APPENDIX II.

The following experiments on riveted joints were made by Professor Tetmajer. The plates were of Low-Moor boiler plate quality, and gave the following results when tested in tension :—

Tensile strength	=	56,000 to 58,000 lbs. per square inch
Elongation	=	24·5 to 22·6 per cent.
Reduction of area at fracture	=	39·5 to 38·4 „ „

The rivets were also of wrought iron, and were put in and closed by hand ; they were 0·66 in. in diameter, and 2·6 in. pitch.

The first four tests consisted in the determination of the admissible distance of the axis of the rivet from the end of the plate in a joint having double covers and one row of rivets on each side of the joint in double shear.

First Test, Fig. 1, Plate, V.

Distance from centre of rivet hole to the edge of the plate

= 2 × 0·66 = 1·32 inch

Effective plate area = 2·86 × 0·308 = 0·88 square inch.

Effective rivet area (double shear) = 4 × 0.342 = 1·33 „ „

The joint opened slightly at 22,000 lbs. and failed at 50,500 by the fracture of the plate between the rivet holes.

Resistance of plate	=	57,000 lbs. per square inch
Resistance of rivets	=	37,000 „ „ „ „
Pressure on the bearing area	=	126,000 „ „ „ „

Second Test, Fig. 2.

Distance from centre of rivet hole to the edge of the plate

= 1·8 × 0·66 = 1·2 inch

Effective plate area = 2·88 × 0·32 = 0·905 square inch

Effective rivet area (double shear) = 1·33 square inch

The joint opened slightly at 22,000 lbs. and failed at 45,000 lbs by the fracture of the plate between the rivet holes.

Resistance of plate	=	50,000 lbs per square inch
Resistance of rivets	=	34,000 lbs. „ „ „
Pressure on the bearing area	=	110,500 lbs. „ „ „

THIRD TEST, FIGS. 3 AND 4.

Distance from centre of rivet hole to the edge of the plate
= 1·45 × 0·66 = 0·96 inch
Effective plate area = 0·84 square inch
Effective rivet area
(double shear) = 1·33 „ „

The joint commenced to open at 22,000 lbs. and failed at 38,500 lbs. by fracture of the plate in the manner shown in Fig. 4

Resistance of plate = 45,500 lbs per square inch
Resistance of rivets = 29,000 lbs. „ „ „
Pressure on bearing area = 99,500 lbs. „ „ „

FOURTH TEST, FIG. 5.

Distance from the centre of rivet hole to the edge of the plate
= 1·45 × 0·66 = 0·96 inches.

This joint was similar to the last, it began to open at 22,000 lbs. and failed at 40,000 lbs. by fracture of plate in the manner shown in Fig. 5

Resistance of plate = 44,000 lbs. per square inch.
Resistance of rivets = 30,000 lbs. „ „ „
Pressure on bearing area = 97,000 lbs. „ „ „

The three following tests were made on joints having one cover plate only on the top and consisting of a through bottom plate. (*See Fig.* 6, 7 *and* 8, *Plate V.)* The joint in each case occurs in the centre of the group and symmetrical with reference to the axis of the joint; the distance from the centre of the rivet hole to the end of the plate is 0·96 inches.

FIFTH TEST, FIG. 6,

One row of rivets with the cover plate arranged next to the joint.

Effective plate area = 0·915 square inch.
Effective rivet area (two rivets
in single shear) = 0·66 square inch.

The joint began to open at 44,000 lbs, and fracture occured at 80,000 lbs. across the rivet holes in the plate.

Resistance of plates = 44,000 lbs. per square inch.
Resistance of rivets = 60,000 lbs. „ „ „
Pressure on the bearing area = 98,000 lbs. „ „ „

Sixth Test, Fig. 7.

Two rows of rivets, with cover plate arranged next to the joint.

Effective plate area	=	0·91 square inch.
Effective rivet area (four rivets in single shear)	=	1·33 „ „

The joint opened slightly at 55,000 and failed at 104,500 lbs. by fracture of the plate between the rivet holes.

Resistance of plates	=	57,500 lbs. per square inch.
Resistance of rivets	=	39,500 lb. „ „ „

Seventh Test, Fig. 7.

Three rows of rivets with the cover plate arranged next to joint.

Effective plate area	=	0·915 square inch.
Effective rivet area (six rivets in single shear)	=	2·05 „ „

The joint opened slightly at 55,000 lbs. and failed at 103,500 lbs. by the fracture of the plate between the rivet holes.

