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MALFUNCTIONING OF G-15 BOMB BACK AND B-7 SHACKLE

by

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MALFUNCTIONING OF G-15 BOMB RACK AND B-7 SHACKLE

Abstract

Incidents occurring at Aberdeen Proving Ground are described in which 1100 lb. Demolition Bombs Mk III and a 600 lb. Demolition Bomb M32 when suspended in a G-15 Bomb Rack by means of a B-7 Shackle failed to be released when the rack was tripped. Experiments are described which led to the conclusion that the cause of these malfunctionings was the lack of sufficient strength in the tripping spring of the bomb rack to completely trip the trigger of the shackle.

1. During a Surveillance Test of War Reserve Bombs at Aberdeen Proving Ground on May 27, 1937 a live loaded 1100 lb. Demonition Bomb Mk III suspended in station number six of the rack of a B10 airplane remained hung on the rack after the solenoid had tripped the rack. After attempting, the over an hour, to shake the bomb loose a landing was made. The bomb dropped free soon after the ship reached the runway. The bomb struck the runway and began to turn end over end. The doors of the bomb bay had been removed prior to the take off, allowing a better opportunity than normal for the ship to pass over the bomb as soon as the tail was deflected a small amount. The damage to the plane consisted to damage to the rear lower end of the bomb bay, a gash in the side of the fuselage and a damaged elevator. Damage to the bomb consisted of a bent suspension lug, broken fin and both the tail and nose fuzes broken.

2. The material involved was Bomber B-10 No. 33-147, Bomb Rack G-15 and Shackle B-7.

3. Master Sergeant Smink who was operating the bomb sights and the bomb rack states that after the release mechanism had been tripped and while the bomb was hung up on the rack he examined the condition of the bomb rack as best he could from his station in the fuselage at the rear of the bomb bay. In his estimation the stirrup (Fig. 1) which operates the trigger (Fig. 2) of the shackle on which the bomb was hung up had moved to a position at which the trigger cam in the shackle should have disenaged the sear. From his station the parallax was great, however, and it was difficult to judge the exact position of the stirrup.

4. Sergeant Smink advanced the theory that due to the variation in the diameter of the bomb along its length the shackle had twisted thus pinching its interior mechanism and introducing sufficient friction to prevent the suspension (Fig. 2) hooks from being tipped by the weight of the bomb. This theory at first looked reasonable for when the shackle is twisted by hand the interior mechanism may be pinched to such an extent that the suspension hooks can not be tipped by hand.

4. Further inve-tigation, however, showed that the diameter of the bomb where it rests against the front side rail of the bomb rack is 19-7/8 inches and where it rests against the rear side rail the diameter is 19-3/4 inches. The small difference in these dismeters (1/8 inch) is not sufficient to cause an appreciable twisting of the shackle.

6. As a further test a 1100 lb. Demolition bomb Mk III without fin assembly (weight 1073 lbs.) was suspended on a B-7 shackle as shown in Figure 3. The bomb was held stationary while the spreader pipe was rotated about the axis of the suspending chain by an amount sufficient to twist the shackle so that its two ends made an angle of approximately 10 degrees with each other. In this position the force required on the trigger to cause it to completely disengage the sear (measured in a manner to be described later) was only 6 lbs. and the weight of the bomb easily tipped the hooks of the shackle to disengage the suspension lugs. The experiment was repeated three times and each trial gave the same result. The shackle used was one picked at random from the shop and had been immersed in a heap of sand.

7. In view of the results of these experiments it is concluded that:-

a. It is highly improbable that the shackle was twisted.

b. Even if the shackle was twisted to some extent the weight of the bomb would have rotated the suspension hooks to release the suspension lugs of the bomb provided the trigger cam had disengaged the sear.

