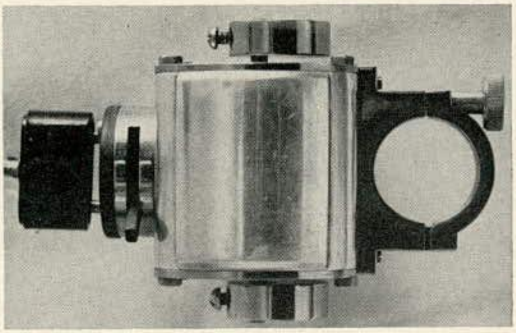

FIGURE 13
View of Type-9-B set of vibrational equipment for compression and shear test devices.

(Figs. 13, 14), mounted on the loading lever of the compression device. Through the loading lever vibrations of given direction, frequency and amplitude are induced by the vibrator in the loaded member.

The weight and size of the counterweights symmetrically mounted along the motor shaft, as well as the amplitude of vibration, are determined in such a manner that, after the settlement has been stabilized for any stage of the statical load applied to the sample, starting the vibrator and its subsequent operation during a given interval of time do not cause additional increase in the settlement. The vibrational equipment is also applicable to dynamical investigation of soils.

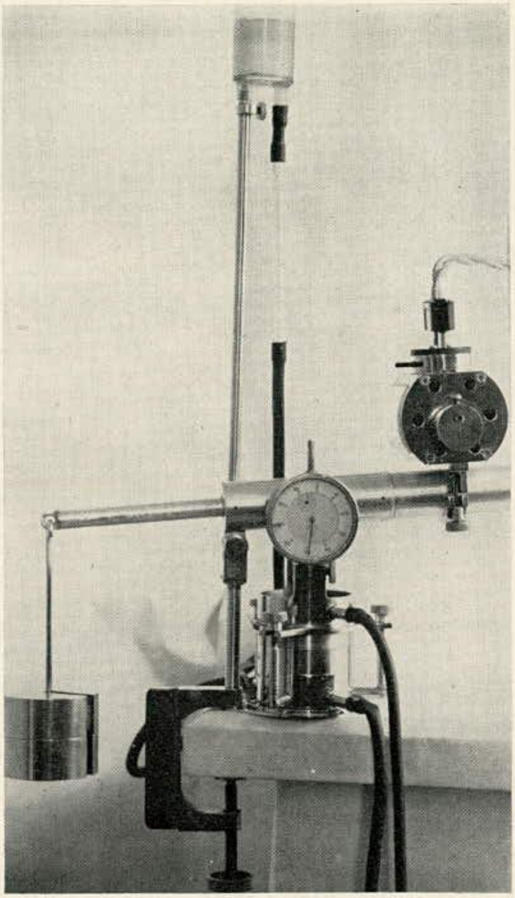

FIGURE 14
Type-9-B set of vibrational equipment during compression tests.

The field laboratories are widely used for the investigation of the building properties of soils in housing, civil engineering, industrial building, road and railway construction, hydraulic engineering, etc., in many countries. These devices are of special value in regions remote from the stationary well-equipped laboratories.

Use of the Vibratory Method for Sinking Piles and Pile Shells in Bridge Construction in the USSR

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The following vibratory drivers were used during the past six to eight years in the bridge building practice of the USSR for sinking piles and pile shells:

VIBRATORY DRIVER VP-1 *(Fig. 1)*

This is a mechanism of single frequency action which has the following structural parts:

1. The body of the vibratory machine consisting of a steel box with outside guide rollers and with loops at the upper corners for raising the vibrator.
2. Four working shafts connected to the body of the vibrator by bearings; eccentric weights are attached to these shafts.
3. A system of cylindrical gears which transmit the rotational movement of the electromotor to the working shafts.

