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SPARROW II LOADING & TRANSPORTER DOLLY

LOG/105/45

September/56 A.R. Littleboy

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LOG/105/45

September, 1956

ENGINEERING DIVISION

AVRO AIRCRAFT LIMITED, MALTON, ONTARIO

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Introduction

The R.C.A.F. specification for the CF-100 Mark 6 aircraft calls for the design of suitable ground equipment to convoy the missile from the "Ready Use" store to the aircraft, and to incorporate a means of raising the missile from the dolly and loading it onto the launcher rail.

On receipt of the R.C.A.F. report entitled "Basic Information Required For Activating An Air-To-Air Missile Building Program", which covers the storing, preparation, testing and a description of the Ready Use store, it was felt that sufficient information was available to prepare a preliminary scheme for the loading dolly. Various schemes were considered, the most promising of which appeared to be a simple dolly, incorporating a cradle which normally laid below the mid position of the missile. When required to raise the missile up to the launcher rail, two cables from the cradle would be attached to lifting points on the launcher rail, and by a simple mechanical winding gear, the cradle would be raised, carrying the missile up to the aircraft. The principle advantage of this scheme being that the correct relationship between the missile and launcher rail would be ensured and considerable misplacement of the transporter dolly tolerated.

Secondly, it was considered that the equipment should be designed so that it would be capable of loading both the CF-100 and C-105 aircraft. Before much work on this scheme had been accomplished, the Company received, through T.S.D. a preliminary specification covering the dolly requirement. This specification was based on using scissor type jack for raising the missile and incorporated several adjustments to compensate for misplacement of the dolly under the rails.

As some work had already been done on the first scheme, it was decided that it would be as well to complete this and present both schemes for consideration.

Both schemes are similar in so much as the missile, complete with the assembly and storage stretcher are rolled onto tracks mounted on the dolly, the missile wings and fins will be stored on the dolly and installed on the missile after it has been loaded onto the aircraft launcher rail. The stowage for the fins is not shown on the dollys illustrated in this report.

Launcher Rail Configuration.

The height from the ground and spacing of the CF-100 wing mounted launcher rail is shown on figure 1.

The C-105 missile arrangement is illustrated on figure 2. It will be seen that the missiles are staggered both fore and aft and in height. The height shown is with the package mounted in the aircraft. These heights are not expected to change significantly were the package loaded while mounted in a servicing stand.

Proposed I Scissor Jack Operation.

A scissor jack operated loading and transporting dolly generally in accordance with the preliminary R.C.A.F. specification is shown on figure 3. It will be appreciated that the sketch is not very detailed or necessarily reflects the best possible chassis configuration. It does, however, serve to illustrate the main consideration involved in the use of the scissor jack principle, details of which are briefly discussed below. It will be seen from figure 2 that there is a considerable difference in height between the missiles mounted in the C-105 pack, the lower pair of which is slightly higher than the CF-100 installation.

If the dolly is to be used for loading both CF-100 and C-105 aircraft, the minimum height of the missile on the dolly must clear the inboard rail position of the CF-100 with sufficient reserve to cover the heavy aircraft condition and undercarriage spring shrinkage due to low temperatures, and the highest missile position of the C-105 in the light aircraft condition. This range of movement is shown of figure 3 and results in a rather cumbersome scissor jack.

Owing to the fore and aft staggering of the C-105 missile, the alternatives are, to either load the two higher or lower missiles from the same dolly, or move the dolly between load each of the staggered missiles.

The first of the alternatives increases the width of the dolly, in the second alternative unless the dolly is moved, the resulting off set load is considered too great for the scissor jack, and in any case, much longer rails would be required.

From a study of the C-100 installation, it will be seen that the missiles are not staggered and the distance apart is roughly half way between the staggered and non-staggered missile of the C-105. In view of the foregoing, the scheme illustrated in figure 3 is based on loading non-staggered missiles from the same dolly into the C-105 pack.

General Description

From a study of the R.C.A.F. report of the missile facility referred to above, it would appear that two cradles or stretchers are employed to assemble the various missile components, these are supported on rollers running in two angle iron tracks which form part of a build up stand. Two identical stands are used for each missile, one carrying the non explosive portion and the other the explosive portion. At one point in the assembly, both halves of the missile are coupled and both assembly stands attached to each other. On completion of assembly, both stands with the missile on them are wheeled into the ready stores and the missile transferred, complete with the stretchers to storage racks.

