THE EFFECTS OF BEARING WEAR AND INDUCED FLUID ROTATION ON SEVERAL FLOWMETERS

by

F. Videon and S. S. Karaki

Conducted for

The Martin Company, Denver Division

Colorado State University
Civil Engineering Section
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INTRODUCTION

The studies reported herein were undertaken to determine qualitatively the effects of bearing wear and induced swirls on the performance characteristics of several turbine-type flowmeters.

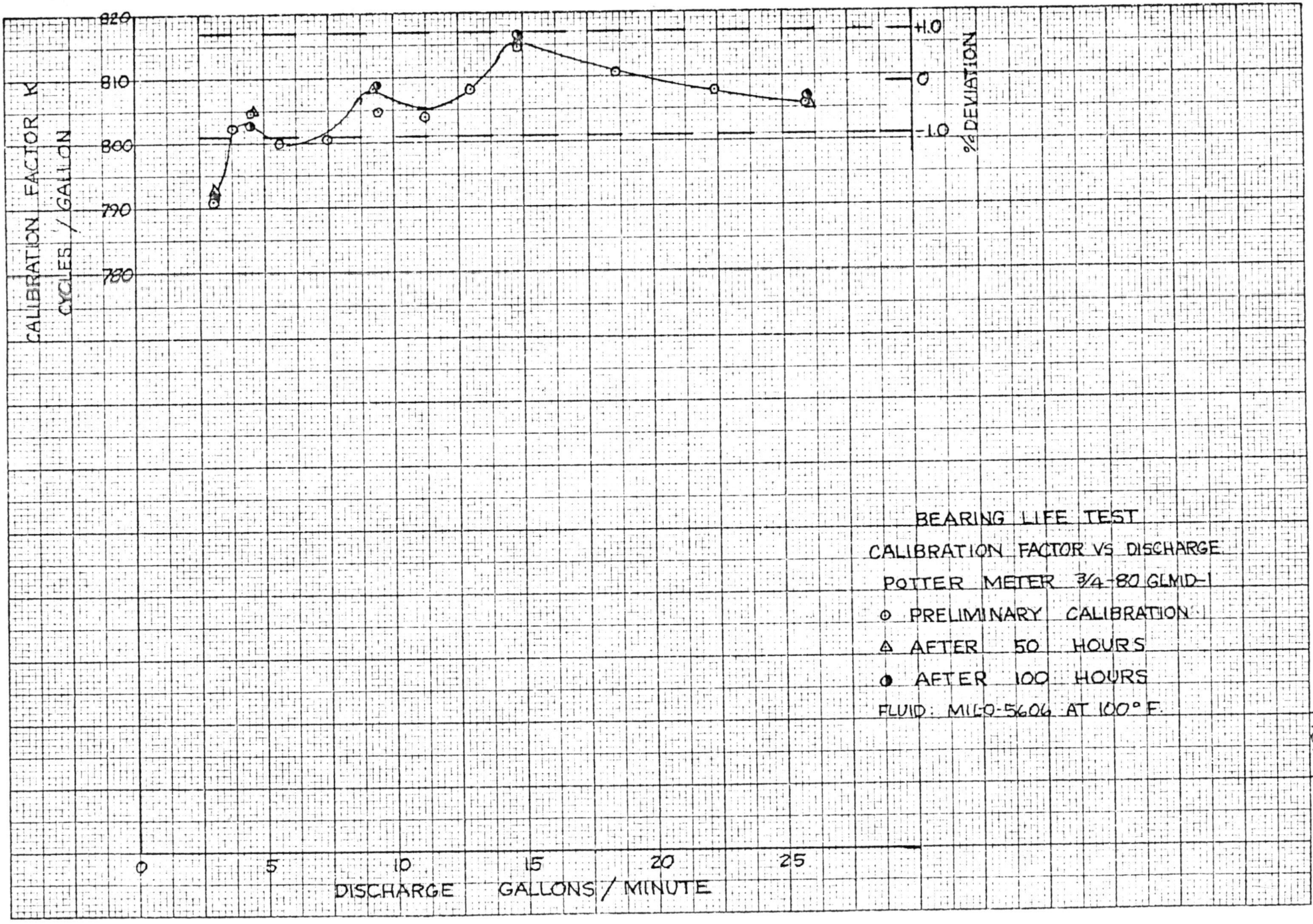
BEARING WEAR

The flowmeters used in the study of bearing wear were: Potter Aeronautical Models 3/4-80 and 2-353A and the Waugh Models FL-125 (3/4 inch) and FB-32-101 (2 inch).

The tests on bearing wear were conducted by running each flowmeter for a period of 100 hours at approximately 3/4 of the maximum discharge recommended by the vendors. The flowmeters were calibrated before, during, and after the 100-hour runs in order to evaluate the effects of wear, if any, on the calibration curve. The fluids used were MIL-0-5606 hydraulic oil with the 3/4-inch flowmeters and water with the 2-inch flowmeters.

