STANDARD FORM NO. 64

PAP-95

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Memorandum
TO : Files

Denver, Colorado
DATE: May 31, 1957

FROM : C. W. Thomas, Hydraulic Laboratory

SUBJECT: "Deflection meter"--International Boundary and Water Commission

PAP 95

A device known as a deflection meter has been successfully used for a number of years in connection with hydrographic work in measuring diversions from the Rio Grande in the lower Rio Grande Valley of Texas. In this area the canals belonging to the various irrigation districts have very flat gradients, low velocities and changing backwater conditions.

The deflection meter was developed under the direction of Mr. Karl F. Keeler, formerly Hydraulic Engineer, International Boundary and Water Commission, now retired. The meter, Drawing No. 11-ND-124 attached, consists essentially of a vane, mounted on a vertical shaft, which is deflected in proportion to the velocity of flow. This index of velocity is charted on a continuous recorder. The depth of flow is charted in a conventional manner by a second recorder. The index of water velocity and depth permits computation of canal flows in locations where backwater conditions are variable because of checks, changes in resistance in the channel due to algae or weed growth, or other obstructions.

Each instrument is custom built to fit requirements at a particular site. The initial calibration is effected by current meters after the instrument is in place. This operation is costly because of the large number of observed flows necessary to establish the relationship between unknowns. Extensive periodic checks by current meters are necessary for continued accuracy, thus, operating costs are appreciable.

Personal contacts with Mr. Keeler, Mr. J. L. Lytel, Project Engineer, and Mr. J. H. Selleck, Hydraulic Engineer, San Benito, Texas, office of IBWC, hydrographers, and operating personnel reveal that a definite need has been met by these devices and all are well satisfied with the results, bearing in mind the conditions prevailing at the sites. The published data on extractions from the lower Rio Grande are taken from measurements provided by these instruments.

The installations are made in open canals. Advantage has been taken of existing bridges in some instances to facilitate construction, Photograph No. H-812-3. In other instances a structure

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similiar to that shown on Drawing No. 3590-RH-12 is used. The current meter rating section for calibration and checking is established in close proximity.

Comments regarding the design, installation and operation of the stations are as follows.

Each installation is designed to fit the needs at the proposed site. General standardization has not been practiced nor does it appear feasible.

The installation is made in the center of the conveyance. The vane is set well below the water surface for maximum discharge, in most instances about 2 feet above the bottom. However, the optimum position is determined in the field.

The vane is triangular in shape as shown on Drawing No. 11-ND-124. The exact dimensions vary with individual installations. It has been reported that the vane has unstable characteristics unless the tip of the triangle is cut off as shown. Other notes appear on the drawing.

Operators report that they have experienced very little trouble with trash since that present passes above the vane. Most installations are on pump deliveries, hence river debris is usually not present in the flow.

The attached photographs and drawings give a good idea of the instruments and installation.

Regarding determination of discharge, the vane is normally installed so that the existing velocity causes a deflection varying from 0 to 10. This is an arbitrary range and is only an index of velocity. It was adopted because of the general use of 10-inch wide recorder charts. The relation used for calculating discharge is

$$Q = FDH \quad \text{or}$$

$$F = Q/DH$$

where Q is the discharge in second-feet; D is the deflection taken from the recorder chart (varies between 0 and 10); H is the water level (from the recorder chart); and F is a coefficient which must be developed from ratings at each field installation. In the lower valley the value of F is determined during the calibration by using a relationship:

