Nov. 21, 1961 R. J. HOPPER ET AL 3,010,103

RADAR REFLECTIVE TOW TARGET

Filed Jan. 16, 1956 4 Sheets-Sheet 1

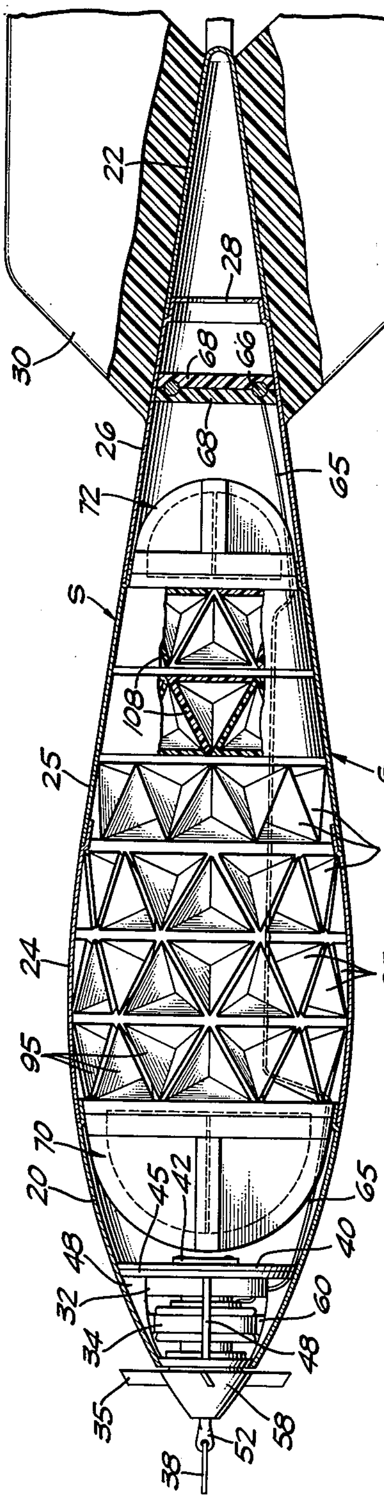


FIG. 2.

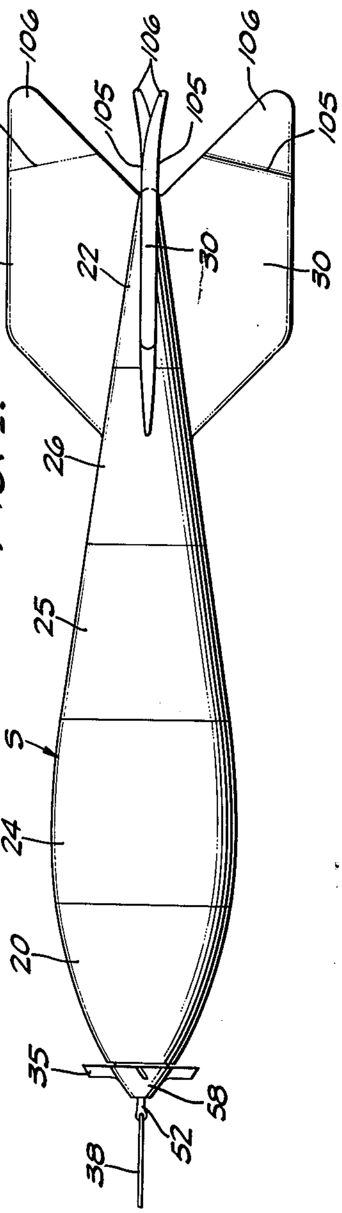


FIG. 1.

