Chapter 8
ARMAMENT LOADING AND OFF-LOADING

CONTENTS

TABLES

ILLUSTRATIONS

GENERAL

1. This chapter outlines the weapon loading and off-loading used with the Vulcan B Mk2, and briefly describes certain features of the aircraft with which the loading team should be familiar. The loading and off-loading procedures for specific weapons are published in the -5A6 of this publication. Tools and equipment other than hand tools to complete the loading or off-loading operations are listed in Table 1.

2. Three, seven-store-carriers can be fitted in the bomb bay; each carrier is designed to carry 7 x 1000 lb bombs in two layers:

(1) A top layer of 4 x 1000 lb bombs

(2) A bottom layer of 3 x 1000 lb bombs

With three seven-store-carriers fitted, 21 x 1000 lb bombs can be loaded. In the training role four 28 lb practice bomb carriers can be fitted on the upper tier stations of the seven-store-carriers.

Safety arrangement

3. To prevent accidental operation of the bomb bay doors, a guard plate is fitted over the bomb door switches in the pilot's cockpit (Fig.1) during loading and off-loading operations and a spreader bar is fitted across the bomb bay doors to prevent them from closing. Lights situated in the bomb bay roof, for use during loading and off-loading, receive power from an external source.

TABLE 1 Equipment Required

Ref No	Description	Where used	AP Reference
4GA/4409477	Trolley, Type F	Transportation of cartridge discharger	110H-0202-125F
4GA/4409801	Trolley, Type S	Transportation of 7-store carried in 28 lb PB role	110H-0103-125F
4GA/4409521 4GA/4409567	SABT Cradle, bomb	Transports 7 x 1000 lb bombs c/w 7 store carrier	110H-0113-12
4GA/4409699	Power pack, Mk2	Hoisting bomb loads c/w 7 store carrier	110H-0223-12
4GA/4409583	Strap, securing	Securing bombs on trolleys	
4GA/4409670	Strap, tensioner	Tensions strap, securing	
4GC/1043793	Hoist, heavy, A/C components 5 cwt	Cartridge Discharger Loading/Off-Loading	
4GC/5433	Cable, ball-end ¾ in		
4GC/4232205	Tube, extension 60in		
4GC/4232210	Tube, extension 84in		
4GC/6036	Top sheath hook		
4GC/4232153	Hoist, Type C	Loading/Off-Loading 1000 lb bombs with 117 tails	110H-0214-125F
5A/1067377	Torch, flame-proof	General use	
5G/560	Cocking, test indicator	Electrical test on release units	
5G/NiV	Cocking test indicator lead		
11A/4486842 11A/4486843	Crutching handle Crutching adaptor	Bomb carrier crutching system	

Weapons/equipments used on Vulcan B Mk2 aircraft

4. Combinations of the following stores can be loaded:

(1) 1000 lb HE bombs, with No 114 tail, with No 907 or 952 Nose Fuze and No 75 or 78 Tail Pistol and detonators (Back-up)

(2) 1000 lb HE bomb with No 114 tail, and Tail Fuze No 947.

(3) 1000 lb HE bomb with No 117 tail, and Tail Fuze No 951.

(4) 1000 lb HE bomb with No 117 tail, and Tail Fuze No 947.

(5) 12 x 28 lb Practice bombs, on Practice bomb carriers fitted to the 7-store carrier.

(6) 4 x 28 lb Practice bombs, on Carrier Bomb 950 lb in 28 lb role.

(7) Transit beams for the carriage of three Septuple Carriers.

(8) Discharger, Cartridge 2.25in fitted to main plane installation.

(9) 950 or 600 lb HE, MC Bomb on Carrier Bomb 950 lb.

THE BOMB BAY

5. The bomb bay extends in a fore and aft direction from the front to the rear aircraft spars, and occupies the width of the fuselage, its dimensions being approximately 30ft long, 8ft wide and 6ft deep.

6. The roof of the bomb bay is in the form of a series of arches across its width, and between the arches are built intercostal assemblies which house the units that facilitate the hoisting and suspension of loaded bomb carriers.

Fig 1 The bomb bay door switches guard plate

Hoisting and suspension units

7. The units, in pairs, are installed at four loading points in the bomb bay, the distance between each unit (fig.2) of a pair being the width of the bay: a pair of hoisting and suspension units accommodates one bomb carrier.

8. The units are attached to aircraft strong points by universal type couplings and a two-pole plug from each unit mates with a corresponding socket in the aircraft, as part of a carrier locking indication electrical circuit.

Bombing electrical circuit connections

9. Built into the bomb bay roof arch formation at each loading point are two electrical sockets (fig.2), one near each lateral extremity of the loading point. The sockets on the port side of the roof are four-pole type for electrical jettison circuits, and those on the starboard side eighteen-pole, for normal release, fuzing and SSD circuits. These sockets are connected to corresponding plugs on the bomb carriers when the carriers are hoisted into position.