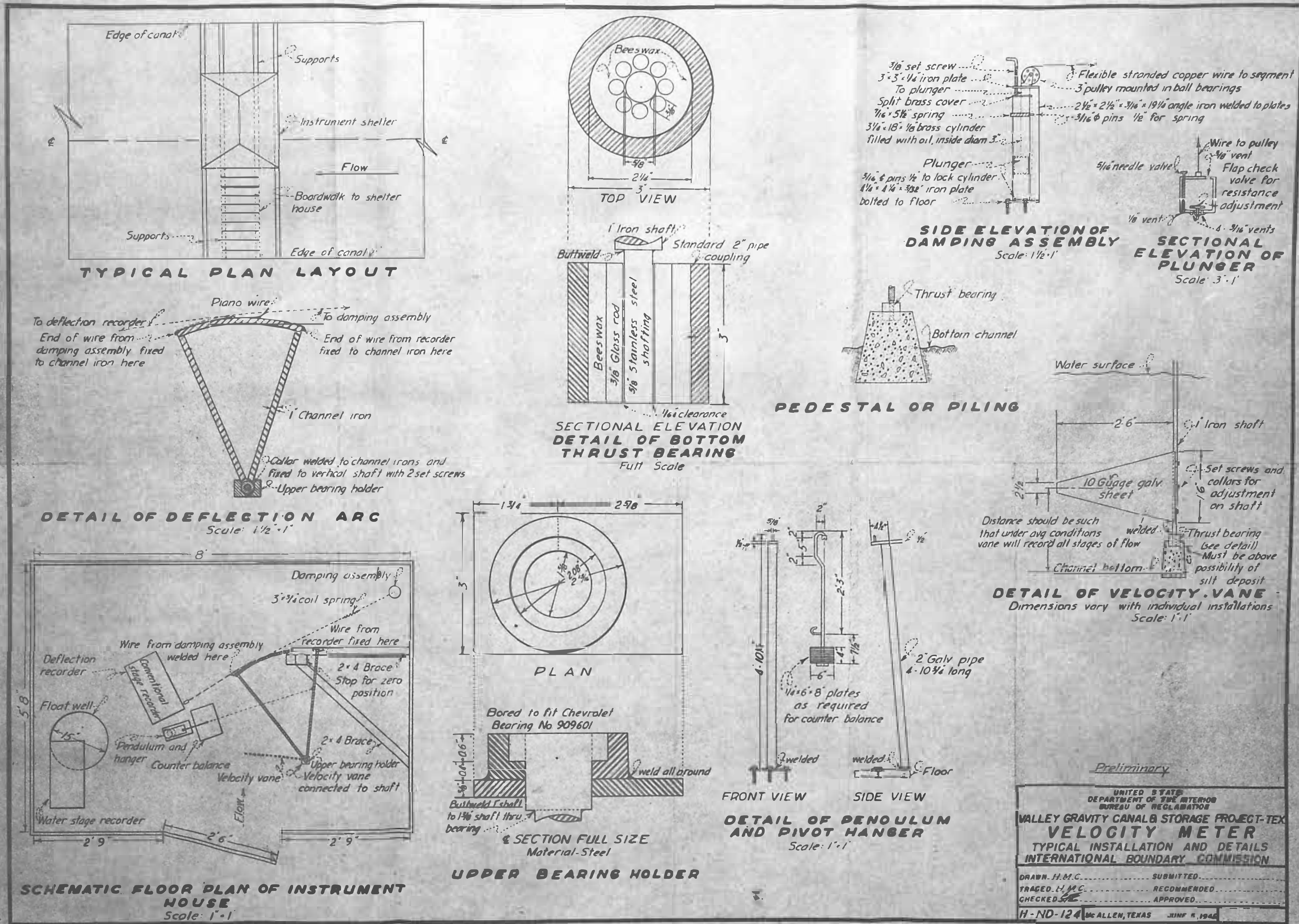
$$F = \frac{\text{Acre feet per hour (determined by current meters)}}{\text{Average gage height x average deflection}}$$