ROBERT J. HOPPER
ORSON B. LOLMAUGH
INVENTORS

BY George J. Smyth

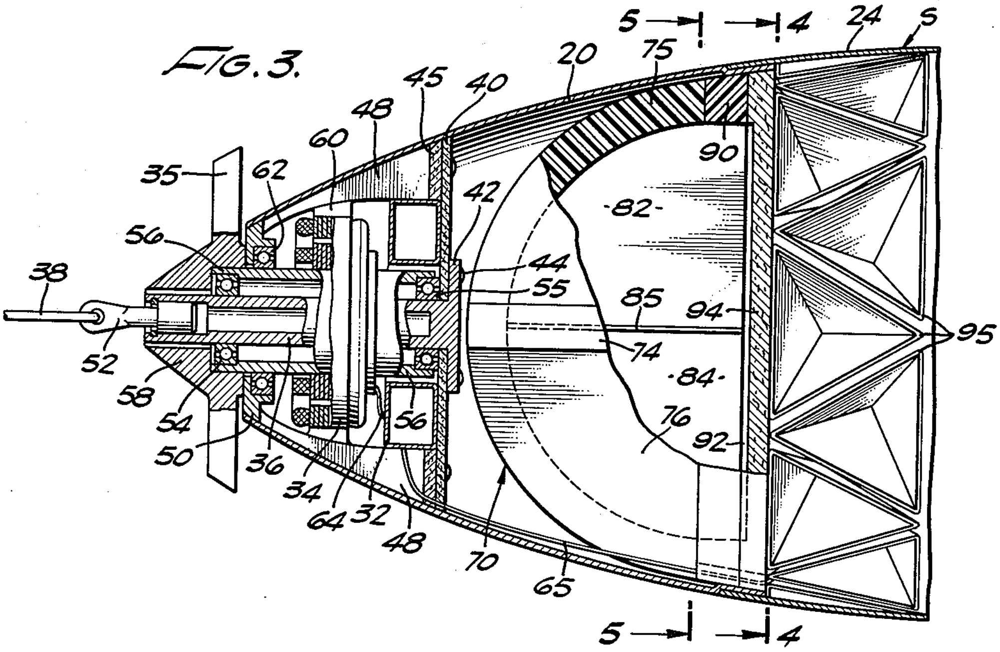
ATTORNEY

Nov. 21, 1961 R. J. HOPPER ET AL 3,010,103

RADAR REFLECTIVE TOW TARGET

Filed Jan. 16, 1956 4 Sheets-Sheet 2

FIG. 3.



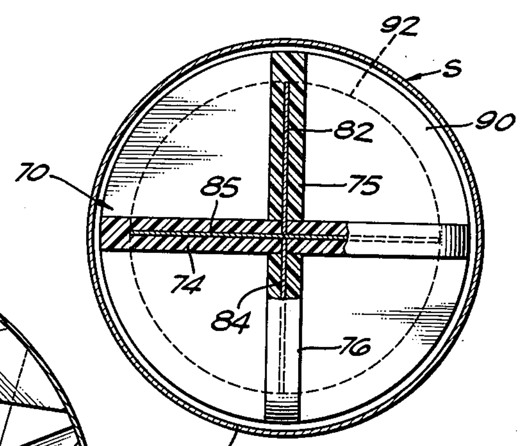
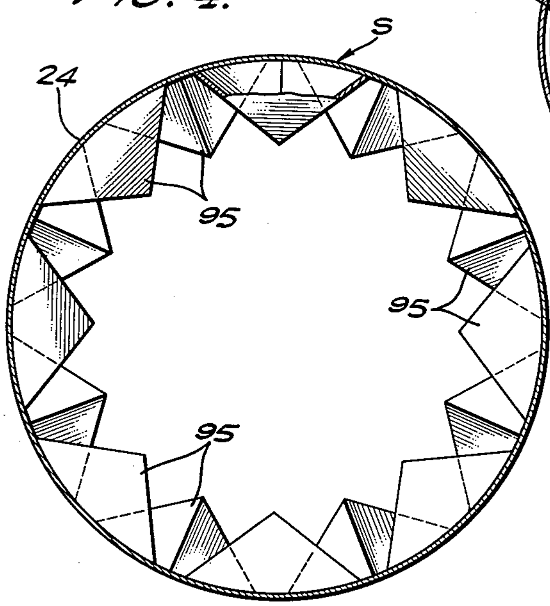


FIG. 5.

FIG. 4.



ROBERT J. HOPPER
ORSON B. LOLMAUGH
INVENTORS

BY George V. Smyth

ATTORNEY

RADAR REFLECTIVE TOW TARGET

Filed Jan. 16, 1956 4 Sheets-Sheet 3

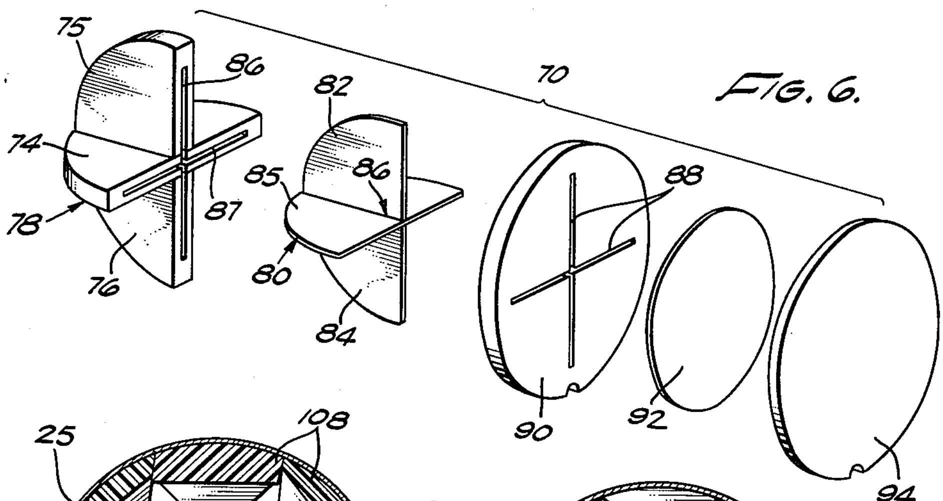


FIG. 6.

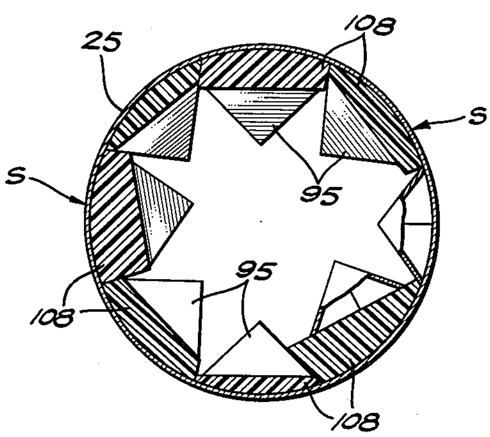


FIG. 7.