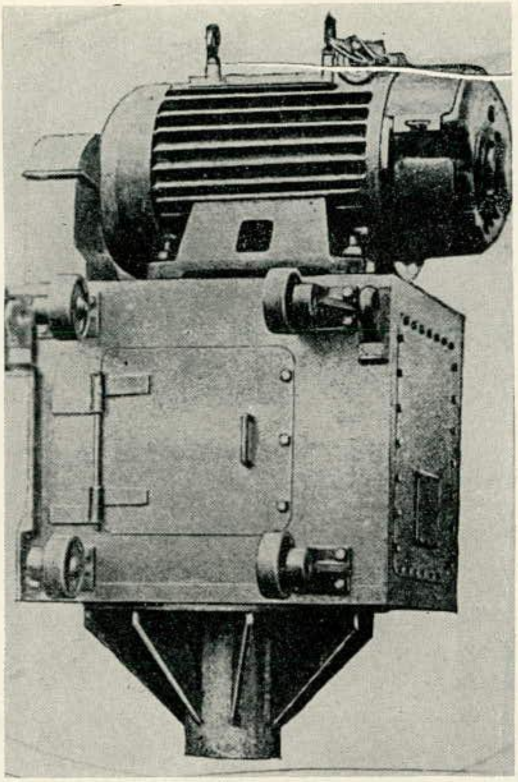

FIGURE 1

4. A conical base for the attachment of the pile to the vibrator.
5. Electromotor.

The dimensions of the vibratory driver VP-1 are: in plan (including the rollers and the loops) 1,300 x 1,240 mm (= 51.2 x 48.8 in.); the height without the base is 1,650 mm (= 65 in.). The height of the base is 450 mm (= 17.7 in.). The weight of the vibratory driver is 4.5 metric tons (= 4.9 long tons). The static moment of the eccentric weights equals 10,000 kg.-cm. (= 8,700 in.-lbs.). The frequency of the oscillations depends on the revolutions of the shafts and equals 420 rpm.

This develops a maximum exciting force of 19 metric tons (= 21 long tons). The amplitude of the vibratory driver in neutral gear equals two centimeters (= 0.79 in.). The power of the electric motor equals 60 kilowatts.

The vibratory driver VP-1 is used in bridge building practice for sinking into the soil piles the critical resistance of which does not exceed 100 metric tons (= 110 long tons).

The attachment of the vibratory driver VP-1 to the head of a pile is made with the help of a conical device which consists of a steel cone and its cone base. The cone base is attached by bolts to the bottom of the vibrator and the cone is attached to the head of the pile. The attachment of the plate of the cone to the pile is usually achieved by means of a steel cover placed on the head of the pile.