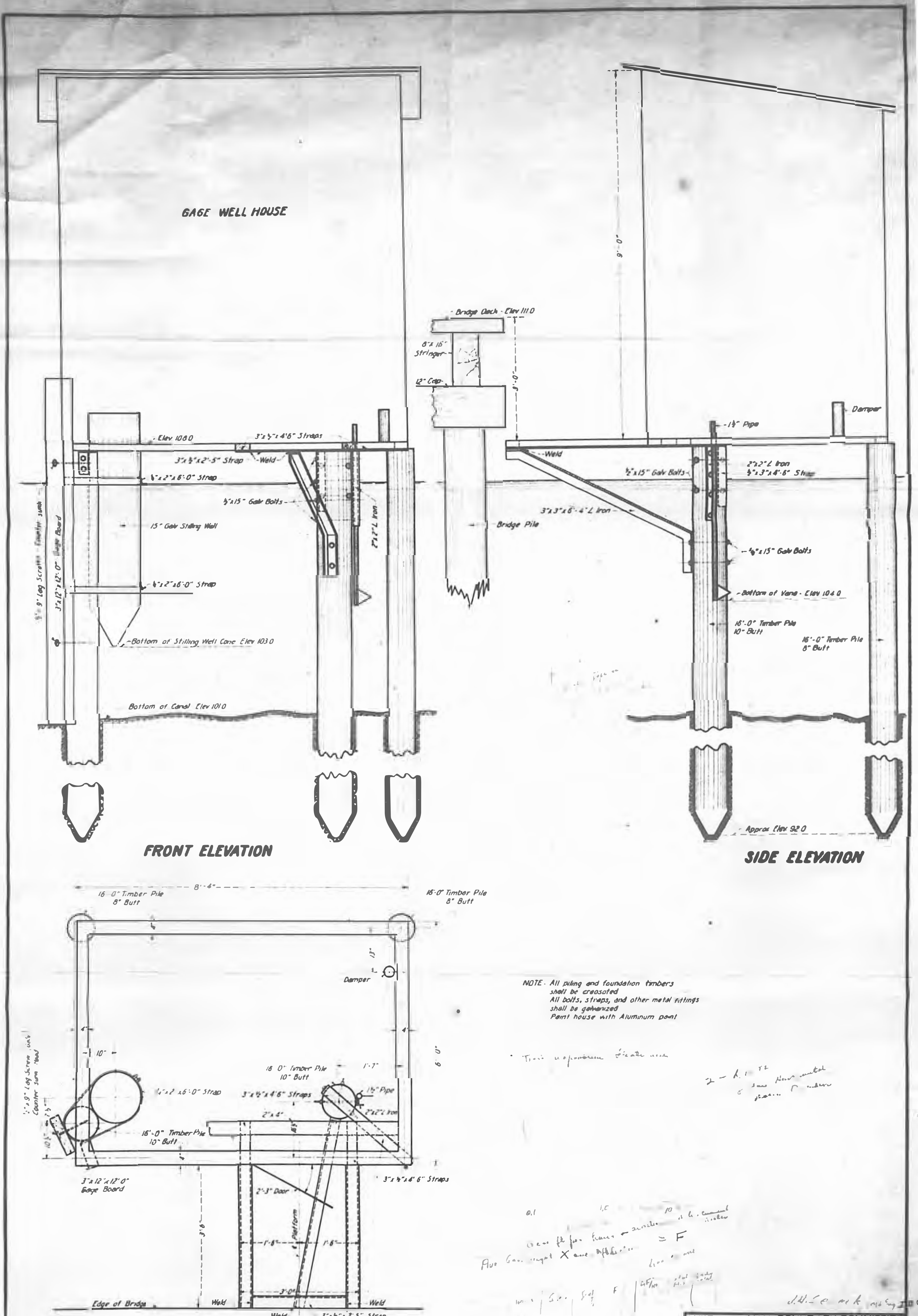
Work plots on semi-log paper showing D (deflection) as abscissa and F as ordinate are used to extend the data obtained from the current meter ratings.

A curve developed in a slightly different manner which shows the "F" - "D" relationship and the resulting table of discharges for the deflection meter station in the Franklin Canal, Rio Grande Project, El Paso, Texas is attached. The procedure used is slightly different from that employed in the lower valley.

CW Thomas

Enclosures


Edge of canal
Supports
Instrument shelter
Flow
Boardwalk to shelter house
Supports
Edge of canal
TYPICAL PLAN LAYOUT
Beeswax
5/8
2 1/4"
3"
TOP VIEW
1" Iron shaft
Buttweld
Standard 2" pipe coupling
Beeswax
3/8" Gloss rod
5/8" Stainless steel shafting
3"
1/16" clearance
SECTIONAL ELEVATION
DETAIL OF BOTTOM THRUST BEARING
Full Scale
3/8 set screw
3 x 3 x 1/4 iron plate
To plunger
Split brass cover
7/16 x 5 1/2 spring
3 1/4 x 18 x 1/8 brass cylinder filled with oil, inside diam 3"
Plunger
3/16 ¢ pins 1/2 to lock cylinder
4 1/4 x 4 1/4 x 3/32 iron plate bolted to floor
Flexible stranded copper wire to segment
3 pulley mounted in ball bearings
2 1/2 x 2 1/2 x 3/16 x 19 1/4 angle iron welded to plates
3/16 ¢ pins 1/2 for spring
SIDE ELEVATION OF DAMPING ASSEMBLY
Scale: 1 1/2 - 1'
Wire to pulley
1/8 vent
5/16 needle valve
Flap check valve for resistance adjustment
1/8 vent
4 - 3/16 vents
SECTIONAL ELEVATION OF PLUNGER
Scale: 3 - 1'
Piano wire
To deflection recorder
To damping assembly
End of wire from damping assembly fixed to channel iron here
End of wire from recorder fixed to channel iron here
1" Channel iron
Collar welded to channel irons and fixed to vertical shaft with 2 set screws
Upper bearing holder
DETAIL OF DEFLECTION ARC
Scale: 1 1/2 - 1'
Thrust bearing
Bottom channel
PEDESTAL OR PILING
Water surface
2'6"
1" Iron shaft
2 1/2
10 Guage galv. sheet
6
Set screws and collars for adjustment on shaft
Distance should be such that under avg conditions vane will record all stages of flow
welded
Thrust bearing (see detail) Must be above possibility of silt deposit
Channel bottom
DETAIL OF VELOCITY VANE
Dimensions vary with individual installations
Scale: 1'-1'
8'
Damping assembly
3 x 3/4 coil spring
Wire from recorder fixed here
Wire from damping assembly welded here
Deflection recorder
Conventional stage recorder
2 x 4 Brace
Stop for zero position
Float well
15"
5'8"
Pendulum and hanger
Counter balance
2 x 4 Brace
Upper bearing holder
Velocity vane
Velocity vane connected to shaft
Flow
Water stage recorder
2'9"
2'6"
2'9"
SCHEMATIC FLOOR PLAN OF INSTRUMENT HOUSE
Scale: 1"-1'
1 3/4
2 5/8
3"
2.08"
2 3/8
PLAN
Bored to fit Chevrolet Bearing No 909601
weld all around
Buttweld I shaft to 1 3/16 shaft thru bearing
℄ SECTION FULL SIZE
Material-Steel
UPPER BEARING HOLDER
5/8
1 1/4
2"
2'3"
4'-10 1/2"
7 1/2
4 1/2
6"
1/4 x 6 x 8 plates as required for counter balance
welded
FRONT VIEW
1/2
2" Galv pipe 4-10 3/4 long
welded
Floor
SIDE VIEW
DETAIL OF PENDULUM AND PIVOT HANGER
Scale: 1'-1'
Preliminary
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
VALLEY GRAVITY CANAL & STORAGE PROJECT-TEX
VELOCITY METER
TYPICAL INSTALLATION AND DETAILS
INTERNATIONAL BOUNDARY COMMISSION
DRAWN H.M.C.
SUBMITTED
TRACED H.M.C.
RECOMMENDED
CHECKED
APPROVED
H-ND-124
McALLEN, TEXAS
JUNE 5, 1946



