JADELLOW

J. A. DELLOW 37 A.B.I.

A.M.B.T. Mk III & IV.

Range of Settings

Airspeed 80 - 200 mph, Wind speed 0 - 60 m.p.h (from cardinal pts.) Apparent bombing ht. 4,10 & 15000 ft. Type of bomb 250 lb G.P. Time of fall 25.5 secs from 10000 ft.

Sequence of Operations

i. Put on MAIN switch ii Put on rectifier switch

In instrument loft

i Remove dust cover on operating side

ii Inspect instrument for general cleanliness and freedom from obstructions

iii Raise lamp as far as possible

iv. Check water level of condenser to within 1 inch from the top

v. Light the lamp by inserting supply plug putting lamp resistance switch to N° I and leaving for a maximum of 5 secs. - into no. 2 for a minimum of 10 secs then to number 3 - Leave lamp raised

Check enemy speed to zero - select wind and height

Lower the lamp until just clear of condenser lenses. Remove picture and obtain maximum light on the floor by using the adjusting screws on the lamp Standard

Re-fit picture and focus - check bushes on lead screws lock

On Bomb Aimer's Gallery

Five or six indicators are found

The top three connecting to the instrument

On these select Airspeed, Enemy bearing to zero and Time - to height set. Transfer settings to lower indicators neglecting temporal if fitted. Near the indicators are one or two switches, if one, it is the Control Switch if two, the larger is always the Selector Switch select forward or No. I & finally put on other switch.

Note i. Never change from forward to reverse or vice versa unless the instrument is at rest

ii. When in reverse ensure that no one touches the bombing Switch.

James. A. Dellow. R.A.F.

3Y. A.B.I. Course.

A.M.B.T. (continued)

Assessing Bombing Errors :- 1" on the floor screen represents $\frac{1}{100}$ of Ht set.

Orientation :- Turn on the rudder bar until the North/South wind frame is at rotation motor end then parallel either the N/S. lead screw OR N/S guide bar with the top channel members of framework. A fine adjustment is at the end of the rotation motor. Check compass needle due North Correcting by a small grub screw in a split coupling found underneath the bombsight Check also Pilot's indicator card

Determining the Trail Point - Prepare instrument Zero Wind & E/S. Ht 10000 ft. - check time indicator to 6000, prepare sight with TV or Bombing angle - Start instrument make two or three bombing runs & place a mark on the floor where each target comes to rest - repeat as many headings as possible & from all the marks obtain a mean point - project Cross of light on to this point - Checking time of fall. Prepare instrument as above & start up take Stop watch & bombing Switch & put on both together when picture comes to rest stop watch & it should record 25½ secs.

Computers

Isothermal Law :- Assumes fixed sea level press of 1013 mbs - fixed temp. of +10° for ht. (+15° for A.S.

I.C.A.N. Law :- Assumes 1013 mbs. Temp +15° for height and airspeed (Temp. lapse rate -2° per 1000')

Computer MK I (plain centre knob) based on Isothermal Law Ind ht to zero - G.P. 1013 mbs temp. then Ind. & Corr. ht pointers should be coincident (for Air Speed alter temparature to +15°)

Computer MK II (black centre) G.P. 1013 mbs Temp +15° Ind ht to zero Should have both ht & Airspeed pointers coincident

Computer MK III (OR Daulton) - based on I.C.A.N Law

Uses. i. Conversion i.e. knots to m.p.h

ii. Computions for ht & airspeed Ind ht zero - temp +15° - everything Coincides

iii Multiplication - 10 on inside against smaller factor, then read off from inside other factor TO outside.

iv. Distance & Time Scale - Set q/s to 36 on mins

Outside Scale so called as "Apple Yard".

'Daulton' (continued)

Internal Scale Range A/S 40 – 440 mph (or knots)

Varying scale drift zero to 30° } Port + Starbd.
zero to 20° }
zero to 10° }

Squared Paper :- For greater accuracy

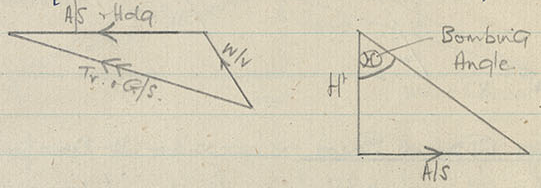
Uses – 3 Drift Wind and for finding drift and ground speed.

◇

Bombing Errors [As applied to Mk IX Sight]

i. Mechanical Errors – (wrong settings etc.)

ii. Human Errors (e.g. Bad sighting or levelling errors { Cannot be dealt with successfully })



3 Groups of Bombing Errors

A. W/S, W/Direction + W/V Errors

Compare 2 lines of sight – Correct + Incorrect to Target and bomb burst. (to A.B. + C.)

B. H' – Airspeed – T.V. – Range Error (overshoots or undershoots)

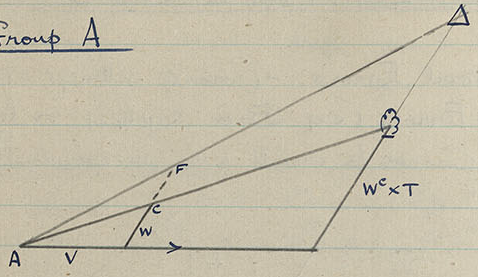
C. Bombs fall to LEFT or RIGHT of Target (qwe LINE)

Causes – Installation + Lateral errors.

See over for diagrams re. errors.

(More detail of Bombing Errors)

Group A



Wind Speed Error – assume W-Direction Correct

Length of W/S bar longer if overset
" " " shorter if underset

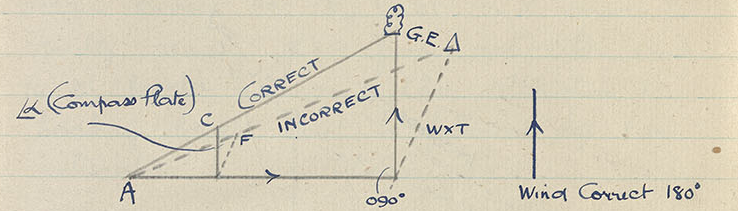
T secs = Time of fall of bomb
F = Incorrect position of foresight or overset W/S.

∴ Overset W/S causes bombs to fall UPWIND of target. & vice versa

Ground Error = W x T i.e. $(W' - W^c) \times T$

W = error in W/S setting in m.p.h.
T = Time of fall in secs, W in mph Convert by multiplying by $\frac{22}{15}$.

Wind Direction Error



Then if WD overset – bombs burst to LEFT of target looking downwind & vice versa

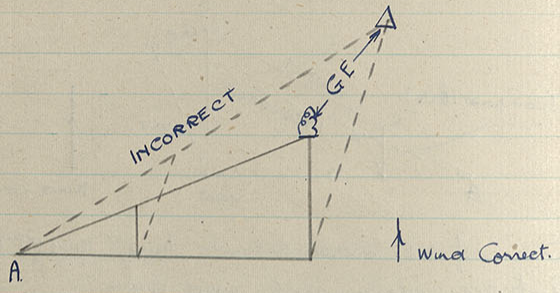
(Assuming $\pi = 3$)

$$\frac{2\pi W.T. \times \alpha}{\frac{360}{60}} = G.E \times 2\pi W.T.$$ (WT = Radius of ⊙)

$$\frac{2\pi W.T.}{}$$

∴ Ground Error = $\frac{\alpha}{60}$ W.T.

W/V (or Vector Error) from Correct to Incorrect in m.p.h. and direction



Bomb bursts Upwind & to the LEFT according to the diagram ONLY

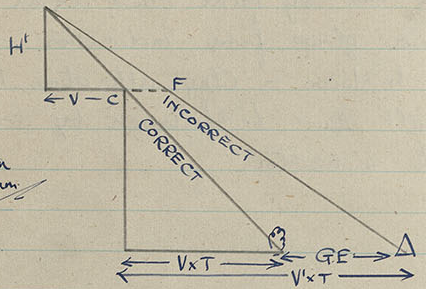
G.E = V.E x T.

Bomb bursts back along V.E. multiplying side of small Δ by time to give ground error or distance

A.M.B.T. continued: If time is less increase time indicator - if more decrease time indicator and obtain correct time by trial and error. Finally - remove glass from indicator and re-set pointer to 10000 - Any alteration to bombing height must be followed by same alteration to indicator.

Bombing Errors (Continued)

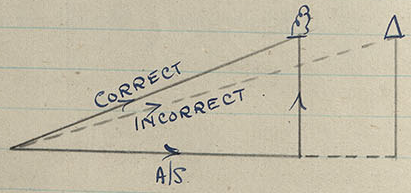
Airspeed – (A Range error Group B)



Elevation Diagram

{ Airspeed overset ~ bombs OVERSHOOT
Airspeed underset ~ bombs UNDERSHOOT }

Plan View.



Formula for Ground Error = GE = V x T

Continued

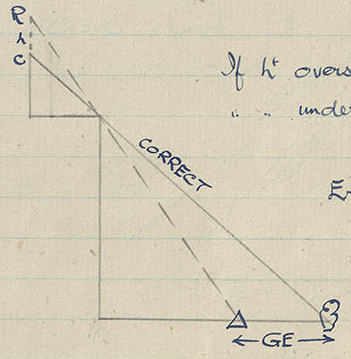
Trail Angle (or i/correct T.V. setting)

Elevation Diagram

$GE = \frac{\lambda^i - \lambda^c}{60} H.$

If trail angle overset then bombs overshoot along heading

Height



If h' overset – bombs overshoot
" " underset – " undershoot

Error ∥ to track

$GE = \frac{Gh}{32T}$

G: Groundspeed in f.p.s
h: amount of incorrect ht
T: Time of fall of bomb

Bombing Errors (Continued)

Proof of Formula

$H = 16T^2$

$H+h = 16(T+t)^2$

$H+h = 16T^2 + 32Tt + 16t^2$

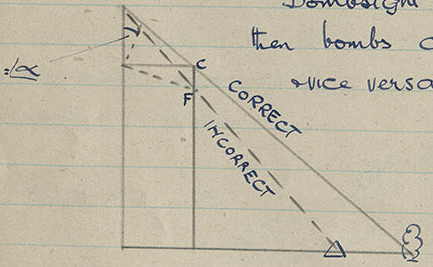
$\therefore h = 32Tt \; (+16t^2)$ – Ignore because it is so small

$h = 32Tt \qquad Gt = Gh$

$32T \qquad 32T$

Fore & Aft. Levelling (range error)

α = Angle of tilt



Bombsight tilted forward then bombs OVERSHOOT

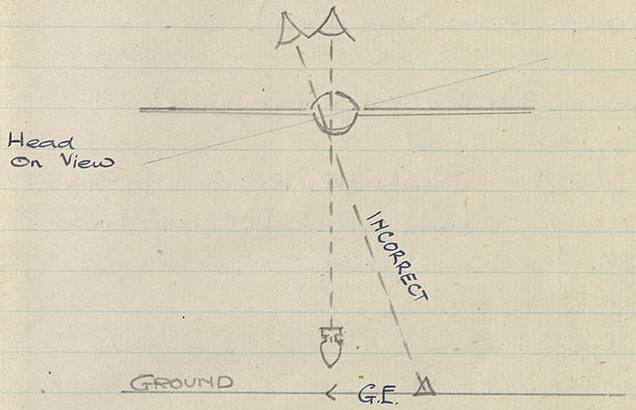
vice versa.

$G.E = \frac{\alpha}{60}\left(H + \frac{G^2}{16}\right)$

α = ∠ of tilt
G = Ground speed in f.p.s.
H = Height

B.E.
(Continued)

Group C — Lateral Levelling



If right wing low – bomb falls to RIGHT of target

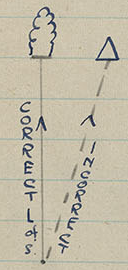
" left " " – " " LEFT " "

$G.E = \frac{\alpha H}{60}$ (α = Angle of tilt)

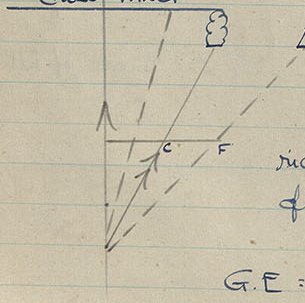
B.E. (continued)

Installation Error (Bomb falls to left or right of target UP or DOWN WIND)

Diagram in PLAN VIEW - (up + down wind)



Bombsight installed to RIGHT bombs fall to LEFT of target +vice versa.



{C: Foresight correct
F: " incorrect}

Bombsight installed to right bombs burst to LEFT of target +vice versa.

$G.E = \frac{\alpha}{60} G.T.$

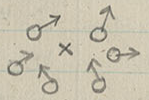
Tabulation of Bombing Errors

No	ERROR	FORMULA	DIRECTION	GROUP
1	Wind Speed	W x T	Up or Down wind	A
2	Wind Direction	$\frac{\alpha}{60}$ WT	Rt. angles to W/Direction	A
3	W/V (V.E)	VE x T	Back along VE	A
4	Airspeed	$\frac{V \times T}{H}$	Parallel to heading	B
5	Trail Angle	$\frac{Gh}{60}$	Parallel to heading	B
6	Height	$\frac{G}{32}T$	Parallel to track	B
7	Fore + Aft. level	$\frac{\alpha}{60}\left(H + \frac{G^2}{16}\right)$	Parallel to track	B
8	Lateral	$\frac{\alpha}{60} H$	Rt. Angles to heading	C
9	Installation	$\frac{\alpha}{60}$ G.T.	Rt. Angles to track	C

Bombing Analysis.

Various groups obtained by incorrect settings on sight

CLOSE Group :-



X = M.P.I.
radius from here

Radius of circle is B/A's error
Causes :- Slight inconsistant sighting errors

Open Group :- 2 types Radial & Tangential

(Radial)

Range errors either consistent over or undershoots on all headings

Error

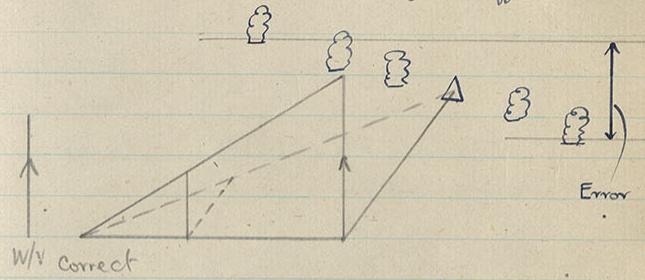
Inner ○ cutting nearest bomb

Outer ○ " furthest "

Causes levelling fore & aft - overset A/S or height.

Line Group :- bombs form an apparent line

Errors due to compass - Red off red



TIME	SPEED	AVERAGE VELOCITY	DISTANCE
Zero			
1	32 f.p.s.	16	16
2	64	48	64
3	96	80	144
4	128	112	256
5	160	144	400
T	32 x T fps.	$\frac{32 \times T}{2}$	$= 16T$ f.p.s.

Dist. bomb gun $= 16T^2$

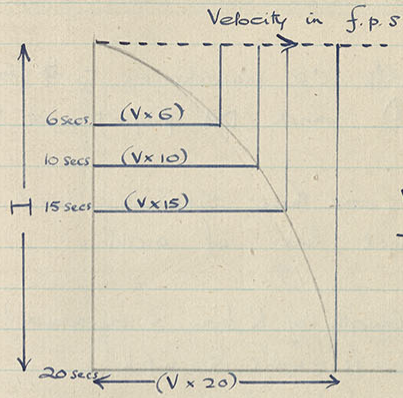
H. $16T^2$

$T^2 = \frac{H}{16}$ $T = \frac{1}{4}\sqrt{H}$

Dist. travelled $= 16T$ fps $\times T = 16T^2$

T	0	1	2	3	4	5
H	0	16	64	144	256	400

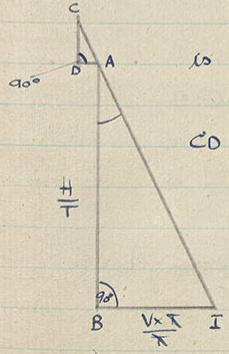
$H = 16T^2$.



V = Velocity

T = Time of fall in secs.

Construction of a Simple Bomb sight



1. To give correct line of sight ΔCDA is constructed similar to Δ ABI

2. This could be done by making CD proportional to CD (or Hᵗ) and DA proportional to BI (V x T)

3. This however would mean that we should have to alter length of both scales for any variations in height (because T varies with hᵗ)

Divide both sides by T to make speed

Simple Bombsight (Continued)

(for Ideal bomb in still air)

4. Hence we make CD proportional to $\frac{H}{T}$ (~~Air Speed~~ of fall of bomb) and DA proportional to V (Air speed)

The 2 Δs are then similar and CA is the correct line of sight.

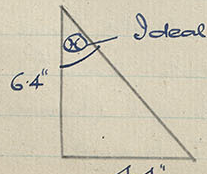
Example - Find length of h' bar & airspeed bar given H' = 6400 ft. & A/S 150 m.p.h.

