STANDARD FORM NO. 64

HYDRAULICS BRANCH
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PAP-95

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Memorandum

TO : Files

Denver, Colorado
DATE: May 31, 1957

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WHEN BORROWED RETURN PROMPTLY

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

PAP 95

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.

C. W. Thomas

Enclosures

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

"D"	"FD" 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.

7-42

7 221 DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

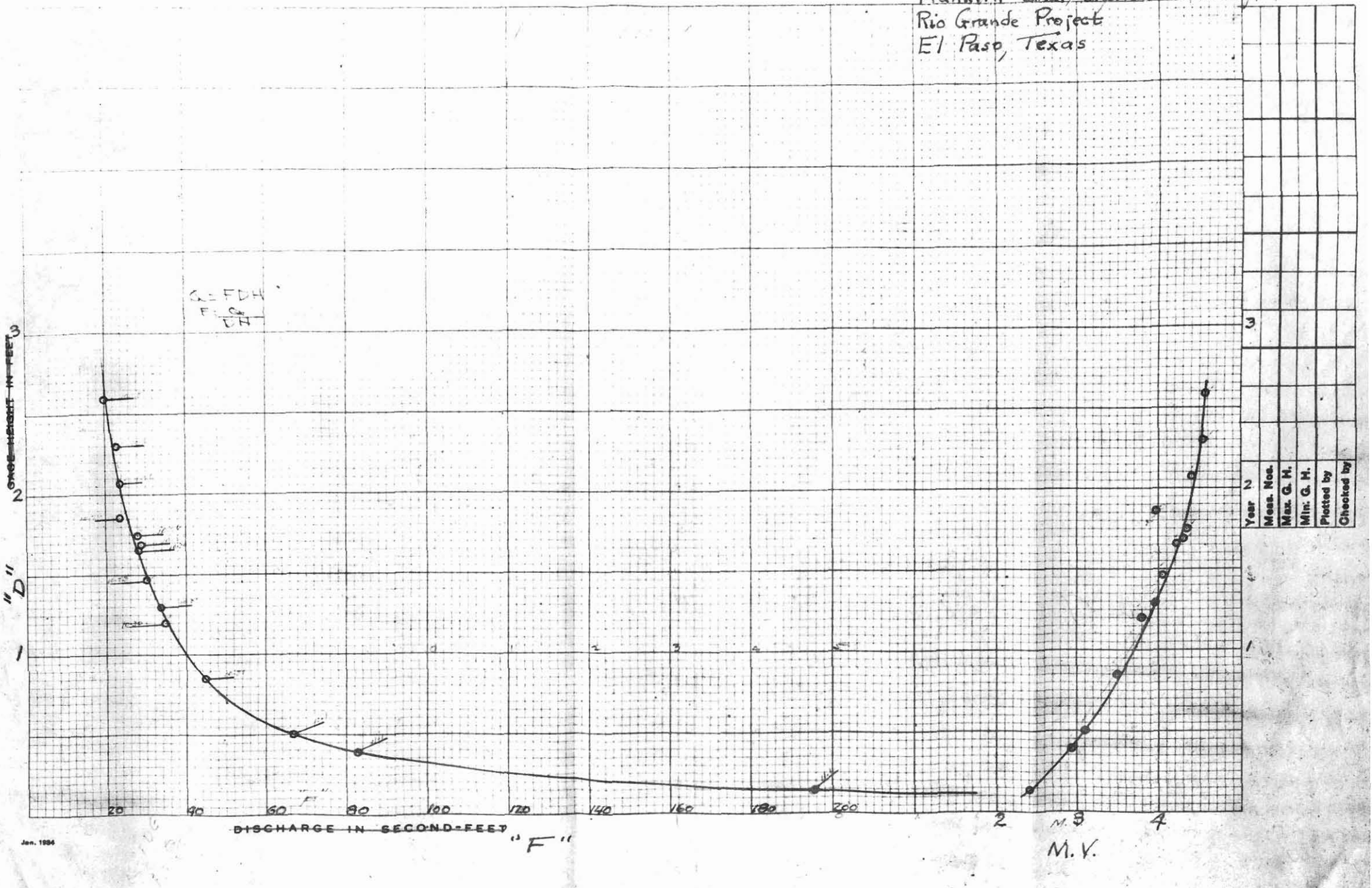
RATING CURVE FOR Keeler Meter

Franklin Canal, Station

Rio Grande Project

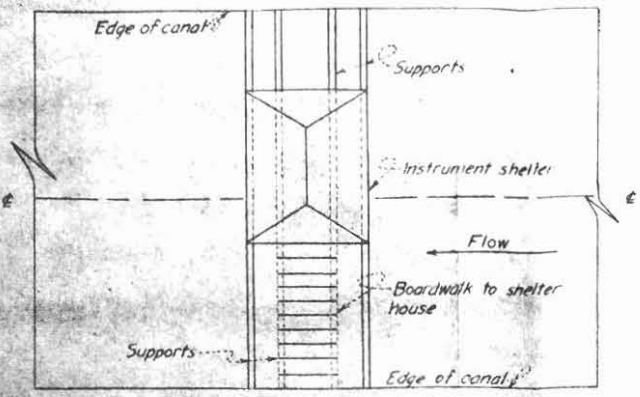
El Paso, Texas

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

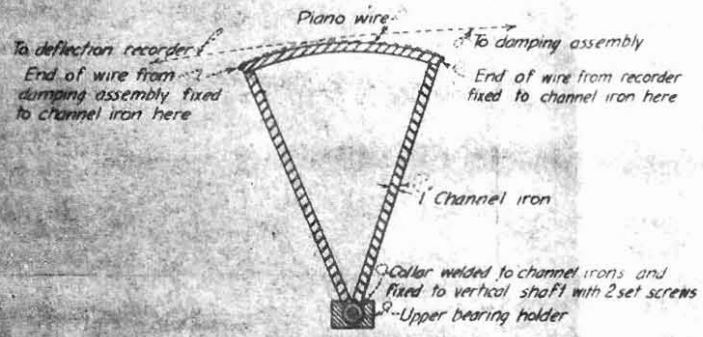


Year	
Meas. Nos.	
Max. G. H.	
Min. G. H.	
Plotted by	
Checked by	

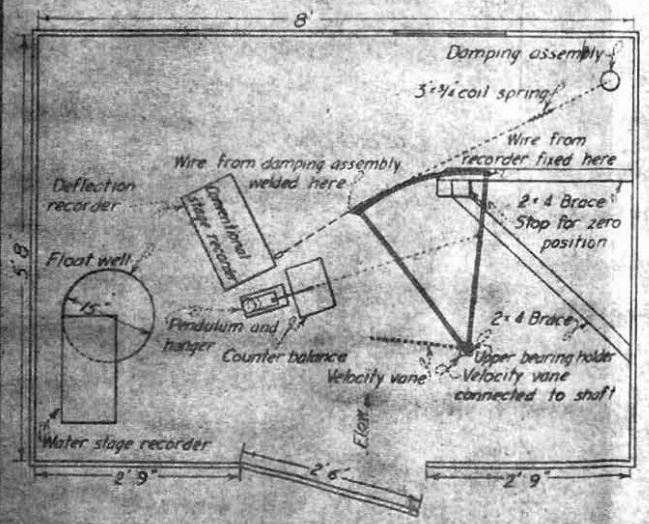
Jan. 1934



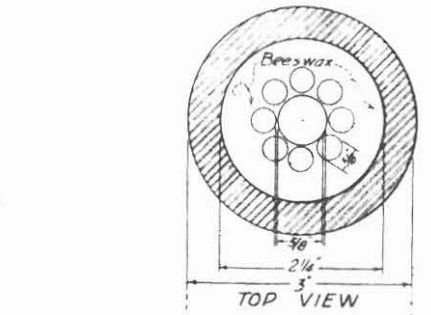
TYPICAL PLAN LAYOUT



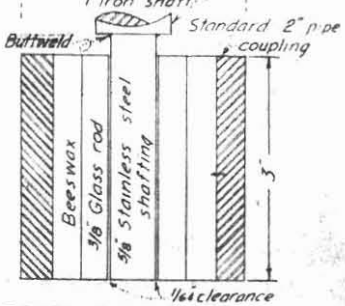
DETAIL OF DEFLECTION ARC
Scale 1½"-1'