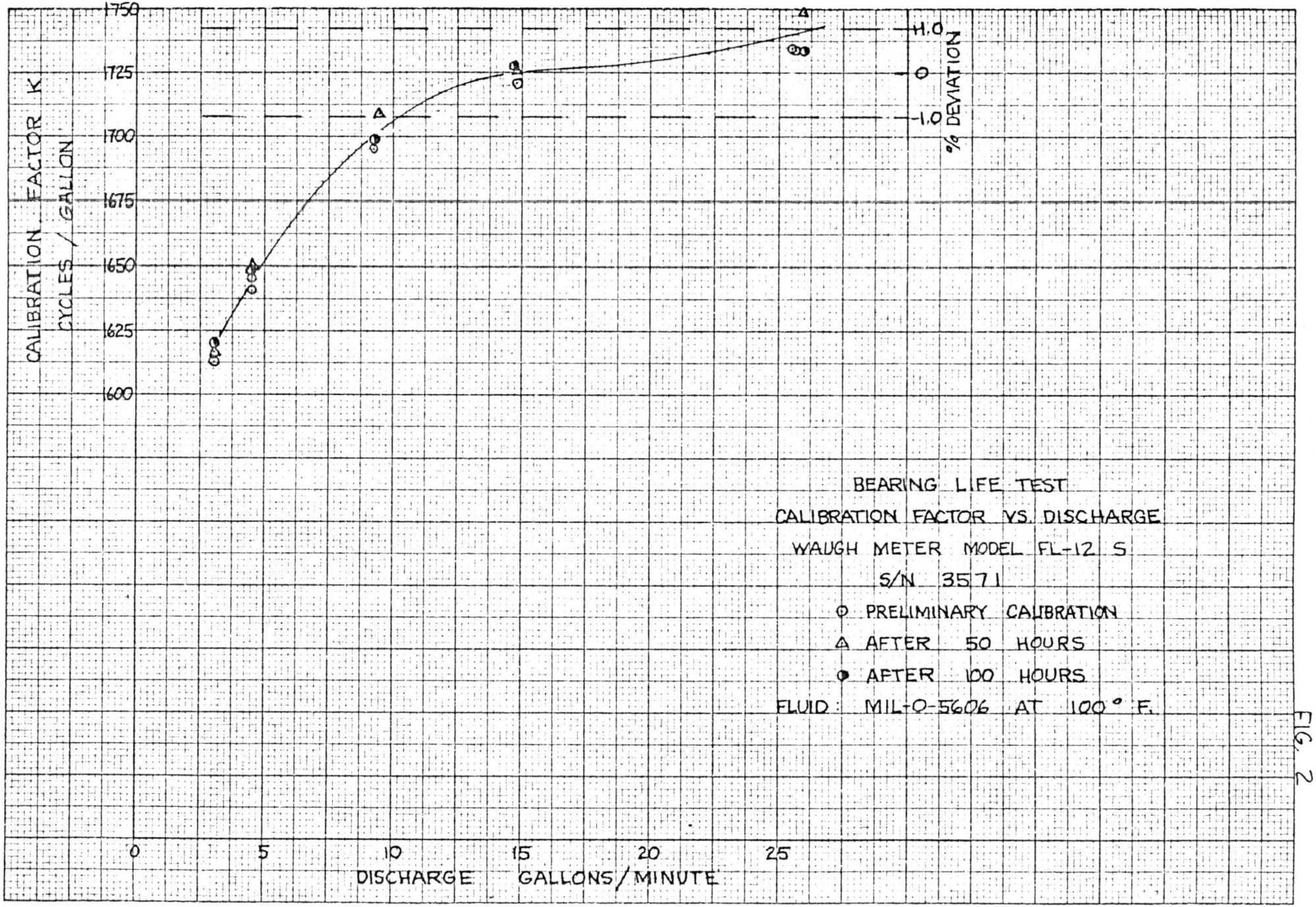
EXPERIMENTAL RESULTS AND OBSERVATIONS

Figures 1 to 4 are plots of the calibration factor in cycles per gallon versus volumetric discharge in gallons per minute for the calibrations before, during, and after the 100-hour test runs. These curves indicated no significant nor systematic change of the calibration curves, suggesting that no significant effect of bearing wear registered during the 100 hours of meter use. This observation is limited to use of these meters with water and oil. Bearing wear of flowmeters with cryogenic fluids at ambient temperatures of about $-300^{0}F$ may have different effects on the calibration curve. To conduct such studies it will be desirable to keep a log for specific meters and to recalibrate these meters from time to time during regular intervals.



BEARING LIFE TEST
CALIBRATION FACTOR VS DISCHARGE
POTTER METER 3/4-80 GLMD-1
⊙ PRELIMINARY CALIBRATION
△ AFTER 50 HOURS
◑ AFTER 100 HOURS
FLUID: MIL-O-5606 AT 100° F

FIG. 1



BEARING LIFE TEST
CALIBRATION FACTOR VS. DISCHARGE
WAUGH METER MODEL FL-12 S
S/N 3571
⊙ PRELIMINARY CALIBRATION
△ AFTER 50 HOURS
● AFTER 100 HOURS
FLUID: MIL-O-5606 AT 100° F.