$\frac{H}{T} = \frac{6400}{20} = 320$ ft. per sec. =

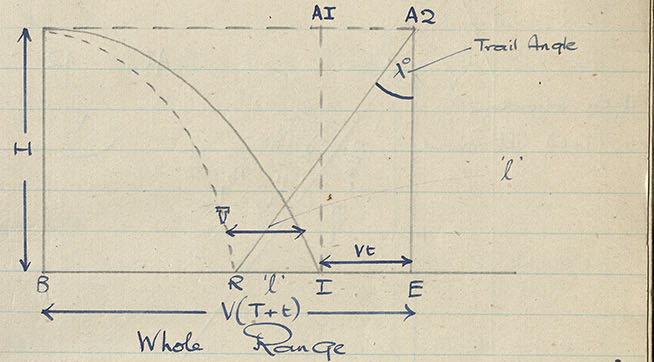
220 f.p.s. = V ~ Using scale of 1" = 50 f.p.s.

then h' bar length = $\frac{320}{50} = 6.4"$

and airspeed bar length: $\frac{220}{50} = 4.4"$



REAL Bomb in Still Air



T = $\frac{1}{4}\sqrt{H}$, R.E = Trail Distance = angle subtended equals Trail Angle which depends on

i. Ballistic qualities of bomb

ii Airspeed of aircraft

Trail Distance = (t + l)

$\frac{\lambda}{360} = \frac{TD}{2\pi H}$

$2\pi R$ (assume $\pi = 3$)

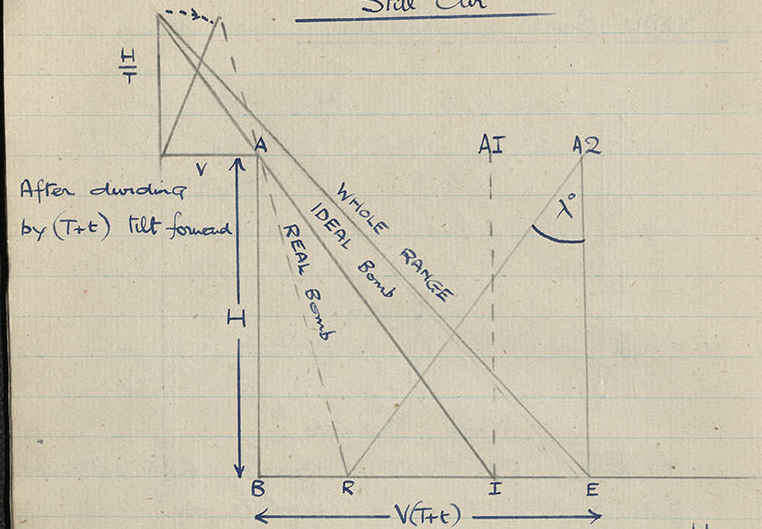
By substitution then $\frac{\lambda}{360} = \frac{TD}{2\pi H}$

$\frac{6H\lambda}{360} = TD.$

$\therefore TD = \frac{\lambda H}{60}$

[Assume are equal to T.D up to 5°]

Modification of Bomb sight for REAL Bomb in Still Air



Shorten height bar by dividing by T+t = $\frac{H}{T+t}$

Airspeed bar = V f.p.s.

Tilt Ht bar forward same angle i.e λ° OR TRAIL ANGLE of bomb to be dropped

Ht bar calibrated Airspeed $\frac{H}{T+t}$ / V

λ° = tilt along heading

(continued)

Example 1

Calculate length of ht and airspeed bars when the bombsight is set up for bombing at 14400 ft and 210 m.p.h Airspeed (in still air) Time lag = 1·5 secs. Scale = 1" = 50 f.p.s.

$T = \frac{1}{4}\sqrt{H} = \frac{1}{4} \times 120 = 30$ secs.

t = 1·5 secs. ; T+t = 31·5 secs.

$\frac{2}{63} \times \frac{14400}{50} = \frac{64}{7} = 9\frac{1}{7}$" or 9·13" for Ht bar

$\frac{210}{50} \times \frac{22}{15} = \frac{154}{25} = 6{\cdot}16$" 6·16" for A/S bar

Example 2

Calculate lengths of ht & airspeed bars at 8100 ft Airspeed = 165 m.p.h. Time lag = 2·5 secs Scale 1" = 50 f.p.s.

$T = \frac{1}{4}\sqrt{H} = \frac{1}{4} \times 90 = 22{\cdot}5$ secs. ; t = 2·5 secs. T+t = 25 secs

Length of Ht bar = $\frac{8100}{25 \times 50} = 6{\cdot}48$"

Length of Airspeed bar = $\frac{165}{50} \times \frac{22}{15} = 4{\cdot}84$"

◇

H' 6400 ft T.A.S. 180 mph Time Lag = 2 secs.
Trail Angle = 5° (Scale = 1" = 50 f.p.s.)

$T = \frac{1}{4}\sqrt{H} = \frac{80}{4} = 20$ secs., $t = 2$ secs.

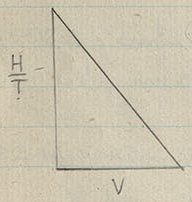
$T + t = 22$ secs.

$\frac{H}{T+t} = \frac{640\phi}{22} \times 5\phi = \frac{320}{55} = 5.8"$ = length of H' bar

$\frac{180}{50} \times \frac{22}{15} = \frac{132}{25} = 5.28"$ = length of Airspeed bar.

Theory of Bombing as applied to Mk XIV

Scale throughout bombsight = 1" = 100 m.p.h.



$\frac{4H}{4 \times \frac{1}{4}\sqrt{H}} = \frac{4\sqrt{H}\sqrt{H}}{\sqrt{H}} = 4\sqrt{H}$

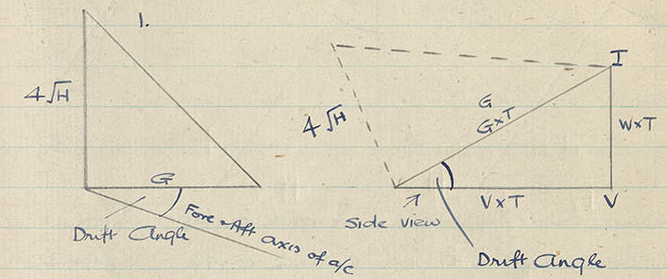
So $\frac{H}{T} = 4\sqrt{H}$ — Ideal bomb in still air

$4\sqrt{H}$ used in Mk XIV (Stage no. I)

Now in next diagram see Ideal Bomb in a wind

Mk XIV Theory (Continued)

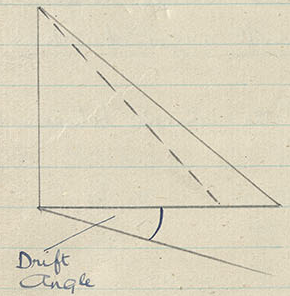
Stage no. 2.



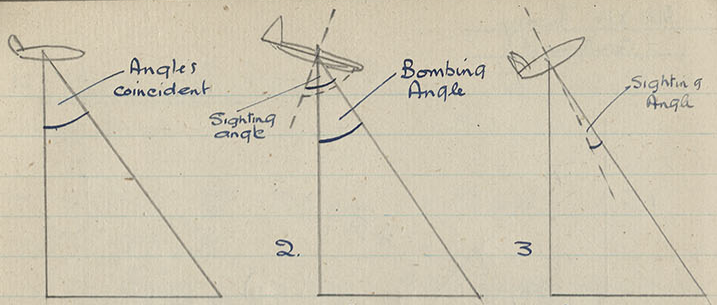
Dotted Δ same as no. I Δ

Trail Distance is mainly dependent on Tv + Airspeed

Stage no. 3.



Real Bombing Angle



Bombing and Sighting Angles coincident in st. level flight

In glide or dive sighting angle is bigger than bombing angle

In climb s/a is smaller than bombing angle

Sighting Angle :- is the angle between vertical at rt. angles to fore + aft axis of a/c. + line of sight

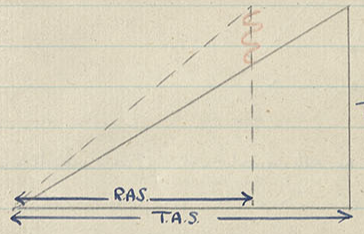
Bombing Angle :- is the angle between vertical and line of sight.

How Mk XIV works on Indicated Values.

I.A.S. + P.E. + I.E. = R.A.S.

R.A.S. converted for Temp. + Pressure = T.A.S.

R.A.S. used throughout the bombsight



Reduce W/S by 1.5% per 1000 ft. of height

Example For 5000 ft where True Wind Speed equals 30 m.p.h. ∴ Reduce by 1.5% per 1000 ft.

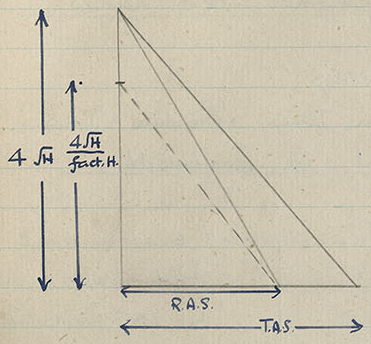
$= \frac{1\frac{1}{2}}{100} \times \frac{3}{5} = \frac{1\frac{1}{2}}{20} \times 3 = \frac{3}{2} \times \frac{36}{26} = \frac{9}{4} = 2.25$ mph.

= 30 − 2.25 Then wind set. 27.75 mph

OR 28 mph approx.

P.T.O.

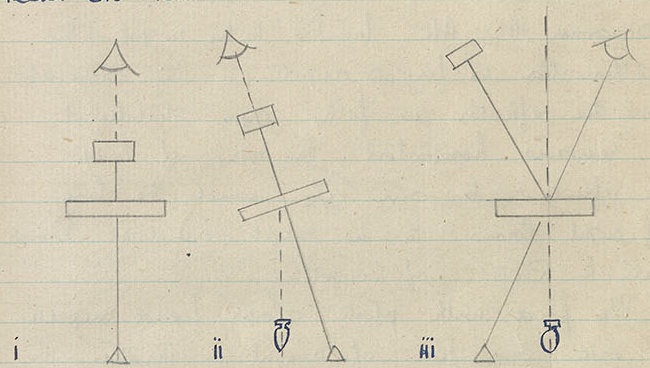
Mk XIV Indicated Values (Continued)



'Factor H' = The mathematical calculation used to reduce True ht. proportionate to R.A.S.

Roll Stabilisation

Head on Views



iv.

If an a/c banks left or right the bombsight stick falls st. down ∴ We always want to maintain our line of sight in the vertical plane.

Diagram i. Flying st. & level our reflector is horizontal & l. of s. is in vertical plane

Diagram ii A/c banks to the right

The collimator & reflector being fixed rigidly to the a/c ~ go through the same

Roll Stabilisation (Continued)

angle of bank – our line of sight is ∴ thrown to the left – and bombs fall to the RIGHT of target.

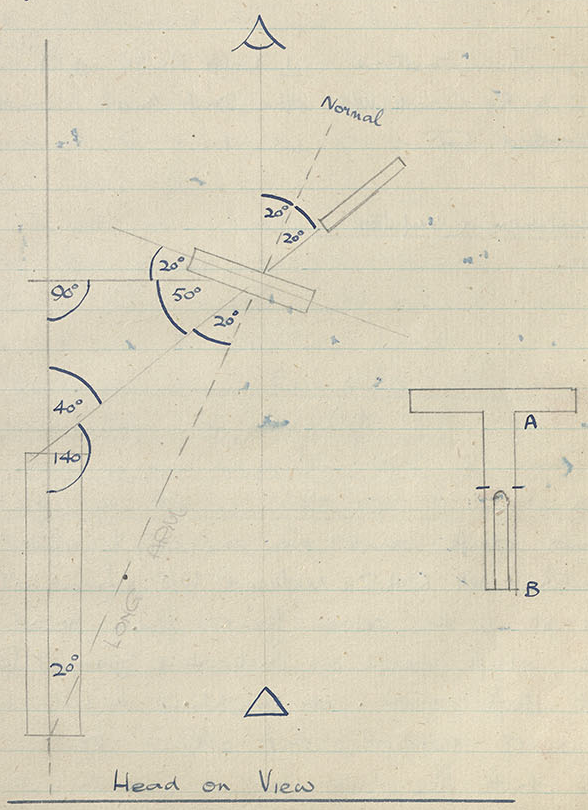
Diagram III A/C banks to the right – the collimator is fixed rigidly to the aircraft but the reflector is fully gyro stabilised ∴ remains horizontal. The ray of light is reflected to our eye and the line of sight thrown to the right and so bombs fall to RIGHT of target

We find with plate glass fixed rigidly to a/c. our line of sight is thrown or reflected to the left, and with reflector fully stabilised l. of st thrown to right (i.e. in both cases banking to the RIGHT)

∴ The solution must be midway between i.e. Tilt reflector through half angle of bank as shown in No. IV. diagram

Proof that reflector glass tilts half no degrees of bank

Diagram



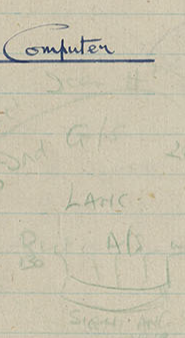
Mk XIV Sighting Head

Use of S.H. only

Two Factors – i. Drift Angle ii. Sighting Angle

R.A.S + Reduced W/S give Drift Angle and Indicated G/S.

Emergency Computer



To find drift angle we use a Boulton Computer – set R.A.S; reduced W/S + from Wind pt. for the course being flown read off the drift angle + Indicated Ground Speed

Set drift angle on sighting head by using manual drift setting knob (The drift flex drive must be disconnected)

Mk XIV S.H. (continued)

To find Sighting Angle – using an emergency Computer set Rect. I.C.A.N ht. above Target the Indicated Ground Speed against

From the opening in the emergency computer read off the sighting angle against the particular R.A.S. at which you are flying

To set on Sighting hd. – disconnect top flex drive – screw in emergency setting knob and rotate until correct angle is set on the sighting head.

NB There is an Emergency Computer for each type of aircraft

There is no need to level S.H. on run up. as this is allowed for in the Computer.

Bombing Angle Computer – similar to Emergency Computer except that bombing angle is read off against

1. T.V. 2. A/S 3 Single arrow

where 1 corresponds to 850 – 1160 T.V. Computer

2 " " 1500 T.V. "

3 " " 1800 T.V. "

P.T.O. for Note.

Bombing Angle Computers (Continued)

N.B. These computers i.e. Bombing Angle can be used with any type of aircraft and on the run up the sighting head MUST be levelled.

◇

C.S.B.S.

Marks	Hᵗ.	Airspeed	Windspeed
7^A	3-20000 ft.	70-180 m.p.h.	Zero to 60 m.p.h.
7^C	Ditto	60-156 knots	Zero to 50 knots
9^A	Ditto	100-240 m.p.h.	Zero to 70 m.p.h.
9^A STAR	Ditto	Ditto	Ditto.
9^C	Ditto	87-208 knots	Zero to 60 knots
9^E	2000-2600 ft.	200-360 m.p.h.	Zero to 100 m.p.h.
9^E STAR	2000-2600	Ditto	Ditto.

The mks. 7^A 7^C 9^A STAR & 9^E STAR have no enemy vector.

Visual Inspection:

Mechanical Tests

i. Fore-sights – Set W/S to zero & adjust A/S until Foresights are vertically over pair of beads – Any distortion will then be apparent.

ii Backsights: Set Fore-sights as above, lower hᵗ. bar & adjust backsights so they are in line

CONTINUED →

with foresights and beads - Distortion will then be apparent.

Repeat with H.T. bar vertical - when sights & beads on one side are in line - the other side should be in line.

iii. Wind gauge bar - Set W/S & E/S zero the bevelled edge of the bar should pass through the centre of bearing plate and zero mark on the drift scale

Moving Parts

Set maximum W/S; A/S = twice W/S By rotating milled knob, the maximum drift obtainable should be 30° (+ or - tolerance)

Back Lash Test (For play or wear in gears)

i. E/S to zero - A/S & W/S to maximum.

ii Rotate compass in clockwise direction till G/S reading on drift box = present A/S.

iii Unlock bearing plate - set N. on to zero on drift scale & relock

iv Continue rotation of compass bowl through approx. 180°, then reverse rotation till pre selected G/S is again registered

V Back lash in degrees can then be read off between N. on bearing plate & Zero on drift scale.

vi Repeat procedure in opposite direction. Total back-lash should not exceed 3°

Visual Inspection

i. Drift wires taut & parallel - beads in place - check auxiliary drift bar

ii Foresights & Backsights (Mechanical)

iii W/S bar be parallel to Wind arrow - check scales and knob.

iv Wind gauge bar (Mechanical)

v H.T. bar - check knob for freedom of movement & scale for legibility.

