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A PORTABLE APPARATUS FOR TRANSVERSE TESTS OF BRICK

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A PORTABLE APPARATUS FOR TRANSVERSE TESTS OF BRICK

By A. H. Stang

ABSTRACT

The increasing importance of knowing the transverse strength of building brick and the desirability of making such tests where the brick are to be used have led the Bureau of Standards to design a portable machine for making these tests. The machine consists of the equalizer apparatus for transverse tests of brick described in Bureau of Standards Technologic Paper No. 251, a hydraulic jack, a frame, and Bourdon pressure gauges which indicate the load. The machine complete weighs 40 pounds.

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I. INTRODUCTION

The modulus of rupture of building bricks is recognized as one of their most important mechanical properties. Since bricks are classed according to the value of this modulus it is desirable that this property be easily and quickly determined. A portable apparatus for this purpose has been designed. By its use an inspector can determine at once whether the bricks supplied have the required transverse strength, thus making it unnecessary to send samples to a testing laboratory and wait for the report.

To secure portability the load is measured by two Bourdon tube gauges. The shortcomings of these gauges are well known, and they should never be used for standard calibrating instruments. However, when calibrated frequently enough, they possess sufficient accuracy for the purpose, and the instrument is so designed that a calibration in a standard testing machine can easily be made without dismantling the apparatus.

II. PORTABLE BRICK TESTER

Photographs of this machine are shown in Figures 1 and 2, and a detail drawing in Figure 3. It is designed for a maximum load of 4,000 pounds, which corresponds to a modulus of rupture on a brick of

standard size of about 2,200 lbs./in.[2] The height of the apparatus is 16 inches, the length 14 inches, and the width 7 inches. The original machine was built of structural steel and weighs about 40 pounds. The use of high-strength steel would reduce this weight materially.

1. EQUALIZER APPARATUS

The American Society for Testing Materials has described the apparatus for making transverse tests of building brick.[1] An equalizer apparatus for such tests, which has the standard 7-inch span and insures proper loading even if the surfaces of the brick are warped or irregular, has recently been designed at the Bureau of Standards.[2] It gives results for the modulus of rupture which are the same within the errors of sampling as those found with apparatus made in accordance with the recommendations of the American Society for Testing Materials.

In the equalizer apparatus, which is more fully described in the reference, the brick is supported on four barrel-shaped bearings, as shown in the figures, each carried on a plate fulcrum. No bearing plates are used for these, as experience has shown that the bricks do not spall at these bearing points. The fulcrums (0.050 by 1.12 inches) were cut from tempered clock-spring stock and driven into their seats in the bearings and in the levers. The equalizer beams rotate independently on the horizontal lower bearing pin which is fastened to the ram of the jack. The function of these levers is to equalize the four forces acting on the lower surface of the brick.

The upper bearing, at the middle of the brick, is self-adjusting about the upper bearing pin, as shown in Figure 3. A bearing plate is attached loosely to the rounded lower edge of the bearing by countersunk screws.

2. HYDRAULIC PUMP, JACK, GAUGES, AND FRAME

To this equalizer apparatus, which was designed for use in an ordinary compression testing machine, have been added a hydraulic jack, pump, and gauges for applying and indicating the load, and a frame which connects the various parts, thus making a self-contained testing machine. The details are shown in Figure 3.

(*a*) Hydraulic Pump.—The pump cylinder is made of 1-inch diameter extra heavy pipe bored to the required diameter. The piston is a short cylinder with a cup-shaped leather packing held on the lower end by a brass washer and cap screw. In the other end is a slot into which the T-shaped end of the plunger rod fits. This plunger rod screws into the cap at the upper end of the pump cylinder and, as the

[1] A. S. T. M. Standards, 1924, specification C 21-20, p. 665.

[2] B. S. Tech. Paper, No. 251, Equalizer Apparatus for Transverse Tests of Brick, by H. L. Whittemore.