8. Experiments were then undertaken to lear something about the amount of force which is required to operate the trigger of the B-7 shackle under various conditions. In these experiments the shackle was attached to the hook of a small hoist as shown in Figure 3. A 1100 lb. Demolition Bomb Mk III without fuze or fin assembly (wt. 1073 lbs.) was attached to the shackle in the normal way and lifted a few inches from the floor. The force required to move the trigger to release the bomb was measured by a spring balance in the manner shown in Fig. 4. The force required to pull the trigger of a number of different shackles under a variety of conditions as indicated in Table 1 was then measured. The values of the forces given in the column headed "front" are those obtained when the suspension lugs of the bomb were as near to the pivots of the suspension hooks as the slots in the shackle will permit (Fig. 5) while the values given in the column headed "rear" are those obtained when the suspension lugs were as far away from the pivots of the suspension hooks as the slots in the shackle will permit (Fig. 6).

TABLE I

Forces required to pull trigger of B-7 Bomb Shackle under various conditions when supporting a 1100 lb. Demolition Bomb Mk III (without fuzes or fin assembly, wt. 1073 lbs.)

Item	Description of condi-	Force in pounds required to pull trigger of shackle		Remarks
		Position of Suspension lug in suspension hook slot		
		Rear	Front	
A	A shackle picked at random from those handing in an airplane		10 9 1/2 10 1/2	Three measurements on the same shackle
B	A shackle picked up at random in the shop	9 6 5 3/4	4 1/2	Four measurements on the same shackle
C	The same shackle as used in item B after sand was poured into the mechanism	6 8		Two measurements

D	The same shackle as used in item C after a pinch of sand had been placed between the cam surface of the trigger and the matching cam surface of the sear.		10		One measurement
E	Two new shackles obtained from the storehouse in the original oiled paper wrappings	No. 1	5 4-1/2	4 1/2	Six measurements
		No. 2	4 3/4 5 1/4	4	
F	Shackles which had been cleaned and left unoiled as prescribed in Air Corps Regulations	No. 1	12	11 1/2	
		No. 2	11	10 1/2	
		No. 3	9 1/3	8 1/4	
		No. 4	10 3/4	10 1/4	
		No. 5	10 3/4	10 1/4	
		No. 6	10 1/4	8 1/2	
		No. 7	11 3/4 14	12 3/4 12 3/4	
		No. 8	10 1/2 11	11	
		No. 9	10 1/2	10	
	Shackle No. 7 of Item F after being oiled thoroughly with a light oil		11 8 11 1/2 10		

an examination of the data given in this table indicates in a general way that when the B-7 bomb shackle, maintained as prescribed by Air Corps Regulations, is loaded to 1073 lbs., forces as great as 14 lbs. may be required to more the trigger to the release position.

9. The 1100 lb. Demolition Bomb Mk III hands in the bomb rack in the manner shown in figure 7. The total weight of the bomb complete is approximately 1132 lbs. and total pull on the two hooks of the shackle under these conditions is approximately 1832 lbs. As the force required to more the trigger is produced almost entirely by the friction between the cam surface of the trigger and the sear and as the pressure of the sear on the cam surface of the trigger is proportional to the total pull on the two

suspension hooks of the shackle. Therefore it is to be expected that forces as great as

$$14 \times \frac{1832}{1073} = 23.9 \text{ lbs.}$$

may be required to pull the trigger of the B-7 shackle when carrying a 1100 lb. Demolition Bomb Mk III in the bomb rack of the B-10 airplane.

10. So far as the data given in table I (Item F) goes it indicates that when the B-7 shackles are maintained as prescribed by regulations and are carrying a 1100 lb. Demolition Bomb Mk III the minimum force on the trigger which will trip the shackle is about

$$8\ 1/4 \times \frac{1832}{1073} = 15.1 \text{ lbs.}$$

11. Measurements were next made to determine the force which will be exerted by the stirrup (Fig. 1) of the bomb rack on the trigger of the shackle when the rack is tripped. These measurements were made with a spring balance and a hook in the nammer shown in figure 8. Measurements were made on all the stations of the bomb racks (G-15) in the B-10 Airplane No. 33141 and are given in table II.

