TWL FEED PUMPS

FAILURES AND THE HOME-BREWED SOLUTION

BY

COMMANDER N. J. B. MORRISON, B.SC(ENG)., R.N.
(H.M.S. Sultan, formerly Fleet Engineering Staff)
AND
LIEUTENANT R. B. JANSON, R.N.
(H.M.S. Sultan)

Introduction

The main novel feature of the TWL feed pump is the lubrication of the rotor shaft PTFE bearings by feed water. The pump measures about 5½ × 3 × 4 feet and weighs about 2 tons complete. The lubricating water system is shown in FIG. 1.

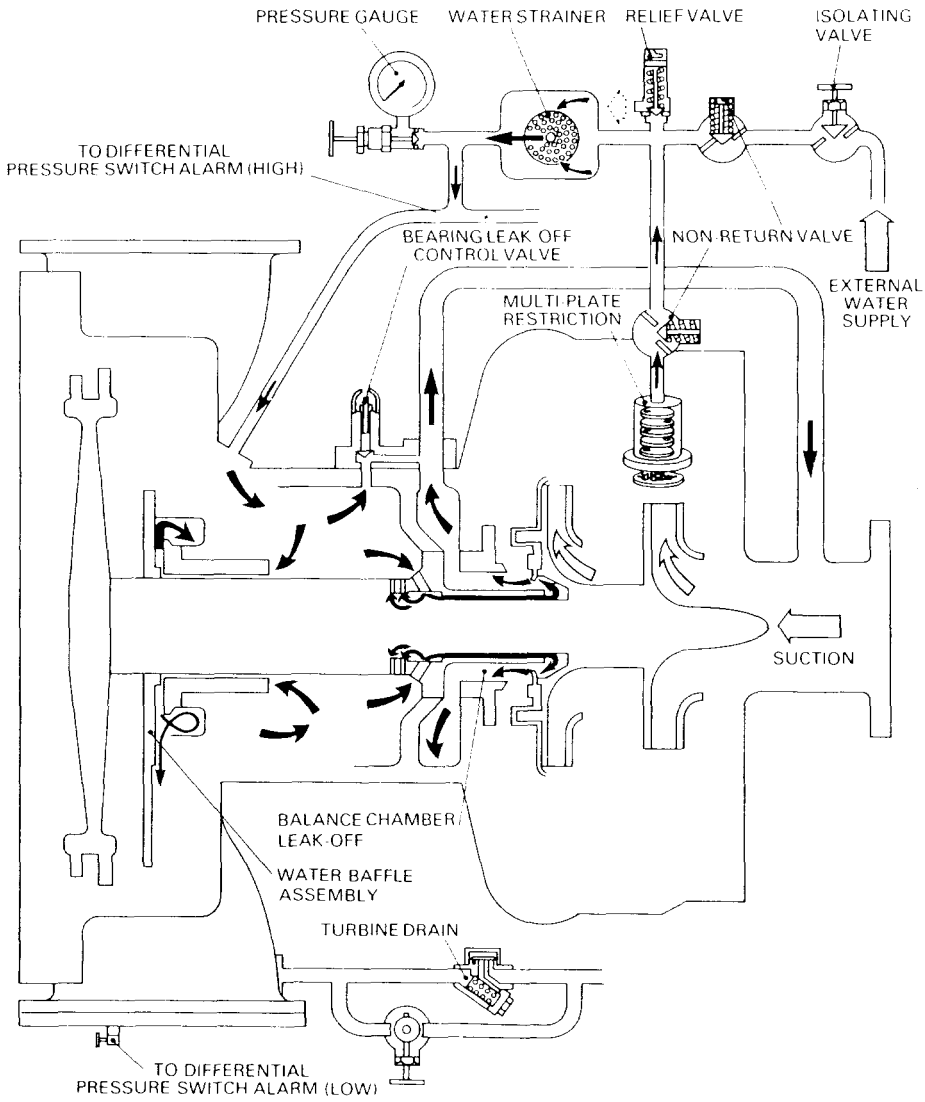

FIG. 1—TYPICAL LUBRICATING WATER SYSTEM

TWL feed pumps have been fitted in WHITBY, ROTHESAY, and LEANDER Classes as well as GMDs and H.M.S. *Bristol.* During their years in service, many failures have been experienced, costing large sums of money in repair bills, the loss of many days of operational time, and causing much heartbreak for officers and men in the Fleet.

A particular problem occurs when the pump is being kept warmed through, ready to feed main boilers should the on-load feed pump fail. In this stand-by condition, the high exhaust steam pressure will *impede* the flow of lubricating water from the external source and damage the PTFE bearings by overheating. Also, too low an exhaust pressure will *increase* the flow of external lubricating water, filling the turbine casing with cold water. The watchkeepers' solution is (and has been for many years) *to shut the exhaust steam valve.*

The files of the Fleet Engineering Staff bulge with dozens of reports of formal enquiries into incidents concerning damage to TWL feed pumps. Prominent amongst these are incidents in which the stand-by TWL feed pump was started with the exhaust steam valve shut. When this is done, the pump and turbine casing distort under full steam pressure, despite the casing relief (or sentinal) valve. The pump then has to be replaced and the damaged pump repaired, and, downstream of the enquiry, the guilty engineer officer and his staff are suitably admonished—a legacy of grief and jeopardized careers.

