California Vocational Agriculture Curriculum Guidelines Instructional Unit

IRRIGATION SYSTEMS

TABLE OF CONTENTS

Introduction to Agriculture	
Agricultural Production	01.01
Agricultural Supplies/Services	01.02
Agricultural Mechanics	01.03
Agricultural Products/Processing	01.04
Ornamental Horticulture	01.05
Renewable Resources/ Rural Recreation	01.06
Forestry	01.07

IRRIGATION SYSTEMS

Unit Goal

The goal of this unit is to increase the students' awareness of the mechanical devices used in irrigation.

Unit Objectives

Upon completion of the unit the student will be able to:

1. Differentiate between deep well turbine, low lift, and booster pumps.
2. Properly start and stop a deep well turbine pump.
3. Use and maintain the mechanical devices used to apply water to crops.

Teaching Outline

I. Delivery Systems

A. Pumps

1. Deep Well Turbines TM 1

a. Rated in gallons per minute, pressure variable depending on impellor design and number of impellors (stages).
b. Draw Down -- TM 2 Before pumping begins water stands at a stable level. When pumping begins this level will lower and stabilize at a new level called the pumping level. The difference between static and pumping level is called draw down. The output of the pump will be reduced as this draw down occurs.
c. Starting Deep Well Turbine Pumps: Push a column of water from the impellors to the discharge point, and when the power to the pump is interrupted the column of water rushes back down the well causing the pump to rotate in reverse. Care must be taken to avoid restarting the pump when the reverse rotation condition exists. The forces involved are great and severe damage can be done to the pump if it is started while the shaft is rotating in the reverse direction.

Starting Procedure: Inspect pump to insure it is not turning, check oil level in motor bearings and shaft oiler, then start. When pump is up to speed, inspect shaft oiler, sight tube and adjust oiler to proper flow such as 7 drops per minute. Specifications are usually listed on the pump. Insure there is sufficient oil in shaft oiler reservoir to last the pumping period.

d. Testing: Power supplier will usually conduct free test to check the pump efficiency and provide a report to the owner of water level -- draw down -- output and pump efficiency.

B. Low Lift Pumps

High volume low pressure pumps used to transfer water from a canal or pond to irrigation system. (Usually push button start and service yearly).

C. Booster Pumps

Used to convert water delivered at low pressure to high pressure to overcome line friction or provide pressure required for sprinkler operation. (Usually push button start, yearly service).

D. Water Districts

1. Water districts supply water to ranchers on:

a. Demand system (water scheduled by time of need at specified volume and duration.
b. Scheduled Water Delivery System: Water supplied by calendar, not based on crop condition.

2. Water is purchased by the acre foot. 1 cubic foot per second (1 cfs) for 12 hours = 1 acre foot. 450 gpm = 1 cfs

3. Water is usually delivered at low pressure volume regulated by gate valve opening at turn out.

SUGGESTED LEARNING ACTIVITIES	SUGGESTED RESOURCE MATERIALS
I. 1. Field trip to local pump dealer or farm to demonstrate pumps, starting and lubrication.	1. AAVIM, Local pump dealer or farmer.
2. Have power supply representative run a pump test or speak to class and show equipment involved and results obtained.	2. Power Company, Farm Representative.
3. Have water district or local farmer explain process of ordering and receiving ditch water.	3. Irrigation District Representative. Local sprinkler dealer.

II. Gravity Distribution Methods

A. Open Ditch: Open with track layer and ditcher.Heavy soil requires four to six passes progressively deepening ditch to compress soil sides sufficiently to hold water. Siphons used to take water from ditch to cro.

1. Advantages:

a. inexpensive
b. can vary volume by enlarging ditch

2. Disadvantages:

a. evaporation
b. must be closed before cultivation or harvest
c. weed problems
d. erosion problems
e. subject to break and leaks
f. must be level or slightly sloping down hill

B. Pipeline

1. Surface:

a. can be moved but interfere with cultivation or harvest unless moved
b. subject to crushing and punctures

2. Subsurface:

a. expensive
b. must be large enough to handle volume without excessive line loss
c. must be vented -- vacuum vents for pressure system,stand pipes for low-pressure system

3. Common Materials:

a. concrete
b. steel
c. plastic
d. transite

4. Water is taken from pipeline to either gated pipe or an open ditch with siphons to apply water to crop.

5. Valves to Control Flow: Many types including hydrants, gates, flappers, etc.

III. Pressurized Distribution System

A. Surface -- all subject to damage by equipment.

1. Aluminum hand move sprinkler systems.

a. high labor requirement
b. high maintenance requirement

2. P.V.C. and polyethylene used for hose pull and drip systems.

B. Subsurface

1. Buried P.V.C. transite mainline and P.V.C. laterals used for sprinklers and drip systems.

2. All pressurized systems need water filtration system.

3. Perforated subsurface application devices are a minor method.

SUGGESTED LEARNING ACTIVITIES	SUGGESTED RESOURCE MATERIALS
II, III, & IV.	
1. Field trip to observe local water delivery systems in use on area ranches.	1. a. Power for irrigation, 8mm Film, Deutz Corporation, Engine Division. b. Computerized Irrigation, 6 1/2 minute, Deere and Company (Modern Talking Pictures).
2. Field trip to sprinkler irrigated farm.	2. Local farm.
3. Learn to start a siphon.	3. Set up a field trip to a local farm on irrigation day.
4. Clean sand filters.	4. Local farm.