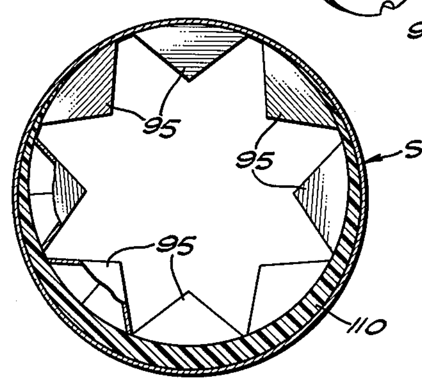


FIG. 8.

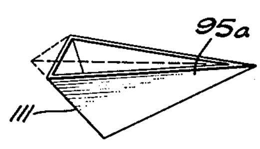


FIG. 9.

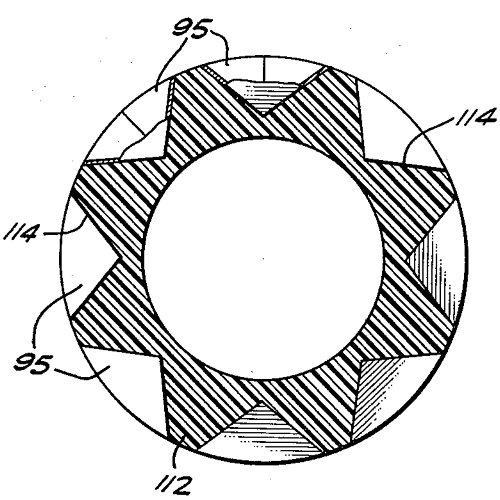


FIG. 10.

ROBERT J. HOPPER
ORSON B. LOLMAUGH
INVENTORS

BY George J. Smyth

ATTORNEY

Nov. 21, 1961 R. J. HOPPER ET AL 3,010,103

RADAR REFLECTIVE TOW TARGET

Filed Jan. 16, 1956 4 Sheets-Sheet 4

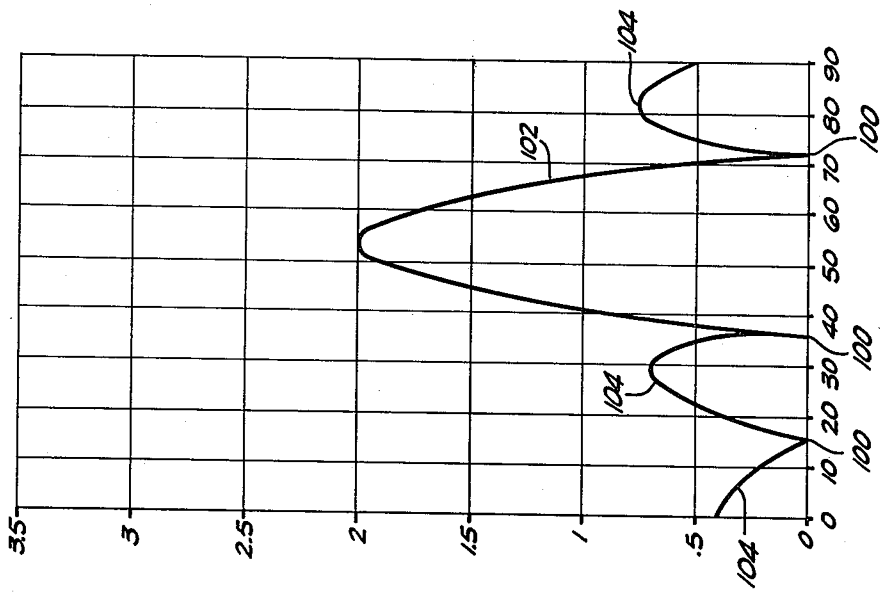


FIG. 12.

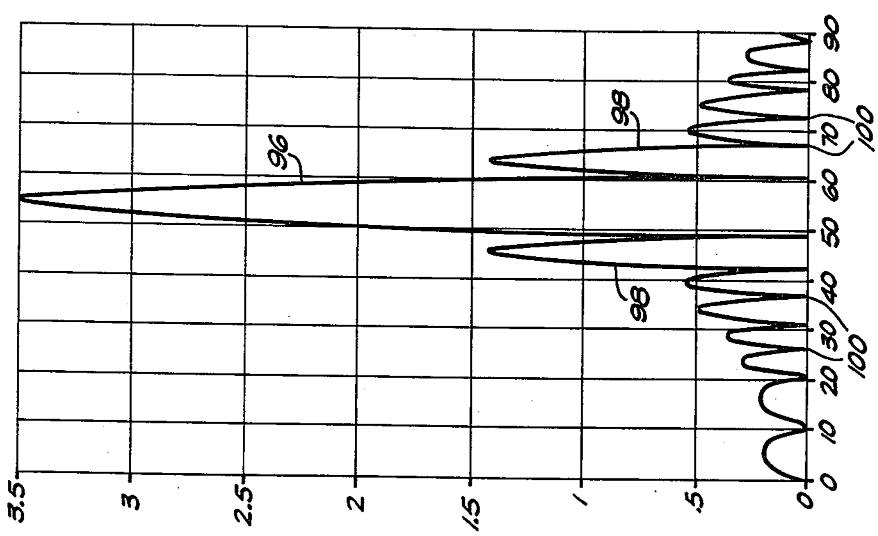


FIG. 11.

