THE UNIVERSITY OF MICHIGAN

COLLEGE OF ENGINEERING
Department of Mechanical Engineering

Progress Report

VISUAL FLOW STUDIES OF CARTER CARBURETOR JETS

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I. INTRODUCTION

The studies of Carter carburetor jets, as reported in Project Report 2813-3-P, provided data for developing an equation which gives the flow in terms of the jet conditions. A knowledge of the nature of the flow through these jets is helpful for explaining these characteristics, including change in the coefficient of discharge. For this purpose a two-dimensional water flow model was constructed. It was hoped that this would give greater understanding of the effect of jet chamfer angle, depth of chamfer, and approach conditions.

II. EQUIPMENT

The flow model, shown on Fig. 1, was made as a long, nearly square section, consisting of two brass side walls 25 x 1-3/4 x 1/4 in., which were held 2 in. apart by two pieces of clear Plexiglas on the top and bottom. Inlet and exit pipes were fitted to the ends, permitting water to flow through the length of the rectangular section duct. Near the center were two gates which held brass profiles of various shapes. These simulated to an enlarged scale the sectional dimensions of various Carter carburetor jets. To gain an impression of scale on the streamline photographs which follow, the thickness from leading to trailing edge of all the brass profile pieces was 1/2 in. These several pairs of brass profiles could be moved transversely to obtain various distances between the pair of parts, and thus simulate different diameters of jets.

Streamlines were shown in the fluid by methyl chloride dye prepared by dissolving crystals in water, which issued from a rake. The dye rake holes were found to be most effective when about 0.020 in. in diameter. Essentially, the model with flowing fluid and dye lines, gave a two-dimensional picture of fluid flowing through a jet in an axial plane cutting a jet diameter.

Two pressure taps were used to measure the pressure difference across the simulated jet, one 8-1/2 in. upstream, and the other 8-1/2 in. downstream. The flow rates used varied from about 20 to 1600 lb/hr, depending on the profile opening and pressure drop. The relationship between pressure drop and flow is shown on Fig. 2 for a jet profile similar to a Carter production jet of the 120-166 type. The precision of these flow measurements was not of the quality of those on the fuel flow stand used for testing the actual jets.

III. RESULTS AND DISCUSSION

The initial work was done at low flows in the range of 10 to 600 lb/hr, in an effort to determine the effect of chamfer angle and other factors upon the flow pattern. At a fixed diameter, photographs were taken of a completely laminar flow (20-200 lb/hr), a high flow just before turbulence occurred upstream (500-600 lb/hr), and at a point in between these flows, called medium flow, which is not included in this report. Later in the study, turbulent flows up to 1600 lb/hr were photographed; some of these are included.

The following Table I is a key to the flow photographs with the variables involved.

TABLE I

LIST OF FIGURES SHOWING FLOW STREAMLINES

Fig. No.	Cylindrical Approach Section Ahead of Chamfer	Chamfer Included Angle, degrees	Nature of Flow
3	No	10	Laminar
4	Yes	10	Laminar
5	Yes	40	Laminar
6	No	40	Laminar
7	Yes	80	Laminar
8	No	80	Laminar
9	*	--	Some laminar Some turbulent
10	Yes	80 and 10	Turbulent
11	Yes	10	Turbulent

*Rounded approach orifice, not comparable to any carburetor jet.

It will be noticed from Table I and the figures that jet profiles were used which simulated the Carter jets with and without the cylindrical approach section used to provide a screwdriver slot in the jet body. This change in geometry with jet diameter is illustrated in Fig. 1 of Report 2813-5-F. Another pair of jet profile parts were provided to simulate a rounded approach orifice, for comparative purposes.

From Figs. 3 to 11 one may gain the impression that the influence of the jet profile is greatest when the flow rate is high, the chamfer angle is small, and with a cylindrical approach section. Figure 9, for the rounded approach orifices, shows very smooth streamlines as one would predict for this shape. Figures 10(a) and 10(b) show clearly an eddy formed by the sharp edge of the inlet cylindrical section. Figures 10(c) and 11 show clearly the formation of a vena contracta for a jet with a 10° chamfer angle.

A sufficient number of flow tests were made to make general comparisons with the flow characteristics of the actual metering jets. The comparison indicated that the flow patterns of the visual models should represent the three-dimensional flow of the actual jets reasonably well.

IV. CONCLUSIONS

1. It has been demonstrated that it is quite practical and effective to demonstrate visually the nature of flow in metering jets by means of a water table, employing a water-soluble dye to show the streamlines.

2. On the basis of this rather preliminary testing, the visual models should be considered more useful as a qualitative rather than as a quantitative tool.

3. The influence of the jet profile seems greatest when the flow is high, the chamfer angle is small, and with a cylindrical approach section.

4. It would be practical to simulate the complete fuel flow passages of a carburetor by the method outlined. A study of the nature of such items as the flow around sharp bends, and the influence of air bleeds, might be helpful.

5. At high flow rates, the sharpness of the entry corner to the cylindrical approach section may be significant in its effect upon the jet flow.

6. The chamfer angle of 40° appears to be a good compromise of the flow and mechanical requirements.

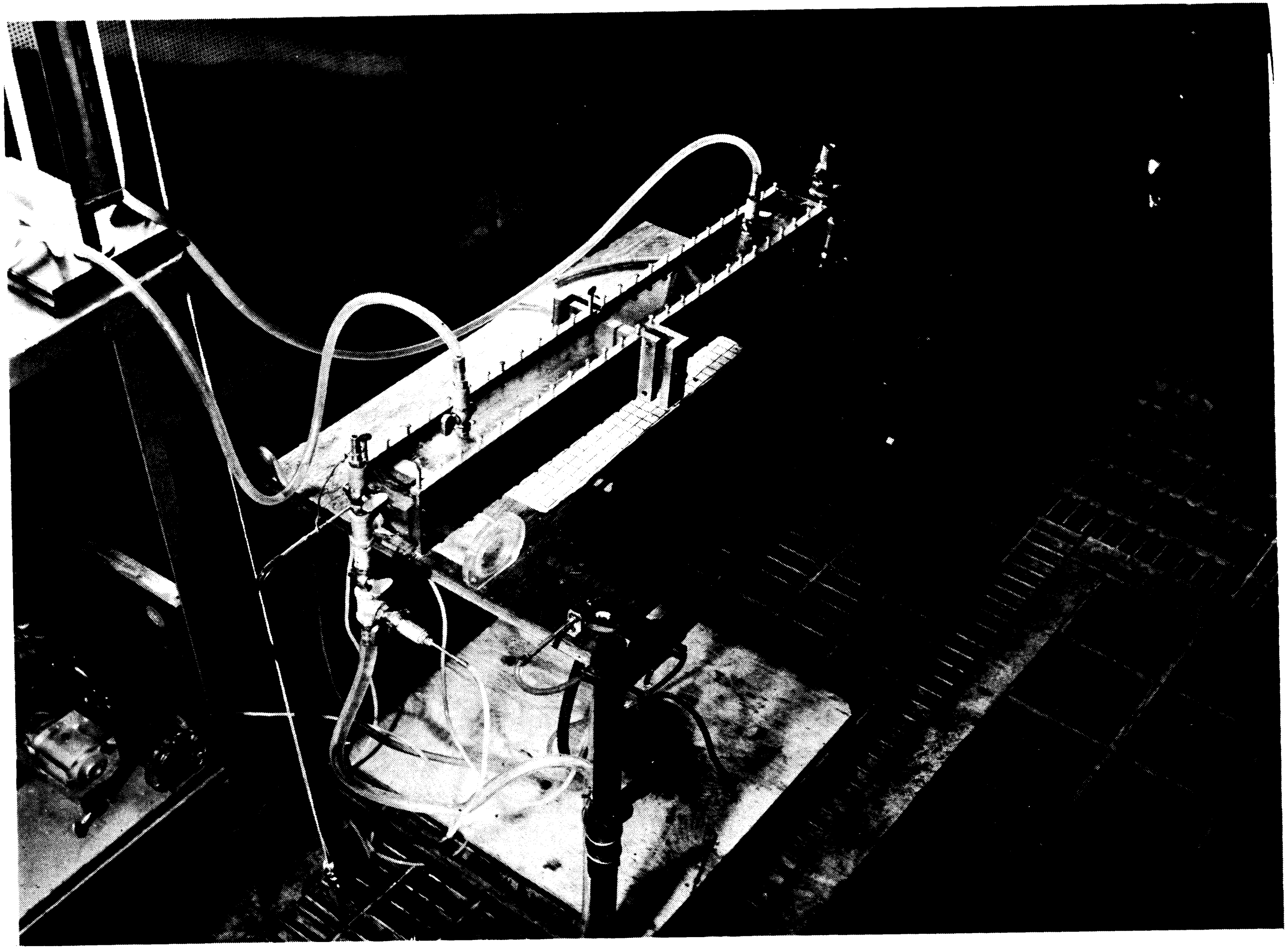


Fig. 1. Photograph of water table equipment used to obtain streamlines in simulated metering orifices.

