Mission and vision of the Department

Vision of Mechanical Department

To establish the state of the art learning center in Mechanical Engineering which will impart global competence, enterprising skills, professional attitude and human values in the student.

Mission of Mechanical Department

1. To impart quality technical education to the students.
2. To develop comprehensive competence in the students through various modes of learning.
3. To enable students for higher studies and competitive examinations.
4. To facilitate students and industry professionals for continuous improvement and innovation.

Program Educational Objectives:

[1] Use core competence acquired in various areas of Mechanical Engineering to solve techno-managerial issues for creating innovative products that lead to better livelihoods & economy of resources.

[2] To establish themselves as effective collaborators and innovators to address technical, managerial and social challenges.

[3]To equip students for their professional development through lifelong learning and career advancement along with organizational growth.

[4] Serve as a driving force for proactive change in industry, society and nation.

PROGRAM SPECIFIC OUTCOMES

Student should have

1) An ability to work professionally in mechanical systems including design, analysis, production, measurement and quality control.

2) An ability to work on diverse disciplinary tasks including manufacturing, materials, thermal, automobile, robotics, mechatronics, engineering software tools, automation and computational fluid dynamics.

Laboratory Manual

INDUSTRIAL HYDRAULICS & PNEUMATICS

For

Third year Students of

Mechanical Engineering

02,Dec 2003- rev 00 – Comp Sc – ISO 9000 Tech Document

FOREWORD

As a student, many of you may be wondering with some of the questions in your mind regarding the subject and exactly what has been tried is to answer through this manual.

As you may be aware that MGM has already been awarded with ISO 9000 certification and it is our endure to technically equip our students taking the advantage of the procedural aspects of ISO 9000 certification.

Faculty members are also advised that covering these aspects in initial stage itself, will greatly relived them in future as much of the load will be taken care by the enthusiasm energies of the students once they are conceptually clear.

Dr.S.D.Deshmukh
Principal

This manual is intended for the third year students of Mechanical Engg. in the subject Industrial Hydraulics & Pneumatics. Manual typically contains practical/ Lab sessions related to basic hydraulic & pneumatic circuits that can be applied for wide range of industrial applications involving fluid power.

A number of circuits are used frequently in fluid power systems to perform useful functions. For example, metering circuits offer precise control of actuator speed without a lot of complicated electronics, decompression circuits reduce pressure surges within a hydraulic system by controlling the release of stored fluid energy, and pump-unloading and regenerative circuits make a system more energy efficient. Other circuits are designed for safety, sequencing of operations, and for controlling force, torque, and position. Still other circuits may enhance the application of specific components, such as pumps, motors, accumulators, filters, and airline lubricators. The circuits appearing on the following pages are provided as a resource of general ideas.

Students are advised to thoroughly go through this manual rather than only topics mentioned in the syllabus as practical aspects are the key to understanding and conceptual visualization of theoretical aspects covered in the books.

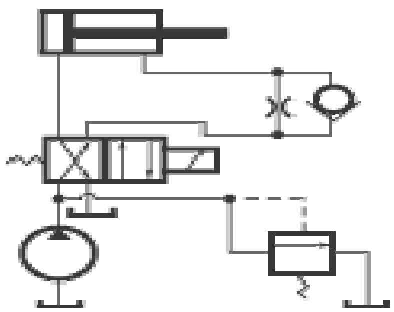
Good luck for your enjoyable laboratory sessions.

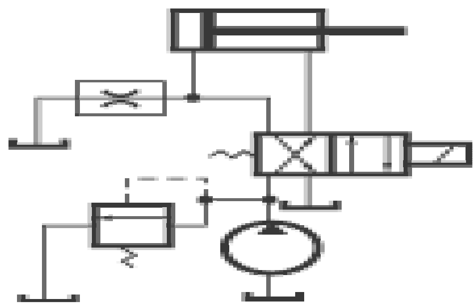
INDEX

EXPERIMENT NO.01

Study of Speed Control Circuit on Hydraulic Trainer

Speed control during a work stroke can be accomplished by regulating flow *to* the cylinder. The check valve allows free reverse flow when the cylinder retracts. It normally gives finer speed control than a meter-out circuit. Regulating flow *from* the cylinder is another way to control speed. This circuit maintains a constant backpressure during rod extension and prevents lunging if the load drops quickly or reverses.