ROBERT J. HOPPER
ORSON B. LOLMAUGH
INVENTORS

BY George J. Smyth
ATTORNEY

United States Patent Office 3,010,103
Patented Nov. 21, 1961

3,010,103
RADAR REFLECTIVE TOW TARGET

Robert J. Hopper, Pacific Palisades, and Orson B. Lolmaugh, Los Angeles, Calif., assignors to Del Mar Engineering Laboratories, Los Angeles, Calif., a corporation

Filed Jan. 16, 1956, Ser. No. 559,372
12 Claims. (Cl. 343—18)

This invention relates to an aerial tow target for training pilots in the use of equipment for detecting and tracking aerial targets and the use of various automatic equipment for such purposes as fire control, missile launching control and target interception.

The invention is particularly directed to certain problems that are encountered in the task of providing realistic target experience for fighter pilots, interceptor pilots and various other military personnel partcipiating in organized teamwork for detecting, tracking and destroying aerial targets.

Any actual military aircraft has numerous reflecting surfaces extending in random directions, including numerous contiguous reflecting surfaces in intercepting planes. Consequently a military aircraft at any position relative to a radar receiver provides at least one adequate radar reflection back to the receiver, which reflection is of sufficient strength for detection of the aircraft at a relatively long distance.

This capability of an aircraft for radar reflectivity adequately distributed over a relatively large cone angle makes possible not only early detection of the aircraft at a distance but also makes possible continued unbroken radar surveillance of the aircraft thereafter. Thus, with the aircraft illuminated by radar transmitted from the ground or from the air, this wide angle of effective reflectivity makes it possible for a missile equipped with a radar receiver-guidance unit to be continuously guided by radar reflections from the aicraft for effective control along a desired curved interception path. A vitally important problem in military training, then, is to provide a practice target that is small enough and light enough to be towed by a tow line several thousand feet long and yet will adequately simulate an actual enemy aircraft with respect to reflection of radar signals.

The invention meets this problem by providing the practice target with a plurality of radar corner reflector units, each of which has three reflecting surfaces that are normal to each other and that meet at a common point at the inner corner of the unit. An exceedingly important factor in the solution of this problem by the invention is that the plurality of corner reflector units includes numerous diversely oriented reflector units that are relatively small. These relatively small reflector units are of a dimension substantially less than five times the wave length of the radar signals employed by the detecting devices.

It has been found that if a corner reflector unit is of a dimension on the order of three or four times the wave length of the radar signal, the unit produces bi-static radar reflection, the signal being substantially diffused. The invention takes advantage of this fact by providing numerous relatively small radar reflectors. In this manner the tow target of the invention provides a high probability that a radar receiver located within, say, an 80° cone measured from the direction of illumination (at any given direction from the tow target) will receive a substantial amount of radar reflection from the target.

The invention further takes into consideration the fact that two signals reflected in this manner to a receiver

may be at or nearly 180° out of phase with each other to result in mutual cancellation. The possibility that such neutral cancellation may completely cut off the desired response of the receiver to the target is adequately minimized by using such diversely spaced corner reflectors as to afford practical assurance that more than two random reflections will be returned to a receiver at any given direction from the target.

An important feature of the invention is the concept of including some relatively large corner reflector units along with the numerous relatively small corner reflector units. The larger reflector units are of a dimension more than five times the wave length of the radar signals. In the preferred practice of the invention, the dimension of the larger reflector units are at least 6½ times the wave length of the radar signals to result in mono-static reflection. As will be explained, the larger corner reflector units may comprise a forward radial assembly and an aft radial assembly with the smaller corner reflector units arranged in a circumferential assembly between these two radial assemblies.

This combining of a minor number of relatively large corner reflector units with a major number of relatively small reflector units completes the requirements for effectively simulating an actual aircraft from the illuminating position since the mono-static radar reflections from the larger reflector units may be picked up at relatively great distances for initial detection of the practice target and the bi-static reflections from the smaller reflector units enable a radar-guided missile to remain constantly locked to the practice target along the desired curved intersection path of the missile. The mono-static reflection patterns from the larger reflector units are desirable for their relatively great amplitude but have null points that are not characteristic of the over-all patterns of radar reflection from actual aircraft. The bi-static reflection patterns from the small corner reflector units fill in these null points to result in a composite reflection pattern that is equivalent in target-guidance effectiveness to the over-all pattern of radar reflection from an actual aircraft. The diffused bi-static reflections may be relatively weak but such reflections are nevertheless adequate for the purpose of the invention since that portion of the interception path where close guidance control of the missile is necessary is relatively close to the practice target.

The preferred practice of the invention is further characterized by the concept of providing aerodynamic means to cause the tow target to spin on its longitudinal axis. This spinning action increases the probability that the radar signals will be adequately reflected to a radar receiver in the desired directions. By virtue of the spinning action, only a relatively few of the small corner reflector units may be used to provide substantially uniform reflection of radar signals from the target in the general illuminating direction.