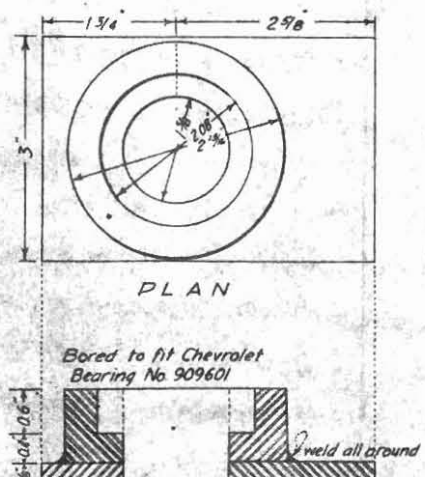
SCHEMATIC FLOOR PLAN OF INSTRUMENT HOUSE
Scale 1"-1'



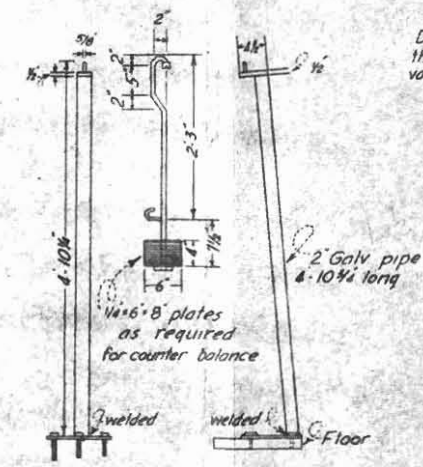
TOP VIEW



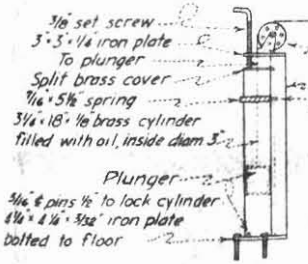
SECTIONAL ELEVATION
DETAIL OF BOTTOM THRUST BEARING
Full Scale



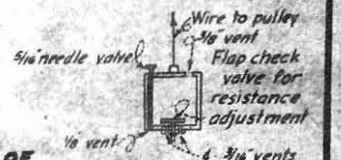
UPPER BEARING HOLDER



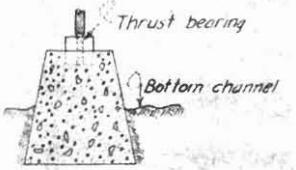
FRONT VIEW SIDE VIEW
DETAIL OF PENDULUM AND PIVOT HANGER
Scale 1"-1'



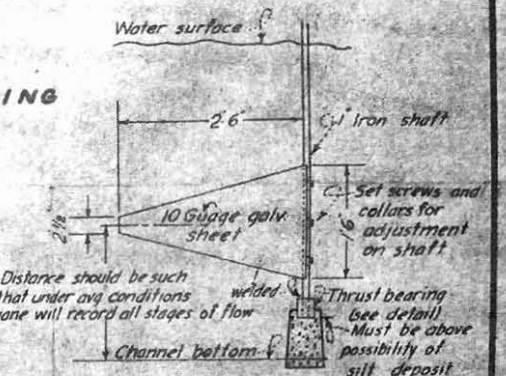
SIDE ELEVATION OF DAMPING ASSEMBLY
Scale 1½"-1'



SECTIONAL ELEVATION OF PLUNGER
Scale 3"-1'



PEDESTAL OR PILING



DETAIL OF VELOCITY VANE
Dimensions vary with individual installations
Scale 1"-1'