The pre-selector unit

10. A pre-selector unit, type C, consisting of a fixed main body and a removable link unit, is fitted in the bomb release circuit between the distributor and the release units. Each pattern of bomb selection is catered for by a particular link unit, type numbered. A removable metal lid, secured by finger screws, covers the main body after insertion of the link unit. The lid has a small central window, through which the type number engraved on the link unit may be viewed.

Hoisting equipment

11. The equipment necessary to hoist a loaded carrier is a power pack, and two hoisting jacks (Fig.3). The jacks are actuated hydraulically by the power pack, each jack being controlled by a separate handle on the pack. (See AP110H-0223-12)

Pre-tensioning pressures

12. Before the hydraulic jacks are used, the power pack relief valve must be adjusted and locked so that when the correct pre-tensioning pressure is obtained, the relief valve operates.

13. The pressure required to ensure that a carrier is rigidly crutched to the aircraft, varies according to the combined weight of the carrier and its load, and the tensioning factor (i.e. 1g, 1½g, 2g, 2½g or 3g) it is proposed to employ.

14. To obtain the pre-tensioning pressure required for a particular load, the following formula is used:

$$P = \frac{L + (L \times G)}{2A} + S \text{ where}$$

P = hydraulic pressure in lb.f/in^2 (gauge reading)
L = total load (i.e. carrier weight + load weight + nominal weight of the jacks)
G = selected tensioning factor
A = effective area of jack piston (8in^2)
S = hydraulic pressure allowance for stiction within the jacks (150 lb.f/in^2)

Table 2 gives the pressure gauge readings for typical loads and tensioning factors. The following example of the formula in use is based on a load of 7 x 1000 lb bombs secured to seven-store carriers, required to be tensioned to 1½g.

Weight of carrier	140 lb
Weight of bombs	7000 lb
Weight of filled jacks, each 152 lbs	304 lb
Total load	7444 lb

$$P = \frac{L + (L \times G)}{2A} + S$$

$$\text{Pressure} = \frac{7444 + (7444) \times 1\frac{1}{2}}{2 \times 8} + 150 \text{ lb.f/in}^2$$

$$= 1313 \text{ lb.f/in}^2$$

The gauge of the power pack is graduated in 100 lb.f/in^2, and when the calculated pre-tensioning pressure is other than a complete number of 100 lb.f/in^2, the relief valve is to be set so that the valve operates when the gauge needle is at the nearest 100 lb.f/in^2 graduation. In the example, this would be 1300 lb.f/in^2.

TABLE 2 Pre-tensioning loads and pressures

Total load (L) (lb.f)	Tensioning factor (G)	Hydraulic pressure (lb.f/in^2)	Gauge pressure (Includes 150 lb.f/in^2 for stiction) (P)
500	1½	78	228
500	2	94	244
500	2½	110	260
500	3	125	275
1000	1½	157	307
1000	2	188	338
1000	2½	219	369
1000	3	250	400
2000	1½	313	463
2000	2	375	525
2000	2½	438	588
2000	3	500	650
3000	1½	471	621
3000	2	564	714
3000	2½	657	807
3000	3	750	900
4000	1½	628	778
4000	2	752	902
4000	2½	876	1026
4000	3	1000	1150
5000	1½	785	935
5000	2	940	1090
5000	2½	1095	1245
5000	3	1250	1400
6000	1½	942	1092
6000	2	1128	1278
6000	2½	1314	1464
6000	3	1500	1650
7000	1½	1099	1249
7000	2	1316	1466
7000	2½	1533	1683
7000	3	1750	1900
8000	1½	1256	1406
8000	2	1504	1654
8000	2½	1752	1902
8000	3	2000	2150
9000	1½	1413	1563
9000	2	1692	1842
9000	2½	1971	2121
9000	3	2250	2400
10000	1½	1570	1720
10000	2	1880	2030
10000	2½	2190	2240
10000	3	2500	2650

Note... For intermediate and other load weights not shown in the table, total loads and hydraulic pressures are proportional, and 150 lb.f/in^2 requires to be added to each calculated hydraulic pressure to ascertain the required gauge pressure.

