Message

Post subject:
Hi

The Gyro Gunsight Mk I - Pt 2

As soon as the Air Staff heard that the design had been completed they made arrangements to rush it into production, the prime contractors being Ferranti and Elliot Bros. (London) Ltd. But the Director of the Gunnery Research Unit advised:

It is the considered opinion of the Gunnery Research Unit that the true value of the sight cannot be proved without operational trials, and before full production is authorised we respectfully advise that a number of Squadrons should be equipped to enable the pilots, after all the advice that can be given by them, to find for themselves to what extent it aids them in actual combat.

Meanwhile, the Air Staff's fears about inaccurate shooting had been borne-out. Intelligence summaries of combat reports quoted pilots who could not understand why their fire seemed to have no effect, even when a long burst was fired from an ideal position.

In early 1941 Farnborough produced the first pre-production batch of Mk I gyro sights and a Spitfire and Defiant were flown into the airfield to be fitted. The sight was rather bulky, and difficult to fit into the turret of the Defiant. The experienced trials pilots reported an almost magical performance. As they turned into the attack on the stooge aircraft, two circles were seen in the eyepiece, the one lagging behind being the aiming point, the leading circle being the direction in which the guns were pointing. It was found a little difficult to locate the target in the small eyepiece, and the circles wandered during a high 'g' turn, but the correct deflection angle was presented.

Feranti (Edinburgh) began low-rate production in April 1941, and Spitfire and Hurricane fighters from operational squadrons tested the sights in interceptions of German raids during July and August. After six weeks the AOC Fighter Command, Sir Sholto Douglas, took his eagerly awaited report (dated September 1941) to Whitehall. It stated:

The initiative and interest shown in these trials has been far from satisfactory, owing to the following reasons: the difficulty of carrying out Service trials of gunsights under operational conditions, and the reluctance of pilots to use experimental sights in a life-and-death situation. Also, the restriction that the sight should not be used where the possibility exists that it might fall into enemy hands has been a drawback. However, sufficient information has been obtained to enable the following conclusions to be arrived at:

1 The hard and angular nature of the sight in the position it occupies constitutes a danger of facial injury to the pilot in the case of a forced landing.

2 The amount of eye freedom is very limited. It is neecessary to place one eye on the small eyepiece, so it is not posible to observe other aircraft which would otherwise be seen within the normal field of vision.

3 The sight is too sensitive. It requires some device to damp the violent changes in position of the moving graticule caused by bumps, and alterations in the rate of turn. Rates of turn above rate 3 cause the graticule to disappear entirely, and on reappearance it takes one or two seconds to settle down. It is therefore considered that in its present form the gyro sight Mk I is not a practical proposition for the operational requirements of Fighter Command. It is recommended that consideration should be given to the development of a reflector sight embodying the principle of the gyro sight, in which the disadvantages referred to above would be eliminated. The value of training pilots in the correct amount of deflection to be applied in air fighting has been considered, and it is proposed to allocate a number of these sights to Operational Training Units of this Command.

Bomber Command had also been testing sights fitted in the rear turrets of Wellingtons. Reports from gunnery officers were more enthusiastic than those of Fighter Command. Once they had mastered the technique, turret gunners showed a 50 per cent improvement in marksmanship over those using Mk III reflector sights. However, as there was no illumination of the graticule, the sight could not be used at night. The restricted nature of the small eyepiece was also mentioned, and the unstable nature of the graticule was a drawback.

Following these reports, the Air Staff had to postpone full-scale production. This was doubly disappointing, as the Spitfire Mk V was being out performed by the new Focke-Wulf Fw 190, and Bomber Command losses due to German fighters were mounting. Limited production continued to give trainee pilots and gunners practice in deflection shooting; some Coastal Command squadrons decided to use the sight operationally.

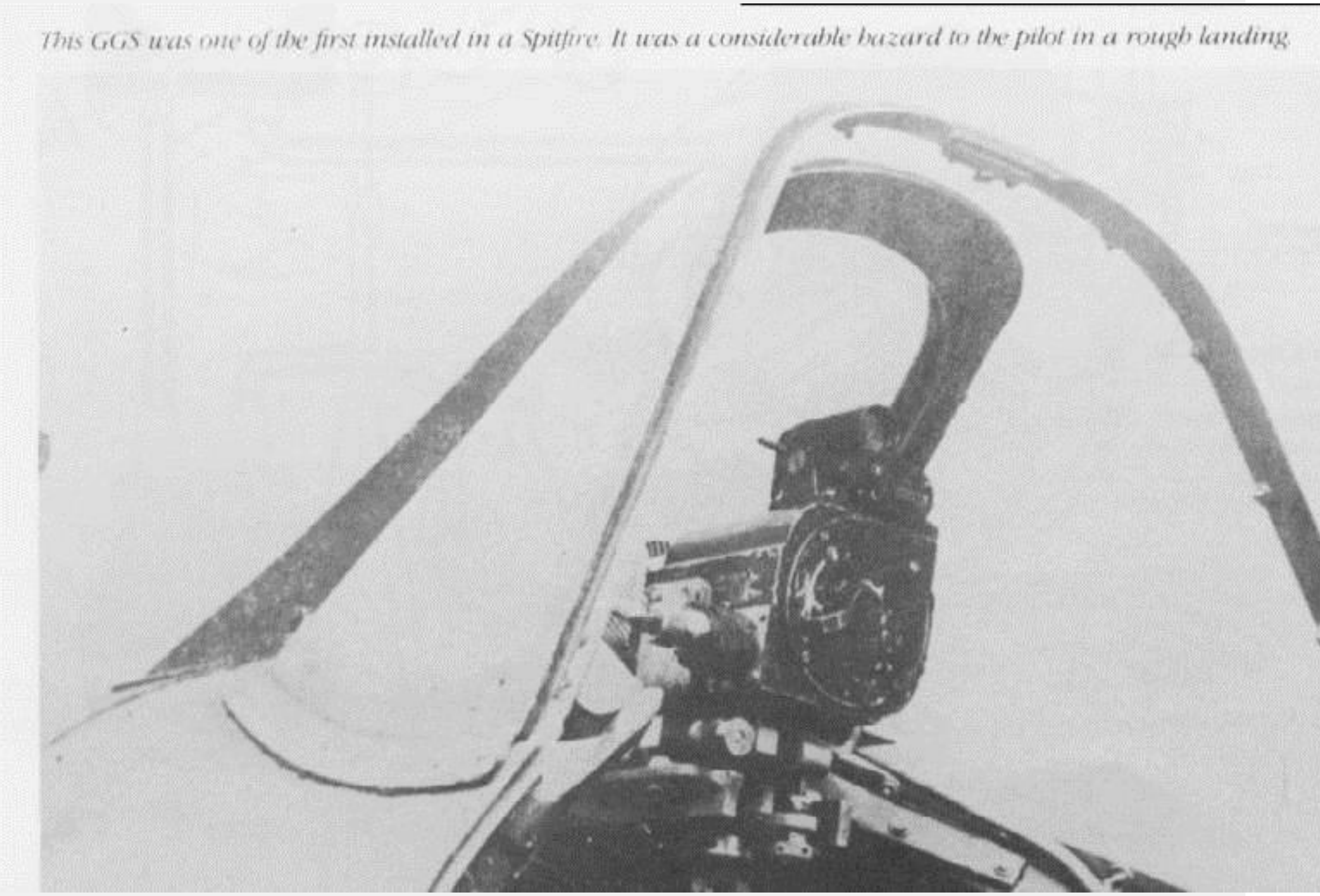
It is perhaps worth outlining again the principles by acting the part of a trainee turret gunner. You first turn on the switch on the end of the body. In a few seconds the gyro will run up to 4,000 rpm. To prevent unnecessary wear, the sight should be switched on only when hostile aircraft are expected. You then set the aircraft's height and speed on a control box on the left side of your turret. Looking through the eyepiece you will see two black circles. The larger graticule is fixed and indicates the direction in which the guns are pointing. The smaller ring is the point of aim computed to allow for deflection and bullet trail. When the turret is stationary and the guns pointing in any direction other than astern, the moving graticule will be seen as being displaced from the fixed ring by the four electro magnets. When you turn your turret to follow a target, the gyro will make the moving graticule lag behind in relation to the rate of turn or rotation. This lag, added to the bullet trail allowance, gives the point of aim required to hit the target - in other words, you can't miss - provided you can manipulate your turret controls accurately. The range of your sight is fixed at 274 m (300 yds), which has been found to be the optimum - you merely place the graticule round the target. The sight is protected from misting by a filter of silica gel, which dries the air as it enters an inlet at the bottom of the sight. Two adjusting screws harmonise the guns with the sight. As the elevation screw is turned part of the anti-vibration cradle is tilted, causing the line of sight to be elevated or depressed. Similarly, as the traverse screw is turned, the line of sight is rotated in azimuth.

The Farnborough team worked urgently to overcome the problems noted in the Fighter Command report. The first and most serious fault was the means of display. It had been decided to base the display of the Mk I on the optics of the GI to save time, but the choice of this system had precluded night use, and the small eyepiece was far too restrictive. The obvious answer was to insert a moving graticule into a reflector sight, as suggested by Sholto Douglas.

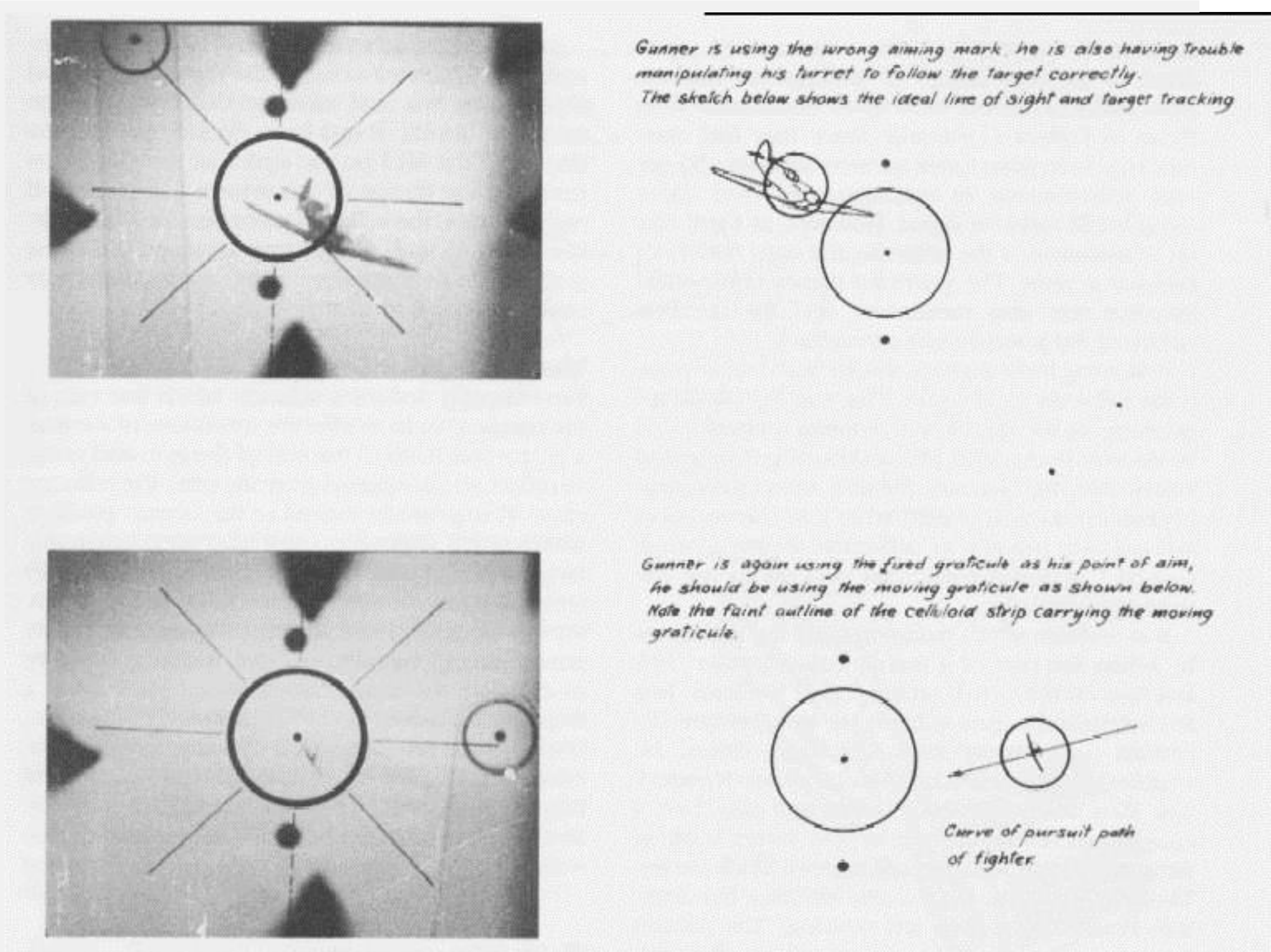
The above text and photos were taken from "British Aircraft Armament Vol.2; Guns and Gunsights", by R Wallace Clarke

Regards

Bob



Gyro sight installed in Sptifire.jpg



Assessment of a turret gunner's aim; serious faults shown by a sight recording camera fitted to a Mk I GGS.

Turret gunner's aim assessment.jpg

Post subject:
Hi

The Gyro Gunsight Mk II - Pt I

Farnborough devised a solution which was one of the simplest yet most effective inventions of the war: a mirror was fixed to the end of the gyro and made to reflect an illuminated graticule onto the reflector plate. This graticule moved to the correct position allowing for deflection, and also incorporated a ranging facility. The graticule consisted of a ring of six small diamonds, the diameter of which could be set to correspond with the target span. The type of enemy aircraft was set on a dial, enabling the sight to calculate the range. The reflector screen was a large glass plate 120 mm

(4.7 in) x 64 mm (2.5 in). Looking into the screen, the operator saw two illuminated graticules. The one on the left was a fixed ring graticule which could be used if the gyro system failed, its main use being to harmonise the guns with the sights. In the right half of the screen was the gyro-controlled ring of six diamonds. The diameter of the ring was adjusted by foot pedals in the turret version of the sight, and by a twist grip on the pilot's throttle lever on the fighter type. Both graticules could be dimmed for night use, or used singly by switching either on or off. The height and speed setting unit of the Mk I was found to be ideal, and could not be improved. The first Mk II sights made at Farnborough were tested by the Armament Research Unit in July 1943, and it was clear that the problems had been solved.

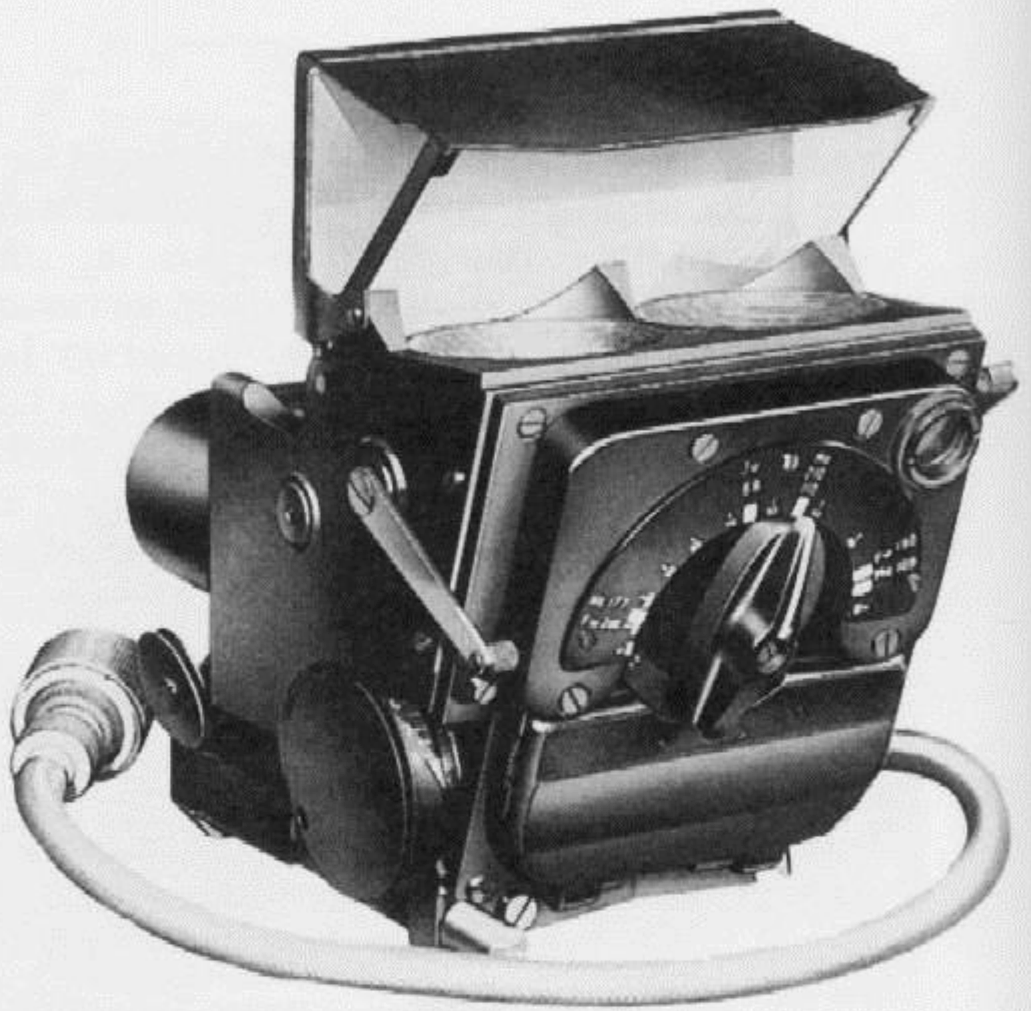
The caption for the midlde sketch is: The optical system of the GGS. The lamp shines through the graticule (G) into the gyro mirror, which reflects the image of the graticule onto the fixed mirror (M), which reflects it through the lens (L) onto the pilot's reflector screen.