NOTE - All piling and foundation timbers shall be creosoted
All bolts, straps, and other metal fittings shall be galvanized
Paint house with Aluminum paint

4.40 .18 12

INTERNATIONAL BOUNDARY COMMISSION
UNITED STATES AND MEXICO
AMERICAN SECTION

FLOOD CONTROL PROJECT
LOWER RIO GRANDE, TEXAS
PLAN FOR DEFLECTION METER SHED
PHARR-SAN JUAN MAIN CANAL
GAGING STATION

DRAWN .... RECOMMENDED ....
CHECKED .... APPROVED ....

3590-RH-12 | SAN BENITO, TEX. AUG. 22, 1941

3590 RH 12

"D-FD" TABLE FOR FRANKLIN CANAL KEELER DEFLECTION METER

"FD"

"D"	0	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.3	30.3	30.6	30.8	31.1	30.3	31.6	31.8	32.1	32.3	32.6
.4	32.8	33.0	33.2	33.4	33.6	33.8	34.0	34.1	34.3	34.4
.5	34.6	34.8	34.9	35.1	35.2	35.4	35.5	35.6	35.8	35.9
.6	36.0	36.1	36.2	36.3	36.4	36.5	36.6	36.6	36.7	36.7
.7	36.8	36.8	36.9	36.9	37.0	37.0	37.0	37.0	37.1	37.1
.8	37.1	37.1	37.1	37.2	37.2	37.2	37.2	37.2	37.3	37.3
.9	37.3	37.3	37.3	37.4	37.4	37.4	37.4	37.4	37.5	37.5
1.0	37.5	37.5	37.5	37.6	37.6	37.6	37.6	37.6	37.7	37.7
1.1	37.7	37.7	37.7	37.8	37.8	37.8	37.8	37.9	37.9	38.0
1.2	38.0	38.1	38.3	38.4	38.6	38.7	38.8	39.0	39.1	39.3
1.3	39.4	39.6	39.7	39.9	40.0	40.2	40.3	40.5	40.6	40.8
1.4	40.9	41.1	41.2	41.4	41.5	41.7	41.9	42.0	42.2	42.3
1.5	42.5	42.7	42.8	43.0	43.1	43.3	43.4	43.6	43.7	43.9
1.6	44.0	44.2	44.3	44.5	44.6	44.8	45.0	45.1	45.3	45.4
1.7	45.6	45.8	45.9	46.1	46.2	46.4	46.6	46.7	46.9	47.0
1.8	47.2	47.3	47.5	47.6	47.8	47.9	48.0	48.1	48.3	48.4
1.9	48.5	48.6	48.7	48.9	49.0	49.1	49.2	49.3	49.4	49.5
2.0	49.6	49.7	49.8	49.9	50.0	50.1	50.2	50.3	50.4	50.5
2.1	50.6	50.7	50.8	50.8	50.9	51.0	51.1	51.2	51.3	51.4
2.2	51.5	51.6	51.7	51.8	51.9	52.0	52.1	52.2	52.2	52.3
2.3	52.4	52.5	52.6	52.6	52.7	52.8	52.9	53.0	53.1	53.2