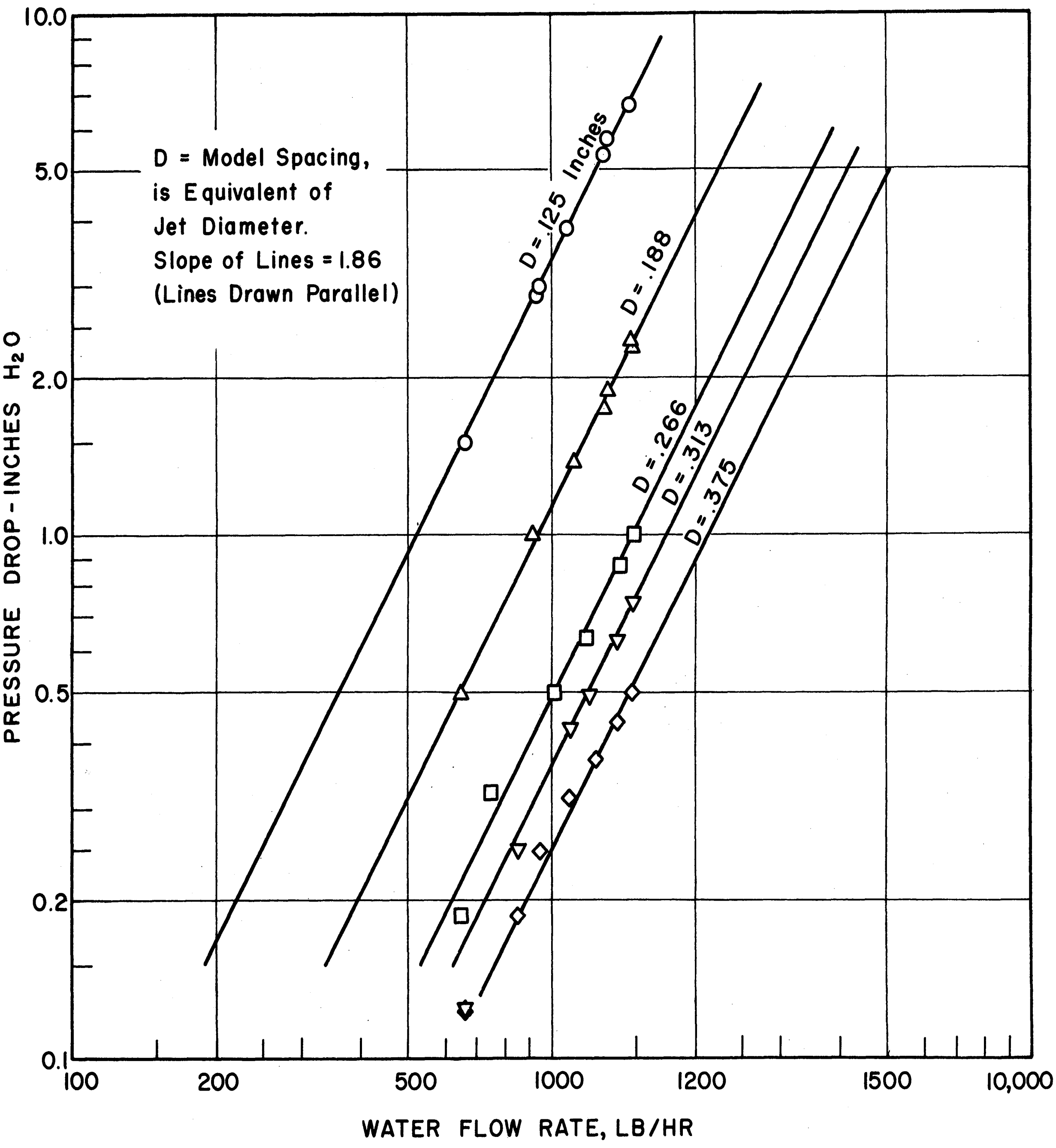
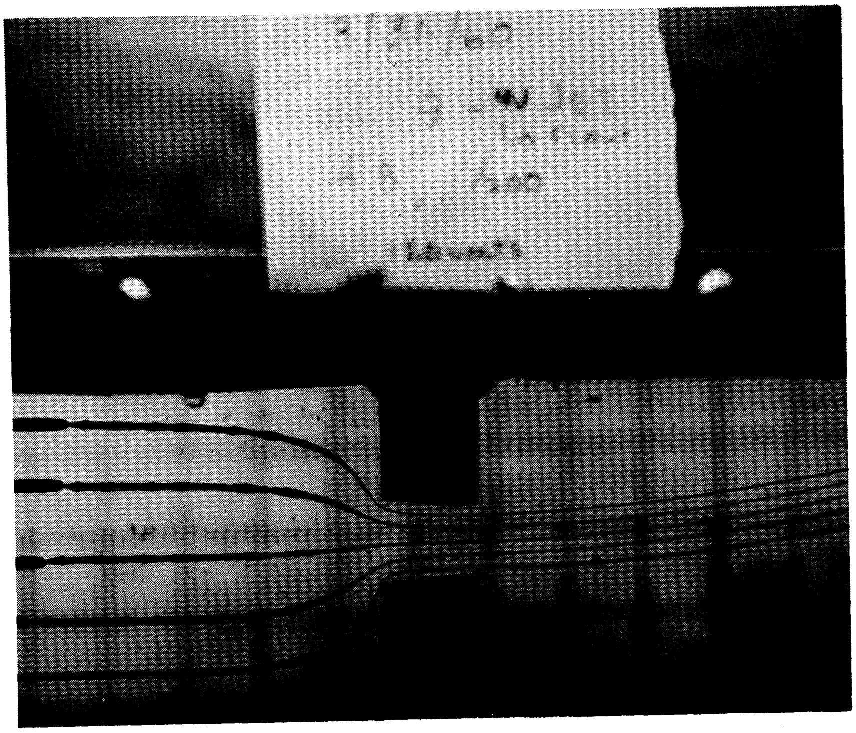


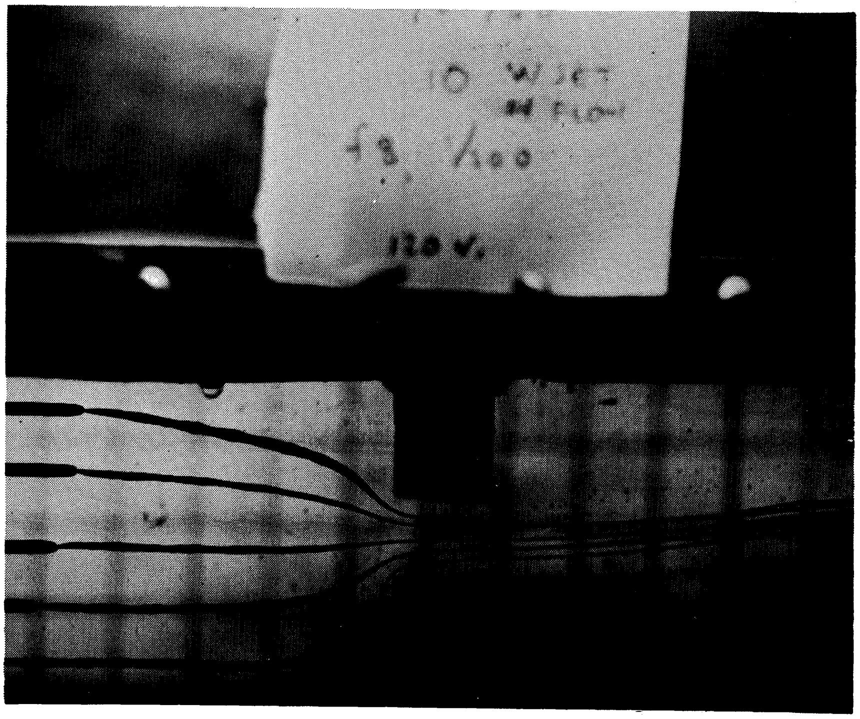
Fig. 2. Flow vs. head relation for visual flow simulator.



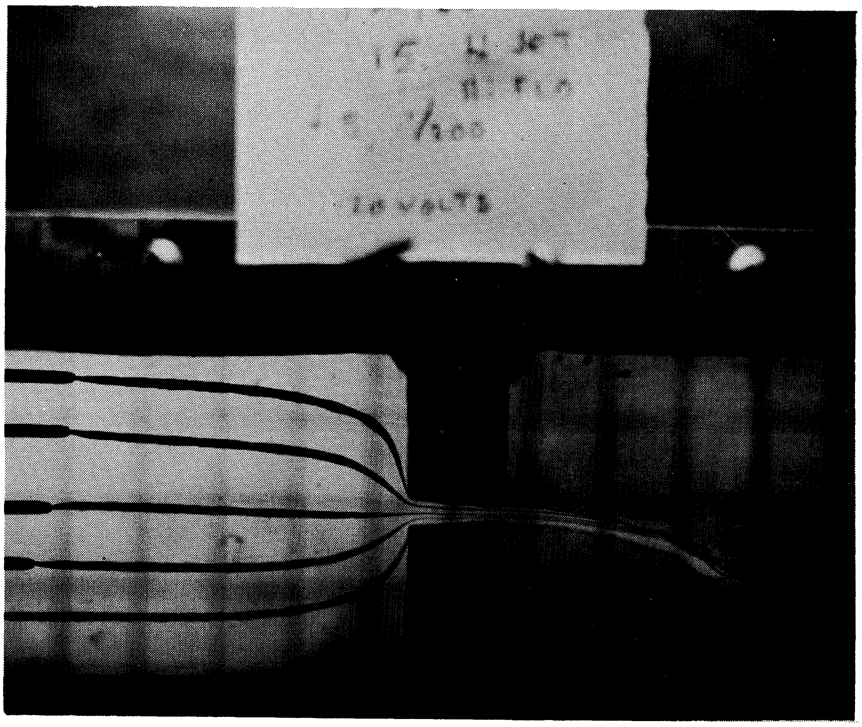
(a) Low flow; 20-200 lb/hr; large diameter.

(b) Low flow; 20-200 lb/hr; small diameter.