The missile loading and transporter dolly is fitted with two pairs of rails similar to the storage racks which are capable of accepting the missile plus stretchers. The length of the rail will depend on the stretchers plus the additional 12 inches required in the R.C.A.F. dolly specification to allow for missile and launcher rail mis-alignment, as the stretchers must be long enough to support the separate missile components during assembly, it is thought that

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the dolly rails plus the additional 12 inches would in fact be as long as the missile.

The design of the dolly chassis is bound up with the following considerations:

(a) That the front wheel or axle is sufficiently far forward to ensure that the towing/steering bar does not come into contact with the missile at full lock.

(b) That the rear wheels are far enough behind the C/G position to ensure stability under all conditions of towing.

(c) The rear towing attachment is far enough aft so that the tow bar of the next dolly in train clears the rear of the missile or rails.

(d) The width of the chassis is determined by the required transverse movement of the scissor jack which is the spacing of the missile launchers, plus 6 inches of additional adjustment to ensure alignment (Ref. R.C.A.F. Specification).

(e) The high and ground clearance is a compromise between the required minimum height of the missile and the extent to which a scissor jack can be collapsed. Due to the required minimum height of the missile and the space occupied by a scissor jack capable of a 30 inch lift, it would appear impossible to mount the scissor jack tracks above the chassis members and retain reasonable ground clearance.

From the foregoing, it would appear that what ever chassis configuration were adopted the overall dimensions are determined by the considerations set out above which add up to a large unit.

<u>Operation</u>

The missile complete with stretchers is transferred from the Ready Use storage racks to the rails mounted on the dolly, and locked in a mid position. At this stage, the scissor jack is situated between the two sets of rails. If the jack were left attached to either set of rails, the screw jack and part of the scissor linkage would extend far out beyond the side of the dolly frame, the length of screw jack necessary to obtain a 30 inch lift with a small closed height is in the order of 4 feet (ref. figure 3) If the scissors were rotated 90° so that the screw jack lay fore and aft in line with the missile, it then becomes something of a problem to operate without the use of a right angle drive on an extremely long handle. The torque necessary to operate the scissors in the closed height position based on a 1 1/2 standard acme thread is as high as 160 inch/lbs. This however, does drop as the angle of the scissors becomes less acute.

With the dolly positioned under the aircraft, move the scissor jack from the stowed position between the rails until it is under the missile rail to be lifted. The top plate of the scissor jack is then attached by a locating peg and quick action clamp to the rails carrying the missile. The rail assembly is released from its attachment points to the chassis, and is then free to be raised by the scissor jack.

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With the missile raised to a point adjacent to the aircraft launching rail, adjust transversely as necessary by means of the transverse jack which runs across the frame. Level the missile to correspond with the aircraft rail attitude, this is accomplished by a secondary screw jack located in the top plate of the scissor jack. Limited movement of the missile in a plane parallel to the ground is achieved by a centre bolt and slot arrangement incorporated in the head of the scissor jack. The missile is then uncaged so that it can be moved back and forth on the rails.

Finally, raise the missile and manoeuvre as necessary until the missile mounting lugs engage in the launcher rail, push forward until locked.

Lower the dolly rail assembly, lock the rails on the dolly frame, uncouple the scissor jack, traverse the jack across the frame until it picks up the second missile and rail assembly to be lifted, repeat the operation described above.

To summarize, it is suggested that the method described above is somewhat cumbersome and suffers from the following disadvantages:-

(a) The equipment as a whole is large.

(b) There are many adjustments to be made to line up the missile with the aircraft launching rail.

(c) The operating load of the scissor screw jack is high over the lower part of the range.

(d) It is difficult to protect both the screw jack and the transverse screw against sand and moisture.

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PROPOSAL II, RAISING THE MISSILE BY MEANS OF CABLES ATTACHED TO THE AIRCRAFT.

The general arrangement of this proposal is illustrated on figure 4, the operation is shown on figure 5 and the schematic arrangement of the hoisting cradle on figure 6. The proposed attachment of the cables to the C-100 launcher rail pylon is shown on figure 7.

The proposal consists of a dolly on which two pairs of rails, capable of receiving missiles complete with their stretchers are permanently fixed. The distance between the rails is a compromise between the C-100 and C-105 aircraft launcher rails. Recessed into, and forming part of the rails is the hoisting cradle. This is situated so that it will pick up under the C/G of the missile which occurs at the junction of the explosive and non-explosive portions of the missile. It is anticipated that the width of the hoisting cradle will not be more than 6 to 8 inches, in which case, when raised, will pass through the gap between the front and rear stretcher. When raised by the cradle free of the stretchers, the missile will swing into place under the launcher rail.