Preliminary

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

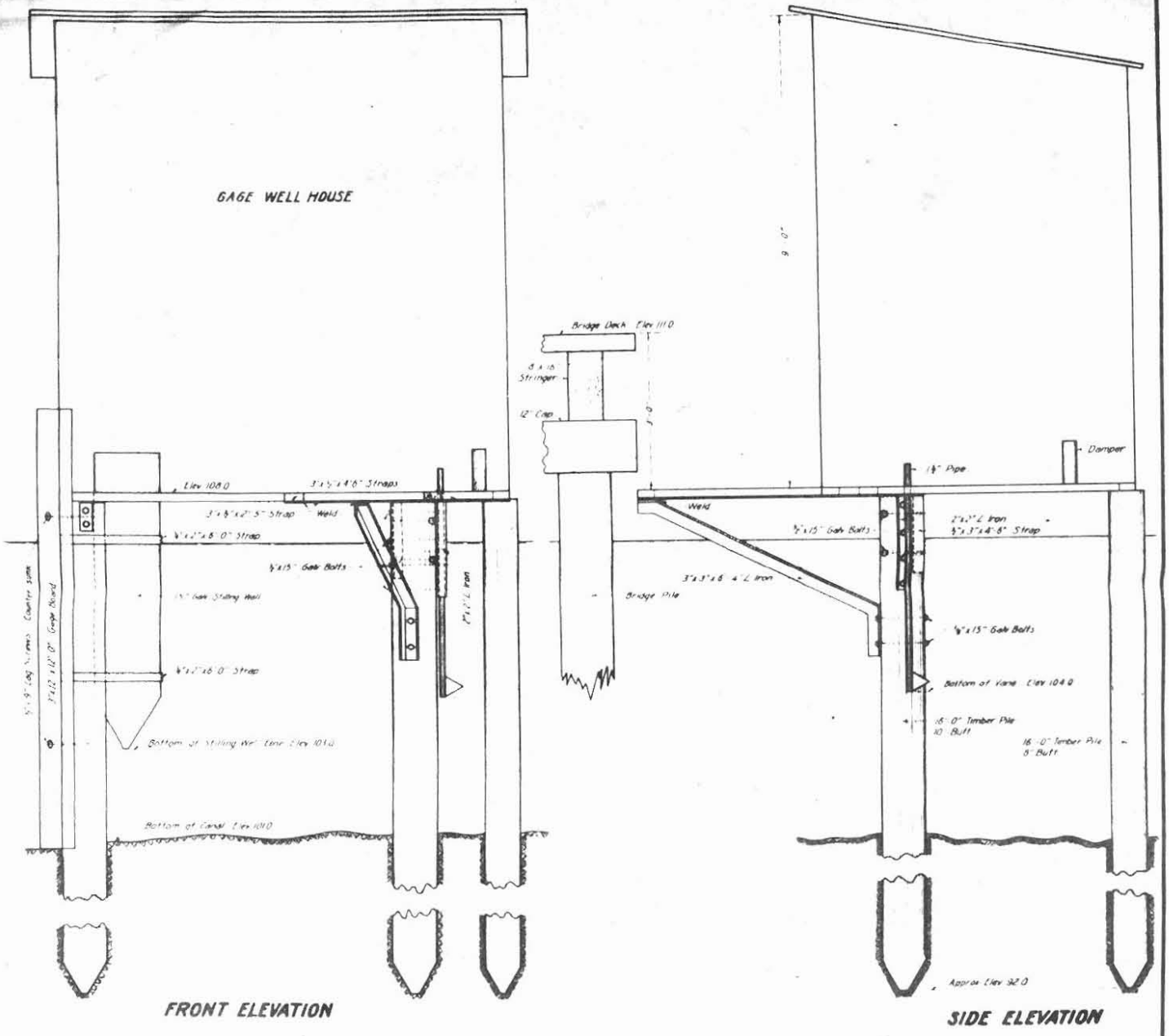
VALLEY GRAVITY CANAL & STORAGE PROJECT-TEX

