THE NEW DECISION FOR PNEUMATIC-HYDRAULIC (FLUIDIC) AMPLIFIER AND ITS USE IN VARIOUS HYDRAULIC DRIVES

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The operational reliability and accuracy of hydraulic drives for different machines and mechanisms is determined by the type of device used for interfacing powerful executing hydraulic linear or rotating motors with the relevant governing pneumatic or electronic-pneumatic processors. Interface Transducers (IT), which presently are in common use for this purpose, are comprised of movable mechanical parts whose operation in the running liquid generates disturbances throughout the circuitries of the automatic control and steering systems.

Those disturbances are caused by phenomena occurring among movable mechanical parts. These phenomena are as follows: dry friction, backlash, magneto-mechanical and hydro-mechanical hysteresis of the elastic mechanical parts, and vibration due to the impact between the mechanical parts or by the liquid flow turbulences.

The new Jet-Stream Pneumatic-Hydraulic Amplifier-Converter (**JPHA**) is designed to replace Interface Transducers in order to eliminate the disturbances described above. The **JPHA** converts a weak input pneumatic signal into a powerful output hydraulic signal where the executing gas is in direct contact with the side surfaces of the plane high-speed liquid jet. No mechanical parts are involved in such input signal converting.

The distinct design of the jet flow in the **JPHA** allows for the insertion of this device into the by-pass pipes of the hydraulic drive. This feature offers the following benefits: 1) Installation on an auxiliary source of hydraulic power is not required; and 2) Only a small expense is required to up-grade an existing high-pressure hydraulic system (up to 40 MPa).

Other proven advantages of the **JPHA** follow:

- The possibility to fulfill the operational functions of trigger and repeater;
- Small ($\leq \pi/4$) and stable output/input phase shift at a frequency up to 50 Hz;
- Capability to operate in pulse mode with a pass band up to 25 pulses per second;
- More than .95 pressure recovery coefficient;
- Maximum consumption of working liquid is 1.0 gallon per minute, thereby preventing the liquid from overheating;
- Fine filtering of the liquid is not required;
- Steady repeatability of output signals;
- Simplicity of setting up predetermined parameters;
- The input pneumatic signal may be produced either by the pneumatic processor or by the electronic processor comprising the electro-pneumatic micro transducer;
- Can operate in either analog or digital mode.

The prototype of a two-stage Jet-and-Valve Amplifier (JVA) for a hydraulic control system of high load trailers was designed as in order to test the JPHA. Full-scale testing revealed a short time response and high operating stability of the JPHA, namely 1) time for valve resetting in the pulse mode was not more than 0.05 seconds; and 2) time delay, as well as positioning hysteresis of the valve, did not register.

The results of the experimental tests of hydraulic drive samples, carrying the **JPHA** inside, indicate the possibility to designate their application scope as follows:

- Industrial robots;
- Casting, milling, forging and pressing equipment operating in specific conditions of high temperature, contaminated air, and vibrations under load;
- Large dimension metalworking equipment gear boxes where it seems to be economically profitable to feed the power input of **JPHA** with the liquid from their oil lubricating systems;
- Automated hydraulic drives for the wheel or track trailers and other vehicles;
- Hydraulic steering or other control drives in water and air vehicles, where it is economically advantageous to feed the power input of **JPHA** with liquid from the vehicular spent fuel system;
- Automated distributing devices for liquid products in petrochemical and food industries;
- Liquid loading level regulators for gas, oil and chemical industries;
- Programmed loading test benches for fatigue trials onto the carrying structures of aircrafts or other structures.

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