It will be appreciated that by employing this method, the overall size of the equipment will be reduced and numerous adjustments to line up the missile with the launcher rail are not required.

The principle of the hoisting cradle is shown on figure 6, and consists of a simple worm gear of standard size, driving a double cable drum. A constant torque of 32 inch/lbs. is required to raise the missile. It is suggested that a dog clutch and simple brake are incorporated so that the empty cradle can be lowered rapidly from the launcher rail without the necessity of cranking it down.

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AIRCRAFT:		REPORT No.	
		SHEET No.	FIG 1
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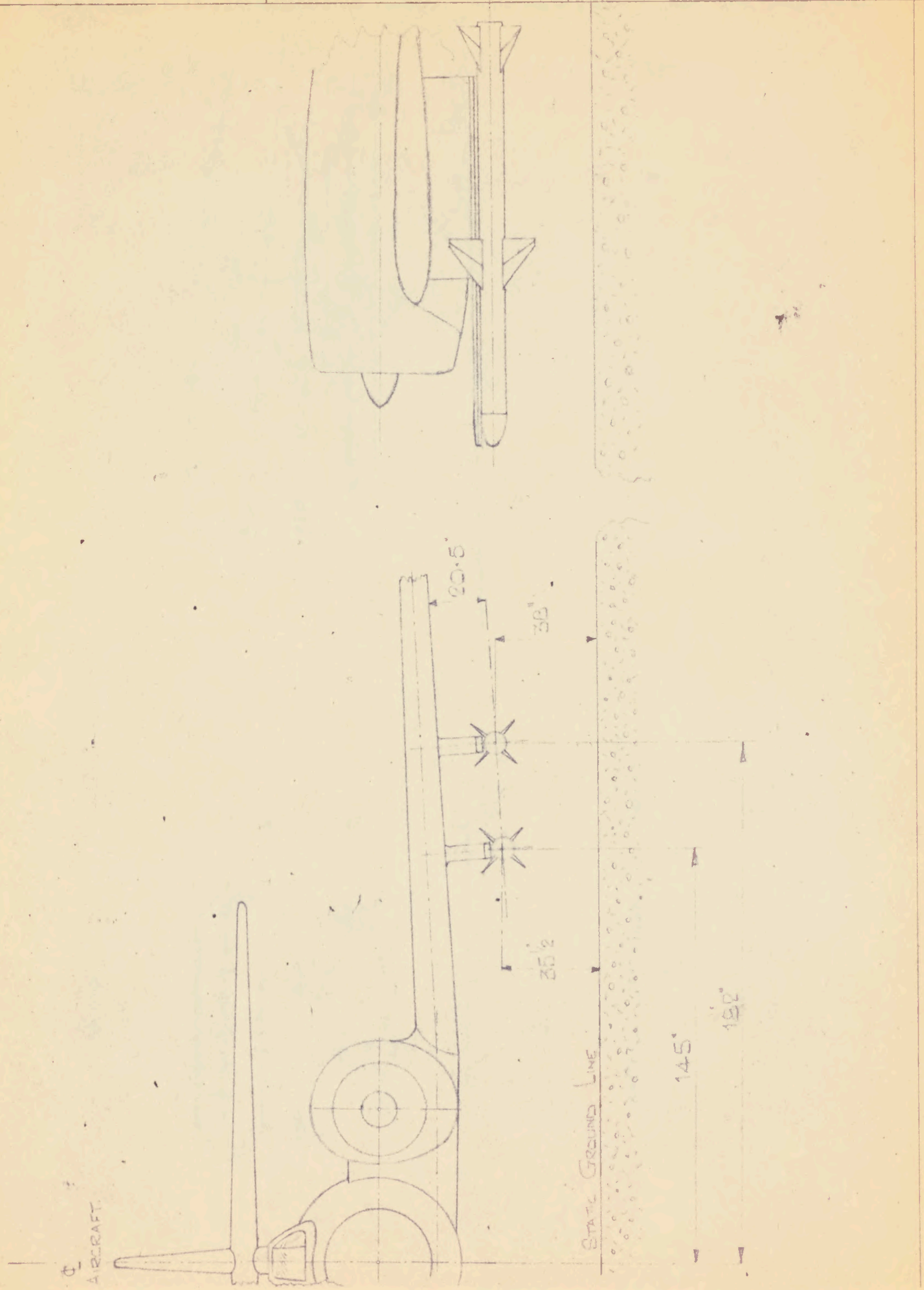

