ALAN HITCHCOX | Editor

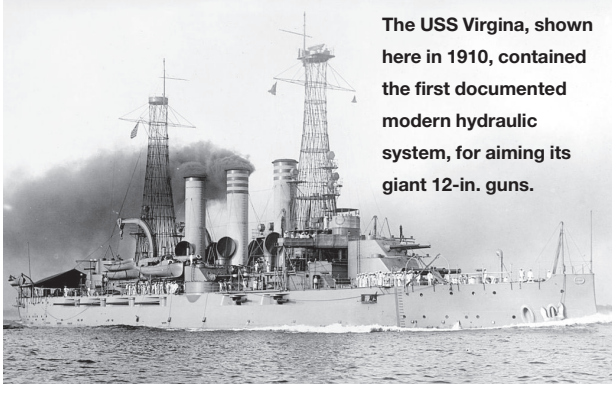
Fluid Power Through the Years

Many aspects of fluid power and design practices have changed dramatically since our first issue was published. But one thing that hasn't is the need for this durable and reliable form of power transmission that still provides unmatched power density.

It goes without saying that much has changed since February 1948. The transistor was successfully demonstrated at Bell Laboratories only two months earlier. Until then, electronic controls consisted of vacuum tubes, mechanical switches, and similar devices that were large, often delicate, and often unsuitable for industrial applications.

Although larger and heavier, hydraulic logic controls were more rugged and reliable (if fluid was kept clean), so many machines—especially machine tools—relied heavily on hydraulics not only for power, but for control. Both methods, however, required skillful technicians for troubleshooting and repair, both lengthy processes that often resulted in substantial machine downtime.

Of course, fluid power technology did not start with the first issue of *Applied Hydraulics* (the original name of *Hydraulics & Pneumatics*). We described the first documented application of "modern" hydraulics in our October 1971 issue:



The USS Virgina, shown here in 1910, contained the first documented modern hydraulic system, for aiming its giant 12-in. guns.

"Waterbury Tool, founded in 1898, produced the first workable hydraulic power drive on 1903, later known as the Waterbury transmission. The first installation of this new equipment occurred in 1906 and was used to train and elevate the big guns of the battleship USS Virginia. In 1940, Waterbury Tool became a division of Vickers Inc. Sperry Corp., which owned Vickers, then merged with Remington Rand, to become Sperry Rand."

Vickers was acquired by Libbey Owens Ford in 1984, which later became Trinova, and was sold to Eaton Corp. in 1999.

BECOMING A FORUM FOR TECHNOLOGY

Any subscriber to *Hydraulics & Pneumatics* knows that the overwhelming majority of our coverage is all technical aspects of fluid power. Most of our material comes from experts in the field. Long before the internet, email, or smart phones existed, *H&P* became an important forum for sharing ideas—and it still is. *H&P* provided a communication vehicle to help industry professionals form the National Fluid Power Association, the Fluid Power Society, and other organizations.

The magazine also provided a means for subscribers to share ideas, both for learning technology basics and for learning different problem-solving techniques. One of these vehicles was our "Circuits of the Month" department. In this section, readers would write in to describe a circuit they designed for accomplishing a specific task. Once the circuit was published, other readers wrote in to comment on the circuit and suggest other ways the same task could be accomplished or how the circuit could be modified to perform some other task.

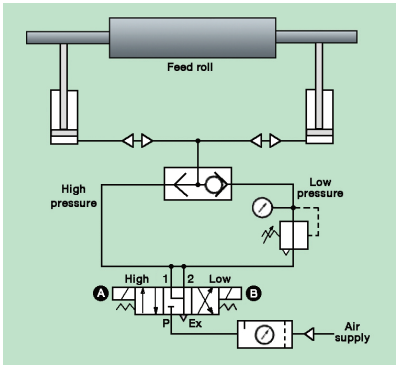
The following example is from the October 1983 issue, where three readers submitted to a submission published in the March 1983 issue.