2.4	53.3	53.4	53.5	53.5	53.6	53.7	53.8	53.8	53.9	53.9
2.5	54.0	54.1	54.1	54.2	54.2	54.3	54.4	53.4	53.5	53.5
2.6	54.6	54.6	54.7	54.7	54.8	54.8	54.9	54.9	55.0	55.0
2.7	55.1	55.1	55.2	55.2	55.3	55.3	55.3	55.3	55.4	55.4
2.8	55.4	55.4	55.5	55.5	55.6	55.6	55.6	55.7	55.7	55.8
2.9	55.8	55.8	55.8	55.9	55.9	55.9	55.9	55.9	56.0	56.0
3.0	56.0	56.0	56.0	56.1	56.1	56.1	56.1	56.1	56.2	56.2
3.1	56.2	56.2	56.2	56.3	56.3	56.3	56.3	56.3	56.3	56.3
3.2	56.3	56.3	56.3	56.4	56.4	56.4	56.4	56.4	56.4	56.4
3.3	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4
3.4	56.4	56.4	56.4	56.3	56.3	56.3	56.3	56.3	56.3	56.3
3.5	56.3	56.3	56.3	56.2	56.2	56.2	56.2	56.2	56.2	56.2
3.6	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2
3.7	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2
3.8	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2
3.9	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2
4.0	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2
4.1	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2	56.2
4.2	56.2	56.2	56.2	56.2	56.2	56.2	56.3	56.3	56.3	56.3
4.3	56.3	56.3	56.4	56.4	56.5	56.5	56.6	56.6	56.7	56.7
4.4	56.8	56.9	57.0	57.0	57.1	57.2	57.3	57.4	57.4	57.5
4.5	57.6	57.7	57.8	57.8	57.9	58.0	58.1	58.2	58.2	58.3
4.6	58.4	58.5	58.6	58.6	58.7	58.8	58.9	59.0	59.0	59.1
4.7	59.2	59.3	59.4	59.4	59.5	59.6	59.7	59.8	59.8	59.9

NOTE To determine discharge take "D" from Recorder chart and read value of "FD" from Table corresponding to "D", and then multiply "FD" by Gage Height. The result is the Canal discharge.
Correct the discharge according to last current meter measurement.

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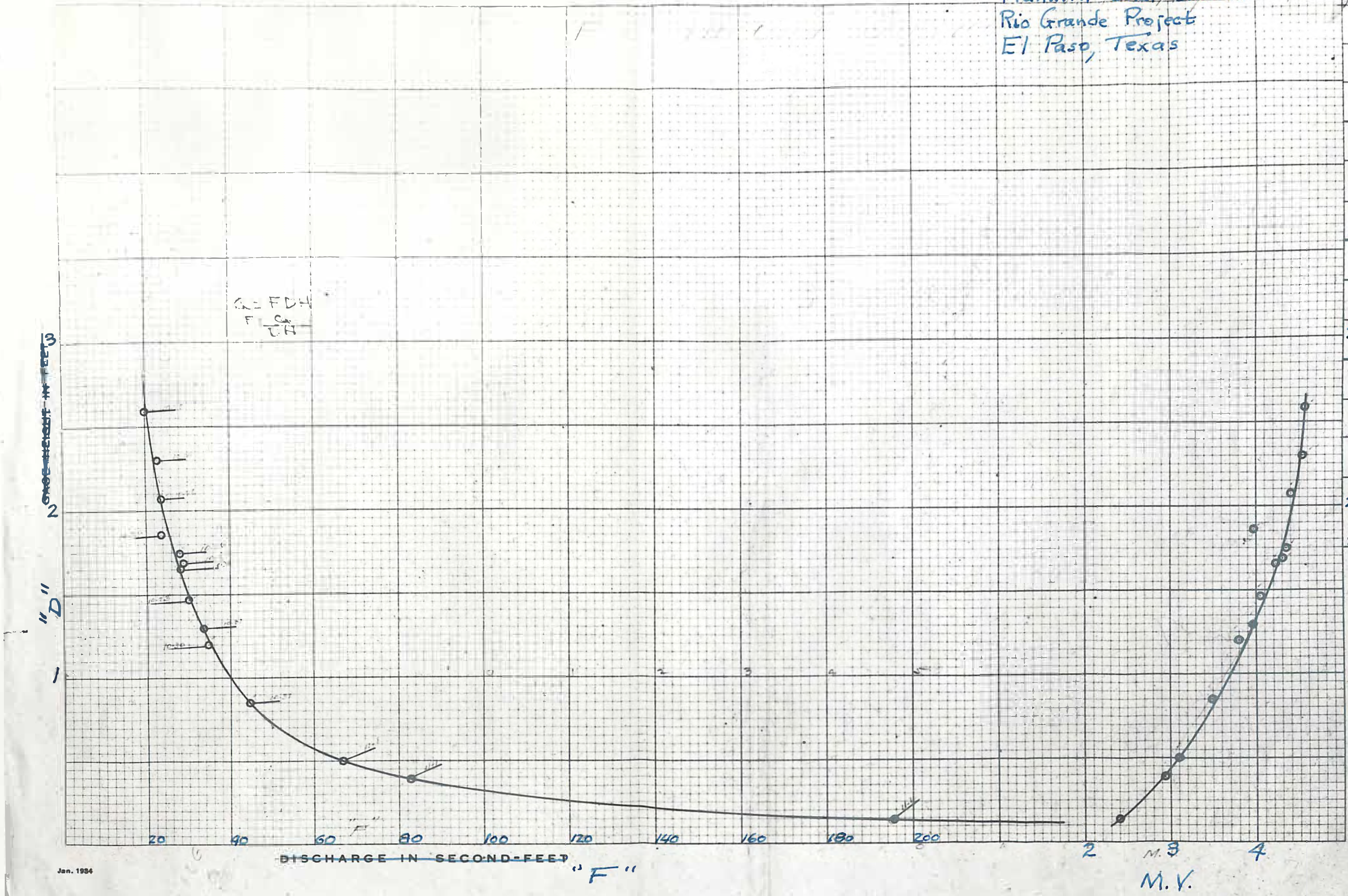
DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