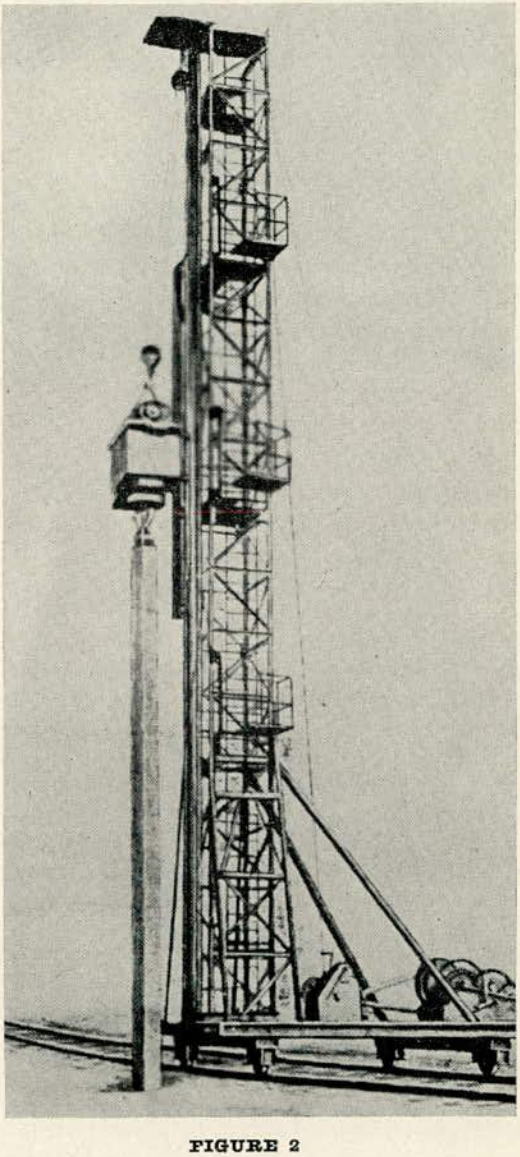

FIGURE 2

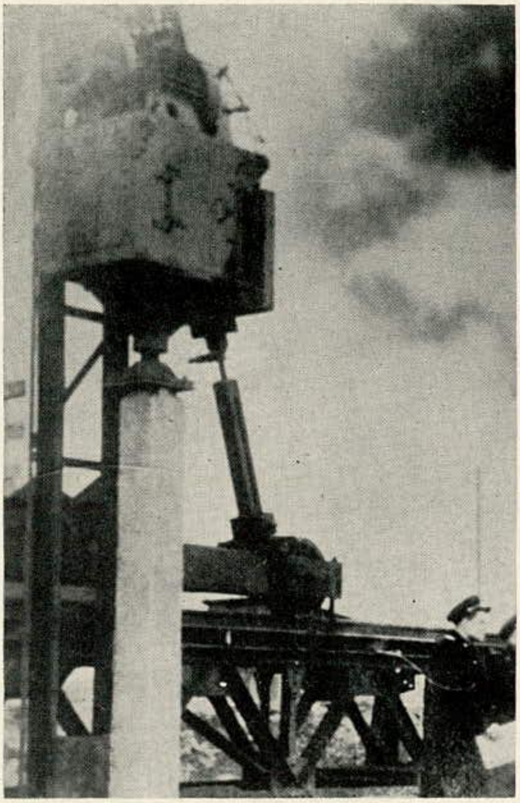

FIGURE 3

The cover consists of two plates with four short shafts welded onto them. The shafts are threaded at their ends. The plates are pressed against the pile on two sides by horizontal tension bolts. The upper sides of these plates are in contact with steel projections welded onto the steel reinforcement near the head of the pile and concreted with it.

The sinking of reinforced concrete piles by a vibratory driver VP-1 with the help of a pile driving frame is shown *(Figs. 2, 3)* and with the help of a crane *(Figs. 4, 5)*.

VIBRATORY DRIVER VP-2

This is intended for sinking into the soil light piles, the critical resistance of which does not exceed 50 metric tons (=55 long tons); also for sinking steel and wooden sheet piles.

The overall dimensions are 950 x 950 x 1,270 mm (= 37.4 x 37.4 x 50 in.). Weight is 2.1 metric tons (= 2.3 long tons). The static moment of the eccentric weights is 4,000 kg.-cm. (= 3,470 in.-lbs.). The number of revolutions of the shafts is 445 rpm.

The exciting force is 8.4 metric tons (= 9.2 long tons). The amplitude in neutral gear is two centimeters (= 0.79 in.). The power of the electric motor is 22 kw.

VIBRATORY DRIVER VP-3

This is designed to sink into the ground piles with a critical load up to 200 metric tons (= 220 long tons) and also for the sinking of pile shells weighing up to 15 tons. Overall dimensions are 1,560 x 1,500 x 2,000 mm (= 61.4 x 59.0 x 78.6 in.). Weight is 7.5 metric tons (= 8.3 long tons). The static moment of the eccentric weights is 26,300 kg.-cm. (= 22,850 in.-lbs.). The number of revolutions of the shafts is 408