TABLE II

Force exerted by the stirrup of the bomb rack on the trigger of the shackle. Bomb Rack type G15 in B-10 airplane No. 33141

Station in Bomb Rack	Force exerted on trigger of shackle by bomb rack firing mechanism	
	At beginning of stroke	At end of stroke
1	12 lbs.	11 lbs.
2	11	9
3	12	10
4	13	10 3/4
5	12 1/4	10
6	12 3/4	9 1/2
7	13	10 1/4
8	12 1/2	10 1/2
9	12 1/4	9 1/4

an examination of the data given in this table indicates that no station in the rack in question exerts a force of more than 12 3/4 lbs. on the trigger of the shackle and that the force exerted by one station (No. 2) is as low as 9 lbs.

12. Comparing these values with the values of the force required to move the trigger to the tripped position as given in paragraphs 9 and 10, it is evident that the failure of the bomb to be released when the rack was tripped as described in paragraph 1 was in all probability due to insufficient strength of tripping spring in the bomb rack. As a temporary measure for overcoming the difficulty a hook was fastened to the end of a stick of sufficient length to permit the trigger of the bomb shackle to be pulled with it by a man stationed in the fuselage behind the bomb bay in the B-10 airplane.

13. On June 10, 1937, another 1100 lb. Demolition Bomb Mk III hung on station 6 of Bomber B-10 No. 33141. This bomb hung in exactly the same manner as did the 1100 lb. Bomb on May 27, 1937 (see paragraph 1). Master Sergeant Smink, Air Corps, and Lt. R. G. Butler, Jr., Ord. Dept., were in the bomb bay on this flight. Both state Dept., were in the bomb bay on this flight. Both state that the condition of the rack was similar to that reported by Sergeant Smink on May 27, 1937, namely that the rack had been tripped, but that the spring had not forced the stirrups all the way to the rear. In this case the stirrup had moved slightly further to the rear than it had on the flight of May 27. In this instance, a slight pull with the hook described in the preceding paragraph the next time the ship passed over the field was sufficient to release the bomb.

14. During acceptance test 600 lb. Demolition bombs M32 on June 23, 1937, the bomb in station 9 failed to be released when the bomb rack was tripped. It fell away, however, as soon as the ship began to bank in the turn for a return trip over the field. The trouble was apparently due to the same cause as in the case of the 1100 lb. Mk III Bombs, although the bomb dropped too soon to allow time for investigation.

15. On June 25, 1937 the tail of Bomber B-10 No. 33147 was hoisted into flying position and several attempts were made to drop an 1100 lb. Bomb T3 (sand loaded). The action of the rack was the same as on the flights of May 27, and June 10, 1937. The stirrup did not move all the way to the rear and the bomb did not drop. Further tests were made using a tripping spring of about double the strength of the standard tripping spring. These tests were successful. The bomb was released without any noticeable lag. Two 1100 lb. Demolition Bombs M33 were dropped from 8000 ft. on June 29, 1937, using this heavier spring. No difficulty was encountered. The bombs left the ship with no noticeable lag.

16. The results of these experiments lead to the conclusion that the tripping springs at present in the G-15 Bomb Rack are not strong enough to dependably release the 600 lb. and 1100 lb. size of bomb when these are suspended on the B-7 shackle as at present constructed and when maintained in accordance with current instructions.