The preferred practice of the invention is further characterized by the incorporation into the tow target structure of an electronic transmitter receiver for transmitting information pertinent to target practice. For example, such an electronic transmitter-receiver unit may function as a miss-distance indicator to transmit information by radio relative to the trajectory of missiles that miss the tow target. In this regard, a feature of the preferred practice of the invention is the provision of a propeller-driven alternator or generator for energizing the electronic transmitter-receiver, the propeller being actuated by the air stream around the tow target.

The various features and advantages of the invention will be understood from the following detailed description considered with the accompanying drawings.

In the drawings, which are to be regarded as merely illustrative:

FIGURE 1 is a side elevation of a typical embodiment of the present invention;

FIGURE 2 is a similar view with portions of the target broken away to reveal concealed structure;

FIGURE 3 is a view of the nose portion of the target, the view being partly in side elevation and partly in section;

FIGURE 4 is a transverse section taken as indicated by the line 4—4 of FIGURE 3 showing how the relatively small corner reflector units are mounted on the inner surface of the target shell to form a circumferential assembly of the units;

FIGURE 5 shows the forward radial assembly of relatively large corner reflector units, the view being partly in front elevation and partly in section as viewed along the line 5—5 of FIGURE 3;

FIGURE 6 is a perspective view of the disassembled components of the forward radial assembly of relatively large corner reflector units;

FIGURE 7 is a transverse sectional view illustrating a modification of the invention in which a circumferential series of the relatively small corner reflector units are positioned in a random manner at various radial distances from the shell of the target;

FIGURE 8 is a similar transverse sectional view of another modification of the invention in which a circumferential series of the corner reflector units are mounted on a circumferentially tapered spacer inside the target shell to position the reflector units at various radial distances inwardly from the target shell;

FIGURE 9 is a perspective view of a corner reflector unit modified by a tapered cut for the introduction of a random factor in another modification of the invention;

FIGURE 10 is a transverse sectional view illustrating another practice of the invention in which the body of the target is made of foamed cellular plastic, the cellular plastic being peripherally recessed to receive the circumferential assembly of corner reflector units;

FIGURE 11 is a graph showing a typical mono-static radar reflection pattern as produced by a corner reflector unit that is relatively large in comparison to the wave length of the radar signal; and

FIGURE 12 is a similar graph showing the bi-static radar reflection pattern produced by a corner reflector that is substantially smaller.

The presently preferred embodiment of the tow target illustrated by FIGURES 1 to 6 of the drawings has a body in the form of a thin streamlined shell, generally designated by the letter S. In the construction shown, the body shell S is made of paper and is molded in a number of sections comprising a nose section **20**, a tail section **22**, and three adjoining intermediate sections **24**, **25** and **26**. The contiguous edges of these various sections are suitably bonded together, for example, by offsetting the edge of one section radially inward to telescope into the edge of the adjacent section as shown. Thus the joints between successive shell sections form internal circumferential reinforcement ribs, for example, as indicated at **28** in FIGURE 2.

In the construction shown, the streamlined body shell S is provided with a set of four stabilizing airfoils or tail fins **30** which may be of any suitable construction. In this instance, each of the tail fins **30** is molded from a suitable cellular plastic material such as expanded styrene plastic available under the trade name Styrofoam. This material has a compressive strength of 2880 pounds per square foot and yet weighss only one and a half to two pounds per cubic foot. The molded cellular tail fin **30** may be simply bonded to the peripheral surface of the tow target shell by suitable adhesive plastic.

In this embodiment of the invention, the nose section **20** of the tow target carries an electronic transmitter-receiver in an annular housing **32** to transmit signals pertinent to target practice procedures and this electronic apparatus is energized by a suitable electromotive source carried by the tow target. In this instance, the electromotive source comprises a suitable generator **34** driven by a forward propeller or air turbine **35** that is actuated by the surrounding air stream. The transmitter-receiver may be, for example, what is termed a miss-distance indicator and for this purpose may send out radio signals at regular time intervals to be received by transponders on missiles directed at the tow target. The transponders respond by returning a radio signal on a different frequency to which the receiver part of the transmitter-receiver is tuned. The transmitter-receiver responds to the returned signal immediately by transmitting a new signal without waiting until the end of the regular time interval. Thus, a station listens in on the signals exchanged by the tow target and the passing missiles and noting the time intervals of the signals obtains data indicative of the distance by which the missiles miss the tow target. One feature of this particular embodiment of the invention is the manner in which the tow target is constructed to include the components of this electronic apparatus.

As best shown in FIGURE 3, the structure of the tow target includes an axial tension member **36** for connection to the usual tow cable **38** and the rear end of this axial member is anchored to a suitable bulkhead **40** which transmits the towing stresses to the body shell S. In the construction shown, the axial member **36** extends through an axial aperture in the bulkhead **40** and has a radial flange **42** which is anchored to the rear face of the bulkhead by suitable attachment elements **44**.

The bulkhead **40** may be of any suitable material and construction. For example, the bulkhead may be made of a polyester resin reinforced by imbedded glass fibers. The peripheral edge of the bulkhead **40**, which may be thickened by the addition of a ring **46** of the same material, is suitably bonded to the body shell S by plastic adhesive. United with the bulkhead **40** is a series of forwardly extending radial gusset plates **48** and which may be integral with the ring **45**. These gusset plates **48** are preferably united with a forward reinforcement ring **50**.