Visual Inspection (Continued)

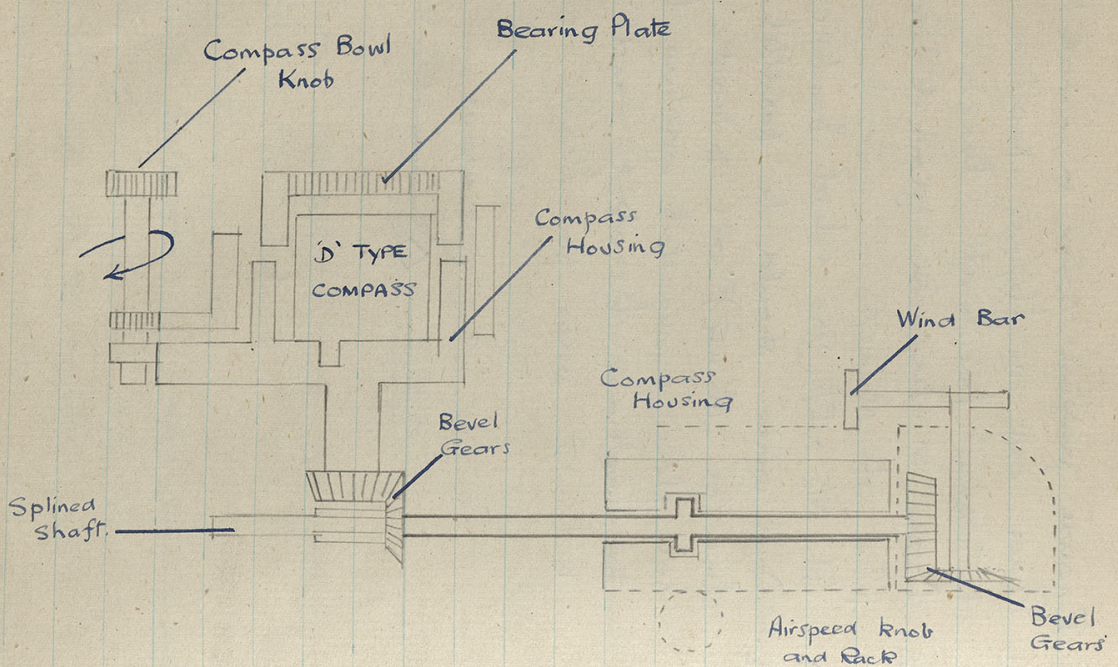
VI. Bearing Plate - Rigid when locked free when unlocked
VII Compass - Examine liquid for bubbles & discolouration. Test for pivot friction - broken arms or chips of paint
VIII Levels - Large or broken bubbles
IX Airspeed - check scale & freedom of movement
X T.V. - Scale & freedom of movement with knob
XI Compass corection magnet box

Installation of C.S.B.S.

i. Ensure serviceability of bombsight
ii Fit levelling bracket to three bolts fitted in a/c
iii Place bombsight on levelling bracket
iv In air damp out vibration by tightening up on rubber pads
v Place a/c on suitable flat surface
vi Ensure pressure same in each tyre
vii Place a/c in flying position & determine fore & aft line.
viii. Draw st. line on ground or use piece of string
ix Set W/S & E/S zero & level bombsight
x Drift wires should be parallel to line (or string) on ground. If not, place laminated washers between the levelling bracket and a/c to bring wires parallel

Swing the Compass.

Parallel Gearing of C.S.B.S. Wind Arrow - W/S Bar



BOMBS AND COMPS.

WEIGHT	MKS.	FUSED		REMARKS
		NOSE	TAIL	
G.P. BOMBS				
20 lb. F.	I, II, III	PISTOL 38 - 45	NIL	Different marks indicate different methods of suspension
40 lb F.	I, II, III	Ditto	Ditto	Ditto
250 - 500 lb	IV	27	28	Exploder pocket in nose and tail - Clip on tail unit.
		42	30	
		44	30	
		NIL	37 LONG DELAY P.	
250 - 500 lb	IV A	Ditto	Ditto	Same as Mk IV (made in America for use with British components
250 - 500 lb	VI			Made in America for use with American Components
1000 lb	I - II	Same as 250 - 500 IV. Mark II has machined flat. MK I has machined flat.		

BOMBS AND COMPS. (Continued)

WEIGHT	MKS.	FUSED		REMARKS
		NOSE	TAIL	
1000 lb	III - IV	NIL	37 Long Delay Pistol	Nose plug welded in position (Can also take 28 - 30 tail pistols
1900 lb	I	Same G.P. Mk IV		Similar to 1000 lb Mk I
4000 lb	I - II	Ditto		Being replaced by 4000 lb M.C.
M.C. Bombs.				
250 lb	I	Same as G.P. Mk IV		
500 lb	III, IV, V	Ditto		
1000 lb		Ditto		Positioning key replacing lug. Tail wing unit secured by bolts,
4000 lb.		Tail unit secured by		hexagonal bolts -
GENERAL NOTE: Body case approx. = thickness as G.P. at Nose + Tail Sides are thinner. M.C. has higher charge rate ratio				replacing 4000 lb G.P. Suspension lug + 2 positioning keys.

Bombs and Comps. (continued)

Weight	Mks.	Fused		Remarks
		Nose	Tail	
H.C. Bombs.				
2000	I	27 42 44	/	Conical nose - 1 nose pistol + two sides pockets
2000	II	Ditto		3 Pistols in nose + 2 side pockets
2000	III			3 Pistols in nose - No side pockets
4000	I	Ditto		Conical nose - 2 nose pistol side pockets
4000	II	Ditto		3 Pistols in nose + 2 side pockets
4000	III. IV	Ditto		3 nose pistols - no side pockets - No crutch pads.
8000	I + II	Ditto		3 nose pistols - Suspension lug + 4 hoisting keys Body in 2 sections
12000	I	Ditto	An 8000lb with Centre Section added Has a cone + drum type of tail unit	

Weight	Mks.	Fused		Remarks
		Nose	Tail	
General Note :- All H.C. bombs have a central tube + are fitted with a retarding band.				
Anti-Sub :-				
100 250 500	II + III	32 Fuze		Fitted with ballistic cap to prevent richoting Strengthened for Catapaulting
100 250 500	IV		30 Pistol	Manufactured with flat nose - clip on tail unit Now used against inland water docks + harbours + fitted with no 35 long delay tail pistol

BOMBS AND COMPS. (continued)

WEIGHT	MKS.	FUSED NOSE	FUSED TAIL	REMARKS
Anti-Sub				
			Fuzes	False nose - Lethal range
600 lb	I		862	28 ft - Serious damage
			875	up to 140 feet
			892	
S.A.P.				Exploder in steel
250	II + III		30	Container
500				
250	II C		30	
500	+ III C.			
250 + 500	IV		30	Clip on tail unit
250 + 500	V		28, 30 pistol	Clip on tail unit
A.P.				
2000 lb	I		37 Fuze	Tail unit secured by 8 bolts
2000 lb	II + III		37 Fuze	At present being modified at MU's to take 30 Tail Pistol
2000 lb	IV		30 Tail Pistol	— No remark

WEIGHT	MKS	FUSED NOSE	FUSED TAIL	REMARKS
L.C.				
30 lb	30 I + IM	38 Fuze		False nose M indicates
30 lb	II			fitted with suspension band
				II - No fuze - heavy flat
				nose & light tin tail drum
65	I + II			18" square droque tied to top
				M.II - 2 distant pieces
250	I + II	36		11oz gunpowder burster
				Charge
500	I			
4 lb Smoke	I + II		859 Fuzes	Carried 42 per s.b.c
100 lb Smoke	I		854 Fuze	- with white phosphorus
				2ozs. Gunpowder charge
				to scatter contents.

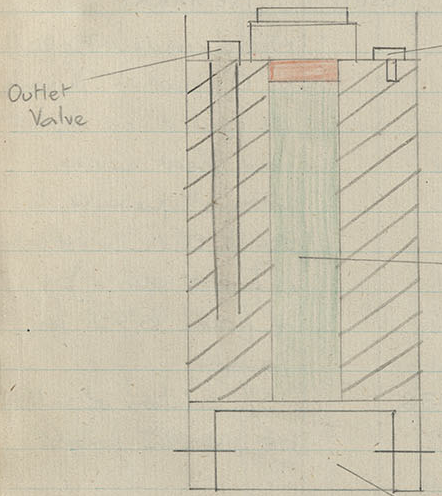
All light CASE carriers painted GREY

All smoke bombs painted GREEN

Bombs and Comps

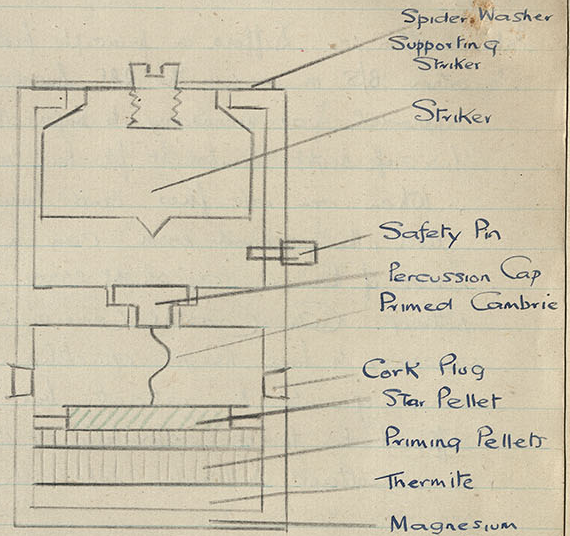
Weight	Mks.	Fused	Remarks
Incendiary			
4 lb	IV	No Fusing	Similar to Mk IV - made in U.S.A.
	IVE		Similar to M.IV & V but
	VE		Gunpowder in the nose
	IX & 2X		Similar to M.IV but has high explosive charge i.e. T.N.T. or C.E pellets in nose
30 lb	II III & IV	846 Fuze	Either 1 lb or ½ lb white phosphorus in nose - main filling is 7 lb or 6½ lb of a 5% solution of perspex or rubber in benzol - Magazine Charge scatters contents approx 30 yards.
30 lb 'J'	I	No Fusing	Main filling 1·3 gallons of a mixture of Methane & Petrol under 92-110 lbs per □" - pressure. Thermite 1 lb ignited on impact and heat raises internal pressure to 300 lb □" - An exit valve is forced open - Jet of flame 15' x 2' for 1 minute
250 lb	I	36	5% solution of rubber OR perspex in benzol

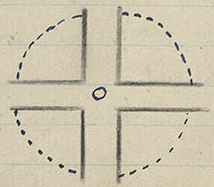
30lb Incendiary Type 'J'



Recognised by 2 bright red bands

4lb. Incendiary MK IV





Plan View of Spider Washer Supporting Striker

Low Level Bombsight Mk III

Introduction :- Differs in principle from any other B/S in use in the R.A.F. because a new approach was necessary to supercede the fixed line of sight bombsight for low level work.

When an a/c flies and bombs at low level, the ground error can be quite large if there is a slight error in the height setting. On Coastal Command it is often necessary to lose height quickly and straight away go into the attack, but it is very difficult to judge accurately HEIGHT when it is altered suddenly especially over the sea.

The Mk III B/S was designed to allow accurate bombing in a glide or climb also to eliminate the error due to inaccurate judgement of height.

Advantages

i. Errors in Ht. Can be ignored

ii Errors in G/S settings cause only half the error on the ground compared with the normal bombsight

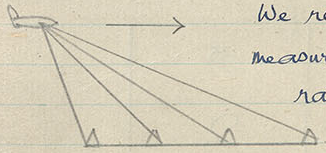
iii Bombing can be carried out in a glide or climb allowing tactical freedom

iv No apparently false settings required for stick bombing

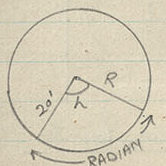
Range Ht. Zero to 1000 ft

Speed 100 to 300 mph. G/S. . .

Theory The b/s is based on angular velocity of the target



We required some method of measuring the angles and rate of change



$\frac{R}{2\pi R} \times 360 = 57.3° = 1$ Radian

At speed of 20 f.p.s.
= 1 Radian per sec.

S B C's

Mark. I. - Ia.

TYPE & WT.	No. PER COMPARTMENT	No COMPARTMENTS	ATTACHMENT
4lb. Incendiary	20 or 30	3	NIL
30lb Incendiary	4	2	NIL
20lb. 'F' M.III	4	3	No I - 'T' shaped
40lb G.P.	3	2	No 2 - 'D' shaped
30lb. C	4	2	NIL
65 lb. L.C.	1	3	NIL
4 lb. Smoke	14	3	NIL
100 lb Smoke	1	3	NIL

Mark VA

4lb Incendiary	50	3
Mark VB		
30 lb Incend	8	2
Mark VC		
30 lb Incend.	8	1
Mark VD		
30 lb Incend	6	1

All Mark V were designed for the Lancaster aircraft

Modifying Electrical Circuit for S.B.C.

1. Stow fusing units on upper side of carrier and place adapter box on underside of front of the carrier.
2. Connect five pin plug from carrier to the five pin socket in adapter box
3. Connect three pin plug from adapter box to aircraft's supply
4. Connect the two leads from junction box on S.B.C. to the two spring-loaded terminals on the adapter box

Light Series Carriers

No.	Store	Attachment
i 4	Practise bombs	—
ii 4	20 lb F.	I & IA
iii 4	40 lb GP.	I & IA
iv 4	20 lb F or GP. with parachute attachment	I, IA & 7
v 4	4" Training Flares	—
vi 4	45 Recco Flares	Flexible F.S.C.L.
vii 4	45 Photo flash	Flexible F.S.C.L
viii 4	Smoke Floats no. I	3A
ix 3	Smoke generator no II	—
x 4	Aluminium Sea Markers Mk 3	I & IA
xi 4	30 lb L.C.	— Nil
xii 4	Marker Marine Mk 2	8.

Universal Carriers Type EM/EF

No.	MK	REMARKS
I	I	For stores 50-250 lb S.H.R.S. and E.M.R.U. Type 'C' or Type N release unit
I	II	Similar above strengthened for catapaulting
II	I	For stores 50-550 lb
II	II	Similar to No 2 mk I but strengthened for catapaulting
—	III	For stores 50-500 lbs Can be used in no. I & no 2. in most cases Flexible F.S.C.L used.

Standard 2000 lb Carriers

Type	Mk	Remarks
'A'	I	Fixed crutches and single sling. Type S.H.R.S. & C.E.M.R.U.
S.H.R.S.		
C.E.M.R.U.		
A	I^A	Similar to Type 'A' MK I but adjustable crutches
B	I	Fixed crutches & 2 slings S.H.R.S. MkIII & C.E.M.R.U.
B	I^A	Similar to Type B, MkI but has adjustable crutches
	II	Similar to Type A, Mk I^A but with adjustable fusing arrangements - Type 'J' E.M.R.U. - Sling consists of three cables
A	III	Similar to the MkII - strengthen for catapaulting
B	III	Similar to Type B Mk I^A but with adjustable fuzing arrangements - Strengthened for Catapaulting

2000 lb Carrier MkII Special

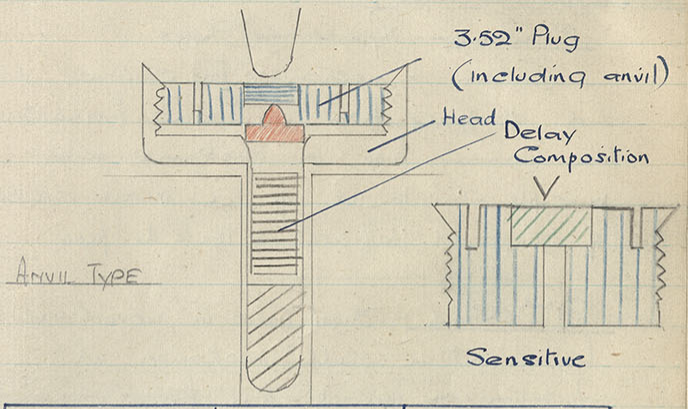
For use in Lancaster and subsequent types Adjustable crutches and fuzing arrangements S.H.R.S Mk III Star & Type 'C' E.M.R.U.

◇

Stores Carried

Mine Type 'A' MKs 1-4, 1500 lb., & Mine 2000 lb.
Bombs - 1000 lb, 1900 lb, 1000 lb M.C
18" Torpedo Mk 12, 1000 lb S.C.1.

DETONATORS



ANVIL TYPE

Delay	Colour	Type
	Green band on stem inside Kept in Green banded box	Sensitive
Instantaneous	White	Anvil + Sensitive
·025 secs.	Black	A. + S.
·04 secs.	Red	Sensitive
·05 secs.	White + Red	Sensitive
·12 secs.	Brown	A. + S.
·5 secs	Aluminium	A + Sensitive
1 Sec.	Yellow	A + S.
2 secs.	Green	Sensitive
3 secs.	Grey	Sensitive
11 secs.	Blue	A + S.
25 to 30 secs.	Blue + Yellow	Sensitive

FUZES

3 Groups of Fuzes

1st Group – Pyrotechnic Fuzes

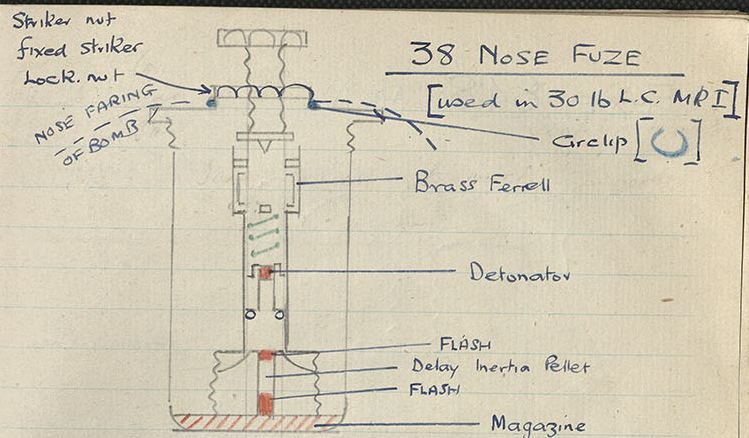
Contain a mechanism for causing delay and dropping from a/c using barometric time burning fuze or clockwork motor principle – this to set off a small charge of gunpowder sufficient to ignite the pyro.