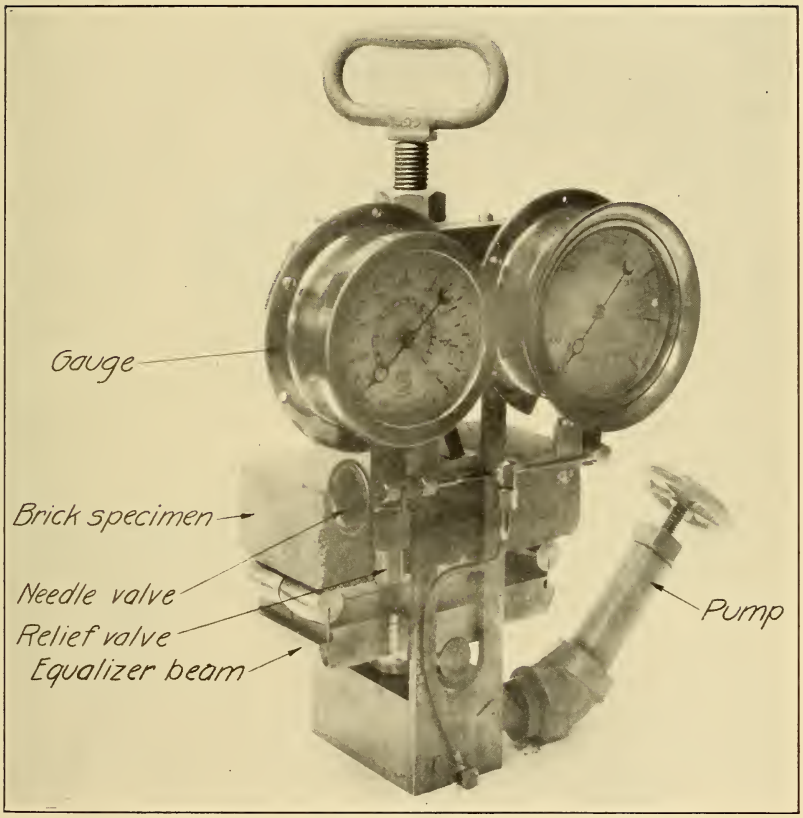

FIG. 1.—*Portable brick tester with a brick in position for test*

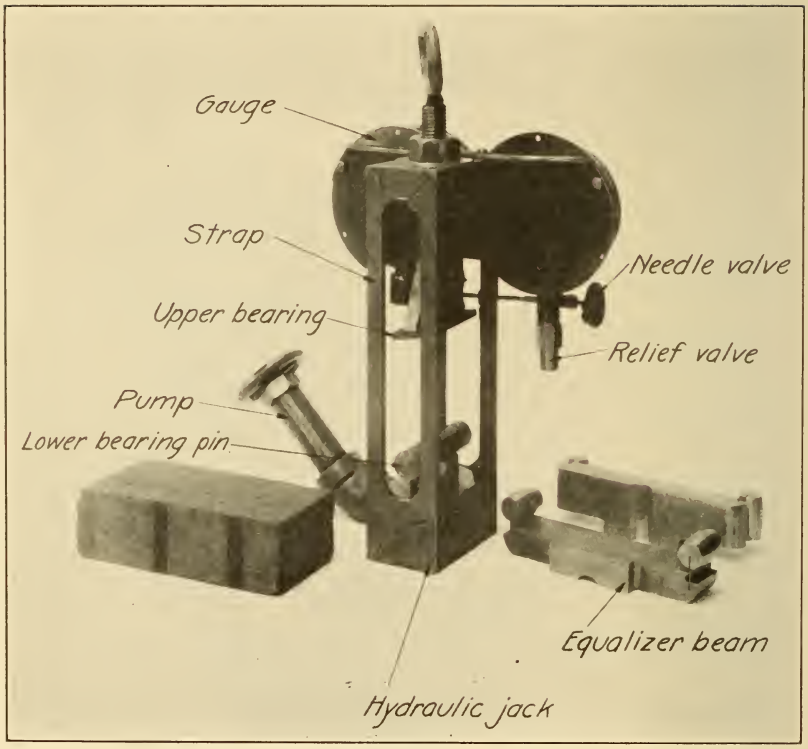

FIG. 2.—*Portable brick tester partially dismantled*

handwheel is turned, forces the piston into the cylinder without rotating the piston. The pump cylinder is connected to the base of the machine by a 45° pipe ell, reducing fitting, and a one-half inch pipe which is screwed into the base beside the cylinder of the jack. Connection with the jack cylinder is made by a hole one-eighth inch in diameter which leads to the bottom of the cylinder.