The above text and photos were taken from "British Aircraft Armament Vol.2; Guns and Gunsights", by R Wallace Clarke.

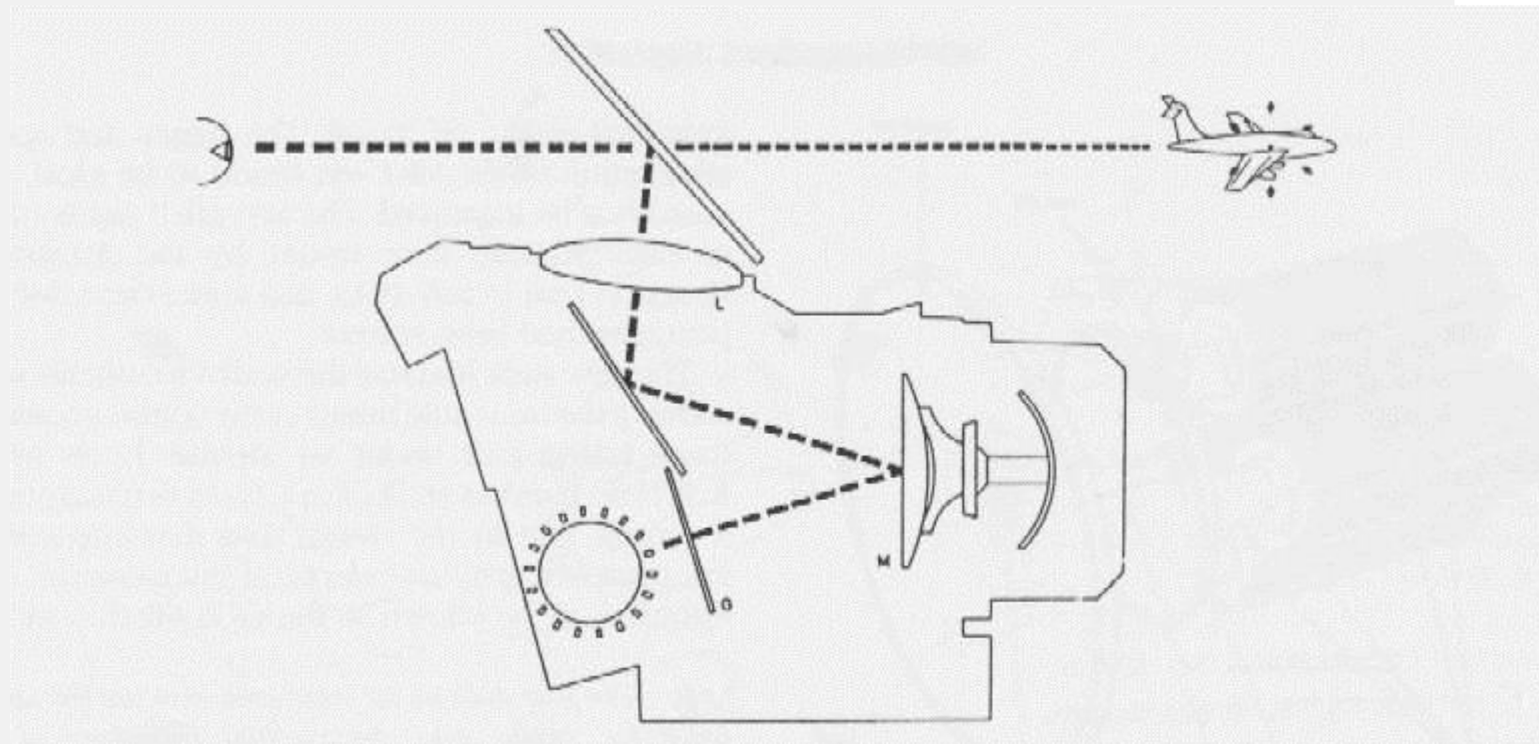
Regards

Bob

The Mk IIC gyro gunsight

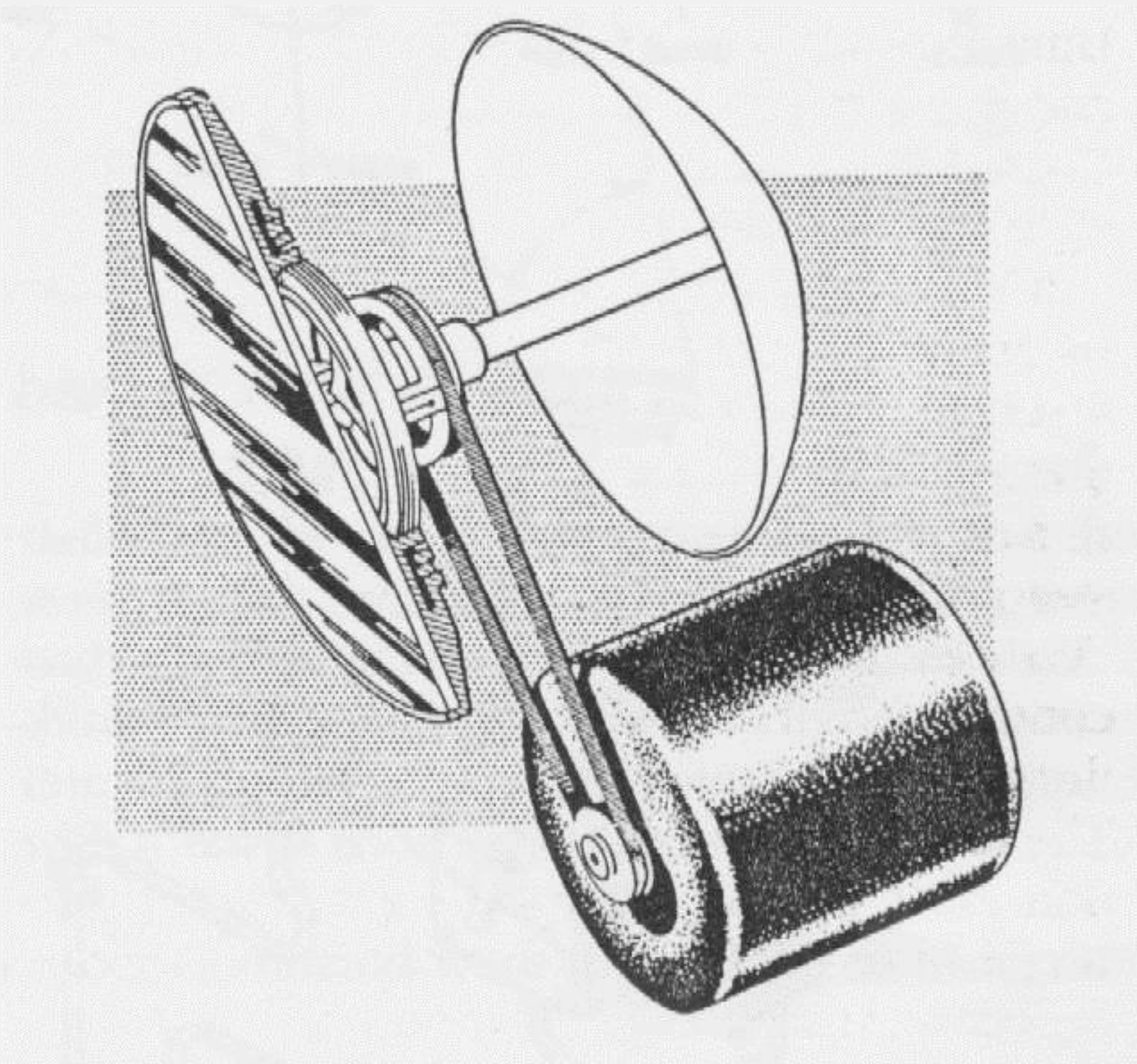


Mk II GGS.jpg



Optical system of GGS.jpg

The Rotor motor, dome and mirror.



Rotor motor.jpg

Post subject:
Hi

The Gyro Gunsight Mk II - Pt 2

The new sight had had the undivided attention of some of the most able brains in the country, some of those taking part under Sir Melville Jones being A.A Hale, B. Sykes and G/Capt. Ford. Ferranti played a central role in the design and development of the complex gyro and electrical components. The sight was to be known as the GGS Mk IIC (turret) and Mk IID (pilot). Deliveries from a purposebuilt factory near Edinburgh began in late 1943.

The sights seemed to possess almost magical qualities. As an ex-Battle of Britain pilot stated: ' I look back on previous combats where the enemy escaped more or less intact, and realised that I could most certainly and easily have destroyed it if I had been using a good gunsight'. A demonstration was also staged for two pilots of the USAAF. One reported:

I believe this sight would improve gunnery at least 100 per cent. Shooting is at the moment for most pilots purely guesswork. A pilot cannot guess with this sight, due to this I am sure that at least the lower bracket of pilots (75 per cent) will improve their shooting to the level of the best gunnery shots now, and the best ones can do even better. It is easy to handle, and there is no situaiton it cannot handle as well as the GM2, and in most cases (90 per cent) it will do better.

The second pilot reported

Speaking from the point of view of the day fighter, I would say that the Mk IID gyro gunsight is definitely the answer to our problem with deflection shooting. We are proving daily that the average pilot cannot do deflection shooting, even with small angles, accurately with a fixed sight. I think that the sight should be put into produciton immediately and fighter squadrons equipped with them as soon as possible.

Bomber Command were also very keen to receive the Mk IIC version. It was first issued to gunnery schools and operational training units where lectures and air-to-air gunnery practice were quickly arranged. The gunnery schools had been very pleased with the Mk I sight, which had proved invaluable for instructional purposes. A compact 16 mm sight-recording camera had been produced, and gunnery training was much improved owing to the fact that no ammunition needed to be fired, and a record of accuracy could be shown to the trainee. As with the Aldis sight, word soon spread round the operational squadrons and the new sight was eagerly awaited.

Caption to top sketch: Stadiametric ranging system, which set the span of the target into the mechanism.

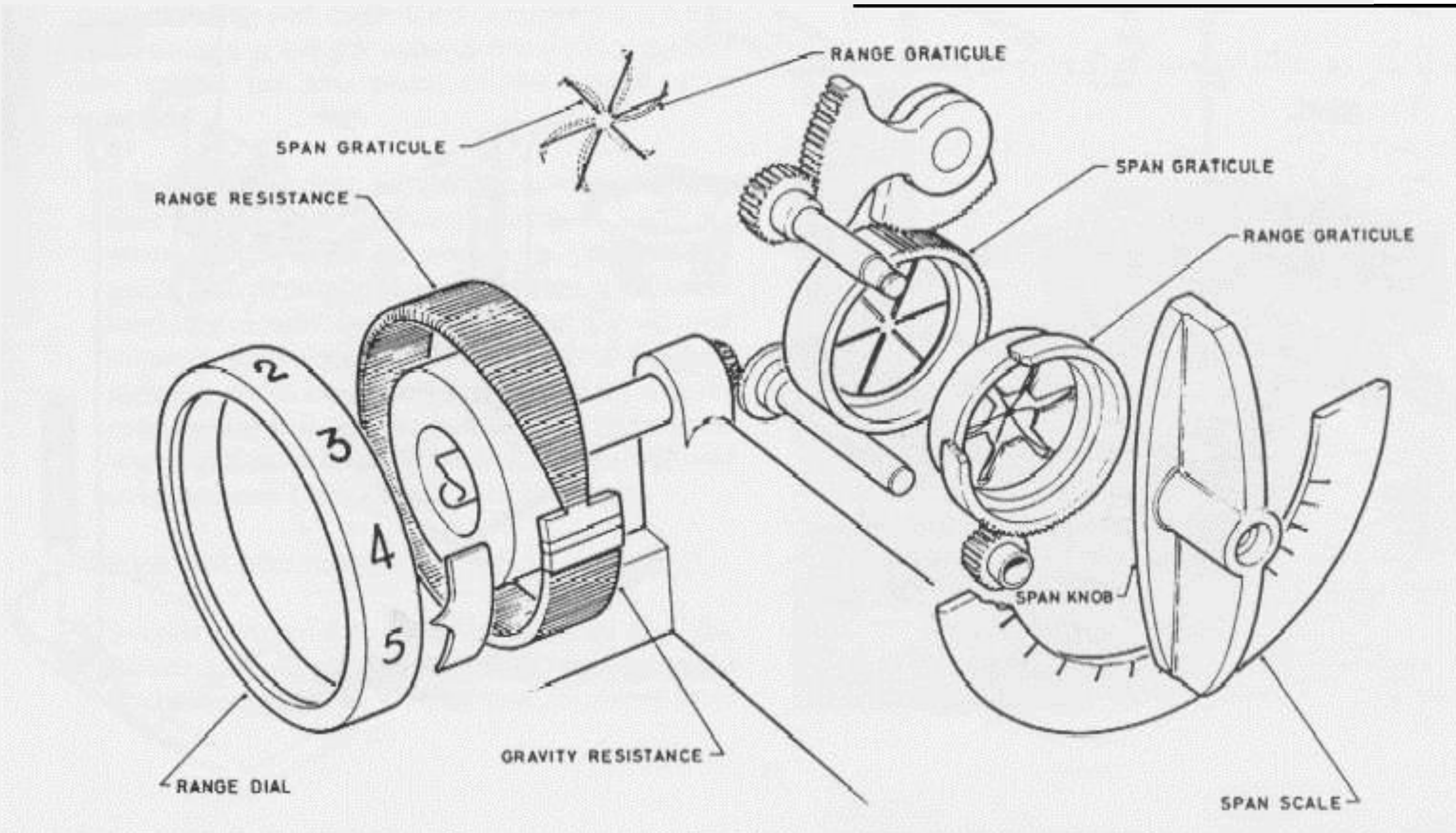
Caption to middle sketch:The four coils in the rotor unit injected the allowance for range and the ballistic trajectory of the ammunition.

Caption to bottom sketch: The Mk IIC gunner's installation showing the various components.

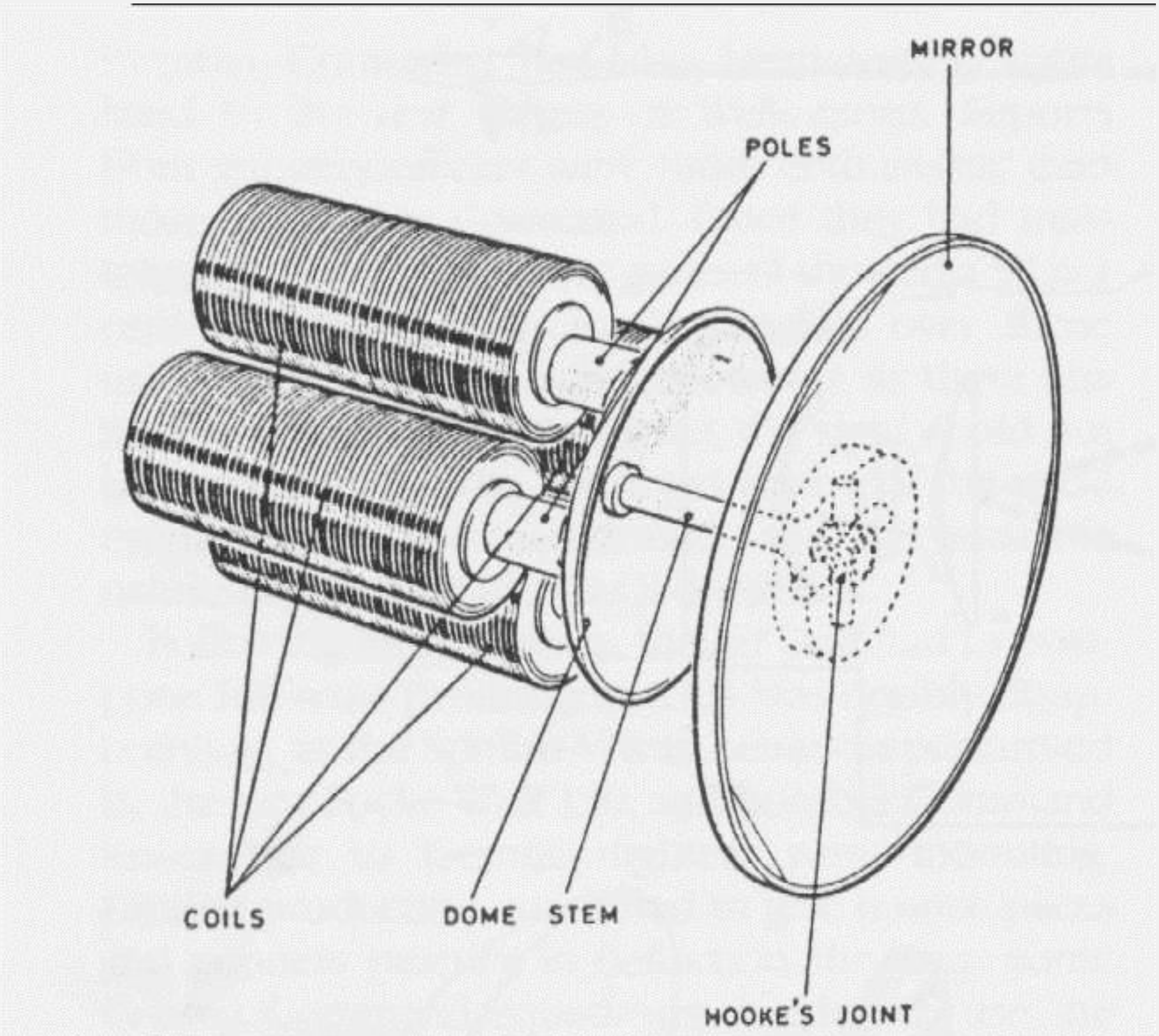
The above text and sketches were taken from "British Aircraft Armament Vol.2: Guns and Gunsights", by R Wallace Clarke.