Resistance of plate	=	56,000 lbs. per square inch.
Resistance of rivets	=	26,000 lbs. „ „ „

The four following tests were made with one through plate on the bottom next to the joint and one through plate between the joint and the cover.

Eighth Test, Figs. 9 and 10.

One row of rivets with cover plate separated from the joint by one thickness of plate.

Effective plate area	=	0·91 square inch.
Effective rivet area (two rivets in single shear)	=	0·66 „ „

The joint opened slightly at 48,484 lbs. and failed at 125,400 lbs. by fracture of the bottom plate between the rivet holes.

Apparent resistance of fractured plate	=	45,500 lbs per square inch.
Apparent resistance of rivets	=	63,000 lbs „ „ „

Ninth Test, Fig. 11.

Two rows of rivets with cover plate separated from the joint by one thickness of plate.

Effective plate area	=	0.91 square inch.
Effective rivet area (four rivets in single shear)	=	1.33 „ „

The joint opened slightly at 84,000 lbs. and failed at 141,000 lbs. by fracture of the bottom plate between the rivet holes.

Apparent resistance of fractured plate	=	51,000 lbs. per square inch.
Apparent resistance of rivets	=	35,000 lbs. „ „ „

Tenth Test, Fig. 12.

Three rows of rivets with cover plate separated from the joint by one thickness of plate.

Effective plate area	=	0·91 square inch
Effective rivet area (six rivets in single shear)	=	2·00 „ „

The joint commenced to open slightly at 92,5000 lbs. and failed at 150,000 lbs. by fracture of the bottom plates between the rivet holes.

Apparent resistance of plate	=	54,000 lbs. per square inch
Apparent resistance of rivets	=	25,000 lbs. „ „ „

Eleventh Test, Fig. 13.

Four rows of rivets with cover plate separated from the joint by one thickness of plate.

Effective plate area	=	0·91 square inch
Effective rivet area (eight rivets in single shear)	=	2·66 „ „

The joint opened slightly at 99,000 lbs. and failed at 153,000 lbs. by the fracture of the three plates and cover between the rivet holes.

Apparent resistance of plate	=	55,000 lbs. per square inch
Apparent resistance of rivets	=	19,500 lbs. „ „ „

CONCLUSIONS.

The results obtained from the first four tests show that with a single row of rivets on each side of a joint, having double covers and rivets in double shear, the distance from the centre of the hole to the end of the plate must be greater than 1·5 times the diameter of the rivet.

In the case of a joint having two or more rows of rivets on each side the distance from the centre of the rivet hole to the end of the

plate may be made 1·5 times the diameter of the rivet, with both single and double cover joints.

In the arrangement of cover, plates, and joints shown in Figs. 9 to 13, Plate V., there is always a loss of strength due to bending, which in the cases tested varied from three per cent. to eight per cent. showing the importance of arranging the plates and cover symmetrically with reference to the joint.

The experiments 8 to 11 also show that it is quite sufficient to provide a rivet area equal to the effective plate area, and that there is no increase in strength when this rivet area is in excess of that in the plate.

PLATE I.