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AIRCRAFT:		REPORT No.	
		SHEET No.	FIG 2
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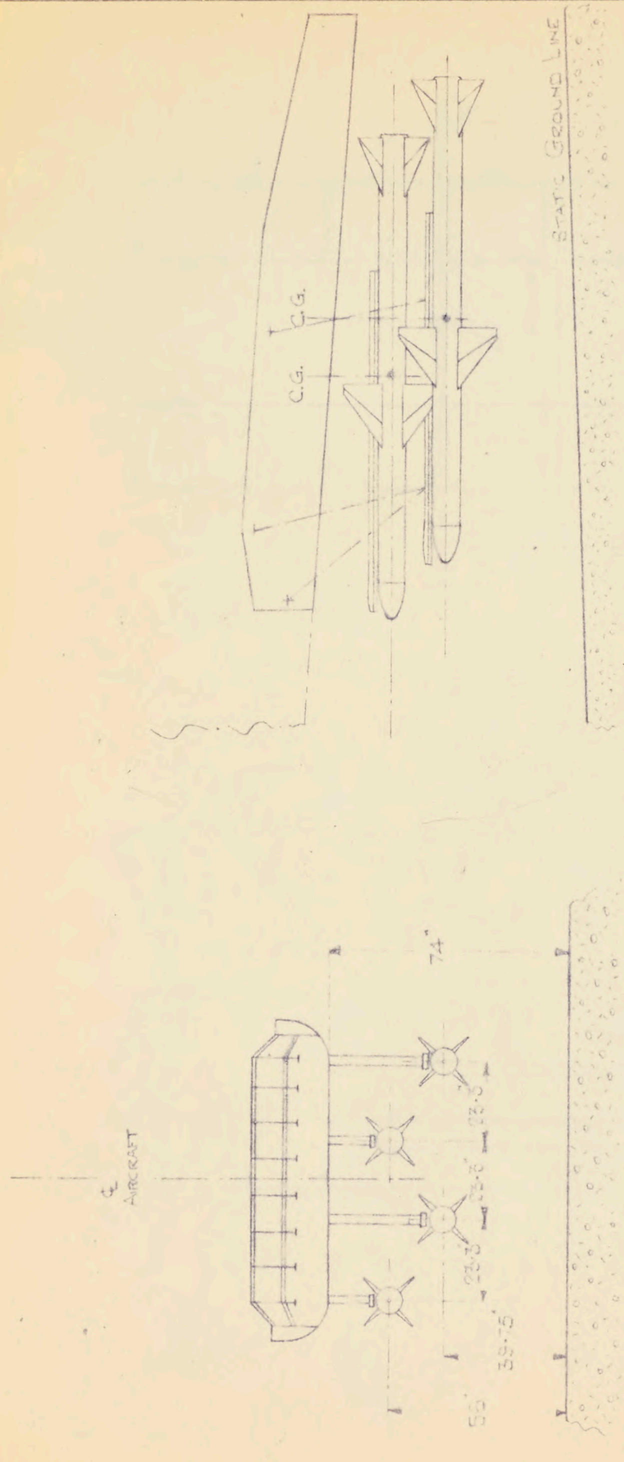

NOTE:- VERTICAL DIMENSIONS TO GROUND ARE GIVEN AT C.G. OF MISSILES.

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REPORT No.
SHEET No. FIG 3

AIRCRAFT:

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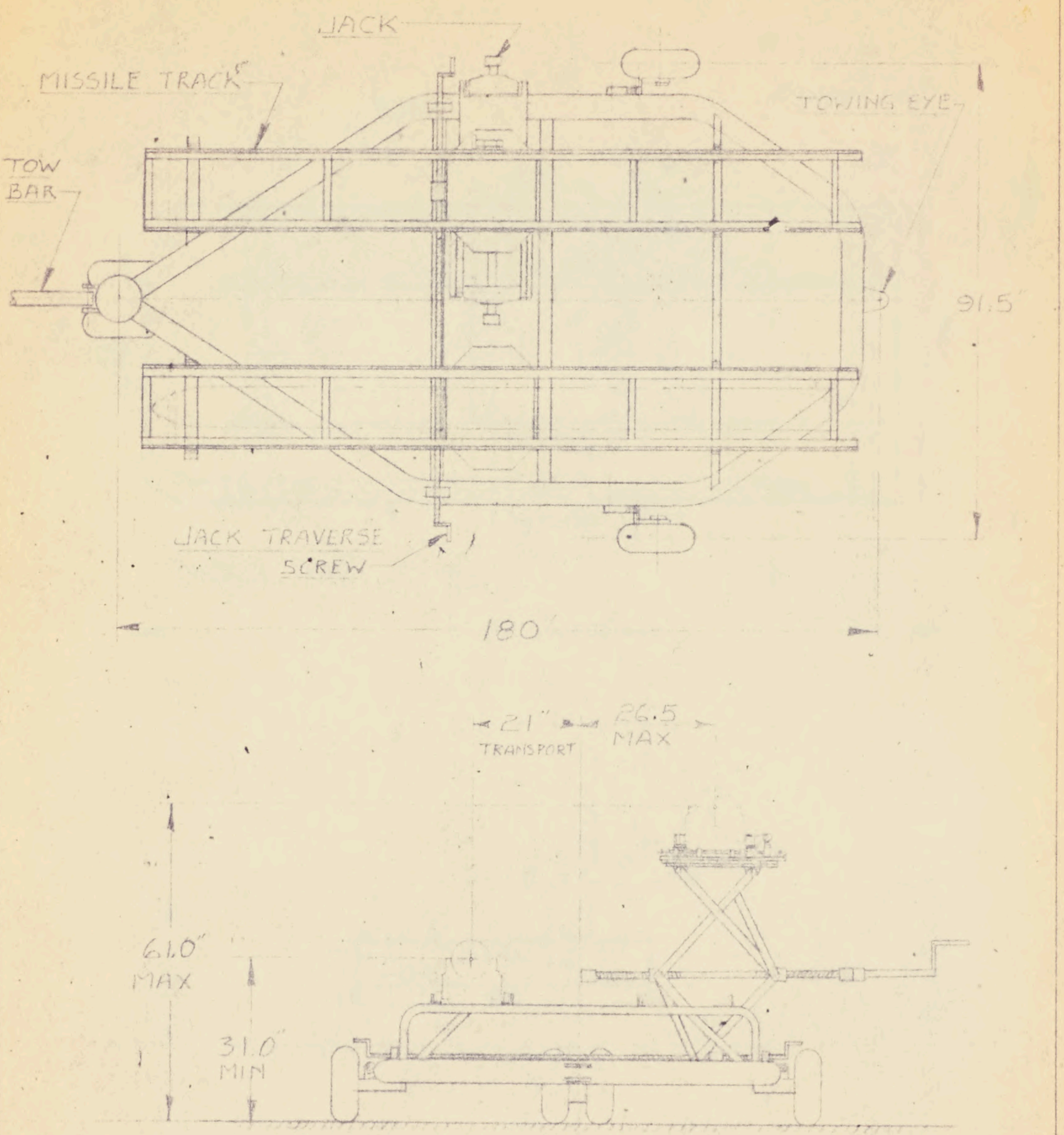