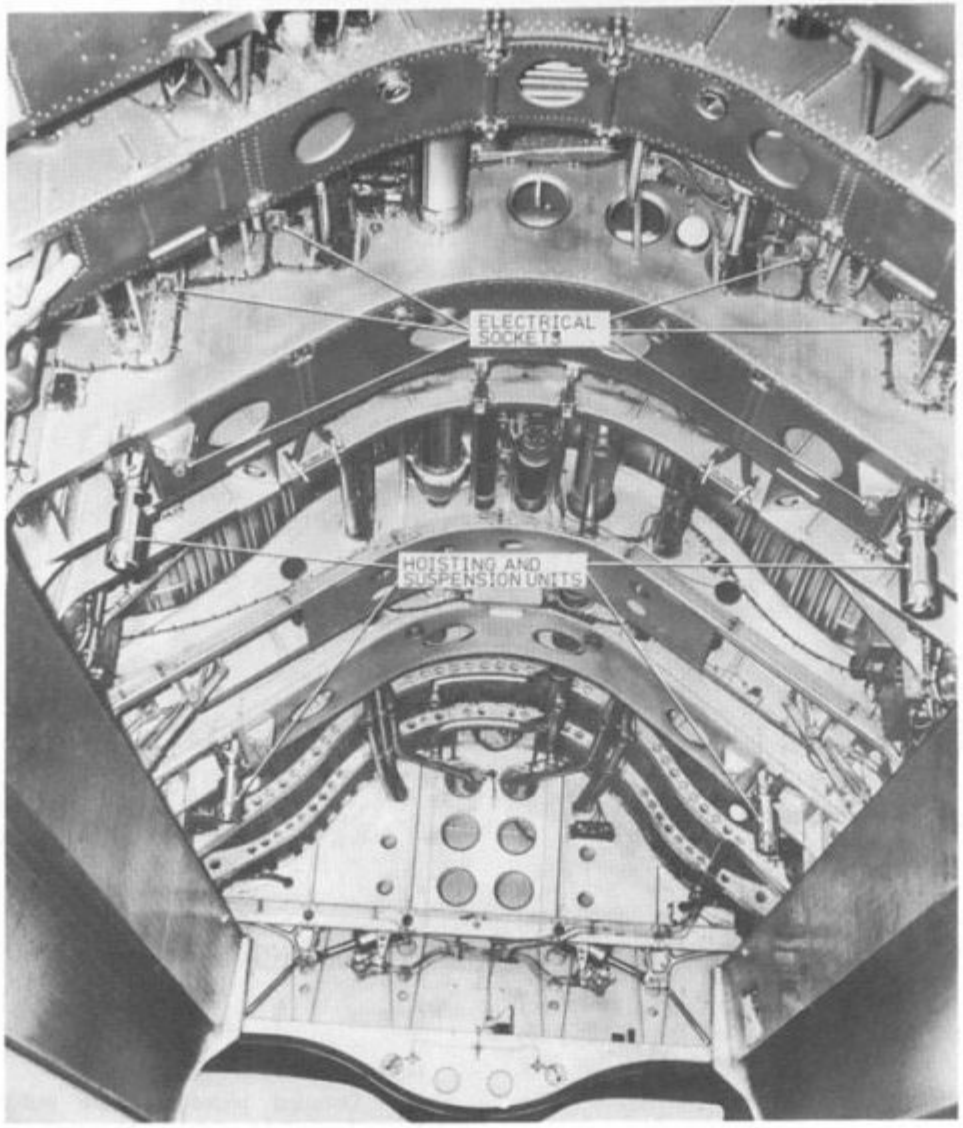

Fig 2 Inside the bomb bay

LOADING

General

Note. . .

Detailed Procedures are published in Topic -5A6 of this publication.

15. The necessary safety precautions having been observed, bomb doors open, position the loaded seven-store carrier mounted on a bomb transporter below the point to be loaded. Bomb stations are to be loaded from nose to tail in the order 1, 3, 4.

Method of hoisting

16. Proceed as follows:

(1) Place the jacks at each side of the transporter. Select 'OPEN' on the power pack control panel and extend the jacks through the ram apertures on the carrier (Fig. 3).

(2) Select 'NEUTRAL' when the ram heads are within approx. two inches of the suspension units. During this operation care must be taken to avoid fouling the bomb doors.

(3) Manually lift and engage the mushroom heads with the hoisting and suspension units (Fig. 4).

(4) Select 'CLOSE' on the power pack control panel to retract the jacks, thus lifting the load clear of transporter and raising it to the hoisting and suspension units.

Locking the carrier to the aircraft

17. After the carrier has been fully raised and pre-tensioned insert the locking handles in the bell-mouthed guides (Fig 5) of the wedge plate housings, and fully screw in the wedge plates. This procedure operates micro-switches within the hoisting and suspension units and completes the carrier locking circuit.

Fig 3 Extending the hydraulic jack rams

Check of carrier locking

18. Plug in the cocking test indicator to the CTI socket on the forward bulkhead of the bomb bay. Two GREEN lights on the CTI indicate correct locking of the carrier to the suspension units.

Disconnecting the hydraulic jacks

19. Select 'OPEN' on the power pack control panel to extend the jacks, and when the jacks are approximately two inches from the ground select 'NEUTRAL'. Lift the jacks manually to disconnect the ram heads from the recesses in the hoisting and suspension units and lower the jacks to the ground. Select 'CLOSE' on the control panel to retract the jacks fully and switch off the power pack engine. Repeat the full procedure for any other stations to be loaded.

After loading

20. With the loading completed, stow the jacks and locking handles on the power pack. Remove bomb transporters and power pack from aircraft vicinity.

OFF LOADING

General

Note. . .

Detailed procedures are published in Topic-5A6 of this publication.

