

ABSTRACT

Andruch III, John P. M.S.A.B.E., Purdue University, December 2010. The Development, Modeling, and Testing of a Hydraulic Topography with Integrated Energy Recovery (TIER). Major Professor: John H. Lumkes Jr.

Current state-of-the art hydraulic systems suffer from poor efficiencies. A significant portion of these losses is due to the power loss across metering valves. Current research trends in hydraulics have been moving in two separate directions. The first movement is towards a displacement control system, while the second movement has been towards independent metering valve systems. The system, called a topography with integrated energy recovery (TIER), is a hybrid of these two types of systems. TIER offers to improve the advantages of these systems, while at the same time minimizing their weaknesses. This research expanded on the earlier TIER research and allows for energy recovery over a wider range of operating points. The enlargement of the operating space was accomplished with an additional variable displacement unit. This unit also expands the number of operating modes from four to 26. These modes were tested for validity via simulations with actual velocity and load data collected from a test fixture. Also, the foundation of a real time control system are explained, while some of the components of this system were tested. The results indicated that all of the 26 operating modes were valid and feasible, while some of the techniques of the control system need further refinement. The simulations suggest at power improvements with lower required pressures while doing the same amount of work.