FIG. 2

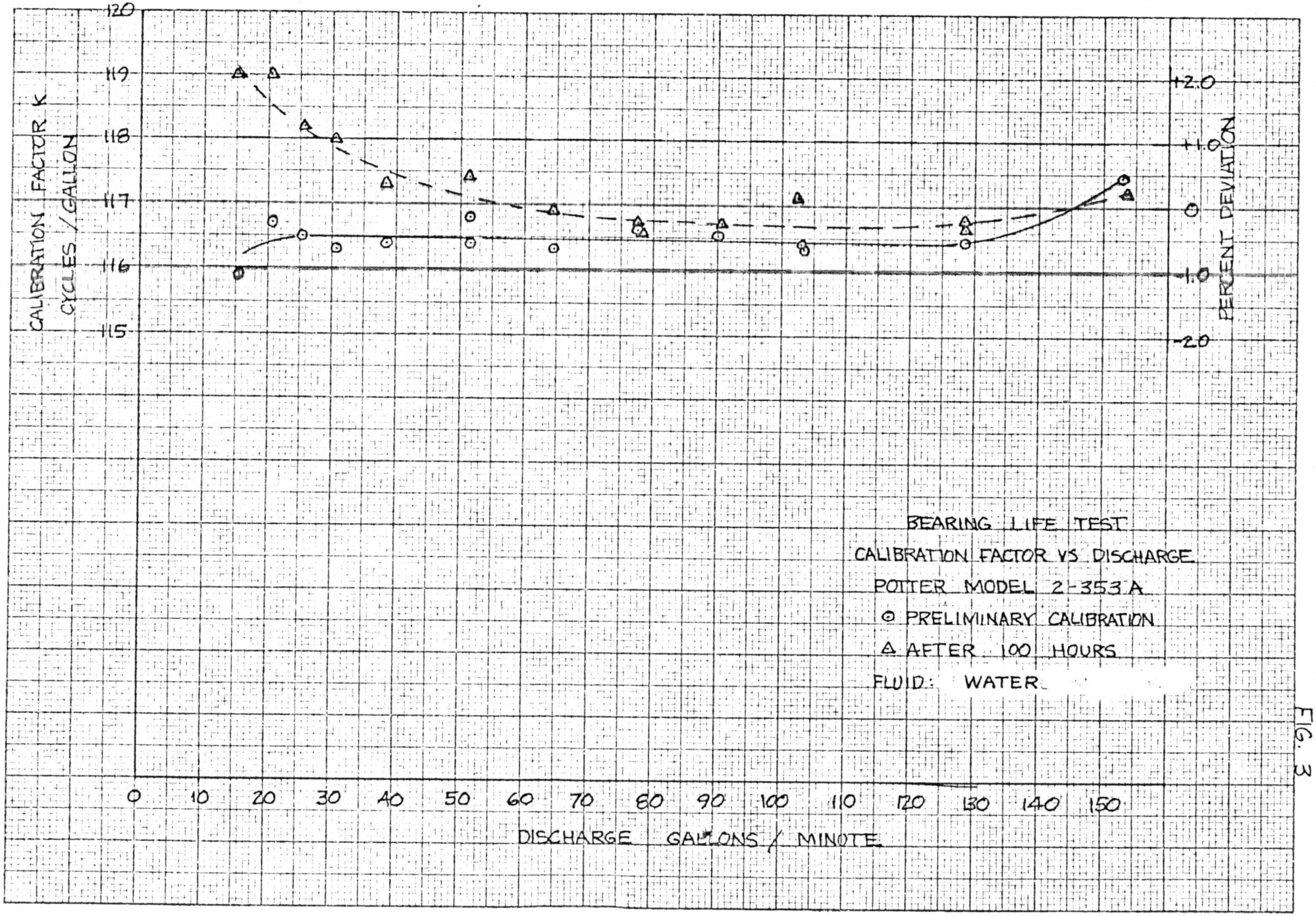


FIG. 3

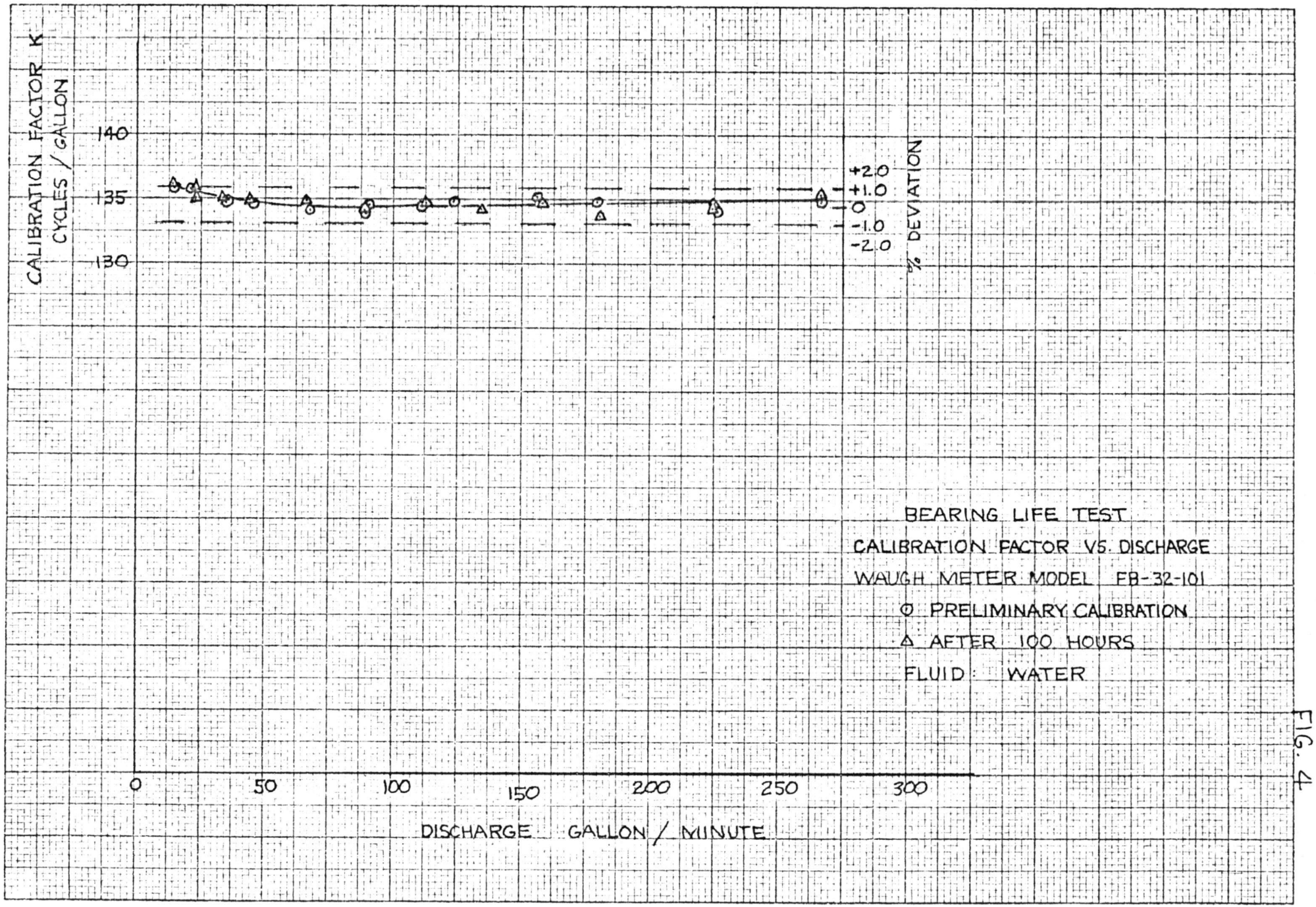


FIG. 4

INDUCED SWIRLS

The flowmeters used for this study included Potter Aeronautical Models 3/4-308, and 2-353A, Waugh Models FF-12-101 (3/4 inch) and FB-32-101 (2 inches), and Fischer and Porter Models 5906 A1 (3/4 inch), and 10C1505 (2 inches). The meter rotation for all of the flowmeters was counterclockwise looking downstream into the meter.

Vanes were used in the approach pipeline adjacent to the meters to induce swirls in the flow field, both with the rotor rotation and in counter-rotation (clockwise movement) to the rotor of the flowmeters. A vane of one revolution in 4 feet was used to induce the swirl for the two-inch meter studies and a vane of one revolution in 1 foot 4-inch was used for the 3/4-inch meters. The type of vane used is shown in Fig. 5.

Oil was used with the 3/4-in meters while water was used for the 2-inch meters.

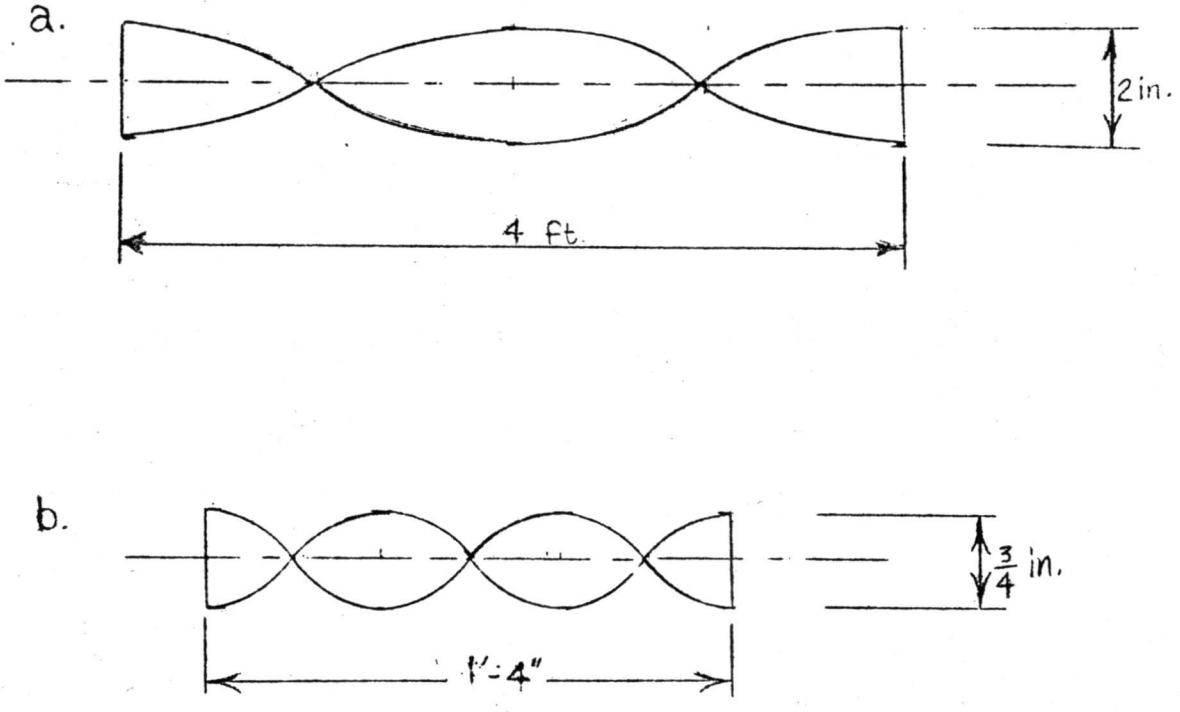


Fig. 5. Vanes used to induce swirls. (a) For two-inch line (b) For 3/4-inch line.

EXPERIMENTAL RESULTS AND OBSERVATIONS

The results of the tests were qualitative and no attempt was made to determine the mechanics of the fluid motion induced by the vanes. Figs. 6 to 11 are plots of the calibration factors in cycles per gallon versus the discharges in gallons per minute. The curves show normal conditions with no fluid rotation, with counterclockwise rotation, (rotation with the turbine), and with clockwise rotation of the flow field (counter-rotation with the rotor). In Figs. 6 - 8 the 3/4-inch flowmeters show differences between the normal flow and counterclockwise rotation of about 2 per cent , while the clockwise flow field produced little change from the normal condition. The induced swirls through the 2-inch flowmeters had very little effect on the calibration curves.

CONCLUSION AND RECOMMENDATIONS

The studies of induced fluid rotation for 3/4 and 2-inch flowmeters showed that some effect on the coefficient of turbine-type meters can be expected for variation from normal flow conditions. Since the rotor blade angle is designed for axial flow, any directional component of velocity deviating from normal will affect the speed of rotation.

It is recommended therefore, that where possible, a straight length of approach pipe be used immediately upstream from a turbine meter. Normally, a length of about twenty diameters is required to establish the flow profile, but where straightening vanes are used with the turbine meters, this requirement can be substantially reduced.