FIG 1

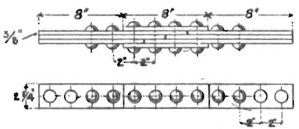


FIG 2

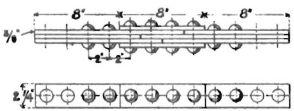


FIG 3

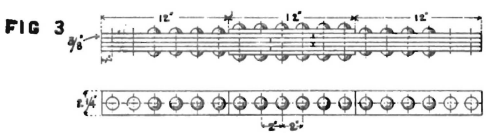


FIG 4

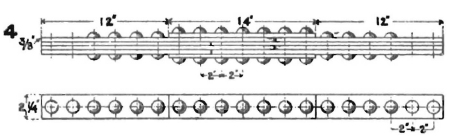


FIG 5

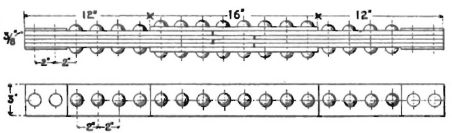


FIG 6

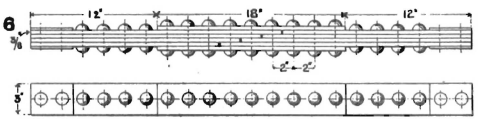


FIG 7

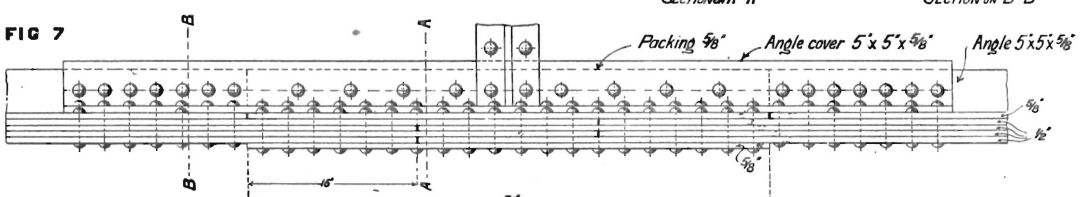


FIG 8

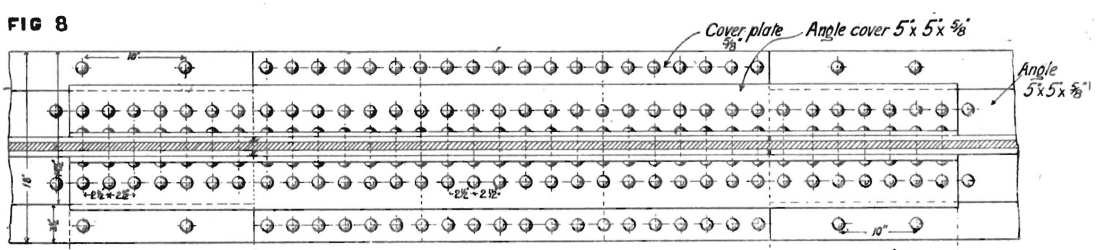
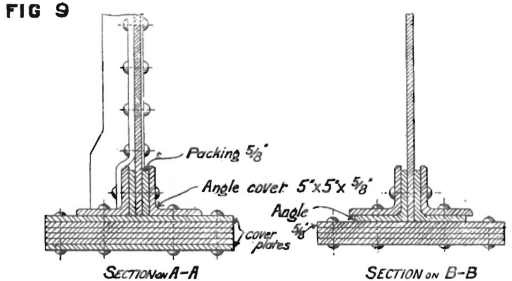


FIG 9



RIVETED JOINTS

PLATE II.

