# Pipe Systems for Irrigation

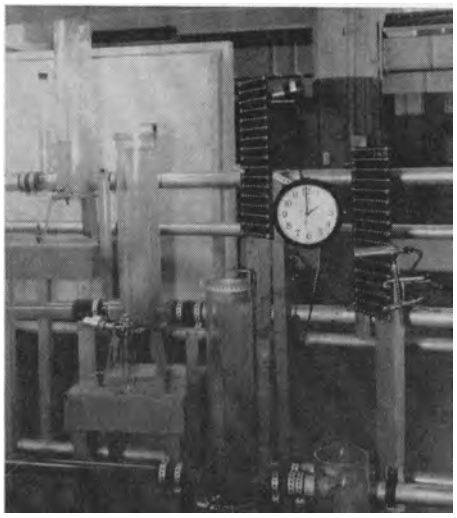
## hydraulic characteristics of pipe systems for irrigation enterprises under investigation

A. F. Pillsbury and E. H. Taylor

**Semiclosed pipe systems** for distribution of water by irrigation districts appear to be superior to other systems in operating characteristics.

Higher cost of water, high value land, and need for more efficient delivery and usage dictate increasing attention to the efficiency of concrete pipe water distribution systems.

Analyses and model studies under way are investigating the several possible types of systems to determine to what extent each provides a certain flexibility required by the farmer; whether or not a high load-factor is possible for reasons of economy; the characteristics of each system as to operational economy; and, the hydraulic characteristics from the viewpoints of design and steadiness of flow.



Scale model of an open system used in laboratory studies.

### Closed Systems

The closed or pressure system—conventional for the distribution of domestic water—is rarely designed for irrigation service, although there are many combination domestic and irrigation systems in southern California. Costs of the pressure pipe required by this system have generally precluded its use.

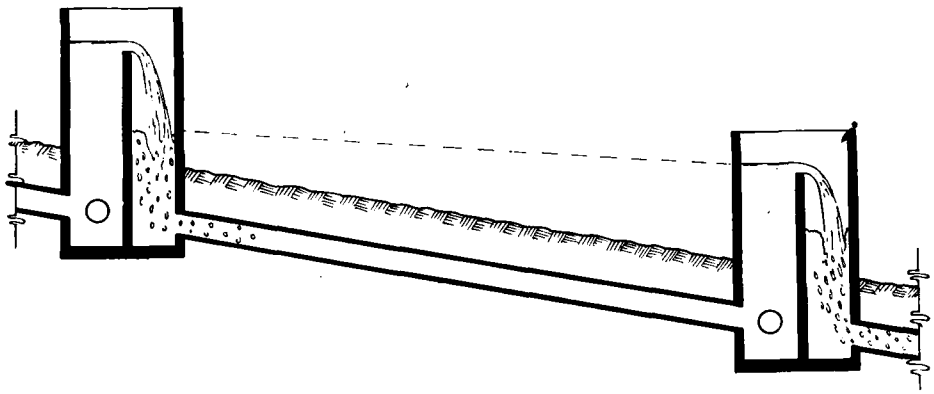
In some instances the use of a closed system might involve water hammer problems. To avoid overload, the number of deliveries open at any one time can be regulated. Deliveries, however, with anything like a high load-factor on the system, would be subject to considerable fluctuation. Downstream control float valves might correct this, and could be installed to give the farmer more flexibility in his delivery.

### Open Systems

Open systems have an overflow stand at periodic intervals. Deliveries are made from the upstream portion of each stand, presumably at a near constant head and hence at steady flow. For good service, there must be provision to discharge regulatory waste at the end of each lateral. Otherwise, the last delivery absorbs all regulatory fluctuations.

Such systems have an inherent instability associated with the entrainment of air.

**Portion of an open system showing overflow stand at periodic intervals. Deliveries are normally made from the upstream portion of each stand.**



A scale model of an open system—fitted with plastic parts—permits laboratory observation of the entrainment of air, the initiation of surge, and a venting design which corrected the surge initiation encountered.

The incidence of surge, observed in the model, resulted from the gradual build-up of an air pocket in the extreme upstream reach of pipe, which periodically blew back into the stand. The surge initiated was not serious, but the amplification in successive reaches downstream was.

In the model, placement of large size vents immediately downstream from each overflow stand prevented any surge initiation. The diameter of these vents should be at least two thirds the diameter of the pipe line. However, when surge was imposed upon the system from outside by any change in flow rate—both rates being steady—surge was amplified as before venting, but dampened out in about two minutes. Although vents were successful in preventing all surge initiation observed in the model, they were not completely successful in preventing the carrying of considerable air into the system at high flows, which appears to adversely affect the friction loss. In such cases a supplemental vent may be necessary a short distance downstream.