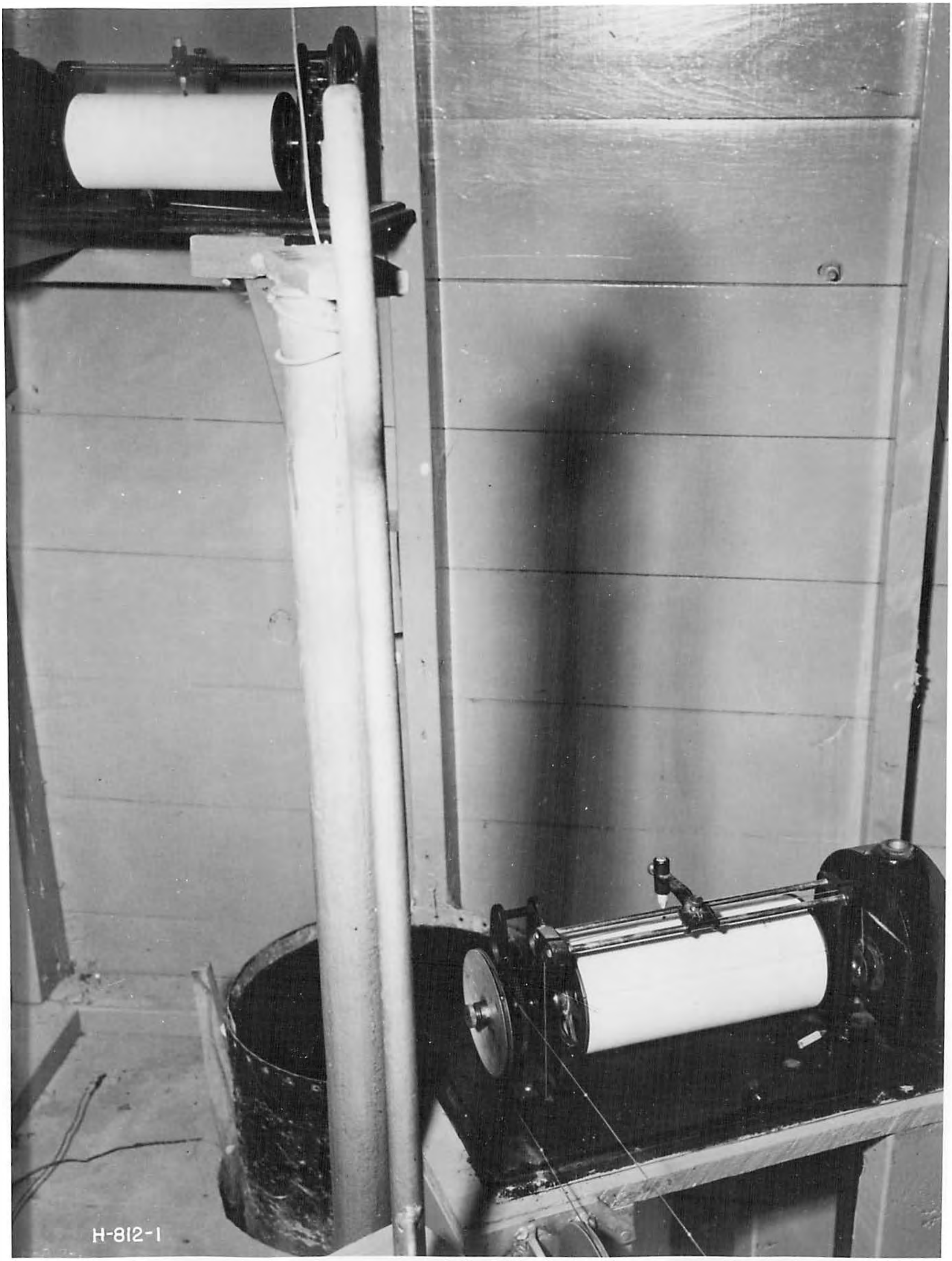
RATING CURVE FOR Keeler Meter
Franklin Canal Station
Rio Grande Project
El Paso, Texas