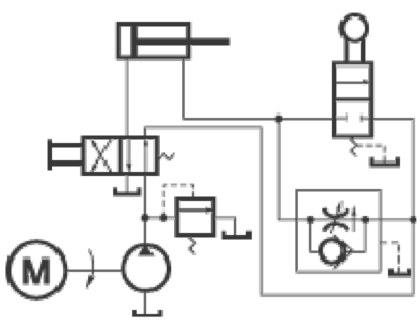


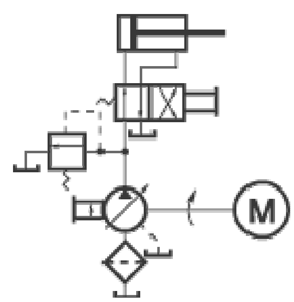


Bleed-off circuit
Flow to the cylinder is regulated by metering part of the pump flow to tank. This circuit is more efficient than meter-in or meter-out, as pump output is only high enough to overcome resistance. However, it does not compensate for pump slip.

Variable-volume pump

Pump flow can be controlled by various means such as manual, electric motor, hydraulic, or mechanical. How closely flow output actually matches command depends, in part, on slip, which increases with load. With a pressure-compensated, variable-volume pump, output flow decreases with the increasing pressure. This type of pump can be used for traverse and clamp operations. An external relief valve is usually unnecessary when a pressure-compensated pump is used.





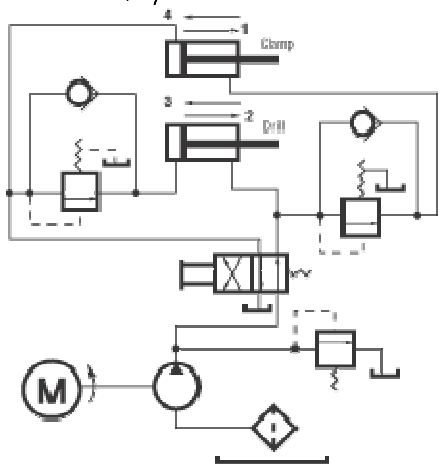
Variable feed
Many machines require intermittent fast and slow feed during their cycles. This can be accomplished by having a cam-operated 2-way valve in parallel with a meter-out flow control valve. Rapid forward movement takes place any time the 2-way valve is open. Closing off the valve slows down cylinder speed. Properly positioning the cams obtains the required speeds in sequence. The check valve in parallel with the flow control permits free return flow, allowing the cylinder rod to return rapidly.

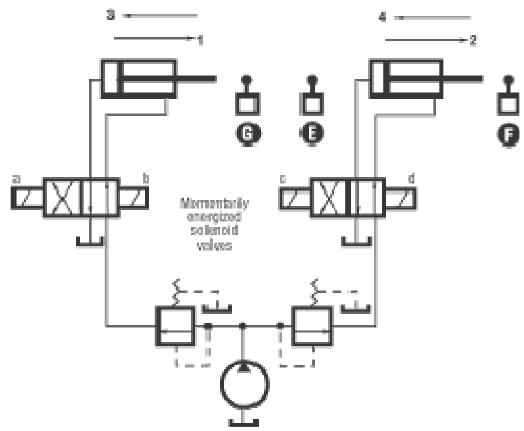
EXPERIMENT NO.02

Study of Sequencing Circuit on Hydraulic Trainer

Sequence valves

Cylinders may be sequenced by restricting flow to one cylinder. One method of restricting flow is with backpressure check valves. They prevent flow until a set pressure is reached. In this circuit, cylinder 1 extends and retracts ahead of cylinder 2.





Several cylinders can be connected to move in sequence on forward and return strokes. In this circuit, a clamp must close before a drill descends. On the return stroke, the drill must pull out of the work before the clamp opens. The sequence valves are arranged to cause pressure buildup when one cylinder completes its stroke, the valve opens to allow flow to the other cylinder.