Regards

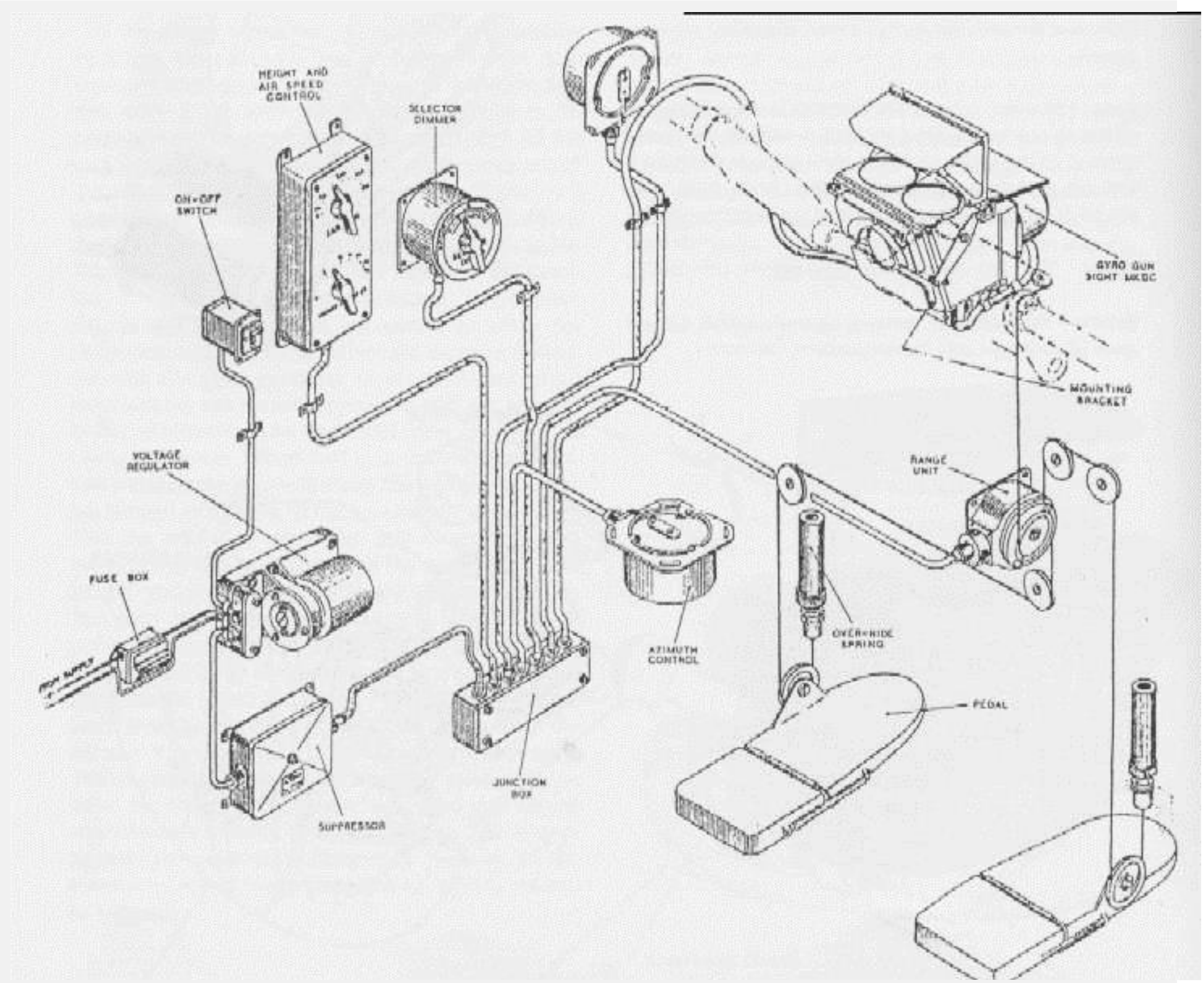
Bob



Stadiametric ranging system.jpg



Rotor unit.jpg



Mk IIC gunner's installation.jpg

Post subject:
Hi

The Gyro Gunsight Mk II - Pt 3

At first there was concern over the possibility of the sight falling into enemy hands, and there were restrictions on gyro-equipped aircraft flying over enemy-held territory, but as they became more numerous this rule was relaxed, and the Luftwaffe began to suffer from the attentions of an enemy who could suddenly fire with uncanny accuracy. Not that all fighter pilots accepted the gyro sight with enthusiam at first, for it required a fair degree of dexterity: select graticule brillance, set graticule presentation, set span level, then once the target is presented align the ring of diamonds to the enemy span. No such preparation was needed on the Mk II, but as pilots gained experience the early scepticism vanished, and results bore witness to the gyro's effectiveness. The US Navy and Army Air Force formally accepted the sight, and production commenced in America where it was designated the Mk 18 (Navy) and K-14 (USAAF). In Canada, Semco Instruments produced a naval sight more robust than aircraft versions and with two dimming screens to counter glare off the sea. Otherwise the 'works' were identical to the Ferranti model.

perhaps the reader can imagine himself seated in the Frazer-Nash FN.20 tail turret of a Lancaster, flying in daylight over Germany in early 1945, when an enemy fighter is seen to dive to the attack.

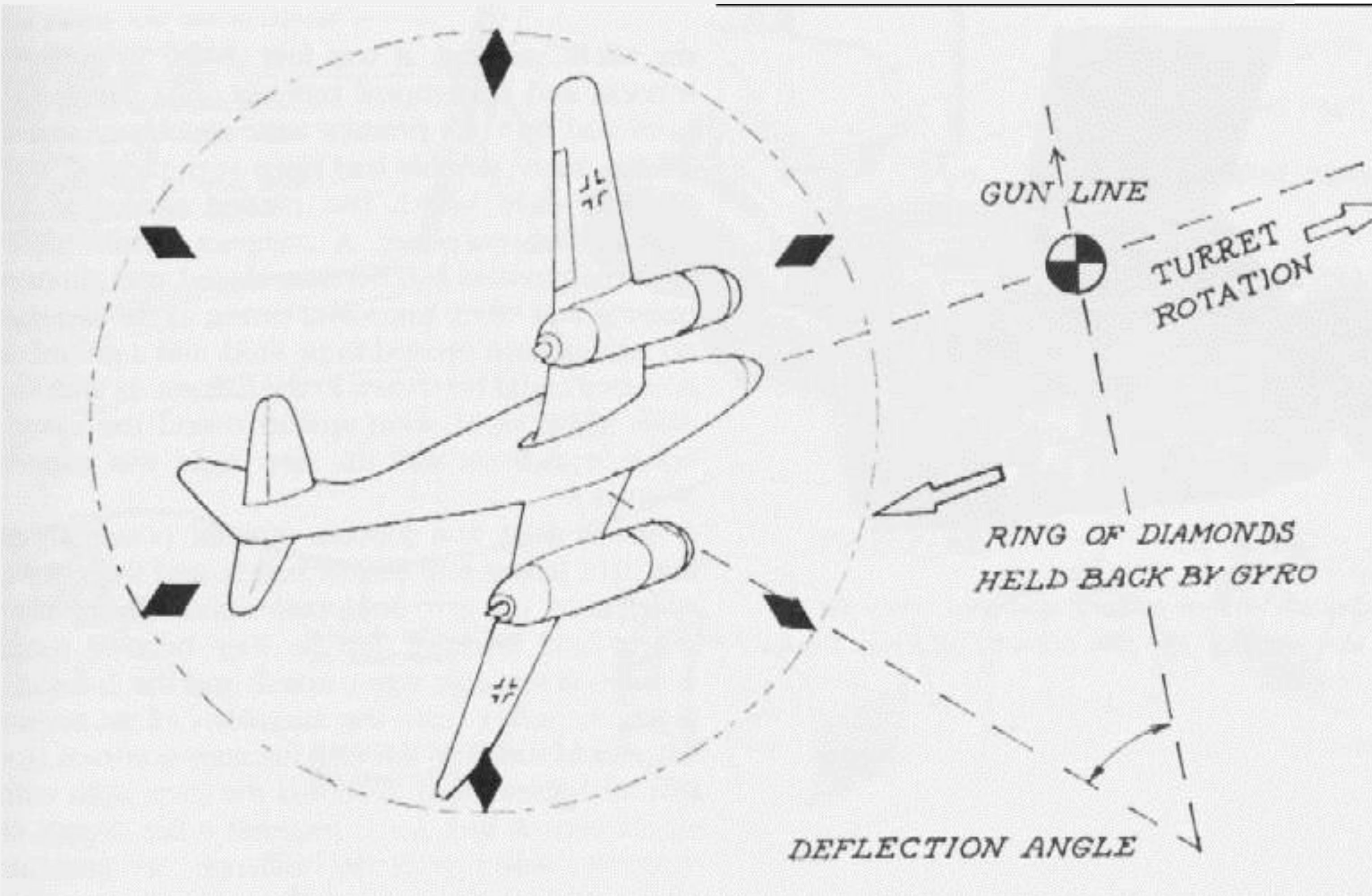
The heart misses a beat, but then you realise that only you can save the aircraft and crew, you are in effect in full control. First you inform the captain and crew of imminent attack, and tell the pilot which way to break away to give the enemy maximum deflection. You will have already set the height and speed on the dials of the control box mounted horizontally at hand level to your right. You identify the fighter and set its wingspan on the span handle. You now operate the left pedal which opens the ring of diamonds to the maximum range setting. As your attacker closes in, you keep him inside the ring until he fills the ring; he is now framed and within range - open fire with a four-second burst. As long as you can keep him centre in the ring your bullets will be striking home. If he keeps coming in, he will appear to get larger; depress the right pedal to control the ring and keep his wingtips touching the diamonds. Track the target accurately and smoothly at the same time as closing the range with the pedals. When the target reaches 183 m (200 yds) the graticule will not get smaller, but the sight will still be accurate. Keep the right foot pressed and aim at the aprt of the fighter where hits will do the most damage.

The above text and photots were taken from "British Aircraft Armament Vol.2: Guns and Gunsights", by R Wallace Clarke.

Regards

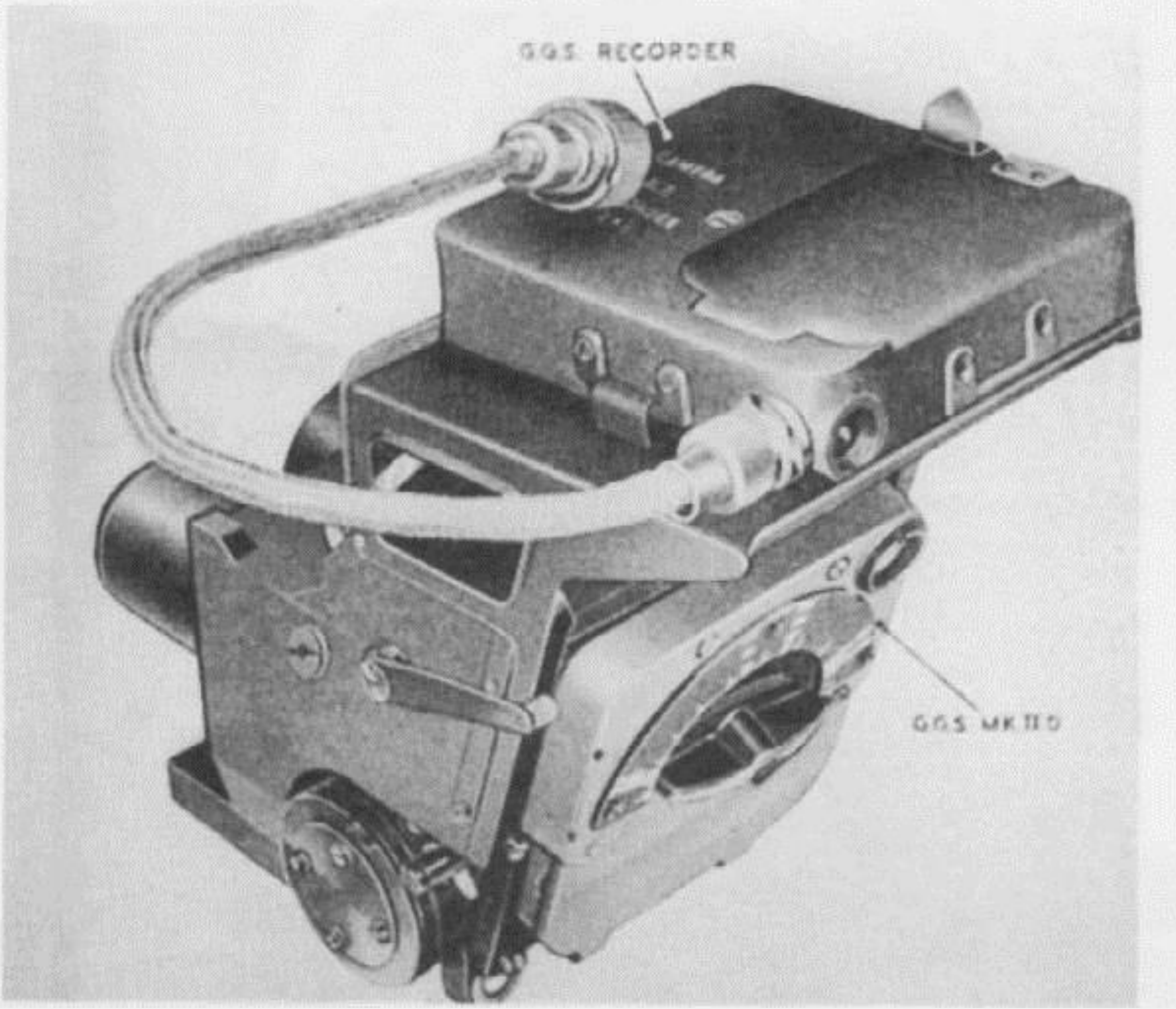
Bob

Automatic deflection angle presented by the GGS.



Deflection angle.jpg

Sight recording camera fitted over the hood of a Mk IID (Ferranti)



Sight recording camera.jpg

The electrically driven camera operated when the gun button was pressed. The film holder (left) was loaded with 16 mm film.

Electrically driven gun camera.jpg

Last edited by Robert Hurst on 26 Mar 2003 12:33; edited 1 time in total

Post subject:
Hi

The Gyro Gunsight Mk II - Pt 4

A fighter pilot using the Mk IID would not use pedals to control the diamonds but a twist grip on his throttle. The operator could select various combinations of illumination. With Gyro Night, only the gyro graticule was visible, and the range was set to 165 m (180 yds) irrespective of pedals or twist grip. This was the usual maximum range at night.

Several types of German aircraft were marked on the dial, and aircraft identification became even more important to pilots and gunners. Gunners were taught to recognise the frontal silhouettes of German and Allied aircraft instantly. Anyone who failed the aircraft recognition test badly often failed the course.

Caption to middle sketch: The American version of the GGS, the K-14 showing its operating sequence.

Caption to bottom sketch: The graticule selector/dimmer unit. The fixed graticule was used mainly for gun harmonising, but was also a standby in case of gyro failure.

Details of Mk II GGS Gyro Sight Production

GGS specification received from Air Ministry to Ferranti Ltd, Edinburgh, February 1943.
Site for new factory purchased December 1942.
Building commenced February 1943.
Factory opened June 1943
First production sight 30 November 1943
Quantity production commenced February 1944
Output by March 1945: 1,000

From a labour force of 100 in July 1943, Ferranti employed 950 at peak production in October 1944.

Number produced.