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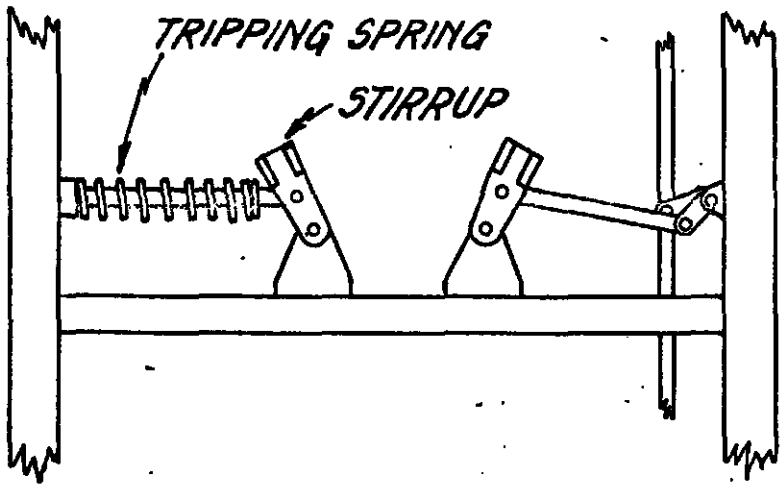


FIG. 1

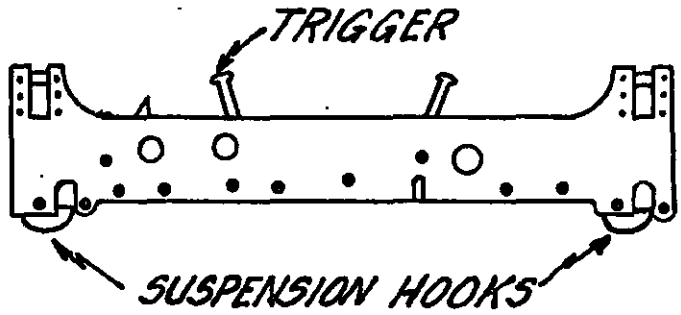


FIG. 2

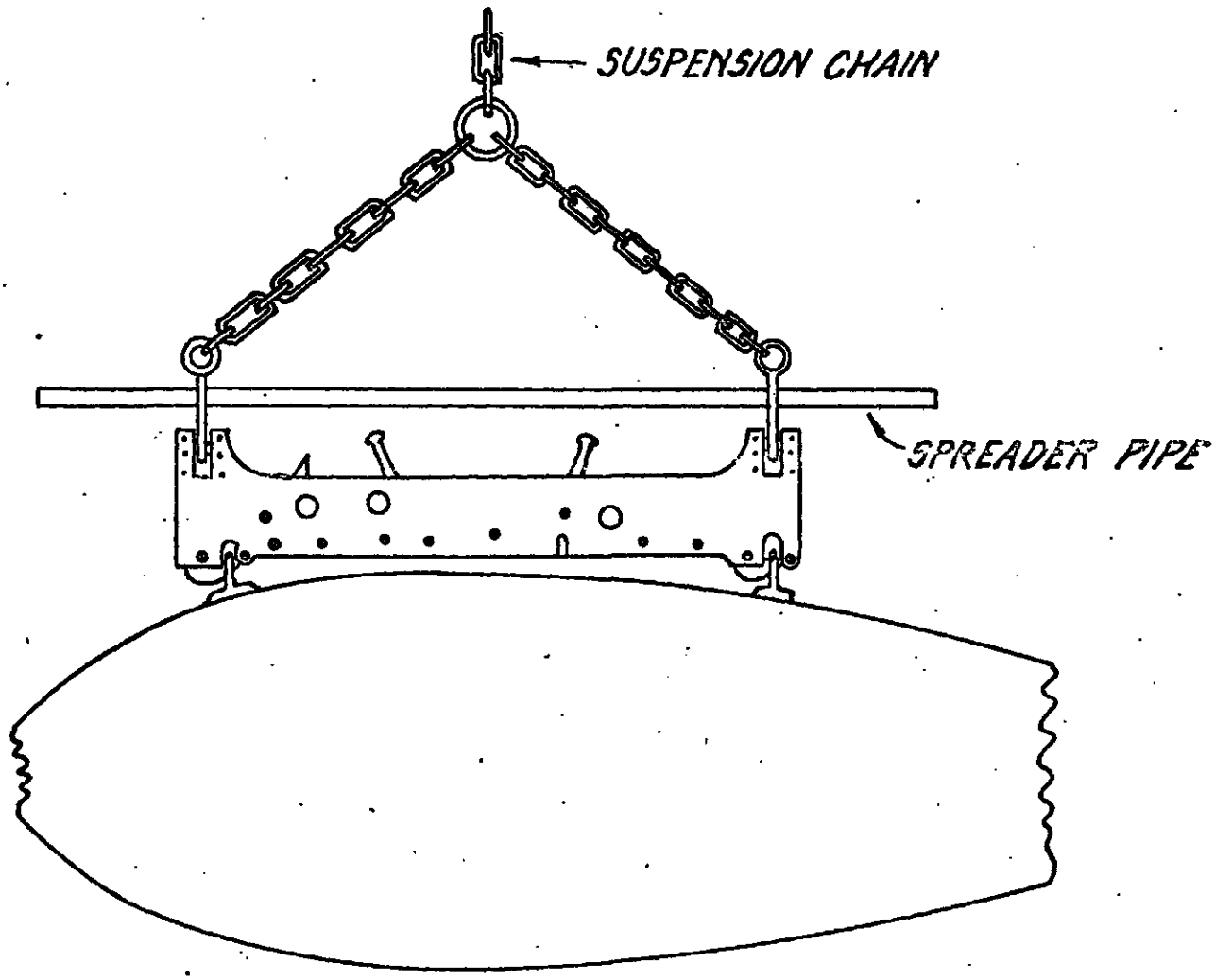

