CHAPTER VIII

SUGGESTION FOR FURTHER WORK

(1) It is seen that the major part in this paper is to study about stress concentration of a parallel - side slit with semi - circular ends centrally placed in a plate loaded by uni-axial uniformly distributed force where an inclination angle varies between 30 degrees and 90 degrees and the ratio of c/r varies between 8 and 24. The end radius of curvature is expected to be 0.5 mm or 0.75 mm. If a parallel - side slit is still of interest, it is suggested that the end radius of curvature of the slit must be different from those values, and an experiment should be conducted by varying the end radius of curvature and the focal length while the ratio of c/r is being kept constant. The study should begin when c/r approaches zero.

(2) This study is partially concerned with a narrow slit with circular ends having the width of 0.35 mm, c/r equal to 16, and the angle of inclination varies from 45 degrees to 90 degrees. From the results of this study, it is shown that its stress concentration factor agrees quite well with that of the parallel - side slit at the same c/r. Therefore, for a further study, the narrow slit should be tested by varying its width and varying the ratio of c/r, and its stress concentration factor should be compared

to that of a parallel - side slit at equal c/r to verify whether they agree with each other as c/r differs from 16.

(3) The limitation of the results obtained from this study is that the stress concentration factors are calculable according to the uni - directional uniformly distributed load. It is advisable that it will be much more applicable if a further study is carried out in such a way that a test specimen should be subjected to biaxial uniformly distributed forces. If possible, the ratio of the two loads in both directions should be varied.

(4) Practically speaking, to find stress concentration factors for case (1), (2) and (3) as suggested above can be accomplished by using strain - gage technique or photoelasticity. It is recommended that if the stress concentration factors cannot be mathematically determined, the strain - gage technique should be employed for a further study to confirm the results in those cases.

(5) On the theoretical point of view, the more applicable theoretical analysis for the stress concentration factor of a parallel - side slit should be attempted by using the evidence from the experimental results obtained here.

APPENDIX

DATA AND SAMPLES OF CALCULATION

Material Fringe Value

The specimen for calibration was loaded as shown in Fig. A 46. Its isochromatic pattern at some values of load were recorded and reported by the picture shown in Fig. A 2 to Fig. A 7. Each values of load applied to the specimen for a particular isochromatic fringe order were revealed in Table 4-2.

In Fig. A 1, the calibration curve of material used in the experiment is plotted according to the data in Table 4-2. The graph of load P plotted against fringe order n varies linearly and satisfies the following equation

$$P = 2dfn$$

and it passes through the origin, then, slope of the graph is defined by

$$\frac{\Delta P}{\Delta n} = 2df$$

From the graph of Fig. A 1, it can be read out that

$$n = 0 , \quad P = 0$$

$$n = 8 , \quad P = 1190 \text{ N}$$

Consequently, $2df = \frac{\Delta P}{\Delta n} = \frac{1190}{8}$ and $d = 14.12$ mm

Thus, the material fringe value is evaluated by

$$f = \frac{1190}{2 \times 14.12 \times 8} = 5.267 \text{ N/mm - order}$$

This value of f is used for an epoxy plate placed in yellow light generated by the monochromatic light source of the circular polariscope.

Sample of Calculation

The experimental value of a stress concentration factor is calculated based on the data shown in Table A 1. The load contained in Table A 1 is the magnitude of force applied to the test specimen until a maximum isochromatic fringe order of 4.5 occurs at the edge of a specified slit. For example, consider the test specimen numbered 19 which is an epoxy plate disturbed by a parallel - side slit with semi - circular ends. Its dimensions are:

Width of the plate	= 79.53	mm
Thickness of the plate	= 1.975	mm
Semi - focal length of slit	= 10.0	mm
End radius of curvature of slit	= 0.5	mm
Width of slit	= 1.0	mm
Inclination angle of slit	= 75	degrees
The ratio of c/r	= 20	
Applied load from Table A 1	= 496.40	N
Maximum fringe order at the edge of slit	= 4.5	

Stress at the edge of slit is expressed by eq. (35)

$$\sigma_t = 2Fn$$

$$= 2fn/h$$

Uniformly distributed load, $S = P/Dh$

Thus, stress concentration factor, $K_F = \sigma_t/S$

$$K_F = 2fDn/P$$

Replace f, D, n and P by their numerical values, gives

$$K_F = \frac{2 \times 5.267 \times 79.53 \times 4.5}{496.40} = 7.60$$

Table A 1 : Load Applied to the Test Specimen Which Gives a Maximum Isochromatic Fringe Order of 4.5 on its Slit's Edge

Specimen no.	Weight W (lb_f)	Applied Load P (N)
1	30.4	886.04
2	28.8	843.34
3	27.1	797.97
4	25.1	744.60
5	24.2	720.58
6	27.2	800.64
7	25.4	752.60
8	23.0	688.55
9	20.8	629.84
10	20.0	608.49

Table A 1 : (continued)

Specimen no.	Weight W (lb_f)	Applied Load P (N)
11	24.6	731.25
12	22.6	677.89
13	20.0	608.49
14	18.1	557.78
15	17.1	531.09
16	22.7	680.54
17	20.6	624.50
18	17.9	552.44
19	15.8	496.40
20	15.0	475.05
21	20.9	632.51
22	18.7	573.79
23	16.2	507.07
24	14.3	456.37
25	13.6	437.68
26	25.0	741.93
27	22.5	675.21
28	19.0	581.80
29	17.0	528.42
30	16.2	507.07
31	22.8	683.21
32	19.2	587.14
33	17.3	536.43
34	16.2	507.07

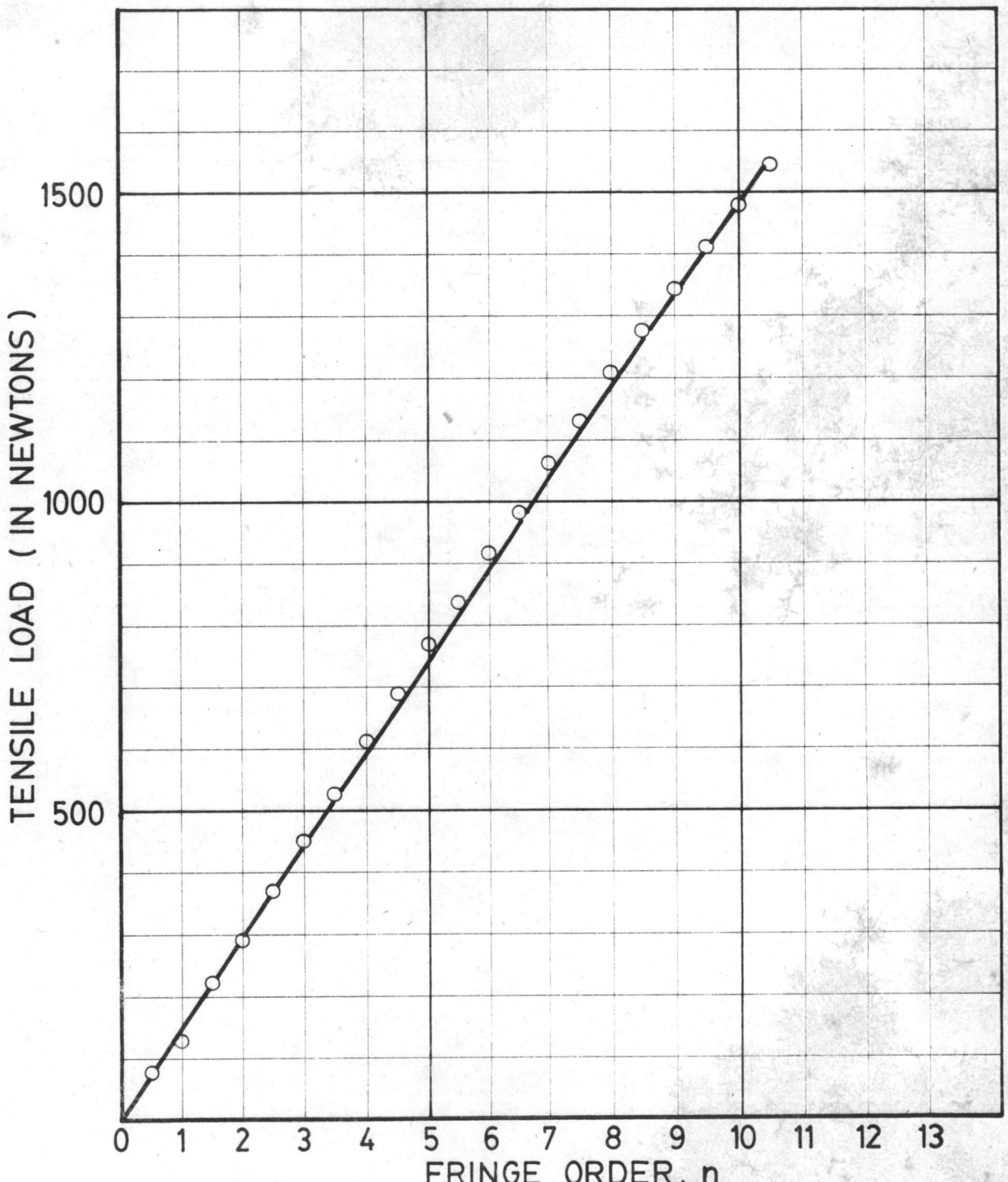
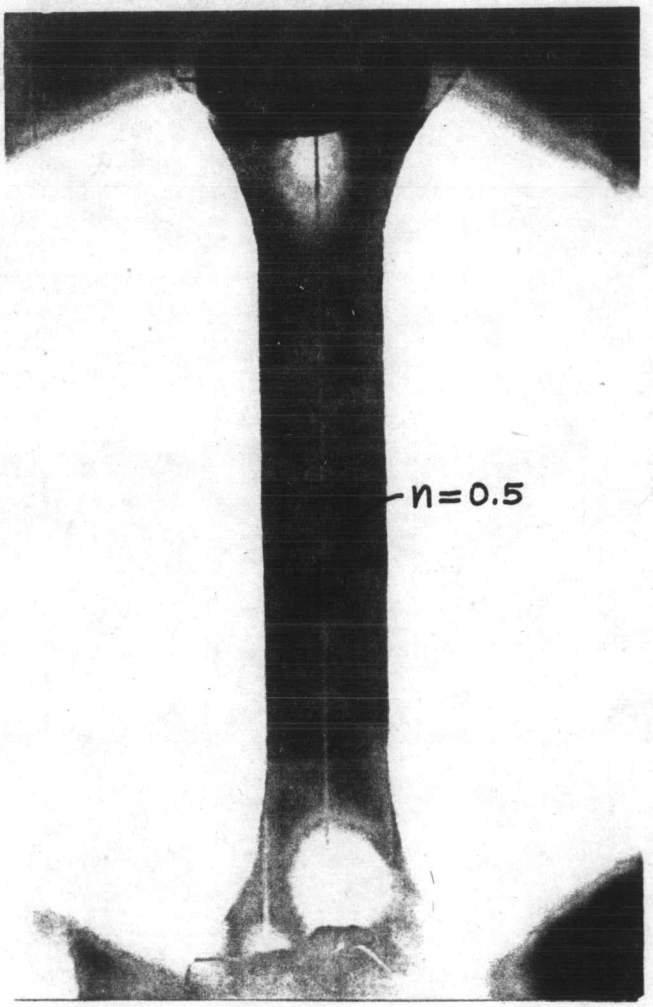
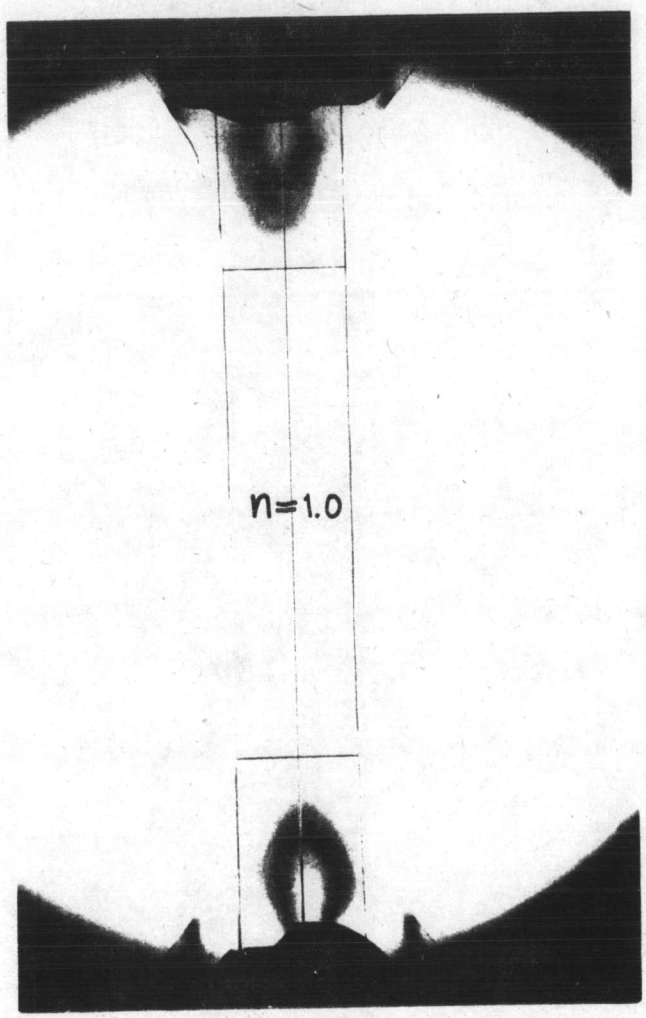