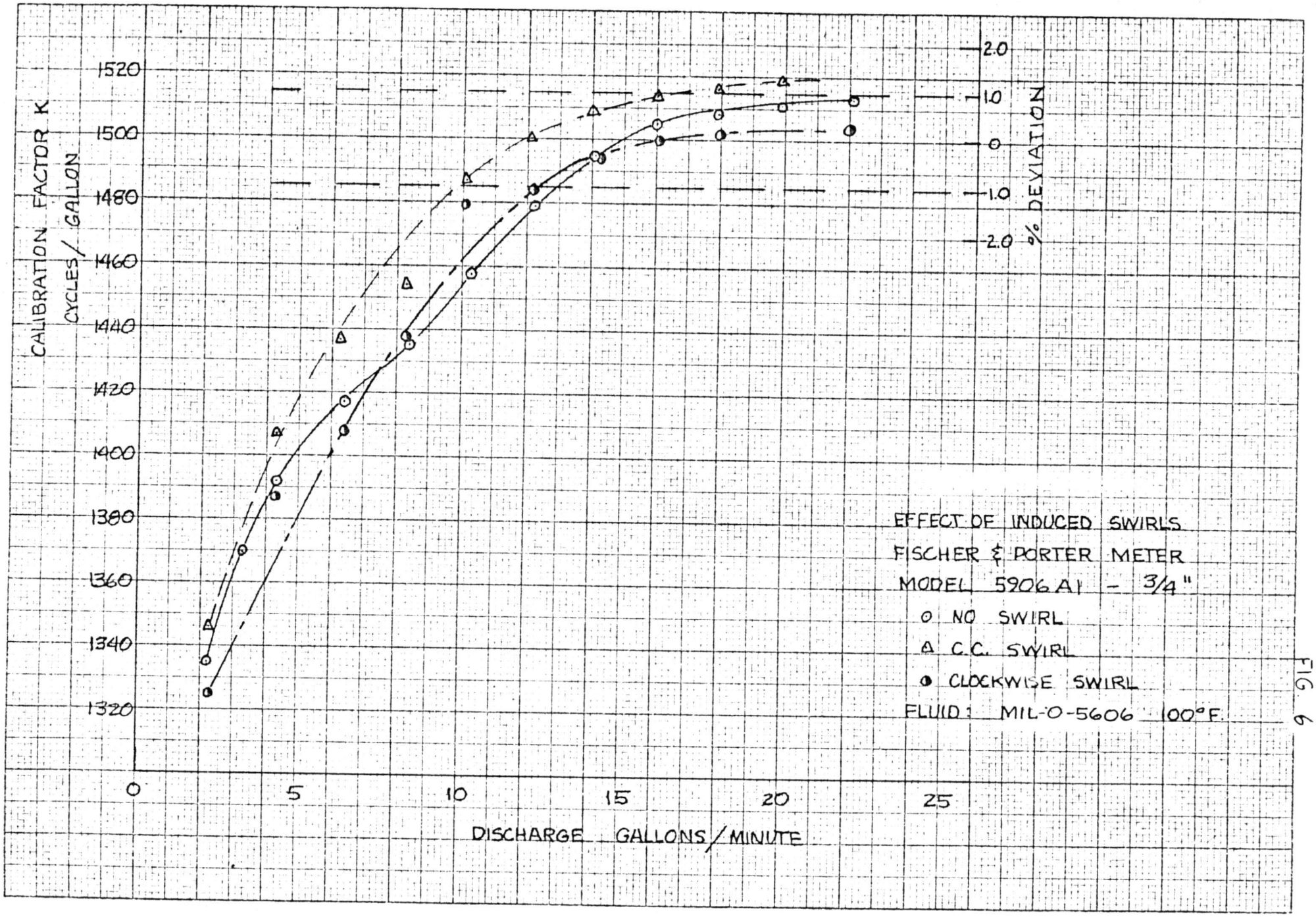


FIG 6

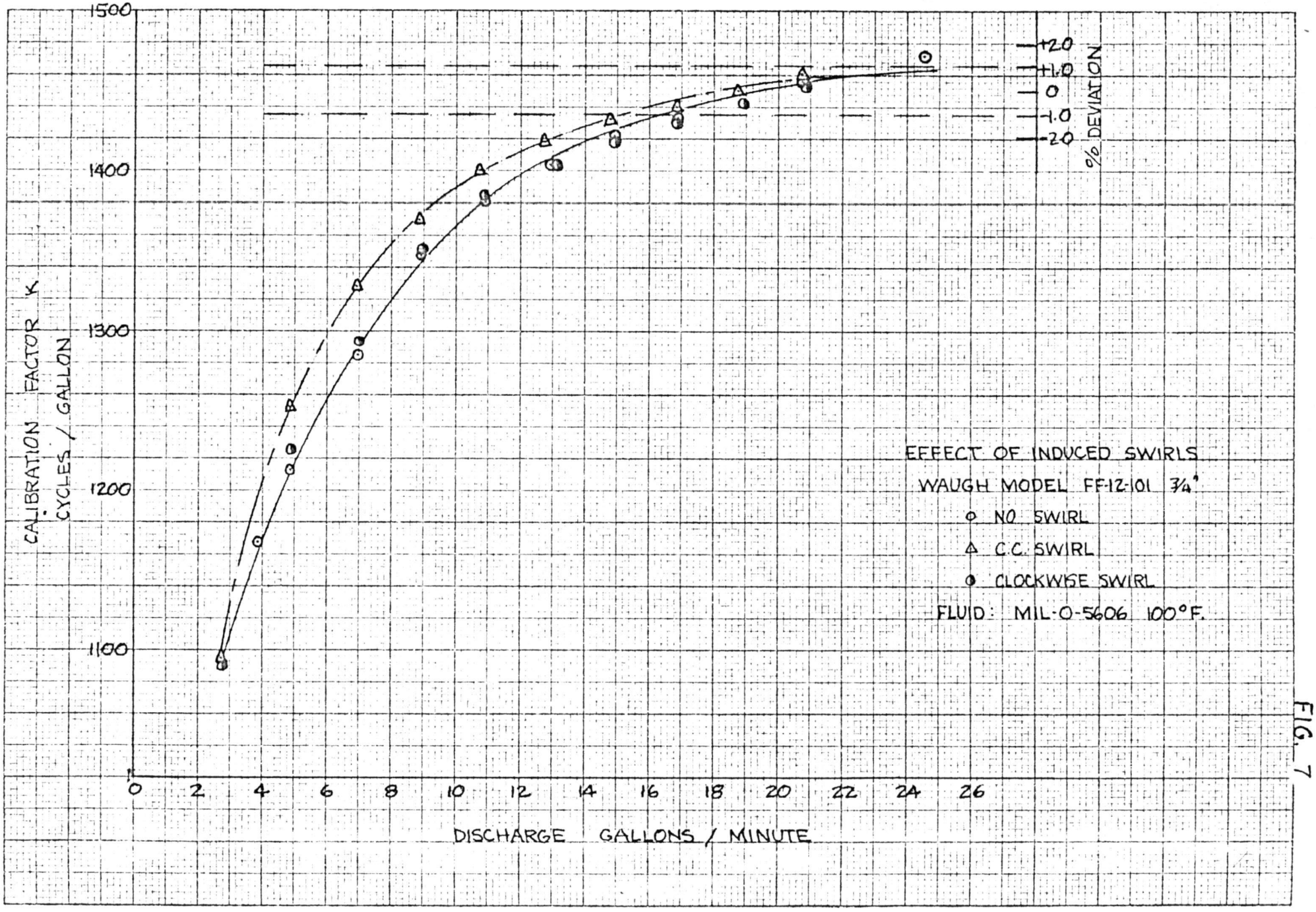