Preferably, the forward end of the axial member **36** is connected to the tow cable **38** by means of a suitable swivel member **52** that is rotatably mounted inside the axial member. Suitably journalled on the axial member **36** by two spaced bearings **54** and **55** is a tubular shaft **56** that carries the propeller **35** as well as the rotor of the generator **34**. In the construction shown, a conical spinner **58** is unitary with the propeller **35**.

The stator of the generator **34** is attached to the gusset plates **48** by radial webs **60** for support thereby and the previously mentioned forward reinforcement ring **50** journals the tubular shaft **56** by means of a suitable ball bearing **62**. Thus the bulkhead assembly, which includes the gusset plates **48** and the forward reinforcement ring **50**, not only supports the stator of the generator **34** but also reinforces and holds rigid the forward end of the axial member **36** by stabilizing the forward end of the tubular shaft **56**.

The generator **34**, which incorporates a suitable voltage regulator, is connected to the transmitter-receiver **32** by a cable **64** and the transmitter-receiver is, in turn, connected to a suitable antenna by a cable **65**. The antenna may be in the form of a loop and may be positioned anywhere on the tow target. In the construction shown, the antenna comprises a loop **66** that is sandwiched between two discs **68** of cellular plastic, these two discs being positioned in the region of the tail fins **30** for reinforcement thereof.

As heretofore stated, the tow target of the present invention includes relatively large radar corner reflector units as well as relatively small radar corner reflector units. In the present construction, the relatively large corner reflector units comprise a forward radial assembly of units, generally indicated by numeral **70**, and an aft radial assembly, generally designated by the numeral **72**. Since both of these radial assemblies are of the same construction a detailed description of the forward assembly will suffice for both.

The structural parts of the forward radial assembly **70** are shown in disassembled state in FIGURE 6. A relatively thick disc of cellular plastic is cut to form a semi-circular piece **74** and two quadrants **75** and **76** and these two quadrants are bonded to opposite faces of the semi-circular piece to form a cruciform body generally designated by numeral **78**. The purpose of the cruciform body **78** is to house and support a cruciform reflector member, generally designated **80**, which may be formed by bonding two sheet metal quadrants **82** and **84** to the opposite faces of a semi-circular piece of sheet metal **85**. The sheet metal may be aluminum or copper, for example. In profile the cruciform reflector member **80** is somewhat larger than semi-circular since the center of curvature of the various arcuate edges is at the point indicated by the arrow **86** and the cruciform reflector extends rearward a short distance from this center.

To permit the cruciform reflector member **80** to be housed in the cruciform body **78**, a circular saw of the same radius of curvature as the reflector member **80** is employed to cut two diametrical kerfs **87** in the cruciform body. It is apparent that the cruciform reflector member **80** will seat in the two kerfs **87** with edge portions of the reflector member protruding rearward from the cruciform body **78**. These rearwardly protruding intersecting diametrical edge portions are received by corresponding kerfs **88** in a disc **90** of the same cellular plastic material, the thickness of the disc being selected to place the rearward edges of the cruciform reflector member flush with the rearward face of the disc. A reflector disc **92** of the same metallic material as the cruciform reflector member **80** is then positioned on the rear face of the cellular plastic disc **90** and is covered by a second cellular plastic disc **94**. It will be noted that the reflector disc **92** is of the same diameter as the cruciform reflector member **80** which diameter is less than the diameter of the two cellular plastic discs **90** and **94**.

It is apparent that when the plastic disc **90** is bonded to the cruciform plastic body **78** and the second foam plastic disc **94** is peripherally bonded to the plastic disc **90**, both the cruciform reflector member **80** and the reflector disc **92** are securely held in place to form a radial array of four relatively large radar corner reflector units, each unit having three planar reflector surfaces that are perpendicular to each other and meet at a common point. It may be noted that the dimension of each of these radar corner reflector units is nearly equal to the radial dimension of the tow target shell S at the particular location of the reflector unit. The corner length of each of these relatively large radar corner reflector units is more than five times the wave length of the radar signal that is employed in the target runs and, in this instance, is from six and a half to eight times the wave length.

A plurality of relatively small radar corner reflector units **95** are positioned inside the tow target shell S in positions facing outward and the dimension of these smaller radar corner reflector units is substantially less than five times the wave length of the radar signal. In this instance the dimension is three to four times the wave length and may be, for example, three and a third times the wave length. Each of the smaller radar corner reflector units **95** may comprise, for example, three cardboard triangles joined at their edges to form a hollow triangular pyramid having three inner faces that are mutually perpendicular and that meet at a common point or vertex, each of these cardboard surfaces being faced or lined with suitable reflecting material such as aluminum

foil. These hollow corner reflector units are bonded by their corners to the inner surface of the tow target shell S.

In the present embodiment of the invention, the plurality of relatively small radar corner reflector units **95** form a peripheral assembly between the two radial assemblies **70** and **72** of the relatively larger corner reflector units. Thus as shown in FIGURE 2, the relatively small radar corner reflector units **95** may be arranged in six annular series or circumferential rows inside the tow target shell S.