Electrical control

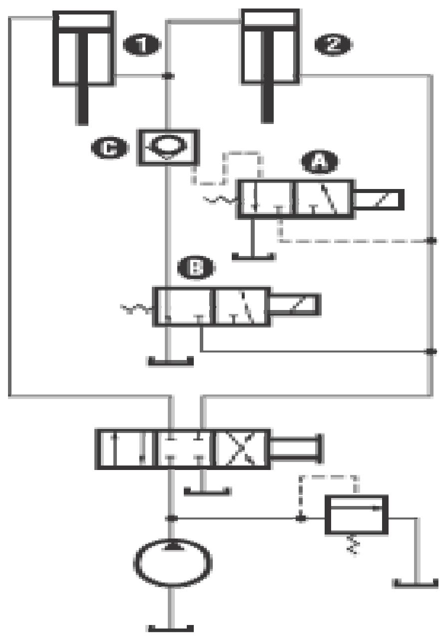
Limit switches momentarily actuated by the cylinders control the solenoid valves to sequence this circuit. Solenoid a is energized by a pushbutton to initiate movement 1. At the completion of movement 1, limit switch E is actuated to energize solenoid c, initiating movement 2. At the end of movement 2, limit switch F is actuated to energize solenoid b, initiating movement 3. At the end of this movement, limit switch G is actuated to energize solenoid d, initiating movement 4. The sequence valves prevent a pressure drop in either cylinder while the other operates.

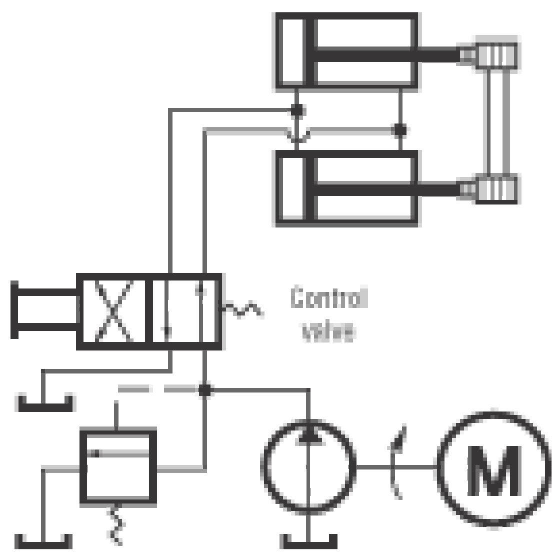
EXPERIMENT NO.03

Study of Synchronizing Circuit on Hydraulic Trainer

An effective flow divider can be made up of two fluid motors of the same size coupled together. Both motors must rotate at the same speed and, therefore, deliver equal volumes of fluid. Variations in load or friction do not greatly affect synchronization, but motor slip is a factor.

One of the considerations in synchronizing cylinders is leakage replacement. Under normal pressure, leakage can be practically zero over one stroke. Accumulated error is the main concern. A replenishing circuit, which replaces leakage after each cylinder stroke, eliminates this trend. In the circuit, the cylinders are connected in series and controlled by the 4-way manual valve. The cylinders actuate limit switches, which control valves A and B. On the return stroke, if cylinder 1 bottoms first, valve A is actuated to open valve C, permitting excess fluid from cylinder 2 to flow to tank. If cylinder 2's piston returns first, valve B is actuated to direct fluid to retract cylinder 1.





Rack and pinion
Mechanically tying two cylinders together by installing a rack on each piston rod and fastening the pinions to a single shaft works well when the linkage is rigid and the mesh is proper. A chain and sprocket arrangement can be used if synchronized motion is required in only one direction.