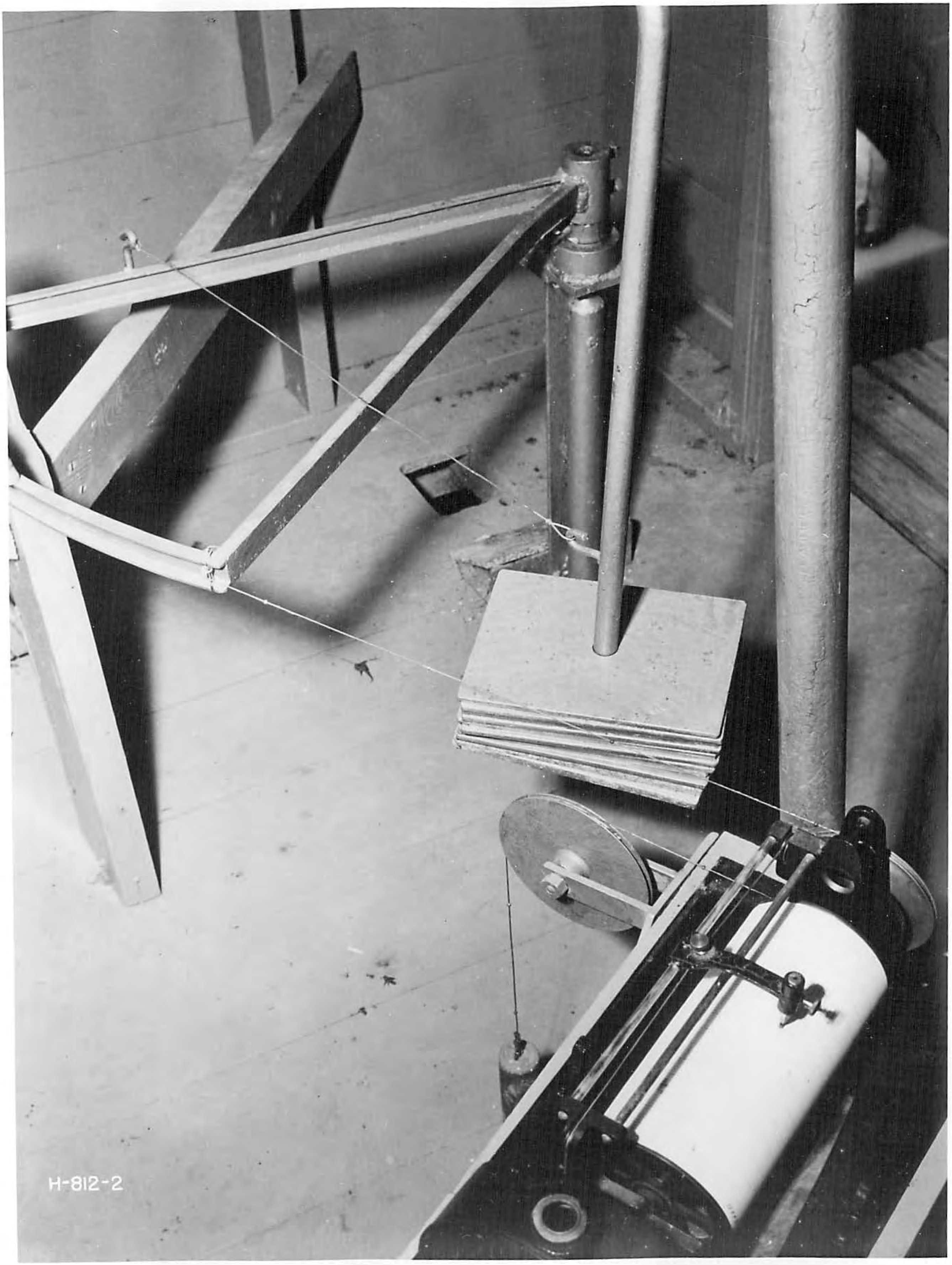
File No. { Washington .... Field ....



