CONTAMINATION OF GUN MOUNTING HYDRAULIC SYSTEMS

BY

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Introduction

In November, 1953, H.M.S. *Defender* arrived at Hong Kong for a three weeks self refit and intermediate docking. At that time she had been operating in Far Eastern waters for approximately 5 months, having left the United Kingdom immediately after the Coronation Review.

A routine examination was carried out on the general service V.S.G. pump ('A' end) of 'X' Turret (4·5 in Mk. 6 R.P. 41 mounting), and heavy deposits of a brownish-black rubbery substance were found on all the internal non-working surfaces of the pump. In the bottom of the pump body there was a sludge of the same substance. This sludge was $\frac{3}{8}$ in thick along the corners of the bottom of the pump body and gradually thinned towards the centre. The running temperature of the system had been reported to be rather high.

Extent of Contamination

An examination to determine the extent of the contamination ensued. The cover of every V.S.G. pump in 'A', 'B' and 'X' turrets was lifted with the result given below :—

	Training Auto System Pump	*Elevating Auto System Pump*	*General Service Pump Revolving Structure*	*General Service Pump Fixed Structure*
'A' Turret	Clear	Clear	Contaminated	Contaminated
'B' Turret	Clear	Clear	Contaminated	Contaminated
'X' Turret	Clear	Clear	Contaminated	Contaminated

