required. A manganin sensor, shown below has been developed in which either the manganin coil is exposed to the test fluid, or alternatively it is housed in a flexible bellows subjected to the pressure and contains a fluid which is compatible with the coil and the electrical seals, and which is not electrically conductive.

This sensor can be used with a direct-reading bridge specially developed for the purpose. Alternatively it can be used with a potentiometric indicator/controller, or the output can be presented in a digital form.

The manganin sensor, if calibrated against a deadweight pressure tester, can form a good secondary standard, but there are problems of temperature stability even with the most carefully selected manganin wire. If the pressure is raised or lowered rapidly the gauge could be in error.

However an alternative wire with much better temperature coefficient of resistance change has recently been developed which overcomes this problem, and can be used as a control element. Alternatively a temperature compensated strain gauge transducer has been developed which can also be used for control.

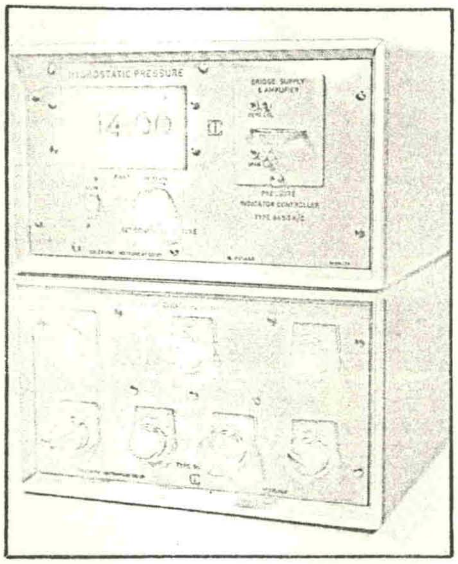
Automatic. The high-pressure components have been built up into an automatic intensifier set. The layout is shown diagrammatically below.

Low pressure oil, at $70\ MN/m^2$ (10 000 lbf/in^2) is provided by a pumping set such as the Enerpac motorized pump or a Towler Brothers set, which is connected to the intensifier by a flexible high-pressure hose.

The pump delivers through a solenoid-operated valve to the low-pressure end of the intensifier. If the desired or set pressure is not achieved in a single stroke, the tell-tale attached to the intensifier piston operates a microswitch which controls the solenoid operated changeover valve.

This connects the pump to the inlet valve of the high-pressure end of the intensifier, if necessary through a transfer cylinder if the high and low pressure fluids are different. At the same time the low-pressure end of the intensifier is connected through the changeover valve to reservoir. When the intensifier is recharged the tell-tale operates a second microswitch which resets the solenoid operated valve.

Digital pressure indicator/controller with electrical control unit



When the preset pressure has been reached the high pressure sensor switches off the pump motor via the digital controller. Alternatively, control can be achieved by using a low-pressure gauge on the pump, calibrated against the high-pressure output and equipped with electrical contacts to switch off the motor. Yet another alternative is to have a pressure control valve in the low-pressure circuit set to give the desired high pressure.

Safety valve. A safety valve is provided in the low-pressure circuit close to the intensifier in case the inlet ball valve should fail, and also to ensure that the low-pressure pumping set cannot be overloaded. A remote-action or manually-controlled spill valve is provided in the high-pressure system.

The high-pressure connexion to the intensifier set is through a cross piece, and it is possible to bring the connecting tube out of the set in any one of three directions which are at right angles to each other.

It is also possible to use pneumatics to control the intensifier and such a system has, in fact, been designed.

In addition to this intensifier system various items of high pressure equipment such as viscometers, a thick-walled cylinder creep machine, compression tester for rock samples, and a torsion machine have been developed and can be used in conjunction with the intensifier.

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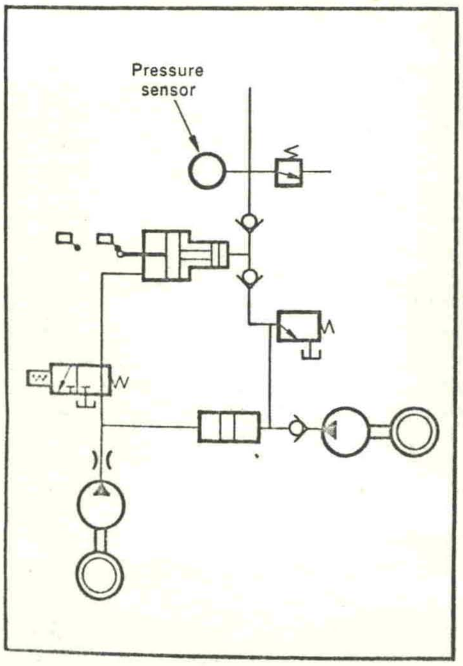
Diagrammatic layout of complete unit



Manganin pressure sensor