Erecting 56-Ton Sheaves For Calumet River Bridge

Special equipment set-up required to raise operating sheaves 210 ft. to tops of towers of Torrence Ave. lift bridge in Chicago

FOUR of the largest and heaviest sheaves ever used in a lift bridge are required in the new Torrence Ave. crossing of the Calumet River in Chicago, which will be opened to traffic this summer. Their weight of 56 tons each and their diameter of 15½ ft. provided the contractor with an unusual erection problem, which he met by ingenious combination and revamping of his existing equipment.

The Torrence Ave. bridge is a 276-ft. lift span, weighing 1,600 tons, and lifted at each corner by 20 cables 2¼ in. in diameter and 156 ft. long. The cables pass over the sheaves at the top of the 240-ft. towers to connect with the counterweight which moves up and down inside the rectangular towers. The sheaves 5 ft. wide, are mounted on a shaft 30 in. in diameter and 9½ ft. long, which is in turn mounted on huge roller-bearing pillow blocks weighing 12 tons. The bridge provides a 200-ft. wide channel for shipping, with 21-ft. vertical clearance in closed position and 125 ft. clearance when open.

Erection of each sheave required the lifting of a 60-ton load, (consisting of the 56-ton sheave and shaft and 4 tons of lifting fittings,) a vertical distance of 210 ft., the installation of the roller bearings and the setting of the assembly in final position. After considering a number of methods, it was finally decided to use a steel stiffleg derrick, with a specially designed and reinforced 40-ft. boom, placed at the top of the tower on the top flange of the river-face girder, which was reinforced with stiffening angles under the derrick mast. The sill anchorages of the derrick were lashed to the tower legs with cables.

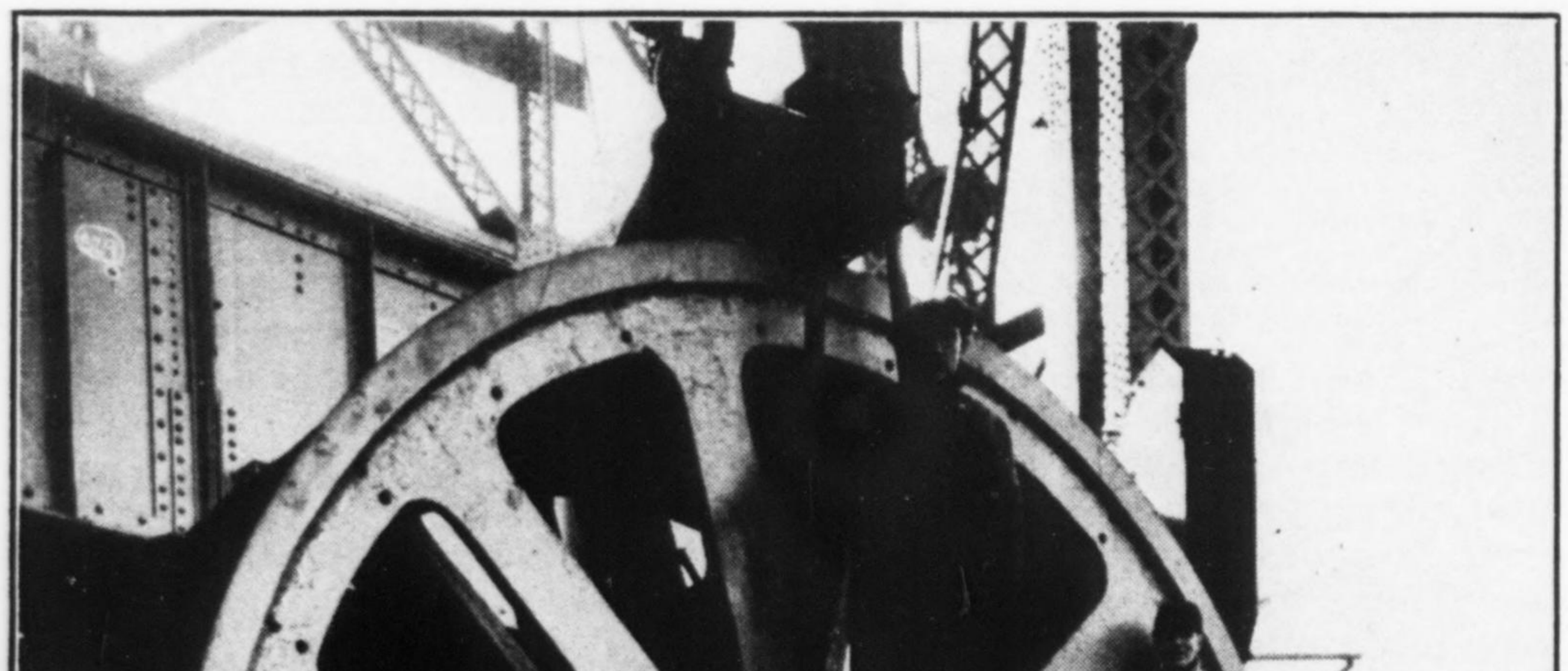


FIG. 1—READY TO RAISE the last sheave using a saddle consisting of stirrups around the shaft connecting to a lifting beam.

