March 14, 1972 F. GAUGER 3,649,727

MAKING CONCRETE TUBES

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Fig. 1

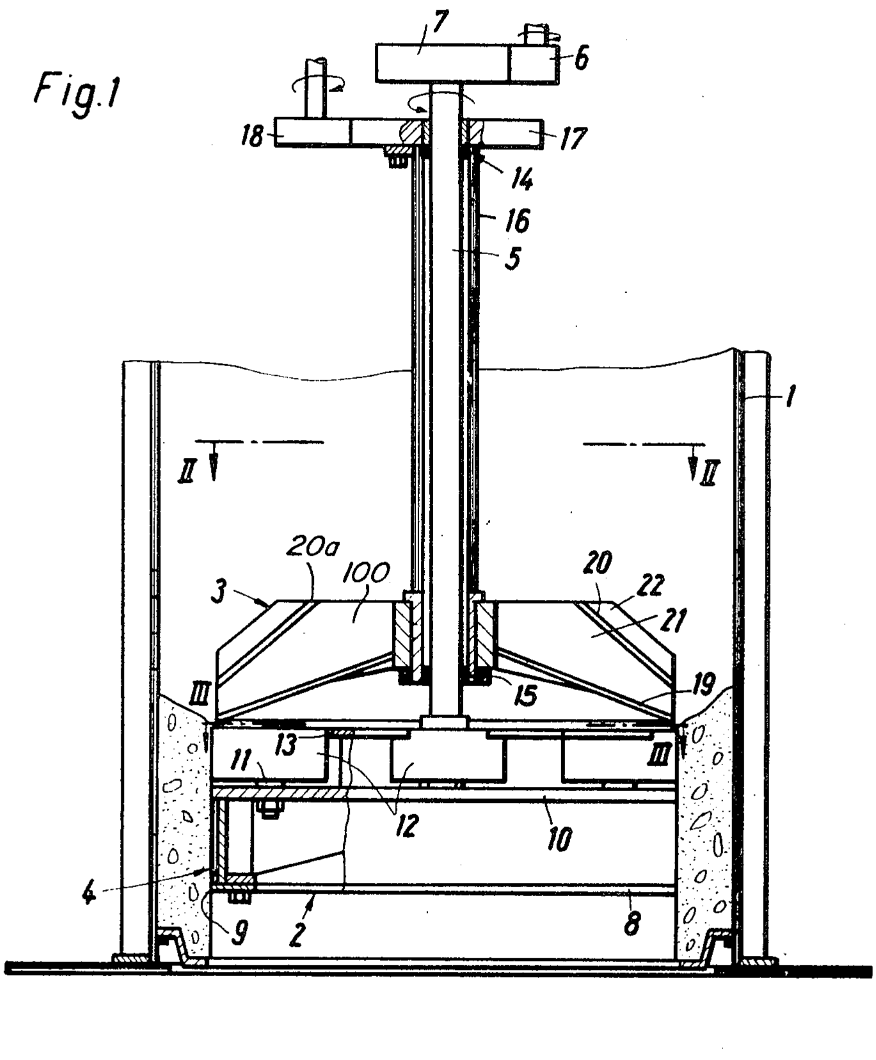


Fig. 2

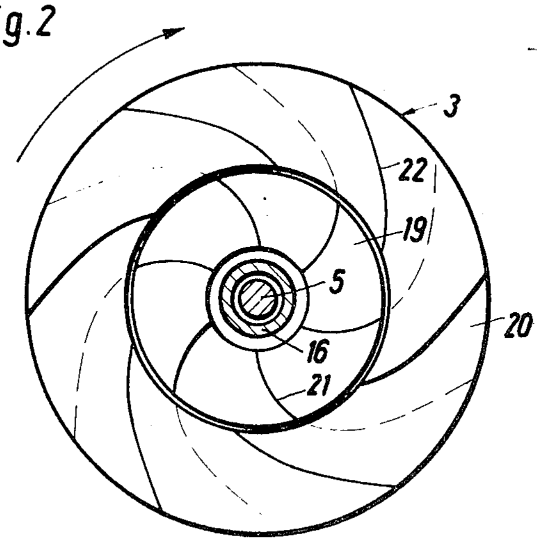


Fig. 3

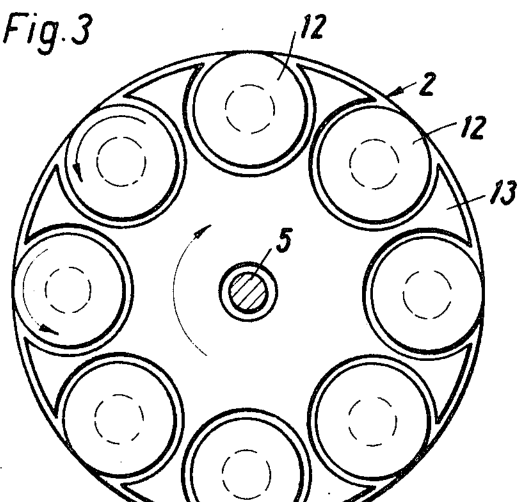
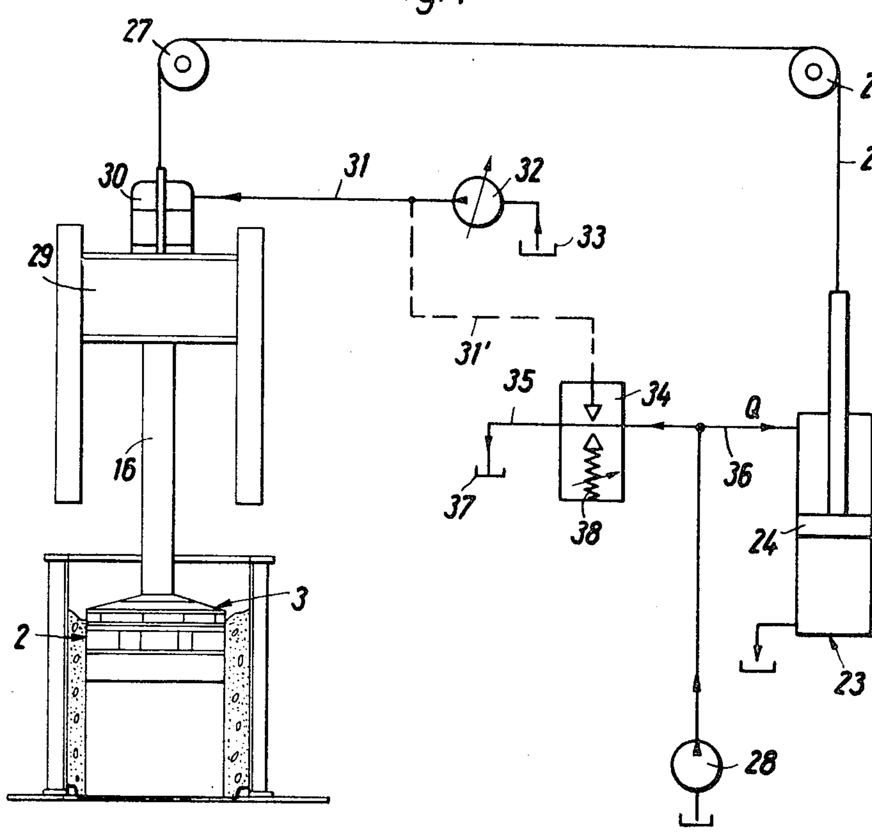


Fig. 4



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MAKING CONCRETE TUBES

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U.S. Cl. 264—40 2 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for producing concrete tubes using a vertical tubular mold with a rotating piston moving upwards axially inside the mold. The piston is operated in such a manner that as the torque required for rotation of the piston decreases owing to a decrease in the supply of concrete, the rate of upward travel of the piston is decreased.

The present invention relates to the production of concrete tubes with the help of a rotating tube forming unit or male mold which rotates in a female mold defining the external dimensions of the tube produced. In such an apparatus concrete is deposited on an impeller on the top of a piston-like pressing device and is thrown radially outward.

In a known method of production of this type, as described in U.S. Pat. 3,096,556, in which the tube forming unit is moved steadily upwards as it rotates, it has been found that the degree of compaction of the tube is not constant so that there are local variations in strength.

Further previously proposed arrangements (see the French Pat. 1,231,155 and U.S. Pat. 2,644,818) have been designed to produce concrete tubes with such a rotating tube forming unit having a pressing device, which is provided with lateral sliding and sealing runners or rails. This tube forming unit is provided with a piston and a stationary cylinder having a chamber connected with a pressure duct, the pressure in the chamber and the thrust acting upon the runners or rails can be adjusted by setting the spring of a valve in the pressure ducts. It has, however, been found that variations in the rate of supply of concrete in the unset condition cause variations in the density of the pipe wall.

One object of the present invention is to improve the above methods of production in such a manner that tubes can be produced which have a substantially even degree of compaction along their whole length.

The method in accordance with the invention may be defined as residing principally in the features that the torque which is supplied by the drive motor to the male mold and which varies in accordance with the rate of supply of the concrete, is detected or measured. The rate of lifting of the tube forming unit is decreased when there is measured a decrease in the amount of torque and increased when there is measured an increase in the torque.