(Continued on page 34)

(Continued from page 24)

COUNTERBALANCE CIRCUIT CONTROLS "WEIGHT" OF FEED ROLL

The feed roll-positioning and weight-control circuit illustrated here is used in a paper-making machine. The circuit positions the feed roll quickly and varies the roll weight that presses on the paper strip being manufactured.



When solenoid *A* is energized, high-pressure air flows through the solenoid and shuttle valves to extend the two air cylinders, lifting the feed roll off the paper. When solenoid *B* is energized, high-pressure air momentarily exhausts through port *1*. Low-pressure air then shifts the shuttle valve, allowing low-pressure air to enter the air cylinders.

The self-relieving air regulator valve is adjusted so the low air pressure does not quite counterbalance the weight of the feed roll. The air cylinders retract slowly because of the non-counterbalanced weight of the roll. Even when the cylinders are almost completely retracted, the full weight of the feed roll does not act on the paper; part of the roll weight remains counterbalanced.

The amount of roll weight that the machine operator counterbalances varies with the width of the paper strip being manufactured; a wide strip of paper requires greater roll-weight force (less weight counterbalance) than a narrow strip does. Without the counterbalancing force, the full weight of the roll would crush the paper.

When both solenoids are de-energized, the solenoid valve centers; ports *1* and *2* are connected to exhaust, and port *P* is blocked. The feed roll is down, is not counterbalanced, and its full weight acts on the machine.

Submitted by Robert Ramsfelder, Engineering Group Leader—Product Support Group, S & S Corrugated Paper Machinery Co., Brooklyn, N. Y.

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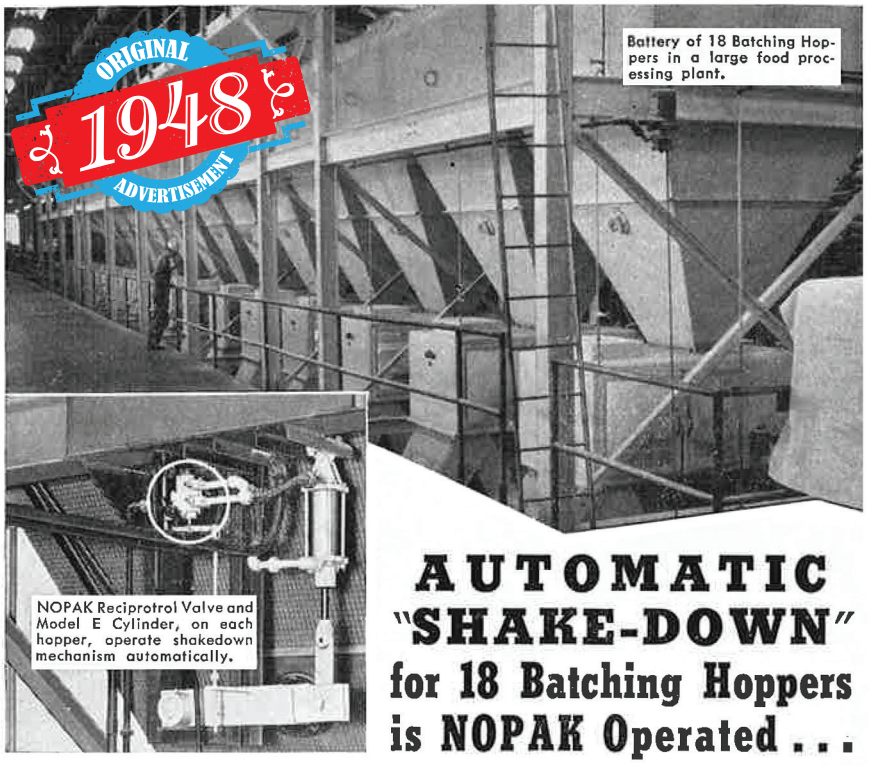

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ROLLING DIAPHRAGM CYLINDER HAS LOW FRICTION

Although the original circuit will work, with properly selected cylinders, the design is neither the simplest nor the least expensive. First, it is assumed that a precise and constant relationship exists between air pressure under the pistons and counterbalance force. At best, this relationship is not likely to be perfect, so the type of air cylinders will be critical.