SUSPENSION CHAIN
SPREADER PIPE

FIG. 3

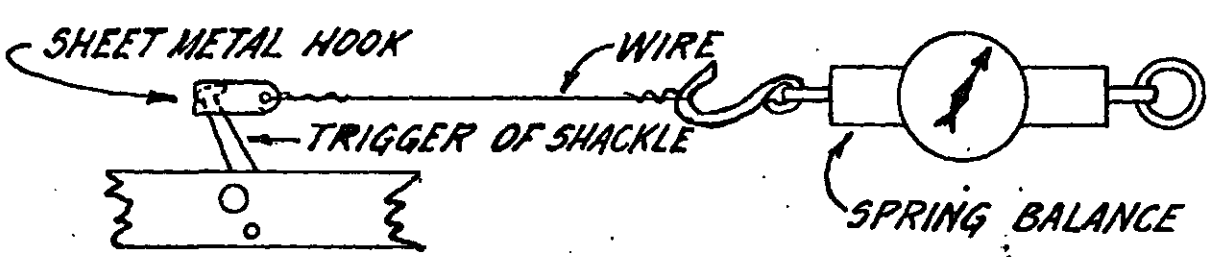

SHEET METAL HOOK
WIRE
TRIGGER OF SHACKLE
SPRING BALANCE

FIG. 4

A

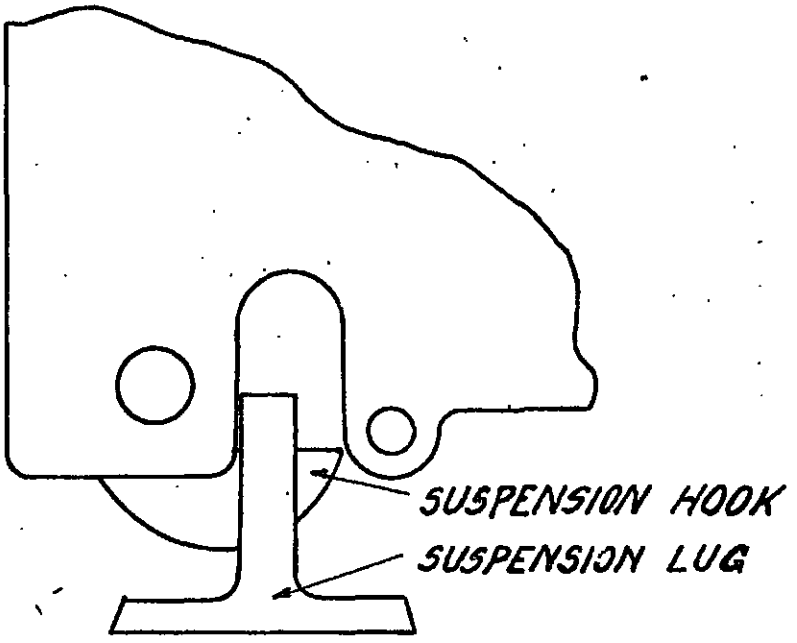