(*b*) Jack.—The cylinder of the hydraulic jack is 1¾ inches in diameter and is located in the center of the base block. The ram is provided with a simple cup leather packing held on the bottom of the ram by a brass washer and cap screw. The top of the ram was

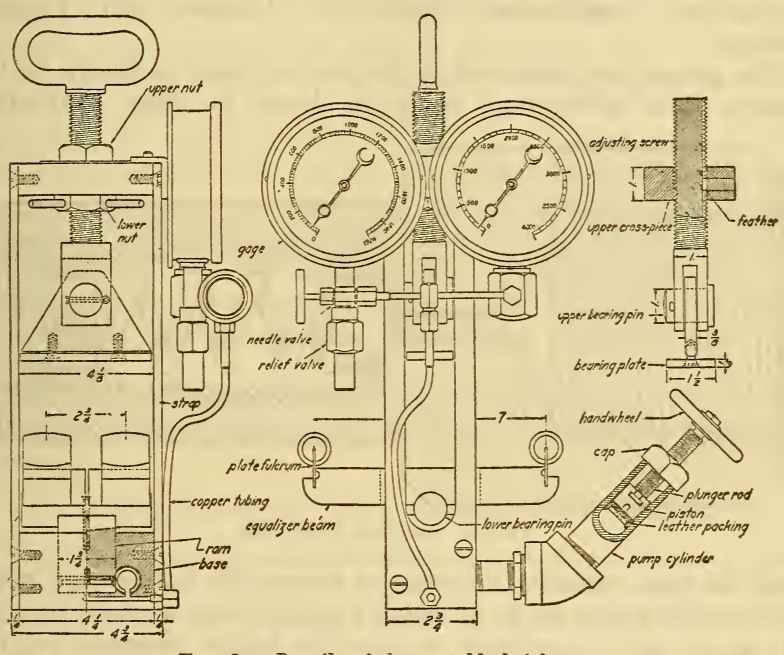

Fig. 3.—*Details of the portable brick tester*

machined to fit the lower bearing pin on which the equalizer beams rest. Provision has been made for filling the oil system without removing the jack from the cylinder.

(*c*) Gauges.—The gauges used have 4½-inch diameter dials. One indicates loads up to 4,000 pounds and was chosen since the maximum load on a brick will seldom exceed this value. The other gauge has a capacity of about 1,900 pounds and was chosen in order that more accurate results might be obtained on bricks having a low transverse strength. The two gauges at lower loads serve as a check on the accuracy of either one. The chance that both gauges will be in error by the same amount is small, and the use of the two gauges, therefore, serves as a secondary means of calibrating the instrument.

Commercial gauges are available which are accurate to 1½ per cent of the maximum reading, when maintained in good calibration. On a gauge covering more than the probable brick-testing range (say, a 4,000-pound load gauge, for instance) this would correspond to a maximum error of 11 per cent on the average modulus of rupture of soft brick, 7½ per cent for medium brick, and correspondingly less on hard and vitrified. By the use of the 1,900-pound gauge the maximum error would be about 5 per cent on the average modulus of rupture of soft brick. A number of manufacturers make gauges of this accuracy, which conform to the requirements of the Navy Department specifications 45–G–1–g "Pressure and Vacuum Gauges."