FIG. 7

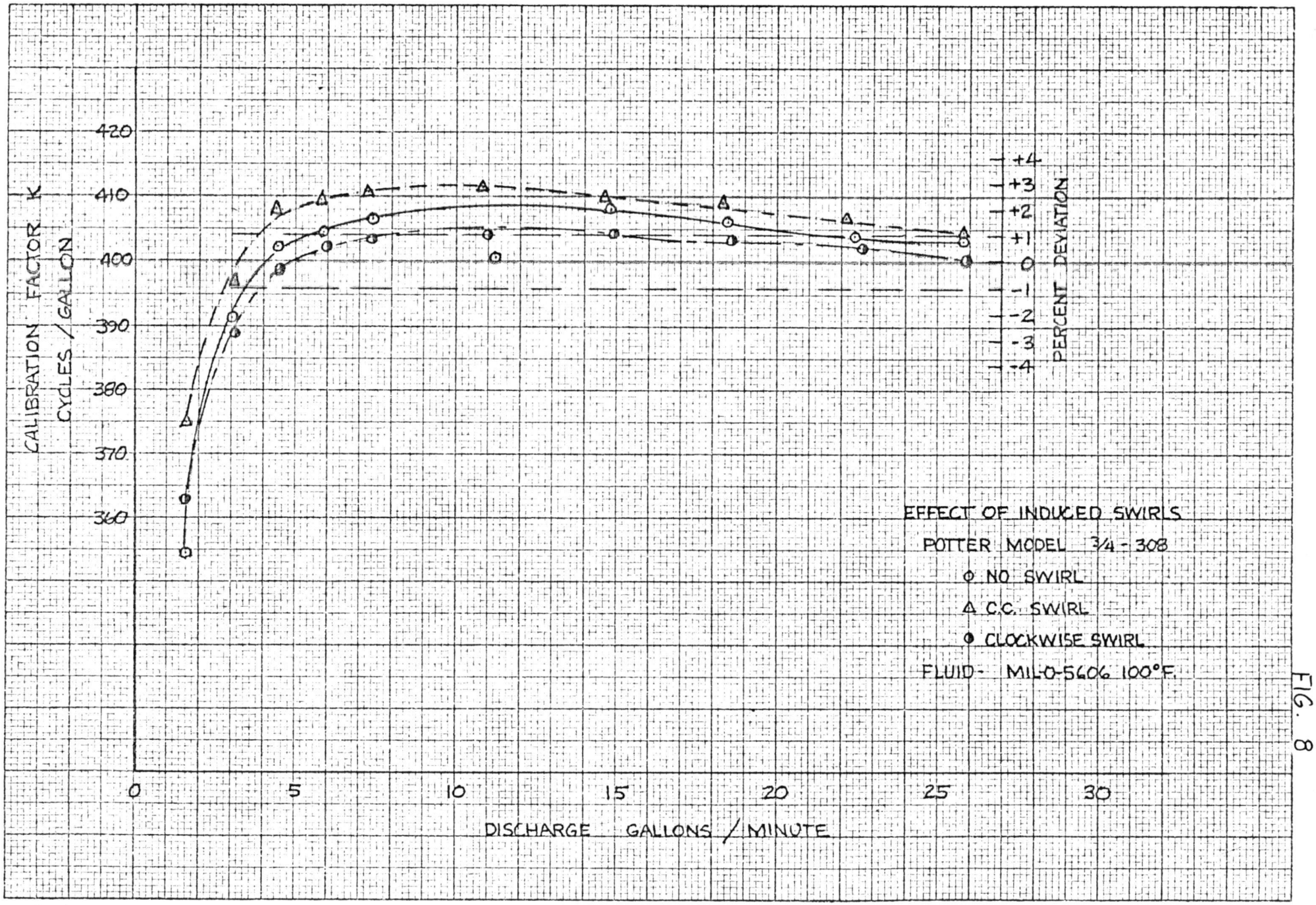


FIG. 8

