Lubrication of Paper Machine Bearings

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Introduction :

The importance of proper lubrication of paper machine bearings cannot be over-emphasised. Failure of a single bearing in the Dryer Section of a machine can cause loss of production, running into thousands of rupees. Paper machines are intended for non-stop operation. The design of a correct lubricating system for heavy, fast moving steam Dryers in a Paper machine poses many problems. The magnitude of the problem can be understood when we learn that there are as many as 350-400 points of lubrication in any one single modern machine.

Lubricant alleviates the friction between two moving surfaces. In Paper machine we come across all the three types of lubrication, namely :

Boundry lubrication ;

Complete lubrication ; and

Incomplete lubrication.

When two rubbing surfaces are separated by a very thin layer of lubricant, it is *Boundary Lubrication.* When the lubrication is arranged so that the rubbing surfaces are separated by a fluid film and the load on the surfaces is carried entirely by the hydro-dynamic and hydro-static pressure in the film, the lubrication is *Complete Lubrication.* When the load on the rubbing surfaces is partly carried by a fluid viscous film and partly by areas of Boundary Lubrication, it is known as *Incomplete Lubrication.*

Description of the Lubrication System :

The bearings of the Dryer Section of the Paper machines are unfortunately not accessible for convenient inspection. When the machines are running, the hot humid air under the hood, makes it practically impossible to carry out the inspection schedule. Since the Dryer Section bearings are lubricated by an automatic lubricating system, the safety of the Dryer Section bearings depends entirely upon the efficiency of the Automatic Lubricating System.

A description of the lubricating system at the West Coast will be representative of any lubricating system of a modern machine. Certain of the problems encountered by the West Coast Paper Mills during the last few years of operation might have been experienced by other mills as well. There are two Fourdrinier machines here. No. 1 machine is for the manufacture of Printing and Writing grade papers and No. 2 machine is an M. G. machine.

The lubrication system for each machine can be divided as follows :

Manual grease lubrication of the closed bearings of table rolls, wire and felt stretch and guide rolls. *(Incomplete Lubrication)*

Central Oil Lubrication system for the bearings in the Dryer Section and Calender Stacks. *(Boundary Lubrication)*

Central Oil Lubrication for the Drive Gears in the Dryer Section and Calender Stacks. *(Incomplete Lubrication)*

Mannual Oil Lubrication for the bearings of the central drive line shaft. *(Complete Lubrication)*

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Mannual Oil Lubrication for the Reduction Gears on the drive side of the machine. *(Incomplete Lubrication)*

Mannual Lubrication for miscellaneous items like Pumps, Fans, Agitators, Saveall chains, Felt conditioners, etc. *(Mixed type Lubrication)*

Before the annual overhauling of the machines in the month of August 1963, few bearing breakdowns were experienced on No. 1 machine. During the overhauling period when the bearings were opened out it was discovered that about fourteen bearings were completely damaged. It was, therefore, felt necessary to take an extensive survey of lubricating system in the machines and to device ways and means to minimise failure of bearings by faulty lubrication in future.

The details of the lubricating system are given below :

The Central Oil Lubrication system takes care of all those gears and bearings lubricated by oil in the Dryer Section and the Calender Stack. Each machine has a separate unit for the purpose. The unit for each of the machines works in two parts.

(a) Lubricating system for the Drive Gears.