21. After flight debriefing of the aircrew, ascertain the reason for the non-release of the bombs (if any) and obtain the bomb safety devices from the bomb-aimer.

Fig 4 Ram head engaged with hoisting and suspension unit

Opening the bomb doors

22. Before opening the bomb bay doors all electrical and bombing switches are set to 'OFF'; then through an inspection door at the forward end of the bomb bay doors, the interior of the bomb bay is examined.

WARNING. . .

IF IT SEEN THAT BOMBS ARE LYING ON THE BOMB BAY DOORS, OR IF HANG-UPS ARE SUSPECTED, THE ARMAMENT OFFICIER IS TO BE INFORMED AND THE DOORS OPENED ONLY UNDER HIS SUPER-VISION.

Safety devices

23. When the bomb bay doors are opened a guard plate is fitted over the bomb bay door switches in the pilots cockpit and a spreader bar is fitted across the doors. All safety devices are put back in the bombs and if hang-ups are suspected the bomb carrier release units are checked for correct locking.

Off-loading 1000 lb bombs

24. Aircraft bomb stations are to be off-loaded from tail to nose in the order 4.3.1. Sufficient transporters are to be provided, fitted with the appropriate bomb cradles; un-fused bombs/spacers will be carried on the cradles in positions corresponding to any bombs that have been dropped. Then when the carrier, complete with the bombs, is lowered from the aircraft it will sit securely in the cradles of the transporter.

Positioning the bomb transporter and power pack

25. The bomb transporter is correctly positioned under the station to be off-loaded and the brakes applied, and the power pack positioned to allow an unobstructed view of the off-loading. The jacks from the power pack are placed either side of the transporter, and the hydraulic power lines from the bases of the jacks to the power pack are laid out in a direct route that will not foul the bomb bay doors.

Fig 5 Screwing home the carrier wedge plates

Extending the jack rams

26. The engine on the power pack is started and 'CLOSE' is selected on the control panel; the relief valve is put to the same setting that was used when the bombs were loaded, and the relief valve nut is locked. The rams of the jacks are extended until they are about two inches below the hoisting and suspension units for the position (by selecting 'OPEN' on the control panel). When the jacks are extended to the desired length, select 'NEUTRAL' on the control panel (during these operations take care not to foul the bomb bay doors). The jacks are manually lifted so that their mush-room shaped heads can be engaged in the hoisting and suspension units for the position.

Lowering the carrier

27. Disconnect the carrier to aircraft electrical connections.

28. Select CLOSE on the control panel causing the jack cylinders to rise and their top-most surfaces to engage the under side of the suspended carrier. Maintain the pressure on the jacks until the relief valve operates indicating that the pretensioned carrier load is supported by the jacks.

29. Insert the locking handles into the bell-mouthed guides of the wedge plate housings and fully unscrew the wedge plates. Remove the locking handles.

30. Lower the load by selecting OPEN on the control panel and select NEUTRAL when the load is approximately six inches above the transporter cradle. Reposition the trans-porter as necessary; continue to lower until the load is supported by the transportation cradle.