1944

February: 8
March: 110
April: 200
May: 250
June: 370
July: 380
August: 420
September: 540
October: 700
November: 720
December: 600

1945

February: 400
March: 1,000
April: 1,100

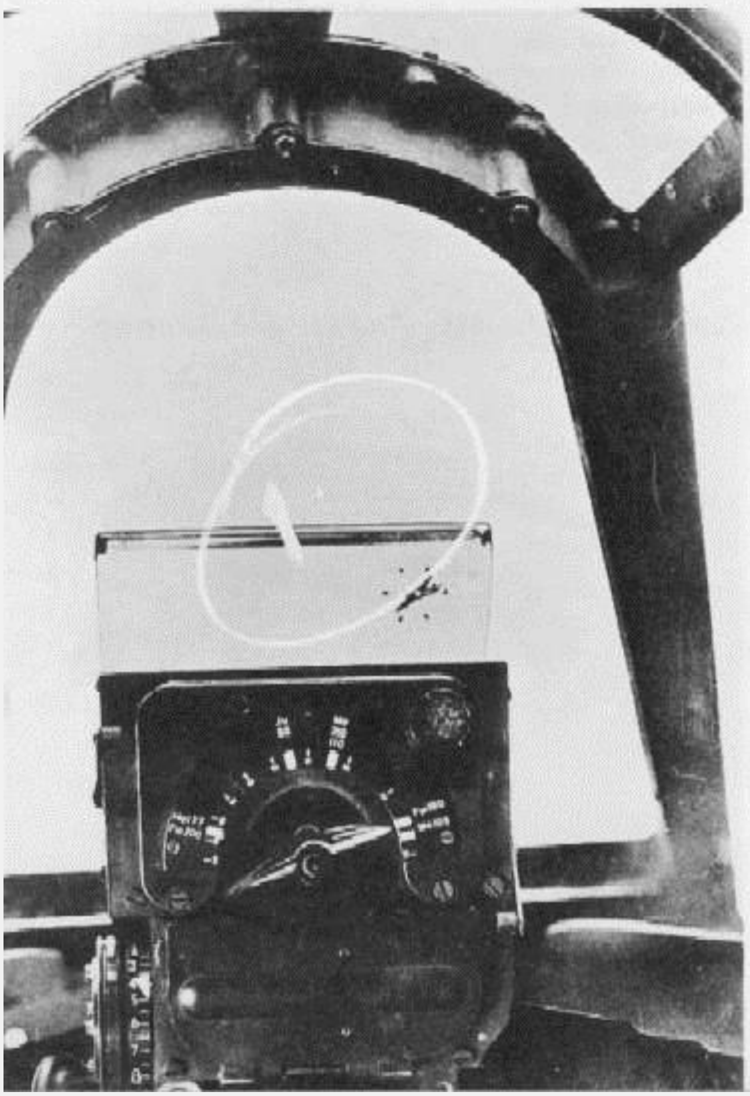
Other companies were also involved in production: Barr & Stroud supplied lenses and produced a small quantity of complete sights. Salford Electrical Company produced gyro sights to Ferranti drawings, and other concerns carried out sub-contract work.

The above text and photos were taken from "British Aircrat Armament Vol.2: Guns and Gunsights", by R Wallace Clarke.

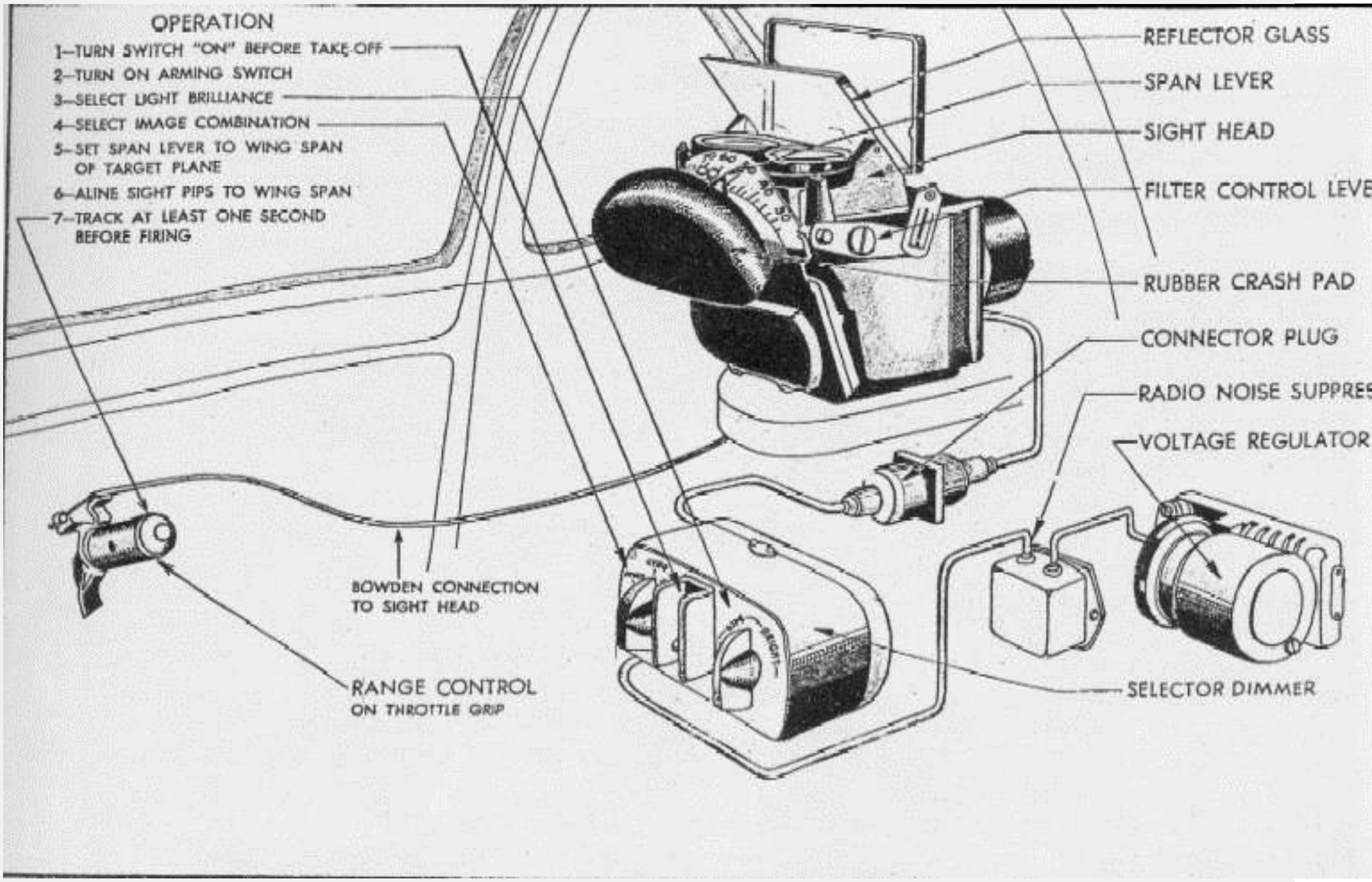
Regards

Bob

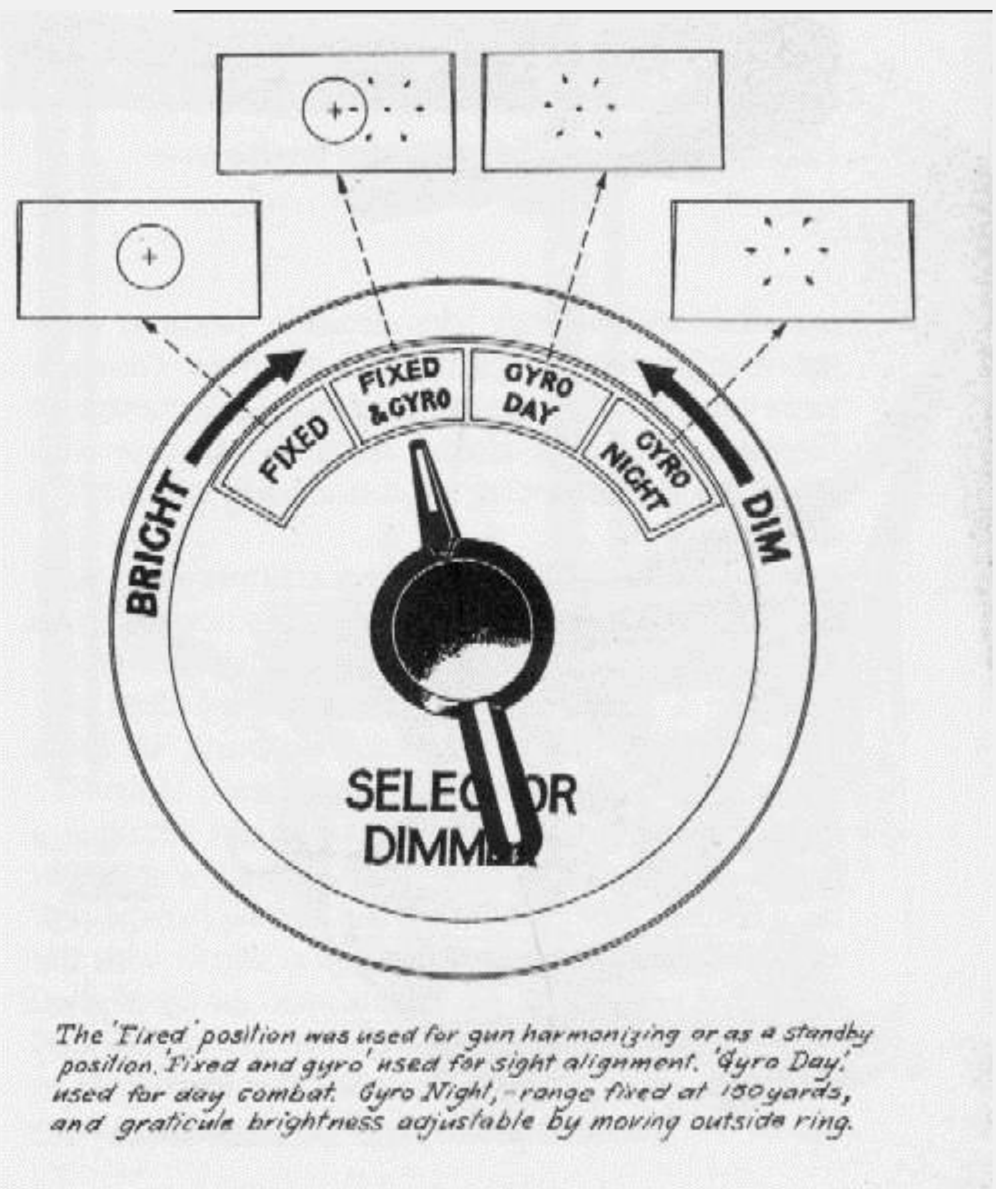
A MkIID in a Hawker Hurricane, set to engage an FW 190 at 350 yd (320 m).



Mk IID Gyro Sight.jpg



K-14 (The American version of the GGS) gyro sight.jpg



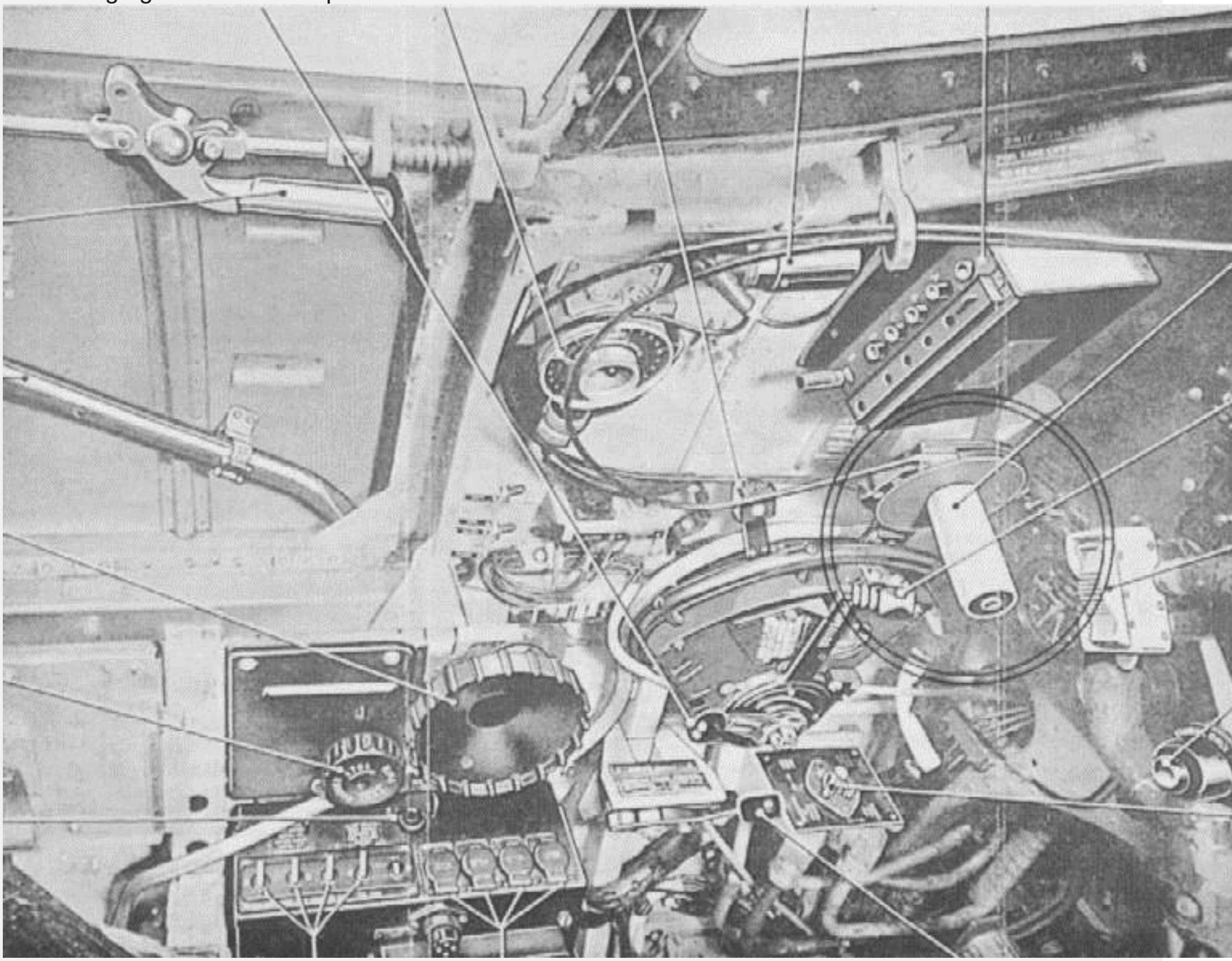
Graticule selector unit.jpg

Post subject:
Hi

Ventral Turret Sights

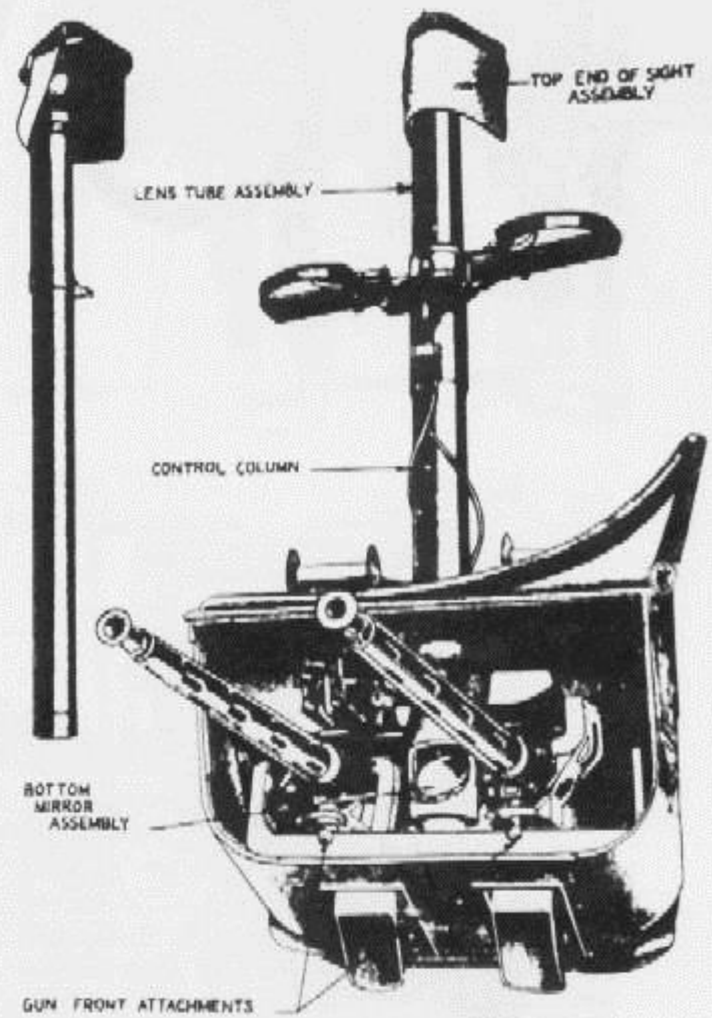
Afrer suffering a high loss rate in the early months of the war, the Blenheim light bomber was fitted with a rearward-firing under turret, the FN.54A. The twin Browning guns were aimed by a periscopic sight, the Type A. This consisted of an optical tube with a mirror at each end, a graticule and angle-of-drift scale. The two operating handles each had a trigger, and the graticule was a black circle. The field covered was 20 degrees each side, and 17 degrees depression. A more elaborate sight was fitted to the Frazer-Nash FN.64 fitted to some Lancasters. This, the Type B, featured a full optical system culminating in a prism linked to the guns in elevation. The turret was powered by a small version of the Nash & Thompson hydraulic system. As in all prismatic systems, the gunner's vision was limited to the narrow FOV through the lenses.

GGS ranging controller on Spitfire throttle lever.

