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MODIFICATION OF OIL CONTROL VALVE IN SCOTT AND WILLIAMS P-9 PULSATOR DRIVE

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SUMMARY

During operation the feed pump systems of the HRT core and blanket produce excess noise, shock and vibration. These feed pumps are driven by Scott and Williams P-9 pulsators which use an oil control valve that vents high pressure oil (2000 psi) to atmospheric pressure in 0.02 secs. Electrical analog studies indicated that the operating characteristics would be improved by increasing the venting time to 0.1 sec. A tapered section was added to the lands on the oil control valve spool which opens the oil inlet and exhaust ports, and resulted in considerable reduction of the shock, noise, and vibration, in an experimental system. This change is recommended for the HRT pumps.

INTRODUCTION AND PROCEDURE

The feed pumps of the HRT are driven by Scott and Williams P-9 pulsator units. During operation the feed systems are very noisy and subjected to considerable shock and vibration as a result of rapid acceleration and decelerations of the three fluids involved. Electrical analog studies indicated that increasing the venting time of the oil from the pulsators from 0.02 sec. to 0.1 sec. would improve the operation. This, in turn, would add to the life of the system's components.

To accomplish this, it was decided to modify the oil control valve. The modifications, which produced the best results and involved the least machining deviation from the standard valve, was an increase in the length of the lands on the valve spool which open the oil inlet and exhaust ports with a 5° taper on this added length. The venting time is 0.06 sec.

Comparison of the various modifications was carried out in the Pulsafeeder Loop No. 2.

Following are sketches and descriptions of the various modifications tried.

DISCUSSION OF RESULTS

Numerical values are not available for comparing the noise, shock and vibration; however, the effect of the modified spool on the pressure variations in the system can be seen in Fig. 5. The remaining roughness in operation while small in comparison to that in the standard valve is undesirable. This probably occurs at the time oil ceases to flow into one pulsator and begins to flow into the other.

CONCLUSION

Due to the difference in the volumes of the Pulsafeeder Loop No. 2 and the HRT core and blanket high pressure systems, changes in the operating characteristics resulting from a modification of the oil control valve will not necessarily be exactly the same. However, on the basis of the improvement in the operation of the experimental system, it is recommended that spools incorporating the modification described here be installed in the HRT feed pump drives.

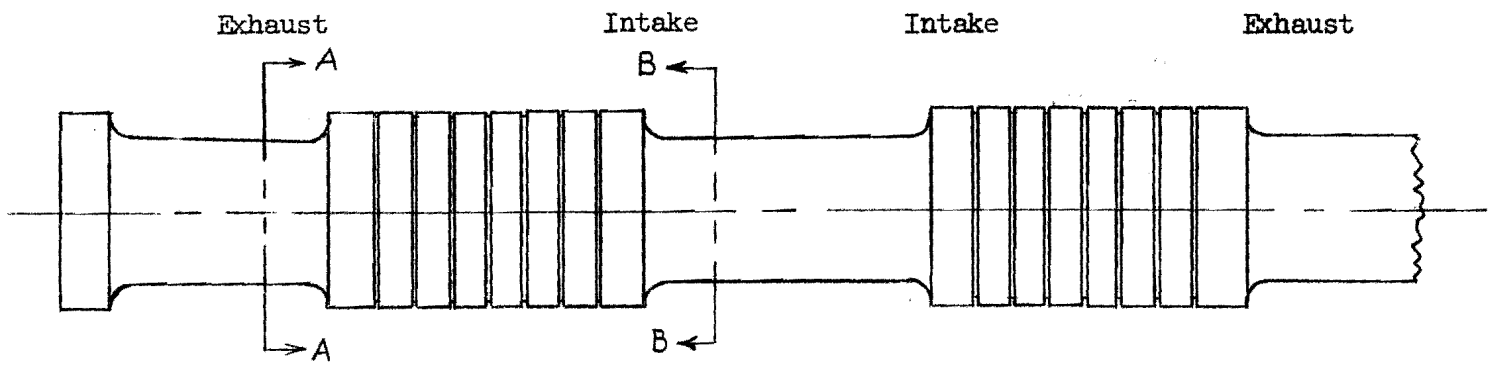


Figure 1
Standard Oil Control Valve Spool

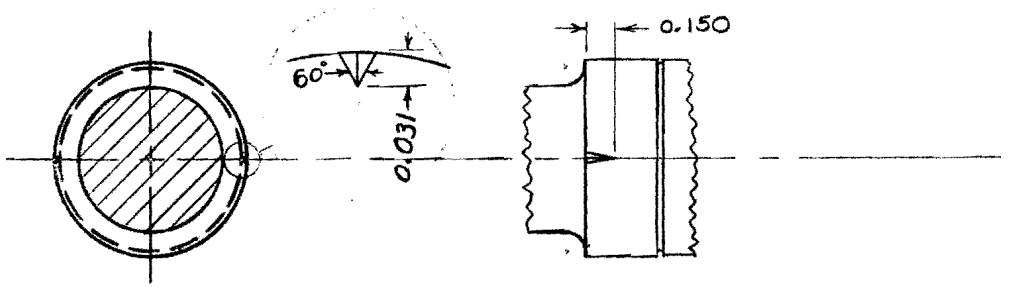


Figure 2
Exhaust Section A-A With Modification No. 1

The pump was originally operated with the standard valve spool shown in Figure 1.