Fig. 3. Streamlines for simulated metering orifices. Chamfer included angle = 10°. No cylindrical approach section.

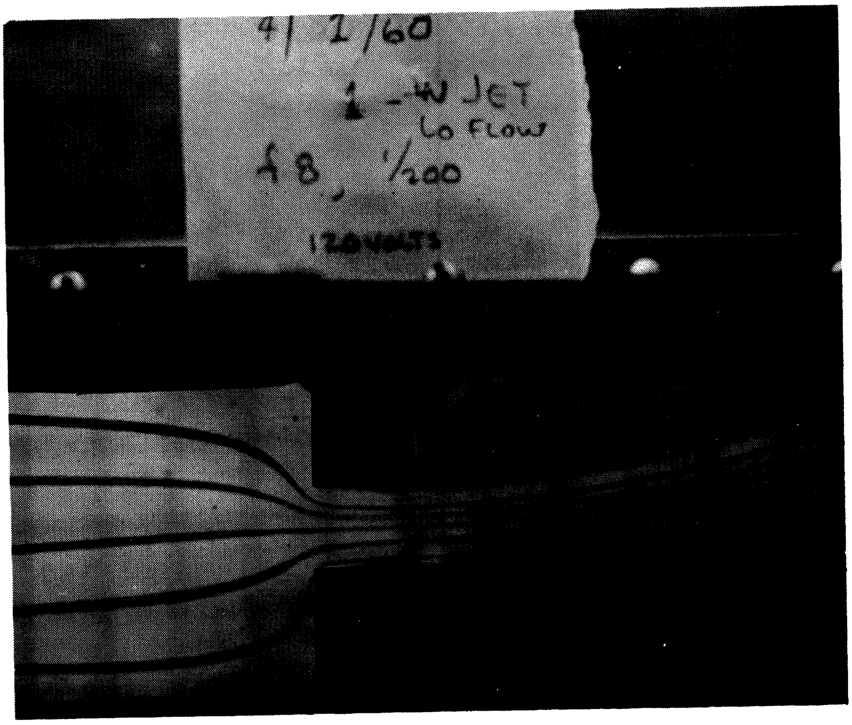


(c) High flow; 400-600 lb/hr; large diameter.

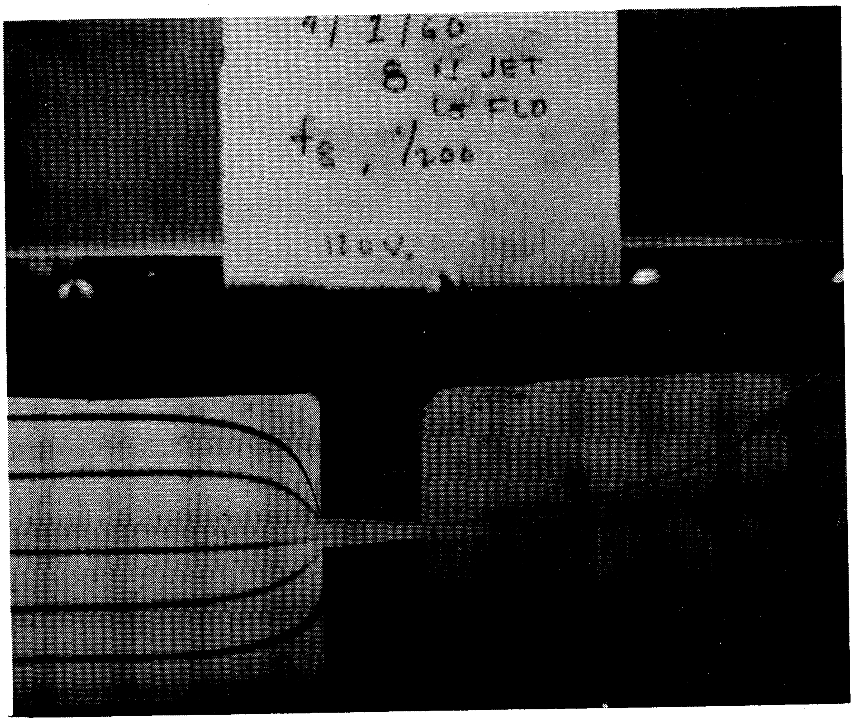


(d) High flow; 400-600 lb/hr; small diameter.

Fig. 3 (concluded).

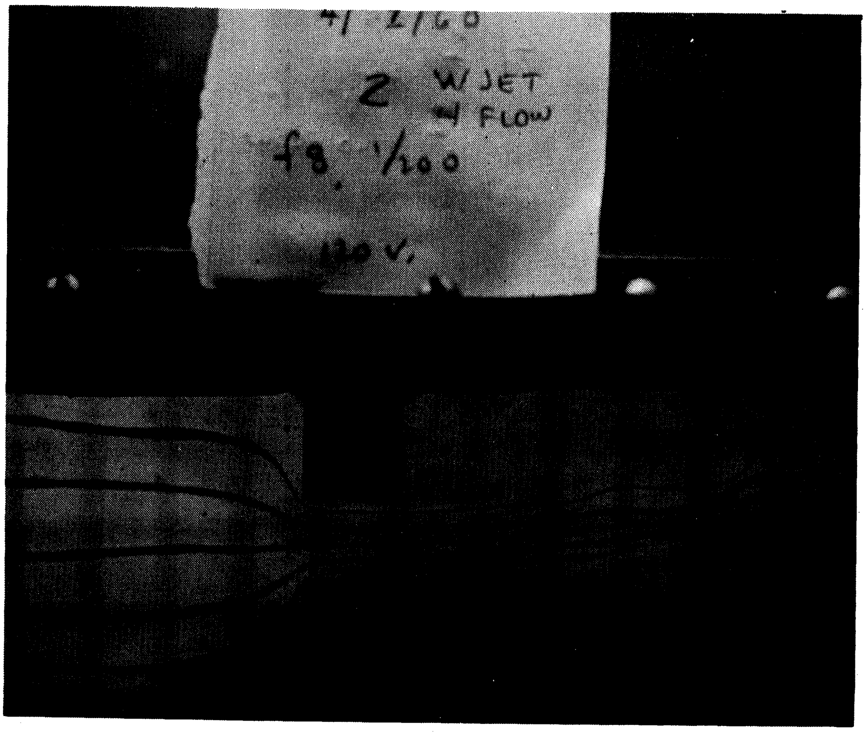


(a) Low flow; 20-200 lb/hr; large diameter.

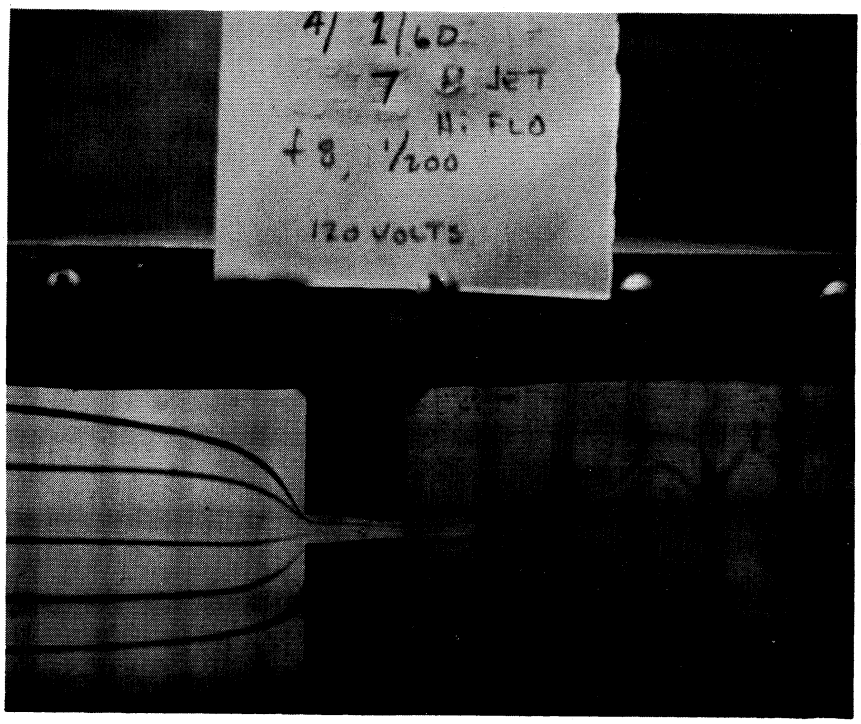


(b) Low flow; 20-200 lb/hr; small diameter.

Fig. 4. Streamlines for simulated metering orifices. Chamfer included angle = 10°. With cylindrical approach section.

