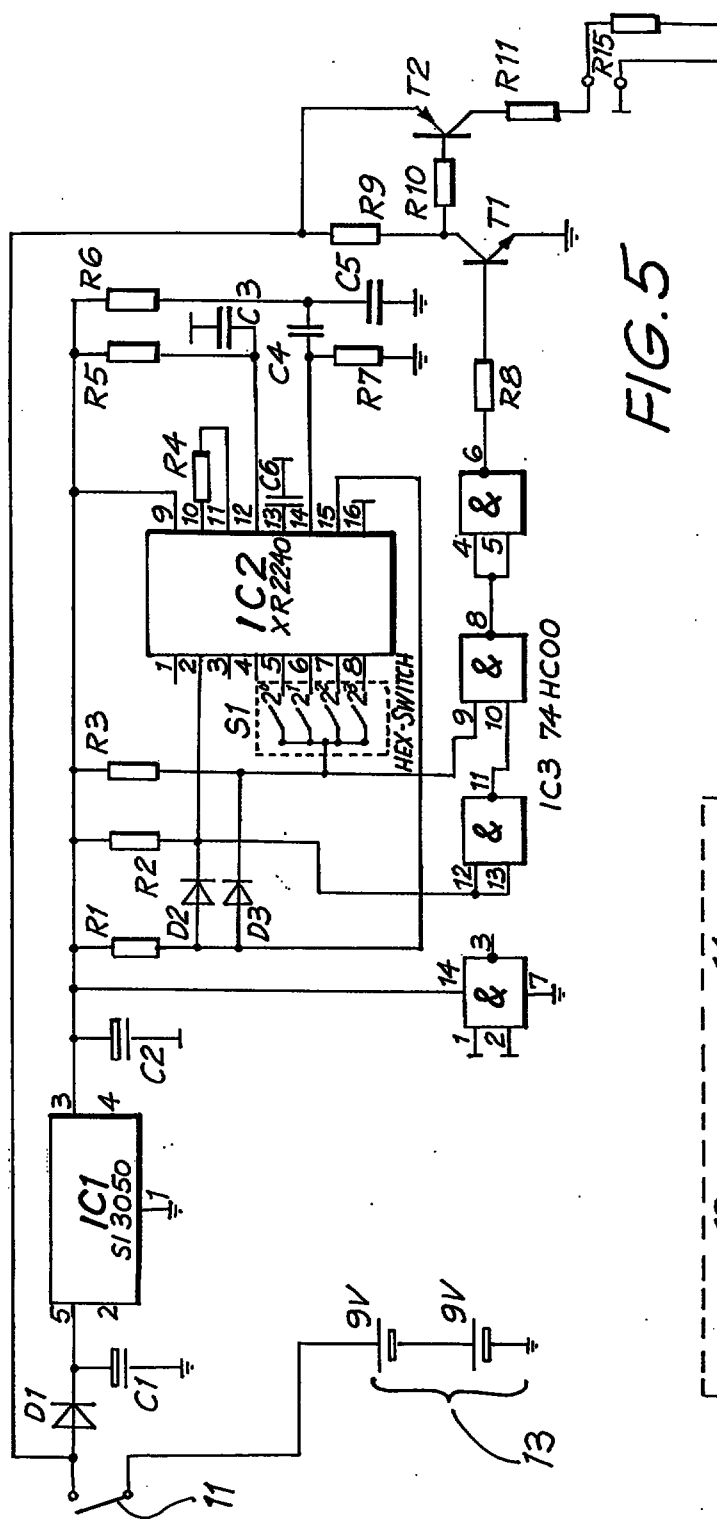


FIG. 5

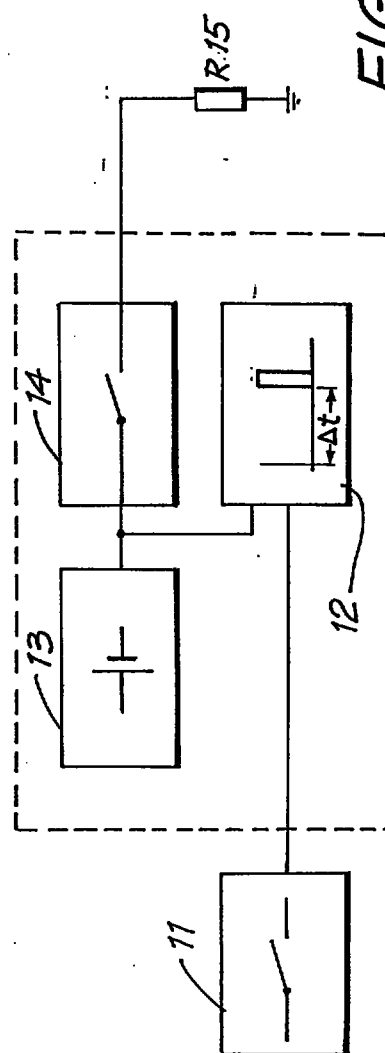


FIG. 4