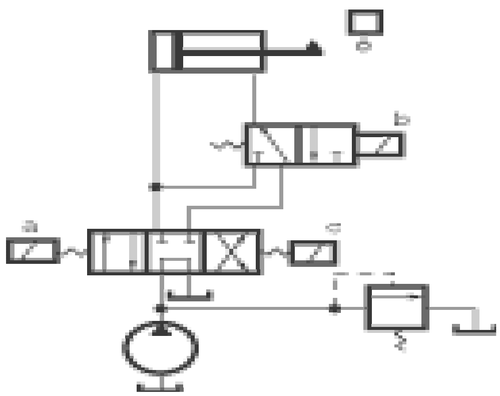
EXPERIMENT NO.04

Study of Regenerative Circuit on Hydraulic Trainer

Rapid rod extension can be achieved by returning the flow of oil from a cylinder's head end back into its cap end. With no load, pressure in both head and cap ends is equal, so when the load is encountered, available working force depends on the differential area

Combining the rapid extension of Circuit 1 with full force in response to an applied load takes full advantage of a regenerative circuit. This circuit produces a rapid approach stroke of the piston. When the rod encounters resistance (workpiece load), pressure rises on the cap end to open the sequence valve and allow oil from the head end to flow to tank through the 4-way valve. Once this occurs, full effective force on the workpiece becomes available.

Instead of a sequence and built-in check, an orifice and check are used. There is some backpressure remaining in the cylinder's head end because of the orifice resistance during final squeeze. But with the cylinder extended, no fluid flows across the orifice, so total available force acts on the cap end. Whether or not this circuit is appropriate for a given application depends on working force requirements.



When electrical control is desired, a limit or proximity switch can be used to activate and de-activate a regenerative circuit. In the circuit shown, energizing solenoids *a* and *b* extends the cylinder in a differential circuit. The limit switch de-energizes solenoid *b*, directing cylinder discharge fluid to tank.

EXPERIMENT NO.05

Study of Counterbalancing Circuit on Hydraulic Trainer

Some actuators with running-away (or overrunning) loads will let the load free fall when the directional valve that controls the actuator shifts to lower the load. Cylinders with large platens and tooling or hydraulic motors on winch drives are two examples of such actuators. When the directional valve shifts, an overrunning load forces the actuator to move faster than pump flow can fill it. Oil at high velocity leaves one end while the opposite side starves for fluid. A vacuum void forms in the inlet side of the actuator that must be filled before applying force. Any running-away or overrunning load needs some method to retard its movement.

A meter-out flow control is one way to control a running-away load at a constant speed. Unless pump flow never changes, setting flow precisely on this type control is critical. Setting the flow control for minimum pump flow will waste energy when pump flow is high. Setting the flow control for maximum pump flow lets the cylinder run ahead when pump flow is low. Incorporating a pressure control valve called a *counterbalance* is a better way to control running-away loads. A counterbalance keeps an actuator from running away even with variable flow rates.

Figure1 shows the symbol for an internally piloted counterbalance valve. Use an internally piloted counterbalance to hold a load back when the actuator does not need full power at the end of stroke. This type of counterbalance valve retards flow continuously, so it resists flow even after work contact stops the actuator. Note that it is necessary to adjust an internally piloted counterbalance valve every time the load changes. The following circuits show these characteristics and how to design around them. Figure 2 shows the symbol for an externally piloted counterbalance valve. This valve's pilot supply is from a source other than the controlled load. An externally piloted counterbalance does not waste energy at the end of stroke and does not require adjustment for changing loads. However, an externally piloted counterbalance valve does waste a little more energy when moving the load to the work.