2nd Group – Fuze used in incendiary bombs Contain simple mechanism while function on impact has large amount of Gunpowder in magazine – sufficient to eject ignite contents of bomb

3rd Group – Fuzes for high explosive bombs – Main reason for use is its safety aspect – main difference to those above is that magazine contains high explosive (C.E or T.N.T pellets) this to cause detonation of bomb in the same way as pistol & detonator.

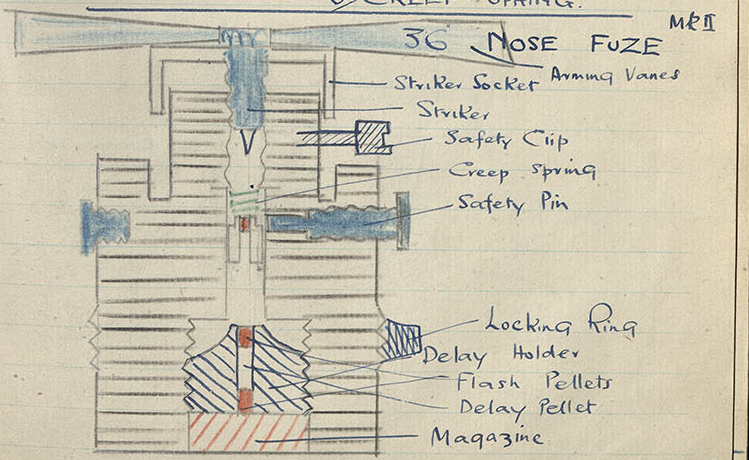
38 NOSE FUZE

[used in 30 lb L.C. MK I]

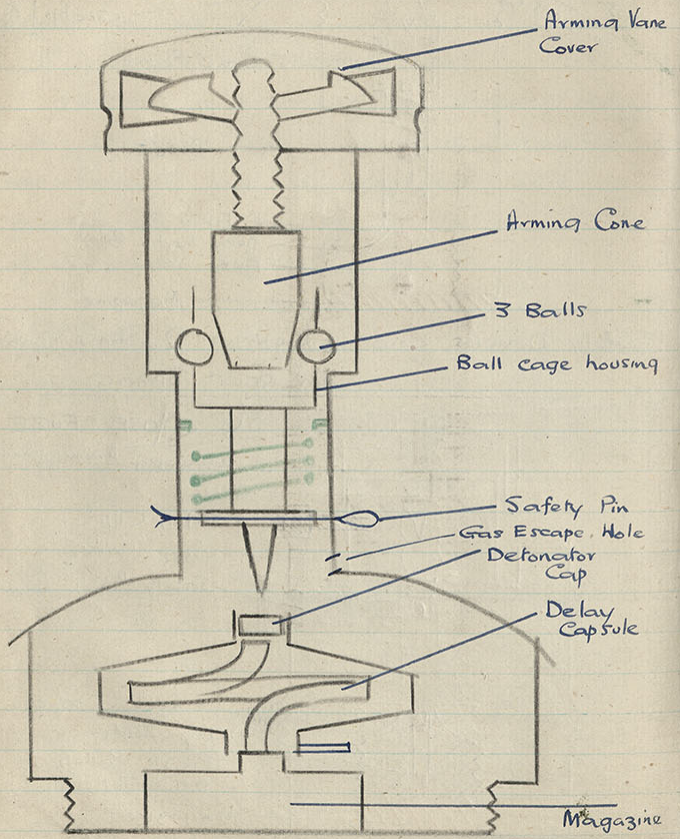


Safety Devices are: 1. LOCKNUT 2. BRASS FARRELL 3. CREEP SPRING.

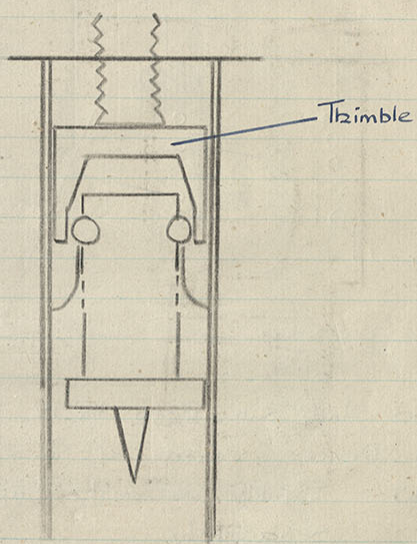
36 NOSE FUZE MK II



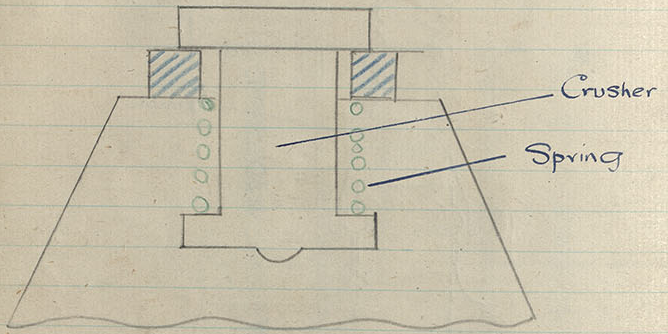
FUZE 848 MK IV



The Mk V 848 Fuze differs only in the striker mechanism as shown below.



No 35 Long Delay Fuze



Used in Anti-Sub. Bomb MK IV

Safety Devices consist of Pin & arming fork

Remarks :- Striker assembly supplied separately

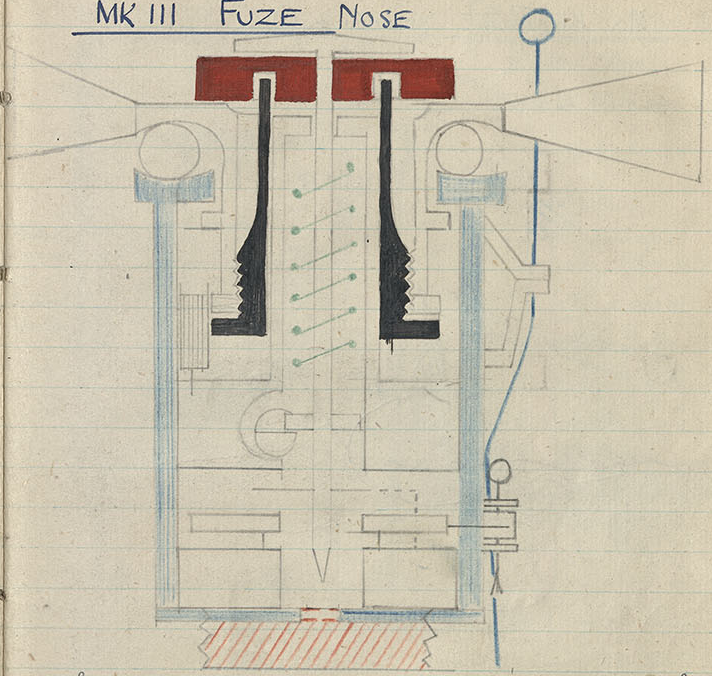
Delay can be 6 - 144 hours

THERE IS NO ANTI-REMOVAL DEVICE

A1

Used in PHOTOFLASH

MK III Fuze Nose



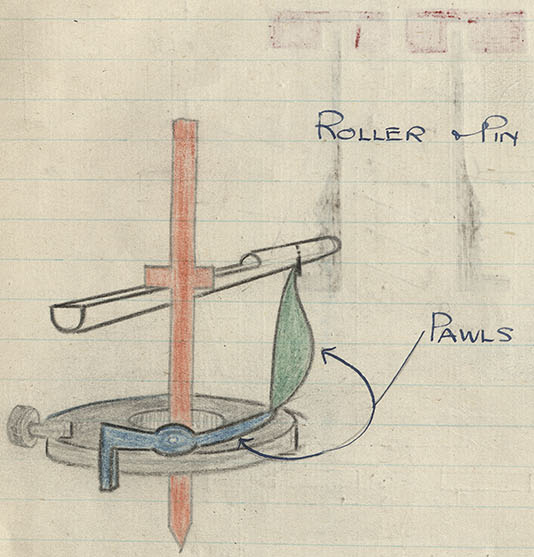
Safety Devices :- i. Safety Disc & segments ii Safety fork iii Lead Seal & wire

N.B. The A2 is stronger than the A1 - has 1 safety segment instead of the A1's 3

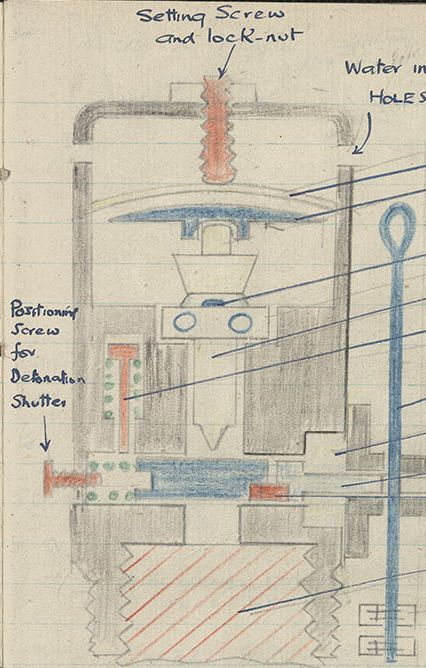
Minimum delay is 5 secs compared with the A1's 15 secs

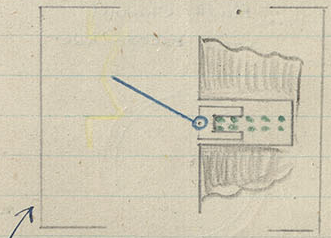
When MK III A is with large mag. is known as the 138 fuse and is used in Clusters.

MK III FUZE (continued)



862 TAIL FUZE [for 600 lb A/Sub. Bomb]

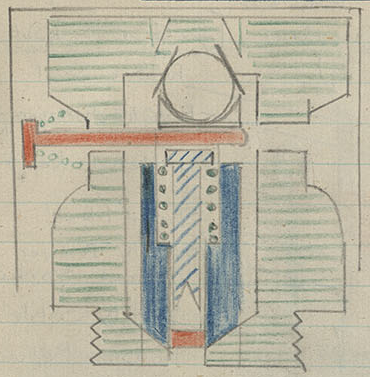




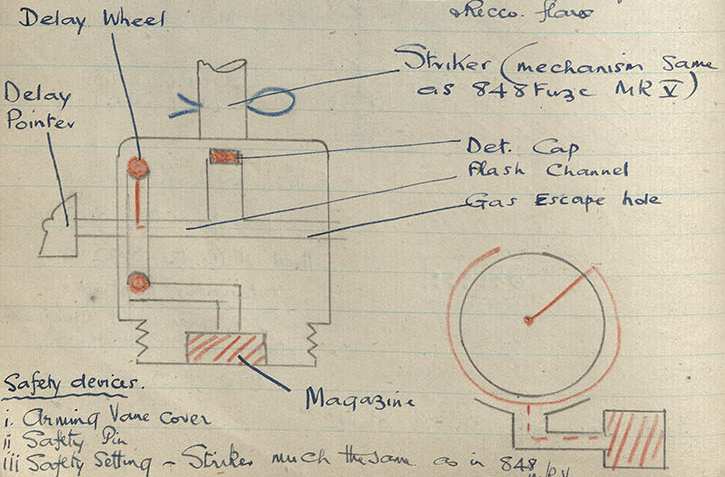
Side view of Striker Block

The 892 fuze only differs from the 862 in that it (i.e the 892's detonator contains 2.8 grams of gunpowder compared with the 862.s 5.6 grams

854 Fuze [used in 100 lb Smoke Bomb]



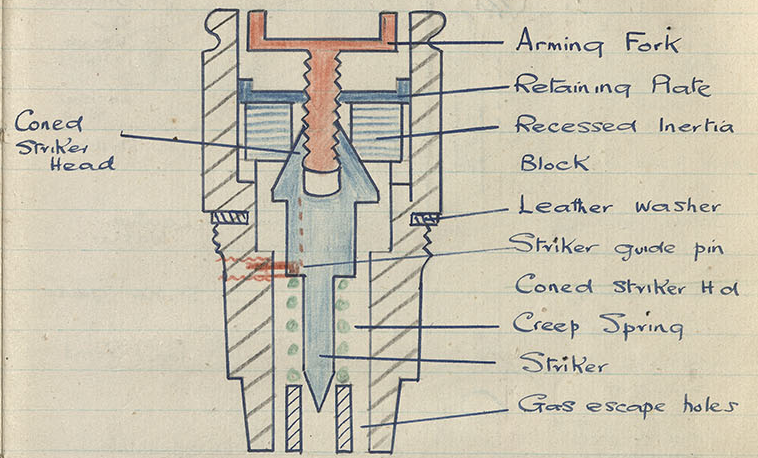
849 Nose Fuze used in Photo flashes & Recco. flares



Safety devices.

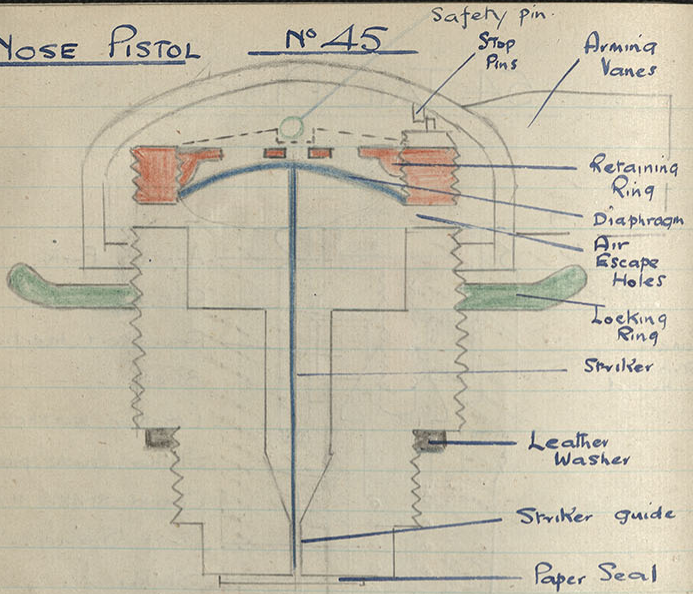
i. Arming Vane Cover
ii Safety Pin
iii Safety Setting - Striker much the same as in 848 MK V.

54 Tail Pistol



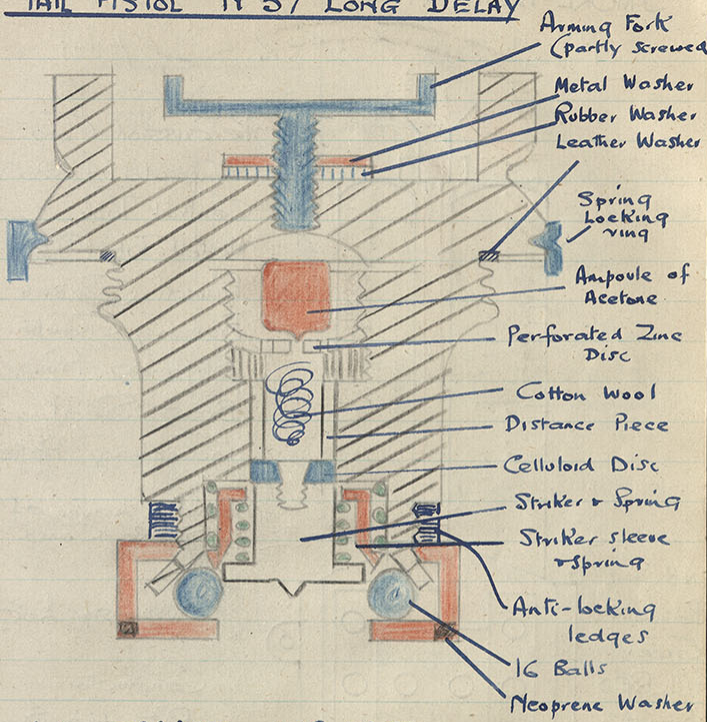
Used in G.P., M.C.

Nose Pistol No 45



In 20 lb. F. & 40 lb G.P.

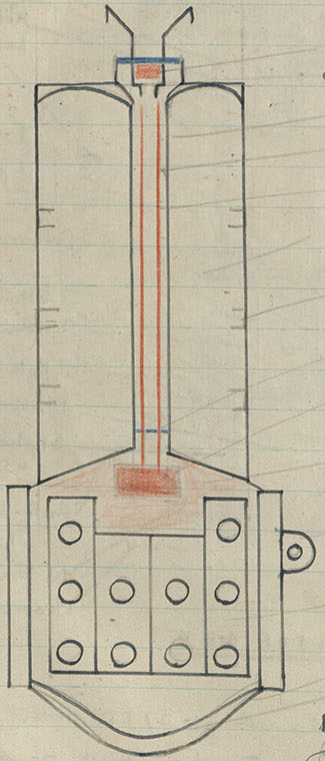
Tail Pistol No 37 Long Delay



Used in G.P. Mk III & S.A.P. Mk V

N.B. If bomb fuzed with No. 37 L.D. pistol falls off bomb trolley the fuze must be considered live.