FIG. A1 CALIBRATION CURVE FOR EPOXY RESIN SHEET IN TENSION USING YELLOW LIGHT TRAVERSING THE THICKNESS OF 3.2 mm



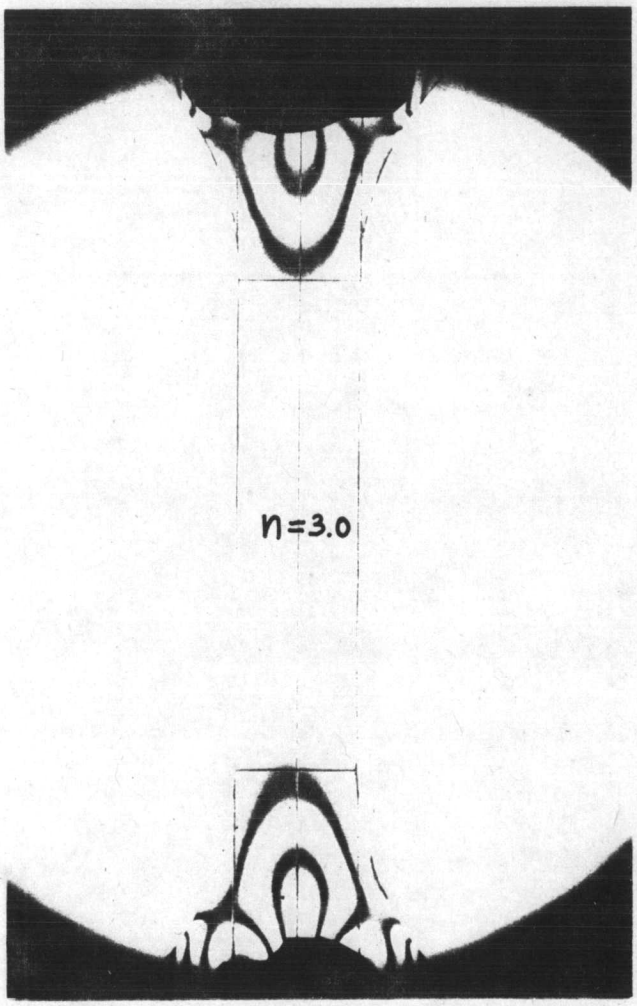
Load = 74.73 N

FIG. A2 ISOCHROMATIC BAND OF SPECIMEN FOR CALIBRATION AT FRINGE ORDER = 0.5



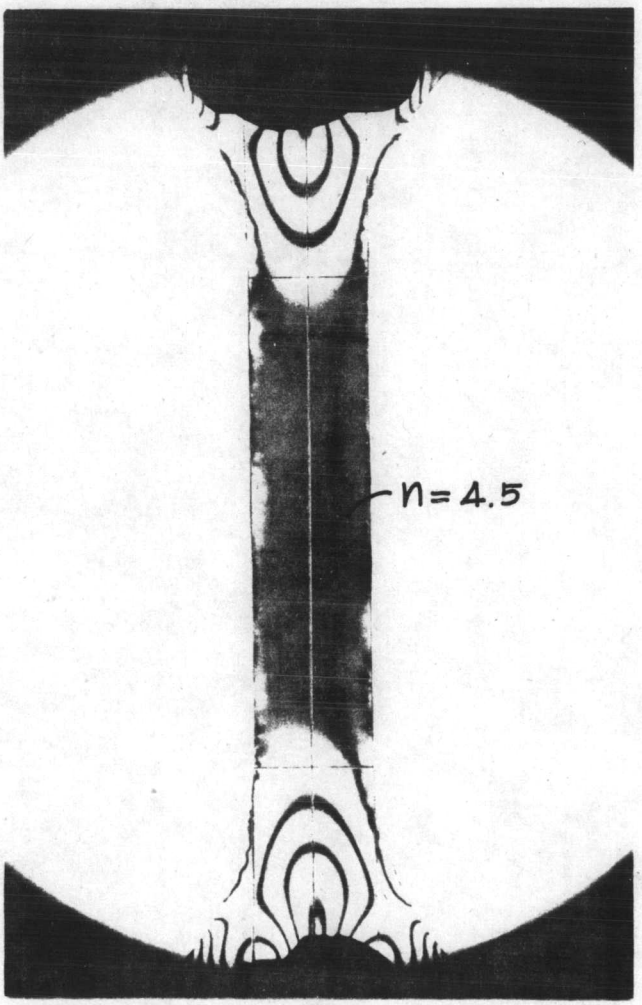
Load = 128.10 N

FIG. A3 ISOCHROMATIC BAND OF SPECIMEN FOR CALIBRATION AT FRINGE ORDER = 1.0



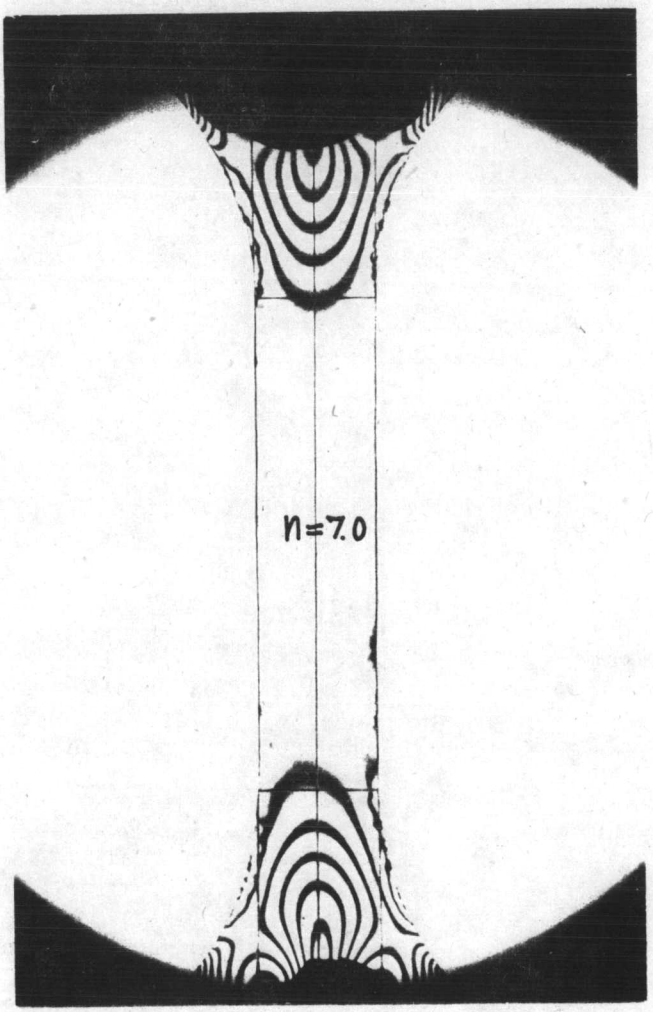
Load = 448.36 N

FIG. A4 ISOCHROMATIC BAND OF SPECIMEN FOR CALIBRATION AT FRINGE ORDER = 3.0



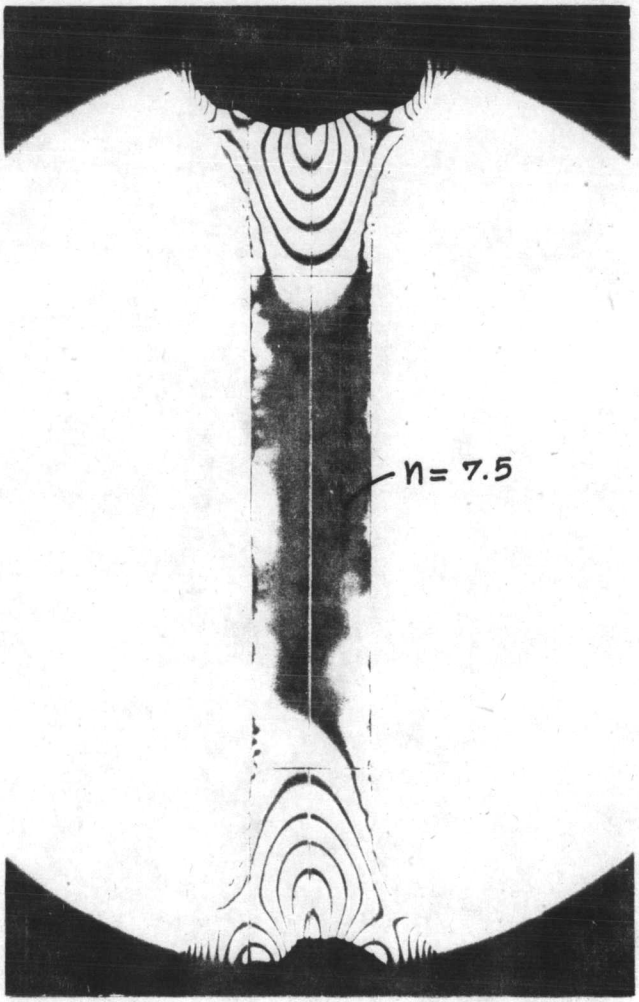
Load = 688.55 N

FIG. A 5 ISOCHROMATIC BAND OF SPECIMEN FOR CALIBRATION AT FRINGE ORDER = 4.5



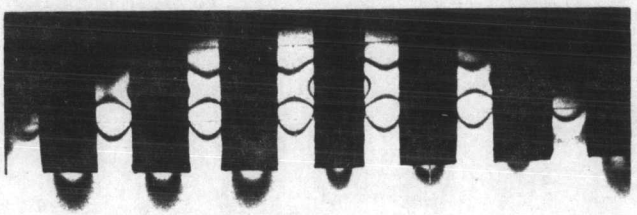
Load = 1062.18 N

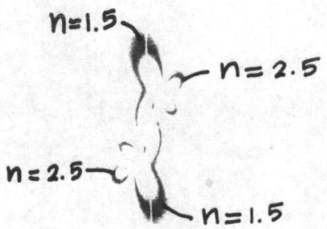
FIG. A6 ISOCHROMATIC BAND OF SPECIMEN FOR CALIBRATION AT FRINGE ORDER = 7.0

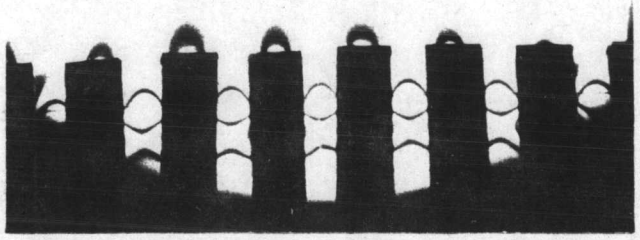


Load = 1128.90 N

FIG. A7 ISOCHROMATIC BAND OF SPECIMEN FOR CALIBRATION AT FRINGE ORDER = 7.5



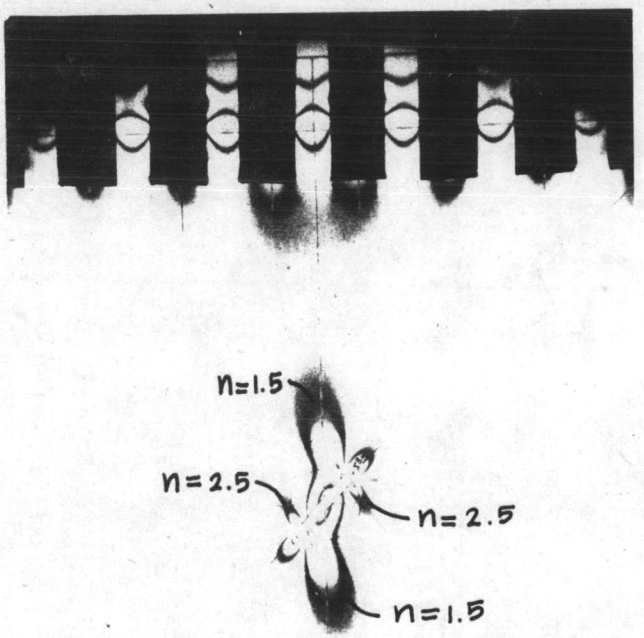




Maximum Order of
Isochromatic Fringe = 7.7

Load Applied to the
Test Specimen = 1515.88 N

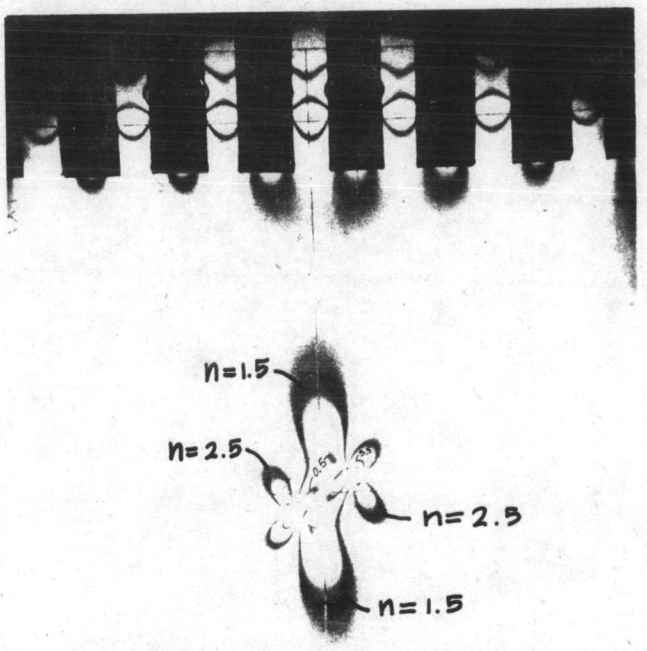
FIG. A8 ISOCHROMATIC PATTERN OF SPECIMEN
No 1