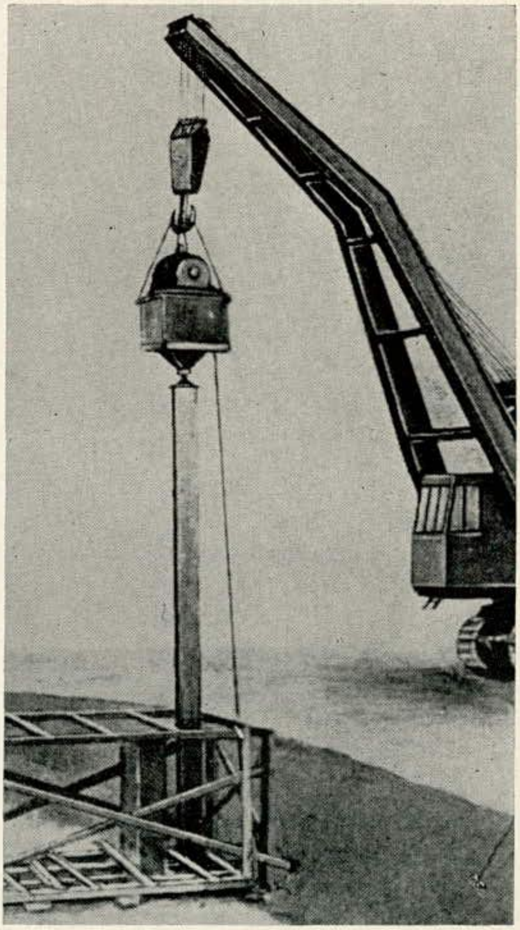

FIGURE 4

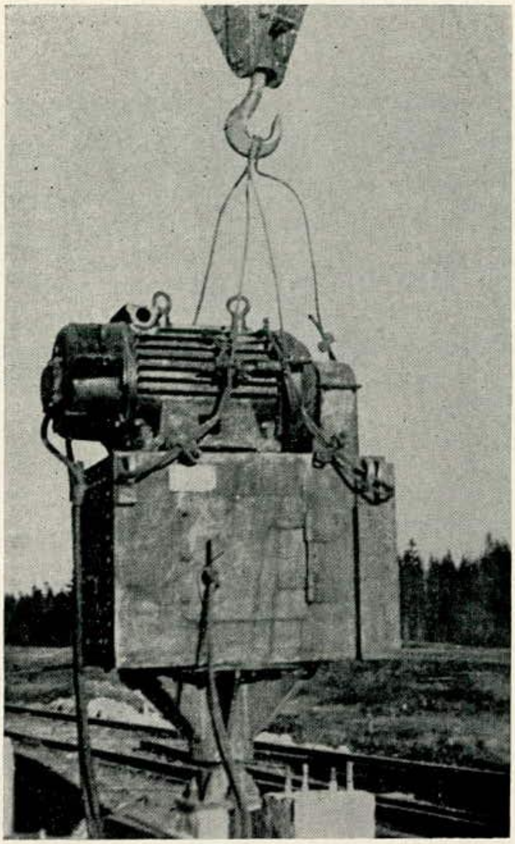

FIGURE 5

VIBRATORY DRIVER VP-160 *(Fig. 10)*

This is intended for sinking into the ground reinforced concrete shells up to five meters (= 19.7 ft) outer diameter to a depth of 30 meters (= 98 ft). The vibratory driver VP-160 is a low frequency 8-shaft vibrator of 2-frequency action. The construction of the vibratory driver permits separate control of the frequency of vibration, the magnitude of the exciting force and of the load moment. Overall dimensions are 1,500 x 1,180 x 3,100 mm (= 59 x 46.4 x 122 in.). Weight is 10.4 metric tons (= 11.5 long tons).

The maximum moment of the eccentric weights is 39,000 kg.-cm. (= 34,000 in.-lbs.). The vibratory driver has three speeds of rotation of its shafts: The first, 800/400 rpm. Exciting force is 44.2 metric tons (= 49 long tons). Amplitude in neutral gear is three centimeters (= 1.18 in.). Power of the electric motor is 100 kw.

Shown *(Figs. 6, 7)* is the sinking of a reinforced concrete shell 15.5 meters (=49 ft) long with an outer diameter of 90 centimeters (= 35.4 in.) and a wall thickness of six centimeters (= 2.36 in.) by a vibratory driver VP-3 with the help of a crane. Also shown *(Fig. 7)* is the ejection of the soil from the interior of the shell by means of an airlift. Soil was sandy gravels.