Since the various relatively small radar corner reflector units **95** are arranged radially, they provide a high probability that a plurality of radar reflections will be directed to a radar receiver that is positioned within a cone centered about the illuminating direction, the transmitter and receiver being located in any given direction from the tow target. Further diversification in the spacing of the plurality of relatively small radar corner reflectors **95** is provided by the configuration of the shell S. Thus the reflectors units of the first two successive circumferential rows are on opposite sides of the point of maximum diameter of the shell and therefore are slightly canted relative to each other. The remaining successive circumferential rows are slightly offset radially from each other by virtue of the taper of the target shell S.

The significance of the combination of relatively large radar corner reflector units with a plurality of relatively small radar corner reflector units may be appreciated by referring to FIGURES 11 and 12. FIGURE 11 shows the character of the reflection of radar signals from a corner reflector unit that is of eight times the dimension of the wave length of the signal, the amplitude of the reflected signals being plotted for different directions of reflection as measured in degrees from one of the three reflecting surfaces of the unit with the transmitter located symmetrical to all three surfaces. The reflection pattern in FIGURE 11 is what is commonly termed mono-static return since it comprises a central peak curve **96** that is of high amplitude but is relatively narrow, and includes only relatively narrow flanking peak curves **98** with numerous null points **100** at the junctures of the various peak curves.

FIGURE 12 shows the character of the reflection of radar signals from a corner reflector unit of a dimension of three and one third times the wave length of the radar signal. The reflection pattern is what is termed bi-static since it comprises a central peak curve **102** that is of substantially less amplitude but broader than the central peak in FIGURE 11, this peak curve **102** being flanked by only one or two lesser peak curves **104** that likewise are relatively broad. It is to be noted that there are only three null points **100** in FIGURE 12. The peak curves **104** at the opposite ends of the graph in FIGURE 12 are exceptionally broad because the radar reflections are greatly diffused at the relatively low angles, the diffusion being analogous to the diffraction of a light beam passing through a relatively small slot or orifice.

When it is considered that the described tow target construction provides such a large number of diversely oriented relatively small radar corner reflector units **95**, it may be readily appreciated that numerous reflections from the relatively small corner units will be received by a radar receiver at any given direction from the tow target. In this regard a feature of the preferred practice of the invention, is that the tow target is caused to spin on its longitudinal axis, such spinning being readily permitted by the provision of the swivel member **52**. To cause the desired spinning action, the four air foils or tail fins **30** are bent at their trailing ends, for example, along the lines **105** in FIGURE 1, to provide angular trailing portions **106** that function in the manner of an air screw to cause the desired spinning action.

The mono-static reflections from the relatively large corner reflector units of the forward and aft radial assemblies **70** and **72** make it possible for the described tow target to be picked up by radar detecting devices at relatively long distances, just as in the case of actual enemy aircraft. On the other hand, the numerous smaller bi-static radar corner reflector units **95** produce somewhat weaker reflections but these reflections are so well dispersed as to eliminate the possibility of any serious blind spots in the radar-guidance of missiles. Thus a radar-guided missile may be launched under the guidance of a mono-static reflection from one of the larger corner reflectors and subsequently may be guided along the desired arcuate interception path by the bi-static reflections from the numerous smaller corner reflector units **95**, there being no significant interruptions in the reflection of the radar signal to the guided missile.

FIGURE 7 indicates how diversification in the orientation of the smaller corner reflector units **95** may be accomplished by an arrangement that places the reflector units at random positions. In FIGURE 7, the relatively small corner reflector units **95** are mounted on the inner faces of cellular plastic spacer blocks **108** and the spacer blocks in turn are bonded to the inner surface of the shell S to serve as spacers between the shell and the corner reflectors. The spacer blocks **108** are of random thicknesses and in addition may have inner faces of random inclination. In assemblying the structure illustrated by FIGURE 7, the spacer blocks **108** are picked at random for installation to form a circumferential series of the corner reflector units **95** and obviously no two series or circumferential rows of the reflector units will be alike. It is to be noted that the random inclination of the inner faces of the spacer blocks **108** causes the reflector units to face in directions at random angles relative to the radii of the target body at the respective locations of the unit.

FIGURE 8 illustrates another procedure for insuring diversification in the orientation of the relatively small corner reflector units **95**. In FIGURE 8, the circumferential row of the reflector units **95** is mounted on the inner surface of a tapered spacer band **110** of cellular plastic, the spacer band being bonded in turn to the inner surface of the shell S. In the arrangement shown, the minimum thickness points and the maximum thickness points of the spacer band **110** are positioned 180° apart. It is apparent that the successive corner reflector units **95** in the circumferential row are progressively offset radially from each other by a small distance.

FIGURE 9 illustrates how a further random factor may be introduced for diversification of the orientation of the plurality of relatively small radar corner reflector units. The corner reflector units **95** heretofore discussed are of conventional symmetrical design having three identical reflecting surfaces. FIGURE 9 shows an asymmetrical corner reflector unit **95***a* which is produced by making a tapered cut on a conventional symmetrical corner reflector. FIGURE 9 shows in dotted lines the configuration of the original symmetrical reflector unit and thus explains the tapered cut. It is apparent that the tapered cut reduces the dimension of the edge **111** relative to the other two edges of the reflector unit.