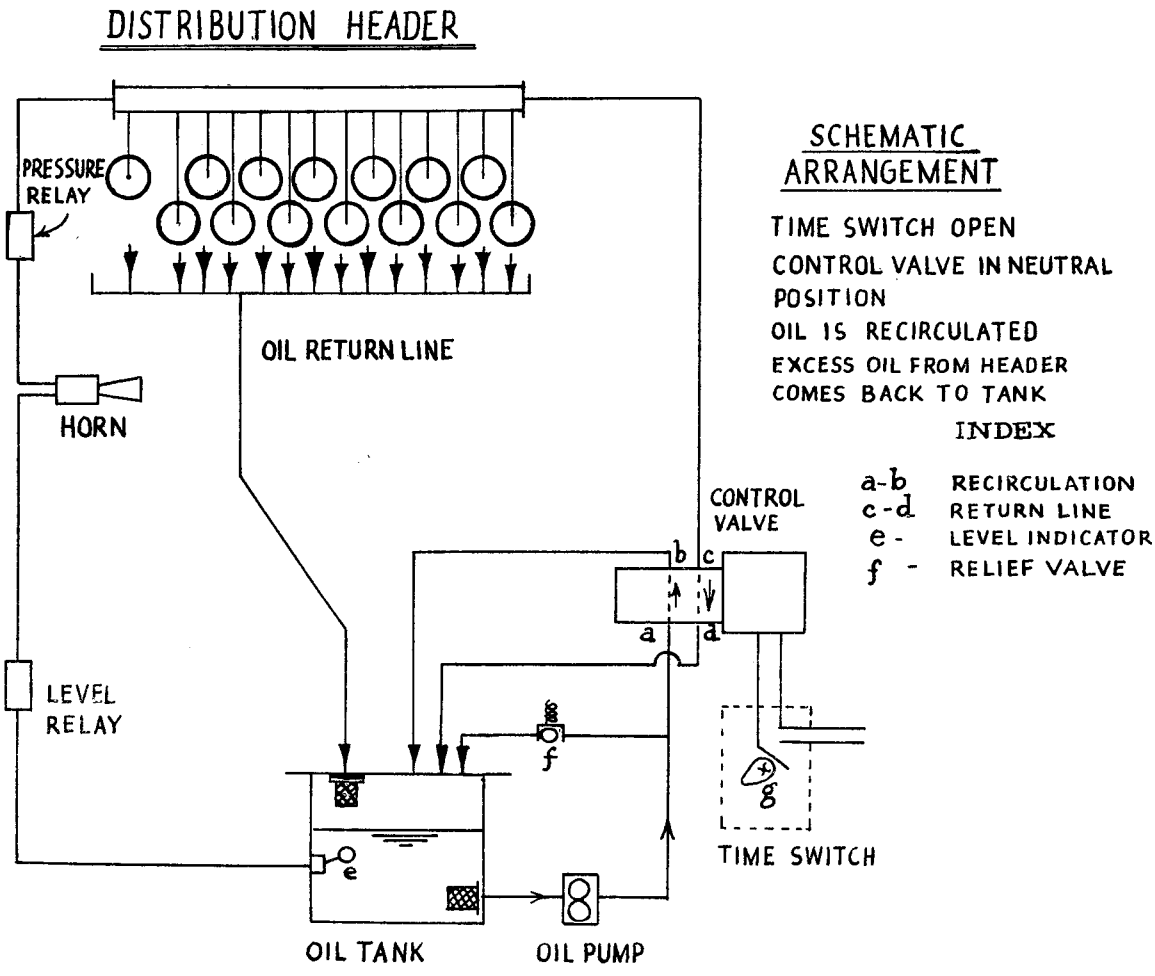
(b) Lubricating system for the bearings for the Dryer Section and Calender Stacks.

The Central Oil Lubrication system was supplied by Messrs. Robert Bosch, GmbH, Stuttgart, West Germany. It is located on the pavement below the machine operating floor. There is a main oil storage and receiving tank. A gear pump, located on the top of this tank, pumps the oil through an oil filter and a cooler. A pressure of 5 kg/cm 2 is maintained at the delivery of the pump. The filtered oil passes through a cooler. The cooler consists of a spiral coil surrounded by water. Mill water is admitted at the bottom of the cooler and hot water flowes out from the top of the cooling shell. The Cooled oil at 35°C goes for lubricating the Gears. After lubricating the Gears, the oil collects at the bottom of the Gear Casing and is returned to the tank. The returned oil has a temperature of 70°C. The lubricating oil going to the Gears serves two purposes, namely lubricating as well as cooling the Gears. Naturally, the oil returned from the Gears is at a higher temperature, that is why it is necessary to cool oil before being returned to the Gears again. The Gear lubrication is not complicated and is working without any trouble.