Symptomatic of the Fleet Engineering Staff's long-standing concern over TWL feed pump failures is the annual re-issue of comprehensive operating instructions, now published as Fleet Engineering Temporary Instruction (FETI) 24/82. Amounting to four typed pages, these seek to reduce the incidence of maloperation by exhorting engineer officers and their watchkeepers to do better. A hint of disciplinary action and sanctions against future transgressors adds spice to the instructions.

In 1978, the then Fleet Marine Engineer Officer took the initiative in making a determined effort to find a solution to the problems of TWL feed pump operation. Fleet Engineering Staff, the Ship Department, Messrs. Weir Pumps Ltd., H.M.S. *Sultan*, and trials ships all became involved in designing and trying out new safety devices.

The Scutt-Tomlin device described in this article eliminates at least this common cause of pump damage. It is simple, cheap, and a product from within the 'engine room' itself.

Maybe invented out of frustration from long years of experience of the shortcomings of the TWL feed pump and no sight of a solution being provided by the 'designers', it is likely that, had the requirement been clearly stated at the outset and a degree of priority made quite evident, a properly engineered solution would then have been made available some years ago. Even if the operators' engineering of detailed design may not be wholly professional, let at least Cicero's injunction *'Salus populi suprema lex esto'* (Let the welfare of the people be the final law) be observed. Well done the two Inventors! How neat that one of them, Mechanician Tomlin, should come from Glasgow, home of the feed pumps themselves. Perhaps a case of 'When Glaswegian meets Glaswegian...'

The Home-brewed Solution

In early 1979, a series of trials were carried out at H.M.S. *Sultan* in an attempt to find a device capable of preventing damage to the TWL feed pump if it were inadvertently run up with the exhaust valve shut. These trials were conducted by personnel from C.-in-C. Fleet Engineering Staff and the Ship Department, using the training facilities in *Sultan*'s Watt hangar. Two of the hangar staff involved in these trials felt that the devices being tested were not particularly satisfactory and, therefore, designed, made, and tested their own device.

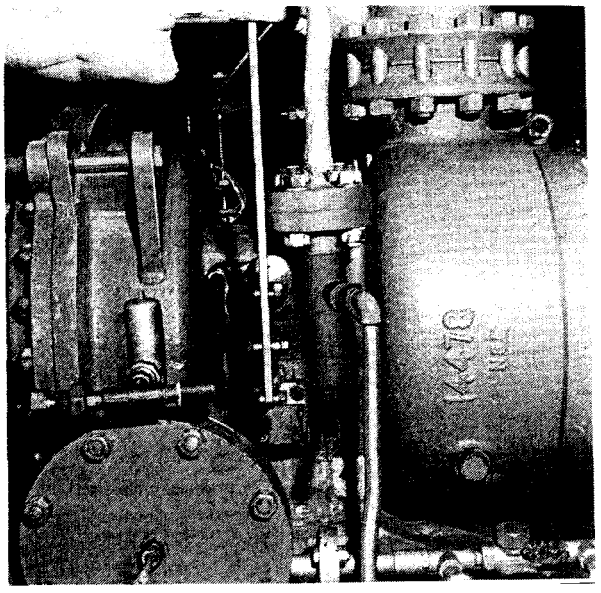

FIG. 2—SCUTT/TOMLIN TRIP BOLTED IN POSITION ON A TWL 35 FEED PUMP

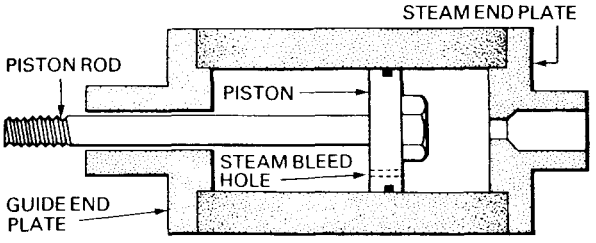

FIG. 3—PISTON ARRANGEMENT

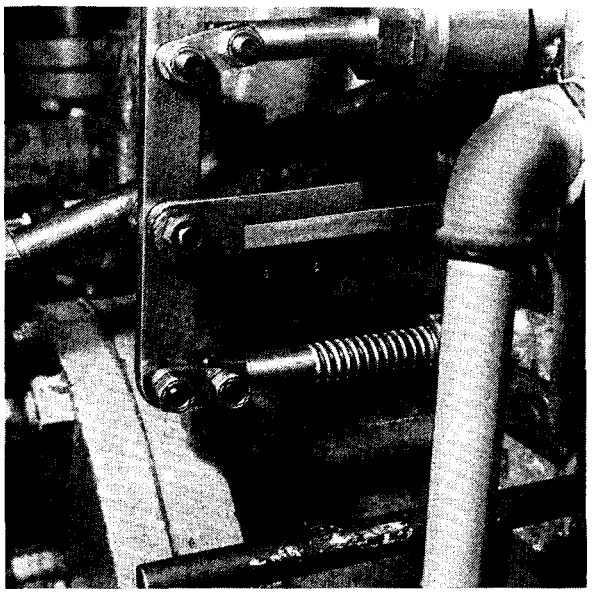

FIG. 4—TRIP LEVER ASSEMBLY

The requirement was for a simple, reliable design that could be fitted to TWL pumps in service by ships' staff, and would not require any major work or modification to existing installations.