### Semiclosed Systems

The semiclosed system simply substitutes a float valve with downstream control for the baffle in each overflow stand of an open system. The semiclosed system has the essential operating characteristics of the closed system, except that pipe line pressures never exceed the value established by the water surface in the next stand upstream. Thus low pressure pipe can be used. Only the water which is delivered flows down the system; so there is no regulatory waste involved—provided there is storage or control all the way upstream. Deliveries can be kept at essentially a constant rate unless the capacity of the system is exceeded.

If desired, farmers can vary their flows at will without causing operating

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# Westside Dust Plots

## slight encouragement in trials hindered by climatic conditions

Lloyd Brown

**One species of grass,** among the 11 varieties of legumes and grasses—planted in December 1952—in test plots in the southern San Joaquin Valley, showed promise in December 1953.

The test plots—of about 500 acres each, and fenced—were established in Fresno, Kings, and Kern counties to introduce plants and develop management practices to alleviate the Westside dust problem.

Trial plantings of grasses and legumes, in rows about 1,300′ long, have been made each year beginning in the autumn of 1951.

Poor plant growth because of lack of rainfall in two seasons out of three has prevented any significant observations on grazing.

In 1952, adequate rainfall produced good plant growth and the rows fertilized with ammo-phos—16–20–0—applied at the rate of about 44 pounds per acre—responded very satisfactorily.

*Schismus arabicus*, a grass native to the Mediterranean area, was first noticed on the Westside Plains some seven or eight years ago. The plant seems to root firmly in the soil and is therefore resistant to wind action. Stockmen reported that stock liked the grass and it seemed to be a good forage plant.

No extensive stands of Schismus were found but plants were scattered over much of the Westside area.

Seeds of the new grass were collected and in early December, 1952—after good early rains—the three test plots were planted with:

*Schismus arabicus*
Crested wheat, *Agropyron cristatum*
Tall wheat, *A. elongatum*
Intermediate wheat, *A. intermedium*
Pubescent wheat, *A. tricophorum*
*Stipa rosengurtii*
Indian ricegrass, *Oryzopsis hymenoides*
Wimmera ryegrass, *Lolium subulatum*
Smilo, *Oryzipsis miliacea*
Rose clover (*Trifolium hirtum*) and bur clover (*Medicago hispida*)—inoculated with nitragin—were seeded at the rate of two pounds per acre each in rows one through 18.

Growth in the test plots started very well and good stands were obtained. However, subsequent rains were light and the plots—along with the native cover on the Westside—dried up in March. The plants did not mature enough to produce seed.

***Schismus arabicus* invaidng slick spots. The plants are growing where the soil had cracked the previous summer. Hence the tile-like appearance.**

Apparently none of the perennials in the 1951 or 1952 test plot plantings survived the summer of 1953.

In the fall of 1953 Schismus plants were found to have invaded slick spots where the soil contains more alkali than adjoining vegetated areas. Apparently the seed produced by the 1952 plantings had been broadcast by the wind to lodge in cracks in the soil—caused by its drying out—and had taken root.

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## PIPE SYSTEMS

Continued from preceding page

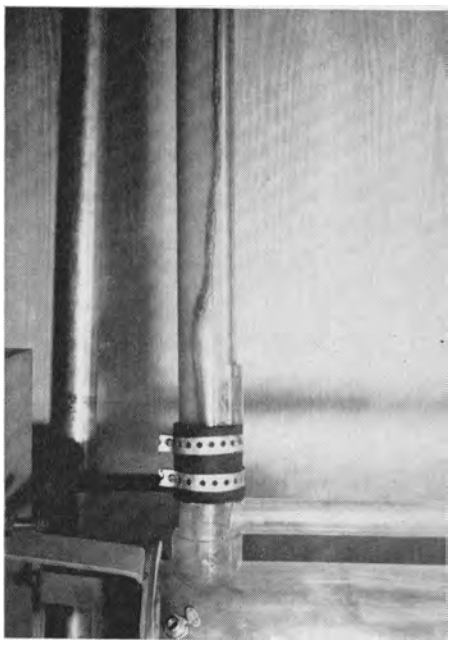
problems as far upstream as the automatic feature is provided. Operation can be completely automatic. There is no opportunity for air entrainment.

Without air entrainment, and with correct design, the semiclosed distribution system provides positive stability in operation.

The hunting of float valves in series is a very real possibility if design is not correct. If the oscillatory properties of the float and valve happen to be matched in just the right way to the characteristics of the pipe and stands, serious surging can result.

Successful conversions of open systems to semiclosed systems have been made on a number of farms on the steeper slopes in southern California. Some valves used had hunting difficulties but most installations were remarkably successful.

**Air bubble forming below an overflow stand. The vent shown is closed.**



The question of water hammer has been raised in regard to semiclosed systems. The factors which make for stability cause a lag in response of the valves for which a foot or two freeboard must be provided in the stand, but as observed in the field, there appears to be no appreciable hammer. Opportunity for hammer would occur with fast closing manual valves on deliveries. Such valves can well be avoided except where deliveries are made directly from a stand. The storage in the stand can absorb most of the shock.

The analyses and model studies currently under way indicate that material improvements can be made in the operation of all three systems.

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