Apparatus for putting my invention into practice can comprise a pressing head or tube forming unit, comprising a driven impeller or distributor disc with impelling blades extending away from the axis of rotation, and a separately driven smoothing roller unit. An important feature of the invention in this apparatus is that the tube forming unit is driven by a hydraulic motor connected with a pressure duct which supplies oil under pressure from a pump and is connected with a pressure measuring or detecting device which reduces the amount of energy supplied to a tube forming unit lifting means when there is a decrease in the supply pressure of the hydraulic motor

causing the tube forming unit to rotate, and vice versa. In this arrangement use is made of the discovery that the degree of compaction of a tube is connected physically with the torque supplied by the hydraulic motor. The latter is again proportional to the pressure of the oil supplied to the hydraulic motor so that the magnitude of the pressure is an indication for the degree of compaction of the concrete tube.

In accordance with a preferred embodiment of the invention the means for lifting the tube forming unit is in the form of a hydraulic ram suitably connected with the tube forming unit and connected by a pressure oil supply pump by means of a duct which is connected with a valve. This valve is responsive to the supply pressure of the hydraulic motor and connects the ram to a greater or lesser extent with an oil container as the pressure in the motor supply duct varies.

In this known method mentioned above use is made of a tube forming unit assembly which comprises an impeller disc which is connected with a drum-like moving piston. A disadvantage of this construction is the comparatively large height of the assembly. Furthermore part of the power supplied by the drive motor of the impeller shaft is lost owing to friction between the smoothing piston and the adjacent concrete of the tube wall. Since the centrifugal force is a function of the speed of rotation of the distributing disc and increase in the speed of the latter is limited owing to friction of the smoothing piston connected with it, compaction of the concrete thrown outwards centrifugally into a circular formation immediately adjacent to the impeller is relatively low. The impeller or impeller disc and the smoothing piston connected with it therefore have a diameter which is less than the subsequent or following pressing means in the form of the roller and smoothing piston unit.

A substantial decrease in the constructional height and other advantages can be obtained in accordance with the present invention by forming the impeller from two annular discs of which the lower one has its outer edge directly above the male mold. The two discs of the impeller are made conical so that they direct the concrete downwards and outwards. The lower disc can be provided with impeller blades which enable it to drive the upper disc. The lower disc can be connected with a drive shaft. Such an arrangement of the impeller assembly with the lower outer disc edge immediately above the pressing device is important for correct functioning of the following pressing device which can immediately respond to the amount of compaction brought about in the circular formation of concrete deposited by the comparatively rapidly rotating impeller. Owing to the pressure responsive means associated with its drive motor, the pressing device can then bring about operation of each lifting means whose operation, as mentioned above, is dependent upon the driving torque of the tube forming unit which in turn is dependent upon the degree of compaction. The pressing device is therefore not only capable of performing a molding or pressing action and also a smoothing action, but can also act as a sensing or feeling means which constantly examines and determines the degree of compaction of the circular formation or layer of concrete deposited by the impeller, and provides a control signal in accordance with the state of this concrete.

Concrete is lowered downwards and passes through an annular gap between vertical drive shaft and an interior edge of the upper disc of the impeller. In between the two discs of the impeller the concrete is thrown outwards by means of the impeller blades. Rapid and uniform compaction of the concrete is brought about by the conical construction of the two discs of the impeller which directs the concrete obliquely outwards and downwards. This avoids the disadvantage present in prior art equipment where the concrete is thrown horizontally and as a result is forced upwards through the annular gap between the tube forming unit or pressing head and the female mold, and thus also avoids the poor compaction occurring with such prior art arrangements in which the concrete is propelled horizontally and not obliquely downwards. Furthermore compaction is brought about in an advantageous manner immediately ahead of the rollers of the male mold part.

Further details, advantages and features of the invention will be gathered from the following descripton which refers to the attached drawings.

FIG. 1 is a vertical section through an apparatus for making concrete tubes comprising a radially acting tube forming unit or pressing head which is provided with an impeller disc constructed and arranged in accordance with the invention.

FIGS. 2 and 3 are respective sectional views taken along the lines II—II and III—III respectively of FIG. 1.

FIG. 4 is a diagrammatic view of the male mold lifting means in accordance with the invention.

As can be seen from the drawing the apparatus comprises an outer or female mold **1** determining the outer dimensions of the tubes to be produced and having in its interior cavity a tube forming unit **2** or pressing head. This tube forming unit **2** includes an impeller or distributor disc **3** and a pressing device **4** in the form of a roller smoothing piston unit. The pressing device **4** is connected with a shaft **5** which is driven by means of a gear wheel **7** attached to its upper end and driven in turn by a pinion **6**. At the bottom end of the shaft **5** there is a smoothing piston or plunger **8** with a sheet metal part **9** which is mounted in the manner of a flange and can be replaced when worn. Attached to an upper disc **10** of the smoothing piston **8**, I provide eccentric bolts **11** carrying rollers **12** by means of sealed ball bearings. The upper ends of the rollers **12** are covered by a piece of sheet metal **13**.