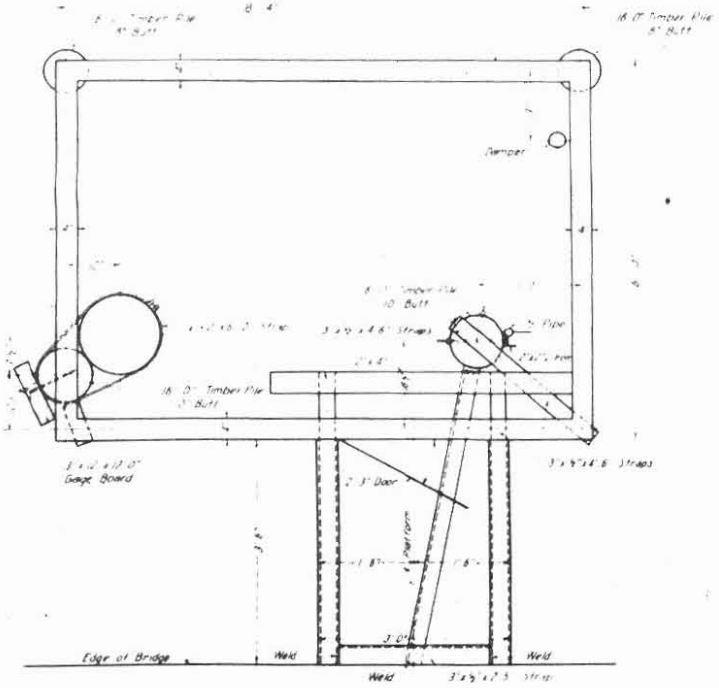
VELOCITY METER

TYPICAL INSTALLATION AND DETAILS
INTERNATIONAL BOUNDARY COMMISSION

DRAWN H.M.C.	SUBMITTED
TRACED H.M.C.	RECOMMENDED
CHECKED	APPROVED

H-ND-124 ALLEN, TEXAS JUNE 8, 1946