Maximum Order of
Isochromatic Fringe = 8.4

Load Applied to the
Test Specimen = 1569.25 N

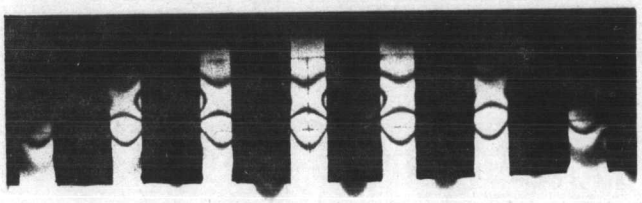
FIG. A9 ISOCHROMATIC PATTERN OF SPECIMEN
№ 2

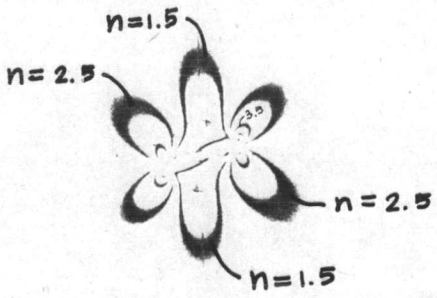


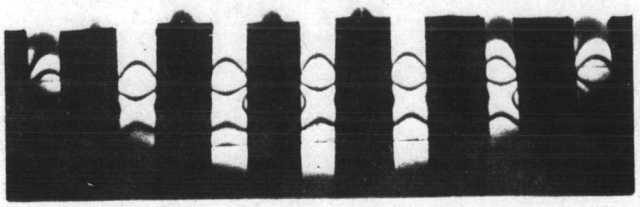
Maximum Order of
Isochromatic Fringe = 8.5

Load Applied to the
Test Specimen = 1515.88 N

FIG. A 10 ISOCHROMATIC PATTERN OF SPECIMEN
№ 3



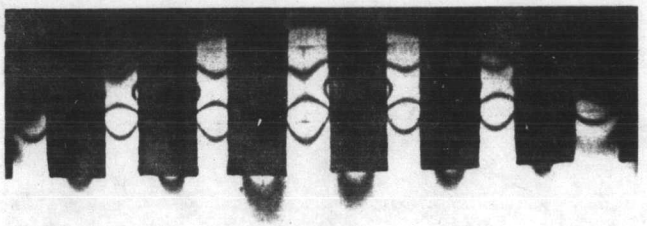


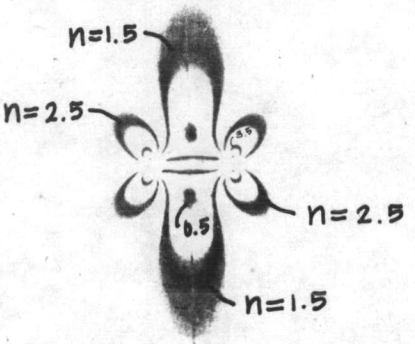


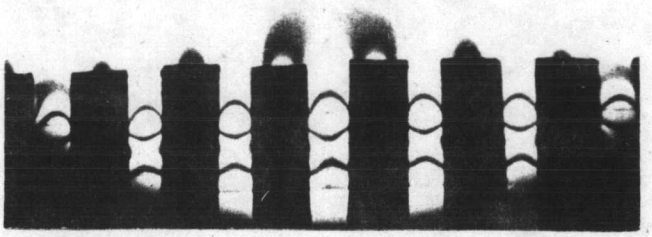
Maximum Order of Isochromatic Fringe = 10.5

Load Applied to the Test Specimen = 1729.38 N

FIG. A 11 ISOCHROMATIC PATTERN OF SPECIMEN No 4



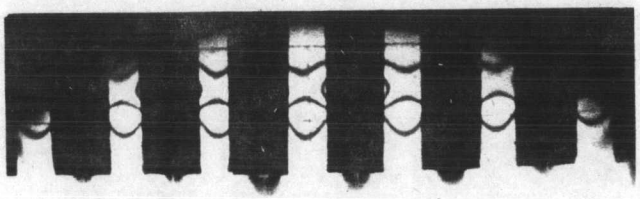


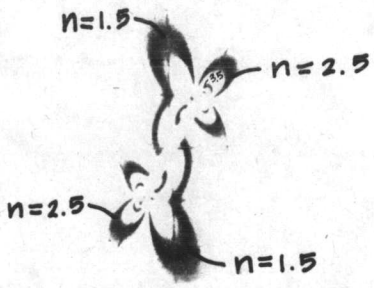


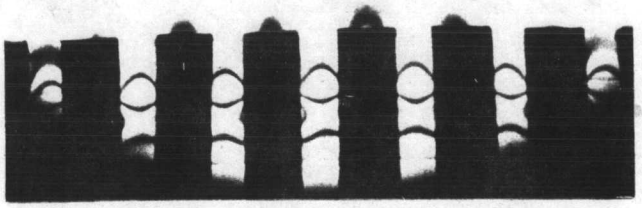
Maximum Order of
Isochromatic Fringe = 9.8

Load Applied to the
Test Specimen = 1569.25 N

FIG. A12 ISOCHROMATIC PATTERN OF SPECIMEN No 5



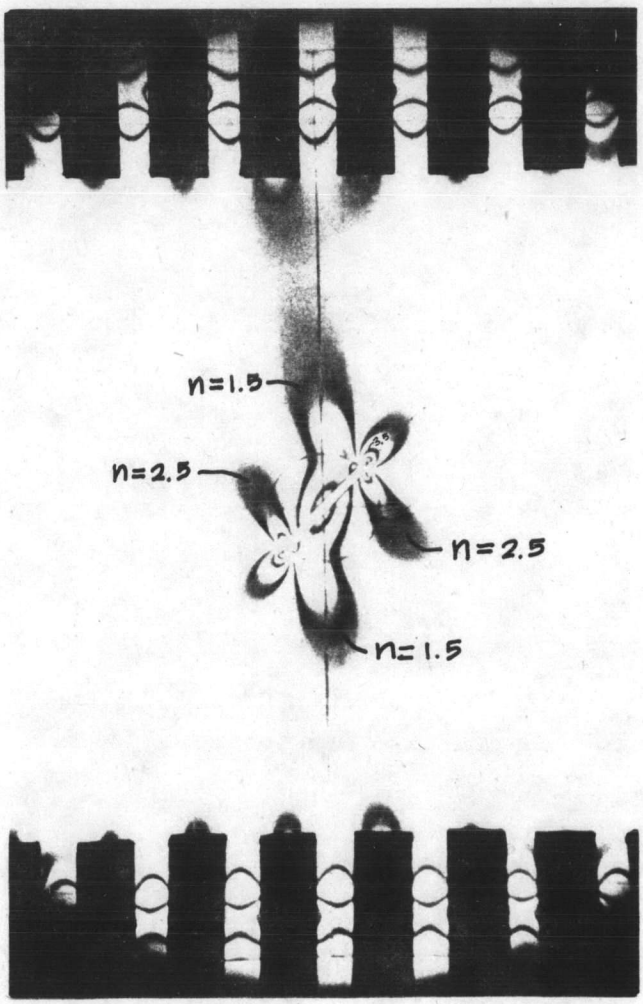




Maximum Order of
Isochromatic Fringe = 9.3

Load Applied to the
Test Specimen = 1649.32 N

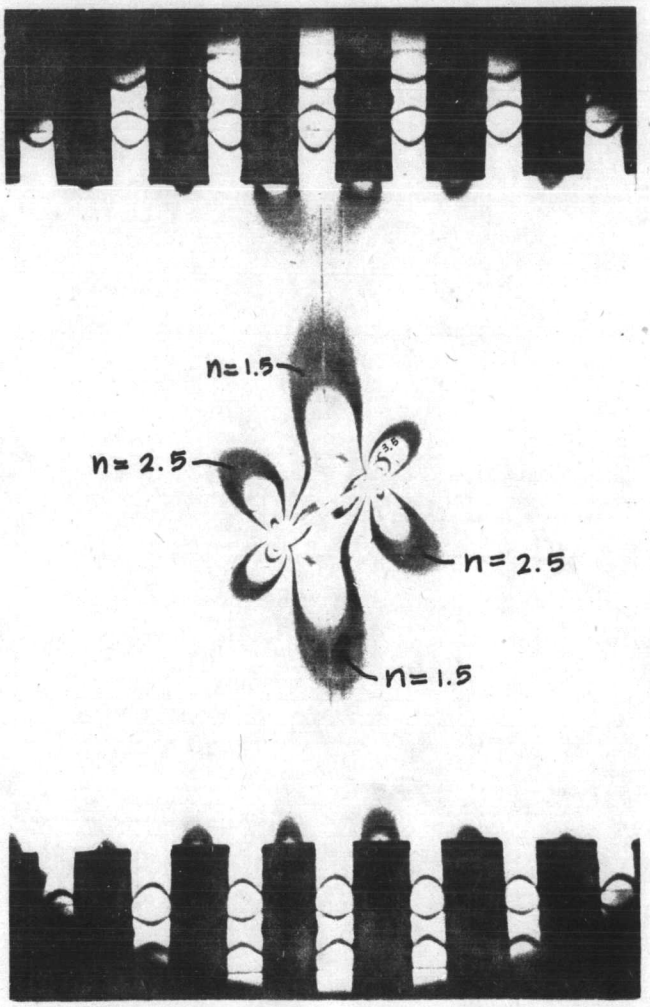
FIG. A13 ISOCHROMATIC PATTERN OF SPECIMEN
No 6



Maximum Order of
Isochromatic Fringe = 9.9

Load Applied to the
Test Specimen = 1649.32 N

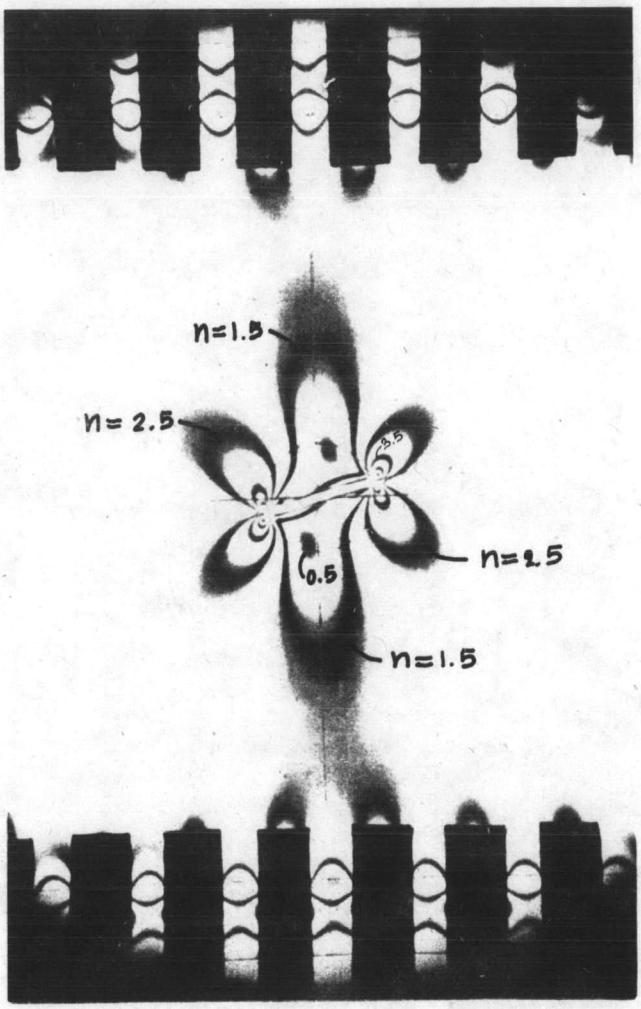
FIG. A14 ISOCHROMATIC PATTERN OF SPECIMEN
No 7



Maximum Order of
Isochromatic Fringe = 10.4

Load Applied to the
Test Specimen = 1595.94 N

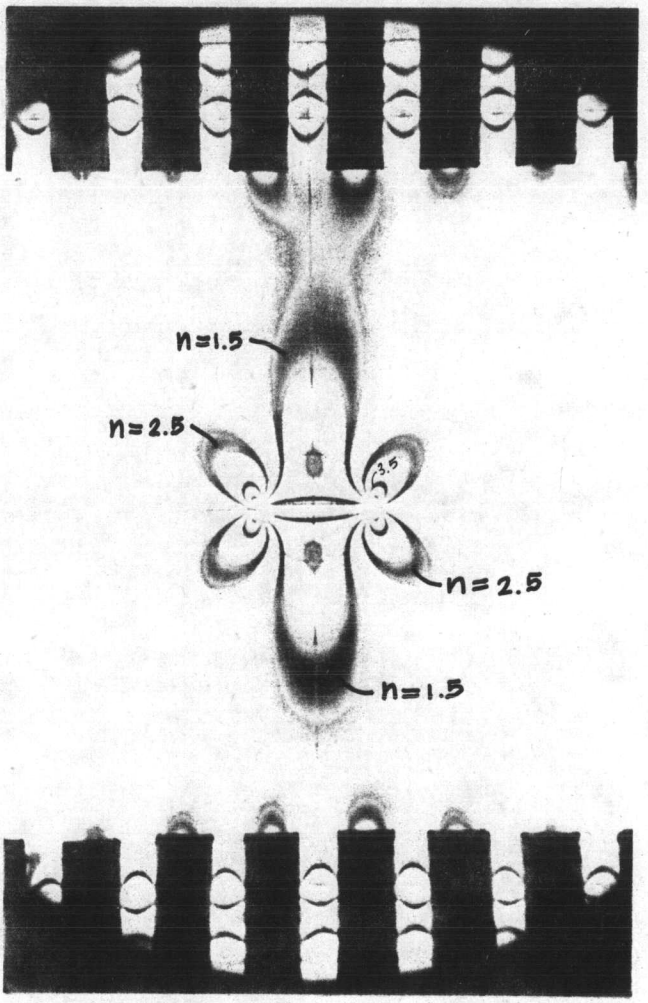
FIG. A15 ISOCHROMATIC PATTERN OF SPECIMEN
№ 8