The gauges are connected to the jack cylinder as shown in the figures. The 4,000-pound gauge is always in direct connection

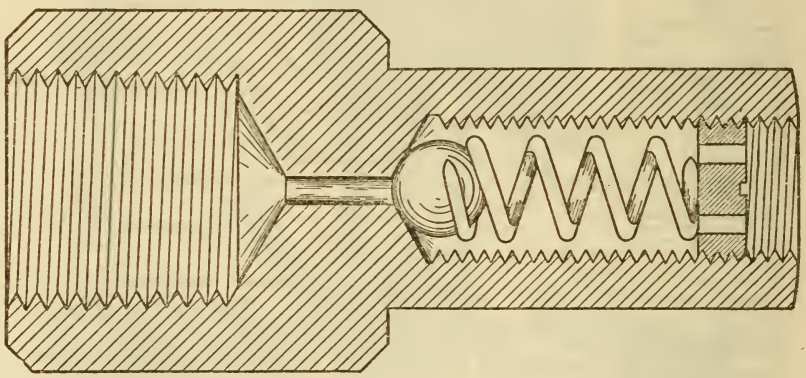

Fig. 4.—*Overload relief valve*

with the jack cylinder. In order to protect the 1,900-pound gauge when strong bricks are to be tested a needle valve is placed between the gauge and the cylinder so that the higher pressures are not applied to this gauge. As a further precaution a simple relief valve is also connected to the 1,900-pound gauge. This relief valve, shown schematically in Figure 4, consists of a ball seated in a cone and held by a helical spring. Proper proportioning of ball size and spring strength gives a positive release at such a load that the low-pressure gauge is amply protected against careless manipulation of the apparatus.

The selection of the capacity of the gauges will, of course, depend upon the type of brick to be tested. If soft or medium bricks only are to be tested, lower capacity gauges can be used with an increased accuracy.

(*d*) Frame.—The frame consists of the upper crosspiece and the two upright straps. At the center of the upper crosspiece is a drilled hole through which the adjusting screw is placed. This

screw and the attached upper bearing are prevented from rotating by a ⅛ by ⅜ inch steel feather in the crosspiece. The thrust during the brick test is taken by the lower nut on the screw and transmitted to the upper crosspiece. The upper nut keeps the upper bearing from falling when the brick breaks.

3. CALIBRATION OF THE TESTER

To calibrate this machine it is set in a compression testing machine, a piece of steel put on the equalizer beams, and the bearing plate lowered upon the steel beam. With both nuts on the adjusting screw free from the upper crosspiece, a steel ball (0.39 inch diameter) is placed in the "center" in the upper end of the screw, and the movable head of the testing machine is brought close to the ball. The jack is then pumped so that the ball is forced against the cross-head of the testing machine, and gauge readings on the brick tester are compared with the beam readings of the testing machine. No dismantling of the brick tester is necessary. Care should be taken to insure that the screw does not come in contact with the upper crosspiece, since frictional forces would then be set up that would not be present in the testing of a brick. Steel bars, fastened to the movable head of the testing machine, which press directly against the equalizer bars are somewhat better in this respect for calibrating purposes.

As noted in the introduction, frequent calibrations of the machine should be made to insure that the Bourdon gauges are functioning properly.

4. OPERATION OF THE PORTABLE BRICK TESTER

The upper bearing plate and fixture are raised and held in position by the upper nut. The brick is then placed on the equalizer beams and adjusted to have an equal overhang at both ends, be centrally located between the upright straps, and have its upper surface horizontal. The upper nut is then backed off and the upper bearing plate brought down on the top of the brick. The lower nut is then screwed against the upper crosspiece to produce a small initial load, care being taken that the brick is not disturbed from its symmetrical position in the machine. With the upper nut near the crosspiece, force is applied with the pump. If the brick withstands a load greater than about 1,800 pounds, the needle valve should be closed to protect the low-pressure gauge. Pumping is then resumed and the brick broken.

As in all jacks, the piston must be kept clean and the pump full of oil if sticking of the piston or leaking of oil is to be avoided. A jerky increase of the gauge readings or excessive leaking of oil would indicate the need of cleaning and recalibrating the instrument.

III. SUMMARY

1. A portable apparatus has been designed and constructed for making transverse tests of brick.

2. It is light in weight, simple in operation, and sufficiently accurate in determining the breaking load.

3. The delays incident to sending samples of bricks to a testing laboratory are avoided by the use of this machine, and inspectors can at once determine whether the bricks proposed for use in a structure have the required transverse strength.

WASHINGTON, March 10, 1927.