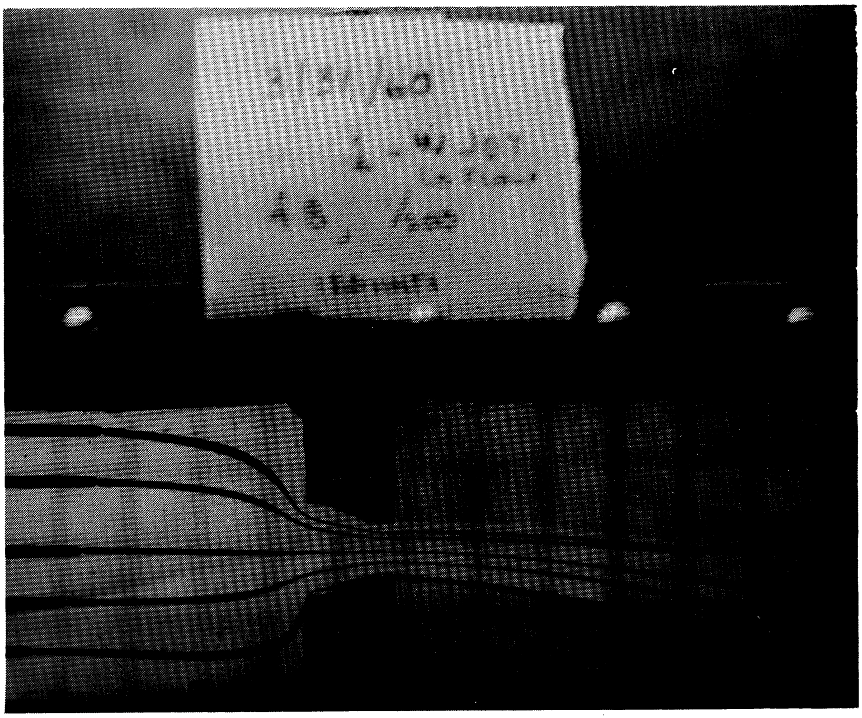


(c) High flow; 400-600 lb/hr; large diameter.

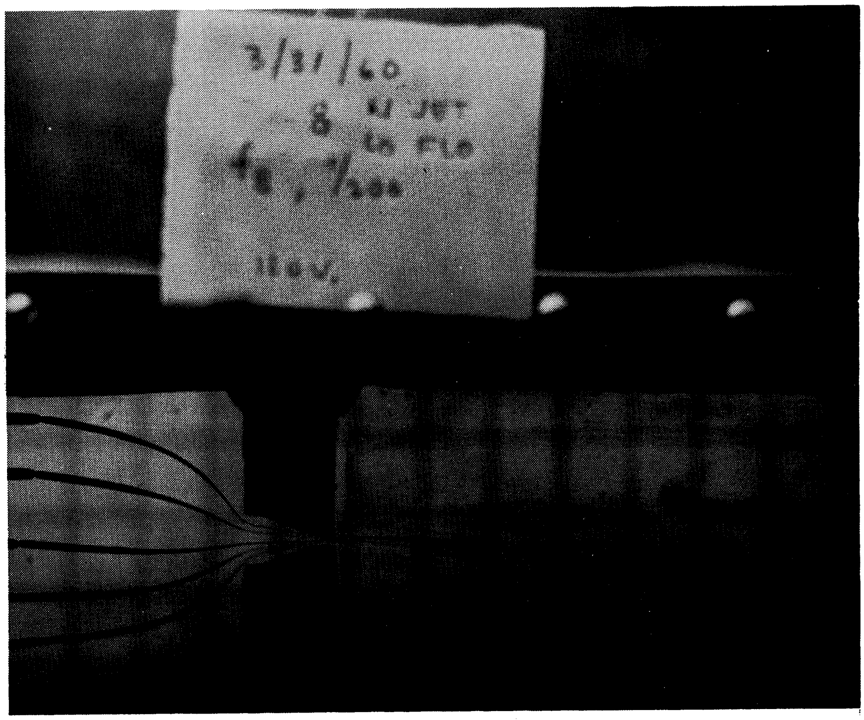


(d) High flow; 400-600 lb/hr; small diameter.

Fig. 4 (concluded).

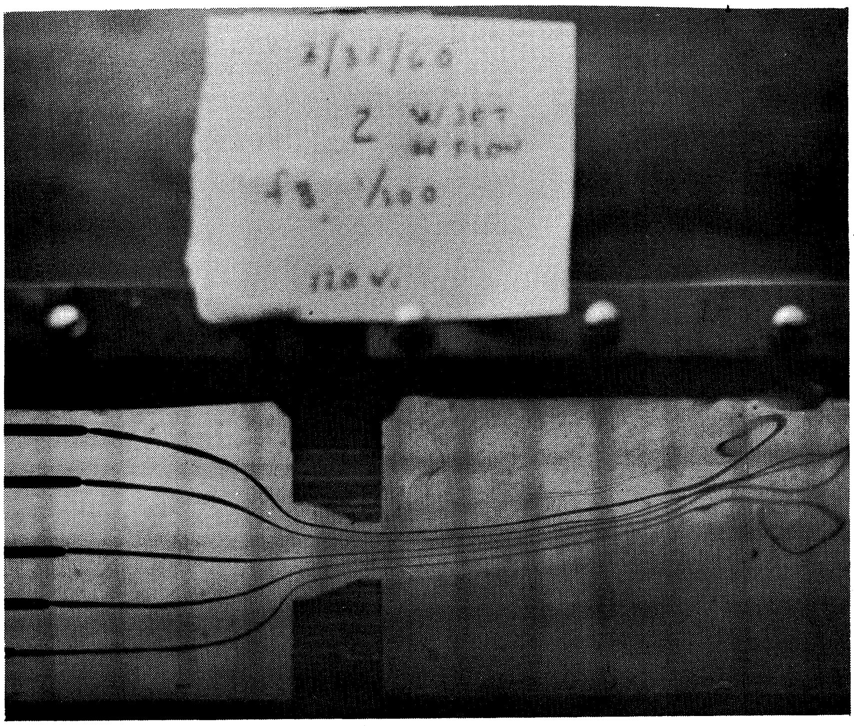


(a) Low flow; 20-200 lb/hr; large diameter.

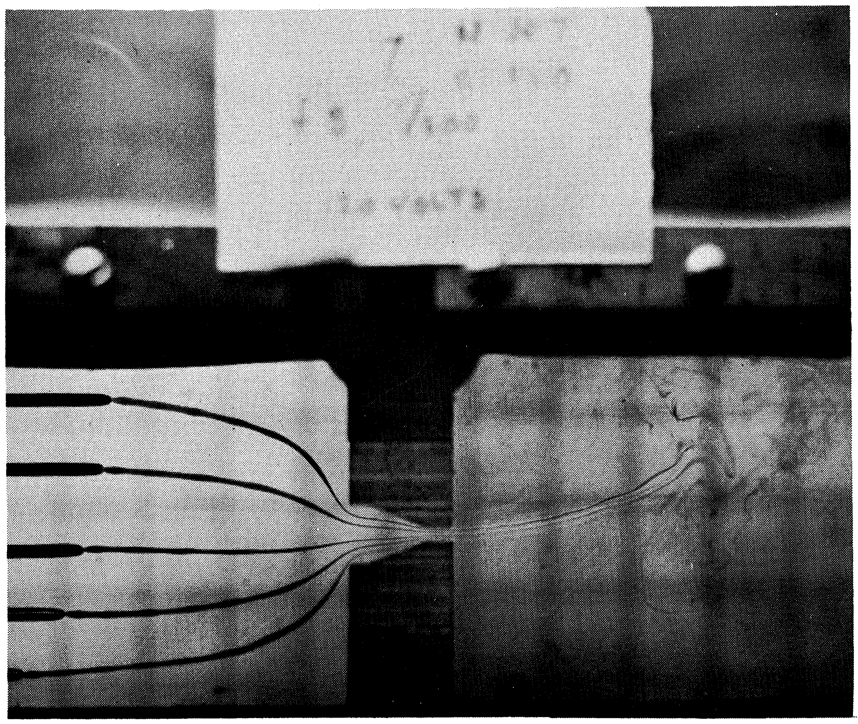


(b) Low flow; 20-200 lb/hr; small diameter.

Fig. 5. Streamlines for simulated metering orifices. Chamfer included angle = 40°. With cylindrical approach section.

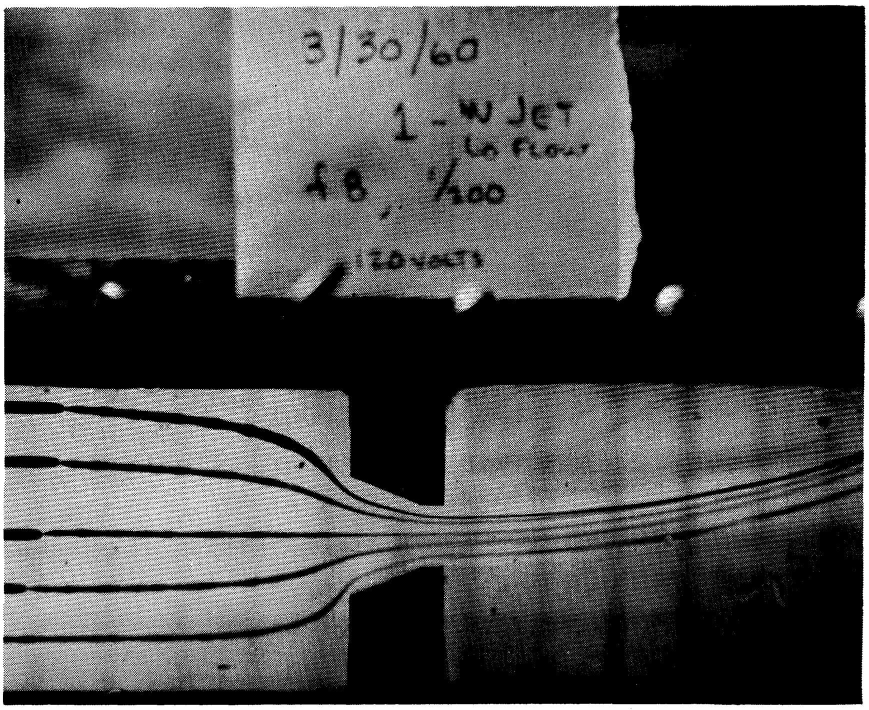


(c) High flow; 400-600 lb/hr; large diameter.