Maximum Order of
Isochromatic Fringe = 11.4

Load Applied to the
Test Specimen = 1595.94 N

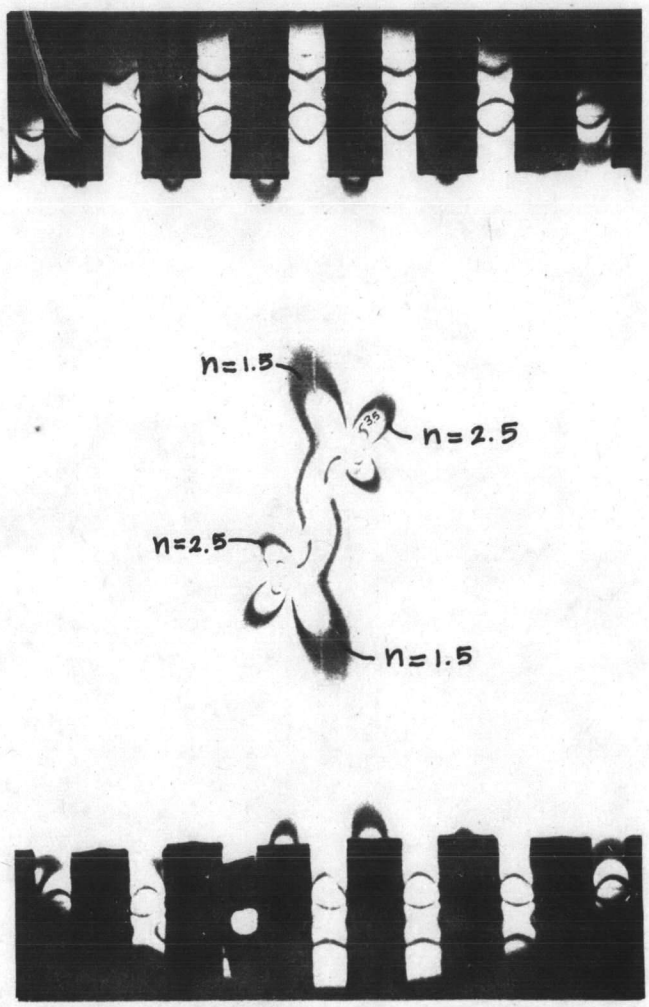
FIG. A16 ISOCHROMATIC PATTERN OF SPECIMEN
NO 9



Maximum Order of
Isochromatic Fringe = 11.8

Load Applied to the
Test Specimen = 1595.94 N

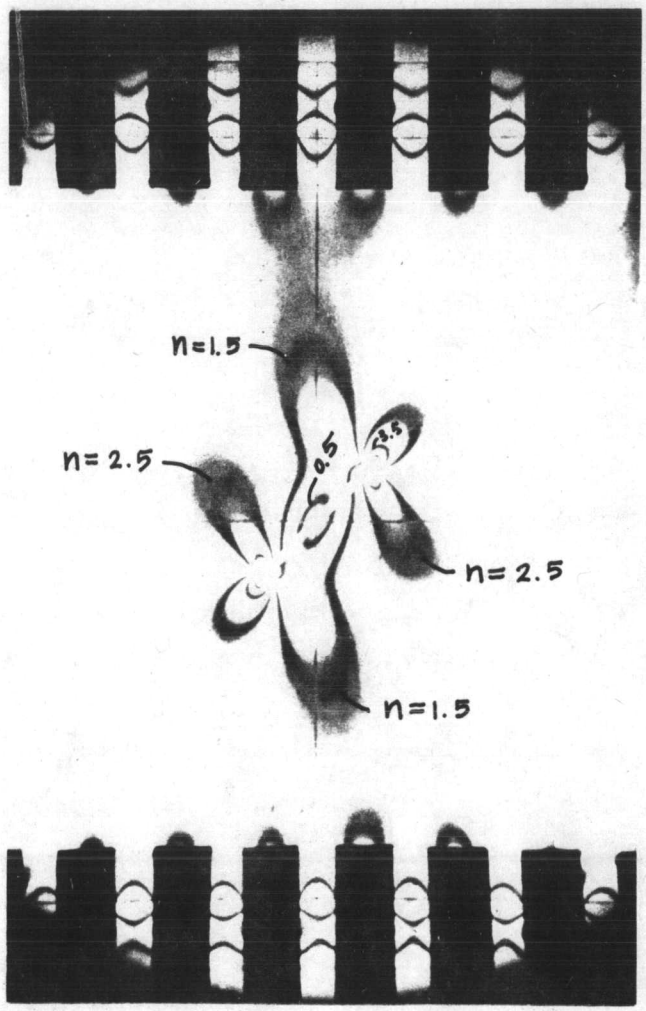
FIG. A17 ISOCHROMATIC PATTERN OF SPECIMEN
NO 10



Maximum Order of
Isochromatic Fringe = 10.1

Load Applied to the
Test Specimen = 1649.32 N

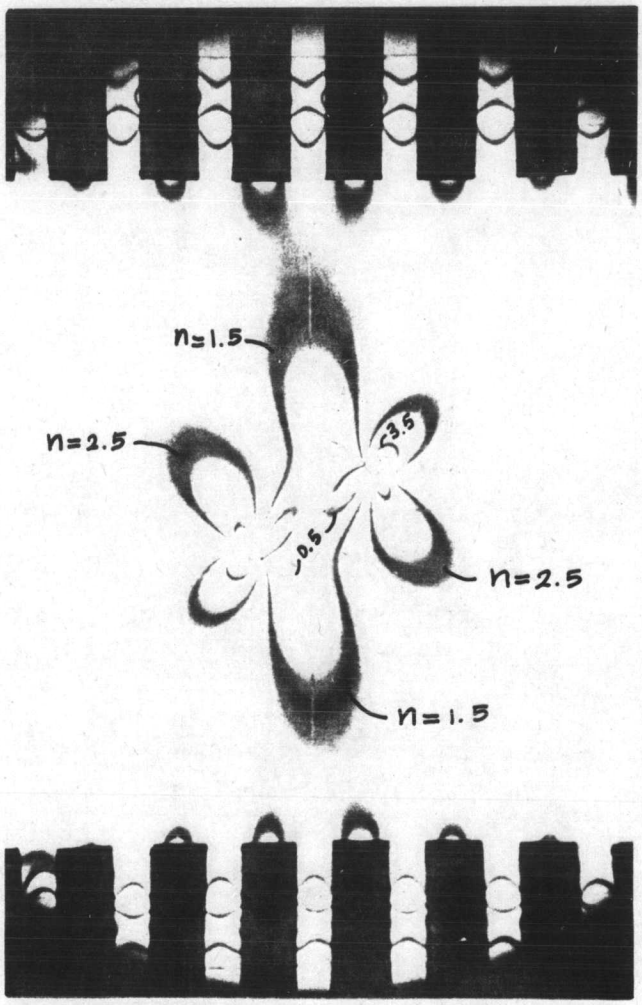
FIG. A18 ISOCHROMATIC PATTERN OF SPECIMEN
№ 11



Maximum Order of Isochromatic Fringe = 10.6

Load Applied to the Test Specimen = 1595.94 N

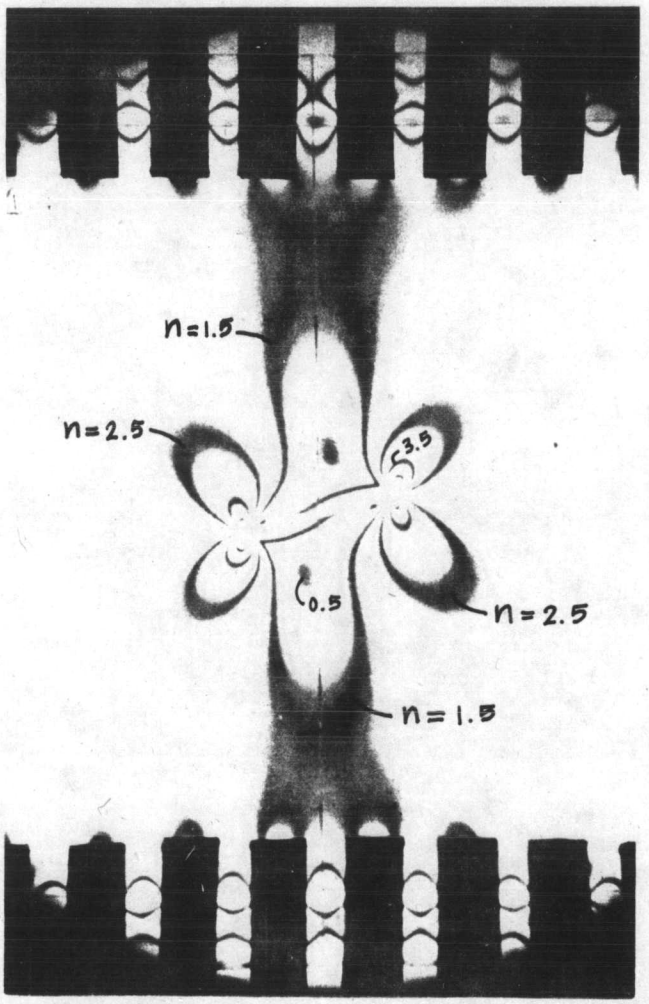
FIG. A 19 ISOCHROMATIC PATTERN OF SPECIMEN № 12



Maximum Order of Isochromatic Fringe = 11.8

Load Applied to the Test Specimen = 1595.94 N

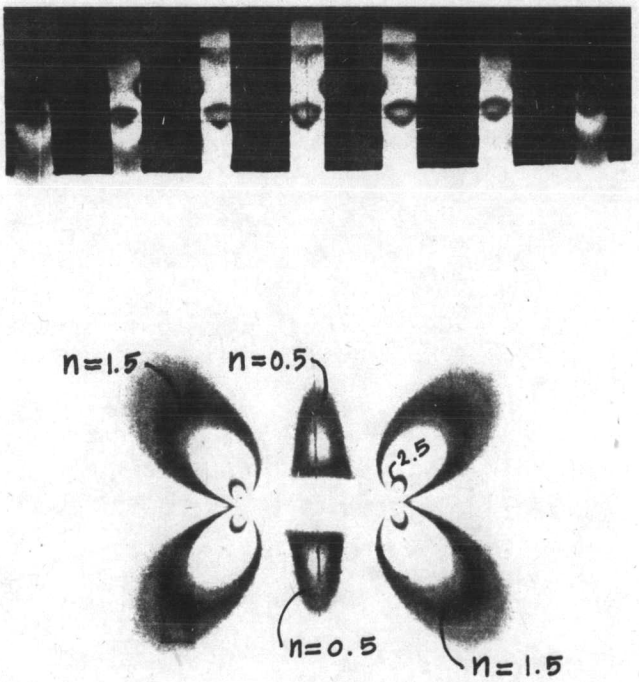
FIG. A20 ISOCHROMATIC PATTERN OF SPECIMEN No 13



Maximum Order of Isochromatic Fringe = 12.9

Load Applied to the Test Specimen = 1595.94 N

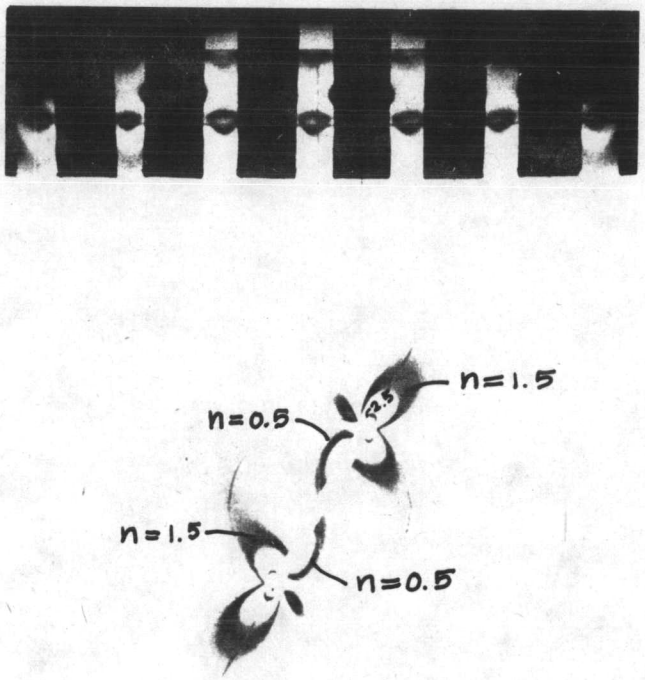
FIG. A 21 ISOCHROMATIC PATTERN OF SPECIMEN NO 14



Maximum Order of
Isochromatic Fringe = 8.3

Load Applied to the
Test Specimen = 982.12 N

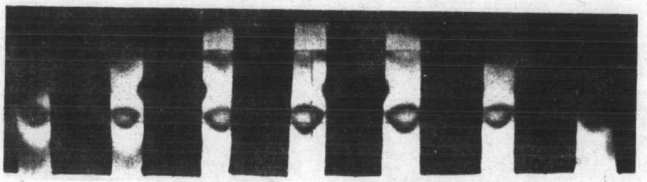
FIG. A22 ISOCHROMATIC PATTERN OF SPECIMEN
NO 15