Shown *(Figs. 8, 9)* is the sinking by a vibrator VP-3 of reinforced concrete shells up to 27 meters (= 88.5 ft) long with an outer diameter of 1.20 meters (= 47.3 in.) and a wall thickness of 10 centimeters (= 4 in.). Soil was silty sand.

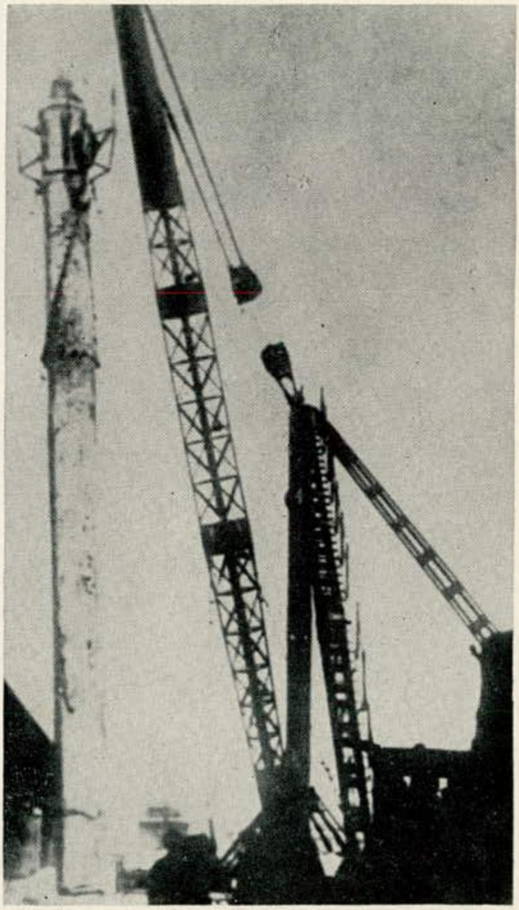

FIGURE 6

FIGURE 7

rpm; second, 900/450 rpm; third, 1,010/505 rpm.

The exciting force is 100 metric tons (= 110 long tons); 130 metric tons (= 144 long tons); 160 metric tons (= 177 long tons). The power of the electric motor is 155 kw. The vibratory driver is adapted for synchronous operation. This vibratory driver has been in production since 1958.

Shown *(Fig. 11)* are two vibratory drivers VP-160 joined together for synchronous operation. On one of them the lid has been removed and one can see the gears and the shafts.

Shown *(Fig. 12)* is the sinking by a vibratory driver VP-160 of a reinforced concrete shell 18 meters (= 59 ft) long with a diameter of 1.60 meters (= 52.5 in.) and with a wall thickness of 10 centimeters (= 4 in.) into sandy clay soils.

Shown *(Fig. 13)* are two paired vibratory drivers VP-160 mounted on a shell of a 3-meter (= 9.8 ft) diameter.

For the purpose of sinking shells up to six meters (= 19.7 ft) diameter to a depth up to 40 meters (131 ft), a vibratory driver VP-250 was to be produced during 1959.