Year	Meas. Nos.	Max. G. H.	Min. G. H.	Plotted by	Checked by

Jan. 1934


H-812-1


H-812-2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DO NOT TRESPASS
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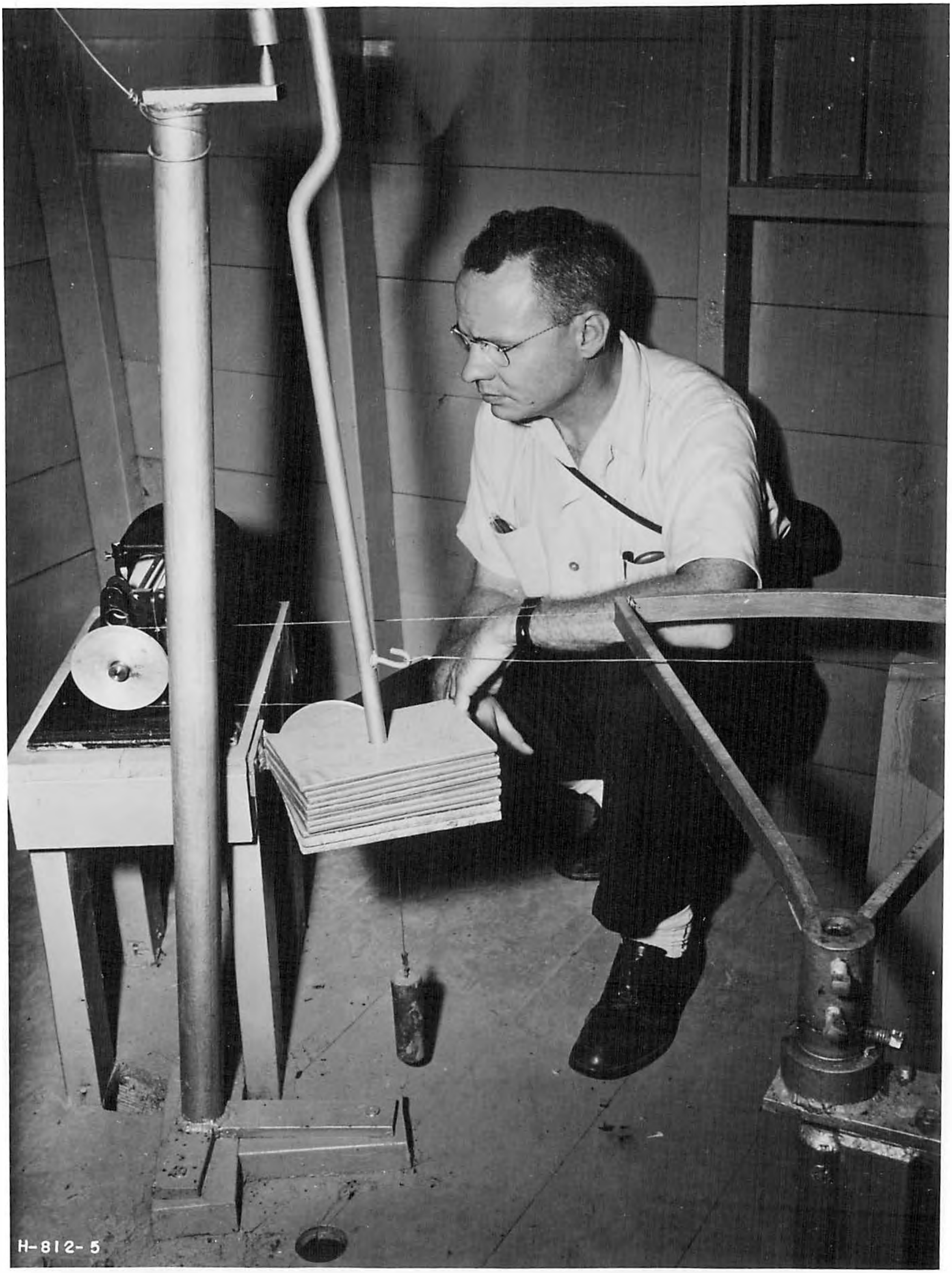
BOUNDARY
COMM.
H-812-3


H-812-4


H-812-5