MEA(P)1 J. S. Scutt and MEMN(P)1 W. Tomlin designed a simple piston and lever arrangement which used excess exhaust pressure to operate the existing hand-trip device, the whole unit bolting on to the side of the trip housing using existing studs.

The unit consists of a piston housed in a cylinder (FIG. 3) open to atmosphere at one end and connected, through a spring-loaded sentinal valve, to the pump exhaust casing at the other end. Movement of the piston is transmitted to the existing pump hand-trip spindle via a lever and pivot arrangement (FIG. 4). The lever is extended at one end to provide a new hand-trip operating position.

In the event of malfunction or maloperation of the TWL feed pump causing the exhaust casing pressure to rise above a predetermined level, sentinal valve A (FIG. 5) lifts admitting steam into chamber B. This causes the piston to move down the cylinder, so rotating the lever DF about pivot E. The movement at point F depresses the trip spindle which shuts the machine down.

When the machine has tripped, the pressure in the exhaust casing will drop causing the sentinal valve to re-seat. Steam pressure remaining in chamber B will bleed via hole H to chamber C and then to atmosphere. The return spring will move the actuating arm to its original position allowing the trip to be reset by hand. The actuating arm is extended to point G to facilitate its use for hand operation of the trip.

The prototype Scutt-Tomlin device was manufactured in *Sultan* by a class of mechanicians undergoing training. Mild steel was used extensively in the prototype because of its availability and the ease of machining; this unit was then fitted to a TWL 20 and to a TWL 35 pump in the Watt hangar.

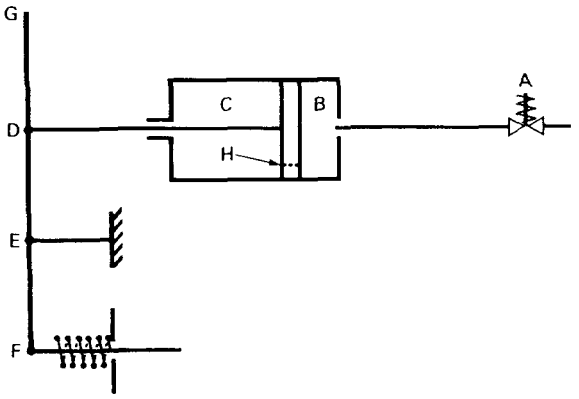

FIG. 5—DIAGRAMMATIC LAYOUT OF LINKAGE

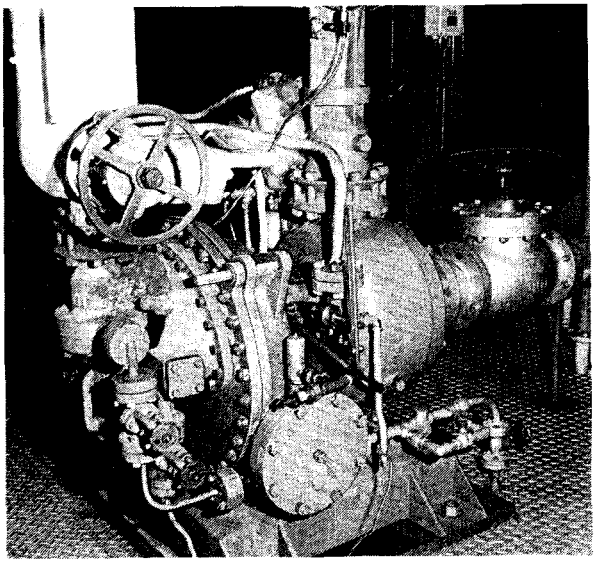

FIG. 6—SCUTT/TOMLIN TRIP FITTED TO TWL 35 FEED PUMP

Initial trials of the device on these machines proved very satisfactory, and so an extensive set of evaluation trials was initiated by D.G. Ships at *Sultan* to monitor peak pressures within the exhaust casing during pump operation. It was found during these trials that the stop valve was shut by the trip mechanism before the rising exhaust casing pressure was able to cause permanent distortion and subsequent damage to the turbine casing.

In parallel with the development of the Scutt-Tomlin device, another design had been produced by the manufacturers at D.G. Ships's behest to try to solve the problem. This was rather more complicated and it was agreed not to proceed with any development of it. The Scutt-Tomlin device is simple, easily fitted, and effective. Thirty of these units were ordered and fitted to pumps in service where they have performed very well.

Application has been made to patent the design of the Scutt-Tomlin trip and, in the meantime, Chief Petty Officers Scutt and Tomlin have each received an award of £1750 for their invention.