A good solution would be using rolling-diaphragm or low break-away friction piston cylinders. The latter would require reliable lubrication, and they might not be easy to operate properly at the low flow rates and infrequent cycling typical of such an application.

Second, the author gives no reason why a solenoid valve is required. If remote operation is essential, a double air piloted valve actuated from remote miniature 3-way valves would cost about 40% less.

If remote operation is not required, a handle- or knob-operated main directional valve would cost about 60% less than the solenoid valve. In addition, neither electrical switches nor air pilot valves would be required with a manual main valve.

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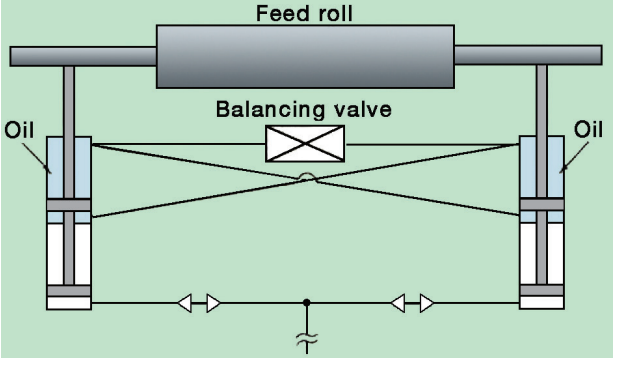
A third possible design arrangement would be to do away with all of the author's circuitry and use a single lever-operated, pressure-regulating valve. With the regulator's lever fully applied, mainline air pressure develops under the pistons, raising the roll. As the lever is moved to reduce the pressure under the pistons, the counterbalance force is reduced, and the load on the roll is proportionately increased. These regulators have a mechanical adjustment to limit the minimum output pressure, if desired.

Although these lever-operated regulators are relatively expensive, one unit would cost less than all of the components in the author's circuit. Also, the installation would be almost zero.

Submitted by Ted Isaacs, President, The Isaacs Co., Cincinnati.

SYNCHRONIZE WITH CROSS-CONNECTED CYLINDERS

Feed rolls of a paper mill are usually synchronized mechanically to keep the center lines of the rolls parallel to each other. The author's circuit shows no synchronizing arrangement. In the circuit, air is used as the power source, and the rolls will get out of synchronization due to the compressibility of air and minute variations in the cylinders.



To synchronize the rolls and still use a fluid power system, I suggest adding cross-connected, hydraulic, double rod-end cylinders to the air cylinder, as drawn at right. Oil, being relatively incompressible, will keep the rolls parallel. The addition of the oil-filled, double rod-end cylinders will not affect the intent of the circuit because the cylinders are pressure balanced.

The circuit could be refined further by adding a line between the top parts of the oil cylinders. This line would contain a shutoff or balancing valve which, when closed, would block flow between hydraulic cylinders. Should the cylinders get out of synchronization; the valve would be opened and when the air cylinders are pressurized, the oil would transfer, to bring the cylinders back into synchronization.

Submitted by William B. Kuhnke, Manager, Application Engineering, Parker Hannifin Corp., Cylinder Division, Des Plaines, Ill.

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USE TWO PRESSURE REGULATORS INSTEAD OF ONE

With the original circuit, the operator adjusts the low-pressure regulator. However, he might inadvertently set the regulator at a point far below the minimum required to support the feed roll. When solenoid B is energized, high pressure air exhausts until the shuttle shifts and the regulator starts relieving. The roll could drop fast enough to be damaged should it hit the opposite feed roll hard enough.

Because the circuit shows no flow controls, energizing solenoid A could possibly extend the cylinders at a rate which would damage either the rolls, the cylinders, or the paper-making machine.

Because the operator must adjust the low-pressure regulator to control the roll weight-to-paper width ratio, the directional valve, shuttle valve, and low-pressure regulator could be eliminated. All their functions can be controlled simply by adjusting the F-R-L's pressure regulator. Because adjusting the regulator control creates a gradual increase or decrease in the "counterbalance" force, the regulator avoids the possibility of fast movement that could damage the equipment.