Smoke Float No 2 Mk 2 Wt 207 lbs.



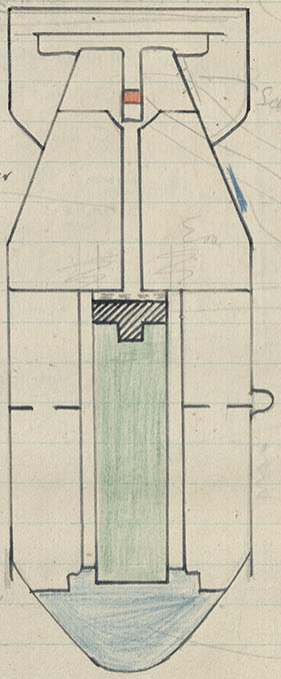
NB Painted Green with RED band

Percussion Cap
Gunpowder (4 seals)
Central Tube
Metal Tube (paper lined)
Primed Cambric
Bouyancy Chamber
Stiffening Rings
Brass Seal
Incendiary Pellet
Priming Layer of Smoke Comp.
Suspension Lug.
Conductor
Retarding Bands
Nose

Burns for 7 mins
Gives off WHITE smoke

Effective Smoke Screen 600ˣ x 200 ft. x 200 ft.

Smoke Float No I (Mk 4, 4Z, 5)



Container
Cap Tube

Retarding Band

Body – Green
Tail – Yellow
½" RED Band round Nose

23 Pistol used with store

Percussion Cap
Flash Comp.
Sinking Disc
Primed Cambric Disc with quickmatch threaded inside
Priming Loose on top pressed underneath

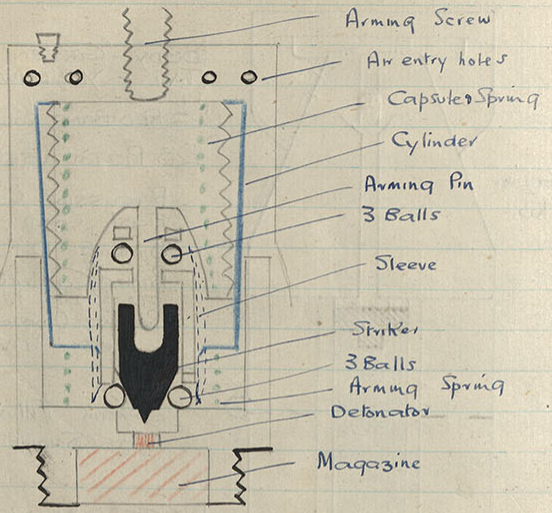
Main Filling of Smoke Comp.

WHITE SMOKE for 6 mins.

Weight is 11½ lbs

SOLID NOSE

860 Fuze Mk I^{A} for 3000 ft.



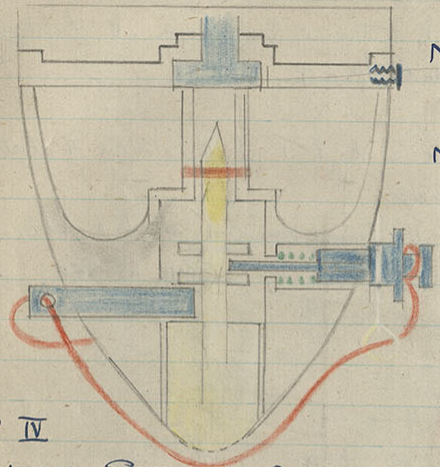
Note.. Mk II A for 1000 ft.
II B for 2000 ft
J for 10000 ft
} Ht above Sea level

860 Fuze Mk I^{A} ✕ 2 is used in J.D. Markers.
Safety Devices i. Arming Vane Cover, ii Safety Wire
iii. Safety Pin and Spring

867 Mk I ~ used in the tail of the number 4 cluster
i.e 30 lb 'J' Bombs.
Safety Devices i. Arming Vane Cover stock ii Safety wire
iii Safety pin and Spring SAME AS 860
but functions at 3000 ft.

1

Pyrotechnics



N°28 Detonator Burster

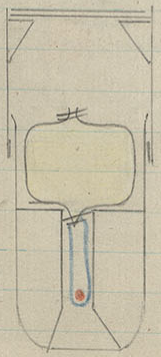
Note: Launch Tail First

T.V is 610 feet per sec

Filled ~~with~~ wt. 10¼lb

MK IV

Aluminium Sea Marker

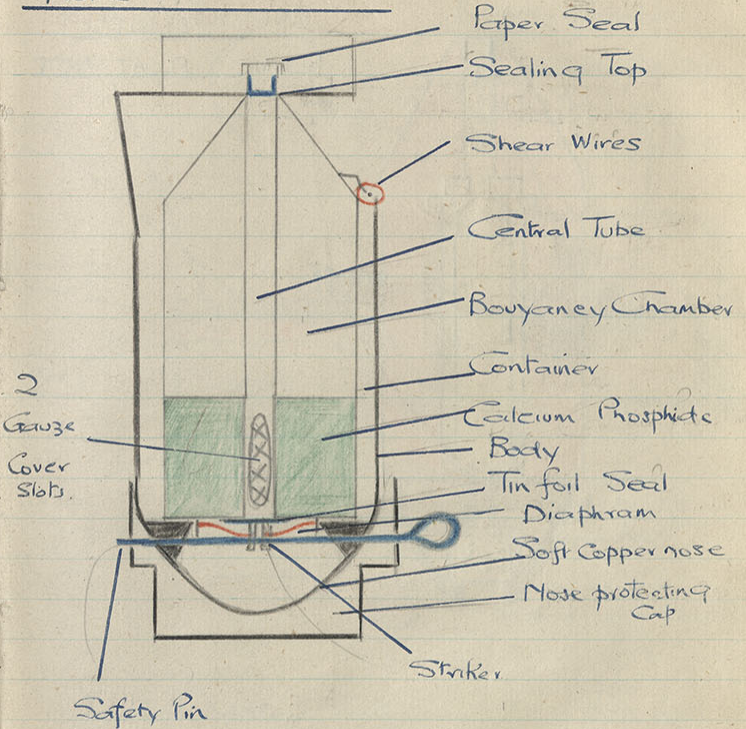


MK V

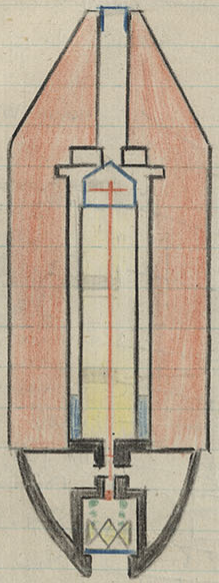
T.V.: 580 f.p.s.

Filled wt. 10 lbs.

Flame Float Mk2

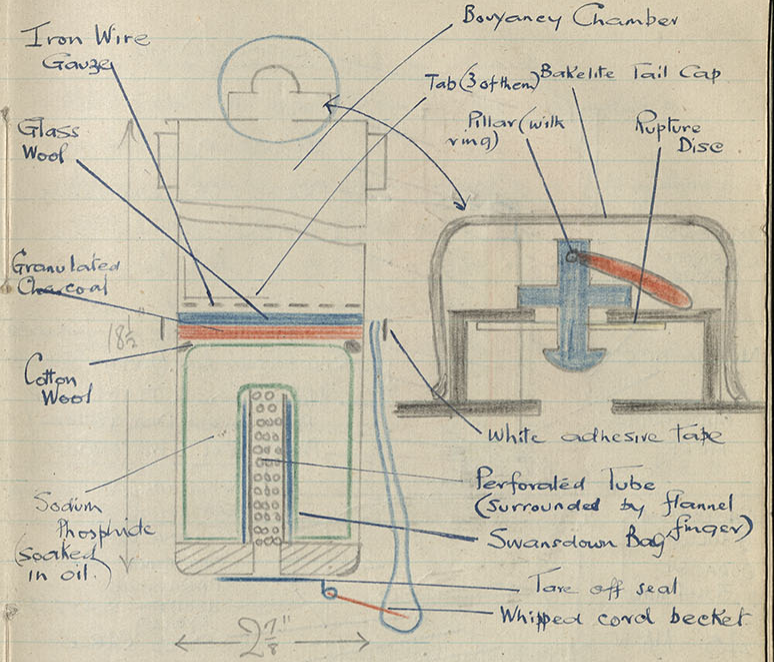


Note: Effective illumination 6 minutes



LIGHT
FLAME FLOAT MK IV

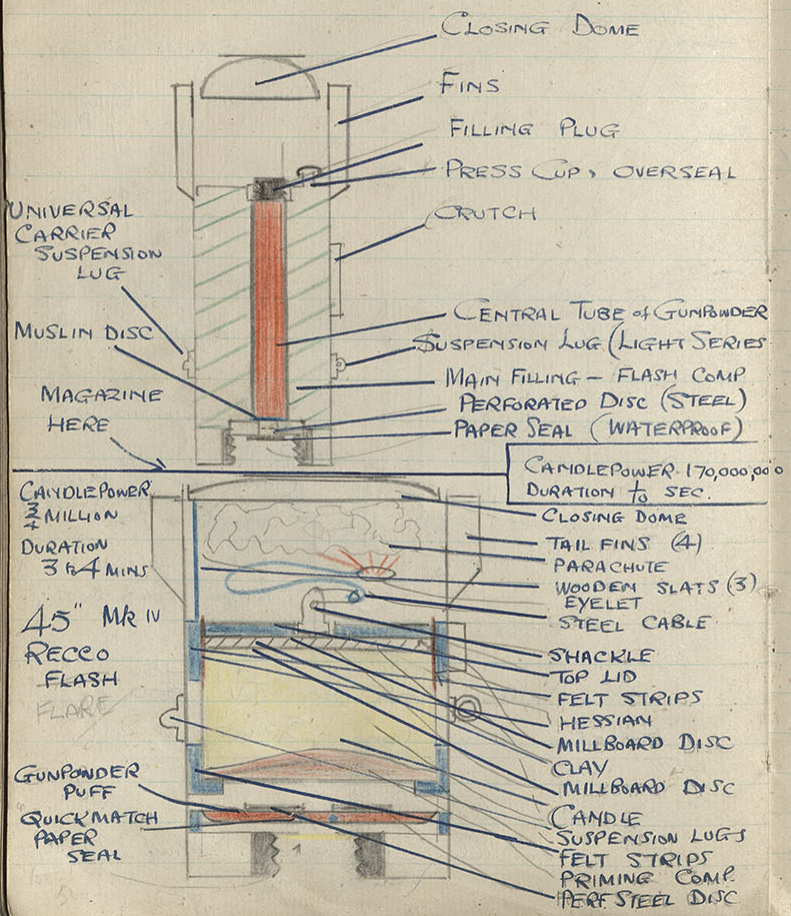
FLAME FLOAT No 3 MK II



Painted Yellow all over T.V. 450 300 f.p.s.
Effective duration - 5 mins. Wt 2 lb.

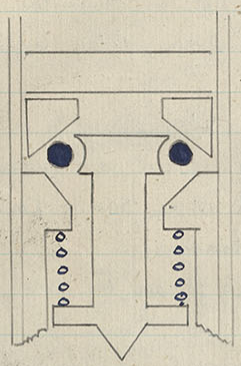
Launch nose forward
Visible over 3 mls day & over 12 mls at night

4.5" Photoflash MK 1.2



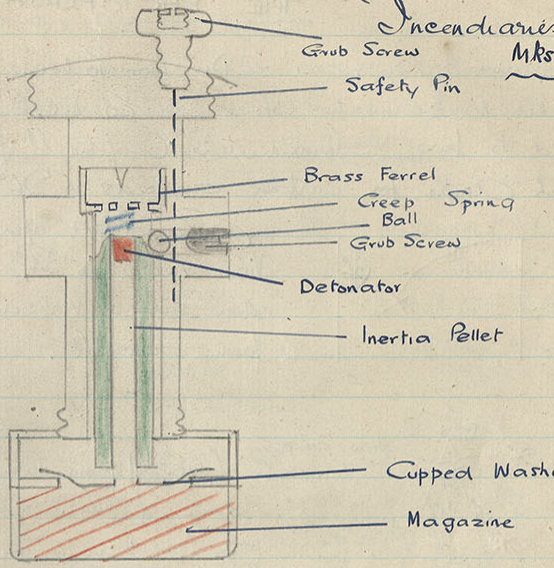
MK IV has parachute 11ft in diameter
MK V & MK VIII have 2 min delay equivalent to a fall of 2000 ft
MK VI has 4 min delay equal to a fall of 4000 ft
P.F. Carry 7 Recco flares in a cluster
Rate of fall of MK IV is 500 ft p.m with parachute open & candle burning
and a rate of 600 ft per min sec when parachute is not open & candle NOT burning
MK VII has a parachute of 18ft diameter
and a rate of fall approx equal to ½ that of the MK IV.

53 Long Delay Tail Pistol.

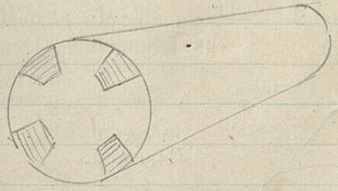


Striker mechanism
Other contents of
Pistol same as 37 L.D.P.
Delay ½ hour
No Anti-removal device.

846 Fuze Nose (used in 30lb Incendiaries) Mks 2.3.4



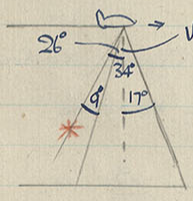
Safety Devices :- 1- Safety Pin 3.
2 Brass Ferrel Creep Spring



NIGHT PHOTOGRAPHY (CARRIED OUT WITH THE PHOTOFLASH)

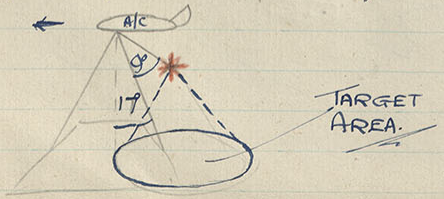
Candlepower 170,000,000 – Duration 1/10 sec.
reaches peak in the space of 1/60 sec.
Timed to burst approximately ⅔ of the ht. flown.
Trail Angle for certain airspeeds is 26°.

Camera F24 open shutter
View angle is 34° OR 17°
either side of vertical dropped from aircraft.

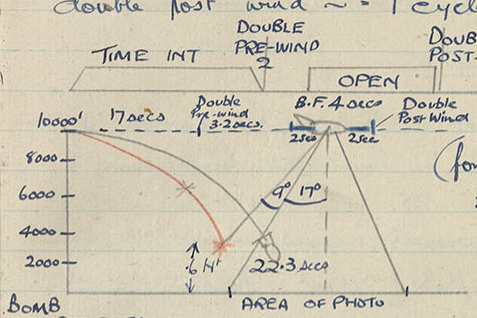


Limits – if more than 11° from edge of view angle or less than 6° – insufficient light

For NIL tilt airspeed = 180 mph.
Fly straight & level to obtain best results

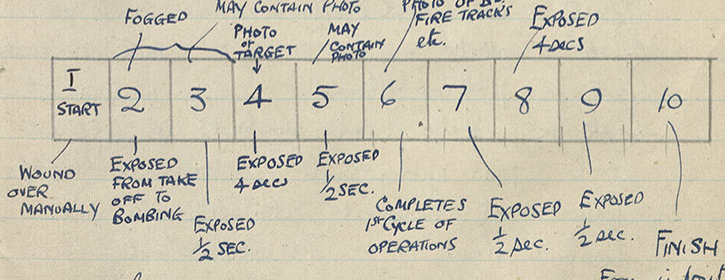


No 19 · 20 Type 35 Control Time Int set on Control
double prewind – open exposure during flash
double post wind – 1 cycle of operations



(Cycle of Operations
Ht. 10000 ft., A/S 180 mph
(for Trail Angle of 26°)
500 lb G.P. T off · 25·5 sec
Photo flash to burst 22·3 sec

(Assuming use of M III) Bombing Frame exposed 4 secs } for 8 secs
With 848 Fuse



Sequence of Frames..

Mk XIV Group - A - errors. Systematic

W/S } W/V
W/D }

Course dial not synchronised with D.R. Master
If manual course control used pilots directional
Gyro not synchronised with P.4 Compass

Group. B.

(Manual)
T.V., Load correction, Target ht. Barometric pres.
↓
Setting scales too low give undershoot
Overset result is undershoot
Target ht. overset gives undershoot.
Barometric press. overset gives overshoot.

Mechanical Errors.

Ht. mechanism :-
Leak in exhausted Capsule gives overshoot
Leak in static " " over or undershoot
Leak in pick up bellows " undershoot
Leak in Static vent blocked at ground level gives undershoot at bombing height
Static vent blocked at 20000ft - when bombing low error is overshoot.
Blocked jets. give undershoot

D.r.s.4 motor same
H'.r.H.S. motor same.

Airspeed. Leak in pitot gives overshoot
Leak in static gives over or undershoot
Blocked static at ground level
gives overshoot.