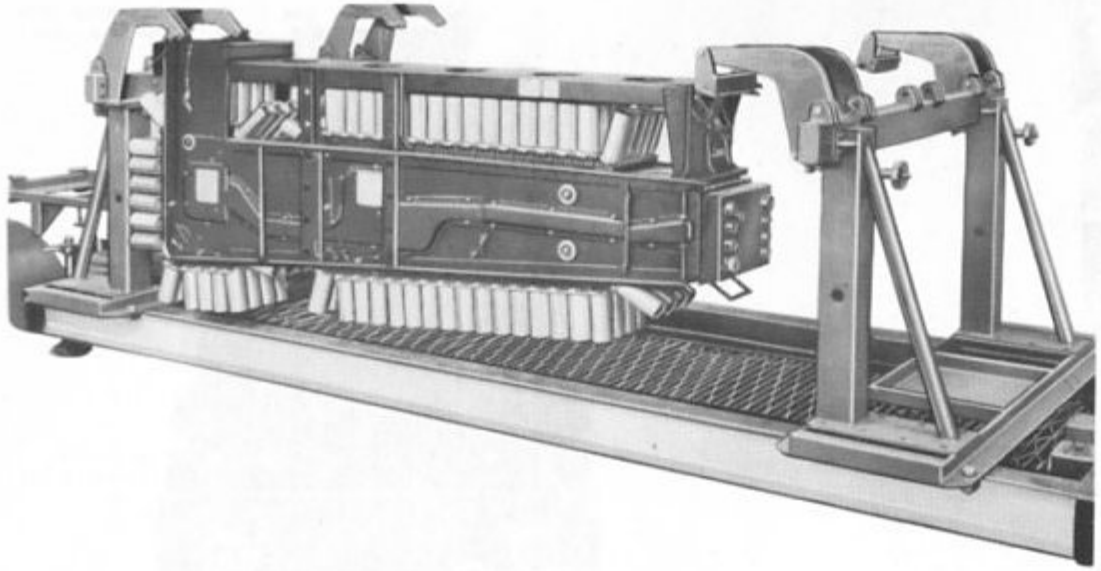

Fig 6 Discharger mounted in cradle on Type-F trolley

31. During lowering operations care must be taken to ensure that the load does not cant. Correct manipulation of the power pack controls will ensure that the load is lowered evenly. When loading/off-loading bombs fitted with No 117 tail units a Type C hoist is to be used in conjunction with the jacks to maintain the stores and carrier in a level plane. The Type C hoist, set to slip at 900lb f, is attached by its No 4 attachment to a bracket on the forward member of the SABT (Mod ARM/4148). The centre bomb on the lower tier has a special plate fitted under the No 59 nose plug to which the cable hook of the Type C hoist is attached.

32. The nose plate is to be removed on the completion of loading/off-loading operations.

Disconnecting the hydraulic jacks

33. Select 'OPEN' on the control panel, and when the bases of the jacks are about two inches from the ground select to 'NEUTRAL'. Lift the jacks manually, to disconnect the ram head from the recesses in the hoisting and suspension units and lower the jack bases to the ground.

34. Retract the jack rams by selecting 'CLOSE' and switch OFF the power pack engine. Stow the jacks in their transit cradles on the power pack and move the power pack clear of the aircraft.

After off-loading

35. Release the transporter brake and move the transporter clear of the aircraft. Disconnect the rear steering arm and fit securing straps and covers to the carrier and bombs.

LOADING/OFF-LOADING 28 lb PRACTICE BOMBS

36. In place of an SABT a Type 'S' trolley is used which is adapted to support one 7-store bomb carrier. The carrier is fitted with four 28 lb practice bomb carriers on the upper tier stations. Each ERU in the practice carriers is armed and loaded with a 28 lb practice bomb. A NO VOLTS check (power on) is carried out at the carrier electrical connection point on the aircraft. The carrier is raised by the hydraulic jacks and locked to the aircraft. A NO VOLTS check (power off) is then carried out at the carrier electrical connection point on the aircraft and the parent carrier release and fuzing plugs connected. The complete carrier is off-loaded in the same way as for 1000 lb but onto Type 'S' trolley.

LOADING THE CARTRIDGE DISCHARGER

37. To avoid injury to personnel or damage to equipment when loading the discharger, it is essential to ensure that the appropriate switches in the cockpit are correctly set. The switches and their settings are as follows:

	Switch	Setting
(1)	Power	OFF
(2)	Test/test lamps/safe/arm	SAFE
(3)	Stick selectors	0

38. The discharger is mounted in a cradle on a Type-F trolley (Fig 6). Two hoists, heavy aircraft, components, are used to lift the discharger into the window compartment in the wing of the aircraft. The external panels on the underside of the wing are removed also the two window-container stays on the inboard side of the window compartment.

