# New Irrigation System Using Pressure Hoses

## By KENJI SHIINA

Chief, 4th Laboratory of Land Improvement, Department of Land Improvement,
Agricultural Engineering Research Station

Accompanied with the progress in technique of synthetic chemistry, the development of pressure flexible hoses has been promoted recently. The hoses have come into use for water conduction in various fields. They even very long ones, are handy to carry, and have a character of portable conduits. And it is hopeful to use them for water conduction in agriculture.

The author has continued investigations and experiments on the utilization of those hoses for irrigation since 1966, succeeding nearly in its practical use. The irrigation system studied by the author is dealt with in this paper.

## Capacities of the pressure hose used as materials

Specifications and capacities of the hoses are shown in Table 1.

## Kinds of irrigation systems using the hoses

Irrigation system using the hoses is divided into five main classes as follows:

1) Use of the hoses for water conduction in the sprinkling set settled on the ground surface

This is a type of irrigation in which the terminal sprinkling set branched from a hydrant of the fixed pipe settled on the surface of the ground during a period when irrigation is needed. This system of irrigation has become popular in recent years because it saves labor, and is good in efficiency. As it is usual that the sprinkling set is settled in a considerably large area in this system the set is desirable to be cheap and durable. From this viewpoint it may be said that a sprinkling set using pressure hoses for water conduction is one of the most suitable sets.

2) Use of the hose for the water-conducting of portable large sprinklers

Saving labor is an important problem in the irrigation by portable sprinkers. According to the results of investigations carried out until now, it is evident that the use of large sprinklers is the most labor-saving system in this type of irrigation. However, there is a problem to be solved about conduction of water from the hydrant to sprinklers. The author intends to use the hose for the water conduction. This type of irrigation becomes the most labor-saving and inexpensive in case the hose reel is used as mentioned below.

3) Use of the perforated hose as a sprinkler.

In the other cases the hose is always used

**Table 1.**

| Item      Inside diameter | Result of test | | | | |
|---|---|---|---|---|---|
| | 25 m/m | 40 m/m | 50 m/m | 65 m/m | 75 m/m |
| Thickness | 1.3~1.6 m/m | 1.6~1.9 m/m | 2~2.1 m/m | 2~2.3 m/m | 2.2~2.4 m/m |
| Weight | 240~260 g/m | 360~390 g/m | 380~400 g/m | 550~600 g/m | 800~900 g/m |
| Burst water pressure test use pressure | 25 kg/cm² ~ 26 kg/cm²  Below 8 kg/cm² | | | | |

for water conduction, but in this case it is perforated and use for a sprinkler in the same way as a usual perforated pipe. It can be used for both portable and settled type of irrigation. As the hose is flexible at low pressure, it is expected to be of high efficiency for sprinkling even in complicated configurations of the ground.

4) Use of the hose as a sub-channel for furrow irrigation

Furrow irrigation is impossible without channels running along every field. However, the network of channels is not only expensive to make but also a great obstacle to the work of agricultural machines. So the author intends to conduct water to the field by the main hose to be irrigated from a channel or a tank distributed rather sparsely, and to irrigate each furrow by a terminal hose branched from the main hose. This method is not obstructive to the work of agricultural machines, and, what is better, saves labor, because it is possible to irrigate all the furrows simultaneously.

5) Use of the hoses for ordinary irrigation

The hose is a portable channel and can be used for conducting water to a paddy field as follows:

a) Temporary water conduction to fields in case of a drought or a shortage of water for preparation of paddy fields.

b) Irrigation of a field far from the channel in case of a rotation between paddy and other crops.

c) Quick and over-all irrigation of a large lot of paddy field.

d) Utilization as temporal channels in case of the repair of rivers and channels, or for carrying mud in case of the soil dressing by warping.

