GATWICK EXPERIMENTS COULD INTRODUCE A MUCH-NEEDED INNOVATION FOR A

THE trials of a new brightness radar display installed at Gatwick Airport in co-operation with the Ministry of Aviation may introduce a much-needed innovation to the sphere of air traffic control.

Considerable advances have been made in radar techniques over the years. The recent inclusion of digital data handling and computation devices into radar systems has opened the way to fast and accurate tracking and control of aircraft.

Improved aerial designs, increased transmitter powers and elegant electronic circuit designs incorporating reliable and efficient transistors have provided modern radar systems of very high quality.

The Cinderella of all this activity has undoubtedly been the cathode ray tube. Improvements in the performance of cathode ray tubes have, of course, been made, but it seems incongruous that with transmitter systems radiating, in some cases, millions of watts of pulse power, the final results are seen upon a fluoride screen with such a small light output that it must be viewed in a darkened room or under special phosphor cathode ray tube.

Because of the relatively slow information rate from the radar aerial head, and the need to observe the tracks of moving targets by afterglow tails, it has always been necessary to use a long afterglow phosphor cathode ray tube.

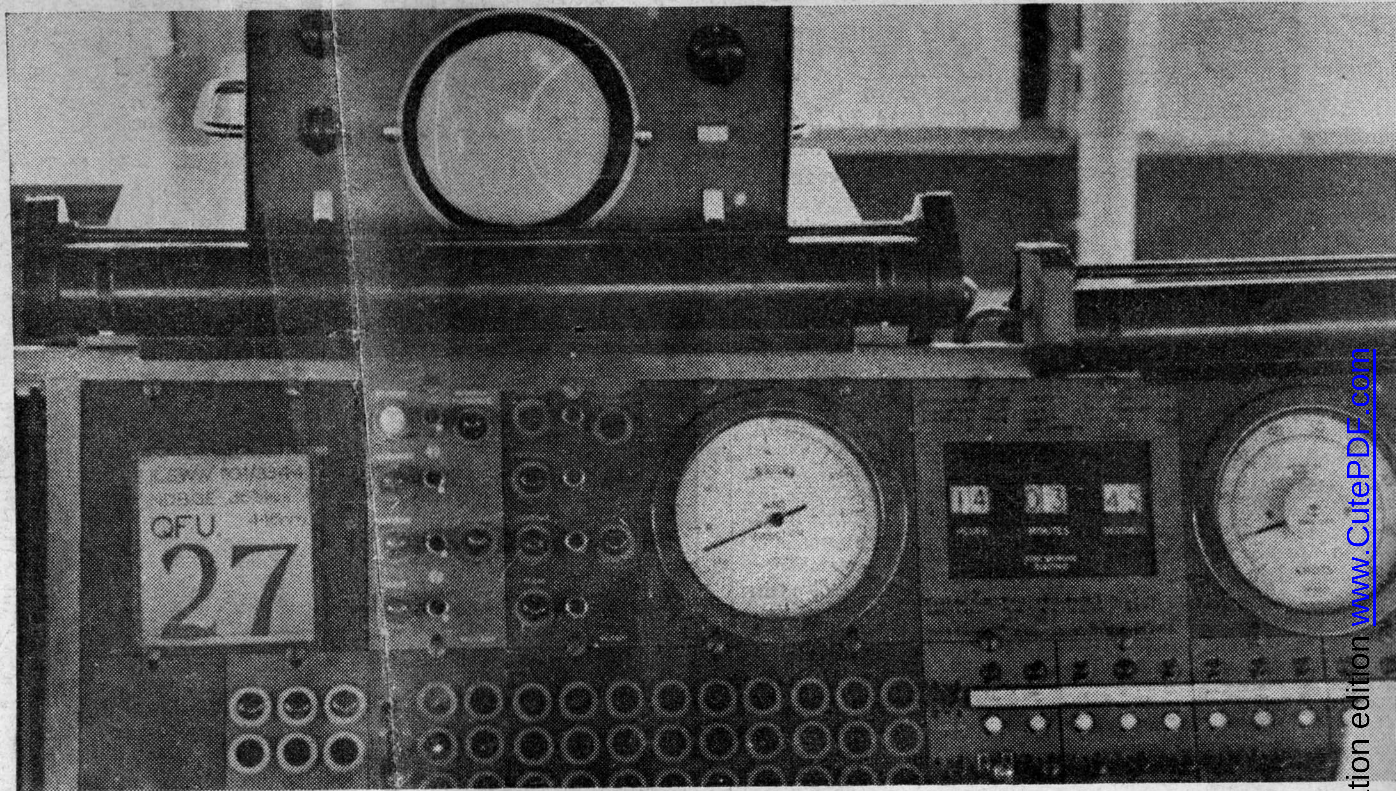
A fluoride phosphor of 200 seconds decay (to one per cent brightness) enables some eight to 10 afterglow target positions to be seen. For an aircraft travelling at 500 knots, and with a display tube radius of five inches, representing 200 nautical miles, a "tail" of about 0.6 inches is obtained.

Unfortunately, the brightness of afterglow picture is very low, and it is virtually impossible to use such tubes effectively under normal lighting conditions. The most common arrangement for viewing a fluoride radar display under bright lighting conditions is to provide a viewing hood. This is generally inconvenient as the operator needs time to allow his vision to become accustomed to the changed lighting conditions.

Viewing hoods are most commonly used for marine radar displays on the bridge of a ship, where it is not possible to provide special lighting conditions. If it is not necessary for the radar operator to be concerned with the external view, then it is common practice to provide artificial lighting which has the amber part of the spectrum removed by suitable filters, and to provide an amber filter over the display tube.