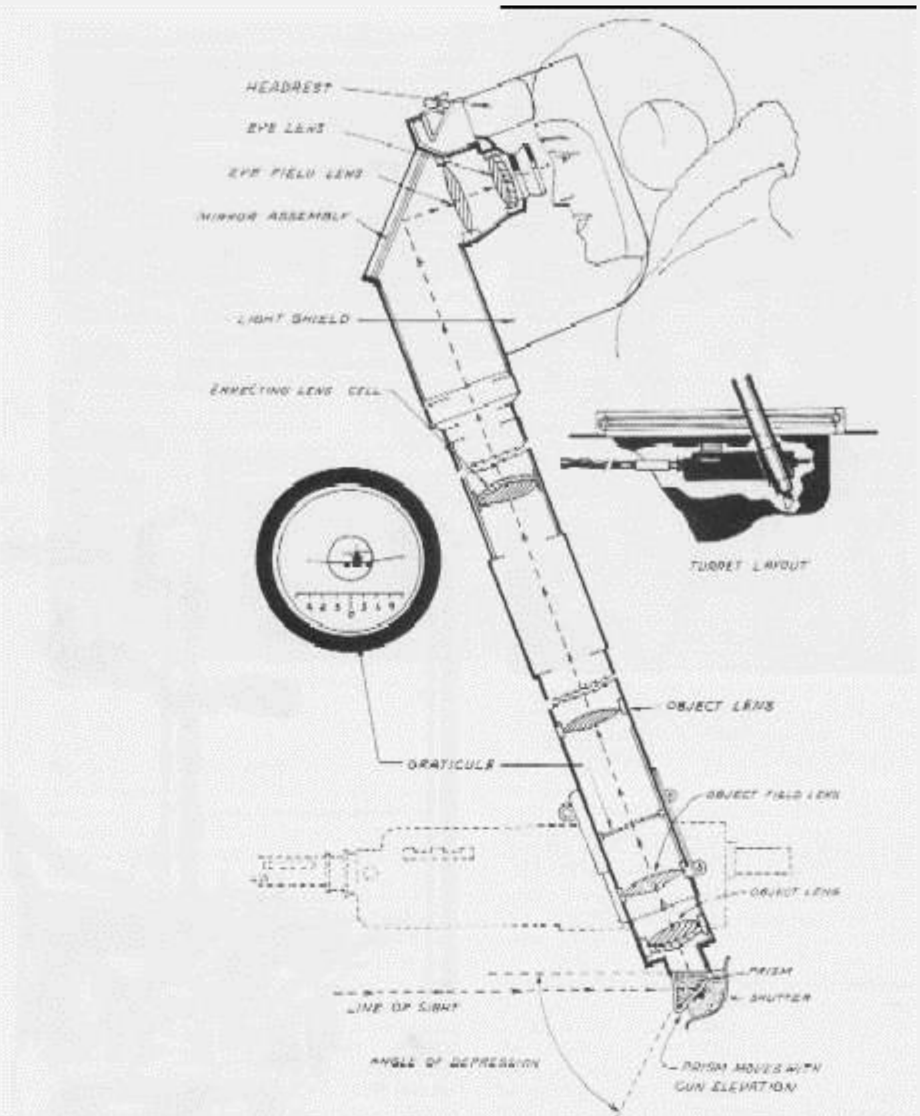


GGS ranging controller.jpg

The Type A periscopic sight used on the Blenheim rearward firing under turrets



Type A periscopic sight.jpg



The Type B periscopic sight designed for the Lancaster FN64 under defence turret. The field of view was very limited and it was not widely used.

Type B periscopic sight.jpg

Post subject:

Hi

The Thompson Sight

In 1941-42 the Royal New Zealand Air Force base at Wigram had a fitter armourer, Cpl. John R. Thompson, who had already invented various gunnery devices, devised a sight which gave the gunner a point of aim which predicted the angle of deflection. In theory, the firer matched the target's path and speed with a moving graticule pattern seen through a screen similar to that of the Mk II reflector sight. The gunner controlled the moving series of graticule sections engraved on an endless belt of heat-resisting 16 mm film, the direction of the graticule being aligned with the apparent path of the target. After a period of tracking, when the target was made to move towards the centre of the sight, the guns were fired when the target reached a line marked across the graticule movement. He produced the drawings and prototype in nine weeks (the Mk IIC gyro sight was developed in 12 months).

Any technical invention of this kind is often met with scepticism by the authorities, and Thompson's was no exception. It was only after a desperate letter to the Chief of the Air Staff dated 26 May 1943 that he was summoned to Britain with his invention, which was evaluated at Farnborough. Unknown to Thompson, the gyro sight was nearing completion, but his sight was thoroughly tested by the Armaments Section. The relevant parts of their conclusions were as follows:

The sight presents to the gunner a collimated graticule which consists of a broken line which can move across the field of view in the direction of its length at a rate which can be controlled by the gunner. The orientation of the travelling line can also be controlled by the gunner, in such a way that it always travels through a central point in the field of view to which the guns are organised. No arrangements for including trail and gravity drop allowance are included.

The sight therefore demands: the setting of guns and graticule pattern to cause the target to fly towards the centre, matching of the apparent graticule speed and the apparent target speed, tracking the target with the aiming point thus determined and judgement of the firing range with stadiametric aid of breaks in the graticule pattern.

The defect of the principle is that the angular velocity of the target is determined sometime before firing, and is determined relative to the gunner's aircraft which must, therefore, fly straight and level if large errors are to be avoided. The operations required of the gunner could present him with difficulty under combat conditions, and the addition of trail and gravity drop allowance would further complicate what is already an involved mechanism.

This sight is a good attempt at the solution of the problems of controlling aircraft guns, and the engineering skill displayed in the design of the prototype is high. The arrangement is, however, outdated by other developments in Great Britiain and in the USA: in particular the British GGS Mk IIC sight is more compact, is likely to be simpler to use, is referred to space axes rather than own aircraft axes, and includes trail and bullet drop. In view of the fact that this development is in production, further work on the Thompson sight is not recommended.

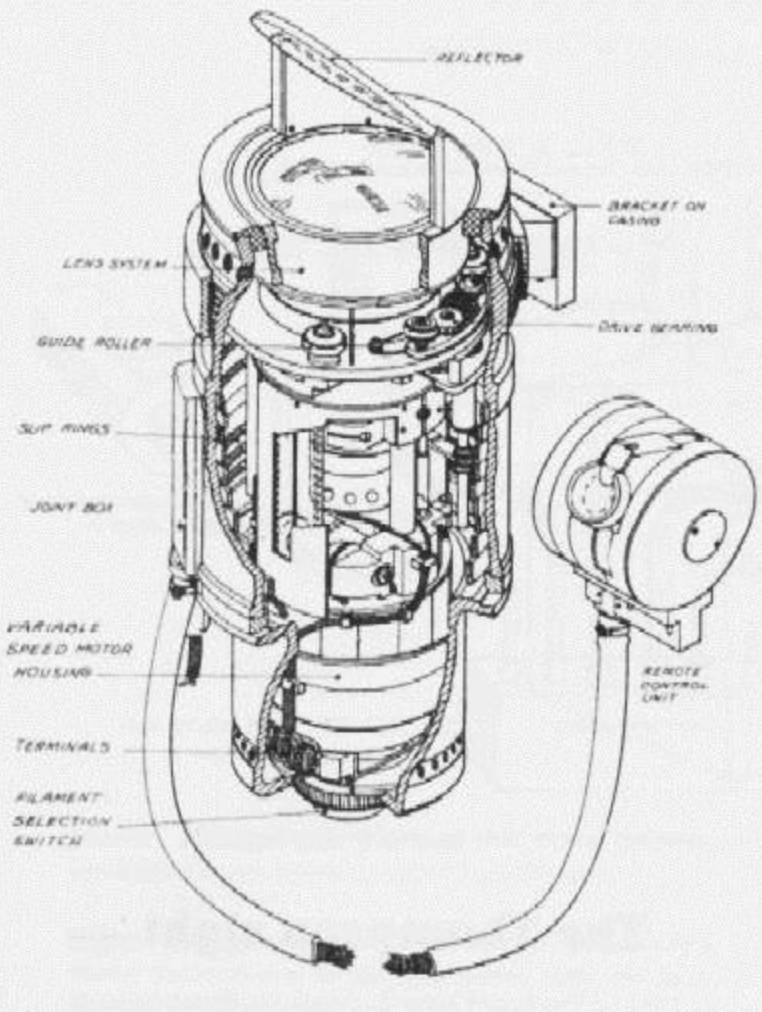
It is recommended, however, that this inventor be encouraged to consider further problems, since the skill and thought shown by his prototype sight is of a high class.

Thompson returned to New Zealand where he continued to work as an engineering officer in the RNZAF. Until 1942 no such sight had been developed by any nation. Thompson's achievement must rank amongst the most remarkable of the war. The official assessment was probably correct, but if the gyroscopic sight had not materialised there is every possibility that the Thompson sight would have been adopted by the RAF. Before the sight was sent to Britain it was demonstrated to a group of visisting operational pilots of the RNZAF, including W/Cdr Wells, who described it as 'the answer to a fighter pilot's prayer'.

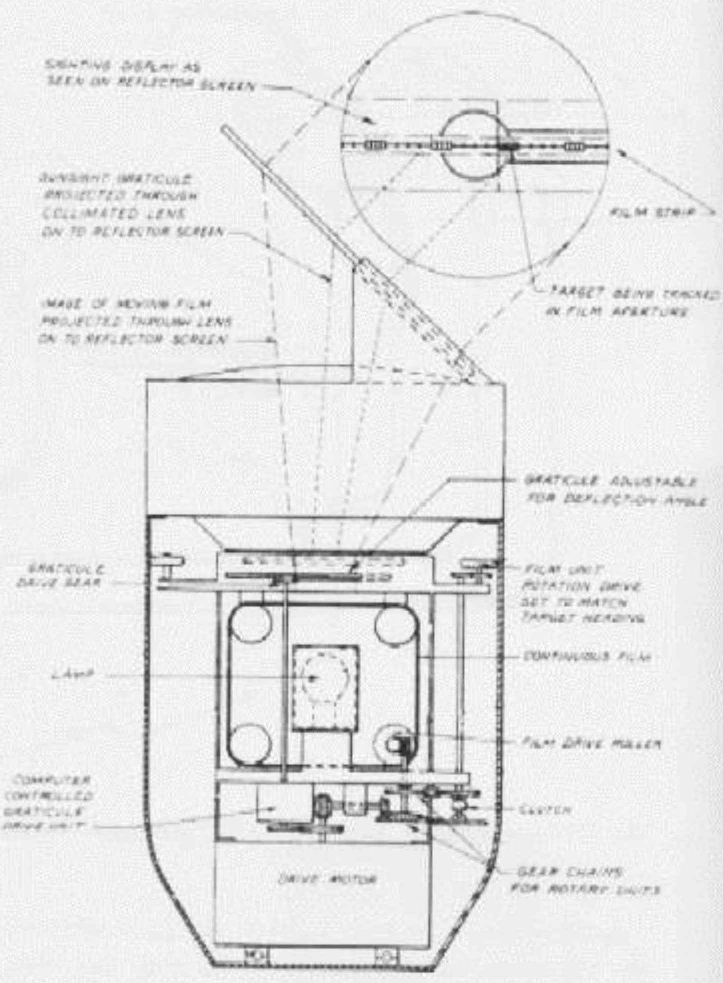
The above text and sketch were taken from "British Aircraft Armament Vol.2: Guns and Gunsights", by R Wallace Clarke.

Regards

Bob



The compensating gunsight invented by Cpl. John Thompson of the RNZAF. This used a film strip moving at a set speed, which was made to coincide with the speed of the target. (RNZAF Wigram)



The moving film/graticule system of the Thompson sight. The target was aligned with the graticule, which could be adjusted to the crossing speed. The moving film then gave the correct deflection. (RNZAF Wigram)

The Thompson sight.jpg

Post subject:
Hi

Airborne Interception Radar Gunsighting

Well before the war it had been realised that if daylight bombing attacks were successfully countered, a future enemy would switch to raids under the cover of darkness. When 'radiolocation' was seen as feasible, a design team was set up at Bawdsley in Suffolk to investigate the possibility of airborne radar detection for night fighters. This project, under the direction of Dr E. G. Bowen, produced the first successful airborne radar sets. The first equipment was limited by having a frequency of 1.5 m (1.64 yds), which gave a very wide beam and limited range. However, these first sets were successful in detecting intruders. After the invention of the cavity magnetron by Messrs Randel and Boot, and the Klystron oscillator, it was possible to produce a radar of 10 cm (3.9 in) frequency, giving a narrow beam of 30 degrees, which was less prone to ground returns.

In March 1941 the first airborne centimetric radar was tested in a Blenheim by Alan Hodgkin of the TRE and Edwards of GEC, the prototype system being known as the AIS. In autumn of 1941 sets had been delivered for service trials by Beaufighters for the FIU (Fighter Interception Unit) and 100 sets were ordered from GEC with Nash & Thompson scanners. The first produciton model was the Mk VII, the first squadron being equipped in March 1942. The first kill was recorded in April 1942, followed by 100 more in the following months of the year.

The Mark VIII

These radars were designed for two-man operation: the radar operator viewed the screen and gave the pilot instructions for the interception. A modification to the earlier Mk V was the 'windscreen project', which consisted of a unit which projected the image of the radar display up onto the pilot's windscreen. It was seen as a step forward and the system was tested at Farnborough, but it was not adopted for service. However, an improved version was designed for the main production version, the Mk VIII. This proved successful but was not adopted for use at that time. The official description of the projector system read:

The windscreen projection endeavours to combine the four main functional aids into a single co-ordinated picture showing the pilot what is happening, and enable him to carry out the interception by its sole aid.

The whole picture is therefore projected ahead of the aircraft, and observed by the pilot looking through his windscreen. The pilot sees the position of the enemy aircraft and its range, his own position relative to it, and his altitude in relation to the horizon and a pre-set heading, the whole being encompassed by the gunsight circle. In this way, many difficulties experienced while carrying out a night interception are hoped to be successfully overcome.

Firstly, the pilot's attention will not be divided between several instruments in his cockpit, concentration will thereby be enhanced at the expense of less strain and time lags reduced. Secondly, the pilot will be in the most favourable condition to achieve a visual since his dark adaptation will be the best possible for the existing night conditions, his eyes will be focused to infinity. Additionally the visual will be aided by the fact that the pilot will be looking out in the direction of the enemy aircraft. Lastly no change in the pilot's eye position will be required throughout the whole interception, since the gunsight ring is included in the picture.

A particular development of the system has been carried out for use with AI Mk VIII to provide the pilot with blind flying information.

Method of Operation of the AI Mk VIII Projector System

When the set was switched on the pilot adjusted the tube brightness and background control; the radar scanning system then began to operate. When a target was detected an electronic spot or 'blip' appeared on the screen, showing the position in relation to the pilot's field of view. The aircraft was then brought into a position where the blip was central. When the range had decreased to 2,286 m (2,500 yds), small horizontal lines or 'wings' began to grow on either side of the blip. The pilot then had to reduce speed to avoid overshooting the target. From this time, depending on conditions, the target was likely to be seen. The gunsight would have been switched on during the search period and adjusted for brightness. When the target was seen the radar image was turned off, leaving only the gunsight graticule visible. The pilot then opened fire.

Other facilities available from the system was IFF (Identification Friend or Foe) and a heading indicator consisting of a vee in the horizon position line which could be set to a beacon or specific heading. Identifiable ground returns noticed during the operation of airborne radar sets led to the development of blind navigation by Dr Bernard Lovell which later became the H2S navigation and blind bombing system.

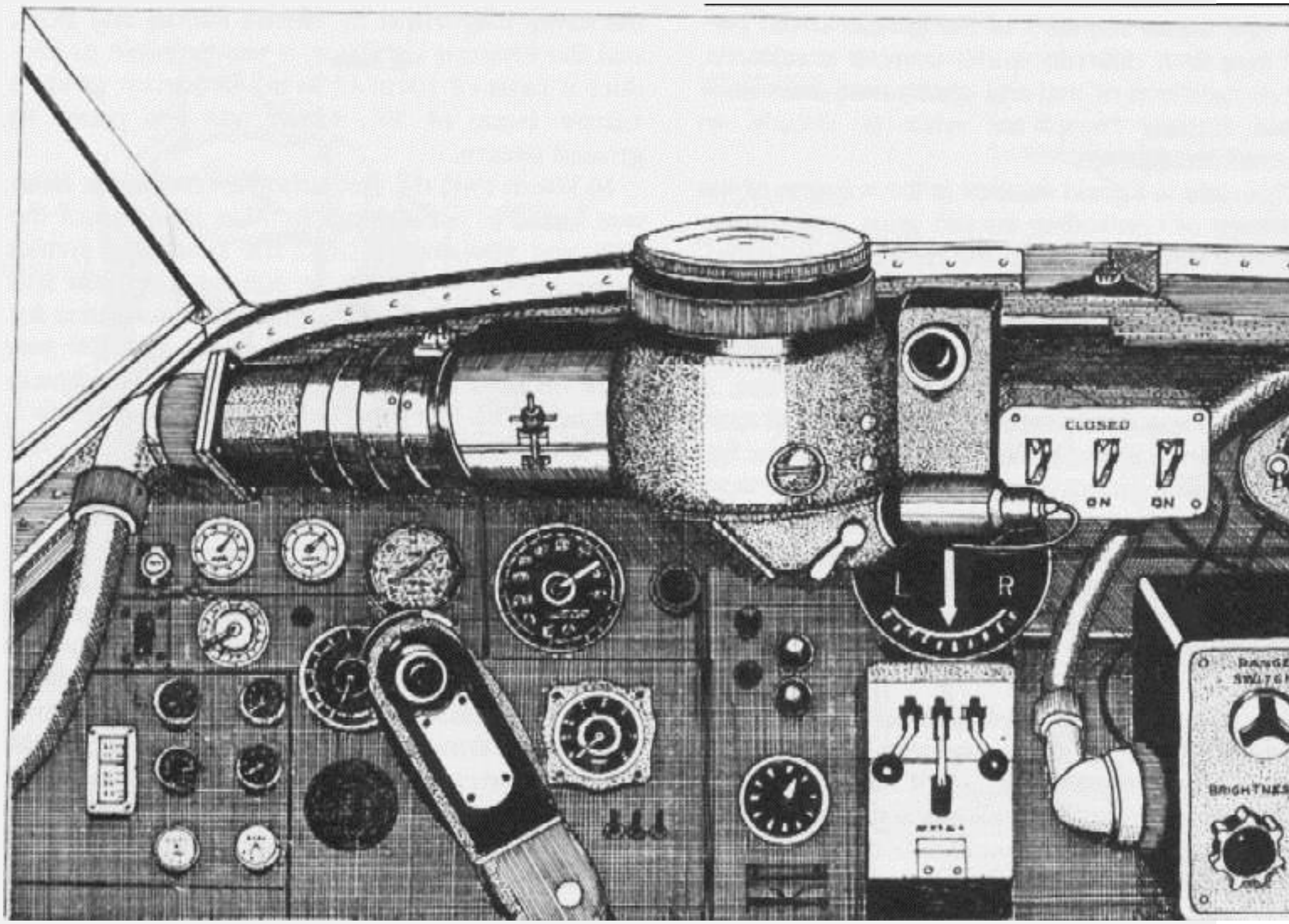
As can be seen by the above description, this system could be regarded as the ancestor to the modern HUD (head-up display). The information projected onto the windscreen consisted of an artificial horizon, target poistion and range, and a gunsight graticule. The gunsight consisted of a lamp in a quick-release housing illuminating a 160 km/h (100 mph) ring and dot graticule. Interposed between the lamp and graticule unit was a hemispherical shutter, pivoted and rotated by a lever, which, when rotated, shrouded the ring, giving a spot graticule only (as in the Beamont modification). The graticule image was projected through a prism and a stadiametric lens system onto the windscreen, and a dimming rheostat was fitted close to the unit on the instrument panel. Pilots who used the Mk V and Mk VIII equipment suggested that as the directional gyro heading indicator (pre-set heading) was rarely used, a more useful aid would have been a presentation of airspeed - an essential ingredient of night interception.

