The smaller and lighter bolts were located by hanging them in the templets, which were so built and supported that this could be done. Old 3-inch boiler tubes were rescued from the scrap pile, cut into 2-foot lengths and used to provide adjustment space at the top of the bolts. Newspapers were employed to center the bolts in the tubes and to prevent the concrete from rising in them.

This foundation was brought up and finished about 1¼ inches below the bottom of the bedplates. After the bedplates had been placed, lined up and levelled, the bolts were sufficiently set up to hold them in position, care being taken to avoid springing. The tubes around the bolts were then filled with fine dry sand to within a short distance of the top of the foundation. A dam was next built around each bedplate and the space below it with the tops of the tubes was filled with grout. Steel wedges made from 2 x ½-inch flat iron drawn down to a point under a steam hammer were used to raise the bedplate, the finished wedge being about 6 inches long. After the grout had set, the steel wedges were knocked out and the holes left were filled with pointing mortar. An ample supply of these steel wedges and 3 x 1-inch steel blocks for use as fillers below the wedges is a great convenience, especially when lining up heavy machinery. Hardwood, maple or oak wedges can be used with light machinery, but they are useless in working with machines having bedplates weighing from 40 to 50 tons.

Direct-connected sets, such as steam turbines and generators, motor-generator sets, rotary converters or well-balanced reciprocating engines with generators can be mounted on structural foundations. Care, however, is necessary in the case of reciprocating units to insure that their cyclical period of vibration does not coincide with that of the supporting structure or is not a harmonic of it. When these cyclical periods harmonize the entire structure will be thrown into vibration. Should this occur the first remedy to be tried is slight alterations in the speed of the machine. A bucket of water should be set on the floor close to the machine and the vibration ripples on the water will show the effect of the changes in the speed. When it is impossible to cure the trouble in this manner, additions can be made to the weight of the machine by filling in the hollow portions of the bedplate with cement concrete. If enough weight cannot be thus added, a platform can be suspended under the machine in the floor below and a foundation built on it. The rods or bolts carrying this dead weight should be threaded to permit their load being clamped up solidly against the ceiling below the machine.

When properly constructed, a reinforced-concrete structure furnishes a favorable foundation. It is rigid and heavy and thoroughly tied together. Structural steel framing with concrete floor slabs makes the next best arrangement, particularly if care is taken to tie the steel frame with portal and "X" bracing. Tile or tile and concrete floors are not as good as heavy slab construction. The design cf this type of foundation should not be lightly undertaken, as it is not a case where "most anything will do" and an improper design will result in trouble, perhaps a serious disaster.

Structural reinforced concrete, sometimes called steel concrete, is not the rough agglomeration it is sometimes imagined to be. Every piece of steel has its reason for being in the position assigned and no liberties can be taken without endangering the structure. Once there was a country millwright who read in the daily papers about reinforced concretes and saw some wonderful pictures of reinforced-concrete dams. It fell to his lot to build a small dam for the local authorities and it was decided to use reinforced concrete. So this millwright bought all the old horseshoes and scrap from the local blacksmith and mixed the mess with sand, cement and gravel and placed it in the forms. The life of this dam was very brief; in fact, it collapsed as soon as the forms were taken partly down, but, fortunately, before any amount of water had accumulated. Steel scrap mixed in the concrete does not act as reinforcing, and it is not wise to attempt a reinforced-concrete structure without competent advice.

## AUTOMATIC CENTRIFUGAL FRICTION CLUTCHES.

Many schemes have been devised to reduce heavy starting currents in electric motors. Ingenuity has been expended and elaborate motors and switch-gear designed to meet this difficulty, but the result has been obtained at the expense of simplicity and reliability.

The subject of this article has been evolved to meet a difficulty often met in practice, i.e., to start and accelerate a load or mass requiring a large starting torque, without using special switch-gear, and with a minimum of starting current. The device is particularly valuable where the machines are frequently started and stopped, such as capstans, hydro-extractors, the travelling motions of cranes, air compressors, hydraulic pumps, etc., etc.

The function of the clutch is to enable the motor to start up unloaded, the load being gradually applied as the motor

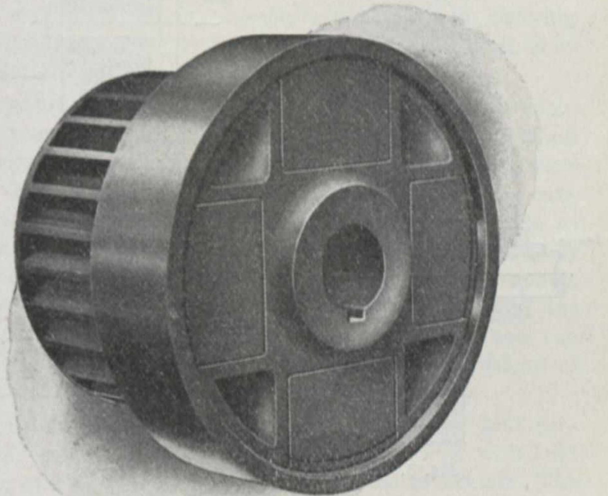

Fig. 1.

accelerates, this rate can be pre-determined when designing the clutch and is entirely independent of the operator. The switch-gear can be of the simplest form; in many cases the motor can be switched direct on the mains without any starting resistance (or its equivalent) whatever. No-volt and overload release devices are not required, the clutch gives all requisite protection to the motor.

The clutch is eminently suitable for use with alternating current motors of the squirrel-cage rotor type. As is well known, this is the simplest and cheapest type of motor, the only wearing parts being the bearings. Up to now, however, its poor starting torque, especially in the single-phase type, has prevented its use in many cases. This disadvantage is at once overcome by using a centrifugal clutch, and complicated switch-gear, with its troublesome coils, resistances, etc., is unnecessary. Belt-shifting arrangements are also done away with, and slipping and wear of belts avoided.

Referring to the illustrations, the clutch consists of a central armed boss keyed to the motor or driving shaft, carrying friction shoes or slippers in suitable slides. These shoes are free to move outwards by centrifugal force as the motor accelerates, and engage with the internal rim of the clutch-pulley which transmits the power to the machine.