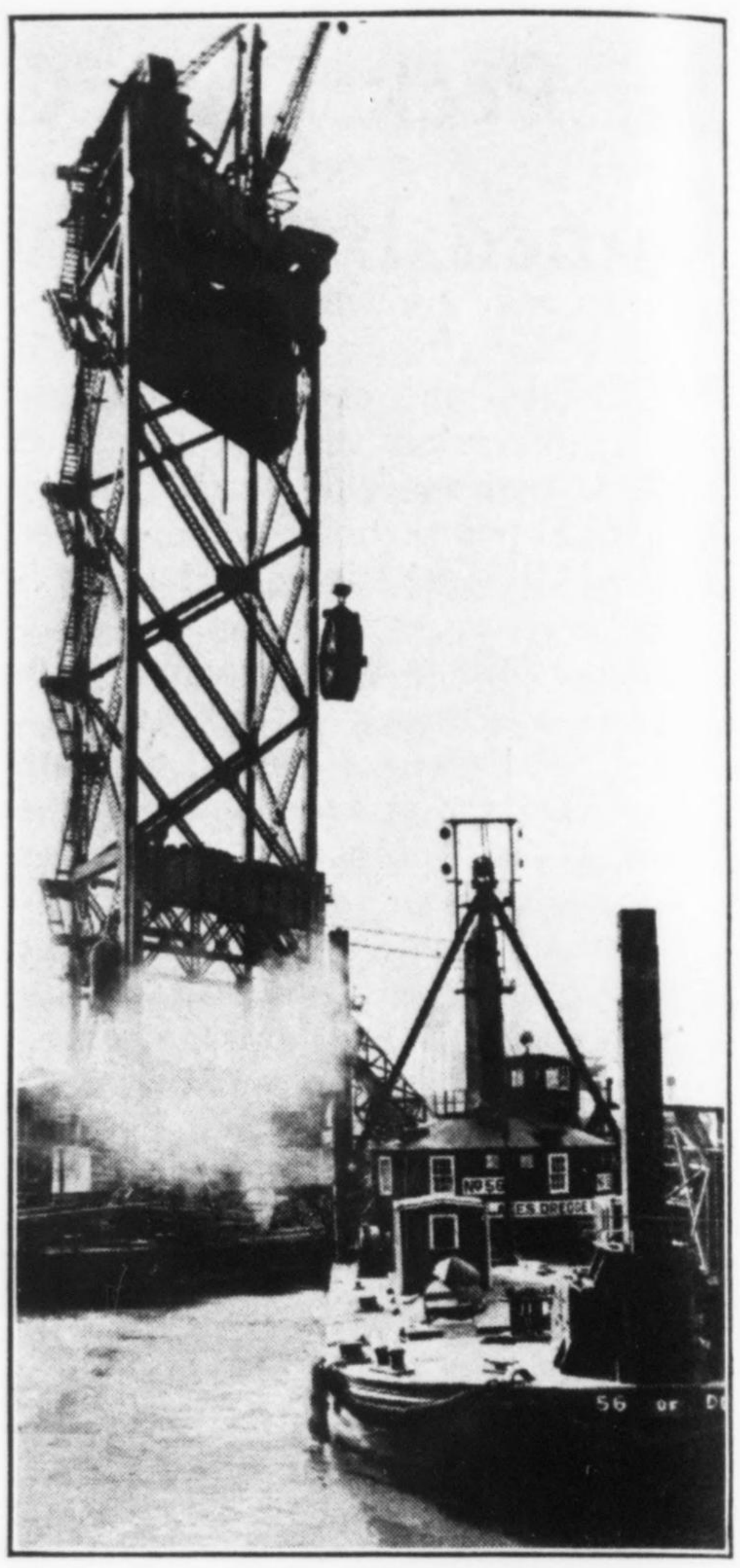


FIG. 2—RAISING A 56-TON SHEAVE onto one of the towers of the Torrence Ave. lift bridge in Chicago using a 9-part line from a hoist on the derrick boat in the foreground