Groundspeed tape stretched gives overshoot.
Sighting Angle tape " " overshoot
All stretched tapes give overshoot
Bombsight incorrectly levelled gives a range error
Gyro giving not correct vertical (cause giving
low Suction (Comp. unit ONLY) Range error
The pitch gyro blade not installed in the Vertical - Range error
Sighting Angle flexed drive not synchronised

Group 'C' (Tangential)

Installation.
Low Suction.
Bent linkage
De-synchronised drift
Aircraft crabbing

Dilated jets give excessive hunt at 40° Port.

Inherent Error Errors of the Mk XIV

i. Line component of trail

ii Small range error up & down wind

JETS

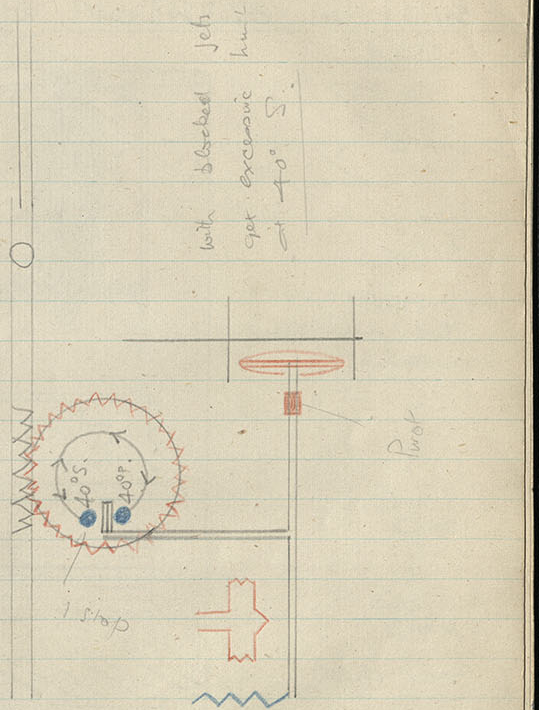
Ht. Jet uncovered - increase ht. vice versa

Airspeed uncovered - decrease "

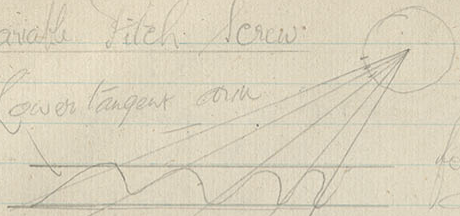
Drift uncovered - Port

Sighting Angle uncovered - increased

If the pilot reduces A/S to maintain ht. he puts the nose up eg. 5° - The pitched Gyro blade assumes we are climbing & only gives a correction of 4.4° but as we are still flying St. & level, we want the full 5° correction So the airspeed blade is so shaped to incorporate change of attitude due to variation of airspeed giving us the extra correction of .6°



Variable Pitch Screw



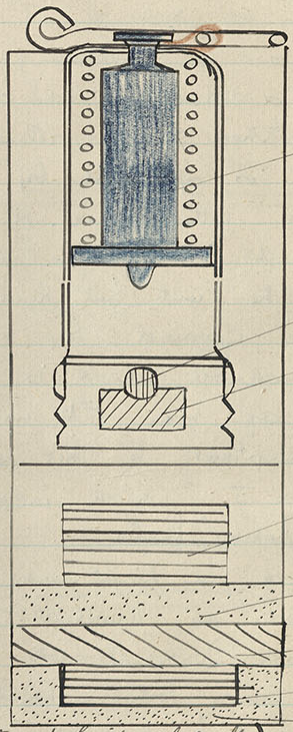
Lower tangent arm

for same angular

change - we must move the arm a greater distance.

Cone pitch to decrease cycling angle

SIGNALS DISTRESS TWO STAR RED.



(Stars ejected to height of 50 ft.)

Delay of approx. 2 secs. before first star ejected

Then delay of approx. 4 to 5 secs. before second star ejected.

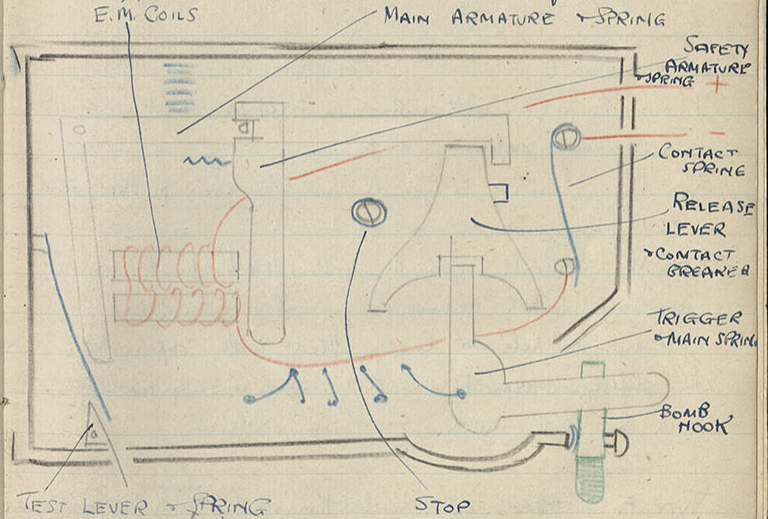
E.M.R.U. [Electro Magnetic Release Units]

Provides a means for controlling the retention or release of a store carried on a bomb carrier. The store is released when the unit is operated by the firing lever or jettison bar. A weight not exceeding 40 lb can be supported directly from the unit but heavier loads must be carried by a release slip or attachment which is under the control of an E.M. unit

The exceptions to this are types F, F.W. & J. which incorporate their own bomb hooks

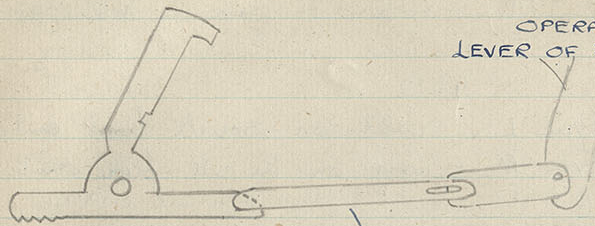
* Type 'A' used on Light series Carriers
* Type 'C' used on universal Carriers
→ and 2000 lb Mks 1-1A.
(i.e. always with S.H.R.S.)
* Type 'D' Special for Wellington
θ Type 'F' 4000 lb bombs, when fitted with G attachment with 8000 or 12000 lb bombs

θ Type 'F/W' - 4000 lb bombs on Wellingtons
θ Type 'J' - used on 2000 lb carrier Mk 2
Type L - used on small bomb containers
* Type M - used on tri-cell flare chutes



TYPE A MK III

TRIGGER of TYPE 'C' E.M.R.U.



Similar to type A

Has linkage attached to trigger that operates single hook release slip

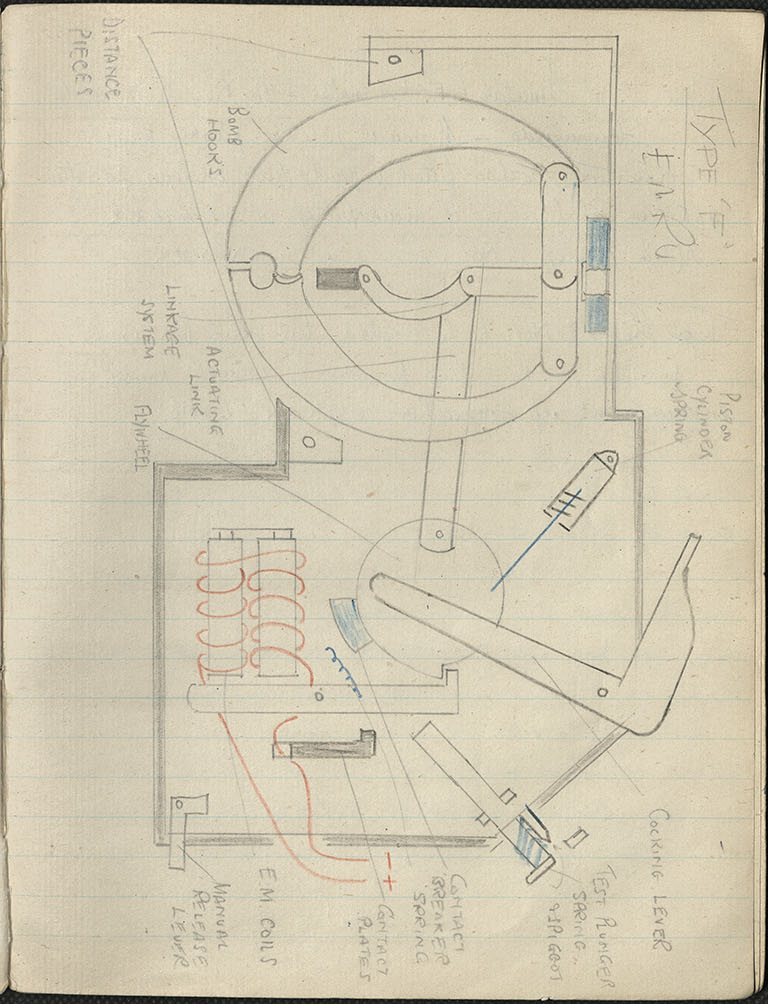
Type 'D' Similar to type A but trigger pushes rod that functions release slip

Type 'M' Really an 'A' with bomb hook and loading latch removed - also fitted is a manual release lever that will operate the safety armature thus used in conjunction with the test lever causes release

Type F. Fitted with heater thermostatic controller and thus functions when temp. drops to 50° Fahrenheit

Type F.W. Similar to the F but with these differences :-

1. Cocking lever rotates downwards.
2. Contact breaker slightly different.
3. Manual release lever already fitted with locking device.



Type J. Similar to F but smaller - cocking lever rotates downwards - Manual release pushes toggle armature also fitted is pawl that ensures positive rotation of flywheel if mainspring is damaged Main spring is NOT encased in a cylinder

Type L - is NOT to be cocked till drop bar is in position - has lens to ensure visual proof of engagement of armature & release lever.

Installation of the Sighting Head of the Mk XIV

1. Determine true fore & aft axis of aircraft - draw line of on the ground
2. Install mounting bracket (spigot approx 1.s. to fore & aft)
3. Install Sighting Head on bracket
4. Connect up electrical supply
5. Using manual drift setting knob adjust to get graticule parallel to line
6. The drift pointer should read zero - if it doesn't, adjust drift pointer using the two screws Maximum movement allowed is 3°. If drift pointer cannot be made to read zero - re-install the mounting bracket

Installation of Computer Box :- We want it near the sighting head & parallel with fore & aft axis of a/c. Connect up bottom flex drive - Switch on Computer With zero wind speed on box - zero drift should be on Sighting Head - Ensure sighting angle on sighting head & Computer box are synchronised - Connect up top flex drive.

Mark XIV

Bombing Procedure :-

Tests to ensure correct functioning

BEFORE Flight

1. Switch on graticule lamp, check graticule can be seen and clearly defined
2. Check that reflector is clean - must not be touched whilst Gyro is running
3. If COURSE is fed into computer by D.R. Compass check that Course dial is same as MASTER UNIT. If necessary turn synchronising knob until it does.

If course if fed in by hand check that Course dial is same as Course indicator If necessary turn Course indicator dial until it does.

TEST FLIGHT : The sight cannot be satisfactorily tested on the ground without special equipment - the sight should therefore be tested in the air before each operational flight

1. Check reflector settles to an apparent horizontal position in straight flight

2. Turn on bombsight cock - where air is obtained from 'GEORGE', the pilot must first turn main Control cock to OUT.
3. Switch on Computer switch
4. Check height mechanism as follows -
5. i. Set zero height (target) to the barometric pressure as set on Pilot's altimeter

ii. Check that Ind. Ht above target shown on Computer box agrees approx. with reading on Pilot's altimeter

iii. Check that I.A.S. on Computer box agrees with Pilot's A/S.I. at levelling speed N.B. At very high or very low speeds these may differ as much as 10 m.p.h.

iv. With aircraft flying straight & level at levelling speed for that particular type of aircraft - check that Glide datum line is opposite the fixed arrow & that the bubble on the sighting head is central - if not, sight must be re-levelled

Note. The glide datum line & bubble may not be exactly central. If the computer has been levelled for all up weight at bomb release - As the all up weight of the test flight is different from this.

V. Check as follow that the correct sighting angle is being transmitted by the computer to the sighting head

(a) Find R.A.S. i.e. I.A.S. corrected by P.E + I.E.

(b) On the emergency computer set Rect. I.C.A.N. ht above ground against R.A.S.

(c) From the opening in emergency computer read off the sighting angle for the particular R.A.S.

(d) Set W/S to zero on Comp Unit.

(e) Set T.V. to 1440 f.p.s. on Comp. unit this is the T.V. for which the emergency Computer is calibrated

(f) Switch ON Computer i.e B/S. Switch.

(g) Check sighting angle on sighting head & computer is within 2° of that obtained from emergency computer. If not within 2° bombsight is U/S.

Bombing.

Before Flight.

i Wind Speed ii Wind Direction (i + ii from Met)

iii. Bombs T.V. iv. Barometric Pressure

v. Target Ht. vi. Check or set levelling scale for sighting head

vii Check or set on levelling scale for computer box.

When approaching target area

i. Turn on B/S. cock ii. Switch on computer i.e. (Cock then electricity)

iii Switch on graticule

iv. Re-set W/S & D. on later information

Bombing Run

~~When approaching~~ If bombsight not Connected to D.R. Compass a second member of the crew must keep Course setting indicator matched with the pilot's directional gyro.

Give pilot necessary instructions 'left, left, OR Right' - release bombs.

After Bombing.

I. Set W/S to zero II Switch off electricity III Switch OFF B/S switch

Wind Finding Mk XIV

2 methods can be used for finding drift as follows

1st Method. Set W/S maximum

Computer unit switched ON - rotate the Wind direction knob until objects on ground move parallel to drift line of the graticule - Note drift for the particular course

2nd Method - Free upper part of sighting head by raising release lever - rotate upper part by hand until objects on ground move parallel to drift line - Note the drift for the particular heading

With two or three drifts found by either method W/S & D. can be found by using a Dualton or C.S.C.

Levelling of S.H. & C.U.

Mechanism for climb & glide has to be measured from a datum line, so we now come to a pt. where we can see that increased weights would have an effect on the attitude of the aircraft & we would have to level for different weights

Levelling I. Fly St. & level ~~for different wts.~~ bomb doors open at speed indicated on levelling Card

II Switch ON Computer box III Uncover level on sighting head & adjust on levelling screws until bubble is central

IV Note reading is between '5 & 8'

V Insert screw driver in hole between T.V. knob & turn screw anti-clockwise until Glide datum line is opposite fixed arrow

VI. Note reading is between 5 & 8

VII Repeat III to VI twice more & take an average of three readings & set on S.H. & C.U.

viii. Enter appropriate data on levelling card

We have now arrived at a pt. where we have a datum wt. & datum figures We increase our weight by 1000 lbs – the pilot has to lift the nose of the a/c. to maintain ht. So we must alter the bombsight otherwise we would get an undershoot

On Lancaster a/c. using 'V' type computer box if we increase wt by 1000 lbs we ADD ·11 degrees to our datum levelling figures So we now arrange a levelling card for various weights

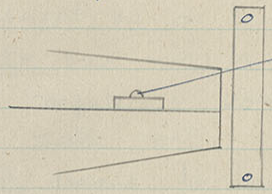
e.g.	S.H.	C.U.	
	6·0	7·4	Load 48000 lb
	6·4	7·8	" 52000 lb
	6·9	8·3	56000 lb

Levelling with computer box switched OFF

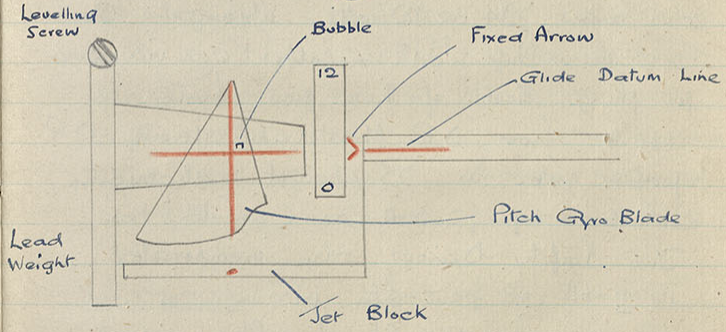
i Take OFF front of computer box

ii Insert screwdriver in screw

iii Rotate anti-clockwise until bubble which is fitted on arm is central – make a note of the reading and take an average of three readings



Levelling of the Computer Box



MK XIV

SERVICES REQUIRED

1. Electrical Supply
2. Compressed Air
3. Static
4. Pitot
5. Suction
6. Exhaust

Electrical Supply - a/c supply operates servo motors 24 or 12 volts - Illuminates Comp. U. Graticule & Drift Scale - enters C.U. via six pin plug three of these pins bringing impulses from D.R. Master. to operate D.R. repeater motor in Bombsight - electricity controlled by Switch on Computer box

Two Safety Devices are incorporated

i. Ht cut out ii. the pressure cut out

Compressed Air for ht airspeed drift & sighting angle provides airpressure for jets in servo system - comes compressor via auto pilot - Hence 'George' must be OUT.

It enters bombsight at 60 lbs □" reduced to 5·4 lbs □" - air is dried & cleaned by before entering bombsight. Air is controlled to bombsight by a bombsight Cock.