The above text and photos were taken from "British Aircraft Armament Vol.2: Guns and Gunsights", R Wallace Clarke.

Regards

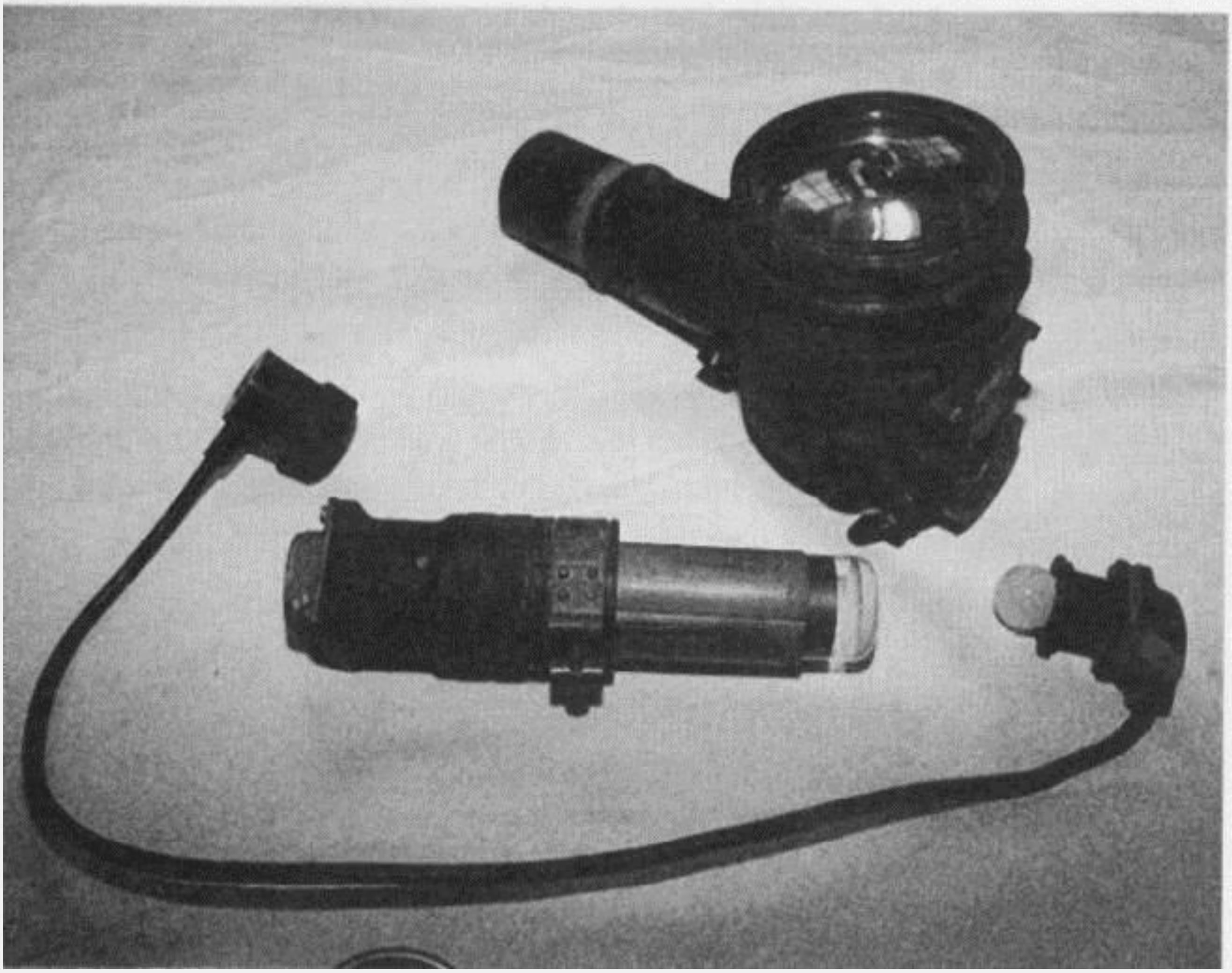
Bob

Drawing showing the position of the AI Mk VIII in a Mosquito night fighter.

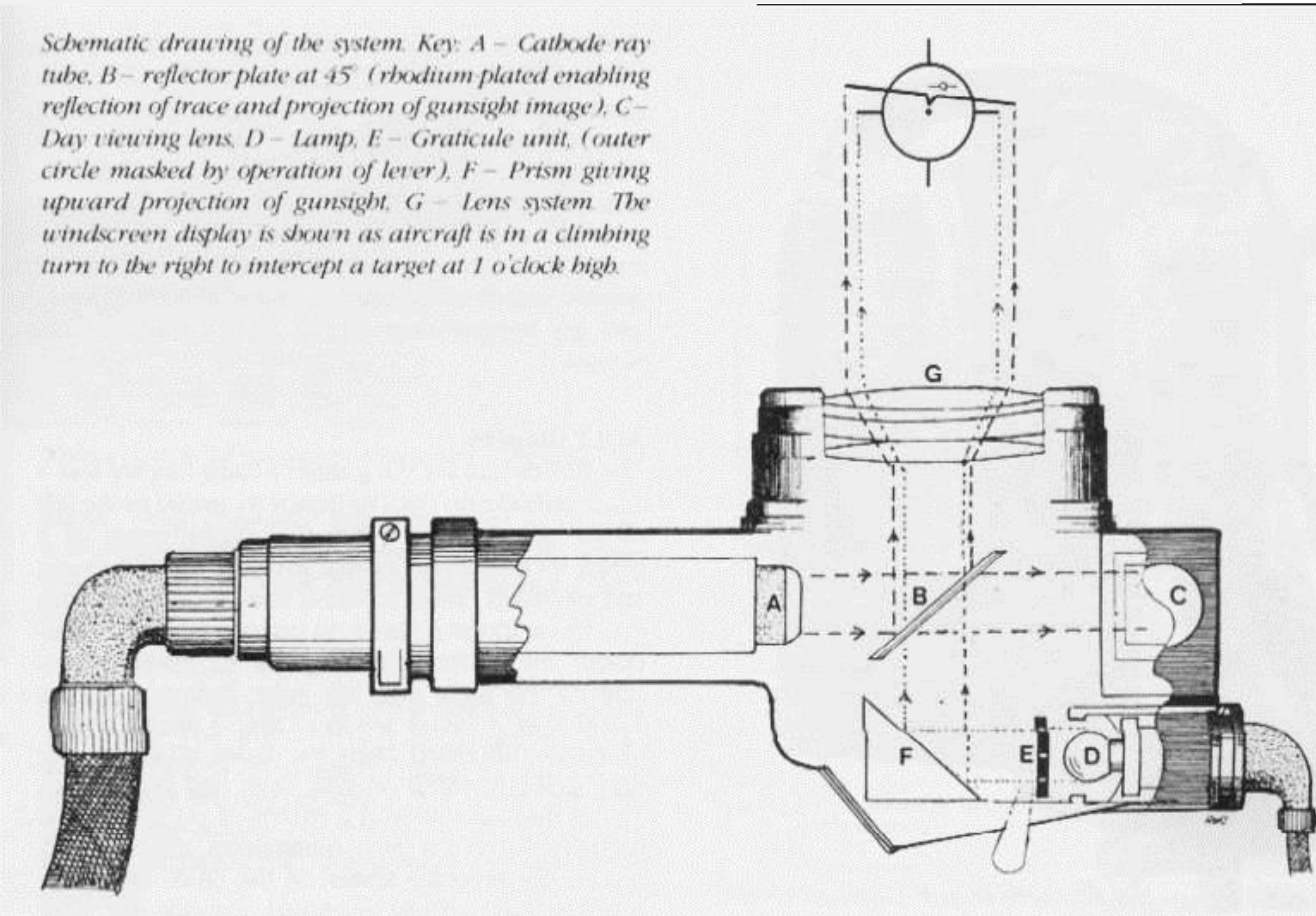


Cockpit layout.jpg

Below *The projector unit of the AI Mk VIII, showing the CRT, gunsight, lampholder and main body.*



Projector unit of Mk VIII.jpg



Schematic drawing of the system. Key: A – Cathode ray tube. B – reflector plate at 45° (rhodium-plated enabling reflection of trace and projection of gunsight image). C – Day viewing lens. D – Lamp. E – Graticule unit. (outer circle masked by operation of lever). F – Prism giving upward projection of gunsight. G – Lens system. The windscreen display is shown as aircraft is in a climbing turn to the right to intercept a target at 1 o'clock high.

Schematic drawing of system.jpg

Post subject:
Hi

Bomber Command Tracer Ranging

Though tracer was known to be a misleading aid, on 8 April 1940 the Farnborough Gunnery Research Department issued a report to Bomber Command gunnery leaders entitled "The use of tracer ammunition as an aid to air sighting". The reason for this was an unforeseen problem encountered by rear gunners. It was found that, when a fighter approached on a 'curve of pursuit' (a turning attack, keeping his guns aligned on the bomber), it was very difficult to make a correct allowance for deflection. This was because a tail gunner had nothing to tell him whether an attacking fighter was moving across his line of fire or not. The gunner had the impression of being suspended in space.

After many novel ideas had been tried, it was found that the solution was the use of tracer. The tracer then in use was the Type G Mk IV, which burned to 549 m (600 yds). The theory was that this would help solve problems with both range and deflection. The advice given was:

As the fighter approaches at long range fire a burst, keeping the centre dot aligned on the target. You will see the tracer rise to the centre of the ring, remain in a cluster, then move sideways in the direction from where the fighter has come. This gives a clear indication of the allowance required. Adjust your line of fire in the opposite direction of the movement.

Commence firing when the target is just over half-way along the trace, then maintain your aim and keep firing until the range closes to 138 m (150 yds) then fire point blank.

The amount of deflection was set out in a directive entitled 'Zone system of sighting allowance'. It gave a series of allowances, such as : 'when a fighter is seen in the sector between 10 degrees and 30 degrees round dead astern, allow two rads (radii of the graticule circle). This may seem complicated, but failure to grasp such advice could mean the loss of an aircraft and crew. Any fighter pilot engaging an aircraft with a skilful rear gunner did so at his peril. A Sunderland on convoy patrol off Norway was attacked by a group of Ju 88s which dived on the flying-boat in pairs. After an hour two of the Junkers had been shot down, and the Sunderland returned to its base at Invergordon.

Various types of tracer were designed by ICI Kynoch. One type burned red to 366 m (400 yds), then a brilliant red, before ending in a puff of smoke. This was to warn the pilot that is ammunition was nearly spent. The G Mk III did not trace until 183 m (200 yds), to avoid giving away the position of the aircraft. The Luftwaffe did not use ball ammunition in its 7.92 mm guns: ammunition comprised tracer, AP and incendiary rounds.

Over-The-Nose Sighting

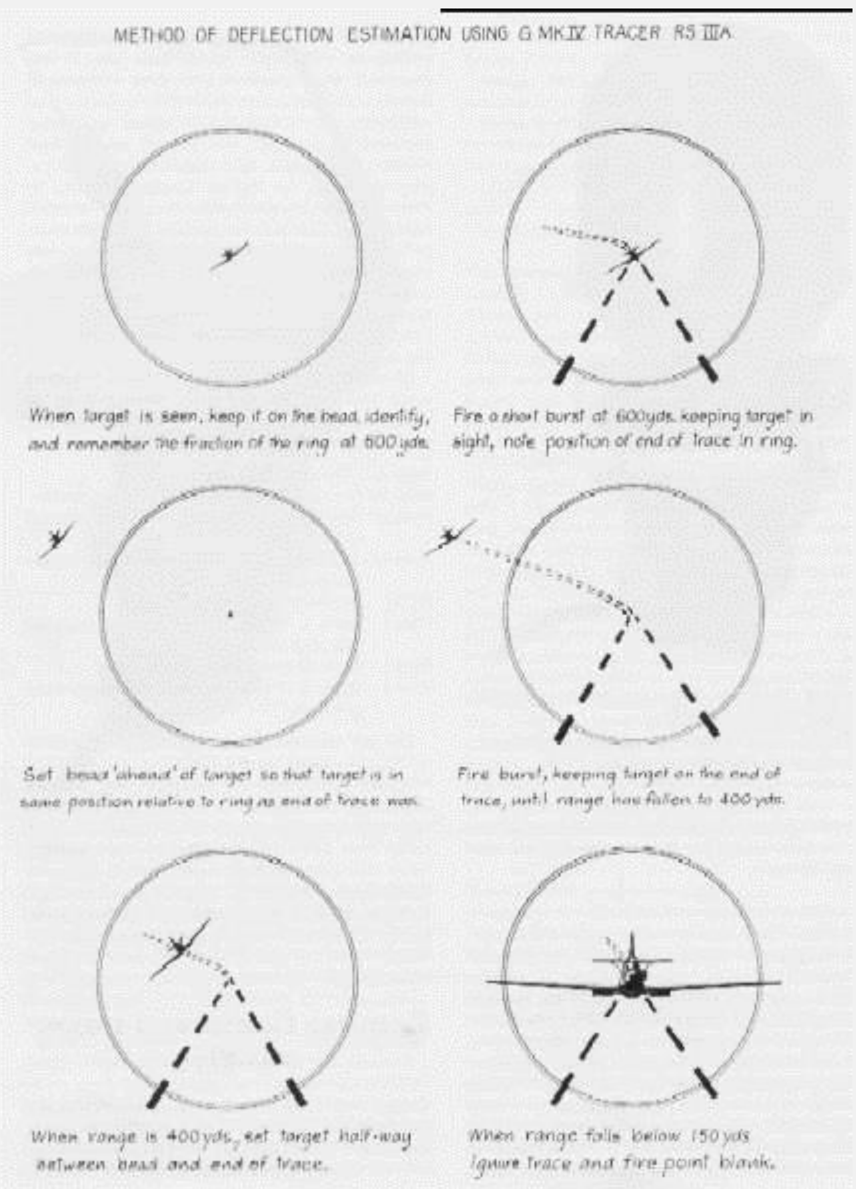
The Spitfire, like many fiighters, gave the pilot a poor view ahead over the long nose cowling. When an enemy was engaged from behind, the point of aim had to be slightly above the target to allow for bullet drop, and when the target was climbing away the pilot needed a lead angle above his quarry. In these situations the pilot had to ease the nose down and observe the target, then pull the nose up slightly and press the gun button.

In early 1942 a periscopic device was tested at the Air Fighting Development Unit at Duxford with a view to overcoming this problem. A Spitfire Mk II (converted Mk I K9830) was fitted with two mirrors, one mounted just behind the gunsight, and the other, much larger, fixed inside the top of the windscreen looking forward into the bliond area. It gave the pilot vision into the blind zone, but it was difficult to keep the target in view once the nose was raised, and was not a practical proposition for the extra few degrees of vision gained. The officer in charge of the tests duly reported these findings and the device was not accepted for Service use.

The above text and drawings were taken from "British Aircraft Armament Vol.2: Guns and Gunsights", by R Wallace Clarke.