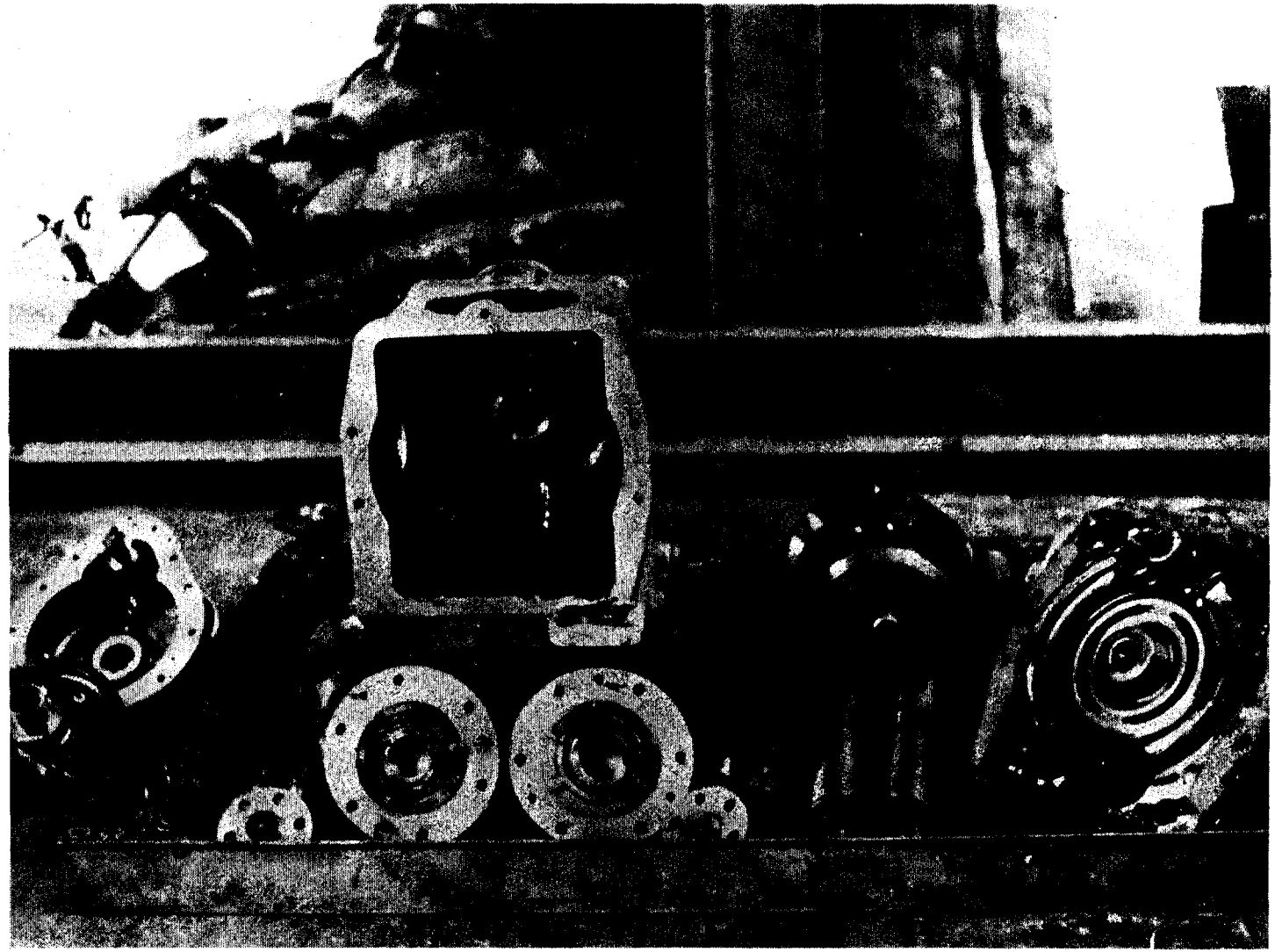

FIG. 1—'X' TURRET REVOLVING STRUCTURE GENERAL SERVICE PUMP, SHOWING EXTENT OF THE DEPOSIT ON COMPONENTS AFTER STRIPPING

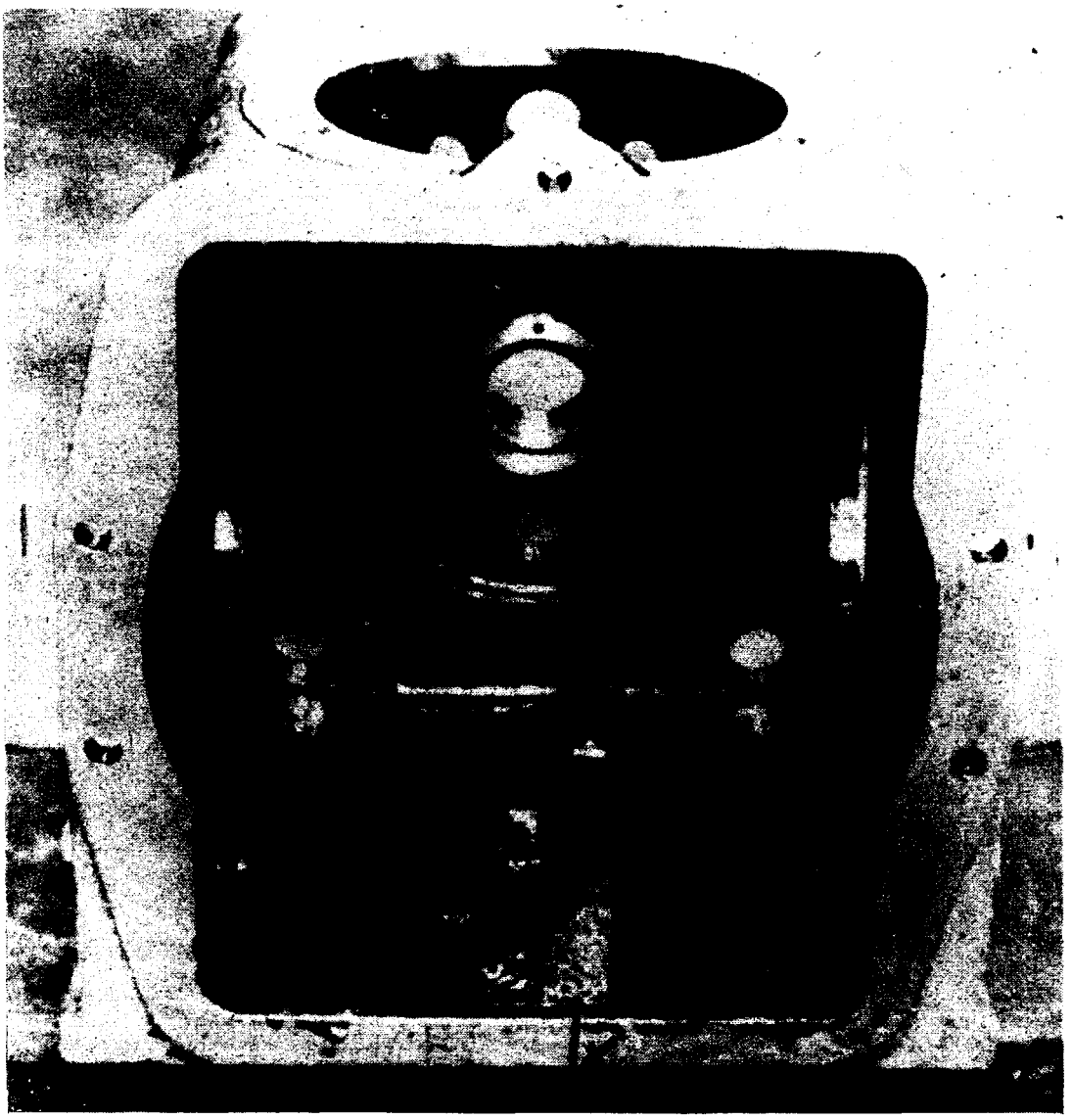

FIG. 2—'X' TURRET REVOLVING STRUCTURE GENERAL SERVICE PUMP SHOWING DEPOSIT. THE LIGHTER 'LANE' AT BOTTOM OF PHOTOGRAPH COMPARES A REASONABLY CLEAN AREA WITH THE REMAINDER

This examination was followed by removal of selected pipes from the general service systems of each turret, both on the fixed and revolving structures. The following parts of each general service system were found to be contaminated :—

Revolving Structure

(*a*) All the suction side of the system, including oil feed tanks, pipes and valves.

(*b*) All the machinery, pipes and valves, etc. on the discharge side of the pump, up to a level of approximately one foot below the deck of the gunhouse. No contamination was present above this level.

Fixed Structure

(*a*) All the suction side of the system, including oil feed tanks, pipes and valves.

(*b*) All machinery, pipes and valves, etc. on the discharge side of the pump, on the hold and platform decks. No contamination was present above this level.

FIG. 3—CYLINDER BLOCK, TILTING RING AND PISTONS

During subsequent cleaning of the oil feed tanks, approximately three pints of thick rubbery sludge were removed from each.

Possible Cause of the Formation of the Deposit

As the training and elevating auto systems were not contaminated, it was thought probable that a difference between it and the general service systems might be a main factor causing the trouble. Flexible rubber hoses are fitted to the general service systems only between the pump and the pipe lines in the following positions :—

(i) Suction from the oil feed tank to the pump.
(ii) Scoop circulation supply from the oil feed tank to the pump.
(iii) Scoop circulation return from the pump to the oil feed tank.
(iv) Pressure discharge from the pump to the main pressure system.

The hoses were therefore suspected. It was also considered possible that the deposit had originated from the oil used in the systems. The problem was, therefore, to try to determine whether the deposit was of rubber or petroleum origin.

The following samples were taken to the Asiatic Petroleum Company at Hong Kong, to see if they could determine whether the oil met the service specification, and if the deposit was caused by the oil or the rubber hoses :—

(i) New oil OM.65.
(ii) Contaminated oil.
(iii) Sludge from the bottom of one of the general service pump casings.
(iv) Selected pieces of the flexible rubber hoses.

The results indicated that the contaminated oil was in good condition and that very little, if any, oxidation or deterioration had taken place while it had