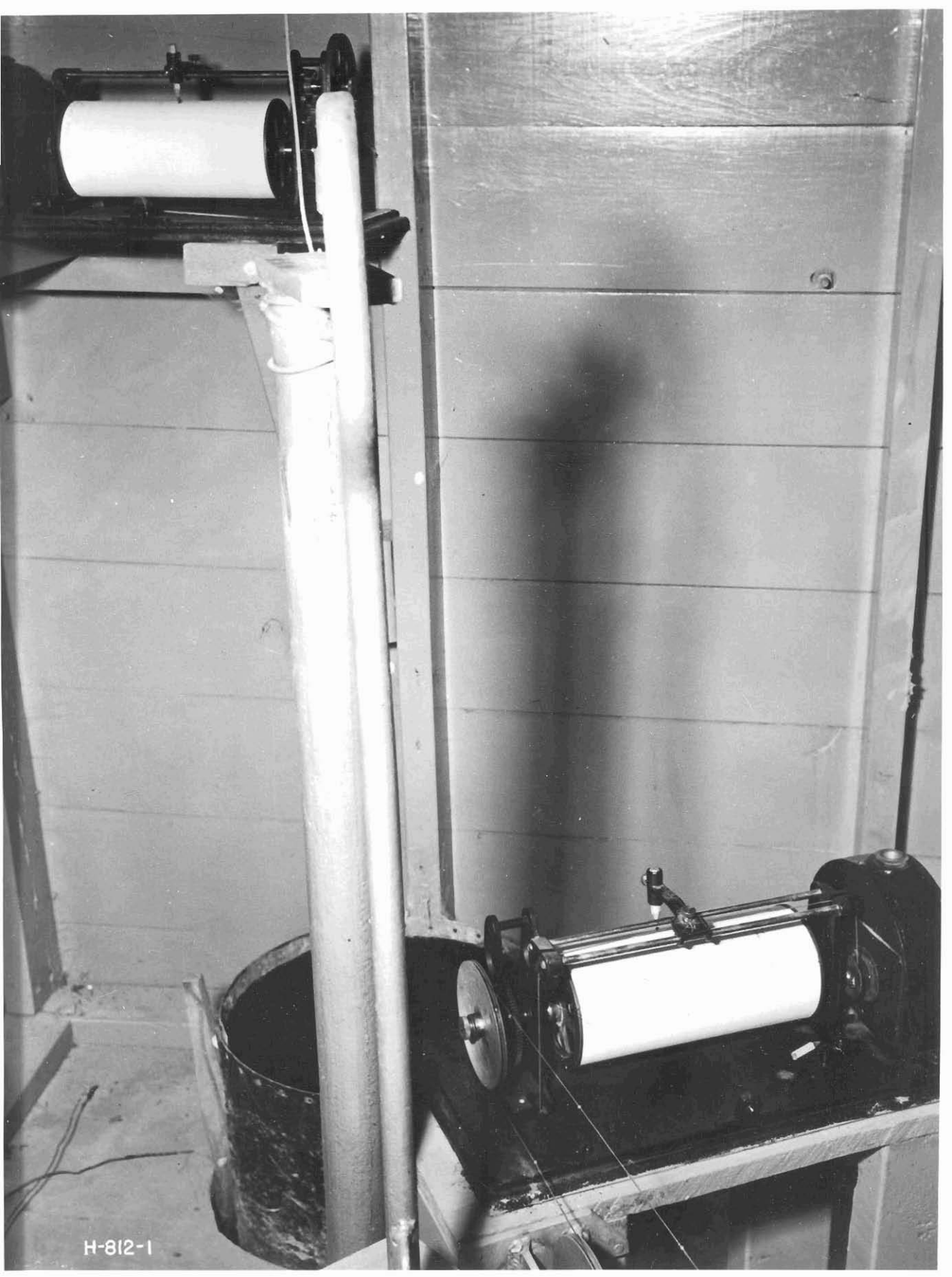


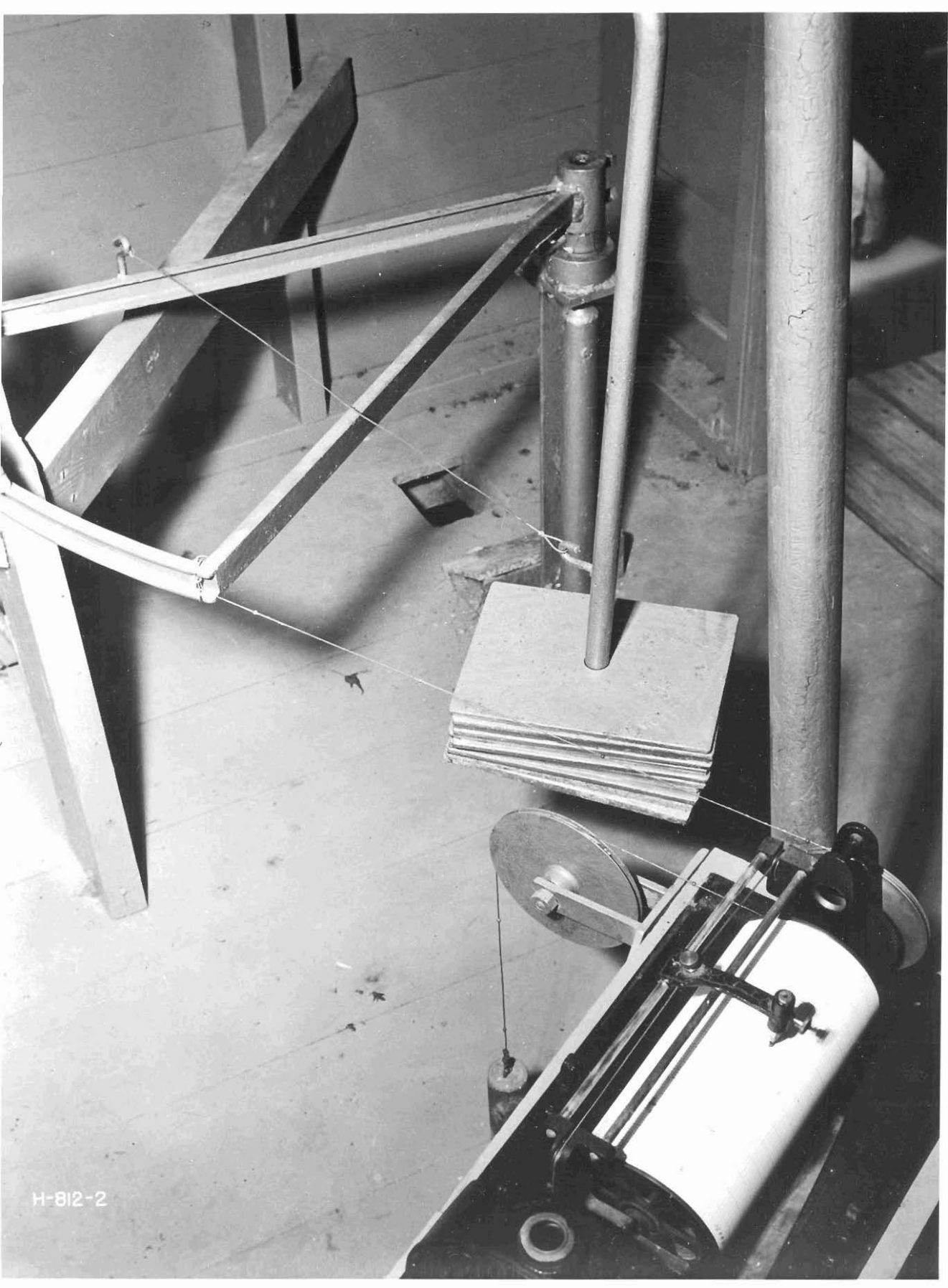


PLAN

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

INTERNATIONAL BOUNDARY COMMISSION
UNITED STATES AND MEXICO
AMERICAN SECTION
FLOOD CONTROL PROJECT
LOWER RIO GRANDE, TEXAS