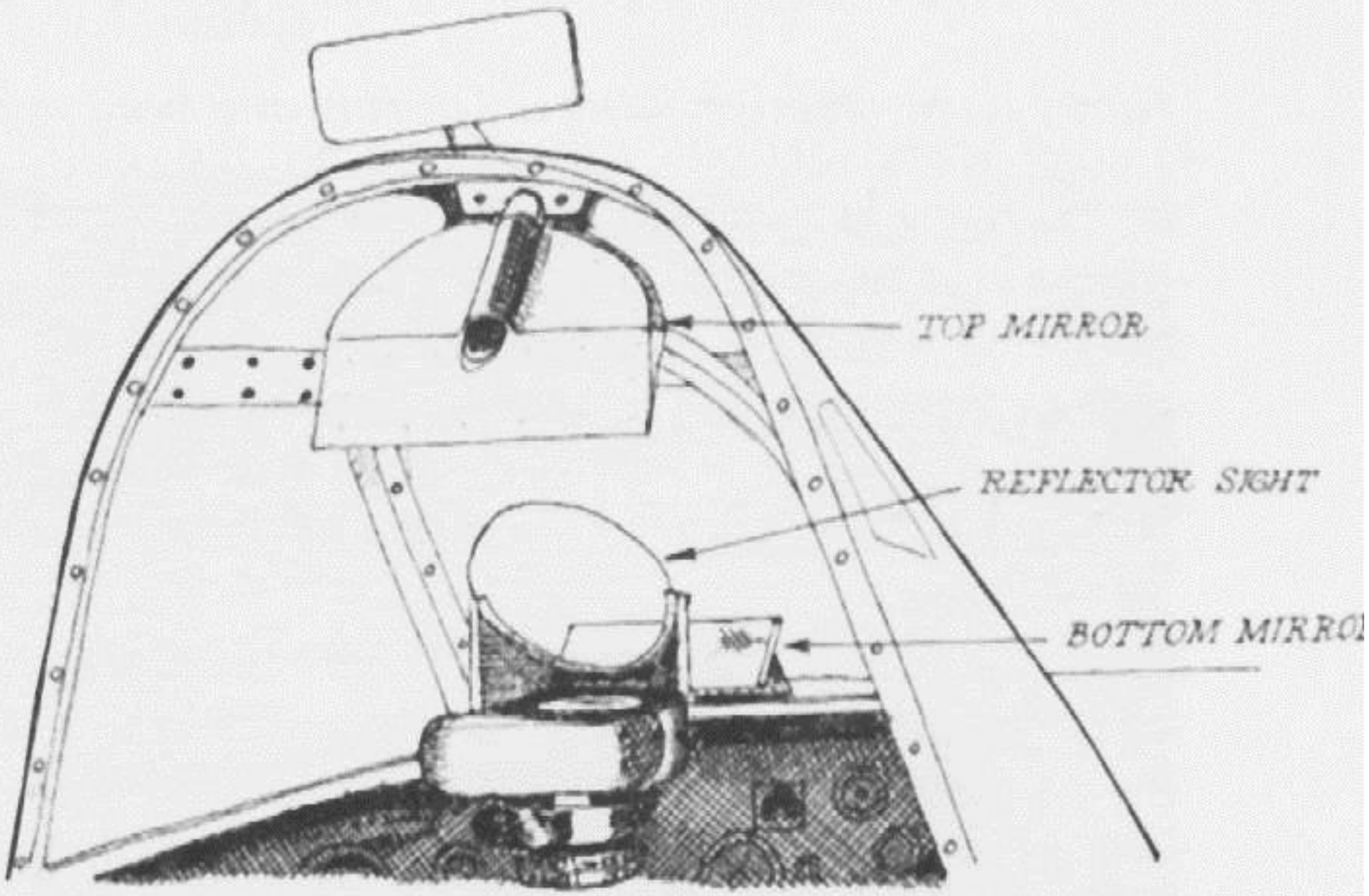
Regards

Bob

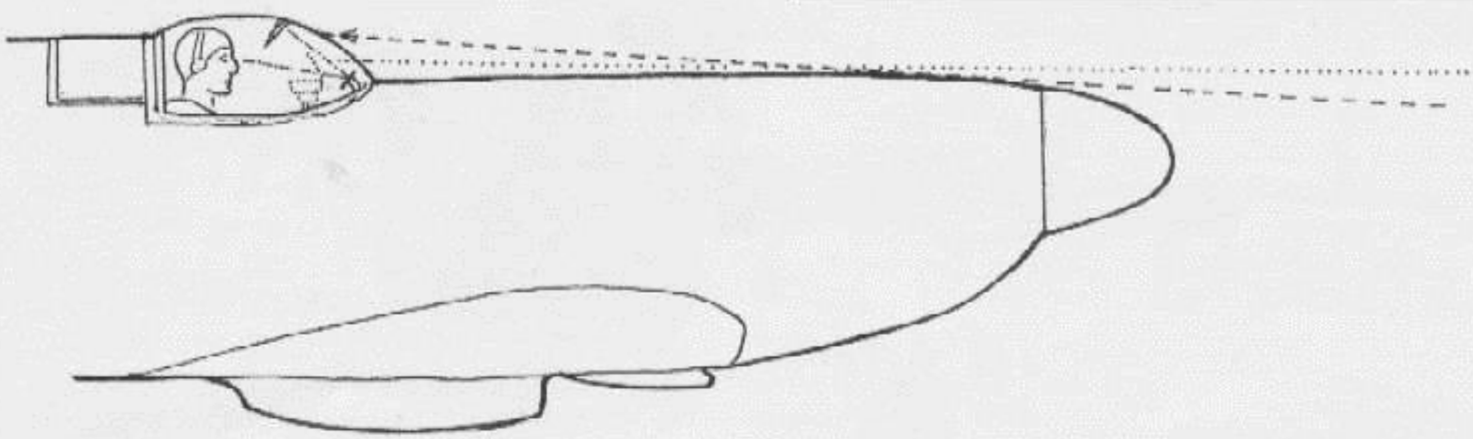


Method of deflection estimation.jpg

Spitfire over-the-nose sighting system, designed to overcome the blind spot created by the cowling.



Over-the-nose sighting system a.jpg



Over-the-nose sighting system b.jpg

Post subject:
Hi

Airborne Gunlaying in Turrets (AGLT) - Pt 1

With the success of air interception radar for night fighters, it was decided to develop a system which would provide rear gunners with a means to locate fighters making a radar-assisted attack. In early 1943 the Air Staff held a conference to advise on a specification for such an installation, resulting in the following suggestions:

The transmitter/receiver to be mounted at the navigator's position to save weight in the tail of the aircraft. The design should include an automatic ranging facility, which would be relayed into the Mk IIC gyro sight. A small scanning aerial should be mounted in such a way as to follow exactly the movement of the guns. The display screen would consist of a small cathode-ray indicator mounted adjacent to the sight screen of the GGS.

A research team under Dr P. I. Dee was formed, the design leader being Dr Alan Hodgkin and the code name 'Village Inn'. The official Air Ministry title was Airborne Gunlaying in Turrets (AGLT).

AGLT Scanning

After various experimental designs, the scanning system was agreed upon. It consisted of a small dipole antenna mounted near the focal point of a 406 mm (16 in) parabolic reflector. The antenna was mounted eccentrically and rotated by an electric motor at 2,000 rpm through a cone angle of 30 degrees. The unit was to be covered by a perspex radome and fixed to the lower rear section of the turret, rotating with it and being connected to the gun elevation system by parallel linkage. The antenna was fed by a 9.1 cm (3.59 in) transmitter remote from the turret, radiating half-micro-second pulses at a prf (pulse repetition frequency) of 660 per second. Limits of operation were 85 degrees to each side and 45 degrees above and below horizontal. When the gunner searched for fighters, the scanner followed, and any approaching aircraft gave a 'blip' on the screen.

AGLT Display

The first design for the gunner's radar display was a small cathode-ray spot indicator mounted to the left of the gunsight, in which the displacement of a green spot from the centre gave the target bearing and elevation. Tests revealed that the gunner, who was trying to get a visual on his attacker and manipulate the turret controls, had to evaluate two screens, his sight and the radar indicator. It was found that a better solution was a single screen which incorporated both the radar spot and the sight graticule. After several ideas had been tried, one of the team devised a means of projecting the radar spot onto a semi-transparent mirror fixed behind the reflector screen of the GGS. This consisted of an upright enclosed cathode-ray tube mounted on the right side of the sight. The tube display was projected upwards through a prism onto the display. This was to become known as the AGLT collimator. The gunner was provided with a control box to adjust the brightness and focus of the spot, and a selector for controlling the signal.

Caption to bottom photos:

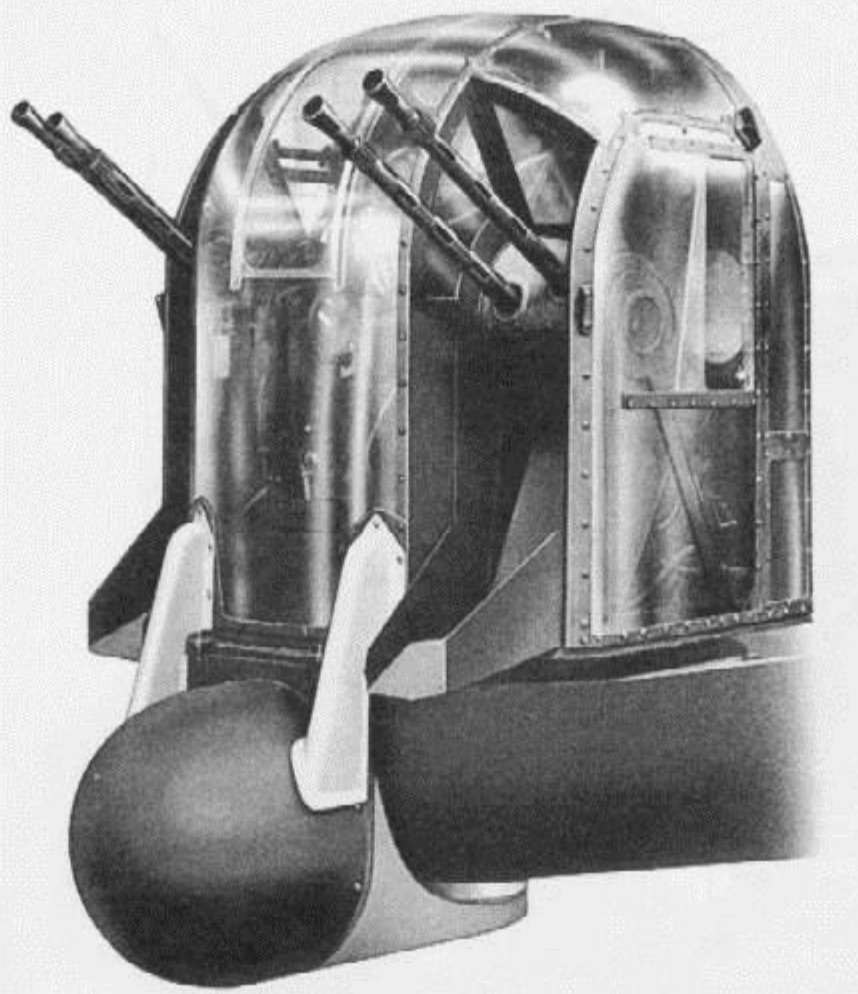
Sketch: AGLT collimator installation. The target 'blip' was projected through the prism onto a small angled reflector plate which was fixed behind the GGS screen.

Photo: A Frazer-Nash FN.82 turret equipped with AGLT. The bracket on the left was for a Type Z indicator designed to detect infra-red IFF projectors to be mounted in the nose of Bomber Command aircraft.

The above text and photos were taken from "British Aircraft Armament Vol.2: Guns and Gunsights", by R Wallace Clarke.

Regards

Bob

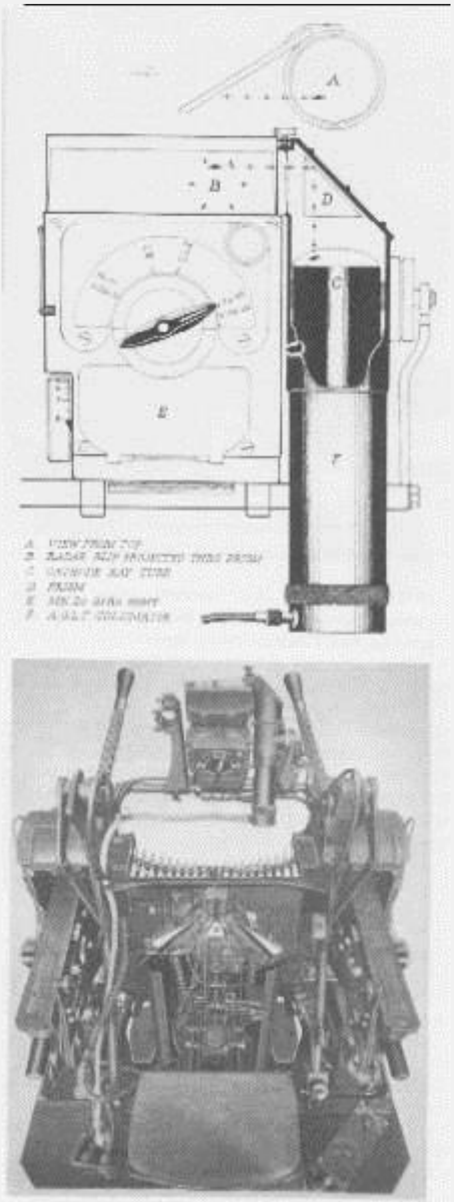


AGLT 'Village Inn' seen here fitted to a Lancaster FN121 tail turret. The scanner under the dome moved in eleva tion with the guns. (Frazer-Nash)

AGLT 'Village Inn'.jpg

Above *An AGLT collimator, now a very collectable item.*

AGLT collimator.jpg



AGLTcollimator installation.jpg

Last edited by Robert Hurst on 28 Mar 2003 15:39; edited 1 time in total

Post subject:
Hi

Airborne Gunlaying in Turrets (AGLT) - Pt 2

AGLT Ranging

In the Mk IIC GGS, target range was fed in by foot pedals, with which the gunner adjusted the diameter of the circle of diamonds to correspond with the target span. The AGLT was designed to make this process automatic. Most of the radar 'black boxes' were in the navigator's compartment, and the range was read by the navigator. Briefly, the ranging system worked as follows: Two integrating valves which emitted timed pulses were controlled by a strobe generator. The timing was fractionally different for each valve, and the difference in echo time was fed into a balancing circuit, which controlled a ranging motor, which controlled a shaft on which were three variable resistances. At the end of the shaft was a range dial reading 0-366 m (0-400 yds). As range information was fed from the balancing circuit, the motor turned the shaft and the range reading was relayed by the navigator over the inter-com. The three resistances triggered: 1. An aural warning of an impending attack (similar to the Monica tail warning system); 2. Control information for the strobe generator; and 3. Continuous ranging information for the predictor section of the gunsight.

A pursuing fighter was ideally detected at 914-1,219 m (1,000-1,333 yds). As it approached, the range would be read off by the navigator. The gunner would aim his guns to keep the 'blip' lined up with his sight graticule, and when he was told that the range was under 366 m (400 yds) he would open fire, whether the target was visible or not. The weak point of all this was the need for a second member of the crew to tell the gunner when his target was in range. To overcome this weakness, the blip was given 'wings' (as in the AI Mk VIII), which gave the appearance of an approaching fighter. When the range was under 457 m (500 yds) the 'span' of the image grew rapidly. This new facility was controlled by a fourth resistance on the range shaft.

As with all new technology, limitations were discovered. The first was 'spot wander' or 'jitter', caused by echo fading when the signal reacted to the propellors of the fighter. Another was the time lag of 0.5 sec before the blip took up its final aiming position. As the antenna rotated with the turret, if the gunner traversed in a jerky manner the blip would wander aimlessly for a fraction of a second. If two aircraft were present within the 30 degree cone, the spot would wander between one target and the other.

To overcome the serious problem of friendly aircraft appearing on the screen, a method of identification was devised. Twin infra-red lamps, appear as small rings, were fitted into the nose cone of bomber aircraft, and the gunners of AGLT-equipped turrets were provided with infra-red detectors mounted on the left side of the sight arm. Known as Z-type IR detectors, they picked up the infra-red emissions from the lamps, which were programmed on an auto timer to the signal of the day.

When AGLT equipment was introduced, a self-destruct unit was fitted to prevent it falling into enemy hands. Before a gunner left the aircraft on or over enemy territory, he lifted a red flap on the device and pressed a red button, which activated a 10 sec timer.

Several Avro Lincolns were fitted with AGLT. These were improved Mk I units mounted on the Boulton Paul Type D turrets, armed with 12.7 mm (0.50 in) Browning guns.

AGLT Mk III

A Mk II version of the system was designed incorporating several modifications, but this was not porcceded with. The Mk III, however, was put into limited production. In this version the scanner was not linked to the turret movement: when a target was located the scanner locked onto the echo, and the information projected onto the collimater. This enabled the gunner to dispense with the continual searching movement of the turret.

Testing was carried out by the Telecommunications Research Establishment at Defford. The aircraft used were Lancasters (ND712) for the Mk I and (JB705 and LL737) for the Mk III. After lengthy development the Mk III was finally put into production. The first operational squadron to be fitted with AGLT was No.101 at Ludford Magna in the autumn of 1944. Soon after this Nos.49, 159 and 635 squadrons were converted. These units found difficulty in operating the equipment, and the scanner drive mechanism gave trouble. Dr Hodgkin's team continued to improve the system but, pending the elimination of the problems, large-scale conversion of turrets was postponed. In September 1945 proving trials were carried out by No.113 squadron, but by this time there was no great urgency as hostilities had ceased.