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AIRCRAFT:		REPORT No.	
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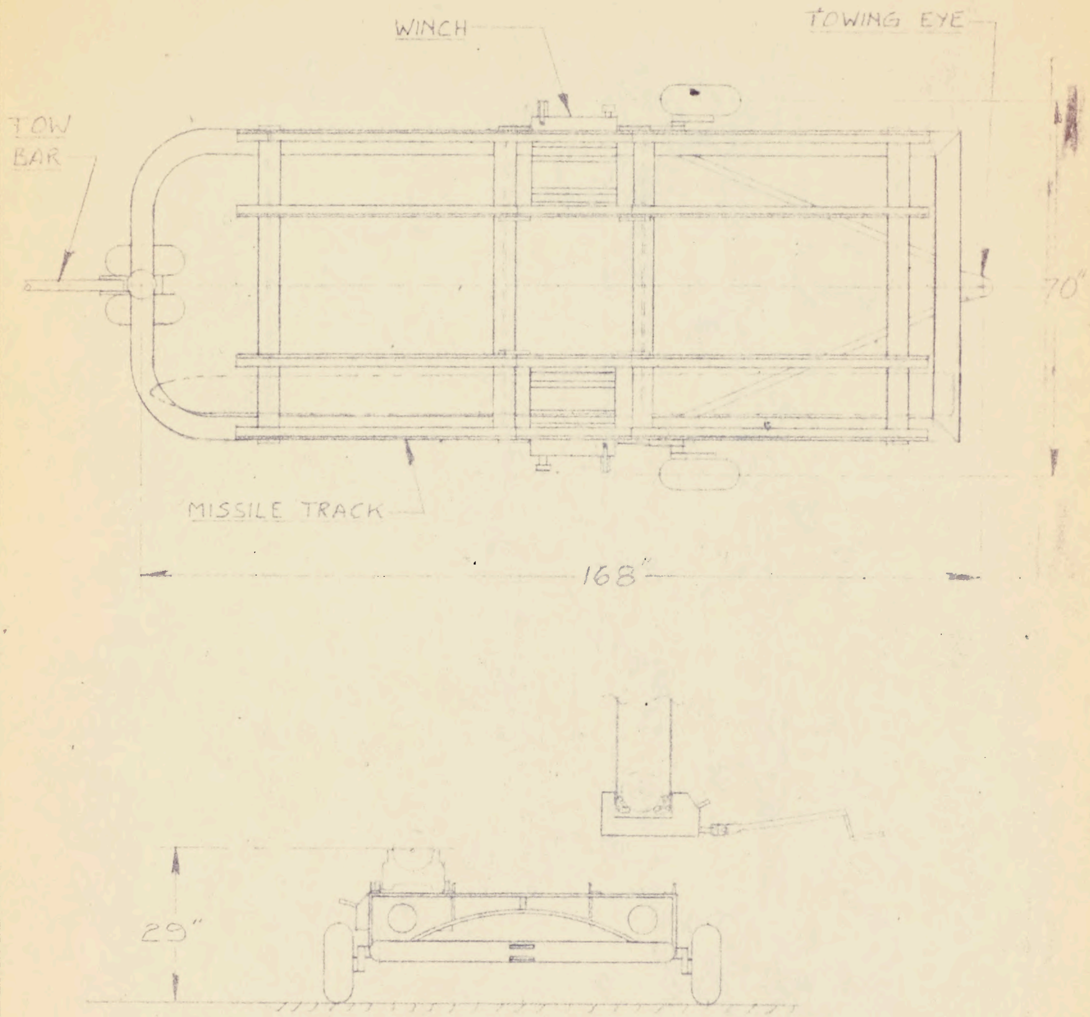

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AIRCRAFT:		REPORT No.	
		SHEET No. FIG 5	
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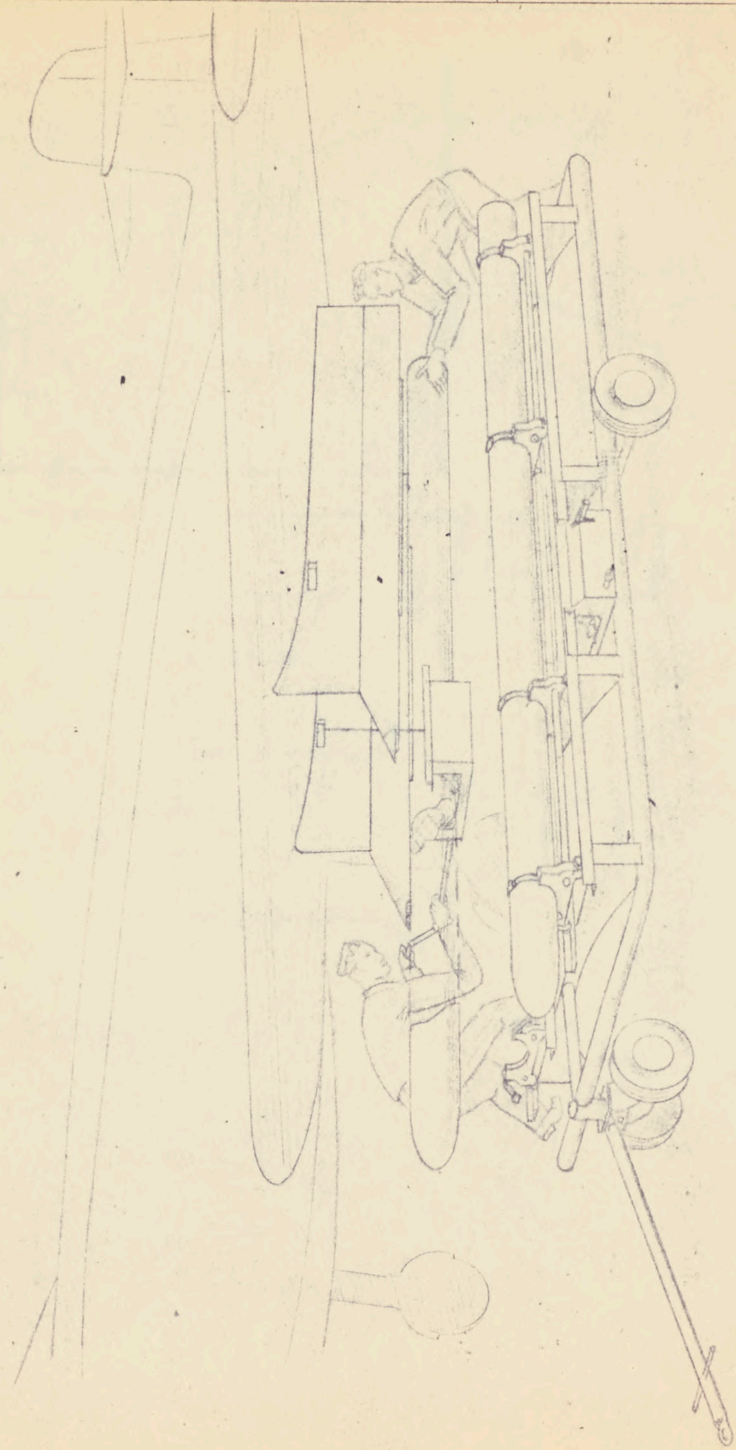

