**University of Kentucky—College of Agriculture**

EXTENSION DIVISION

THOMAS P. COOPER, Dean and Director

Circular No. 246 June, 1931

Published in connection with the agricultural extension work carried on by cooperation of the College of Agriculture, University of Kentucky, with the U. S. Department of Agriculture, and distributed in furtherance of the work provided for in the Act of Congress of May 8, 1914.

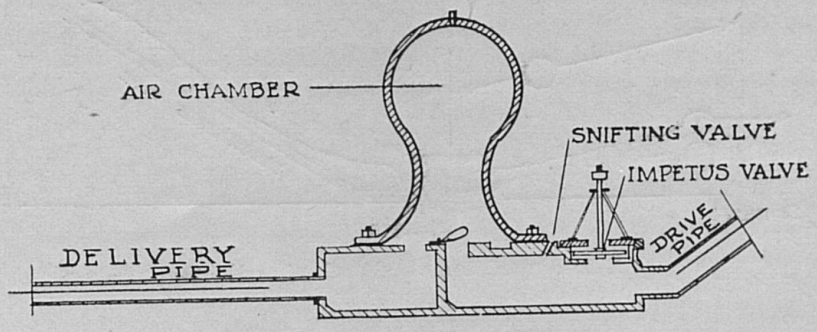
# The Hydraulic Ram

By HOWARD MATSON

A hydraulic ram is a device by which the momentum of a large quantity of water flowing down a pipe is used to force a small quantity to a higher level than the source. A ram can be used wherever a sufficient volume of water can be piped from its source to a level several feet lower.

## PRINCIPLE OF OPERATION

Water flows down the drive pipe into the body of the ram and out thru the impetus valve, gaining velocity until its momentum is sufficient to close the valve. The sudden closing of this valve causes the moving column of water to exert great force upon the valve in the bottom of the air chamber, driving water in and compressing the air until the energy of the water column is spent. The air-chamber valve then closes, and the compressed air forces water out thru the delivery




Diagrammatic section of a hydraulic ram.

pipe. At the time the air-chamber valve closes, the column of water in the drive pipe rebounds slightly, removing the pressure from the impetus valve and permitting it to open. This cycle is repeated as long as the drive pipe is kept full of water.

## REQUIREMENTS FOR SATISFACTORY OPERATION

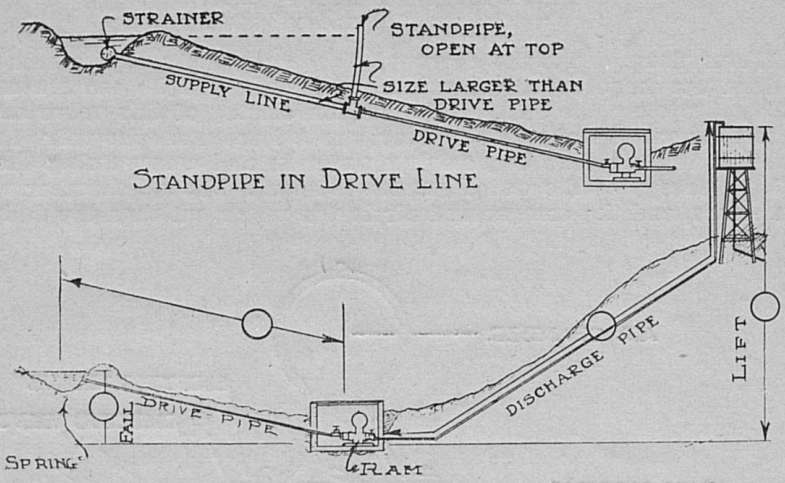
The fall from the source of supply to the ram must be at least two feet and the minimum flow of water approximately one gallon a minute, but the amount of fall required depends upon the volume of water needed and the height to which it is to be raised.

**To Determine the Fall.** The fall can be determined with a leveling instrument or by the use of a carpenter's level.

**To Determine the Flow.** If the source is a spring, the volume of water flowing may be determined by making a dirt dam around the spring, placing a short pipe thru the dam, large enough to carry the full flow of the spring, catching the water in a pail of known capacity, and noting by means of a watch the length of time required to fill the pail. For accuracy the measurement should be made several times and the average used to compute the flow in gallons a minute.

**Lift.** This is the height to which the water is to be raised. It should not be more than 10 or 12 times the fall. To measure it, ascertain the vertical height of the top of the storage tank above the level of the ram.