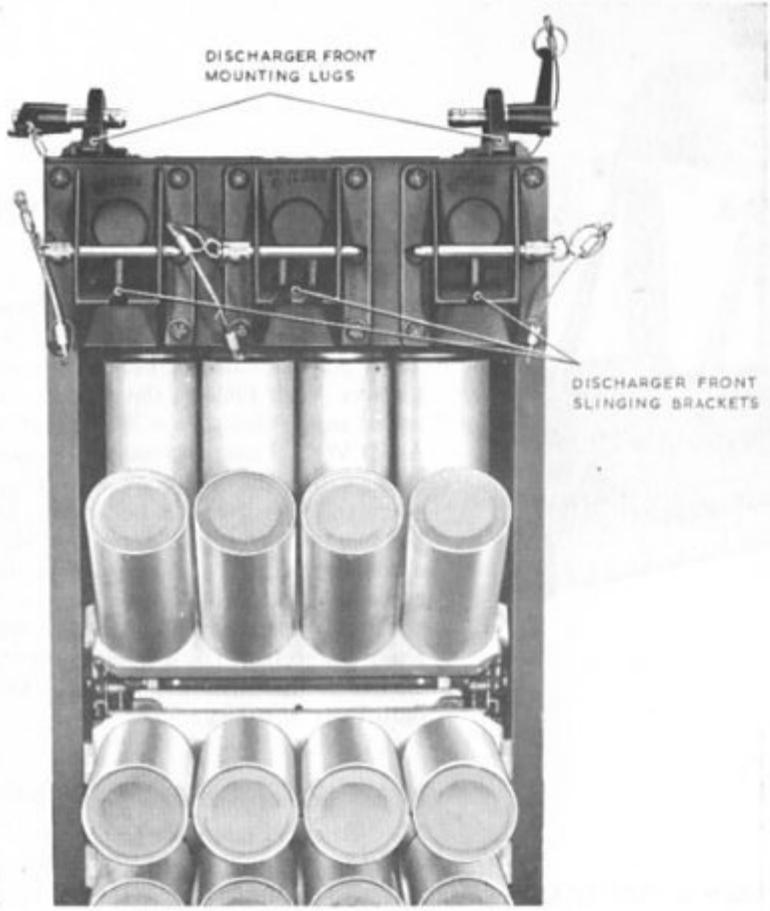

Fig 7 Discharger, front view

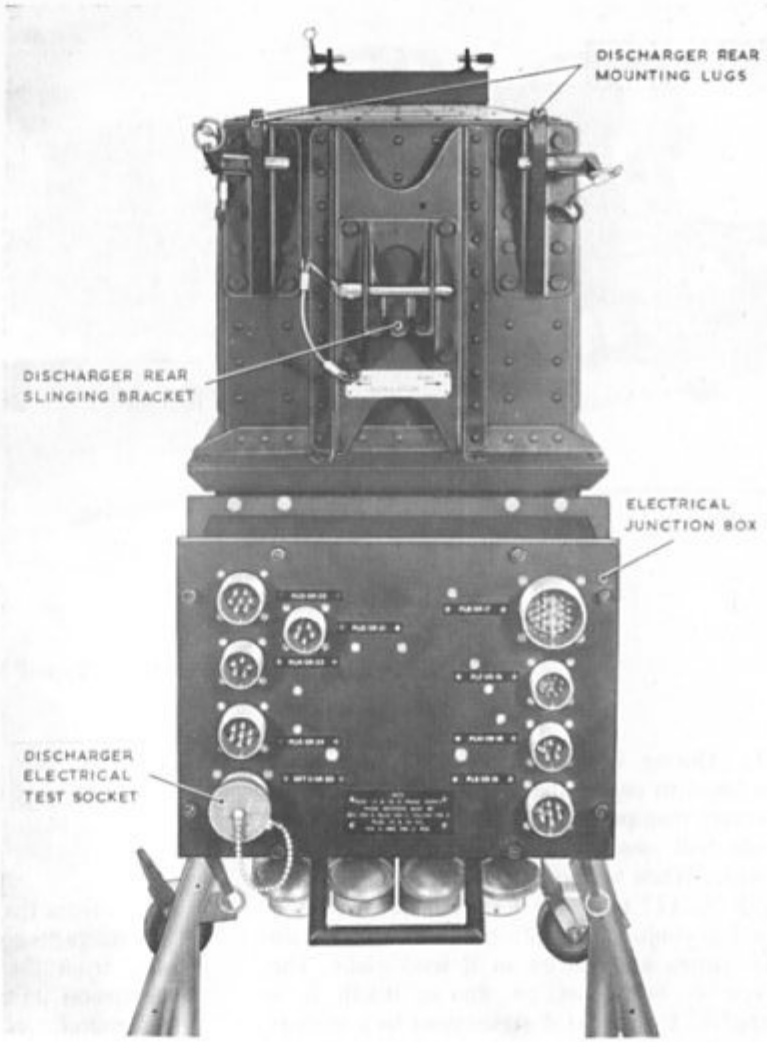

Fig 8 Discharger, rear view

39. Attach the two hoists to the aircraft. The 84in extension tube, fitted with the top sheath hook, is used in the forward position and a 60 inch extension tube, fitted with the top sheath hook, is used in the rear position; a ball end is fitted to each cable. If the discharger only is to be hoisted the cable is threaded over the 'in-line' pulley; if the discharger has an automatic window dispenser fitted, the cable is threaded over the 'off-centre' pulley.

40. The trolley is now positioned under the loading position and a check is made to ensure that the discharger compartment switch settings are as recorded on the cartridge loading form. Attach the hoist cables to the discharger.

41. The pins which secure the discharger to the cradle arms are removed and the arms pivoted clear of the discharger. Operate the hoists to raise the rear end of the discharger 6 inches, then operate both hoists together to raise the discharger a further 6 inches. As soon as the discharger is clear of the cradle, remove the trolley from under the aircraft.

42. Keeping the discharger level, hoist it to the aircraft. Attach the discharger to the aircraft at the forward attachment points (Fig 7), using two ½in. dia quick-release pins, then fit the rear attachment (Fig 8), using the two ⅜in. dia quick-release pins. The hoists are disconnected and removed from the aircraft and the discharger stay is fitted to the discharger bracket, and secured with its quick-release pin.

43. Remove the aircraft electrical cables from their stowage positions and remove the protective caps from the discharger and the automatic window dispenser. Fit the protective caps to the aircraft stowage positions and connect the plugs on the aircraft supply cables to the sockets on the rear face of the junction box at the rear of the discharger and to the automatic window dispenser (Fig 8).

44. Check that the selector box power supply switch is 'OFF' and that the aircraft 28V and 200V external power supplies are 'ON'. With the TEST/TEST LAMPS/SAFE/ARM switch on the selector box at the 'SAFE' position, operate the selector box power supply switch; the 2 green SAFE indicator lamps on the selector box should light (Fig 9).