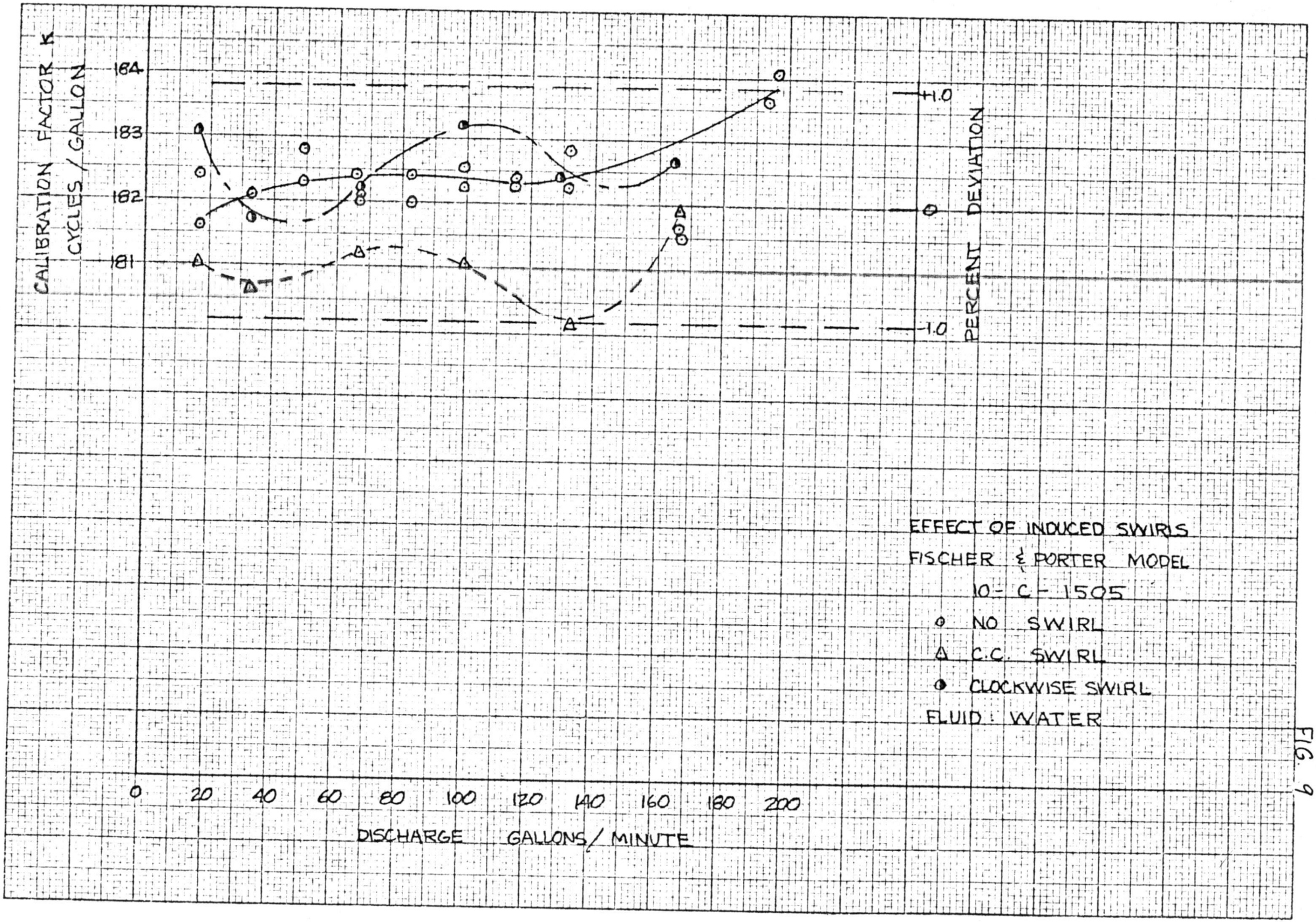


FIG. 9

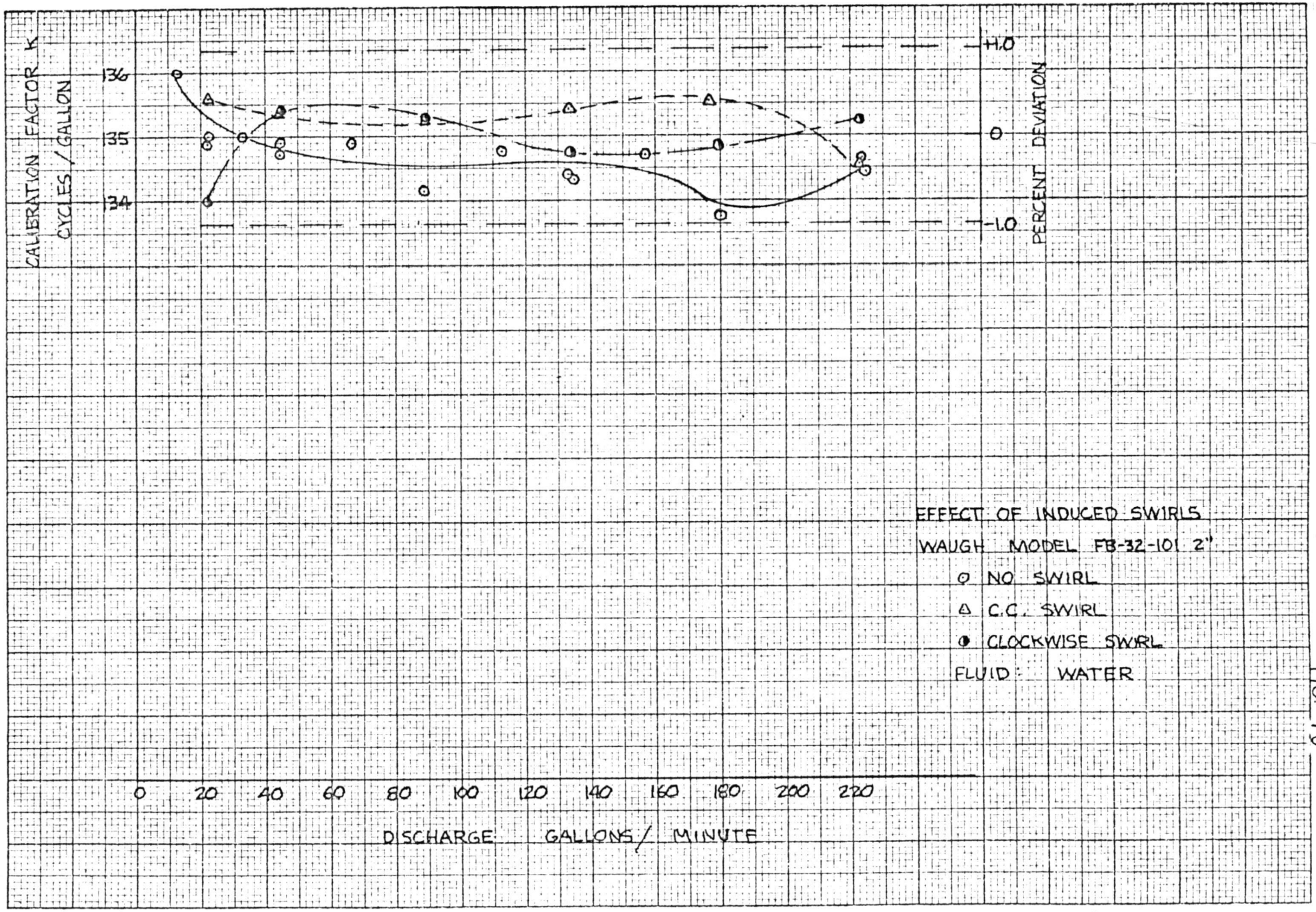


