

COPY TO : MR. HARRISON
MR. GUNN
MR. HAPPE. ✓

11th December, 1941.

SECRET.

Director of Navy Contracts,
Admiralty,
BATH.

Dear Sir,

The development work on the Dome A.A. Teacher is, for all practical purposes, complete and a standardised product is in production.

In view of this fact we suggest that the features of this development originated by the staff of Technicolor Limited should be patented. We request, therefore, that permission be granted to apply for a Provisional Patent on the lines of the attached draft in the names of Technicolor Limited, L. B. Happe and F. G. Gunn.

Yours faithfully,
TECHNICOLOR LIMITED.

(Sgd.) L. W. OLIVER.

Plant Superintendent.

Copy to : Captain, H.M.S. EXCELLENT.

LWO:BW

This invention relates to cinematograph apparatus and more particularly to apparatus for training personnel to aim at aerial targets.

Means have been devised to simulate the appearance of moving bodies by projecting images of such bodies on to the concave surface of spherical structures, giving such movement to the projected images so that an observer at or near the centre of the spherical surface views an apparently moving body. The planetariums erected to show the normal or accelerated relative movements of stars and planets are an example of this method. Means have also been proposed whereby the flight of an aircraft in the sky can be simulated by photographing the aircraft with a film camera and moving the camera so as to follow the flight of the aircraft. A positive print made of the negative so obtained and projected - using a projection lens of the same focal length as the camera taking lens - on to a spherical surface from the centre of such surface, moving the projector in precisely the same manner as the camera was moved - the film in both taking and projector apparatus moving at the same frames per second - would produce to an observer at the centre of the sphere the appearance of an aircraft having the same aspect, apparent size and speed as would have been observed from the camera during the original photography.

The actual movement of a camera to follow the flight of an aircraft and the exact reproduction of this movement by a projector is difficult to carry into effect owing to the heavy nature of the apparatus to be moved and the exactitude with which such movement has to be carried out.

The object of this invention is to provide improved apparatus whereby the abovementioned difficulty is obviated.

To this end, in apparatus constructed in accordance with this invention, the camera is fixed so that, for instance, the optical axis of the lens is inclined upwards at 45° , and in

front of the lens a mirror is mounted in such a position and manner that it can be tilted in any direction so as to allow the camera to be photographing any portion of the sky.

The mirror may be mounted so that with the surface of the mirror vertical it can be rotated about a vertical axis passing along the surface of the mirror the position of this axis being, for instance, in the centre of the width of the mirror. At the same time it is arranged that the mirror can also be rotated about a horizontal axis, again passing along the surface of the mirror and situated approximately mid-way across the vertical height of the mirror. By a combination of these two turning movements the mirror can be positioned so as to allow the lens to photograph any portion of the sky over, for instance, an arc of 90° vertical and 180° horizontal embracing, therefore, one-half of the celestial concave.

Means may be provided for recording the angular movements of the mirror about these two axes; for instance, it can be arranged to affix drums on each of these two axes engraved in degrees and by a second camera suitably fixed having film running at the same speed as the main camera, for instance, 24 frames per second, a photograph of the position of these drums relative to non-rotating pointers, can be recorded. The flight of an aircraft flying in the portion of the sky to which the camera is directed by the mirror can be photographed and with each frame of the film so exposed a corresponding frame on the second recording camera will record the position of the mirror relative to its two axes of rotation.

A projector system can be arranged using a lens of the same focal length as that employed on the main camera, projecting an image by a similar mirror system to that employed on the taking system, on to the interior of a whitened spherical surface or dome. If the mirror is situated at the centre of the dome and is moved for each frame of the projected positive film

to positions corresponding to those occupied by the taking mirror for corresponding frames of the negative film, then an observer at the centre of the dome will view an image of the aircraft having substantially all the characteristics of speed, size, angular aspect and movement of the original aircraft as viewed from the taking camera.

However, for training purposes it is difficult to arrange for aircraft to fly over a definite prescribed course with great accuracy and where types of aircraft not available are required, a great simplification can be effected if model aircraft is used.

A real aircraft, flying at a constant height in a circular path, has, to an observer on the ground at a point vertically below the centre of the circular path, the same appearance throughout the whole of the flight. If such a flight were photographed on cinematograph film and the camera moved so as to keep the aircraft in the centre of the frame the whole time, then the shape and size and appearance of the image of the aircraft on the film would not change throughout the flight. Conversely, in the case of an aircraft flying on any other type of course, when photographed on cinematograph film, the appearance of the aircraft will change in size and angular aspect depending on range and the type of course flown. Therefore, it will be obvious that if a model aircraft is photographed, suitable adjustments being made as to the distance of the aircraft from the camera and the angular aspect of the aircraft presented to the camera, then any given flight can be simulated so far as cinematograph film records are concerned.

Cinematograph film records of a model photographed in this manner could be projected on a dome surface as previously described through a projector moved in such a way that the aircraft appeared to fly at its correct speed. Further, if the cinematograph film was projected with a fixed projector via

movable mirror as above described, then if the mirror is moved at a suitable rate about both its axes, the conditions of flight would be simulated except that as the mirror is moved around the vertical axes the projected frame of the film and, therefore, the aircraft image, would appear to be rotated by varying amounts. If, however, in the photography of a model run as previously described, the model aircraft or camera is rotated about the optical axis of the lens in such a manner as to compensate for this projection rotation then such a run can be projected through a mirror actuated projector system and the image will appear to have all the speed, size and angular aspect characteristics of the real aircraft run.

Means may also be provided whereby the position of the mirror and projector in the dome can be displaced from the centre of the dome so as to provide room for other apparatus and an observer at or near the centre and still provide an accurate representation of a real aircraft flight. The displacement of the projection apparatus from the centre of the dome will introduce a variable size and angular aspect error of the projected image on the dome surface. These errors can be calculated and compensating corrections made to the angular aspect of the model aircraft being photographed and the distance of the camera from the aircraft so that these projection errors are thereby corrected.

For the purposes of training in anti-aircraft gunnery, for example, a suitable sight unit, simulating the sight of a given weapon, may be mounted at or near the centre of the dome and personnel may thus be trained in aiming at a moving target by the use of the projection apparatus described. The direction in which the sight unit is pointed may be represented by a beam of light from a suitable projector attached thereto.

For a particular type of gun and projectile there is a correct point at which the gun should be aimed in order to hit an

aeroplane in flight. This correct point can be indicated on films of the type above described by a cross or mark on each frame of the film suitably positioned relative to the image of the aircraft. This mark may, for instance, be made Yellow in colour so that it becomes invisible to the gunner when his view of the aircraft through his sight is covered by a Yellow filter of suitable hue. Spots of colours other than Yellow can be used and rendered invisible by the use of a filter of suitable hue, but yellow is specially suitable.