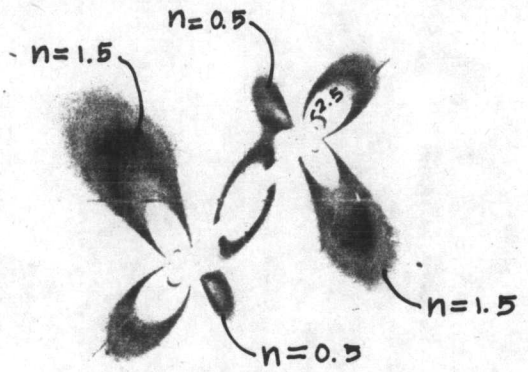


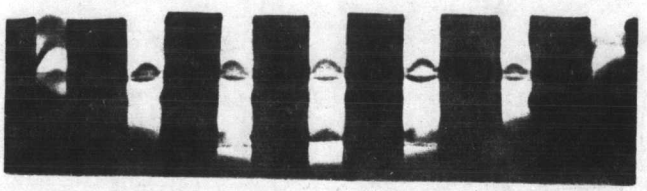
Maximum Order of
Isochromatic Fringe = 6.5

Load Applied to the
Test Specimen = 982.12 N

FIG. A23 ISOCHROMATIC PATTERN OF SPECIMEN No 16



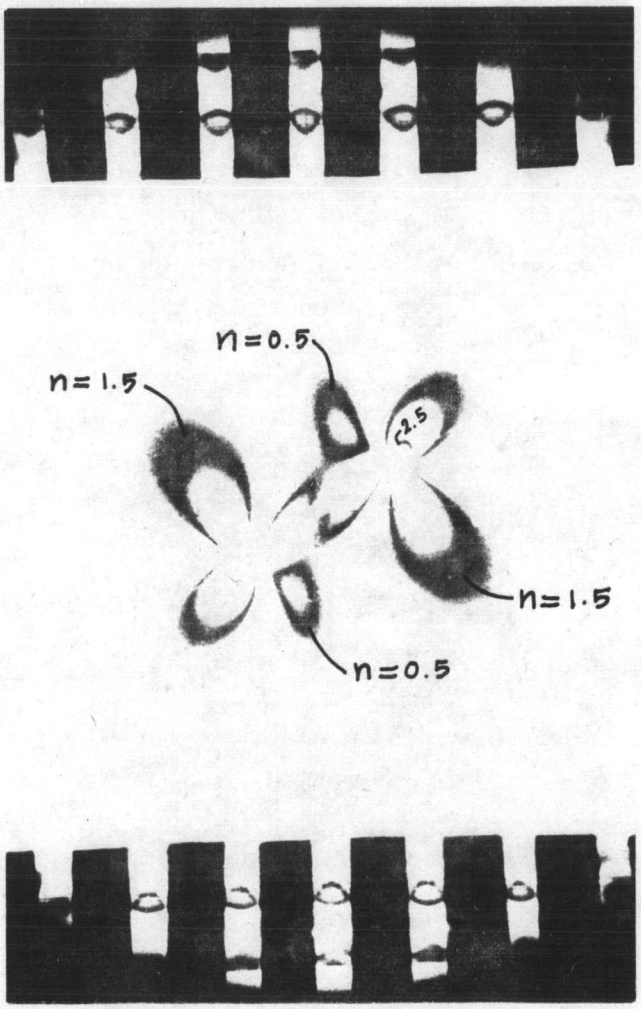




Maximum Order of
Isochromatic Fringe = 7.1

Load Applied to the
Test Specimen = 982.12 N

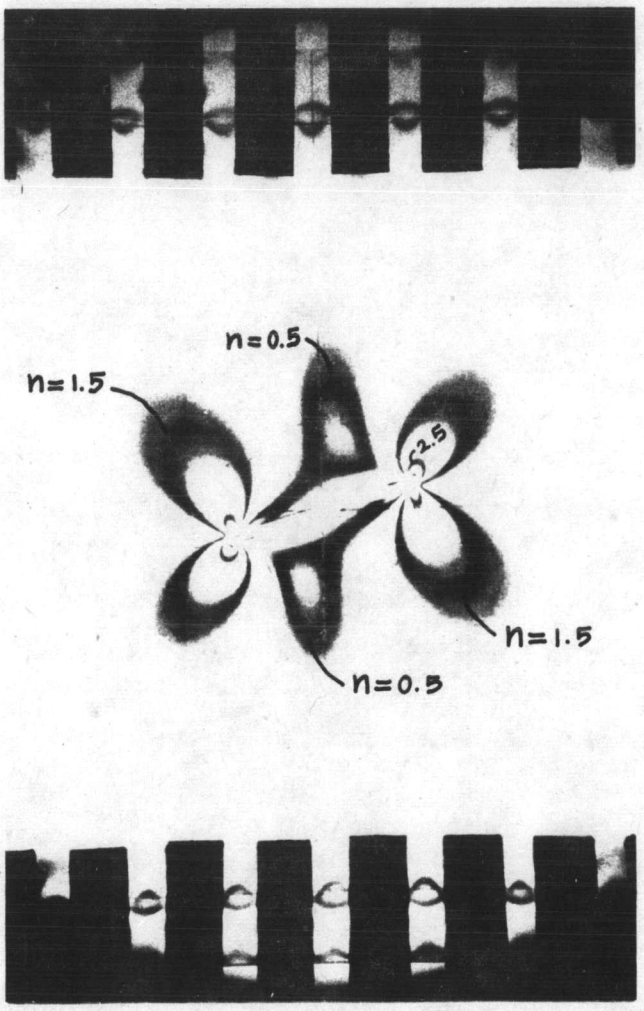
FIG. A24 ISOCHROMATIC PATTERN OF SPECIMEN
No 17



Maximum Order of
Isochromatic Fringe = 7.6

Load Applied to the
Test Specimen = 928.74 N

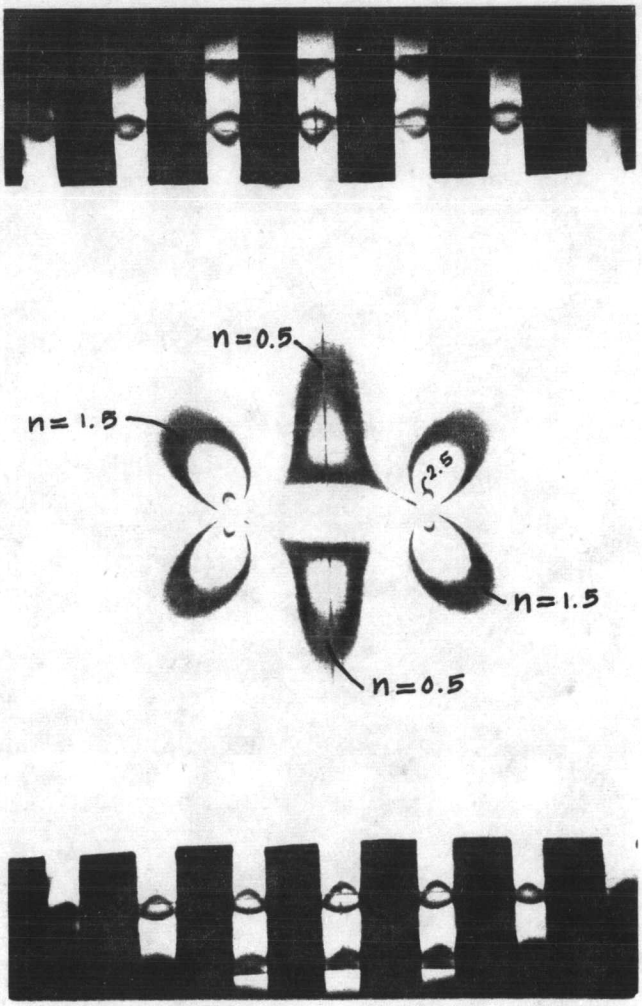
FIG. A25 ISOCHROMATIC PATTERN OF SPECIMEN
№ 18



Maximum Order of
Isochromatic Fringe = 8.2

Load Applied to the
Test Specimen = 902.05 N

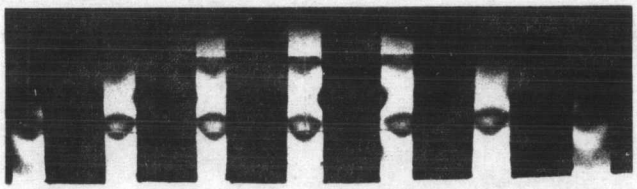
FIG. A26 ISOCHROMATIC PATTERN OF SPECIMEN
№ 19

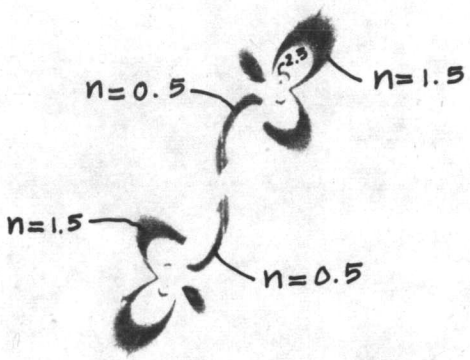


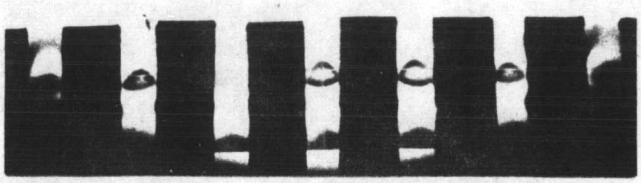
Maximum Order of
Isochromatic Fringe = 8.0

Load Applied to the
Test Specimen = 848.68 N

FIG. A27 ISOCHROMATIC PATTERN OF SPECIMEN
No 20



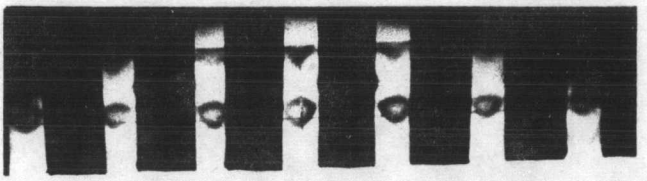


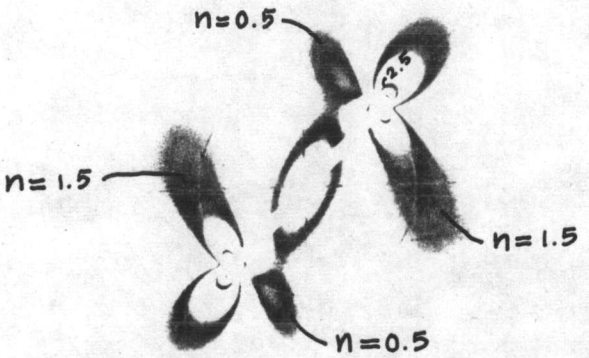


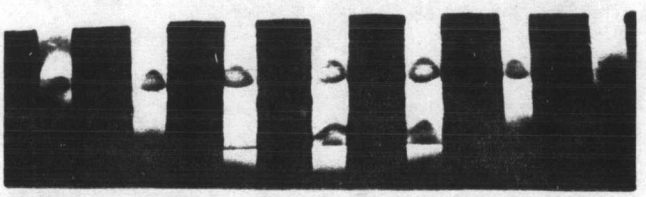
Maximum Order of Isochromatic Fringe = 6.4