The first modification, shown in Figure 2, consisted of two small notches at 180°. The mating body was machined to contain a circumferential groove 1/4-in. wide and 1/16-in. deep to insure mating of the notches with the six exhaust ports in the body.

Modification No. 2 was to increase the size of the original notches by grinding.

Modification No. 3 was an addition of two more notches 90° from the originals.

The performance with the above spool modifications was also checked in the standard body. None of the above changes made an appreciable difference in the noise level of the pump.

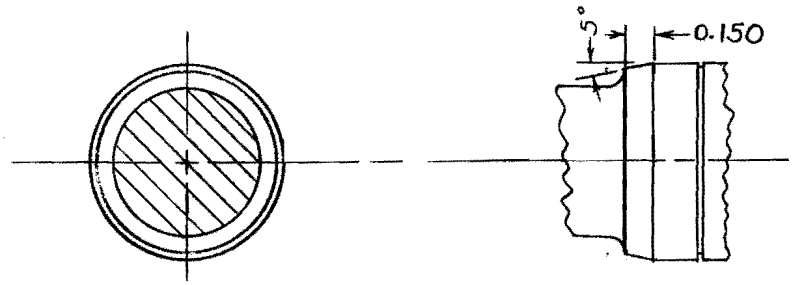


Figure 3
Exhaust Section A-A With Modification No. 4

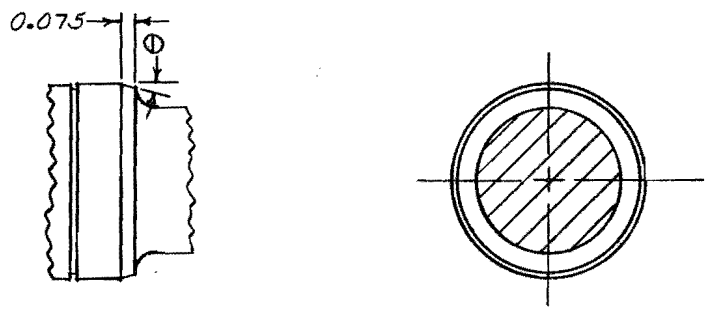


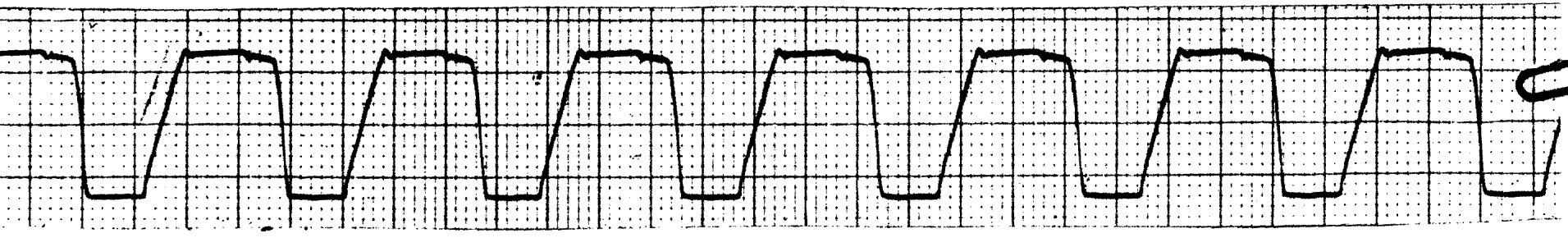
Figure 4
Intake Section B-B With Modification No. 5

The fourth modification consisted of a taper instead of notches, shown in Figure 3, which uncovers the exhaust ports gradually. The pump operated more quietly.

In the fifth modification, Figure 4, a taper was machined in the intake land of the spool as well as the exhaust. Two angles, 2° and 5°, were tried. Audibly, there was little difference in using modification No. 4 only or a combination of No. 4 and No. 5. However, a smoother pressure vs. time tracing is produced by using both modifications.

HRT FEED PUMP S & W DRIVE PRESSURE VS. TIME

STANDARD SLIDE VALVE SPOOL



DOUBLE TAPER SPOOL

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