Static press. must be known to measure h' & A/S so the computer is connected by a pipe to the static vent

Pitot pressure for measuring A/S is obtained from Pitot Head

Suction To operate Sighting head & Comp. unit gyros - Controlled by changeover Cock in Pilots Cockpit - obtained from a 'Pesco' pump in Starboard inner engine. Hence when engines are running gyros are running - Suction required is 4·5 hg - Lowest permissible is 4 hg (inches of mercury).

Exhaust The case of the Computer is connected to the return line of the air system so that the same air circulates continuously through the bombsight making it unnecessary to dry a large volume of air

LIMITATIONS OF MK XIV

Gyros The S.H. gyro topples if a bank of over 80° left or right. The limit of bank will be such that the bombs when dropped will clear the bomb bay

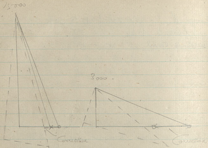
Computer box gyro will topple if climbs or dives are greater than 40°

However the S.Angle is only corrected for attitudes between 5° Climb & 20° Glide

Attitude on approach must be maintained between 2° & 10 secs. prior to bomb release. Any abrupt on bombing run will cause large range errors

Rate of correction of Sighting Angle 3/4 degree per sec.

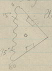
Wind Speed	0 - 76 mph
A/Speed	120 - 300 mph
Height	1080 - 20000 ft
T.V.	∞ - 1000 f.p.s.
Sighting Angle	15° - 75°
Drift Angle	40° P. & 40° S. (Mech) 42° P.S. Manually
Bar. Press.	970 - 1050 mbs
Target Ht.	- 1000 ft + 5000 ft
Comp. levelling Scale	0 - 12°
Sighting Head	0 - 15°



o = Bomb strikes at str level when in glide at 15000
x = " " " " when in glide at 3000

Smaller the angle the greater the correction
Larger " " " smaller " "

Safety Devices – Sighting Angle cut out



Operates at 15° and 75°
Blocked jets 15°
Distorted Blade 75°

Breakback Mechanism or Variable Ratio Lever

Ensures that with an acute increase ground speed that the tape is not broken – The lever is allowed to break in the middle a cushioning effect being given by the spring.

Turning ON Procedure

When Engines Started – Check auto Control Press gauge It should read 55–60 lbs □" – Check suction 4.5 lbs Merc.

~~To turn on B/S~~

1. Turn on B/S cock to 'ON'
2. Switch on electrical supply to computer box.
3. Switch on Graticule

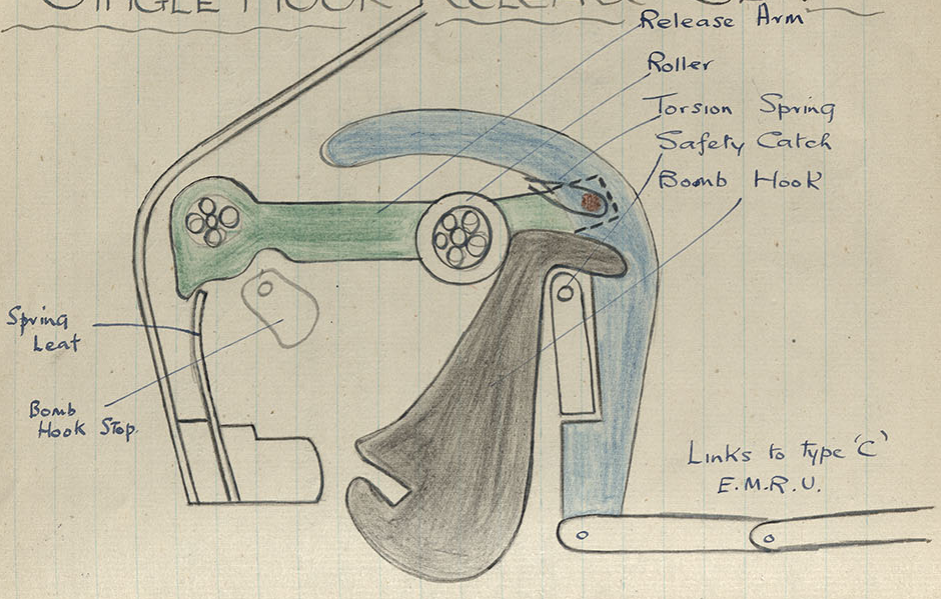
Settings to be made

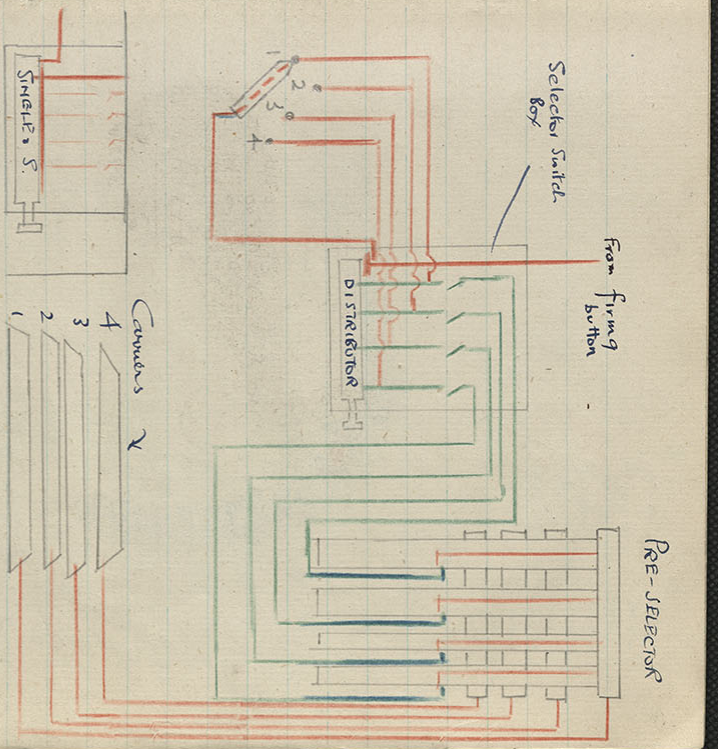
1. T.V
2. W/S & D when found
3. Target ht against barometric pressure at Target
4. Check level reading on C.U agree with levelling Card.

TURN everything to Zero 30 secs before B/S is turned OFF

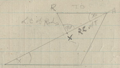
◇

Single Hook Release Slip.





Wiring of Distributor, Pre-Selector & Selector Box



Wind

Find L.C of T

Sin ∠x = $\frac{\text{Opp}}{\text{hyp.}}$

Opp = hyp x Sin ∠x

Then by substitution

L C T = H Tan λ x Sin ∠x

Cos x = $\frac{\text{adj}}{\text{hyp.}}$

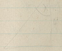
Find length adjacent side

adj = hyp x Cos X

substitution

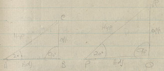
R.C of Rad = H tan λ x Cos X

1 Distance Tan λ = $\frac{\text{Opp}}{\text{adj}}$



A	B
Leeds	Jaffe
Davis G.	Sanson
Brown	Holmes
Hughes	Jackson
Skuse	Coates
Beswick	Hurst
Carpenter	Griffiths
	Saunf
	Darlington
	Aitken

Sine & Cosine of an Angle



Similar Δs

$\frac{BC}{AC} = \frac{QR}{PR}$ Sine 20° = $\frac{\text{Opp}}{\text{Hyp.}}$

$\frac{AB}{AC} = \frac{PQ}{PR}$ $\frac{\text{Adj}}{\text{Hyp.}}$ Cosine of 20°

Tan = $\frac{\text{Opp}}{\text{adjacent}}$

} Terms Applied to Bombing Theory.

To Modify for S.B.C.

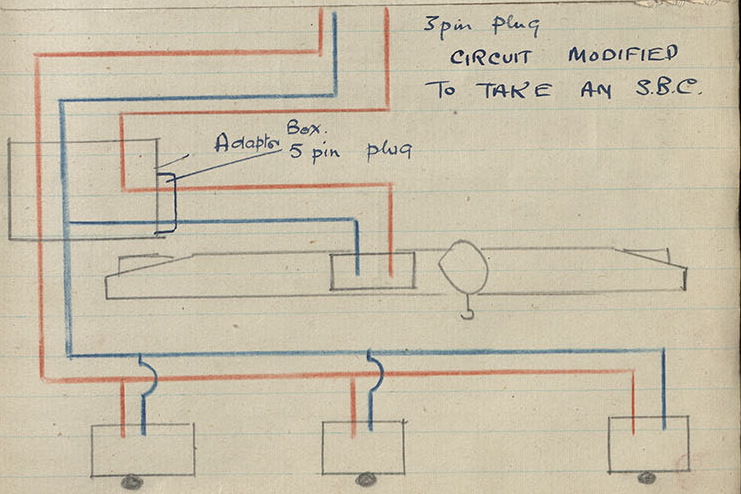
i. Remove 5 pin Carrier plug from a/c and plug into adapter box

ii. Put 3 pin plug from adapter box into a/c supply

iii. Connect the two leads from SBC to push button connections of the adapter box.

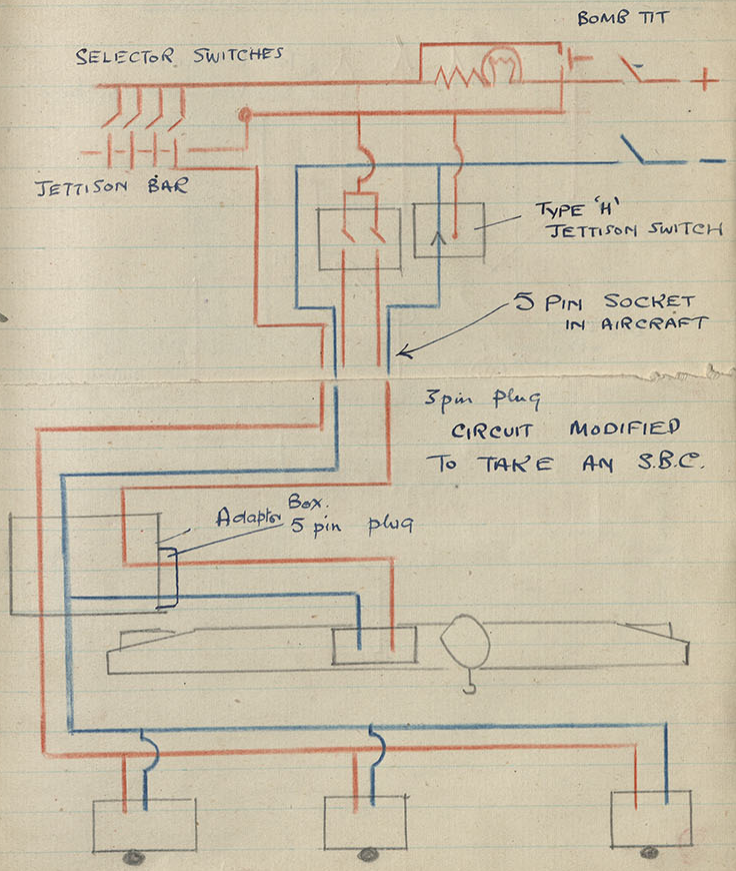
With the circuit modified in the above manner on pressing the type H Jettison Switch You convert what was the negative return from the fuzing units to a positive supply to the E.M. unit on the universal Carrier, thereby Jettisoning the S.B.C. 'Safe'. Should the fuzing units on the other Carriers carrying H.E bombs switched ON. at the moment of pressing the H type Jettison Switch, you obviously make these inoperative by sending two positive lead to each fuzing unit. So that by keeping it pressed and pushing the normal Jettison bars across, all other bombs will drop SAFE' too.

Note:- To Jettison mixed load Safe Type H must be operated before the Jettison bars.

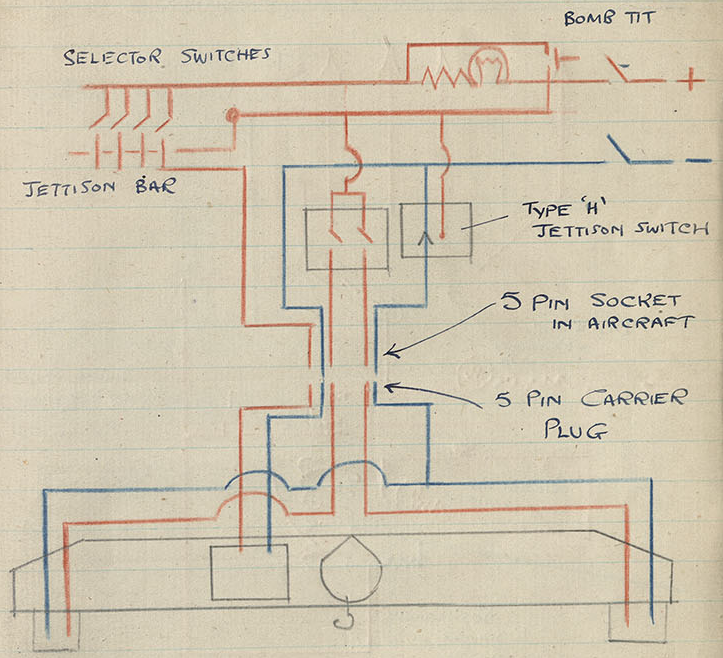


Switch You convert what was the negative return from the fuzing units to a positive supply to the E.M. unit on the universal Carrier, thereby Jettisoning the S.B.C. 'Safe'. Should the fuzing units on the other Carriers carrying H.E bombs switched ON. at the moment of pressing the H type Jettison switch, you obviously make these inoperative by sending two positive lead to each fuzing unit. So that by keeping it pressed and pushing the normal Jettison bars across, all other bombs will drop SAFE' too.

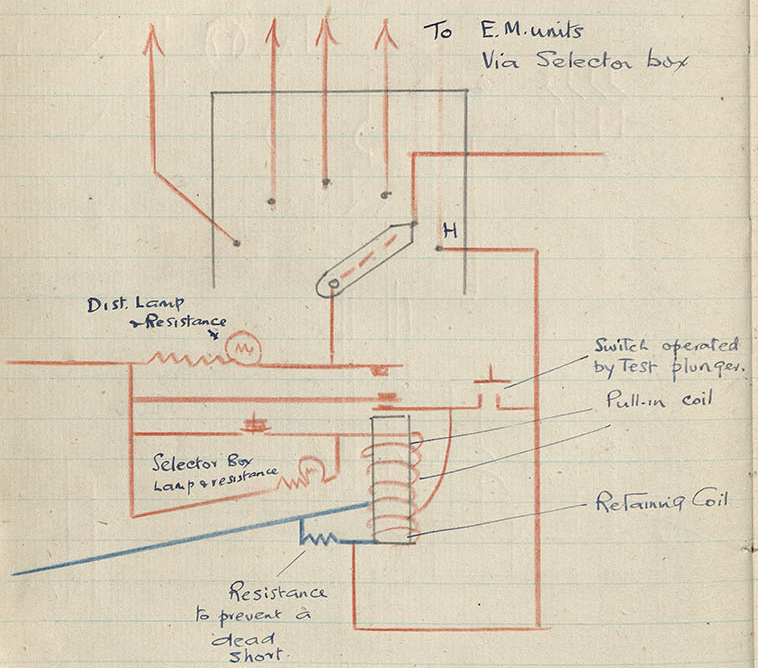
SIMPLE CIRCUIT TO A UNIVERSAL CARRIER



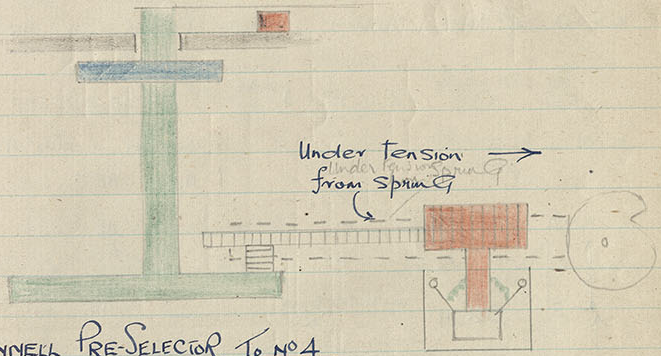
Simple Circuit To A Universal Carrier



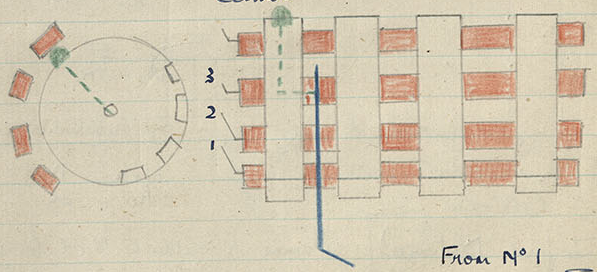
Circuit of MK VI Distributor



Time Gearing of MK VI Distributor

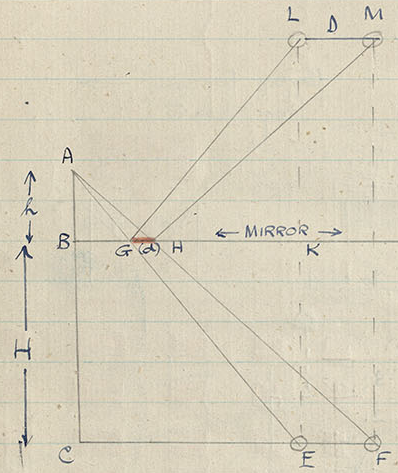


Connell Pre-Selector To No 4 Corner



Hills Mirrors Observation.