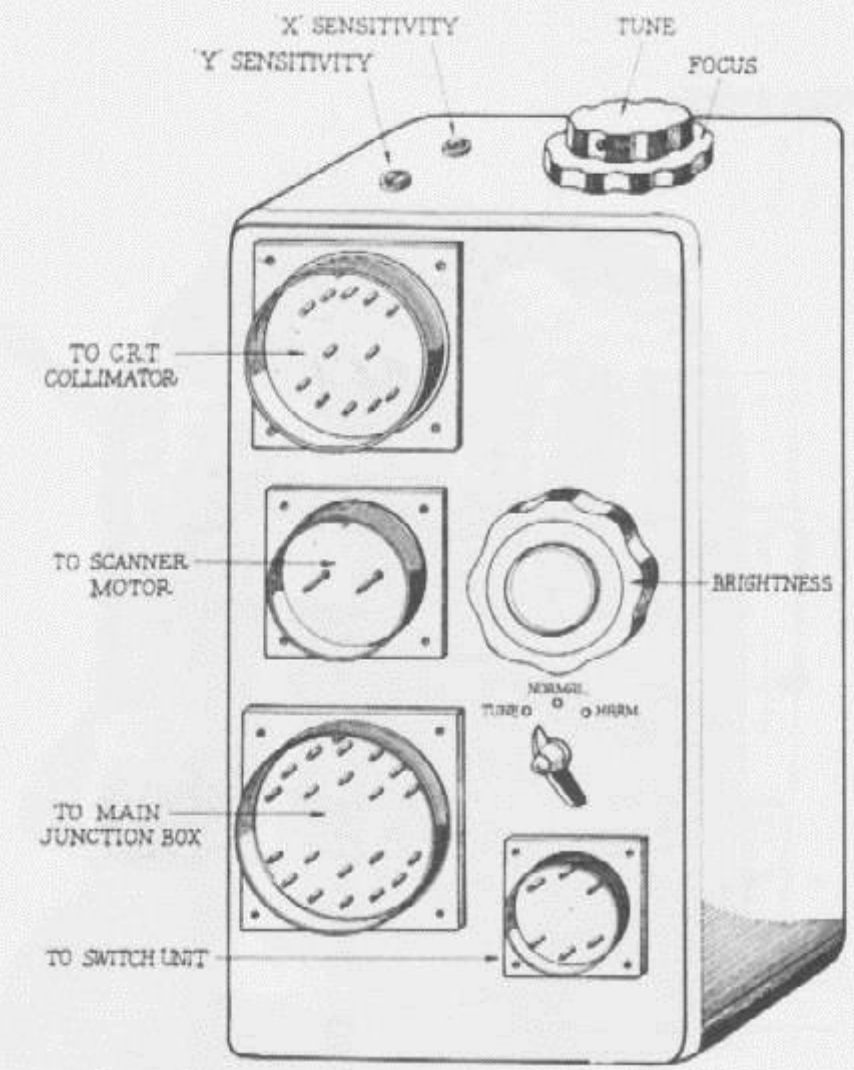
Emerson APG-8

Running concurrently at Defford was the evaluation of an American turret radar system. In 1944 a Canadian-built Lancaster, (KB805), had been sent to the St Louis factory of Emerson Electric, where a Model 3 tail turret had been installed equipped with the APG-8 blind tracking radar. Defford found that the US system was not quite so effective as the British design, and in fact only 15 APG-8s were produced before the project was shelved.

The above text and photos were taken from "British Aircraft Armament Vol.2: Guns and Gunsights", by R Wallace Clarke.

Regards

Bob



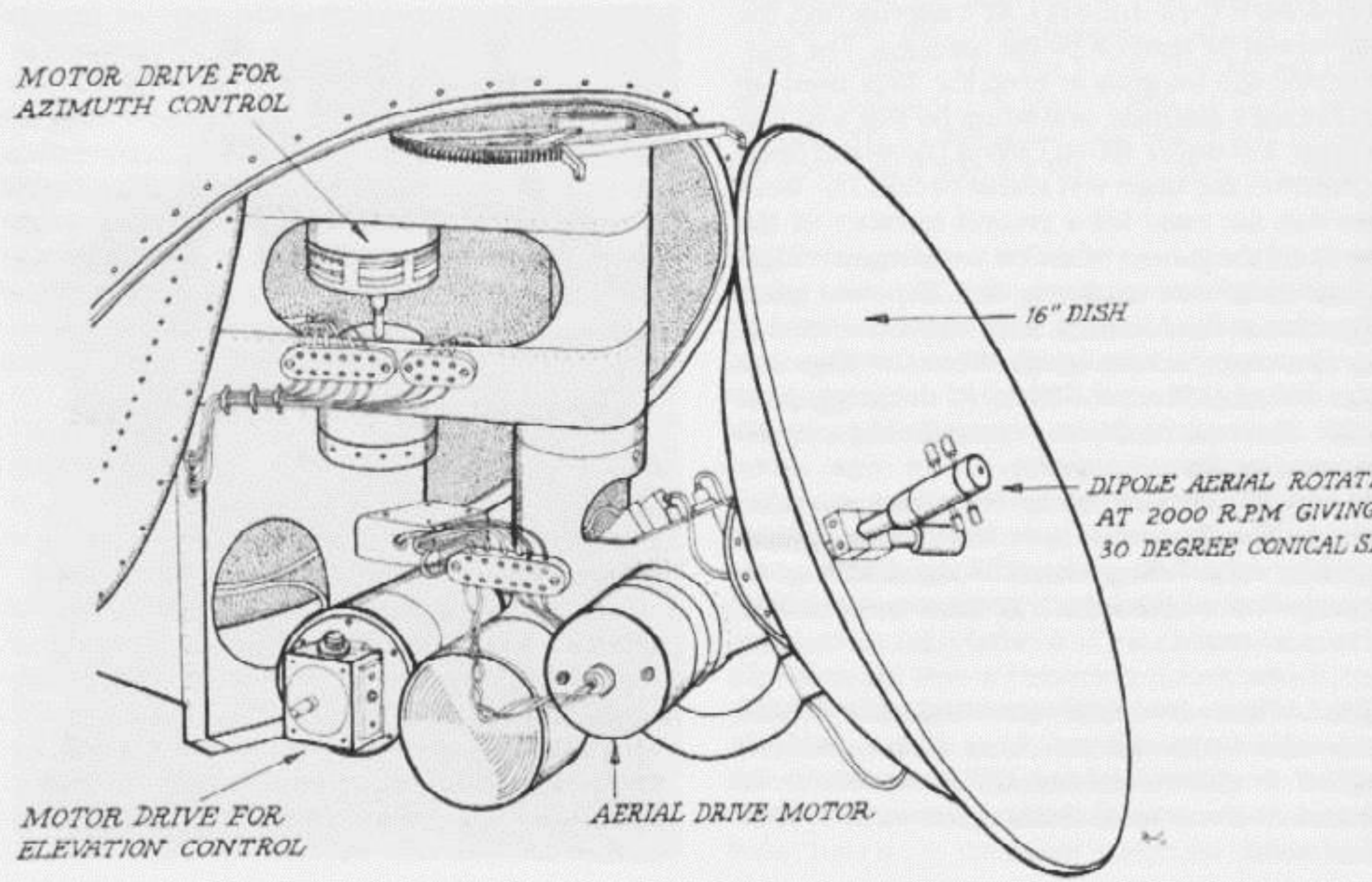
Above *Gunner's control unit, 'Village Inn'*

Gunner's control unit.jpg

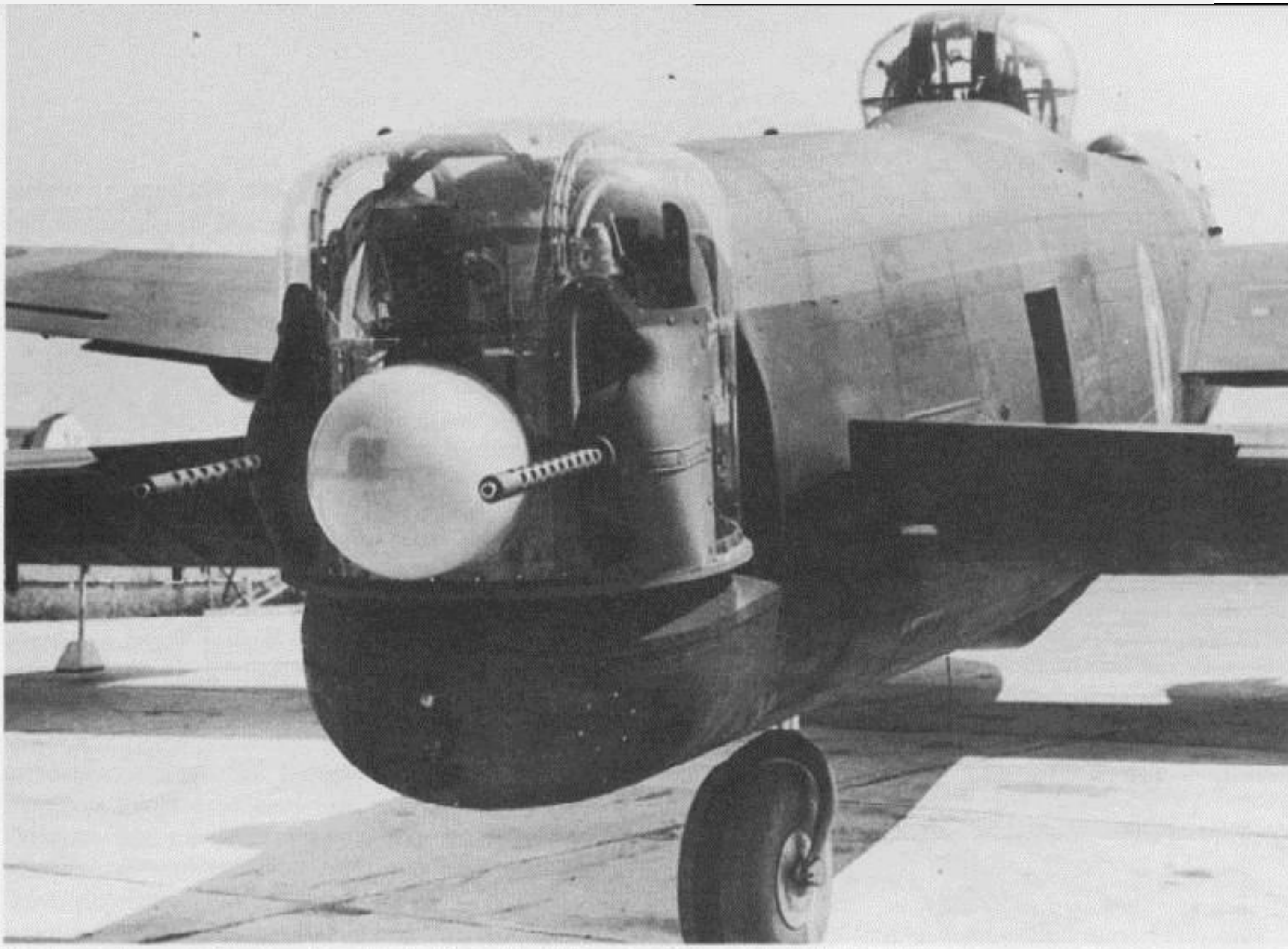
Below *The Mk III AGLT scanning system. The dish scanned the rear hemisphere until a target blip was received, then it locked onto the signal.*

AGLT Mk III

A Mk II version of the system was designed inc



AGLT Mk III scanning system.jpg



Emerson Electric blind-tracking radar fitted to Lancaster KB805 for trials. The installation, the EM APG-8, was no accepted for use by the RAF

Emerson Electric APG-8.jpg

Post subject:
Hi

Remotely Sighted Gun Turrets

In May 1942 the Air Ministry placed an order for a comprehensive remotely controlled turret system for Bomber Command aircraft. The main contractors were Boulton Paul who would produce the turrets, or barbettes as they were to be known, and British Thompson Houston, who had experience of remote control systems for ground use. The gunner would occupy a sighting station in the tail, where he would have an ideal field of vision unimpeded by the usual guns and power systems.

The BTH remote control system employed an Amplidyne (Ward Leonard) electrical system for gun and turret control which was to be linked with a 'convergence computer' designed by the Royal Aeronautical Establishment. When the gunner aligned his sight onto the target, electrical impulses would be transmitted to the computer, which would control the power system of the barbette and 20 mm guns to coincide with the alignment of the sight, allowing for deflection and the angular differences of the barbette and sight.

Meanwhile, in 1943 Vickers-Armstrongs were asked to investigate the possibility of installing remotely controlled barbettes in the rear of engine nacelles, aimed by a sighting station in the tail. This system was developed by Vickers who used an electro-hydraulic linking controller initially, which was later dropped in favour of the Metropolitan-Vickers all-electric 'Metadyne' system. However, testing by the RAE revealed that the distortions set up in the wing structure during flight seriously affected the accuracy of gun alignment of the nacelle barbettes, and the project was terminated.

By 1944 Boulton Paul had completed the fuselage barbettes which passed their functioning tests in July. The sighting and remote control systems, however, were not so advanced, for the requirements were so complex as to require completely new technology. The designers were gradually overcoming the problems, but were not very pleased when the Air Staff made a requirement for the inclusion of AGLT radar tracking in the system.

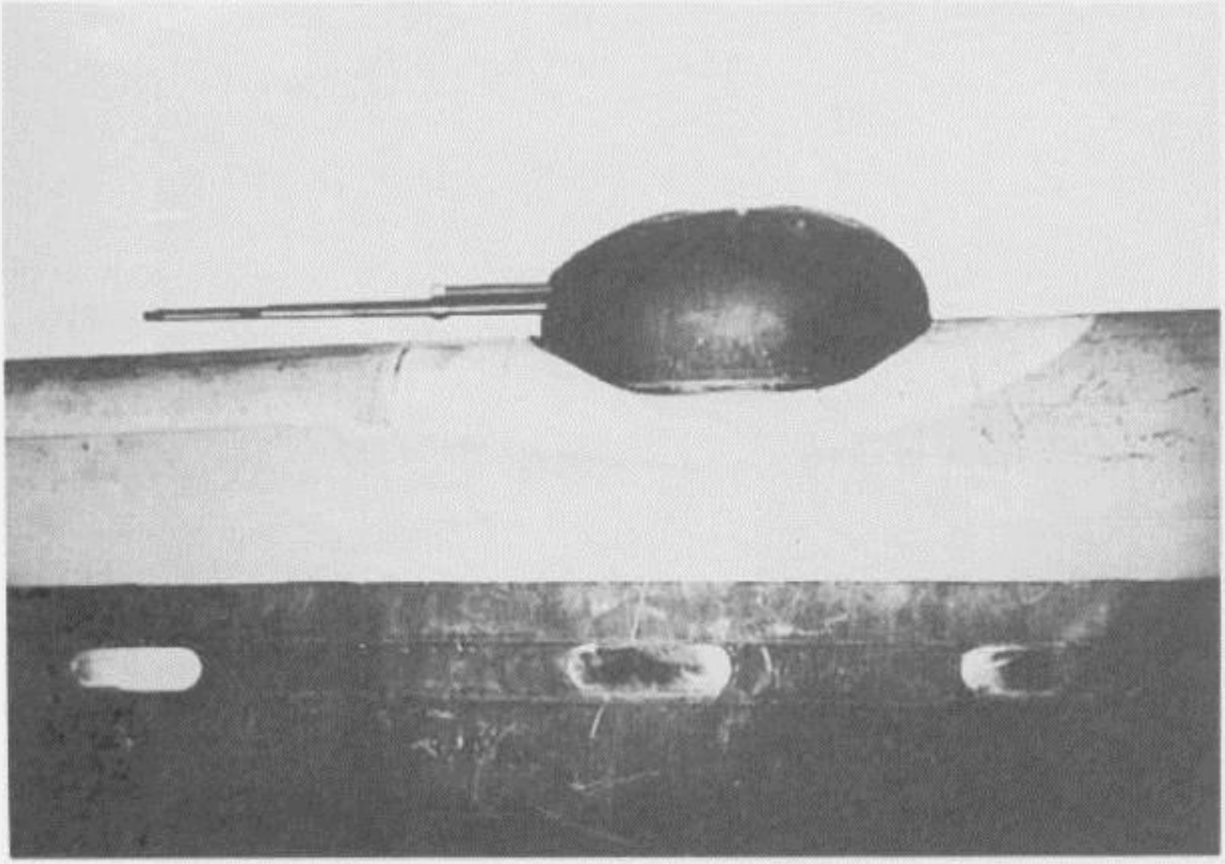
Development proceeded until the end of hostilities in 1945. The ground and air testing was delayed when operations ceased, but the system was finally passed for Service use in late 1945. The system was however never adopted, for two reasons. Firstly, the development of radar sighting had reached a stage where the fire controller could carry out search and firing without the aid of radar from a central poistion in the aircraft; secondly, the jet bombers then being designed would not need guns for protection.

This project was the British equivalent to the American RCT system. That this was brought to a successful conclusion was a credit to all concerned, and if the war had continued there is no doubt that it would have been adopted by Bomber Command.

The above text and photos were taken from "British Aircraft Armament Vol.2: Guns and Gunsights", by R Wallace Clarke.

Regards

Bob



The upper barbette of the remote sighting system mounted in a Lancaster. Armed with twin 20 mm Hispano guns, the barbettes were linked to the tail sighting station by an electrical control system.

Remote Sighting System mounted on a Lancaster.jpg

Vickers Warwick prototype with remote barbettes mounted in the engine nacelles. The tail sighting station was simil
to that of the fuselage mounted Boulton Paul BTH system. (Vickers)

Vickers Warwick fitted with engine mounted barbettes.jpg

Goto page Previous 1, 2