45. Set the selector box power supply switch to OFF; the green SAFE indicator lamps on the selector box should go out. Disconnect the aircraft 28V and 200V external power supplies.

46. Set the counters on the selector box by depressing the reset lever and rotating the wheel to give the correct number of shots available in each compartment of the dischargers.

47. Remove or fit, as required, the 'window' panels to the aircraft access panel and fit the access panel to the under surface of the aircraft wing.

48. Warning notices should be placed at the aircraft entrance and on the navigators panel.

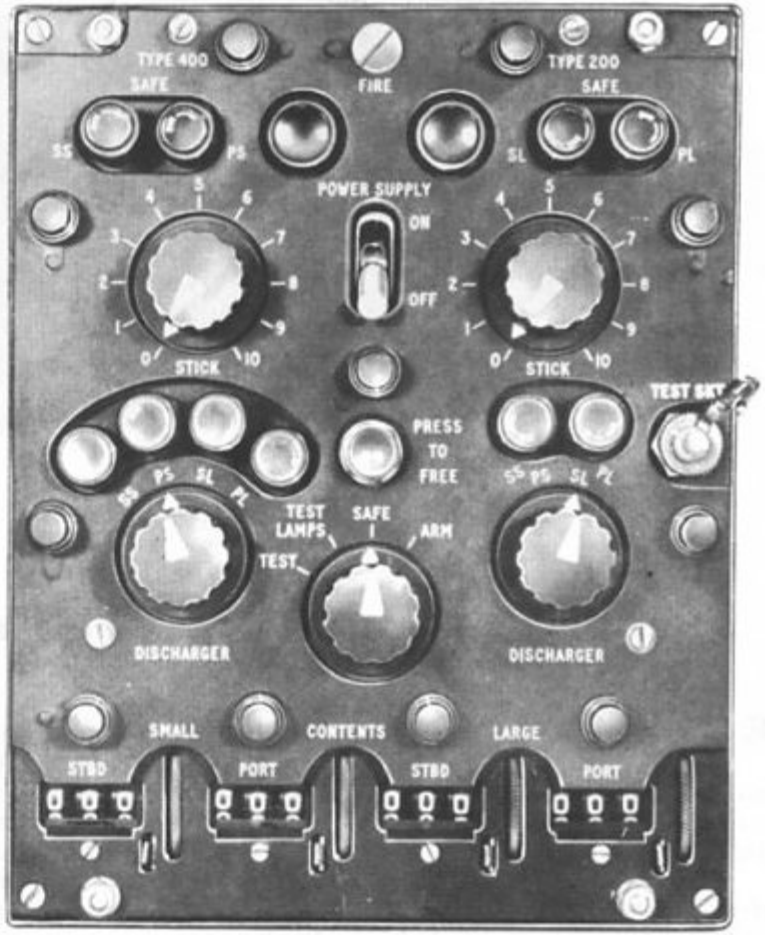

Fig 9 Selector unit front panel

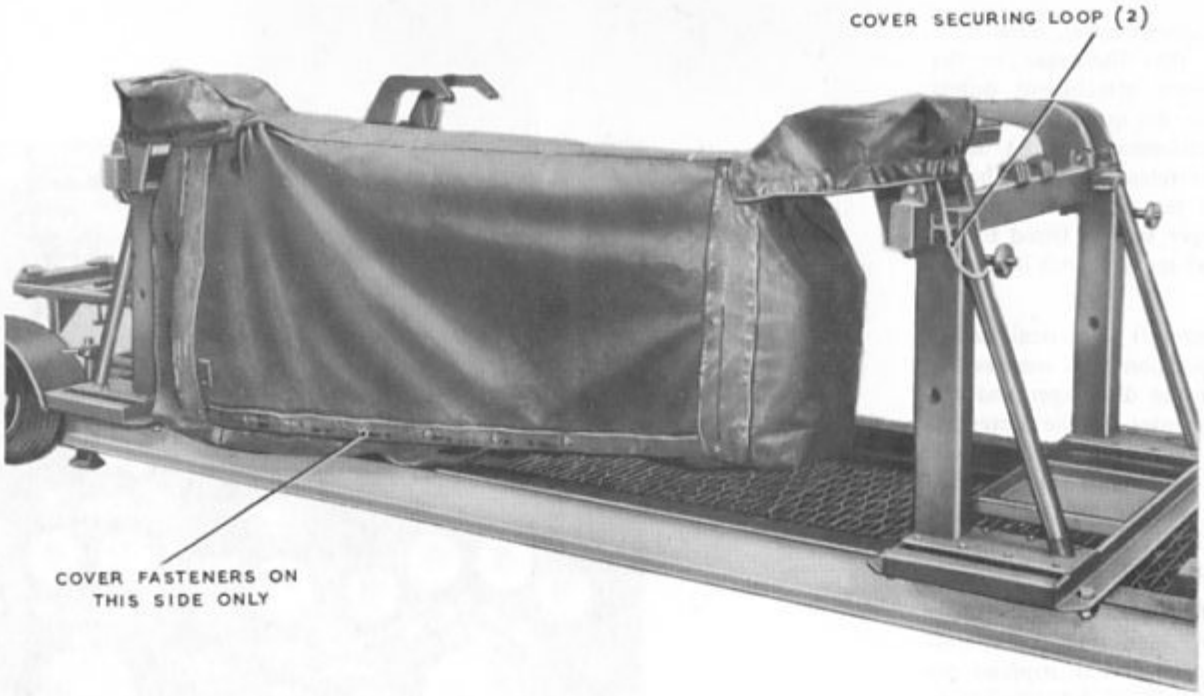

Fig 10 Discharger, with cover, mounted in cradle on Type F trolley

OFF-LOADING THE CARTRIDGE DISCHARGER

49. Only personnel directly concerned with off-loading are to be in the off-loading area during off-loading operations.

50. Failure of the Dowty Type 1322 microswitch, fitted in the SAFE position of the firing circuit of the discharger, could result in the firing pins remaining in contact with the cartridges, even with the control switch in the SAFE position and all electrical power OFF. A simultaneous failure of the Rad haz filter could place the system in a hazardous condition.

51. No personnel are to be in the vicinity of the discharger firing apertures. Ensure that the TEST/TEST LAMPS/SAFE/ARM switch set to SAFE. With ground electrical supplies connected, set the selector box power switch to ON; the 2 green SAFE lamps should light, indicating that all firing pins are withdrawn from the cartridges and that the system is SAFE.

52. If one or more green SAFE lamps do not light, test the lamp(s) for serviceability: if the lamp(s) are serviceable the discharger is considered unserviceable.

53. Set the power switch to OFF and disconnect external power supply; switches on the selector unit are set:

	Switch	Setting
(1)	Power	OFF
(2)	TEST/TEST LAMPS/SAFE/ ARM	SAFE
(3)	Stick selectors	0

54. Remove the external panels from the underside of the wing and visually examine all accessible cartridges for defects. Disconnect the aircraft electrical cables from the junction box on the rear of the discharger and from the automatic window dispenser. Remove the protective caps from the stowage positions in the aircraft and fit them to the discharger and the automatic window dispenser. Secure the aircraft electrical cables to their appropriate stowage positions.

55. Attach the two hoists to the aircraft. The 84in extension tube, fitted with the top sheath hook, is used in the forward position and the 60in extension tube, fitted with the top sheath hook, is used in the rear position; a ball end is fitted to each cable. The front hoist cable is threaded over the pulley in the 'in line' position, for the discharger only, or over the 'off centre' pulley for the discharger and automatic window dispenser.