Load Applied to the Test Specimen = 902.05 N

FIG. A28 ISOCHROMATIC PATTERN OF SPECIMEN NO 21



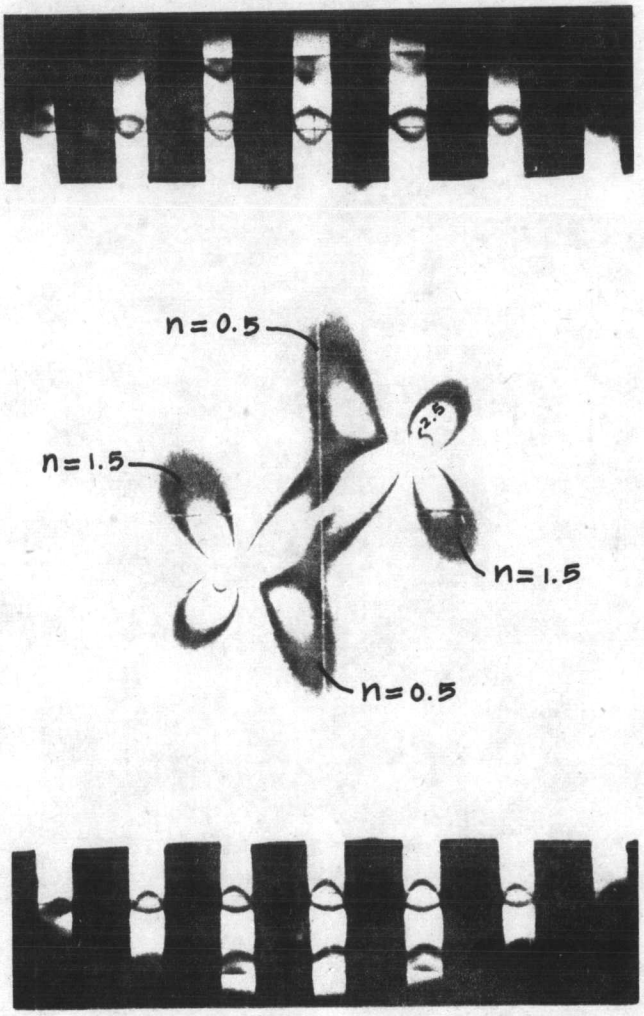




Maximum Order of
Isochromatic Fringe = 6.7

Load Applied to the
Test Specimen = 848.68 N

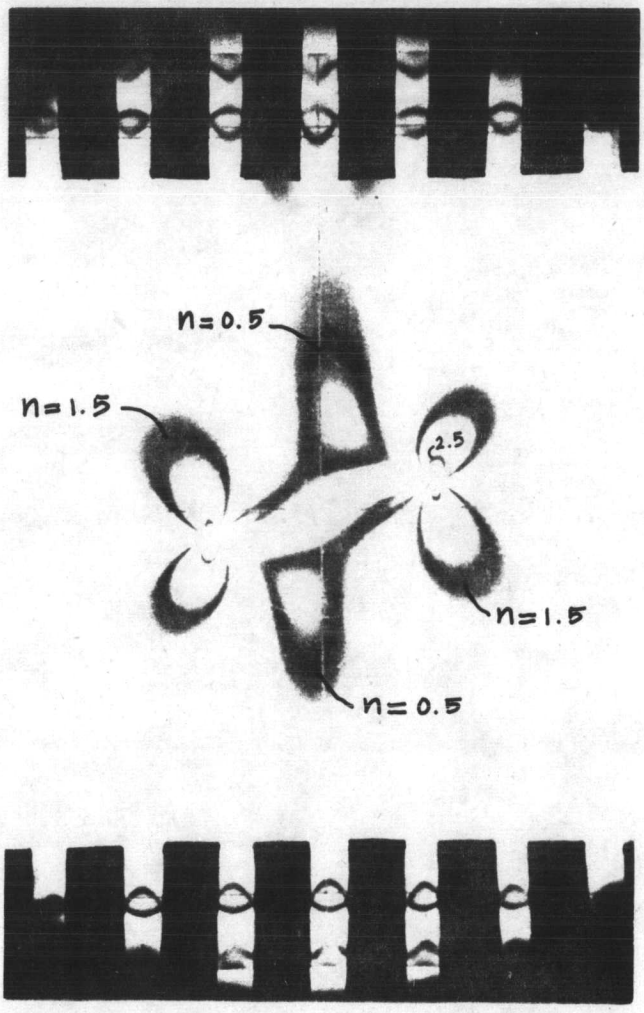
FIG. A29 ISOCHROMATIC PATTERN OF SPECIMEN
№ 22



Maximum Order of
Isochromatic Fringe = 7.1

Load Applied to the
Test Specimen = 795.30 N

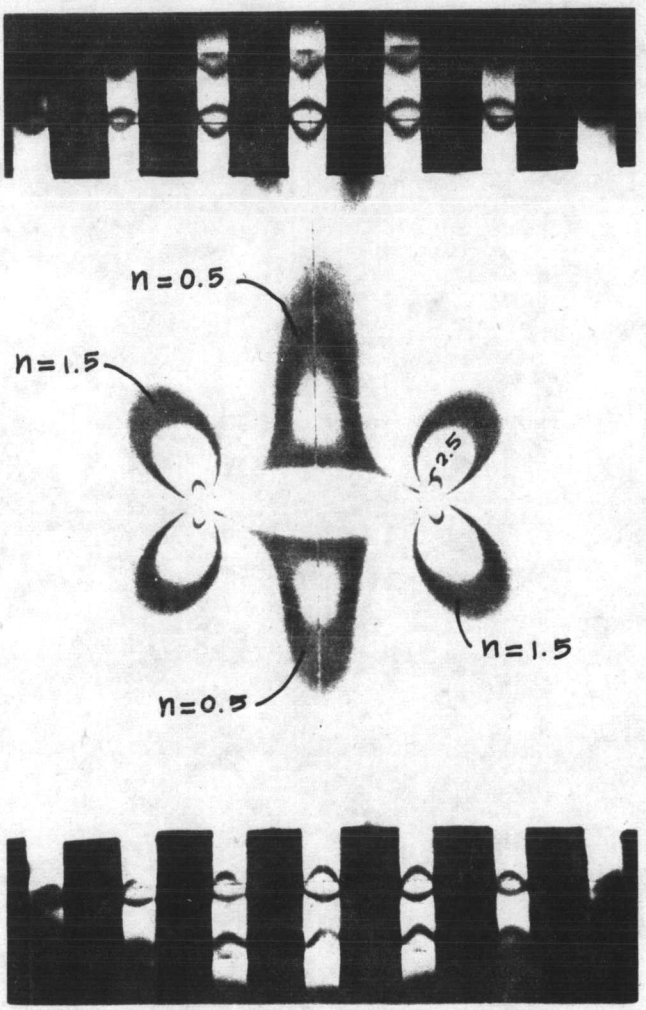
FIG. A30 ISOCHROMATIC PATTERN OF SPECIMEN
№ 23



Maximum Order of
Isochromatic Fringe = 7.8

Load Applied to the
Test Specimen = 795.30 N

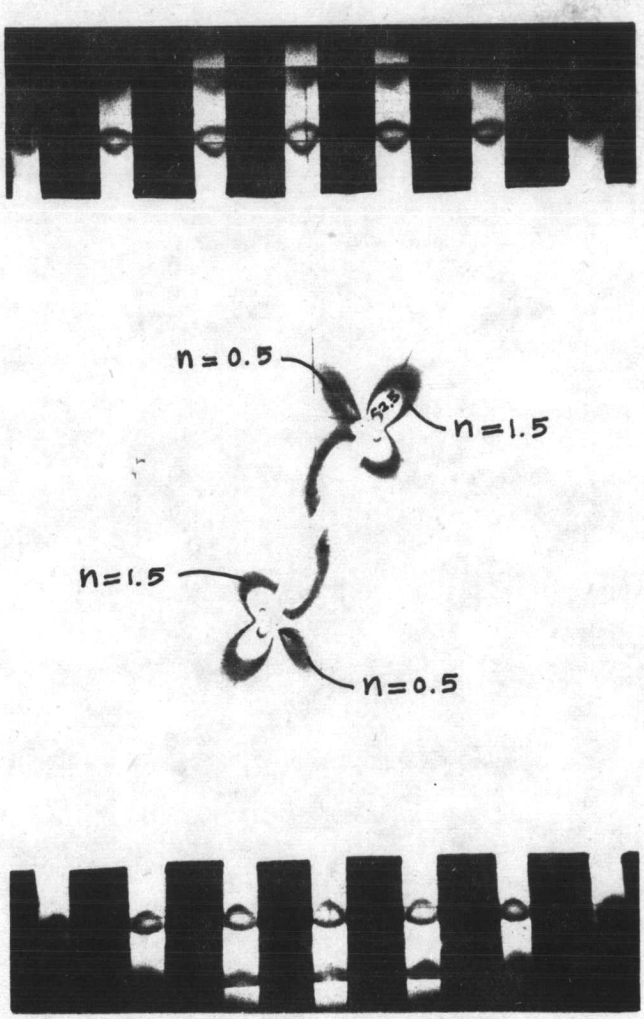
FIG. A31 ISOCHROMATIC PATTERN OF SPECIMEN
№ 24



Maximum Order of
Isochromatic Fringe = 8.2

Load Applied to the
Test Specimen = 795.30 N

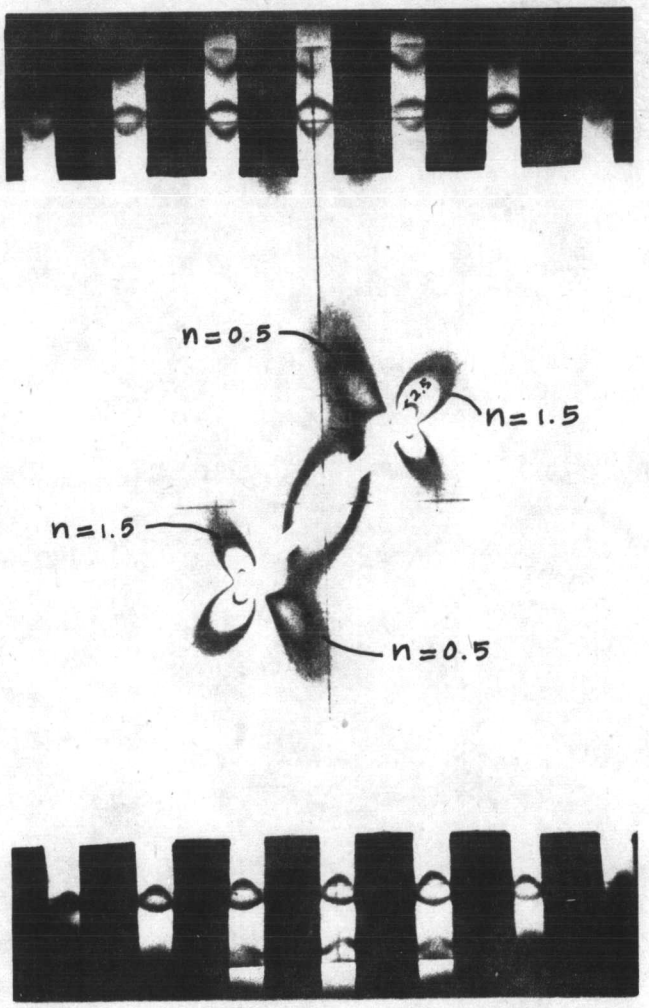
FIG. A32 ISOCHROMATIC PATTERN OF SPECIMEN
No 25



Maximum Order of
Isochromatic Fringe = 4.9

Load Applied to the
Test Specimen = 848.68 N

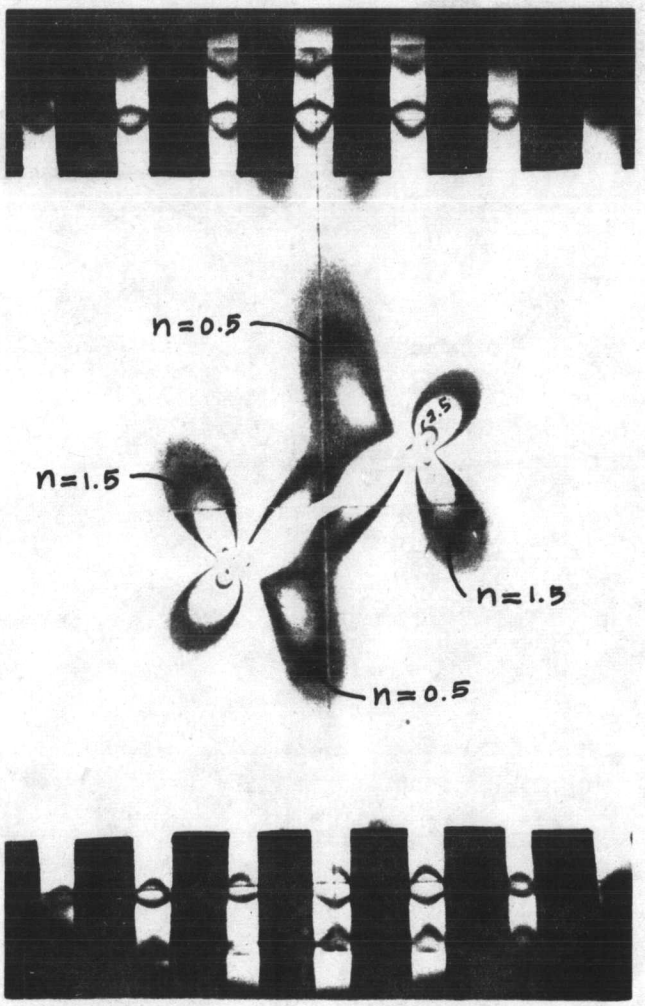
FIG. A33 ISOCHROMATIC PATTERN OF SPECIMEN
NO 26



Maximum Order of
Isochromatic Fringe = 4.9

Load Applied to the
Test Specimen = 795.30 N

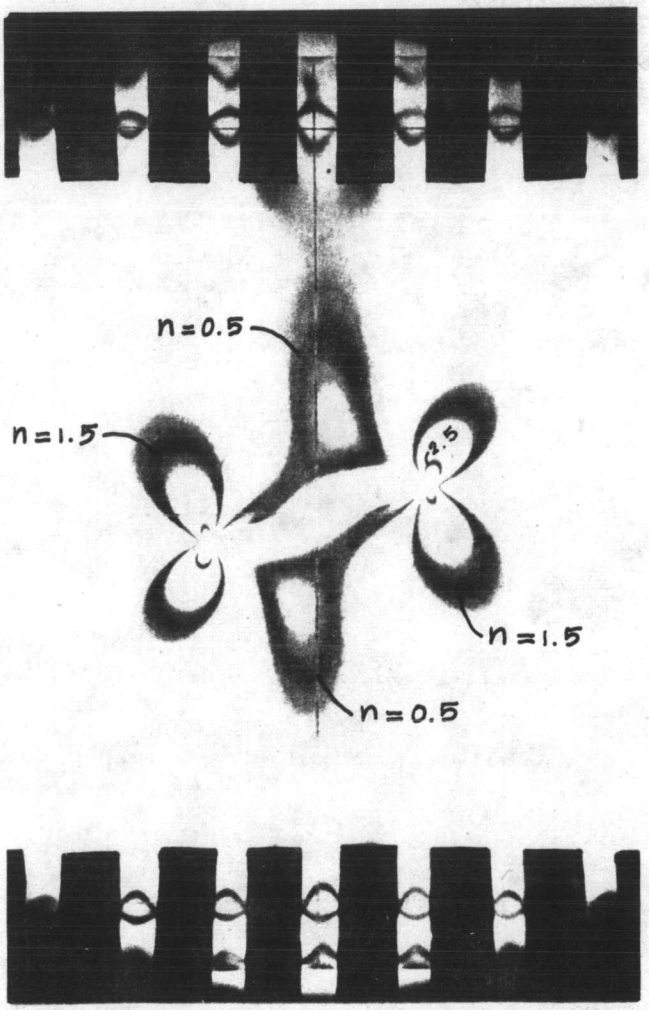
FIG. A34 ISOCHROMATIC PATTERN OF SPECIMEN
№ 27