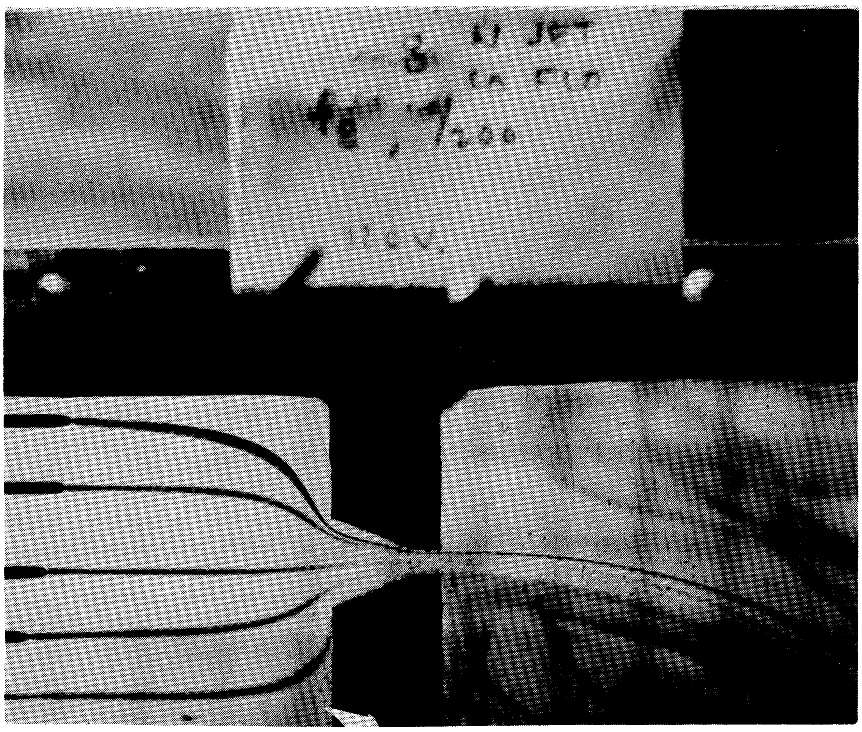


(d) High flow; 400-600 lb/hr; small diameter.

Fig. 5 (concluded).

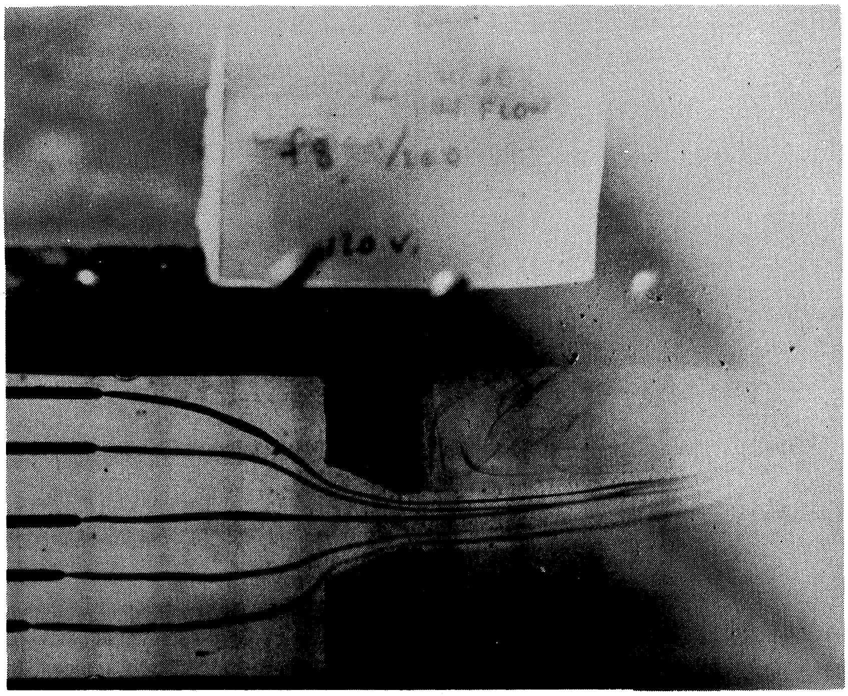


(a) Low flow; 20-200 lb/hr; large diameter.



(b) Low flow; 20-200 lb/hr; small diameter.

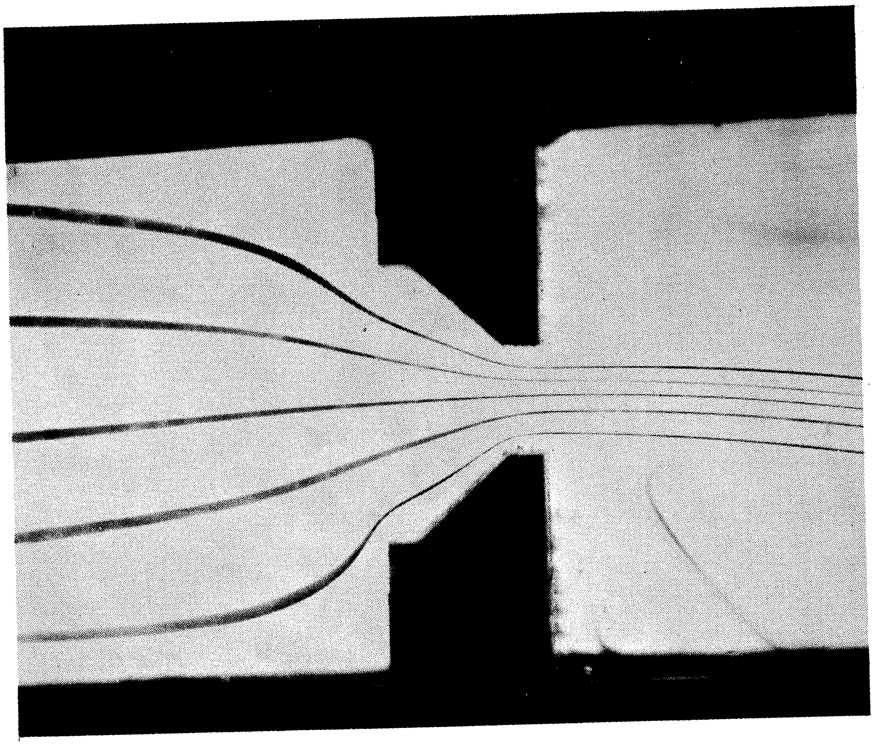
Fig. 6. Streamlines for simulated metering orifices. Chamfer included angle = 40°. No cylindrical section.



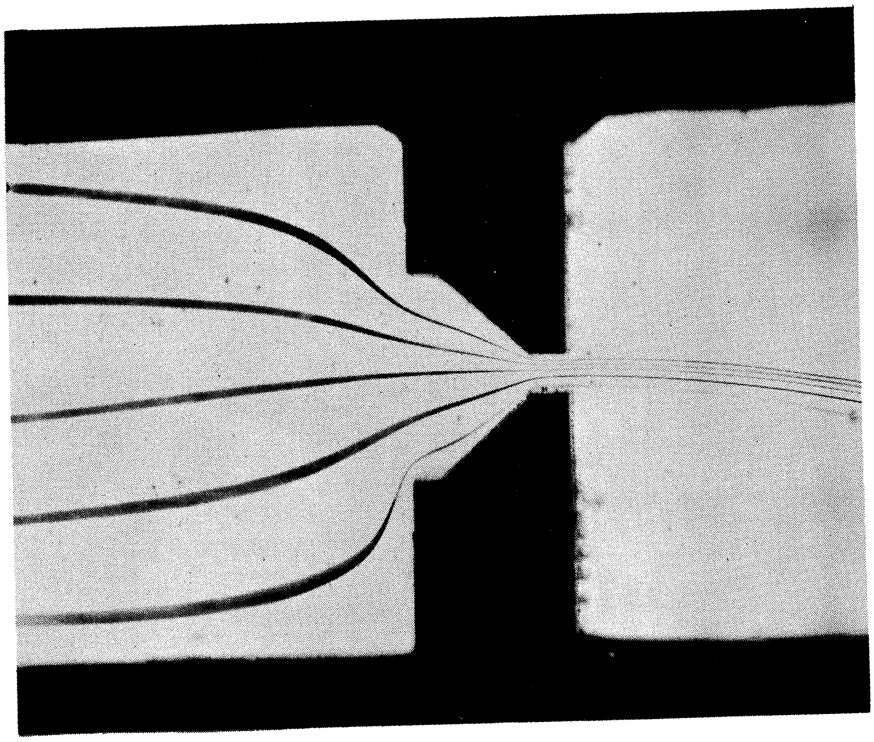
(c) High flow; 400-600 lb/hr; large diameter.

(d) High flow; 400-600 lb/hr; small diameter.

Fig. 6 (concluded).