IV. Operation

A. All water control devices should be operated with care.

1. Rapid opening and/or closing of any valves increases pressure to dangerous levels. Avoid Hammer effect by opening valves slowly.

2. Review starting procedure for pumps.

3. Pressure gauges checked periodically.

4. Clean sand filters periodically.

SUGGESTED LEARNING ACTIVITIES

SUGGESTED RESOURCE MATERIALS

Student Evaluation

1. What is the purpose and characteristics of the following pumps:

   a. Deep Well Turbine:

   b. Low Lift Pump:

   c. Booster Pump:

2. Define draw down as it applies to irrigation pumping.

3. Define the two types of water delivery systems an irrigator can use.

4. List two types of on farm water distribution systems and an advantage and disadvantage of each.

5. List four types of water application systems.

   a.

   b.

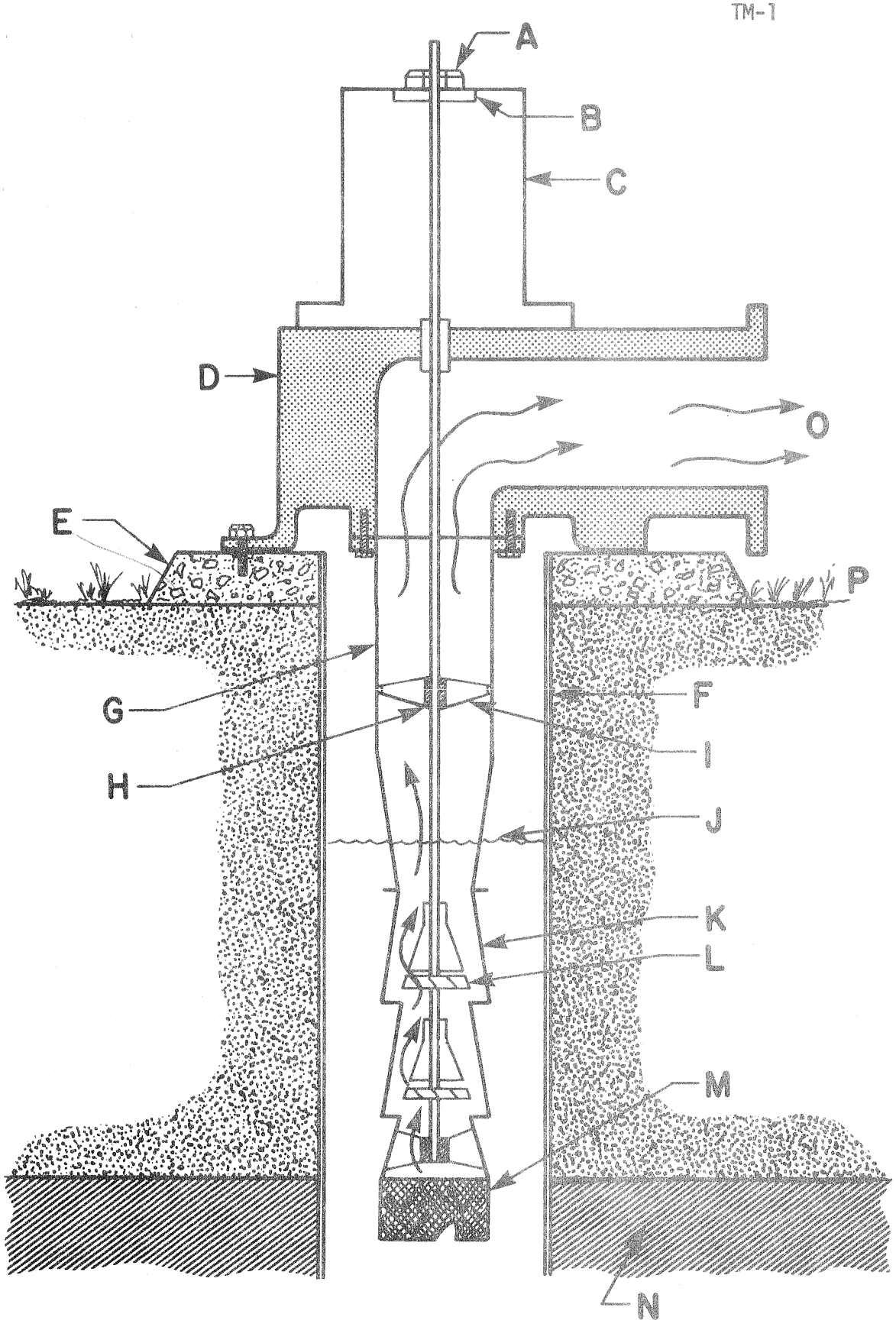
   c

   d.