Amber is used as this is the colour of the activated fluoride phosphor. This provides maximum ambient lighting consistent with a high contrast radar display.

However, this is hardly an ideal situation, and at the very best,



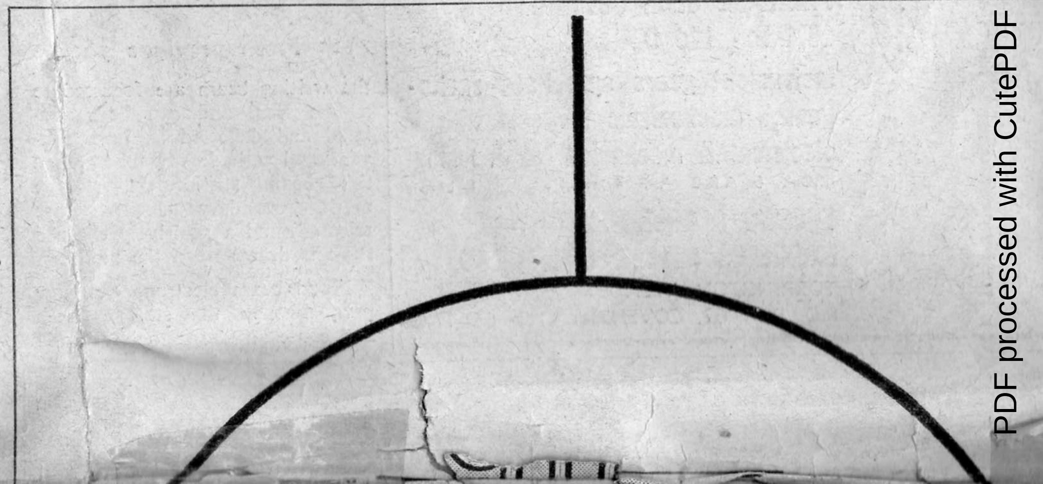
The Marconi bright radar approach display unit in Gatwick control tower. It is on trial as a transfer device to give visual information to aerodrome controllers about the position of aircraft approach or climb-out from the runway.

A bright radar display

BY D. W. G. BYATT

in the cockpit of a high flying aircraft.

This tube is known as the



commits the radar operators to unsatisfactory working conditions. Apart from this fundamental lack of brightness, the conventional long afterglow phosphor tube provides a most satisfactory display.

A resolution of over 1,000 lines is readily achievable, and tube costs are relatively low. There remains, however, the need for a radar display that can be viewed under essentially high ambient lighting conditions.

One particular environment where the bright display could be very useful is in the airfield control tower. Even on the larger airports, with comprehensive radar and air traffic control facilities, it it most desirable that the airfield controllers should be able to view, by radar, in normal lighting or room-lighting conditions, aircraft in the vicinity of the airfield, and also surface movements in the airfield.

Essential

The medium size and smaller aerodromes could often work exclusively from bright displays in the control tower more conveniently and efficiently than at present. The special environment of the radar control room is often provided solely as an extension of the airfield controller's facilities, with all the disadvantages of remote operation via telephones or other forms of internal communications.

Another environment where a bright display would be a considerable step forward is on a ship. For local navigation and collision avoidance, it is essential that the officer in charge of the ship shall be able to view his radar screen as well as the outside world, without great changes of brightness levels.

A system known as Scan Conversion has been used fairly successfully to provide bright radar displays, particularly in the USA. This involves converting slow radial radar time base signals to high-speed television line / frame

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Initially working on navigational aids and direction finders, he has been specialising on displays and radar data handling since 1959.

signals in a special electronic tube.

This tube has a storage surface placed between a radar writing gun and a TV reading gun, which takes the place of both the radar display phosphor and the television camera tube target. However, the system is rather complex and inflexible, and the line structure and frame flicker are often objected to.

The ideal tube to provide the bright radar display is one of similar form and functions to the existing fluoride CRTs but with considerably enhanced brightness.

Fortunately, a tube has been developed for short range airborne radar where conditions of extreme brightness often prevail

This tube is known as the Direct View Storage Tube, and in its earlier forms was too small to be of practical value for ground radar. The English Electric E702, a five-inch direct view storage tube (DVST) with a resolution of about 150 lines per inch and a light output around 2,000ft. lamberts, has been incorporated by the Marconi Company into an airfield radar display, which is now on trial at Gatwick.

A DVST is so called because both the storage element and viewing surface are within the one envelope. The short persistence high efficiency phosphor viewing screen is on the inside of the tube faceplate as for a normal CRT.

Just behind the phosphor is placed an extremely fine metal mesh, of the same diameter as the tube face and in the neck of the tube there are two electron guns, a writing gun and a flood gun.

The metal mesh has deposited upon it a high insulation material on the side nearest the flood gun. It is this material which provides the storage property of the tube, by virtue of the capacity between the front surface of the insulating material and the target mesh.

The flood gun electrons are collimated by an electrode to arrive normally to the screen, and to illuminate the whole area uniformly.

The velocity of the electrons from the flood gun are sufficiently low, so that when they strike the storage mesh, the secondary emission ratio is less than unity. A negative change is therefore built up in the mesh surface until it is stabilised to the flood gun cathode potential.

The flood gun electrons then penetrate the mesh and uniformly illuminate the whole of the viewing phosphor. If the storage mesh insulator potential is then made negative with respect to the cathode, the flood beam electrons are repelled, and collected by a collector mesh. The storage mesh is now primed for writing upon.

The high velocity electrons of

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