I note that the circuit diagram shows no muffler at the exhaust port of the directional control valve. I assume the actual machine had a muffler. It is worth reminding designers that high-speed exhaust of high-pressure air is noisy and frequently above allowable noise limits. Also, unless the exhausting valve is in a protected area, a high-pressure air burst could be a hazard to an operator.

Submitted by Ronald L. Eller, Mechanical Engineer, Elevator Systems, Unidynamics/St. Louis Inc., St. Louis.

FEED ROLL RISES WITH ELECTRICAL FAILURE

The original circuit for counterbalancing the weight of a feed roll is unique. Although I have not seen a shuttle valve used in this manner, there appears nothing wrong with it.

When I needed a similar dual-pressure feed roll circuit, I used the system shown in the accompanying drawing. It does the same job, is safer, and uses less air per cycle. I feel that this circuit is safer because the roll is raised without energizing a solenoid. Also, the feed roll raises automatically in case of electrical power failure. When required, this circuit can even be used to apply downward force on the roll.

Here is how it works: In the cylinder-retract sub-circuit: Pressure regulator A feeding receiver B is set high enough to raise the roll: about 25% higher than needed to just counterbalance the roll. The receiver is sized to accept the volume from the rod end of the two cylinders with a nominal pressure increase when they extend.

For maintenance, small manual valve C exhausts the receiver and cylinders. Valve C could also be located in the line

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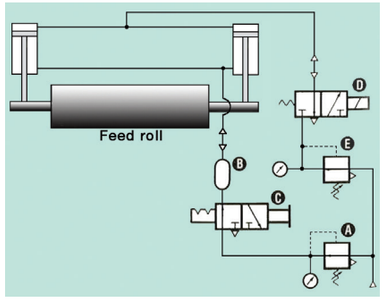
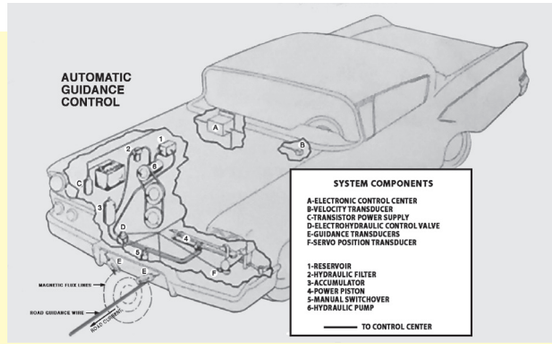


between the receiver and the cylinders; this would eliminate exhausting the receiver to extend the cylinders.

In the cylinder-extend sub-circuit: First, the pressure of pressure regulator A is set and the cylinders are retracted. Then solenoid valve D is energized and the pressure in the cap end of the cylinders plus the weight of the roll allow them to extend with any force or counterbalance required, as set by pressure regulator E. De-energizing solenoid valve D exhausts the air from the cap end of the cylinders to raise the roll to the open position.

Submitted by Edgar (Bud) Trinkel, Jr., Fluid Power Specialist, Moehlenpah Engineering, Inc., Evansville, Ind. hp

A LOOK TO THE FUTURE…60 YEARS AGO



IT SEEMS CERTAIN that some of us will have self-driving cars in the foreseeable future. An article in our 1959 issue described a self-steering car. It may not have been self-driving, but it must've sounded pretty futuristic back then.

Here's a car that can steer itself. The experimental car, developed by General Motors Research Staff, picks up magnetic signals from a cable buried in the highway and uses current to keep the car in line.

Two electric transducers mounted on the bumper pick up the current from the road guidance wire and feed it to an electronic computer. The computer gives command signals to the power steering system. As the car tends to wander from the road cable, the voltage difference in the transducers is fed to the analog computer, which sends a signal to the electrohydraulic servovalve controlling the power steering.

The hydraulic system's pump is driven by a V-belt from the engine fan. An accumulator is used in the system to supply pressure during short periods when the engine is not running. A position transducer furnishes the feedback signal to the electrohydraulic servo steering valve.

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