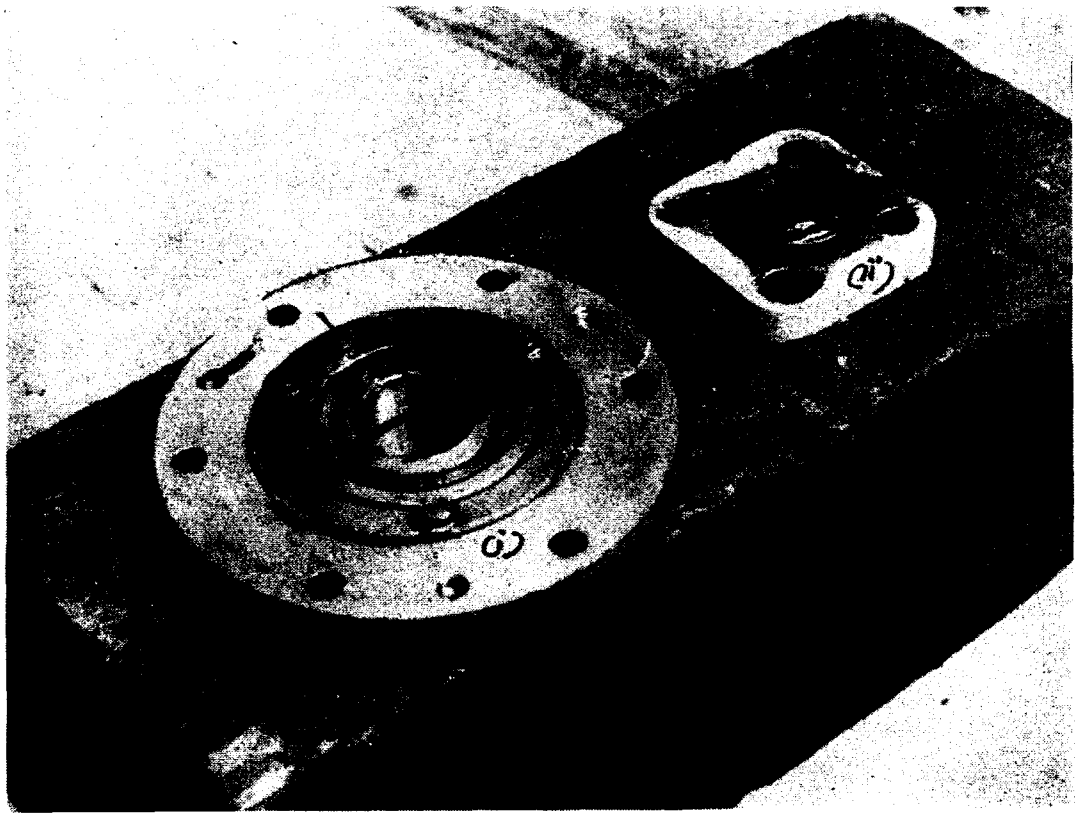

FIG. 4—END BEARING CAP AND BLANK FLANGE FROM PRESSURE PIPE SYSTEM. UPPER PORTION IN PHOTOGRAPH OF THE BLANK FLANGE HAS BEEN CLEANED, THE REMAINDER IS STILL HEAVILY COATED

been in use. The sludge was found to be soluble in benzine but not in acetone, thus indicating that it originated from natural rubber rather than petroleum. A section of the inner lining of one of the flexible rubber hoses was heated in oil for 10 hours at 175°F. At the end of this period, the woven reinforcement layers were coming apart slightly at the ends of the section and the inner rubber lining had softened to such an extent that it could be rubbed from the hose quite easily.

It was considered, from all this, that the inner lining of the hose was of natural rubber, and vulnerable to attack by the oil, thus causing the deposits. The oil probably took small particles of rubber or bonding material into suspension and passed it round the system while the machinery was running. When the machinery was stopped, the oil drained to the lower half of the systems, cooled off, and deposited the particles. This would account for the deposit not being in evidence in the upper parts of the systems.

The presence of natural rubber in the hoses was a departure from the specification.

Damage Caused to Machinery

The actual damage found in the machinery was confined mainly to the V.S.G. pumps. These all suffered from scored valves and valve seatings. Whether this was due to the deposit or other forms of dirt, which may have been present in the systems, is not known. Wiping and scoring of the whitemetal bushes supporting the reduction gear of the pumps was also general, and this was probably a direct effect of the rubbery deposit, which must have contributed to the high running temperature of the systems. The damage was repaired at Hong Kong.