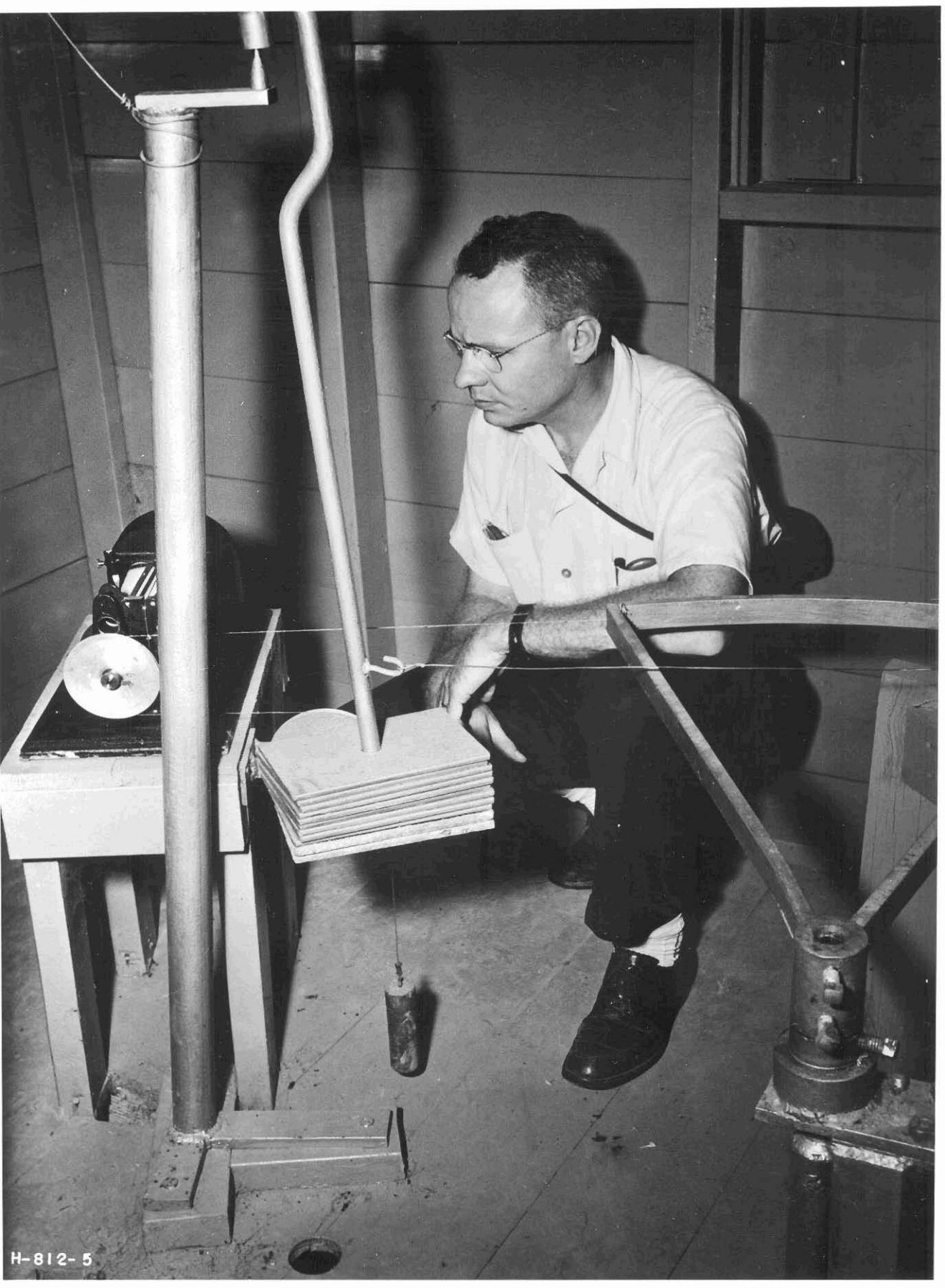

H-812-1


H-812-2

PROPERTY
OF THE
GOVERNMENT
DO NOT TRESPASS
INTERNATIONAL
BOUNDARY
COMM.

H-812-3

H-812-



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