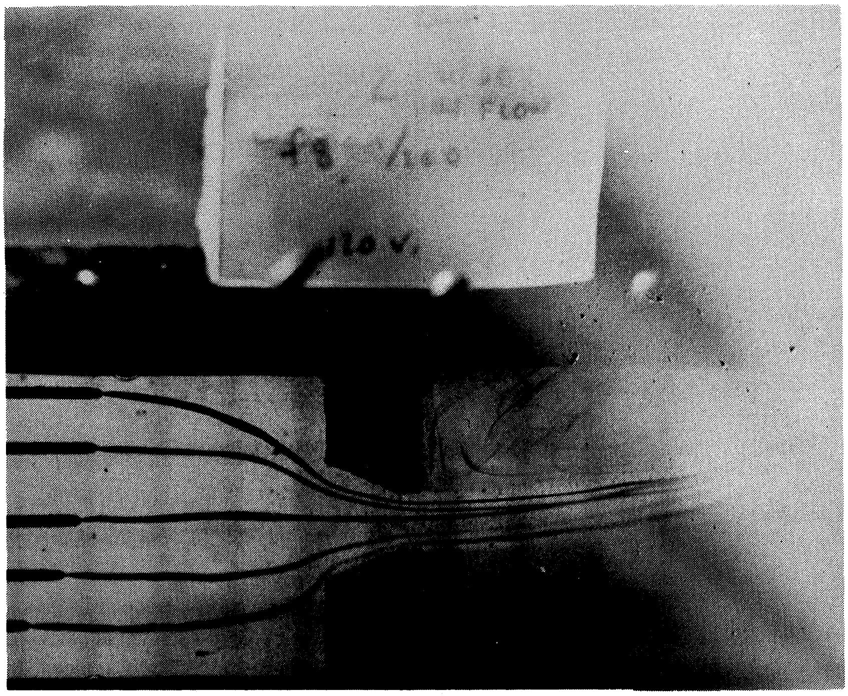


(a) Low flow; 20-200 lb/hr; large diameter.



(b) Low flow; 20-200 lb/hr; small diameter

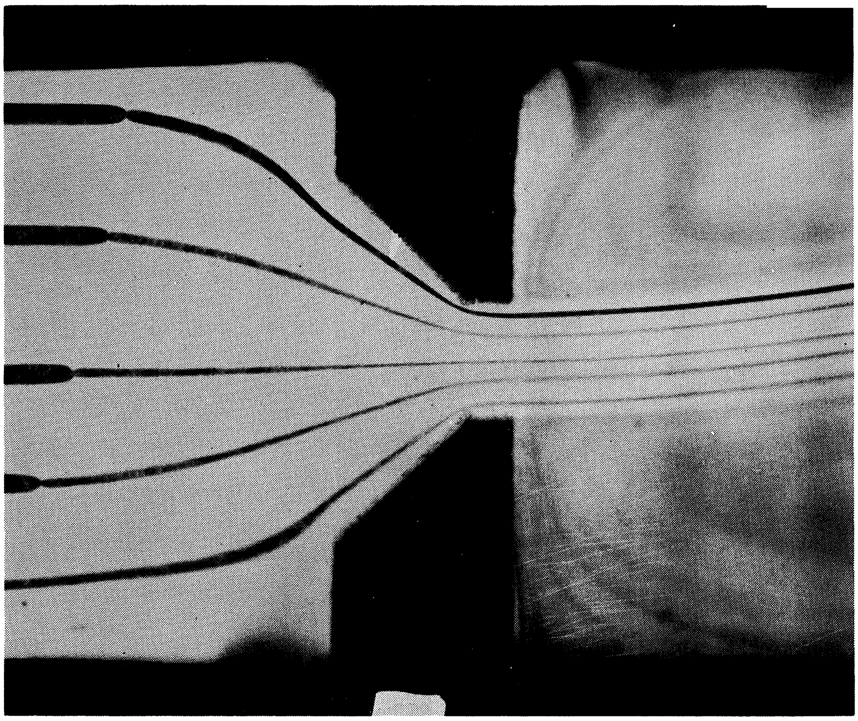
Fig. 7. Streamlines for simulated metering orifices. Chamfer included angle = 80°. With cylindrical approach section.



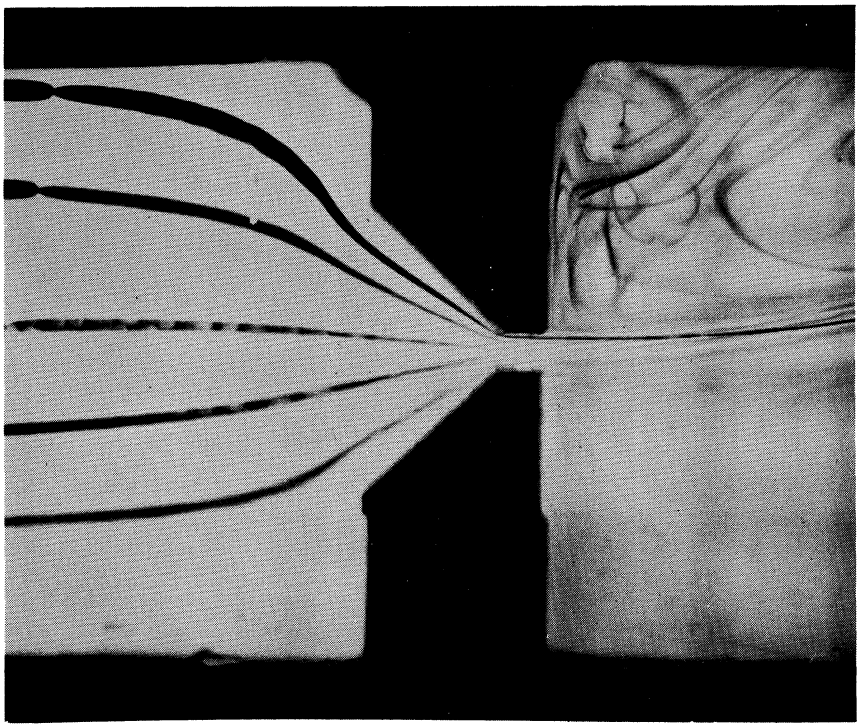
(c) High flow; 400-600 lb/hr; large diameter.

(d) High flow; 400-600 lb/hr; small diameter.

Fig. 6 (concluded).

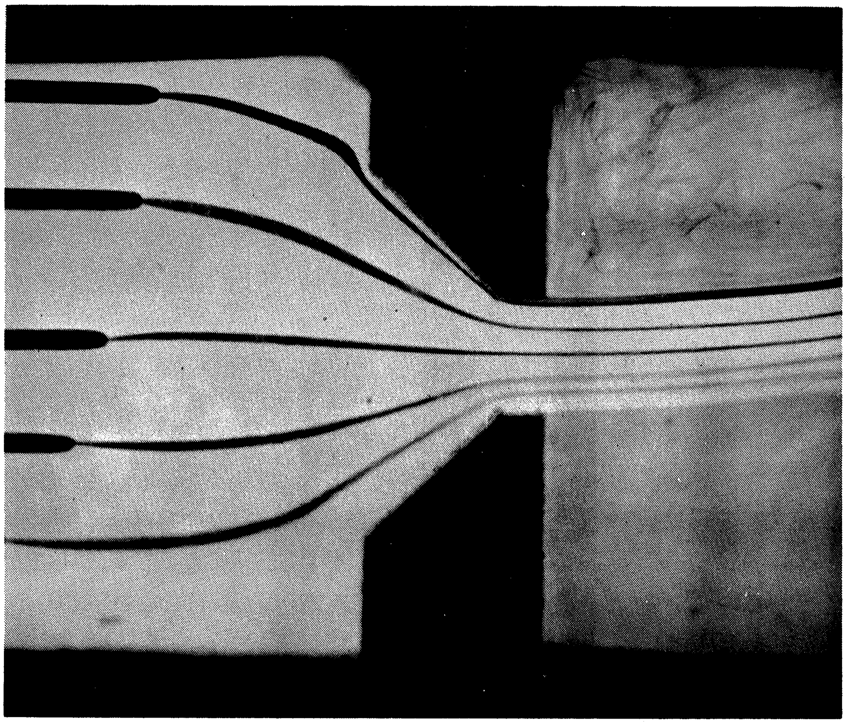


(a) Low flow; 40-200 lb/hr; large diameter.

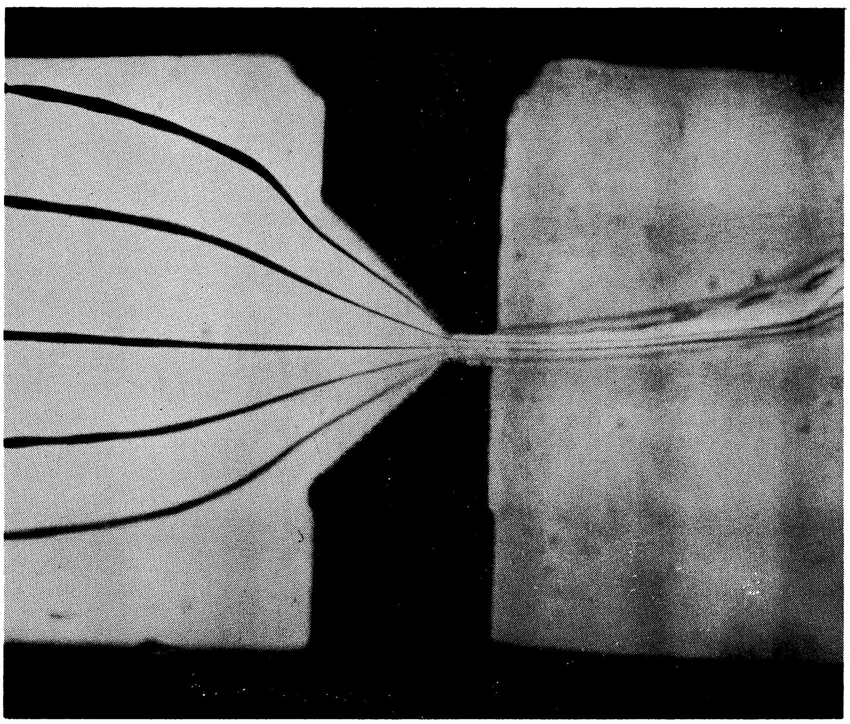


(b) Low flow; 40-200 lb/hr; small diameter.