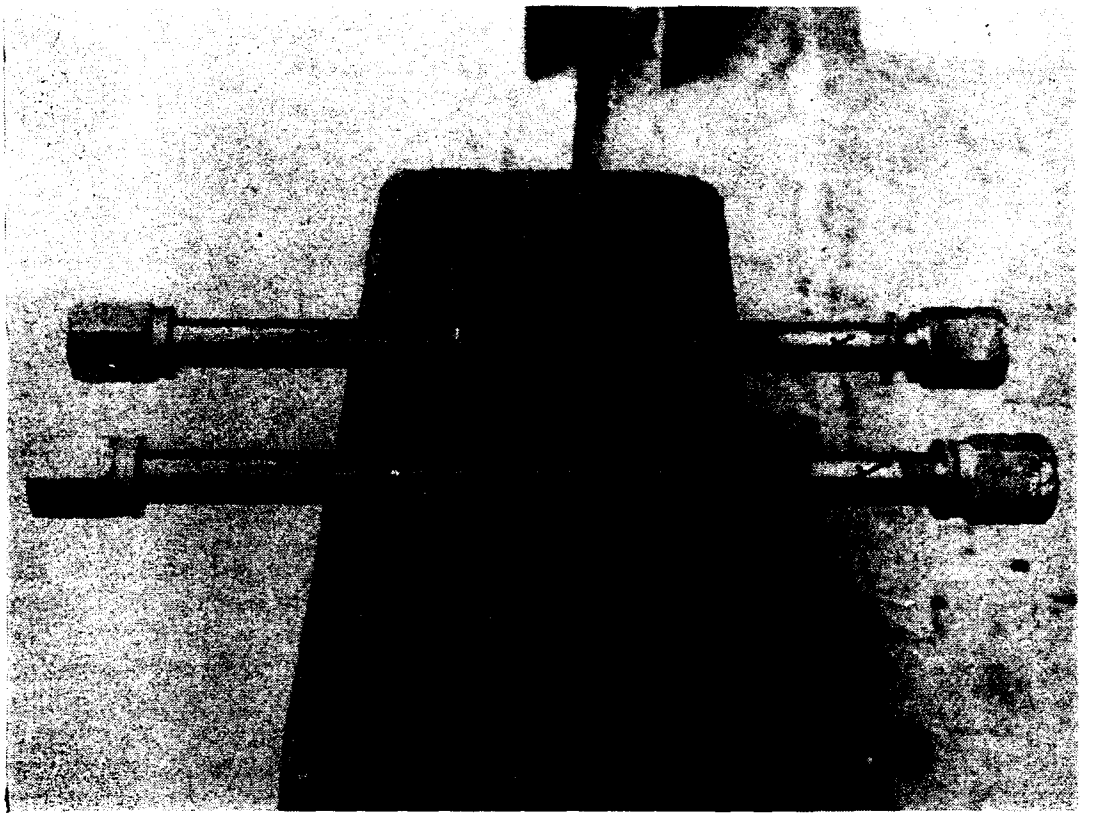

FIG. 5—TWO HEAVILY COATED TIE BOLTS FROM THE PUMP. RIGHT HAND ENDS HAVE BEEN CLEANED

Cleaning the systems was a major task because it involved removing all the contaminated machinery and pipes, hand cleaning and replacing them. D.N.O. ' Q ' Section sent a complete set of replacement hoses to Hong Kong within ten days of the demand being placed—a creditable achievement.

Conclusion

This was one of the snags that beset maintainers of machinery from a direction in which they are least expected—namely materials not in accordance with specification. Had the contamination not been discovered and checked, it is probable that all the gun turrets would ultimately have suffered major damage, and the fighting equipment would have been reduced to a helpless state. The lessons to be learned from it are probably that :—

(*a*) Faulty material should always be considered in diagnosis of faults.

(*b*) Unless routine examinations are properly carried out, trouble, in the form of creeping paralysis, may be brewing for the unwary maintainer.

ADMIRALTY COMMENT

This incident drew attention to the general conditions governing the adoption of high pressure oil hoses in gunmountings. Immediate action was taken to produce hoses which would fully satisfy the worst service conditions. Negotiations with leading manufacturers, which lasted for two years, have produced a very rigid specification. Supplies are now being made to mountings under construction, but quantities will shortly be available to replace all hoses in service and a Fleet Order is to be issued.