The bearings of the Dryer Section and Calender Stacks are lubricated by a continuous automatic lubrication system. By the side of the tank which supply oil to the Gears there is another small tank. This tank is located in such a way that oil can flow by gravity to this small tank and fill it up. The bigger tank has a sight glass indicating the level of oil in the tank. The oil for lubricating the Gears of the Dryer Section and Calender Stack is pumped from the smaller tank. A small gear pump supplies the oil for lubrication. At the suction of this pump, there is a strainer to filter the oil before it is fed to the bearings. This strainer is having a filter medium and a permanent magnet to filter the oil and to remove fine metal particles. On the delivery side of the pump there is a control valve controlled by a timer. The timer maintains alternatly a working cycle and neutral cycle for the control valve. In the working cycle, the control valve is operated in such a way that all the oil delivered by the pump goes through the lines into the metering valves. This cycle is for seven seconds. During this period, the pressure of oil in the delivery side rises as all the metering valves are closed and when the pressure comes to 26—28 kgs/cm2, the oil is circulated back into the tank through a bypass valve. After a working cycle of seven seconds, the control valve changes to its neutral position. In the neutral cycle the pump circulates the oil through the recirculation line. The pressure developed in the delivery line during the working cycle is relieved and the oil in the delivery line is

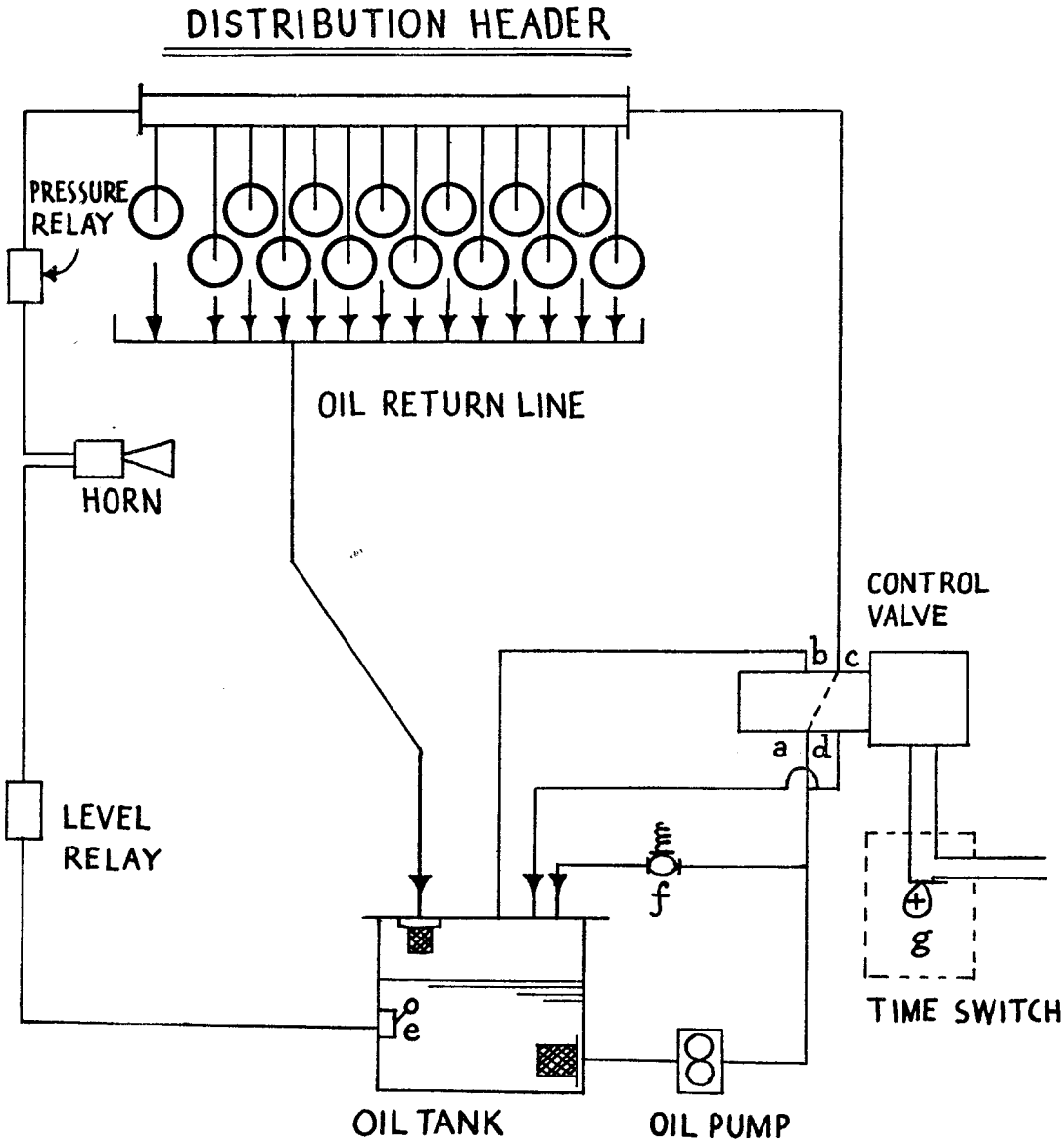
returned in the tank. When the pressure in the line is relieved, the metering valves open and the oil in the metering valves drops through the nozzles to the bearings. This relieving of pressure is necessary to recharge the metering valve at the end of a lubricating cycle.