Maximum Order of
Isochromatic Fringe = 5.4

Load Applied to the
Test Specimen = 795.30 N

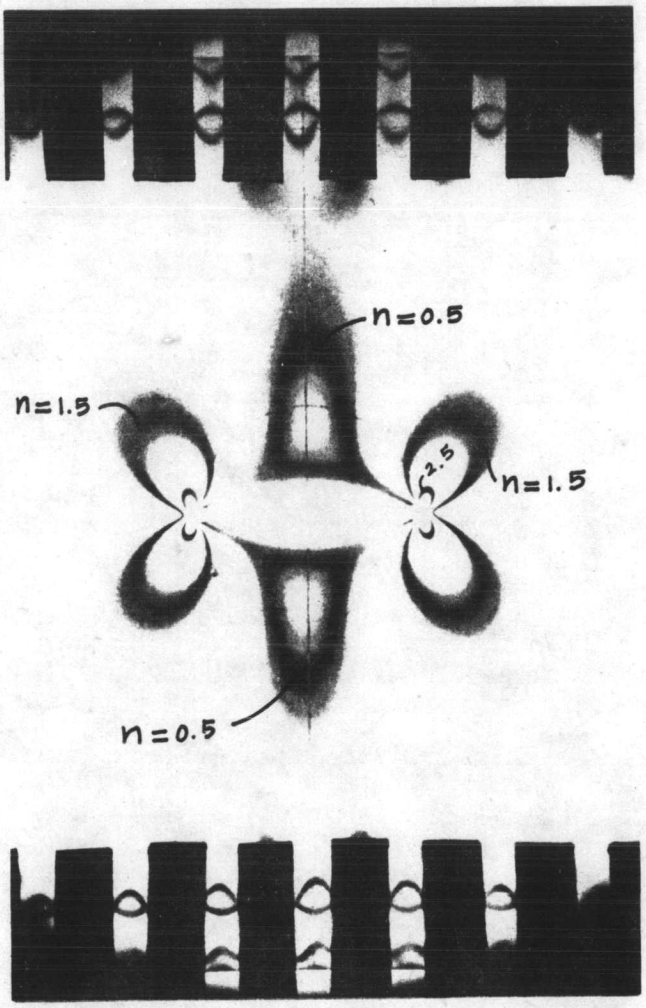
FIG. A35 ISOCHROMATIC PATTERN OF SPECIMEN
№ 28



Maximum Order of
Isochromatic Fringe = 5.9

Load Applied to the
Test Specimen = 795.30 N

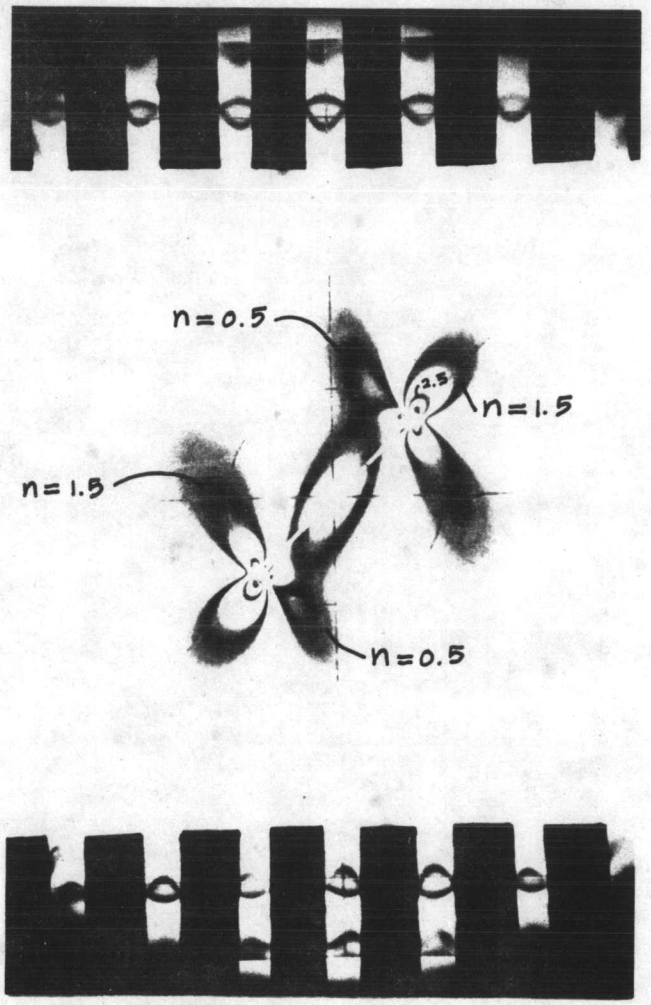
FIG. A36 ISOCHROMATIC PATTERN OF SPECIMEN
No 29



Maximum Order of
Isochromatic Fringe = 6.2

Load Applied to the
Test Specimen = 795.30 N

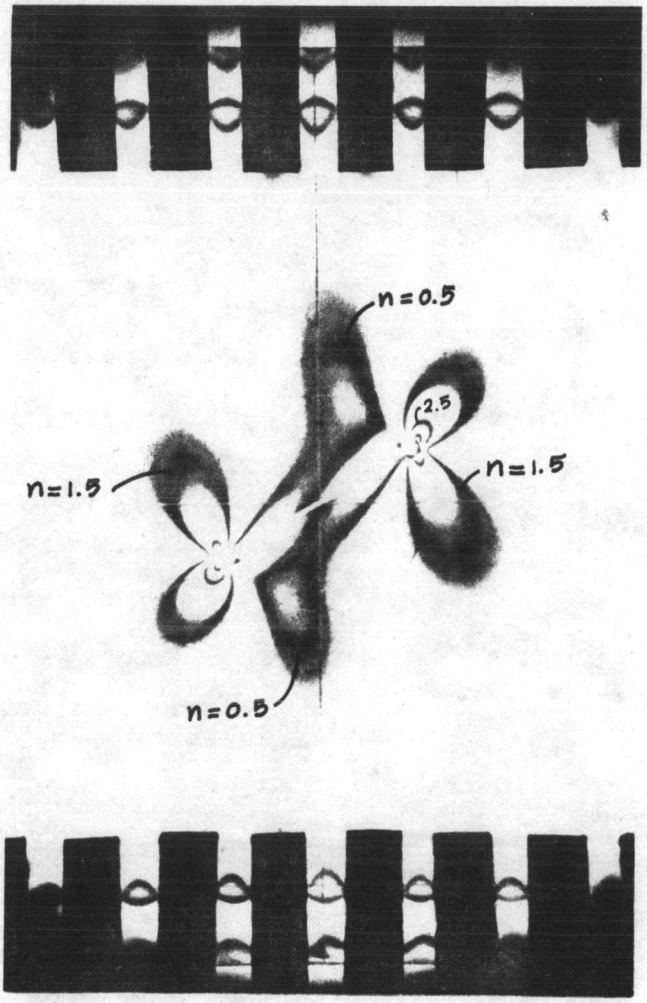
FIG. A37 ISOCHROMATIC PATTERN OF SPECIMEN
№ 30



Maximum Order of
Isochromatic Fringe = 5.1

Load Applied to the
Test Specimen = 848.68 N

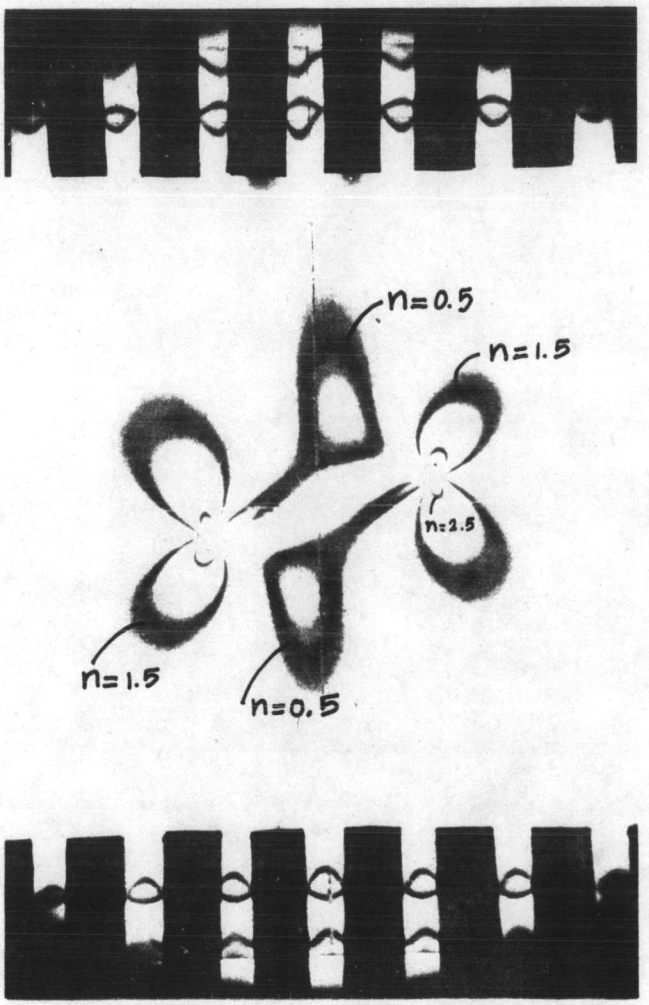
FIG. A38 ISOCHROMATIC PATTERN OF SPECIMEN
№ 31



Maximum Order of
Isochromatic Fringe = 5.7

Load Applied to the
Test Specimen = 848.68 N

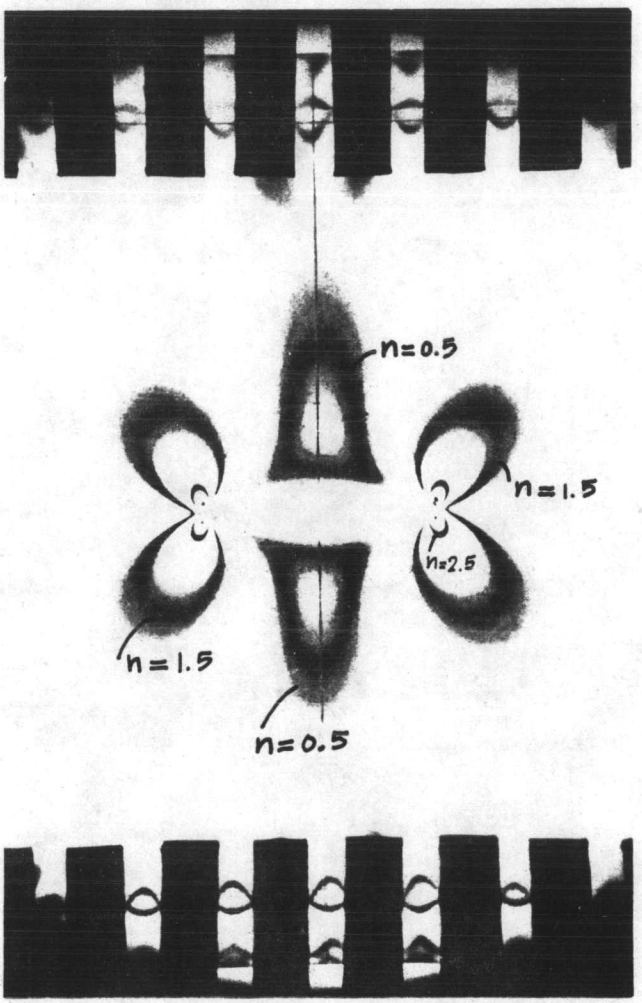
FIG. A39 ISOCHROMATIC PATTERN OF SPECIMEN
№ 32