56. Position the trolley, with the discharger cradle fitted, under the discharger to be unloaded. Disconnect the aircraft side stay from the discharger bracket, and stow it in its clip. Attach the hoist cables to the discharger and operate the hoists to support the weight of the discharger. If the automatic window dispenser is fitted, the forward hoist cable is connected to the discharger suspension point adjacent to the automatic window dispenser.

57. Remove the four quick-release pins attaching the discharger to the aircraft, and commence lowering the discharger. Care must be taken, during lowering, to guide the discharger clear of the aircraft discharger compartment and to prevent the cartridges fouling the cradle arms.

58. Pivot the cradle arms to meet the discharger and secure the discharger to the arms by the quick-release pins. Visually examine the remaining cartridges. Remove any defective cartridges and place them in a suitable container for disposal.

59. Disconnect the hoist cables from the discharger and remove the ball ends from the cables; then remove the hoists from the aircraft. Refit the two window container stays on the inboard side of the window compartment and replace the panels on the undersurface of the aircraft wing. Remove all equipment from the vicinity of the aircraft.

60. Replace the discharger cover (Fig 10).

ON THE FLOOR METHOD OF MISSILE PREPARATION

61. This method of preparation is normally carried out in the Missile Preparation Area, but, as an operational requirement may be carried out at the Designated Arming Area.

62. The bombs will be delivered to the arming area on a Standard Airfield Bomb Transporting Trolley. Using a suitable crane and a hoisting beam, the seven bombs are transferred to two loading assisters placed on the ground in front of the SABT. The missile preparation is then carried out as laid down in AP110B - 0109 - 125NQ.

63. On completion of missile preparation, the seven-store carrier is removed from the carrier transportation trolley by the crane and hoisting beam and positioned above a set of four bombs. The carrier is then lowered on to the bombs and the appropriate release units connected with the bomb suspension lugs.

64. On completion of a release unit cocking test, the tier forks are raised to lightly crutch all four bombs against the carrier crutch pads. The carrier load can then be raised and positioned above a set of three bombs and the loading procedure repeated.

65. The fuze arming leads and the shear wire assemblies are then connected and the clutch of seven bombs raised approximately six inches in order to complete the torque loading of the bombs to the carrier. The completed clutch of seven bombs is then raised and positioned on the cradle on the SABT and the bombs loaded to the aircraft as described in para 15 to 20.