**Quantity Discharged.** A ram discharges approximately 1-7 to 1-25 of the water supplied to it, according to the ratio of the fall to the lift. The approximate quantity discharged a minute is equal to the product of the fall in feet by the number of gallons a minute supplied to the ram, divided by twice the lift in feet.




Relation of the ram and pipe lines.

## INFORMATION REQUIRED

In writing to manufacturers for recommendations concerning the size of ram to be used, its cost, and the method of installation, the following information should be given:

1. **Flow of spring,** or number of gallons of water a minute to supply the ram.

2. **Fall,** or vertical distance in feet from the surface of the water in the supply basin to the probable location of the ram.

3. **Distance in feet,** from source to ram location.

4. **Length,** in feet, of the pipe to convey the water from the ram to the top of the storage tank.

5. **Lift,** or vertical height in feet above the level of the ram at which water is to be discharged.

6. **Daily water requirement,** or number of gallons needed a day to meet all requirements.

## INSTALLATION PRECAUTIONS

**Protection of Ram.** The ram should be bolted to a substantial, level foundation in a tight, frost-proof pit of masonry or concrete with adequate provision for waste water drainage.

**Drive Pipe.** The length of the drive pipe should be from five to ten times the fall. If, in order to obtain the necessary fall, the ram must be located at a greater distance than this from the source of water, an intermediate reservoir or standpipe should be provided at the proper distance from the ram, open at the top and extending above the water level in the supply reservoir.

The pipe connecting the source of supply to the intermediate reservoir or standpipe should be at least one size larger than the drive pipe. The top of the supply pipe should be at least a foot below the surface of the water in the supply reservoir and not less than six or eight inches above the bottom of the reservoir. It should be fitted with a strainer. A gate valve should be placed in the drive pipe, inside the ram pit, to make it possible to control the flow in the drive pipe or stop it entirely.

**Discharge Pipe.** There is no definite limit to the length of the discharge pipe, but in long lines the pipe used must be of sufficient size to prevent excessive friction loss.

**Storage Tank.** The reservoir or storage tank should be provided with an overflow pipe, and should hold several days' supply.

**Laying Pipes.** All pipes should be laid below frost line, and long bends should be used wherever turns are necessary. Before covering any pipe, all connections should be made and the ram started, so that the lines can be examined carefully for leaks.

## RAM TROUBLES

If a ram ceases to operate, or functions imperfectly, several possible causes should be investigated. If the ram stops from lack of sufficient water flowing into the drive pipe, the valve on that pipe at the ram should be closed until enough water has accumulated in the reservoir. The drive line may then be opened and the ram started by pressing down on the impetus valve, allowing the water to escape, then permitting the valve to rise again. After repeating this operation a few times the ram will continue to operate automatically. By adjusting the ram to a shorter stroke, it may be made to use less water during a period of diminished supply. Dirt or sand may get into the valve and keep it from seating properly. This may

be remedied by thoroly flushing the ram with clear water and cleaning both valves and valve seats. Worn valves may cause trouble; if so, new ones should be put in.

One of the most common causes for the stopping of the ram action is a waterlogged air chamber. Because of the pressure in the chamber, air is constantly being absorbed by the water, and the air supply must be replenished in some manner. Most rams are equipped with a snifting valve to admit a small quantity of air during each cycle of operation. The suction produced by the recoil of the column of water draws in a little air at each stroke. If this valve becomes clogged, it should be cleaned. When this has been done, or if the ram has not such a valve, the air chamber must be drained and allowed to fill with air, after which the ram may be started.

## MANUFACTURERS OF HYDRAULIC RAMS

Barnes Manufacturing Company, Mansfield, Ohio.
The Deming Company, Salem, Ohio.
W. & B. Douglas Pump Company, Philadelphia, Pennsylvania.
Goulds Pumps, Inc., Seneca Falls, New York.
Humphryes Mfg. Company, Mansfield, Ohio.
Johnson Mfg. Company, Seattle, Washington.
Montgomery Ward & Company, Chicago, Illinois.
Niagara Hydraulic Engine Company, Chester, Pennsylvania.
Payne Ram Company, Rome, New York.
Rife Hydraulic Engine Mfg. Company, New York City.
Rumsey Pump Company, Ltd., Seneca Falls, New York.
Skookum Company, Portland, Oregon.
Ward-Love Pump Corporation, Rockford, Illinois.

Further information on the selection, installation, and operation of hydraulic rams may be obtained by writing to the Extension Division of the College of Agriculture, Lexington, Ky.