## Plans of installations making use of hose

1) Irrigation system settled on the surface of the ground

A plan of the sprinkler set for a field of 10 a and that for an area of 30 a are shown in Figs. 1 and 2, respectively. The set can freely be designed according to the type of

sprinklers suitable for the area of the field. There are two types of risers. One is the type made of lead and aluminum as before
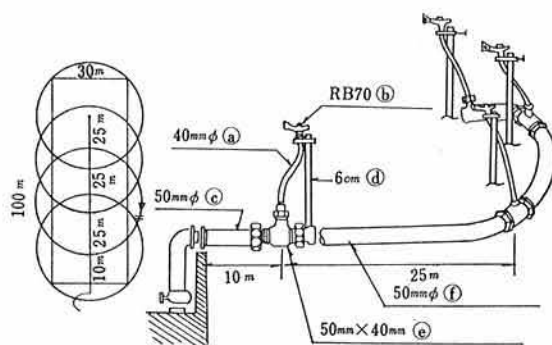


Fig. 1. Irrigation set settled on the surface of the ground (for an area of 10 a):
a: riser with a three-legged support.
b: RB 30 sprinkler.
c: Socket for a riser.
d: 50 mm intake hose (with machi-joint, and a TK joint).
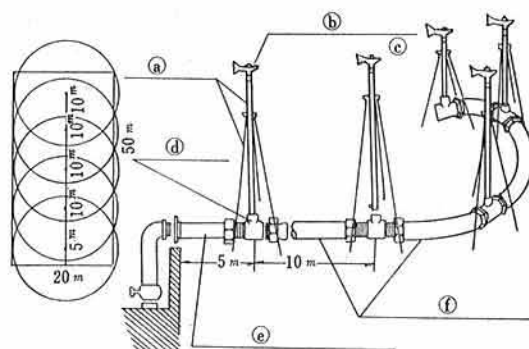e: 50 mm water conducting hose with a TK joints.



Fig. 2. Irrigation set settled on the surface of the ground (for an area of 30 a):
a: 40 mm φ Takata econ-hose (H).
b: RB 70 sprinkler.
c: 50 mm φ intake hose, Takata econ-hose (H).
d: 6 cm square lumber.
e: TK joint (50 mm×40 mm).
f: 50 mm φ water coducting, Takata econ-hose (H).

(Fig. 3), and the other consists of a hose and Kler-joint attached to a square lumber as shown in Fig. 4. Those risers can also be arranged radially with the aid of a distribution controller (Fig. 5).

(Suggestions)

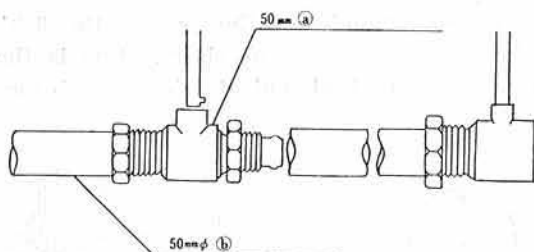a) The distribution of sprinklers is estimated at 10 × 20 m and 25 × 30 m in the

Fig. 3. Riser (Type 1):
  a: 50 mm TK joint:
  b: 50 mm φ water conducting hose.
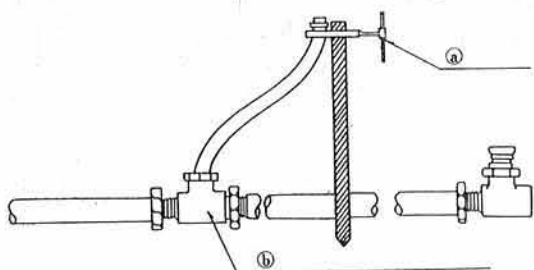


Fig. 4. Riser (Type 2):
  a: Kler-joint:
  b: TK joint (500 mm × 40 mm).

figures. However, it is important to determine the distribution of sprinklers to secure the maximum of efficiency by adjustment of hoses which can easily be cut at need.

b) In case of the crop rotation it is a good way to settle sprinklers in a field only during the period when irrigation is needed most frequently there.

c) The use of Kler-joint is favorable in the sprinkling set for an area of more than 30 a.

d) The uniformity of sprinkling is much influenced by the wind.