The delivery line from the pump is a 3/8" line. This line branches into two, one going to the drive side and the other to the service side of the machine. Tappings are taken for lubricating the bearings from these two main headers. Each bearing has a separate tapping point. Each tapping consists of a metering valve and a dropper with a sight glass.



SCHEMATIC ARRANGEMENT

TIME SWITCH IN CLOSED POSITION
CONTROL VALVE IN WORKING POSITION
OIL IS DELIVERED TO SYSTEM



Investigation and Recommendations :

As a result of the survey held to study the system and to improve its working, it was observed that there were two major defects in the system.

1. Water was finding its way into the oil system contaminating the oil.
2. In No. 1 machine, the gear pump supplying oil to the bearings was not developing sufficient pressure to lubricate all the points. This was detected when the pressure gauge in the delivery line of the pump was replaced by a new one.

Right from the start-up of the machine it was suspected that water was getting into the oil system. Steam from the Dryers leaks into the Gear Casing and Bearing-housing and condenses in the oil system. Another source of water is the humid machine room air which leaks into the oil-return-line through the vents. Accumulation of water in the system was kept under check by occassionally draining water from the bottom of the receiving tank. Periodically the oil in circulation was centrifuged to separate out the emulsion formed with water. Water mixes with the oil to form emulsion, which in contact with air catalytically gets oxidised to acids. These acids cause corrosion and it deposits sludge and gum-like material which is formed as a result of the degradation of the oil.

In No. 1 machine the oil pump was not developing sufficient pressure. On inspection, the pump was found all right. The timer and working of the control valves were checked. Because the machine was shut for overhauling the sight glasses inside the hood could also be observed. During the working cycle of the control valve no oil is supposed to be going to the bearings through the metering valves. But it was observed that the oil was flowing through quite a few metering valves during the working cycle of the control valve. Because of this leakage through certain metering valves, the pressure of oil in delivery line was not building up and as a result the other metering valves did not get sufficient oil for proper lubrication of the bearings. Improper lubrication combined with emulsion formation resulted in the damage of good number of bearings. A number of metering valves were, therefore, changed. Now the pressure in the oil line remains at 20 kg/cm^2. It is proposed to replace the remaining few damaged metering valves with the new ones.

A detailed method of checking up the lubrication system is now strictly followed and after more than a year's operation the bearings have not given any trouble. It is felt that the failures due to poor lubrication are now minimised.

The following details are observed and strictly checked up on a routine basis :

1. Pressure developed by the oil pump is recorded daily.
2. Working of the timer and control valve is checked for the cycles of working everyday. Any variation from the set cycle is immediately attended to.
3. Routine check-up of the number of drops of oil going through the metering valves is regularly done. This can be seen through the sight glass. The performance of the metering valves in the closed hood cannot be inspected when the machine is running. It has been decided to alter the position of the metering valves in the hood and locate them outside the hood so that their working can be observed when the machine is working.
4. Periodically oil from the bearing houses on the tender side is collected for examination and test. The oil is tested for

colour, sludge separation and water content. The water in the oil is estimated by centrifuging the oil sample in the Laboratory Centrifuge. If the percentage of water in the oil is more than 0.1% the oil in circulation in the lubricating system is centrifuged till the water content comes to 0.1 percent.

As a result of the investigation, the operating as well as maintenance crew of the West Coast have become more alert than before to see that the proper lubrication is maintained throughout. Saving in down-time due to failures of Paper machine bearings, etc. have resulted in contributing to the increased production of the mill. It is felt that if a proper Lubrication Schedule and Inspection is carried out, the country can save valuable foreign exchange for importing different types of bearings and equipments.