Since the existing steam hoists on the steel erecting derrick had neither adequate continuous lifting capacity nor drum capacity for this high and heavy lift, requiring the use of 2,700 lin. ft. of ⅞-in. cable reeved in nine parts, the contractor's 100-ton floating diesel-electric derrick was brought into service. First, the standard hoist cable was removed from the steel erecting derrick, and the special ⅞-in. cable substituted and reeved through special roller bearing blocks to the drum on the floating derrick. Then, since this drum was grooved to accommodate 1⅛-in. cable and in addition could store only about one-third of the amount of cable required, it was necessary to remodel it. This was done by welding a new drum outside of the existing drum and building up the sides of this addition to a height of 7¼ in., to hold the nine layers of cable required. Ample lifting power thus was available from the floating plant, and the other movements of the steel erecting derrick, such as swinging, lowering and raising the boom, were handled by the hoist on shore.

A special lifting saddle was designed

for handling the sheaves, consisting of two stirrups made from 1¾-in. square steel bars bent to conform to the circumference of the shaft and extending upward to a steel lifting beam placed across the top of the sheave as shown in Fig. 1. This beam was made up of two 15-in. channels between which are inserted a triangular plate 1-in. thick reinforced by two 1-in. pin plates. A 3½-in. diameter pin was used to attach this saddle to the derrick falls.

After careful preparation and tests as to the adequacy of this equipment, the sheaves were raised into place, the lifting operations consuming about ten minutes per sheave. Each sheave was landed at the top of the tower on an I-beam grillage supported by hydraulic jacks, which permitted the removal of the lifting stirrups and the installation of the roller bearing blocks on either end of the shaft. With the bearings in place, the assembly was put in position.

The erection scheme was devised and the equipment designed by the contractor, the Great Lakes Dredge & Dock Co., Chicago.

The unusual size of these sheaves was at the root of another special problem, namely, the insertion of the shafts into the sheaves at the fabricating plant. Usually such shafts are inserted after the sheave hole has been expanded by heating. The large size of these sheaves made this impracticable, and the alternative of shrinking the shaft by cooling was adopted by the fabricator, the American Bridge Co. The cooling medium consisted of a mixture of 459 gallons of alcohol and 9,600 lb. of dry ice, which was placed in a boxlike structure 11 ft. deep into which the shaft was lowered in vertical position. A 6- to 8-hr. exposure to a 90 deg. F. below zero temperature caused a 1/64 in. shrinkage in shaft diameter. The sheave had been made in two vertical halves, and the shaft was quickly removed from the bath and lowered into one of these halves. Then the other half of the sheave was lowered over the shaft, completing the assembly in an elapsed time of about 4 minutes. In 6 hours the shaft had expanded to normal size, providing a satisfactory fit.

The Torrence Ave. bridge will cost $1,150,000, is being financed by a PWA grant and a state gas tax refund to the city. It is being built under the direction of the bureau of engineering of the Chicago department of public works. Loran D. Gayton is city engineer.

Finding Good Subgrade Materials

EMPLOYING simple apparatus, the Arizona highway department is conducting tests to develop a test measure of the stability of subgrade materials. A description of the apparatus and process with some test results are published by J. W. Powers, engineer of materials, W. G. O'Harra, chemist, and R. J. Shaw, laboratory helper, in *Arizona Highways* for March, 1937. The following description of the apparatus and testing process is taken from that paper.