The hoses, therefore, are desirable to be long enough to move the positions of sprinklers according to the weather of the day.
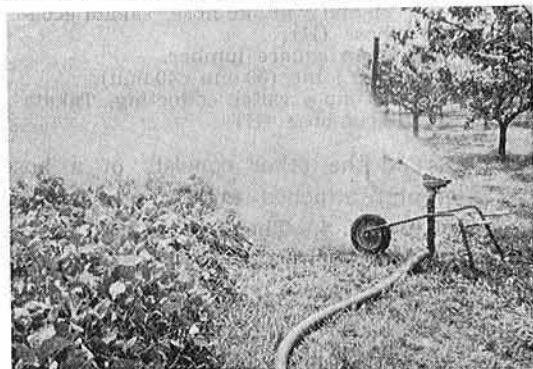


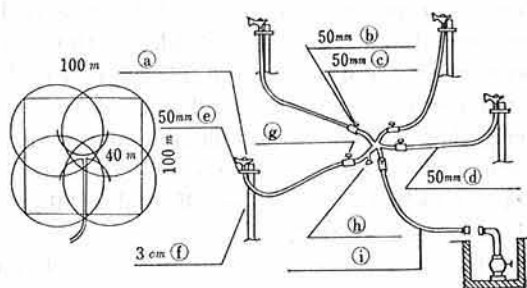Fig. 8. Portable system of large sprinkler



Fig. 5. Irrigation set arranged radially (for an area of 1 ha):
  a: Mannesman MR40 sprinkler.
  b: 50 mm joint.
  c: 50 mm sluice-valve.
  d: 50 mm water conducting hose.
  e: 50 mm kler-joint.
  f: 3 cm square lumber.
  g: Distribution controller.
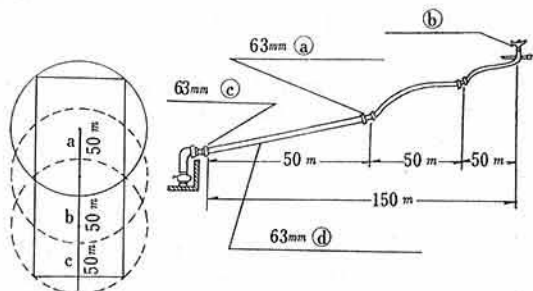  h: Leg of controller.
  i: 63 mm intake hose.



Fig. 6. Large portable irrigation set (Model A):
  a: 63 mm TK joint.
  b: Rain-Gun No. 50:
  c: 63 mm machino joint.
  d: 63 mm portable main hose.

2) Portable system of large sprinklers

An outline of the portable system is shown in Fig. 6 and Fig. 8. The sprinkler is easily moved by a cart in case the spacing between rows is properly wide. The hose consists of pieces 25-50 m long connected with each other by joints where they can be detached and reeled by the reeler when they are carried to another place.

(Suggestions)

a) This type of irrigation can be carried out at the lowest expense in a grassland or an upland farm after land consolidation.