SUSPENSION HOOK
SUSPENSION LUG

FIG. 5

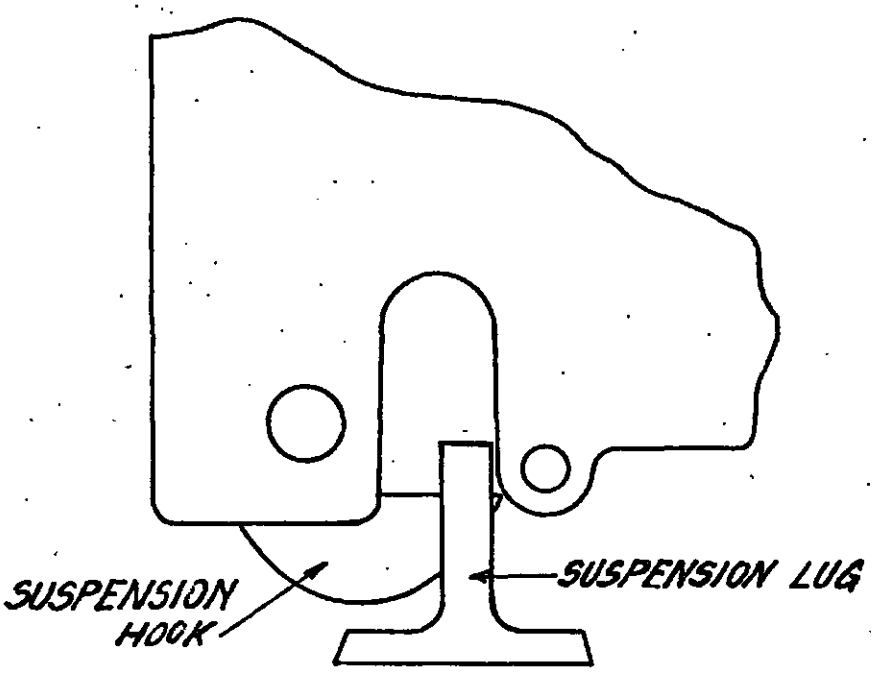
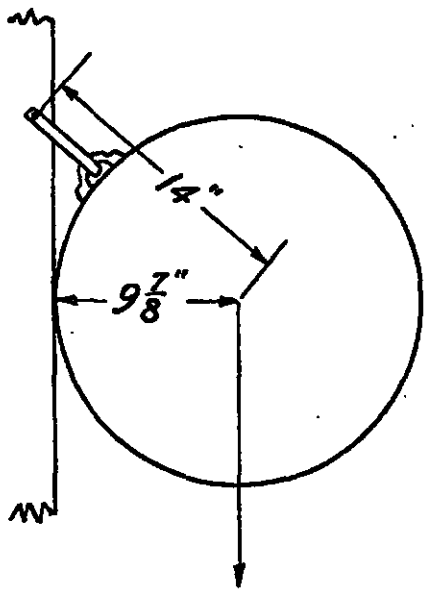
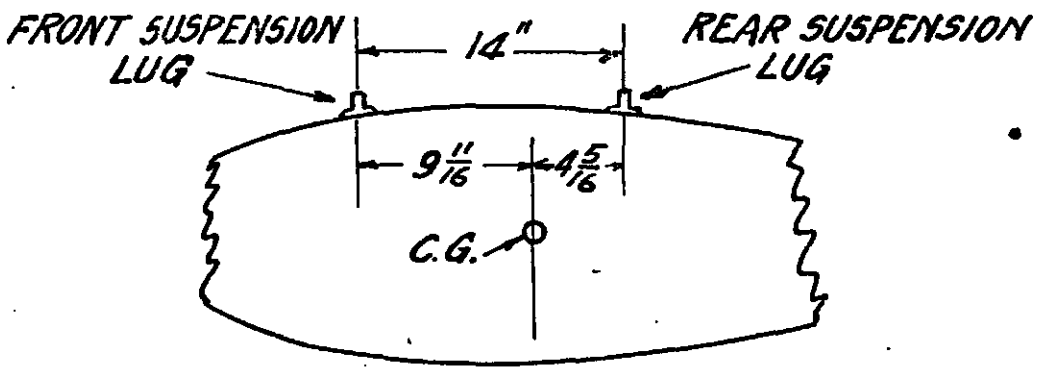