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AIRCRAFT:		REPORT NO.:	
		SHEET NO.	FIG 6
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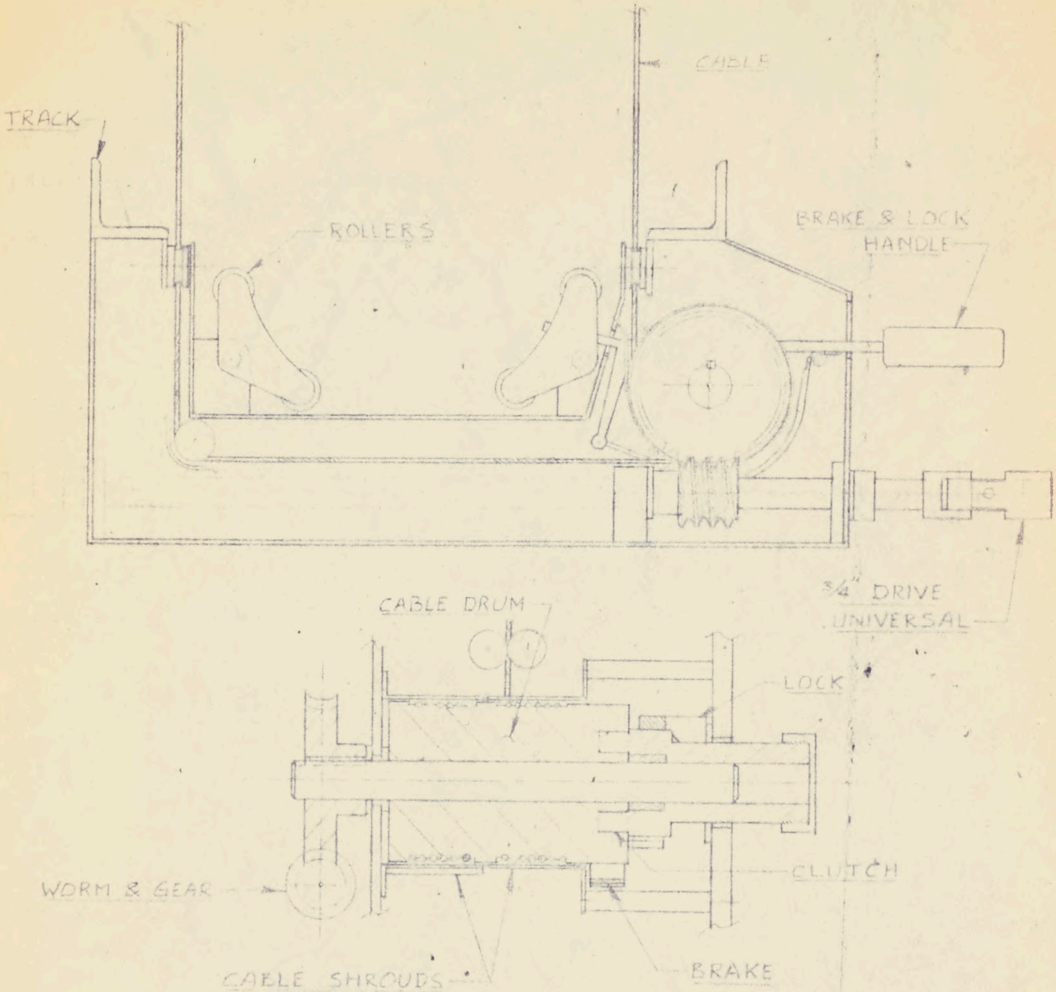