b) When the reeler is not used, the hose is detached at the joints, a, b and c in Fig. 6, to carry and connected with a sprinkler in the new place. In this case it is recommended
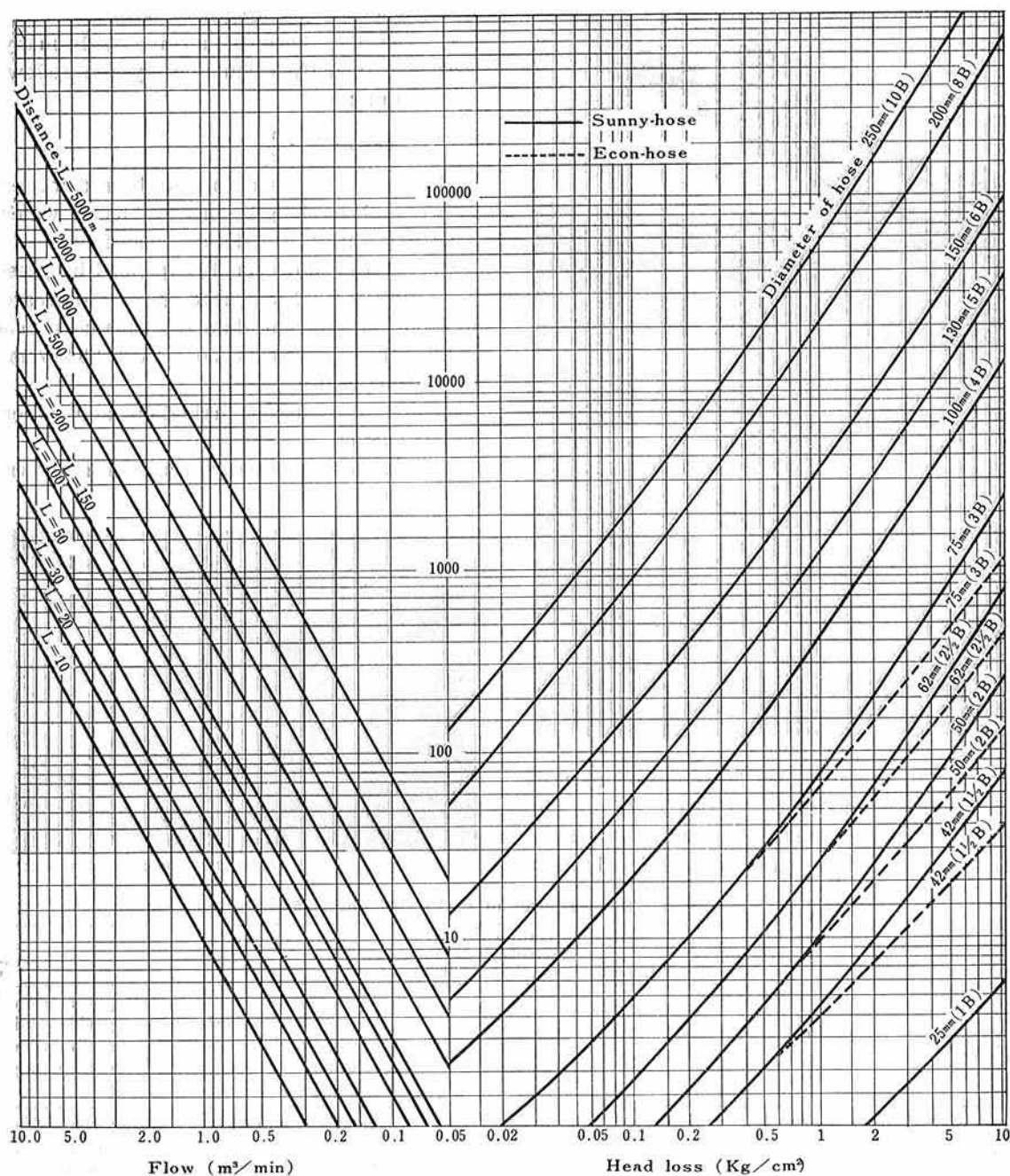
Fig. 7. Nomograph of the loss of head.

to have some spare hoses to make the arrangement in advance at odd moments in the next sprinkling place scheduled.

3) Perforated hoses

The kinds, capacities and uses of perforated hoses are shown in Table 2 (see also Fig. 9.)

*(Suggestions)*

a) Those perforated hoses are comparatively high in irrigation intensity. So it is necessary to be careful of the soil erosion, when they are used on clay soil.

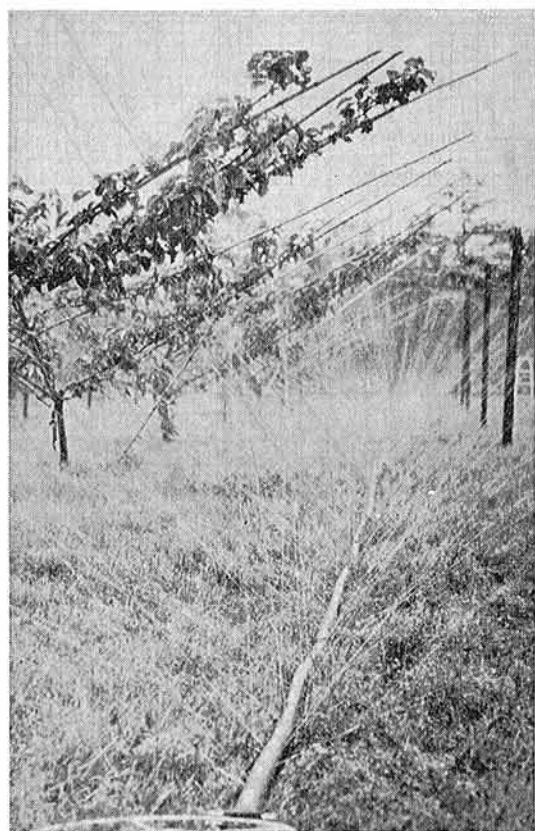b) The pattern efficiency is different ac-