It is contemplated that the successive tapered corner reflector units **95***a* in a series of such units will be turned to various directions with respect to the location of the shortened corner edge **111**. Thus the successive tapered corner reflections will be selectively effective in random directions.

FIGURE 10 illustrates another practice of the invention, in which the body of the tow target is made of a mass of cellular plastic material instead of a relatively thin shell. Thus FIGURE 10 shows a streamlined tow target body **112** of the cellular plastic material which body may, if desired, be hollow as shown. Numerous recesses **114** are formed in the periphery of the plastic body **112** and each of the recesses conforms in configuration to the shape of a relatively small radar corner reflector unit **95**. The recesses **114** may be molded into the body, or may be carved into the body by suitable cutting tools, or may be formed by the application of a heated tool of the required shape, the heated tool melting the cellular plastic material to form the desired peripheral recesses. The peripheral recesses **114** are then lined by insertion of the cardboard corner reflector units **95**.

Our description in specific detail of selected practices of the invention will suggest to those skilled in the art various changes, substitutions and other departures from our disclosure that properly fall within the spirit and scope of the appended claims.

We claim:

1. An aerial tow target, comprising: an elongated body of streamlined configuration; an axial member mounted in the nose portion of said body for attachment to a tow cable whereby said tow target may be towed by an aircraft to which said tow cable is connected; structural means internally of said body attached to said axial member for transmitting towing stress to said body; an electrical component carried within said body; propeller means rotatably surrounding said axial member, said propeller means including blade elements extending into the air stream for deriving power therefrom as said tow target is towed by an aircraft; an electrical generator carried within said body; and means operatively interconnecting said propeller means and said electrical generator whereby said propeller means rotatably drives said electrical generator in the towed flight of the target for energizing said electrical component.

2. An aerial tow target as set forth in claim 1 which includes air foils on the tow target body to cause the body to spin on its longitudinal axis; and which includes swivel means on the front end of said axial member for connection with a tow cable to permit the target body to spin independently of the cable.

3. An aerial tow target as set forth in claim 2 in which said electrical generator surrounds said axial member.

4. In a streamlined radar reflective rotary aerial tow target to simulate an enemy aircraft for practice runs with radar target-detecting devices employing radar signals of a given wave length, means for reflecting said radar signals, comprising: two pluralities of outwardly facing radar corner reflectors positioned within the streamlined configuration of said body, the dimension of one of said pluralities of corner reflectors being more than five times said wave length for substantially monostatic reflection of the radar signals for initial detection of the tow target at relatively long distances, the dimension of the other of said pluralities of corner reflectors being less than five times said wave length for substantially bistatic reflection of the radar signals whereby at any given moment in the rotation of the tow target it is highly probable that at least one of said reflectors of said other of the pluralities will be positioned for diffused reflection of the radar signals to a detecting receiver in a direction at a low angle relative to one planar surface of said one corner reflector.

5. Means for reflecting the radar signals as set forth in claim 4 in which said second plurality of corner reflectors is offset inwardly from the periphery of said body by various radial distances.

6. Means for reflecting the radar signals as set forth in claim 4 in which said second plurality of corner reflectors face at various angles to radii of the tow target body for random return reflection of the radar signals.

7. Means for reflecting the radar signals as set forth in claim 4 in which each of the corner reflectors of said second plurality is asymmetrical for selective effect in one direction.

8. Means for reflecting the radar signals as set forth in claim 7 in which said asymmetrical corner reflectors are oriented in random directions for selective effect in random directions.

9. Means for reflecting the radar signals as set forth in claim 4 in which the depth of said monostatic corner

reflectors is approximately the radial dimension of the aerial tow target at the respective locations of the reflectors.

10. Means for reflecting the radar signals as set forth in claim 4 in which the dimension of the monostatic corner reflectors is at least six and one-half times said wave length and the dimension of said bistatic corner reflectors is on the order of three to four times said wave length.

11. In a streamlined radar reflective rotary aerial tow target to simulate an enemy aircraft for practice runs with radar target-detecting devices employing radar signals of a given wave length, means for reflecting said radar signals, comprising: a forwardly facing assembly of corner reflectors the dimension of which is greater than five times said wave length for substantially monostatic forward reflection of the radar signals; a rearwardly facing assembly of corner reflectors the dimension of which is greater than five times said wave length for substantially monostatic rearward reflection of the radar signals; and a plurality of circumferentially distributed corner reflectors located between said two assemblies, the corner reflectors of said plurality being less than five

times said wave length for substantially bistatic reflection of the radar signals.

12. Means for reflecting the radar signals as set forth in claim 11 in which the dimension of the monostatic corner reflectors is at least six and one-half times said wave length and the dimension of said bistatic corner reflectors is on the order of three to four times said wave length.

References Cited in the file of this patent

UNITED STATES PATENTS

1,860,982	Binnie	May 31, 1932
2,146,723	Dunham	Feb. 14, 1939
2,419,549	Griesinger	Apr. 29, 1947
2,448,587	Green	Sept. 7, 1948
2,463,517	Chromak	Mar. 8, 1949
2,525,332	Alger	Oct. 10, 1950
2,667,351	McKinney	Jan. 26, 1954
2,795,778	Bagby	June 11, 1957
2,805,065	Cotton	Sept. 3, 1957
2,821,396	Seeley	Jan. 28, 1958