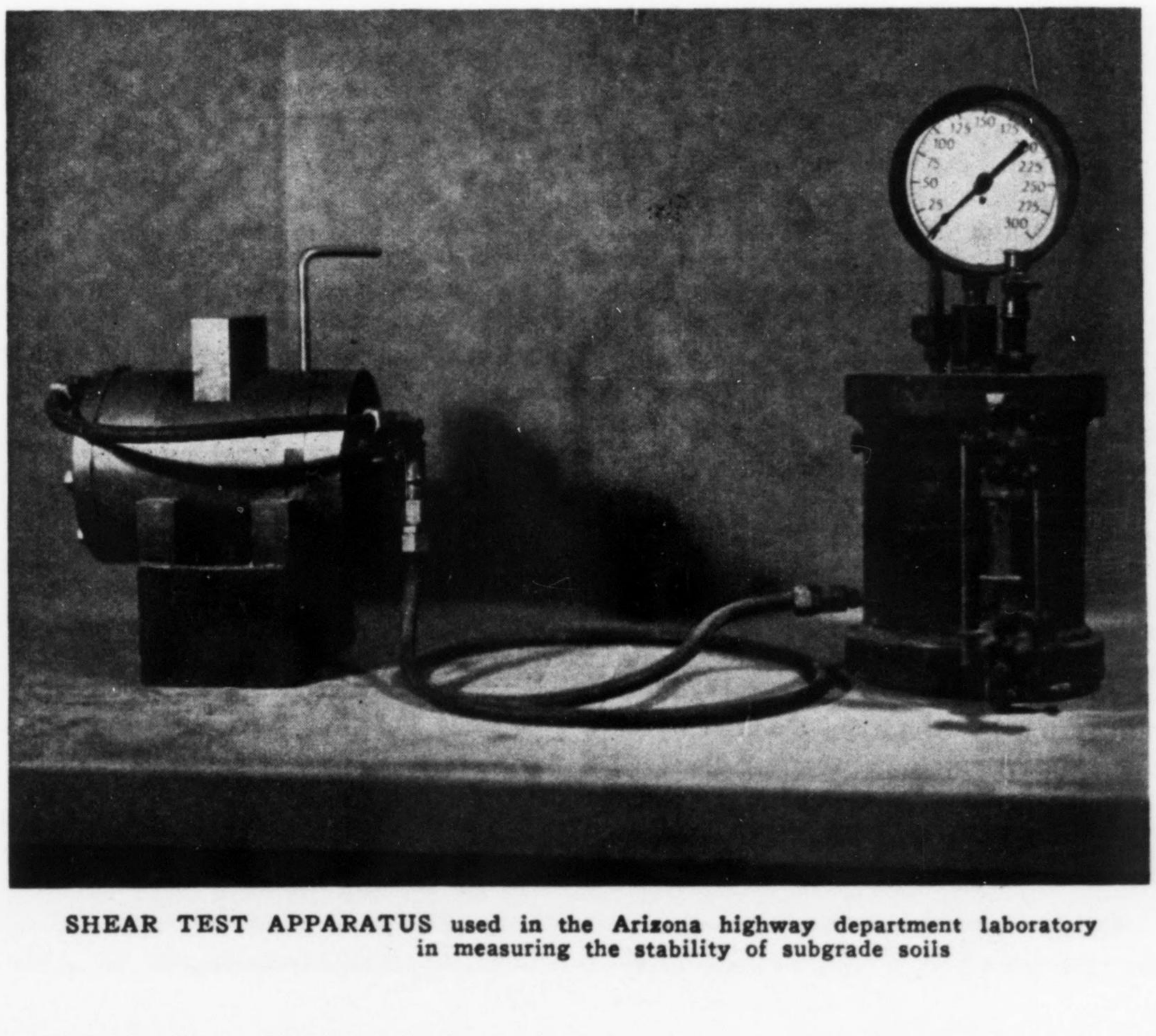
It is found in practice that highway subgrade failures occur in materials that will accumulate sufficient water under actual conditions to cause them to become plastic. The object in this method is to determine the shear strength of the material at moisture contents that are likely to occur under actual conditions.

The apparatus, is essentially the same as that used by Berry, but has been altered to allow the use of compressed air in applying the pressure normal to the shearing force. The material to be tested is first passed through a 3-mesh square sieve. Several 1,000-gr. batches are then made up, using different amounts of water varying from that necessary to produce a nearly dry mix to that necessary to produce a very wet mix. The material is placed in the cylinder in 1-in. layers, and tamped to ultimate compaction; the Hubbard-Field tamping spade having a tamping edge ¼x1⅝ in. is suitable. The top of each layer is roughened before the next layer is added.

Air connections are now made to the air reservoir, the cylinder is placed in the saddle and the aparatus is placed in Hubbard-Field press. The air pressure is run up to 100 lb. per sq.in. for 1 min., then decreased to 75 lb. per sq.in., at which pressure the test is run. The load is then applied at the rate of 0.8 in. (40 turns) per minute; this rate is maintained until the gage indicates a maximum has been passed. The apparatus is then removed and cleaned, a sample of the material from the middle of the cylinder being retained for moisture determination. The test is now repeated, using the remaining batches.

A centrifuge moisture equivalent is then run on the material in the same manner as that used in the Bureau of Public Roads soil constants, but with the following variations: 25 gr. of material passing 3-mesh is used to have the C.M.E. value on the same material as is used in the shear test, thus affording a basis for direct comparison with the moisture content in the shear tests. However, in the case of materials which will almost entirely pass a 40-mesh sieve, the 5 gr., 40-mesh C. M. E. is used.

The shearing loads are plotted against the corresponding moisture contents, and the intersection of the resulting curve with the C.M.E. percentage is noted. Actual correlation between shear values and field observations of subgrade conditions have been made on about 75 materials. This is not deemed a sufficiently large number to warrant any final conclusions, but enough materials have been tested to realize the possibilities of the test.



SHEAR TEST APPARATUS used in the Arizona highway department laboratory in measuring the stability of subgrade soils