Fig. 9. Perforated hoses:

cording to the pressure at the time of use. However, a difference of 0.2-0.5 kg/cm² in pressure between the basal and terminal points of a hose has little effect on the distribution

of efficiency in the length of 50 m.

c) The loss head of a pipe with many nozzles is usually calculated by the following formula:

$$he = \lambda \cdot \frac{e}{d} \cdot \frac{v^2}{2g} \cdot \frac{1}{3}$$

where, he: loss head (m), d: hose diameter (m), e: hose length (m), v: mean water velocity (m/s), $\lambda$: friction coefficient.

Those hoses, however, is expanded by pressure, so the actual loss head shows a decrease of about 20 per cent than the calculated one in case the pressure is more than 1.5 kg/cm² at the time of use.

4) Hoses for furrow irrigation and water conduction

A set of hoses for furrow irrigation is shown in Fig. 10.



Fig. 10. A set of hoses for furrow irrigation:

Table 2. Kinds, capacities and uses of perforated hoses (50 m in length)

| Kind | Use pressure (kg/cm²) | Flow (l/min) | Irrigation intensity (mm/h) | Scattering distance (m) | Use |
|---|---|---|---|---|---|
| General use for upland farm (Rainy-hose SR) | 1.5~2.0 | 6 | 22.5 | 16 | This is suitable for irrigating the even fields of edible herbs, root vegetables and flowers, and for applicating fertilizers in solution. It is also used for irrigating nurseries of plums and grapes. |
| For irrigation of fields covered with trees (Rainy-hose LR) | 1.5~2.0 | 3 | 16.0 | 14 | This is suitable for irrigating the fields covered with peaches, pears and grapes. The settled type of irrigation is recommended. |
| For irrigation of terraces (Rainy-hose TR) | 1.5~2.0 | 0.6 | 7.5 | 4~5 | This is suitable for irrigation of the terraces of oranges and apples. Sprinklers are settled in each terrace. |
| For particular kinds of vegetables (Rainy-hose HR) | 1.5 | 1.7 | | 0.5 | This is used for irrigation of the fields of vegetable fruits, as cucumbers, tomatoes and eggplants. Sprinklers are settled in each furrow. |

Those hoses are plastic pipes and have their own effect of elasticities. Accordingly, the effect of elasticity must be taken into consideration for the hydraulic calculation of water conduction. To make the fairly complicated calculation easy, the author prepared a nomograph for calculating the relation among the flow, diameter, length and head loss. (Fig. 7).

Using this nomograph, installations of hoses for water conduction can easily be designed. One-third of the value obtained by this nomograph is adopted as the loss of head in the hoses for furrow irrigation.

**Errata**

| No. | Page | Line | Wrong | Correct |
|---|---|---|---|---|
| Vol. 3, No. 3 | 5 | 6 | aso of | also of |
| " | 6 | Fig. 1 Central | Kikyogahara Branch, Nagano. | Kikyogahara Branch, Nagano Pref. Agr. Expt. Sta. |
| " | " | Fig. 1 | Period to | Ecological Type |
| | | | Flowering | Period from germination to flowering |
| | | | Ripening | Period from flowering to ripening |
| " | 7 | 5 (from bottom) | And seads of | And seeds of |
| Vol. 3, No. 4 | 31 | 2 (from bottom) | picle (s) | picul (s) |
| | | 4 " | " | " |
| " | 32 | 6 | " | " |
| | | 9 | " | " |
| | | 31 | " | " |
| | | 46 | " | " |
| " | 31 | 4 (from bottom) | 600 kg | 60 kg |
| " | 32 | 12–13 | Nua Rachasima tanok Kamen Pratin etc. | Nua, Rachasima, Tanok, Kamen, Pratin, etc. |