Fig. 8. Streamlines for simulated metering orifices. Chamfer included angle = 80°. No cylindrical approach section.

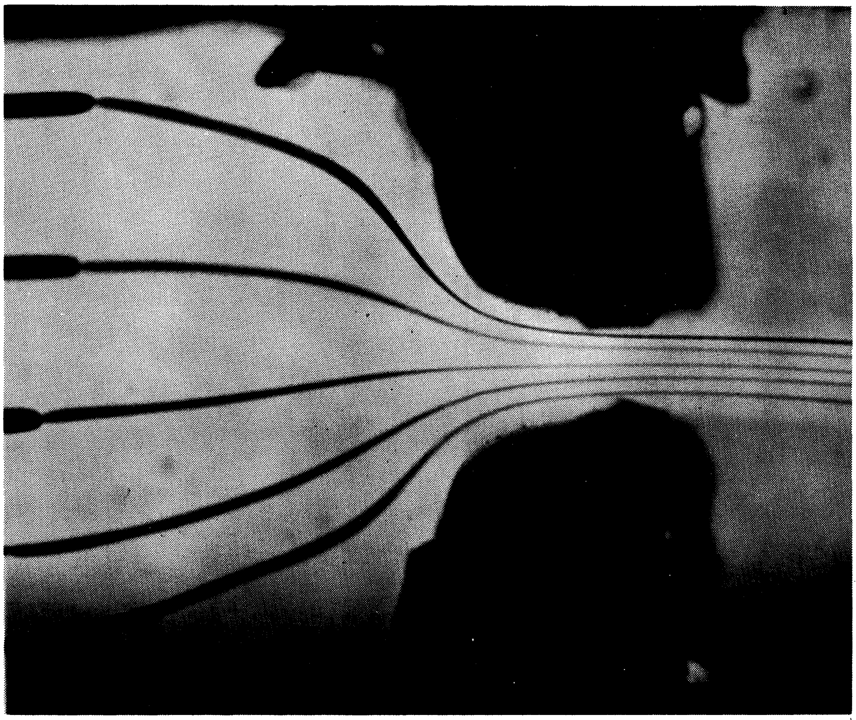


(c) High flow; 400-600 lb/hr; large diameter.

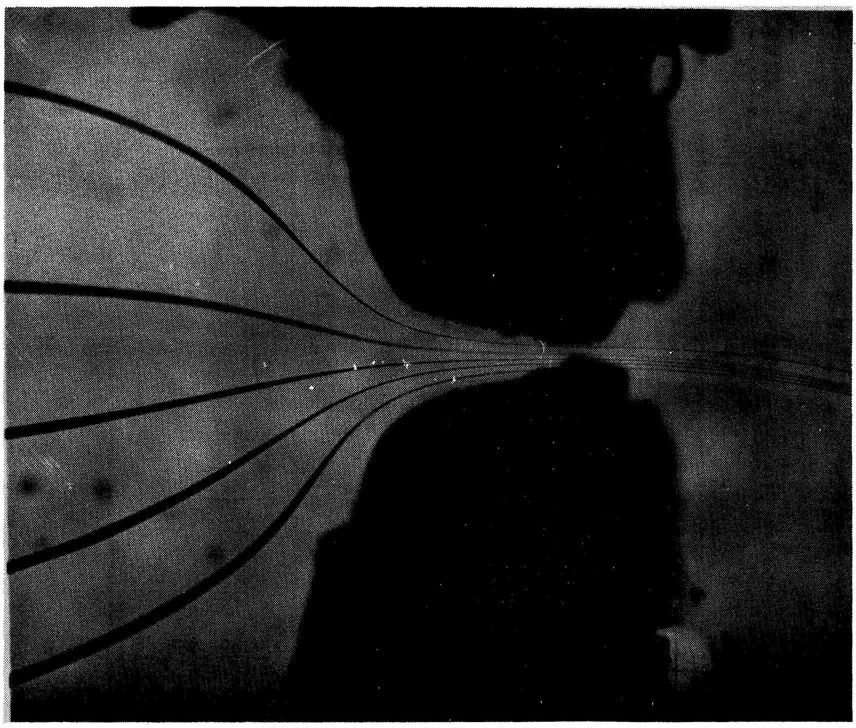


(d) High flow; 400-600 lb/hr; small diameter.

Fig. 8 (concluded).

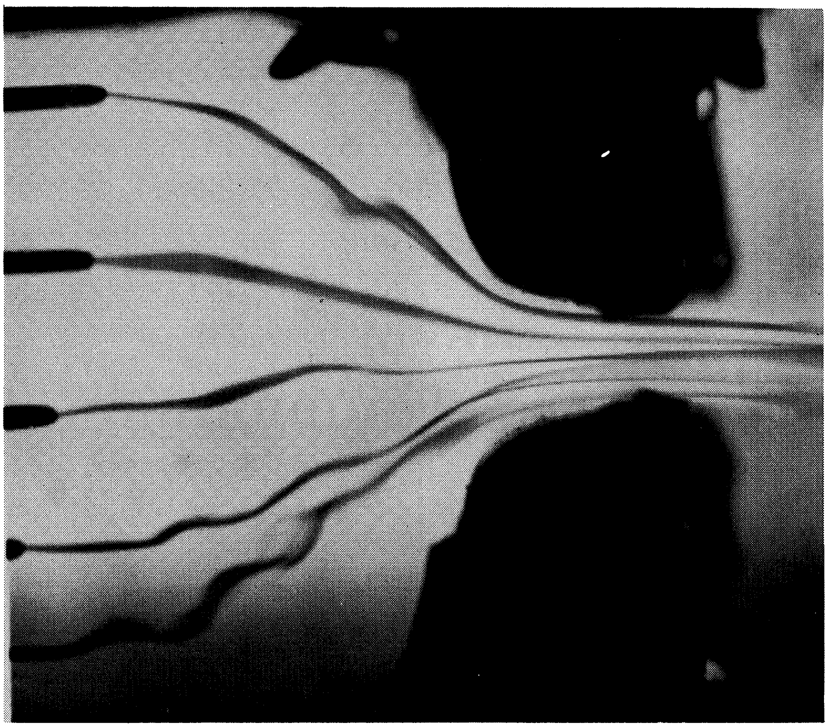


(a) Low flow; 20-200 lb/hr; large diameter.

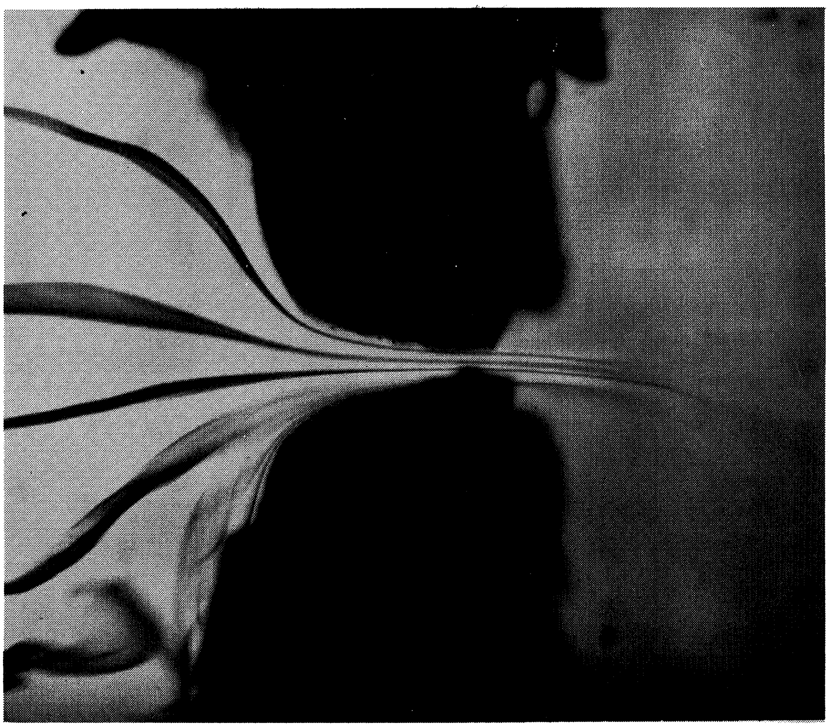


(b) Low flow; 20-200 lb/hr; small diameter.

Fig. 9. Streamlines for simulated metering orifices. Rounded approach orifice.

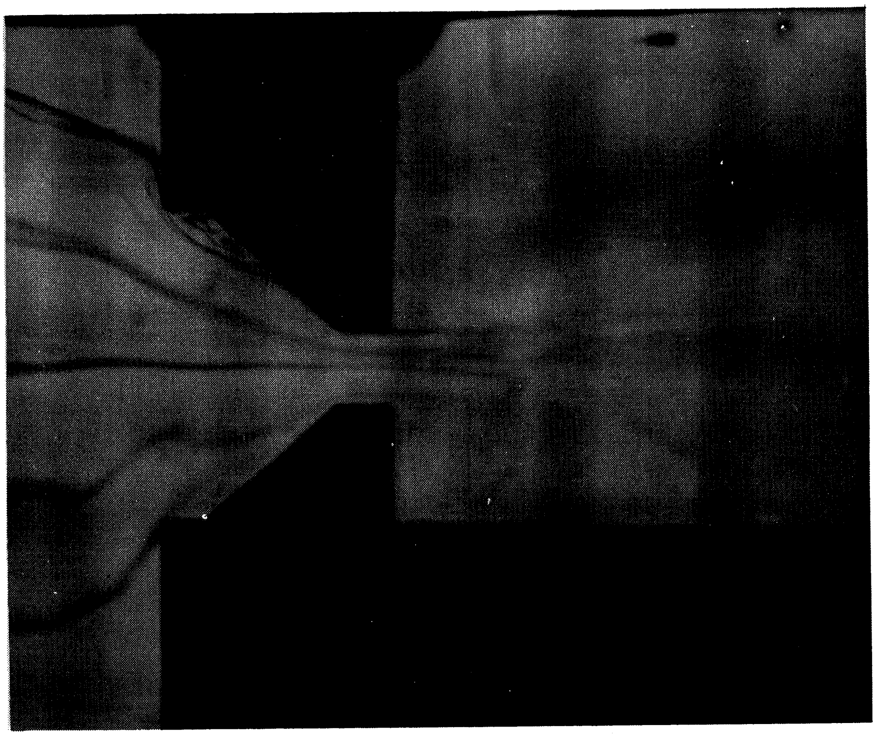


(c) Very high flow; 1600 lb/hr; large diameter.