Maximum Order of
Isochromatic Fringe = 6.3

Load Applied to the
Test Specimen = 848.68 N

FIG. A40 ISOCHROMATIC PATTERN OF SPECIMEN
№ 33



Maximum Order of
Isochromatic Fringe = 6.4

Load Applied to the
Test Specimen = 848.68 N

FIG. A41 ISOCHROMATIC PATTERN OF SPECIMEN
No 34

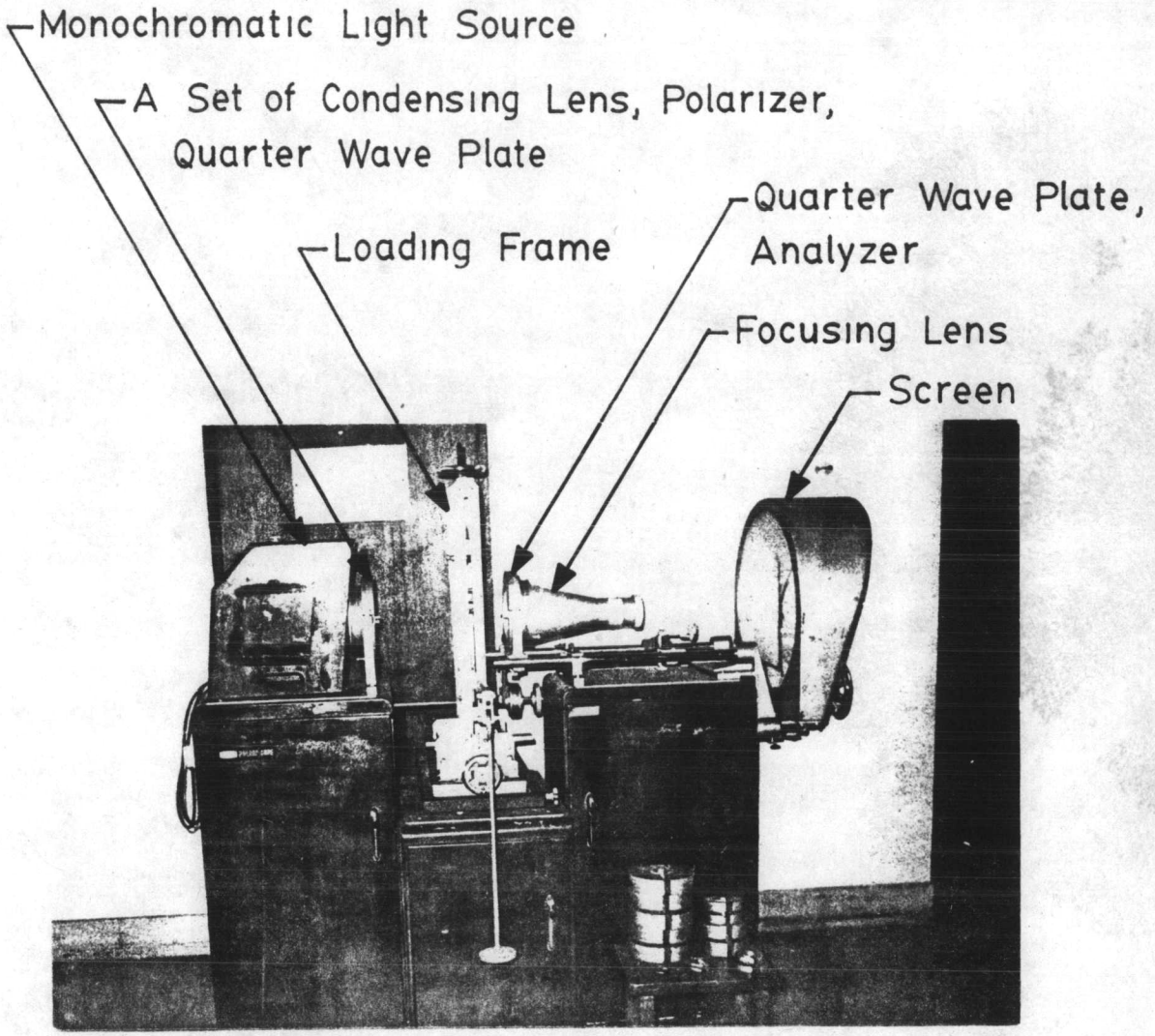


FIG. A42 STANDARD CIRCULAR POLARISCOPE WITH SCREEN

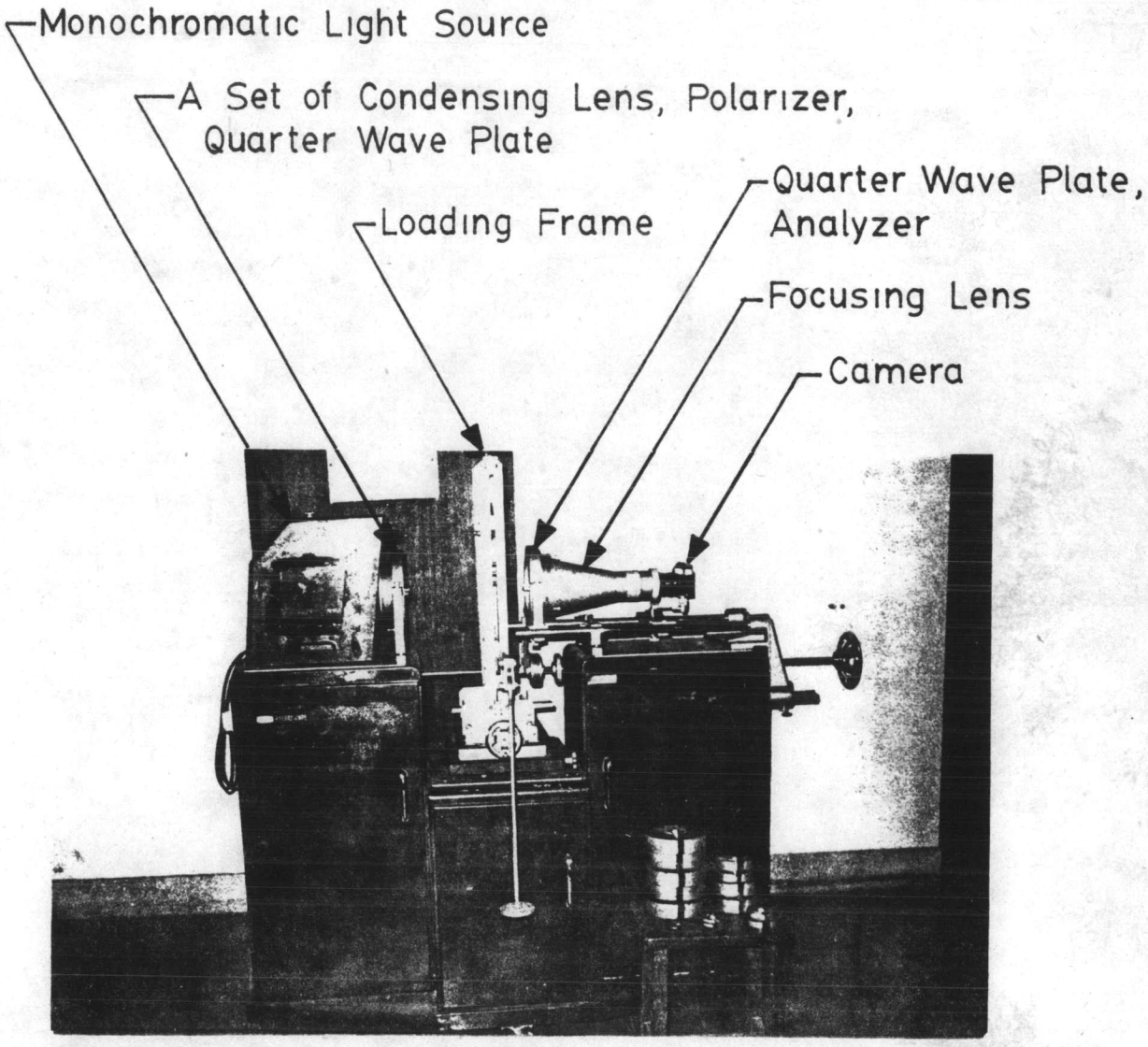


FIG. A43 TYPICAL STANDARD POLARISCOPE

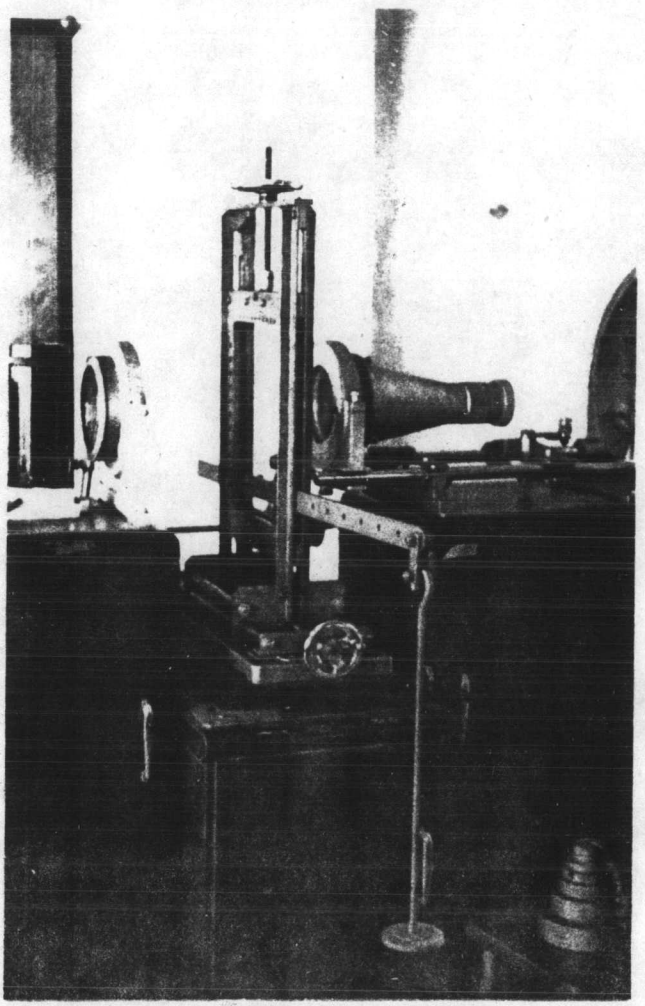


FIG. A44 A VIEW OF LOADING FRAME

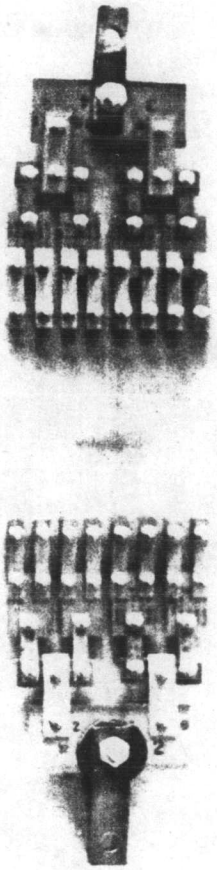


FIG. A45 TEST SPECIMEN WITH LINKS

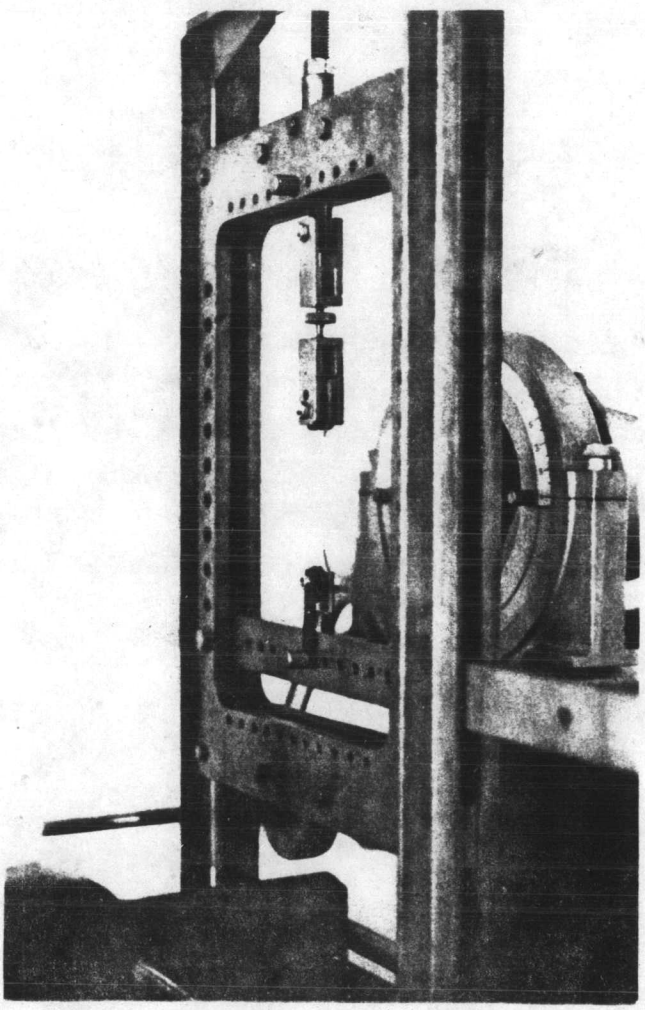


FIG. A46 SPECIMEN FOR CALIBRATION UNDER LOAD

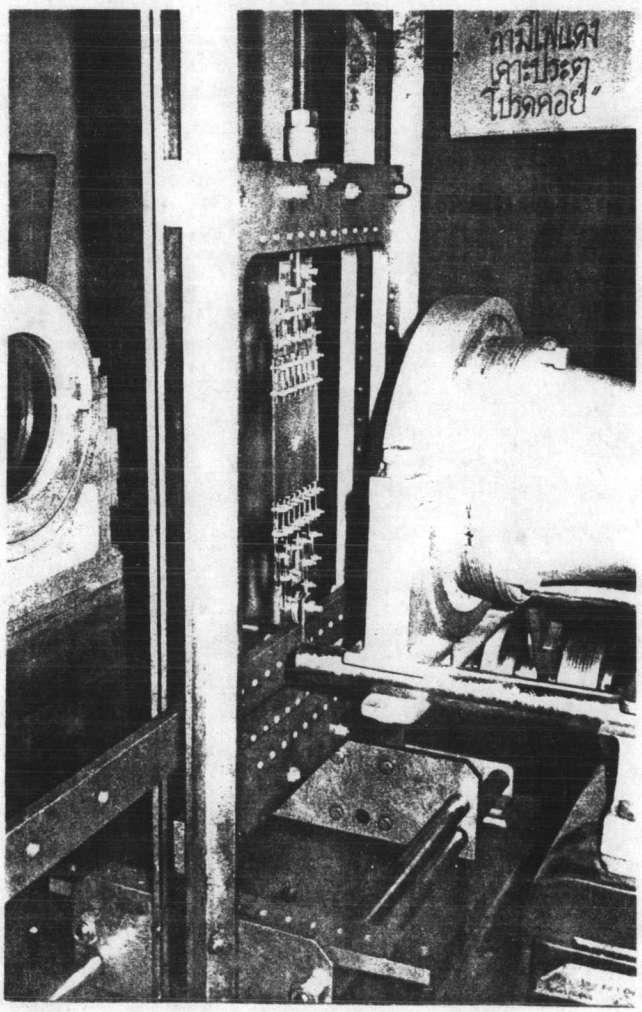


FIG. A47 SPECIMEN UNDER LOAD