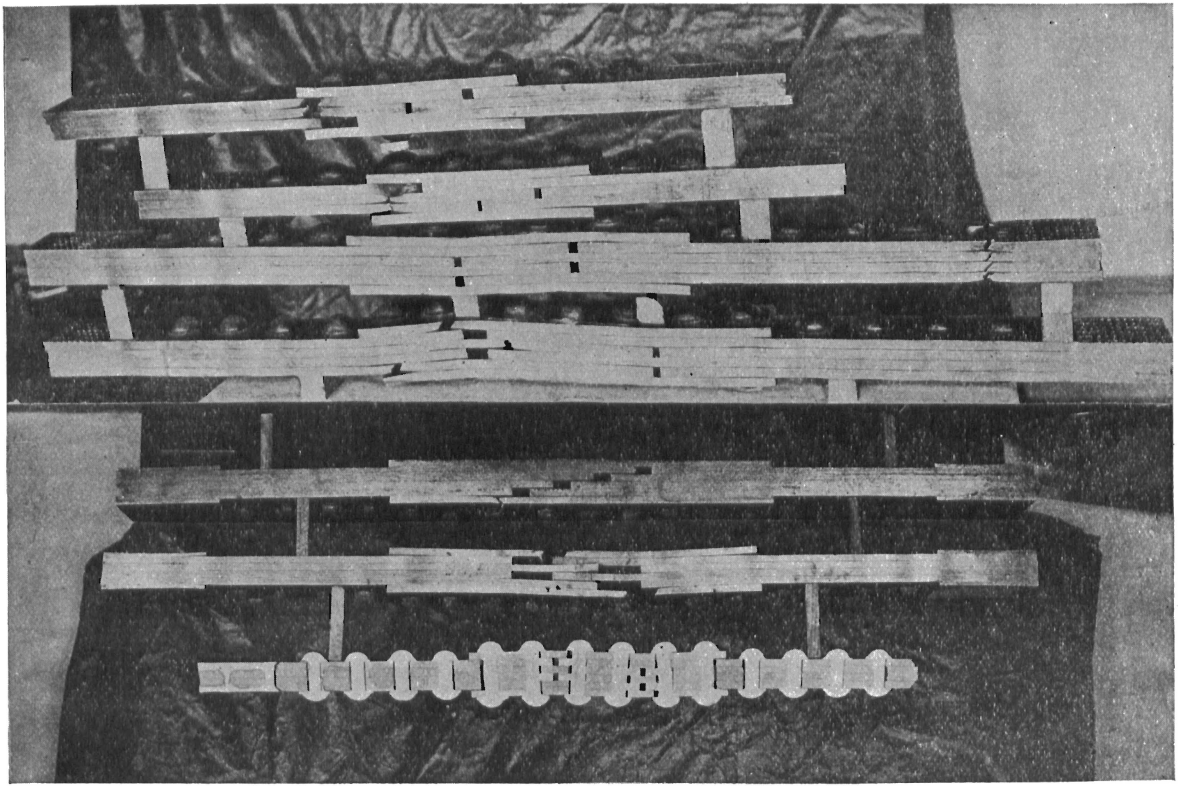


Photo. 1.

Photo. 2.

Photo. 3.

Photo. 4.

Photo. 5.

Photo. 6.

Photo. 3a.

PHOTOGRAPHS OF THE SPECIMENS OF RIVETED JOINTS TAKEN AFTER THEY WERE TESTED.

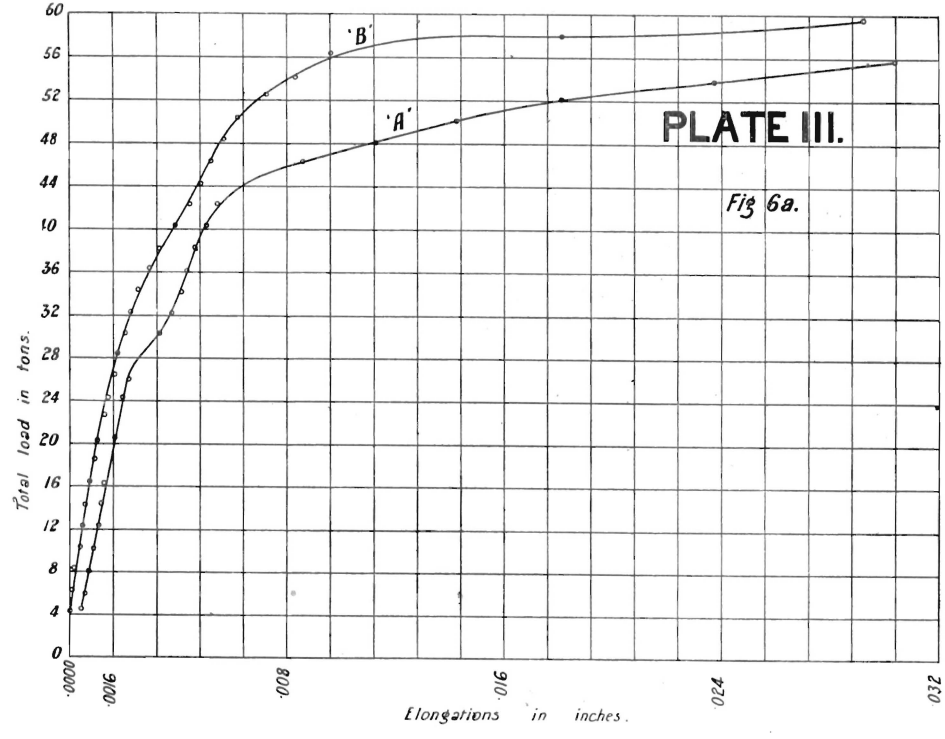


PLATE III.
Fig 6a.
'B'
'A'
Total load in tons.
60
56
52
48
44
10
36
32
28
24
20
16
12
8
4
0
·0000
·0016
·008
·016
·024
·032
Elongations in inches.