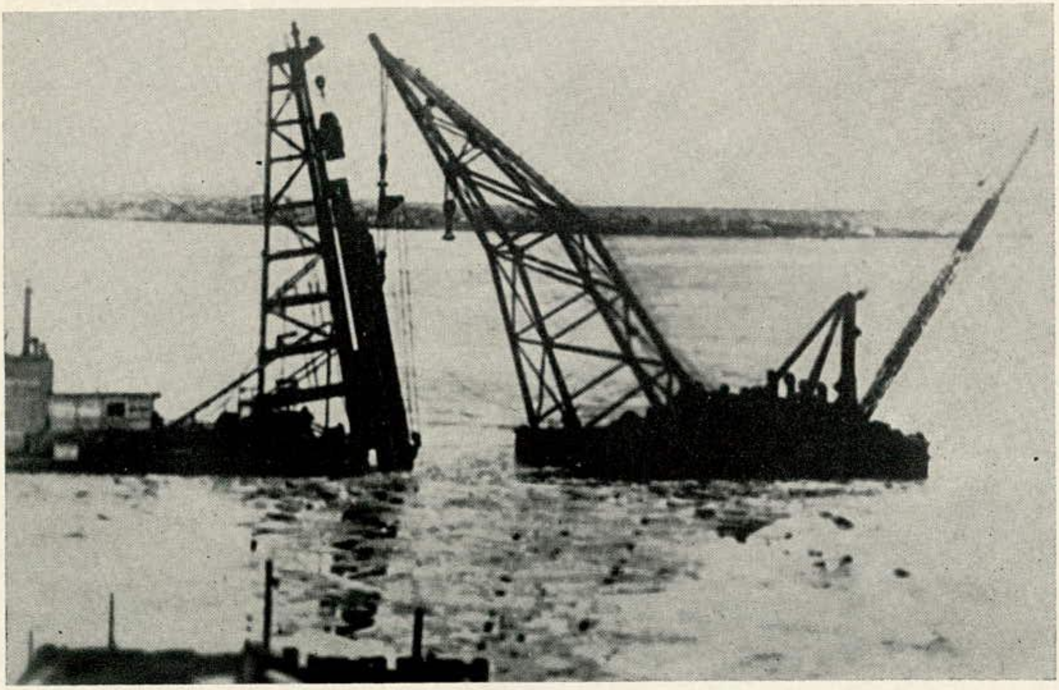

FIGURE 8

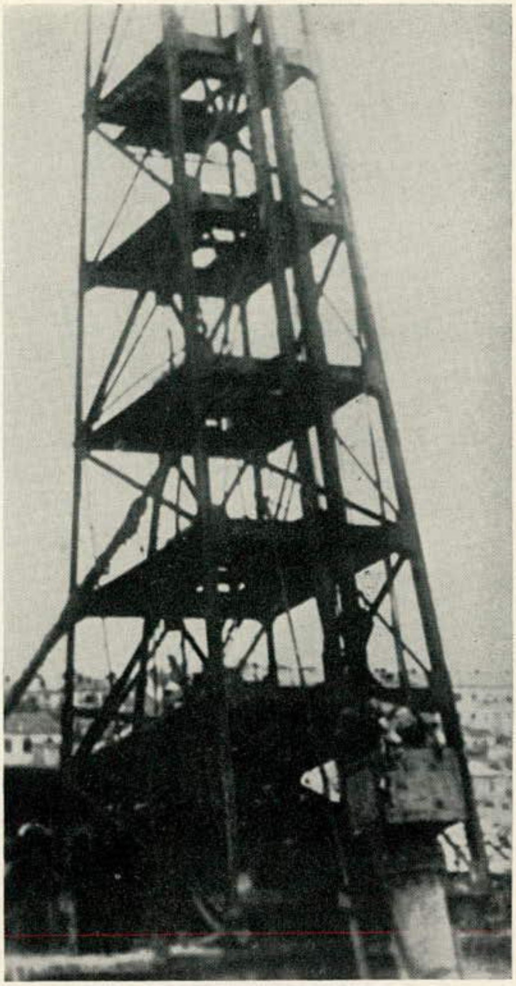

FIGURE 9

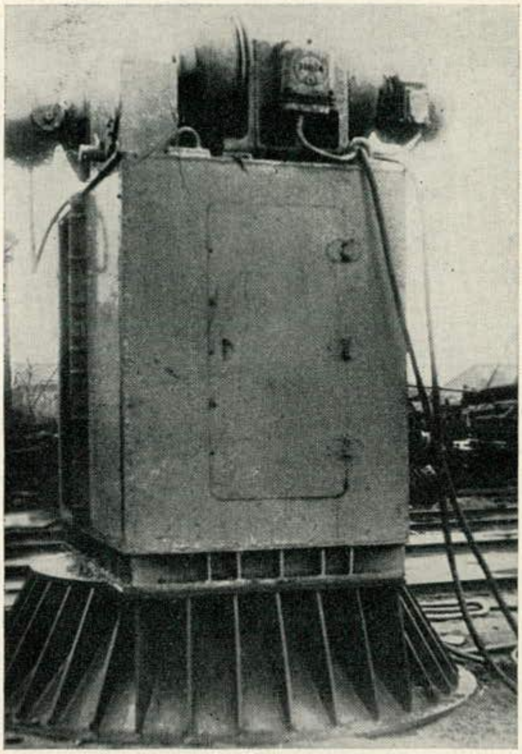

FIGURE 10

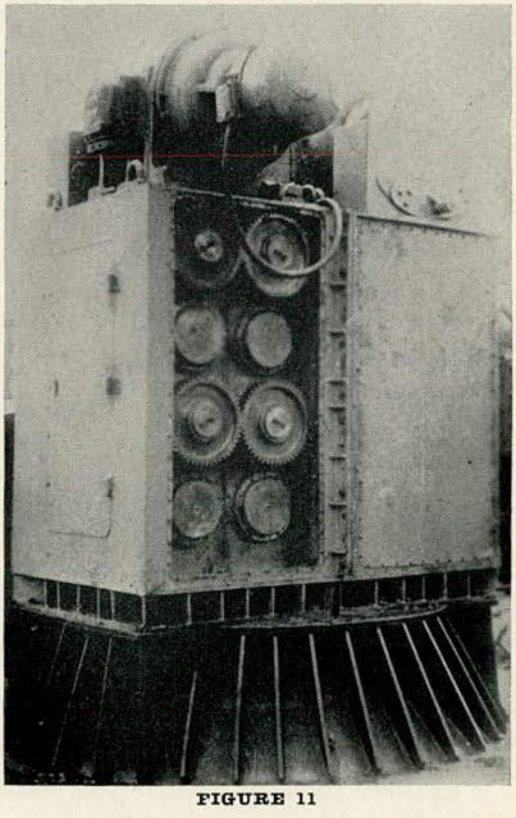

FIGURE 11

It would have a maximum value of the exciting force equal to 250 metric tons (= 275 long tons) and it would also permit variations of the value of the load moment and of the frequency of oscillations. The possibility of synchronous action of these vibratory drivers is also foreseen.

In connection with the abandonment of deep massive foundations for bridge piers and the adoption of composite reinforced concrete shells during the coming year on the construction sites of several large bridges, a large number of composite reinforced concrete shells from 0.6 to 5 meters (= from 1.97 to 16.3 ft) are to be sunk by