FIG. 10

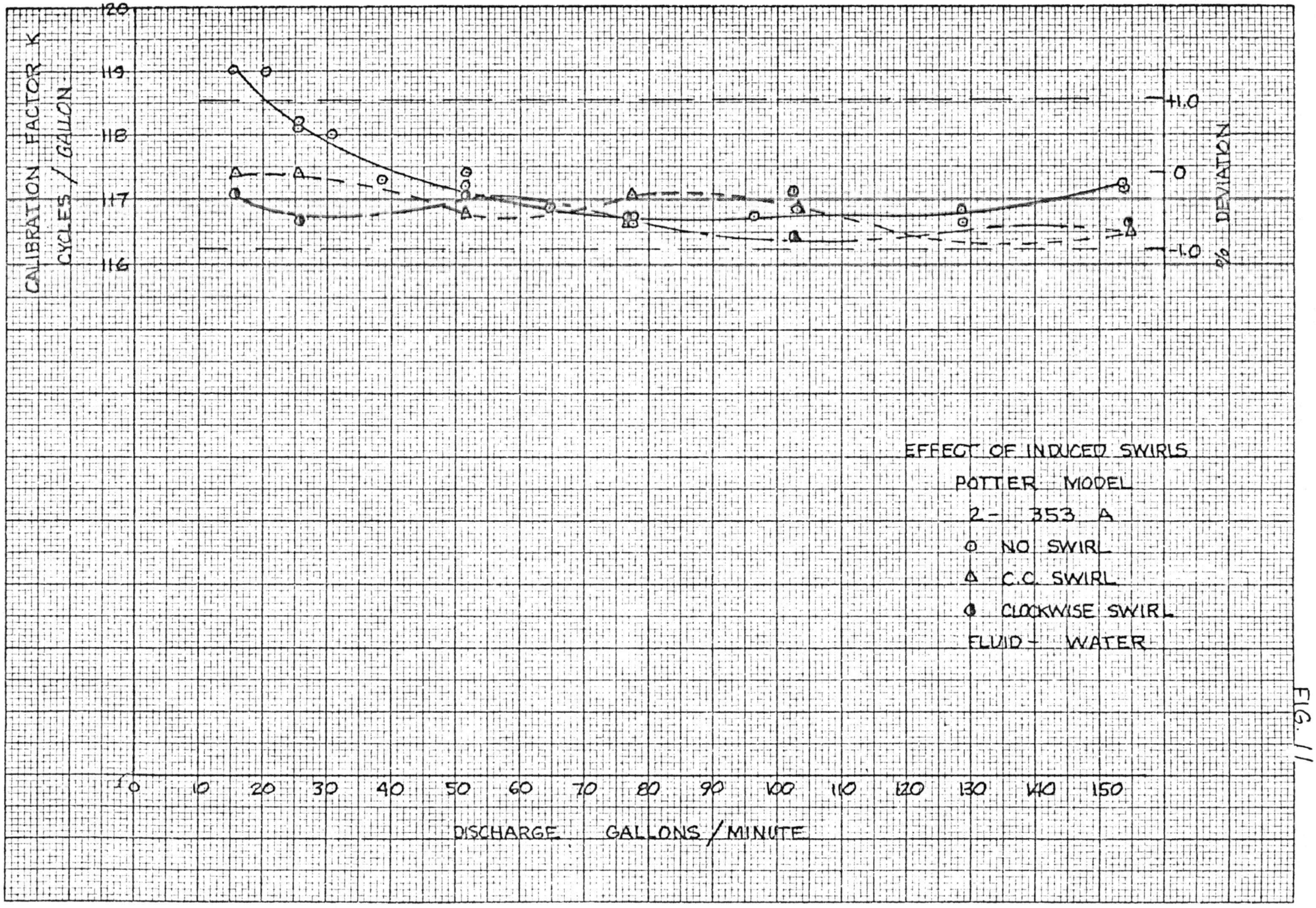


FIG. 11