SUSPENSION HOOK
SUSPENSION LUG

FIG. 6



TOTAL WT. OF
1100 LB. DEM. BOMB MK. III
1132 LBS.



LOAD ON SHACKLE WHEN CARRYING 1100 LB.
DEM. BOMB MK. III.

FRONT HOOK	564 LBS.
REAR HOOK	1268 LBS.
TOTAL	1832 LBS.

FIG. 7

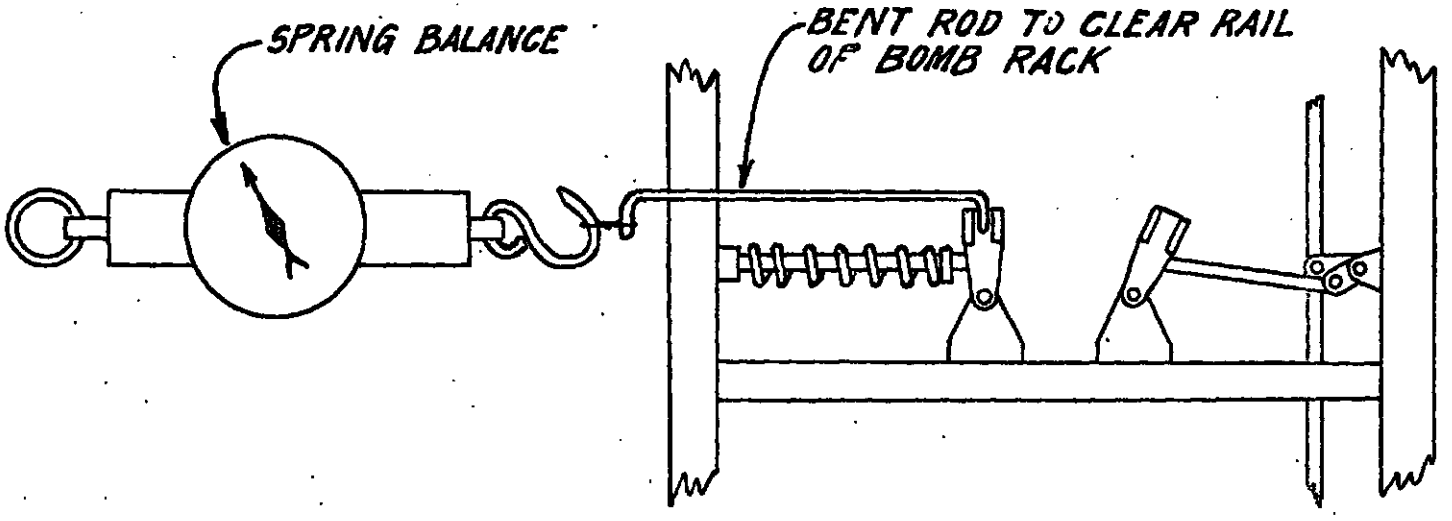


FIG. 8