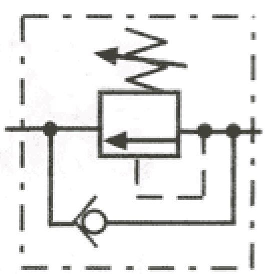


Fig.1Internally piloted counterbalance valve

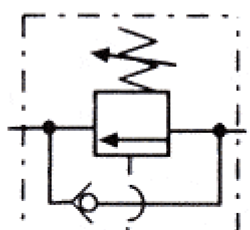
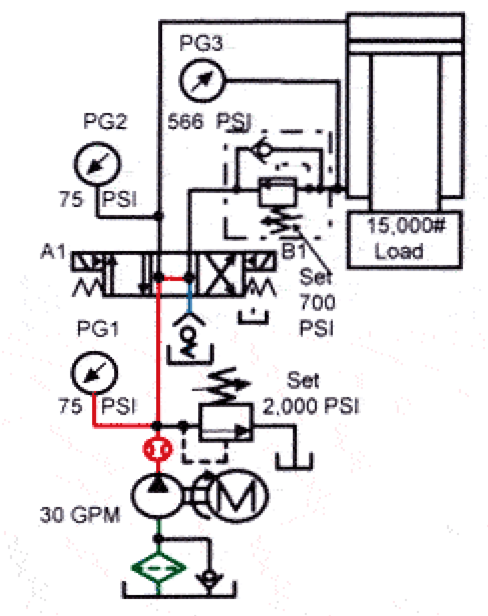


Fig.2 Externally piloted counterbalance valve

Internally piloted counterbalance valve

Figure 3 pictures a circuit with a running-away load. This circuit demonstrates the operation of an internally piloted counterbalance valve. The cylinder has a static pressure of 566 psi in the rod end due to the 15,000-lb load on the 26.51- in.2 area. (15,000 / 26.51 = 566 psi). An open-center directional valve unloads the pump and keeps backpressure off the counterbalance valve outlet and pilot port. The cylinder holds in any position if the counterbalance valve is set correctly and does not leak. Set the counterbalance approximately 100 to 150 psi higher than the load- induced pressure.

Fig.4 Internally piloted counterbalance valve with cylinder extending



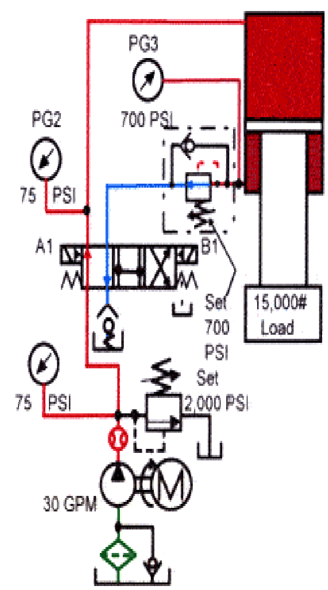


Fig.3 Internally piloted counterbalance valve at rest with pump running

Normal procedure for setting a counterbalance valve is to turn the adjusting screw to its highest pressure before raising the cylinder. After starting the pump, energize the directional valve and carefully raise the load a short distance. With the load suspended, deenergize the directional valve. A working counterbalance will hold the load suspended and gauge *PG3* will show the load-induced pressure. Now start lowering the counterbalance pressure setting slowly. When the cylinder begins to creep downward, increase the pressure until creeping stops. Then continue turning the adjusting control in the same direction another to turn. After setting the counterbalance this way, power the cylinder down and notice the pressure reading on gauge *PG3*. Pressure should be approximately 700 to 750 psi. Any time the cylinder loading changes, repeat the above process. Resetting the counterbalance valve keeps the cylinder from running away and reduces energy loss with a lighter load.

When the directional valve shifts to extend the cylinder in Fig.4, oil from the pump flows into the cap end of the cylinder and pressure starts to build. When pressure in the cap end of the cylinder reaches about 75 psi, the cylinder should start to stroke. (This is because it builds an extra 140 psi in the rod end, adding to the load's 566 psi.) At this point the cylinder starts to extend and continues to move as long as the pump supplies oil at 75 psi or higher to the cylinder cap end. If pump flow changes, cylinder speed changes also.

EXPERIMENT NO.06

Study of ANS/ ISO Fluid Power Symbols

Assignment based on following points: -

01) Introduction about ANS/ISO fluid power symbols

02) Tabulation of graphic symbols of various fluid power components

03) Representation of composite symbols involving logic gates using fluid power components

EXPERIMENT NO.07

Visit Report for Demonstration of Fluid Power Circuit

Students are expected to submit a report based on demonstration of fluid power circuits in an industrial establishment.

The report should comprise of brief information about the industry visited, fluid power set-up demonstrated and the various circuits studied with applications.