6. Describe method of opening pipeline valves to avoid water "hammer".

VERTICAL TURBINE PUMP

TM-1



Vertical Turbine Pump KEY

TM-1A

A. Nut

B. Thrust Bearing

C. Motor

D. Discharge Head

E. Concrete Base

F. Well Casing

G. Pump Column

H. Rubber Bearing

I. Bearing Spider

J. Water Level

K. Impeller Bowl

L. Impeller

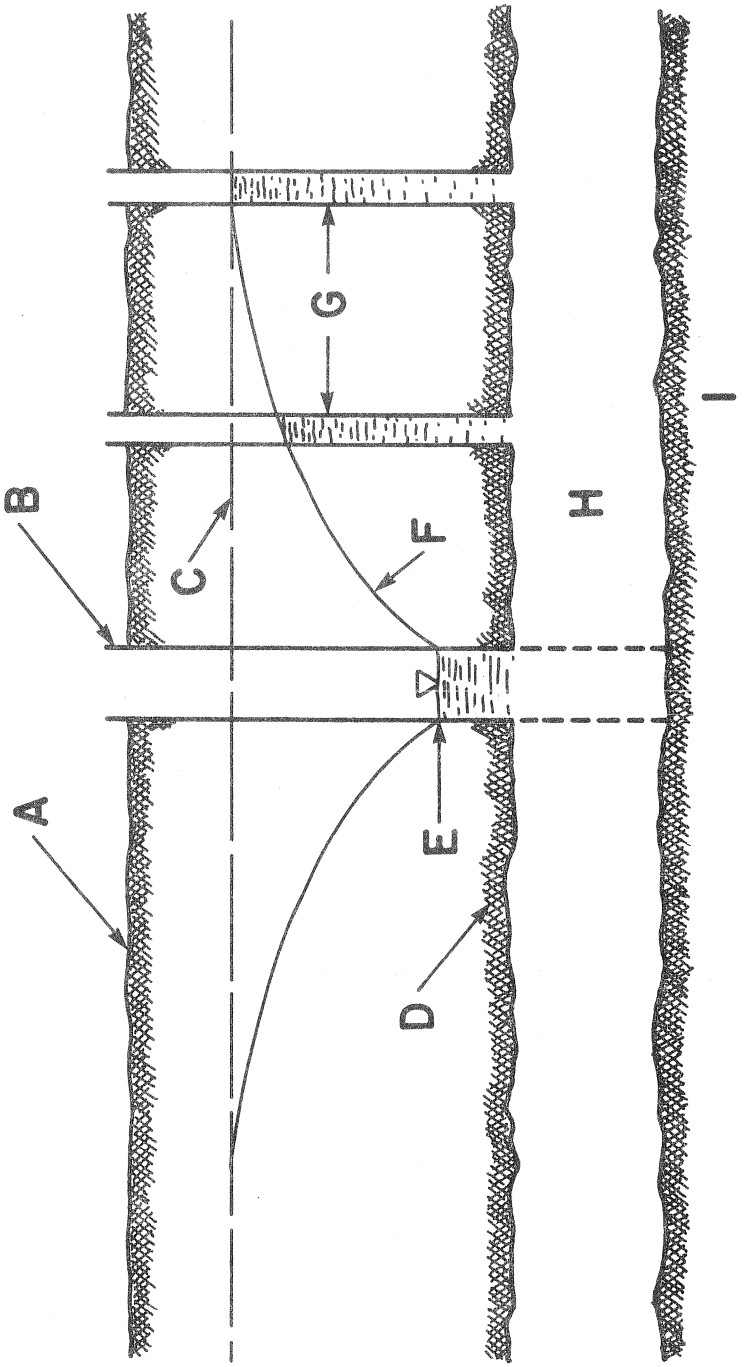
M. Screen

N. Solid Rock

O. Flow

P. Surface

RADIAL FLOW IN A CONFINED AQUIFER



Radial Flow in a Confined Aquifer
KEY

A. Ground surface

B. Well

C. Static piezometric surface

D. Impermeable

E. Well level

F. Drawdown curve

G. Observation wells

H. Confined aquifer

I. Impermeable

General References

Concrete Pipe for Irrigation, U.C Extension, Circular # 418.

Planning an Irrigation System, AAVIM.

LowHead Irrigation Pipe, Division of Agricultural Sciences, U.C. Leaflet #2908.

Water Wells and Pumps, Division of Ag Science U.C. Bulletin #7889