A means of obtaining W/S & D. & Tr. & G/S of a/c.
W/S & D. of most common. Theory based on similar Δs



Δs ABG & ACE are similar - also Δs AGH & AEF are similar

$$\frac{AC}{AB} = \frac{AE}{AG}$$

$$\therefore \frac{AC}{AB} = \frac{EF}{GH}$$

$$\frac{AE}{AG} = \frac{EF}{GH}$$

$$\frac{AC}{AB} = \frac{EF}{GH}$$

By substitution

$$\frac{H+h}{h} = \frac{D}{d}$$

[To find D(istance)] Ignore 'h' adding to H because its negligible

So $\frac{H}{h} = \frac{D}{d}$ $\therefore D = \frac{Hd}{h}$

Speed = (Distance over Time)

[To find Speed] $\frac{D}{t} = \frac{Hd}{ht}$ H' (in feet) d (in inches) h in inches t(

Multiply by $\frac{15}{22}$ to obtain m.p.h.

H' of Eyepiece = 13·33".
Thickness of Mirror = + ·3" (Thus total H' = 13·36")

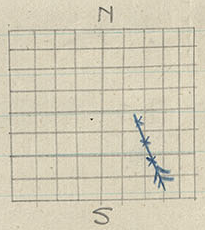
$t = \frac{1}{200} H$, $H = 200t$

$S = \frac{200}{ht} \times \frac{15}{22}$ then $S = \frac{200d}{13·63} \times \frac{15}{22}$

$= \frac{3000d}{299·86} = 10d$

Multiply no. of inches on mirror by 10 d. to obtain m.p.h $S = 10d$.

To find Direction of wind :-



In diagram Wind Direction is approx. 160° (M.).

1. Set tripod on firm ground away from any obstruction and any magnetic material that may affect the Compass
2. Set mirror on a tripod ensuring it is levelled

3. Set landing Compass in the centre of the mirror

4. About 50 yds away on N/S line indicated by the compass an object is fixed

5. Set one peep sight at each central line of the mirror - turn mirror on its bearings until its peep sights are in line with the object

6 Mark centre line N/S & re-check levelling (Spirit levels with mirror)

'A' Squad

F/o	Walgate	12/-
F/s	Gunner	12/-
F/o	Underwood	12/-
F/o	Witchell	12/-
F/s	Bennett	12/-
F/s	Berriman	12/-
F/s	Dimond	12/-
F/s	Duck	12/-

B

103

F/o ATKINSON
W/o ALLAN
F/o BARLEY
Sr. Fisher
- Childs
- Shiell
- Richardson
- Boulden
~~Cook~~

104

F/o Whitnall
Bush.
Ablett
Newell
Hall.
Adamson.
P/o Liggett
Spencer
Mackay
Bignon -
~~Cook & Davies~~ (104)

EXPLOSIVES

T.N.T. – TRI – NITRO – TULUEME – VERY INSENSITIVE Filling
Pale yellowish solid.

AMATOL – AMMONIUM NITRATE.
and T.N.T. mixture
80/20 in A.P. means 80 parts Amm. Nitr. 20 parts T.N.T.
Very sensitive to water
Not used in Coastal Command or F.A.A.

BARATOL – BARIUM NITRATE (10%) & T.N.T. (90%) – Insensitive

GUNPOWDER – POTTASIUM NITRATE – CARBON & SULPHUR

FULMATE OF MERCURY – Used in Dets. – Very sensitive

SHELLATE – PITRIC ACID and DINITRO – PHENOL
used in A.P. bombs.

THERMITE – NOT AN EXPLOSIVE

MINOL (After 1940) Ammonium Nitrate, T.N.T and Aluminium Powder

R D X Research Dept. Explosive X

AMATEX – Common filling for bombs
Ammonium Nitrate (40%) T.N.T. (51%) & RDX
(Insensitive.)

TORPEX 41% RDX 41% T.N.T & Ammon & 18% Aluminium powder
Very great blast effect
limited range.

	250 lb G.P.	500 lb G.P.	500 lb M.C.	1000 G.P.	1000 M.C.	1900 G.P.	2000 H.C.	4000 G.P.	4000 H.C.	8000 H.C.	H.C. 12000
Filling	AMATOL	AMATOL	AMATEX	AMATEX	AMATOL	AMATOL	AMATOL	AMATEX	AMATOL	AMATEX	AMATEX
Av. Wt.	230 lbs	470 lb	445	1080	1020	1785	1840	3550	3544	7860	11800
Av Wt of Filling (High Explosive)	72 lb	155	229	344	460	480	1214	1140	2178	5171	7800
Rad of Demolition (fts)	5	7	12	13	15	15	24	23	40	60	80
Area of Demolition (Sq yds)	60	140	325	500	650	650	1150	1500	3200	7200	12000
Rad. of Damage (fts)	?	?	15	18	21	21	50	32	80	120	160
Area of Damage Sq fts	?	?	650	900	1300	1300	5000	2800	13000	29000	48000

For further Gen on Subject see B.C. 45
" — Gen on Safety heights of bombs
See B.C. 35.

overset - lower TD large overset (may be better for Sgt W/S)

Flying Times for Turweston

DATE	Time	
1.9.44 - Sgt Granville	3 hrs 55 mins	Sgt KNAPE
1.9.44 -		F/SGT [illegible]
		F/SGT [illegible]
		Sgt [illegible]
F/S Walgate		F/SGT BELL
F/O Underwood		F/O PUFF
F/S Mitchell		
F/S Bowman		Sgt Peel
F/S Gunn		F/S Holdaford
F/S Dixon		
F/S Bonnell		
F/S Duck		

Total to date 96

19-12-9

Inherrent Errors of Mk XIV

Range Errors

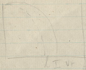
Range error results from the trail mechanism allowing for a distance TD – Vt when it should make an allowance TD – Gt therefore when G/S differs from A/S an error in range will result

when attacking up & down wind there is the maximum difference between G+V & the maximum difference between G+V & the maximum ground error will be obtained – but in cross wind attacks V = G effror therefore there will be no range error. The effect of this range error is to cause bombs which are dropped on headings other A/S is less than A/S to undershoot the target & vice versa

Combined effect of Cross trail & Range Errors

The final effect of these two errors is to cause bombs to fall in a close group downwind of target – this gives the appearance of W/S being overset Most of the errors would be greatly reduced if the W/S was slightly overset – the oversetting would depend on the type of bomb i.e higher TD – smaller

Points

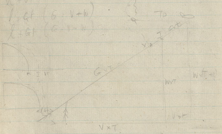


27
28
30
33
38
42
44
45

l I Vr

No Ran [illegible] [illegible]
[illegible] [illegible] [illegible]
12 Aug
12/8/44
[illegible]
No. 1 AAS.

l + Vr
l + Gt (G. V + W)
l + Gt (G. V + W)



Flying Time. MANBY

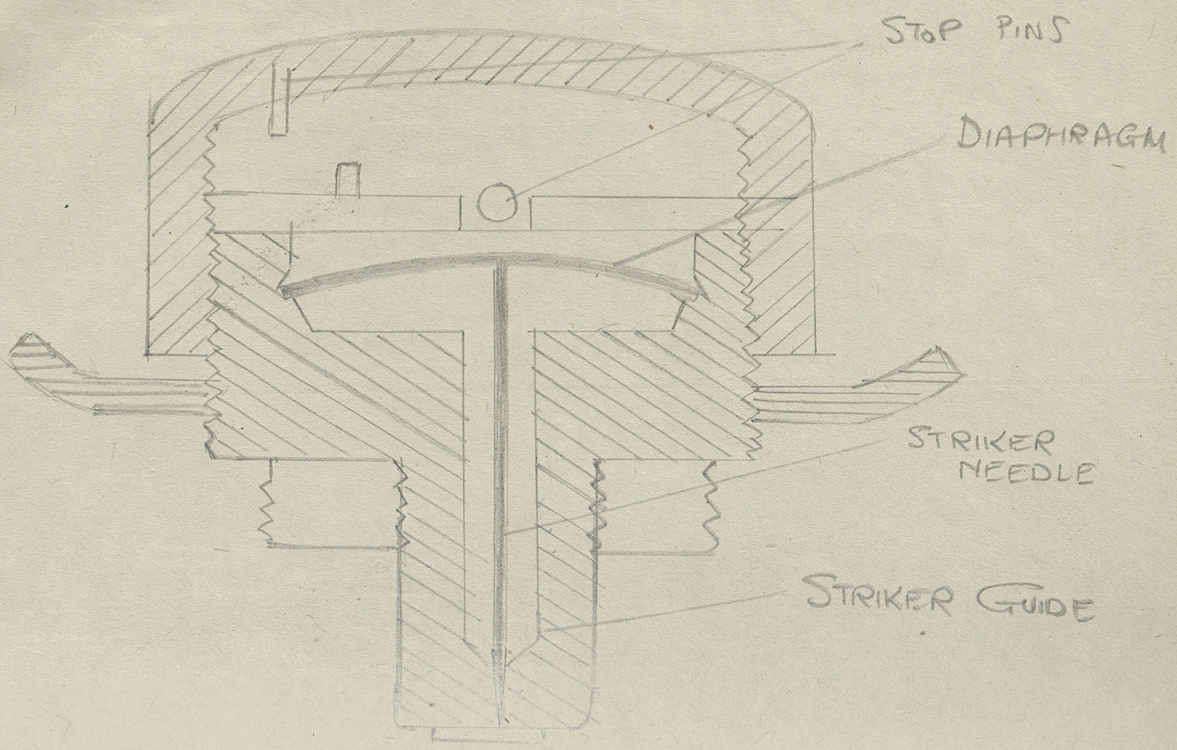
	PILOT.	A/C	TIME OFF	DURATION
15th July	F/S NELSON	763 [illegible]	0830	1hr 15 ✓
15th July	HARWORTH	394	1300	1hr. ✓
[illegible] July	F/S DEVER	226	1445	30 mins
17th	F/O MACHARLIN	5807	1000	30 mins
17th	F/S DEVER	390	1015	2hr. 5 mins
19th	S/L CAMPBELL-PEARN	228	1830	1h
[illegible]	F/S ~~[illegible]~~ STEPHENSON	5923	0815	45 mins
[illegible]	F/S STEPH	728	1300	1hr 10
[illegible]	F/S STEPH	948	630	1hr 5m
				9 - 20

TOTAL FLYING TIMES
AT NO 1 A.A.S. hrs mins

HOPE - FRAMPTON ~
SIMMONDS - MALLOY ~

S/Ldr
O.C BOMBING

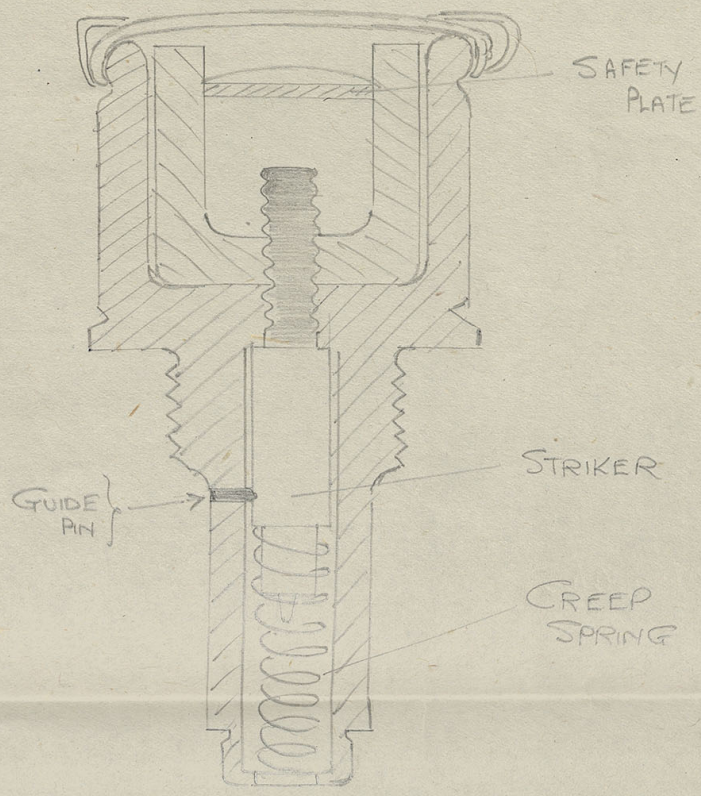
44 Nose Pistol



Used in G.P. M.C & H.C. Bombs

45 Pistol exactly the same except it has a shorter stem and is used in 2 & 16 lb. & 4 & 16 lb G.P.

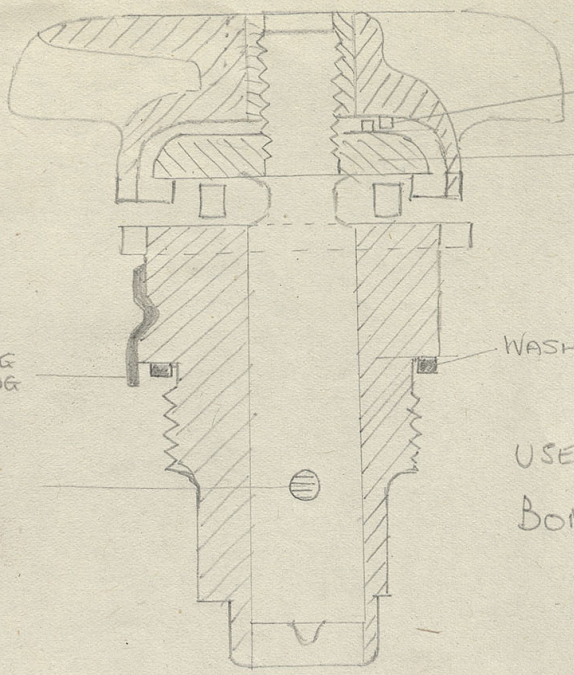
28 TAIL PISTOL



USED IN G.P. MK. IV., M.C., & H.

N.B N° 30 same as 28 except it has a sharper striker & a weaker creep spring and used with a SENSITIVE det. Has a GREEN band painted round body.

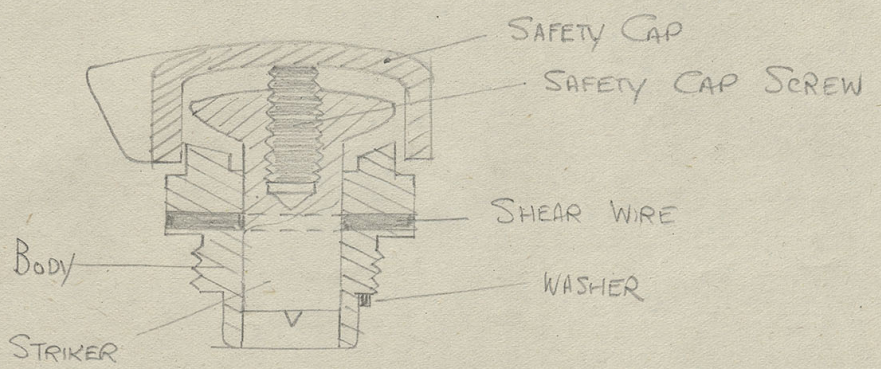
27 NOSE PISTOL



USED IN THE FOLLOWING BOMBS :- GP M.K.IV. M.C. H.C.

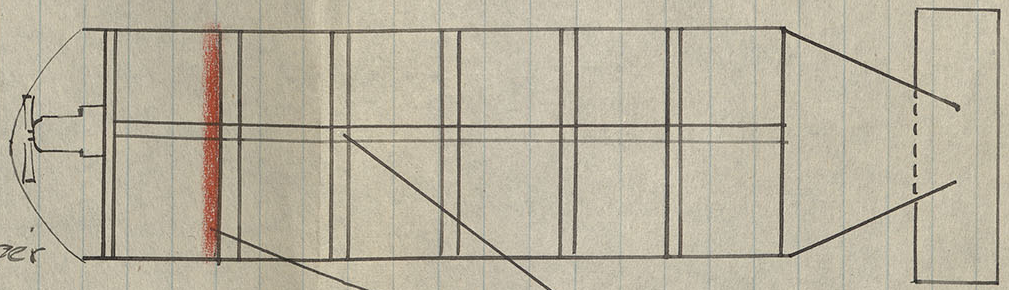
NOTE :- The 42 NOSE PISTOL is the same as the 27 and used in the same bombs BUT it differs in that it the vanes are painted GREEN - the striker is much more sharper and is used with SENSITIVE DETONATORS

38 NOSE PISTOL



USED IN THE 20lb F BOMB.
40lb GP

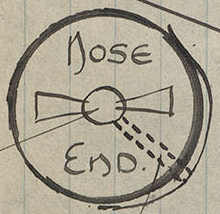
American M17 Cluster {4lb Inc. 10% 'X' Type}



Nose Fuze No. 138 = 111 + Larger Mag.

Explosive "Cortex"

thin strap iron bands broken by explosive "Cortex"



138 Fuse

train of Cortex

Note:- Not using 30 lb. inc. so much ~ 4 lbs. coming into greater use.