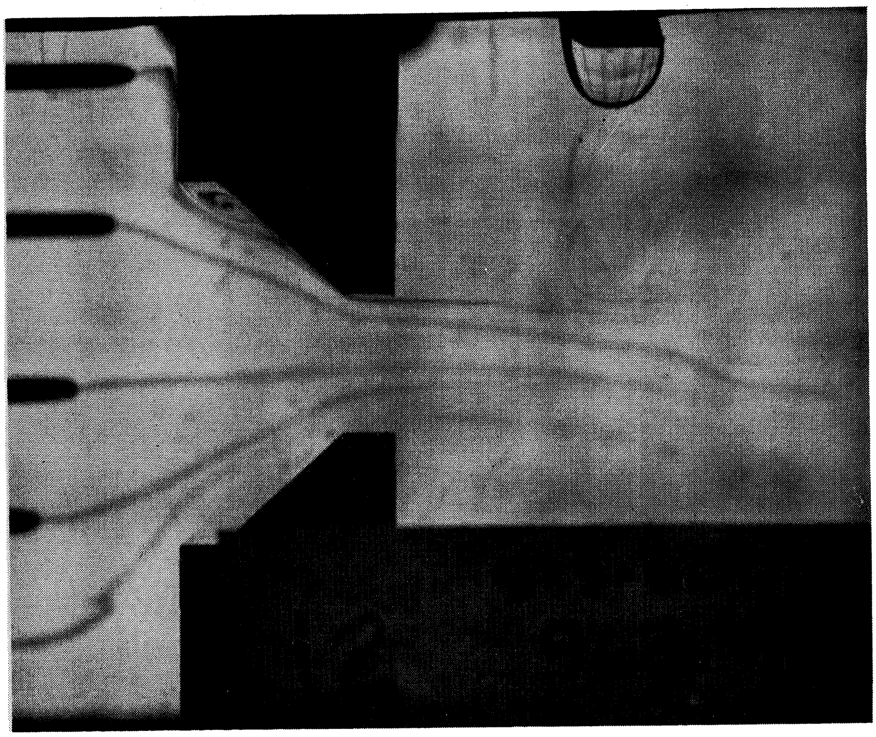


(d) Very high flow; 1600 lb/hr; small diameter.

Fig. 9 (concluded).

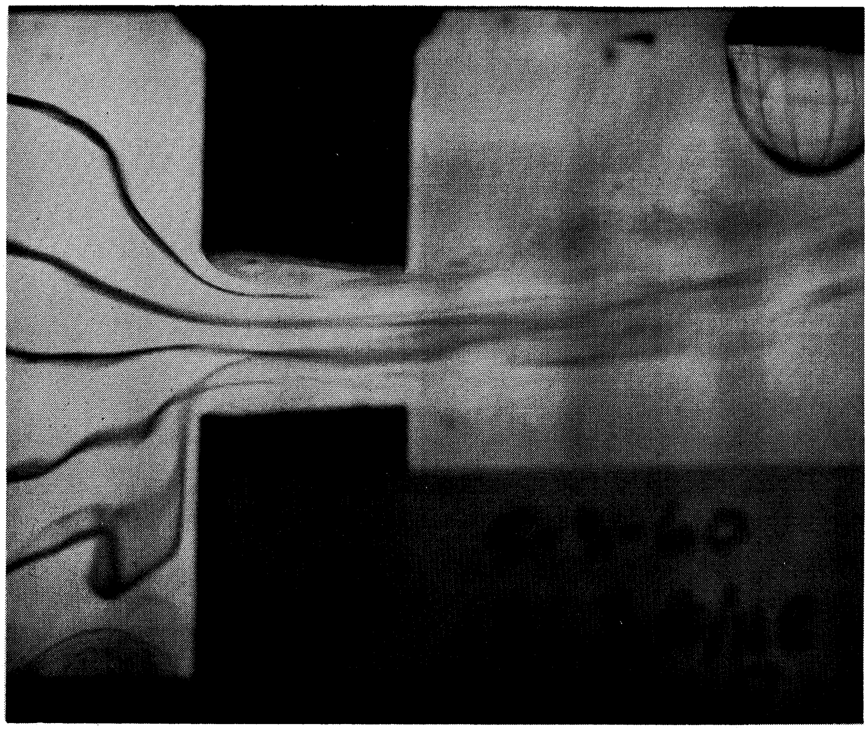


(a) Chamfer included angle = 80°; high flow; 1610 lb/hr.



(b) Chamfer included angle = 80°; high flow; 960 lb/hr.

Fig. 10. Streamlines for simulated metering orifices. With cylindrical approach section.



(c) Chamfer included angle = 10°; high flow; 1460 lb/hr.

Fig. 10 (concluded).

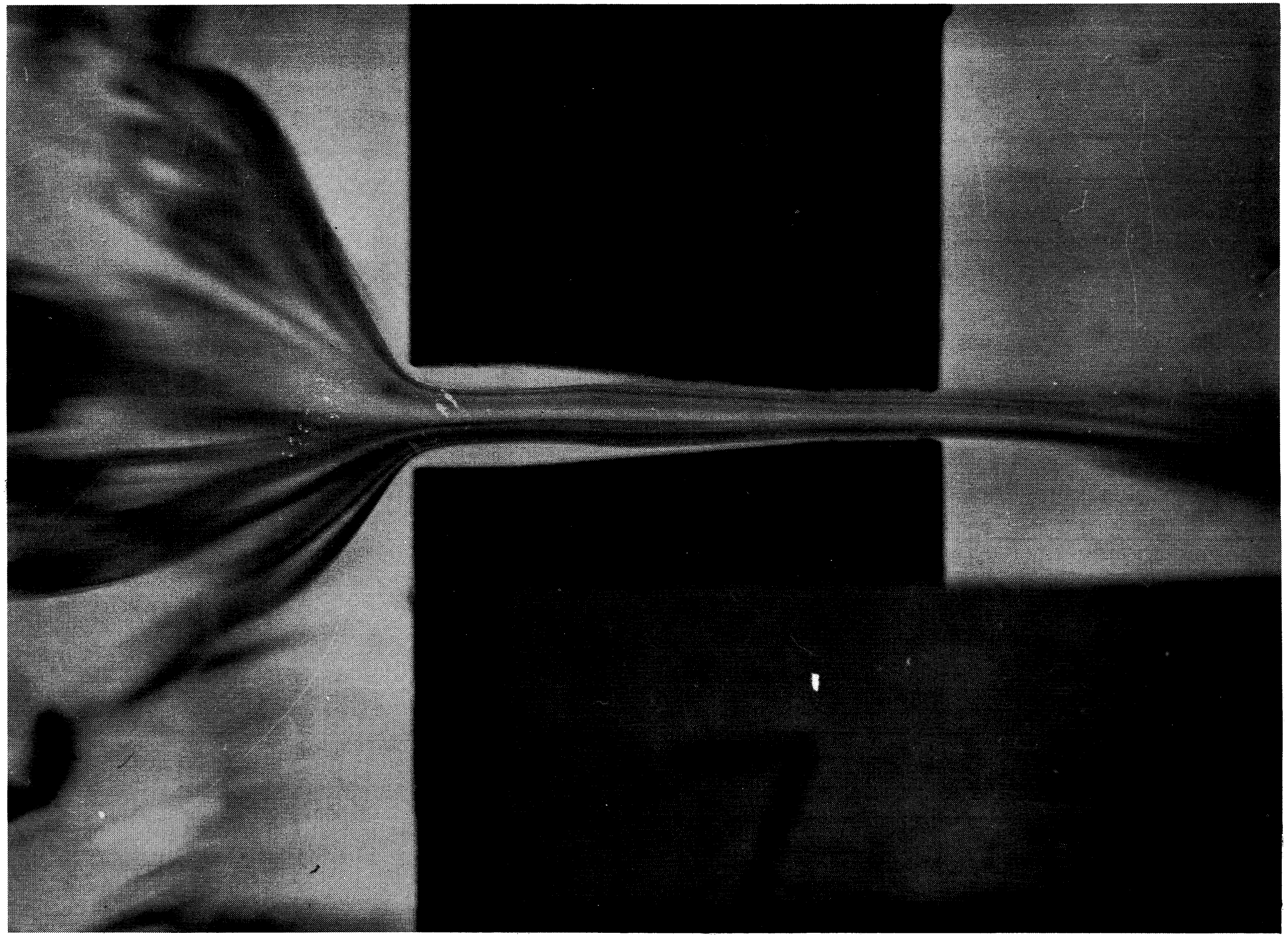


Fig. 11. Streamlines for simulated metering orifice. Chamfer included angle = 10°. With cylindrical approach section. 1600 lb/hr.

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