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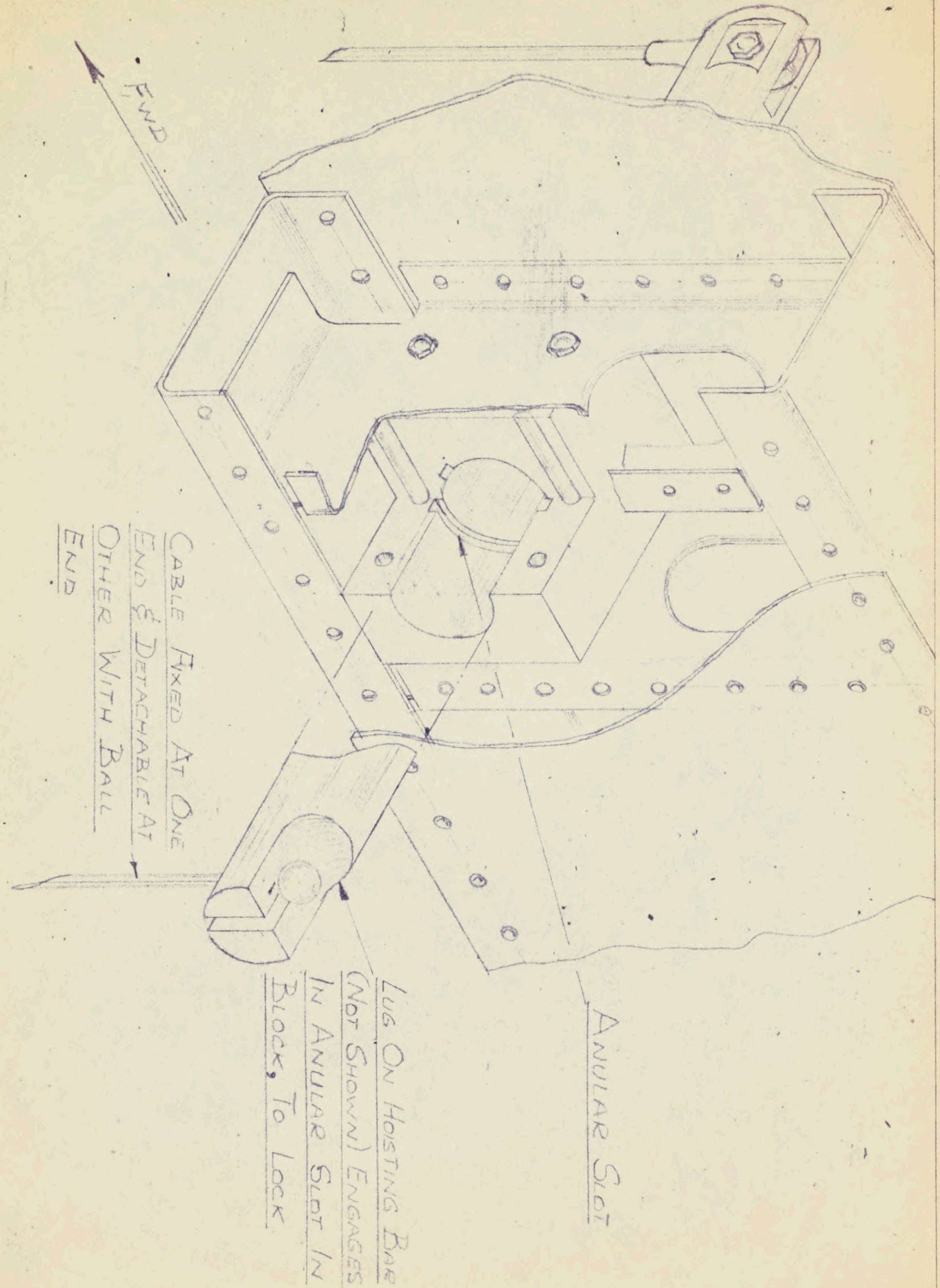

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