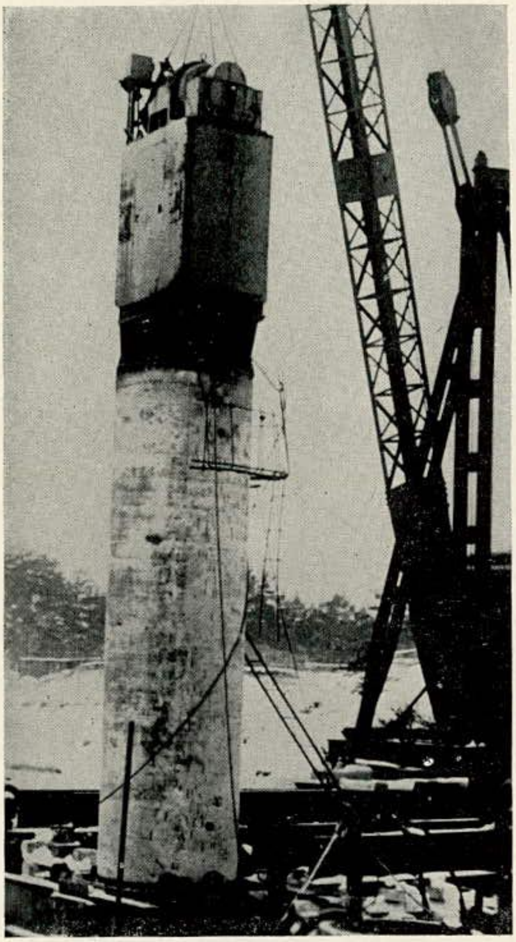

FIGURE 12

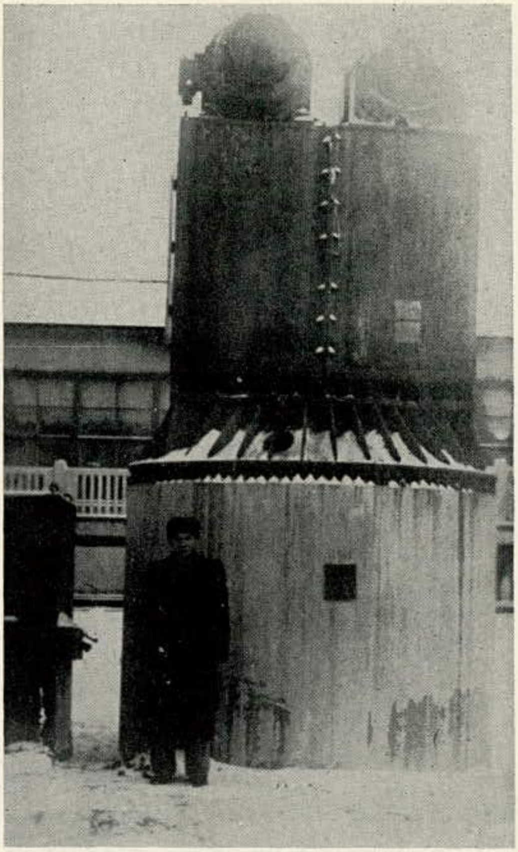

FIGURE 13

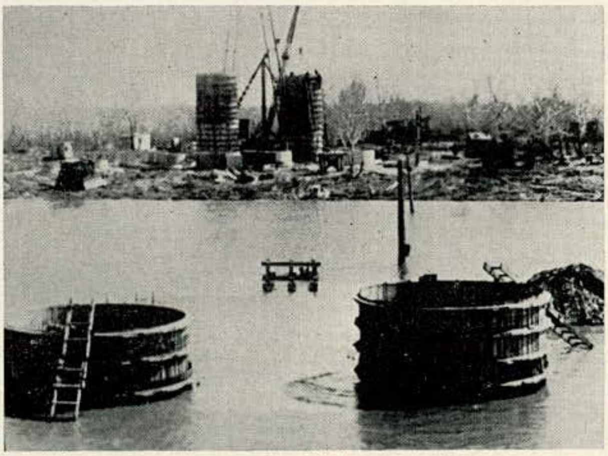

FIGURE 14

means of vibratory drivers. Shown *(Figs. 14, 15)* is the manufacture of reinforced concrete shells of 5.0 meters (= 16.3 ft) diameter with a wall thickness of 14 centimeters (= 5.5 in.) on a motor road bridge under construction. They are being sunk into sand with fine gravel to a depth of 22 meters (= 72 ft).

FIGURE 15

On the Development of Soil Mechanics in the USSR

Nikolai A. Tsytovich

The present communication is devoted to the development of the basic ideas of modern soil mechanics in the work of Russian and Soviet scientists.

The scientists and the engineers of the USSR attach considerable importance to the solution of problems in the field of soil mechanics, since important territories of the Soviet Union are covered by loose deposits of mineral soils of considerable depth. The erection of structures on such soils requires specific knowledge of soil mechanics.

This is all the more important since during the last decades many industrial and housing structures are being erected in the Soviet Union which often structurally are statically indeterminate and which are very sensitive to uneven settlements. A forecast of the magnitude of such settlements can be made only through the use of solutions provided by soil mechanics.

All this compelled Russian scientists a long time ago to devote their studies to the development of problems of the theory of bases of structures (publications of V. I. Kourdyumov, 1889 and others) and to their practical applications to foundation engineering. It is significant that, for instance, a text on "Bases and Foundations" by V. M. Karlovich *(Ref. 1)* was published in the Russian language in 1869 and a systematic text on soil mechanics appeared in 1934 *(Ref. 3)*.