PLATE IV

FIG 10

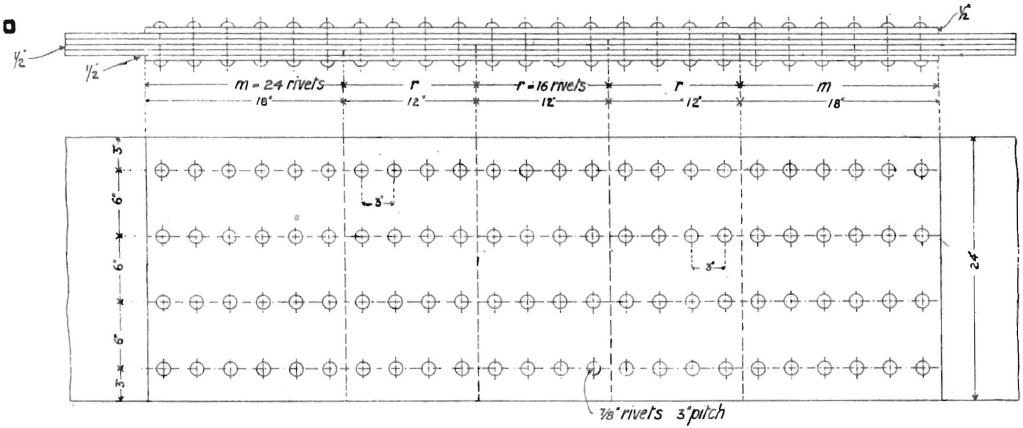


FIG 11

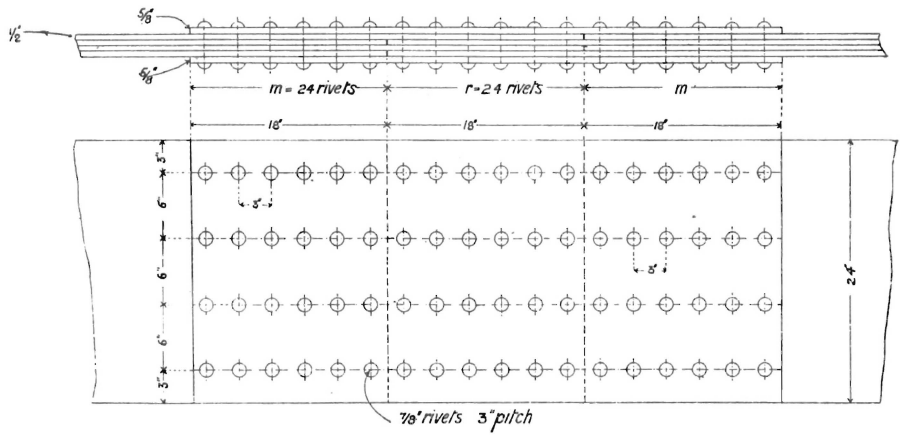


PLATE V

FIG 1

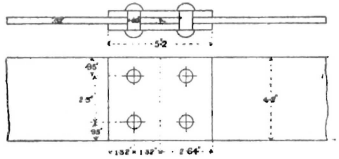


FIG 2

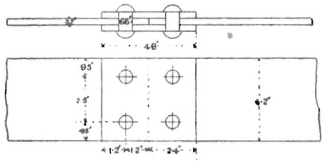


FIG 3

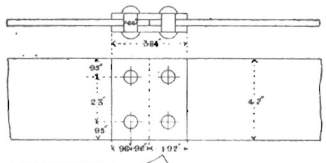


FIG 4

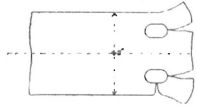


FIG 5

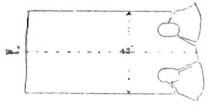


FIG 6

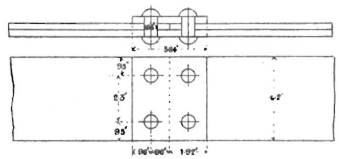


FIG 7

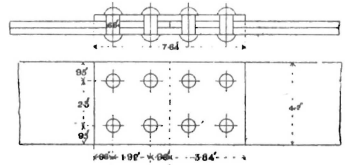


FIG 8

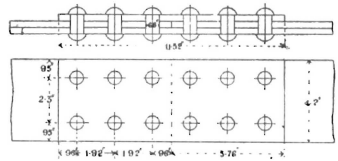


FIG 9

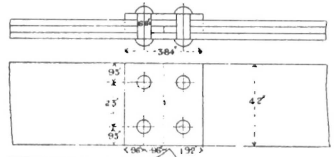


FIG 10

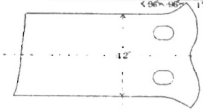


FIG 11

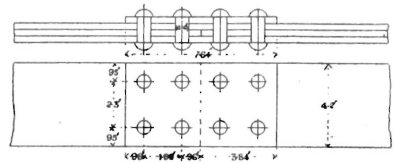


FIG 12

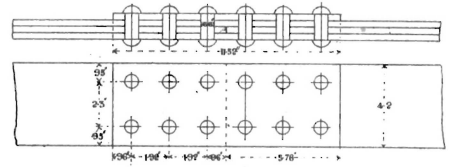
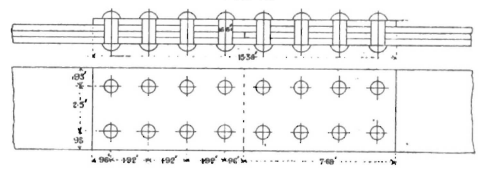



FIG 13