A hollow shaft **16** is carried on shaft **5** by means of roller element bearings **14** and **15**. This hollow shaft **16** is driven by means of a pinion **18** which meshes with a gear wheel **17** fixed at the upper end of the shaft **16**. At the bottom end of the latter the distributor or impeller **3** is fixed. It comprises two frusto-conical discs **19** and **20**. The lower annular disc **19** is directly connected with the shaft **16** while the upper annular disc **20** is connected to the lower disc **19** by means of impeller blades **21** which follow spiral curves as shown in FIG. 2. The upper disc **20** has additional impeller blades **22** mounted on it.

As appears from FIG. 1 the lower outer edge of the impeller **3**, that is to say the lower outer edge of the disc **19** is located immediately above the pressing device **4** and is consequentially situated closely adjacent the rollers **12**. As can also be seen from this figure, the frusto-conical discs extend downwards and outwards away from the axis of the two shafts **5**, **16**.

FIG. 4 shows the drive arrangement of the pressing device **4** including means for controlling lifting. In the embodiment shown, the lifting means for the pressing device consists of a piston and cylinder ram unit **23**. The rod of the piston **24** of this unit is connected by means of a chain **25** or the like, which passes over pulleys **26** and **27**, with the pressing device. If oil under pressure is supplied by a pump **28** into the upper chamber of the ram unit **23**, the piston **24** moves downwards so that there occurs lifting of the pressing device and the impeller.

For driving the pressing device **4**, I provide a transmission **29** and a driving hydraulic motor **30** which is preferably arranged to run at a constant speed.

This motor is supplied by a pump **32** with oil from an oil reservoir or container **33**. A pressure oil duct **31** is connected by means of a branch or control duct **31'** with a regulating valve **34**. This valve **34** is arranged to control flow of pressure oil along a branch duct **35** which is connected with the pump **28** and the upper piston space of the ram unit **23**. The duct **35** leads to an oil reservoir or container **37**. The control or regulating valve **34** has a plunger which can move so as to alter to a greater or lesser extent the degree of overlap of cooperating valve ports in the path of oil along the duct **35** to the oil container **37**. This plunger is acted upon, on the one hand, by the pressure of the oil supplied through the duct **31** and the branch duct **31'**, while on the other hand it is acted upon by a spring **38** whose force can be adjusted by setting a screw, not shown. In accordance with the setting of the spring **38** the amount of response of the plunger to the pressure prevailing in the duct **31** (transmitted via duct **31'**) can be varied.

The apparatus for producing concrete tubes operates as follows.

Unset concrete supplied to the apparatus passes through the annular gap **100** between the upper edge **20*a*** of the frusto-conical disc **20** and the shaft **16** so as to be acted upon by the blades **21**, or alternatively is impelled by the blades **22** on top of the frusto-conical disc **20**. Owing to the rotation of the impeller **3** the concrete is impelled centrifugally outwards by the blades **21** and **22** against the female mold **1**.

Since the concrete is conveyed or impelled in a radially outward and downward direction and the rollers **12** of the pressing device **4** are located immediately adjacent to the impeller **3**, deposition of the concrete against the wall of the female mold **1** to a level above the impelled is prevented. Such a deposition ahead of the impeller would lead to a tube with poor compaction being produced. The arrangement ensures that the concrete is placed in a position adjacent to the rollers **12**. Despite the small height dimension of the tube forming unit **2** (comprising the pressing device **4** and the impeller **3**) an extremely rapid compaction of concrete in the mold **1** can be brought about. It has been found that the degree of compaction of a tube is physically connected with the torque of the hydraulic motor **30**. Since this torque M_d is proportional to the hydraulic supply pressure p, the supply pressure p is also proportional to the degree of compaction of the tube concrete. If while the tube forming unit is being moved upwards by the descending piston **24** of the ram, the rate of supply of concrete is, for example, reduced, the torque M_d of the hydraulic motor **30** is also reduced. Consequently the pressure p in the duct **31** is reduced together with the pressure in duct **31'**. The piston or plunger of the regulating valve **34** is moved upwards by spring **38** and decreases the throttling action in the duct **35**. As a result a larger amount of the oil under pressure from pump **28** can pass to the oil container **37** instead of passing to the upper part of the ram unit **23** through the duct **36**. Consequently the speed of lifting of the tube forming unit **2** is reduced and more concrete is deposited against the inner wall of the mold in a circular formation so that proper compaction still takes place despite the reduction in the rate of supply of concrete to the impeller. There will then be an increase in the pressure in the duct **31** leading to the hydraulic motor **30** and in the control duct **31'** so that the regulating valve **34** will be actuated and its plunger moved downwards against the action of spring **38**. This will cause the valve **34** to exert a stronger throttling action so that, consequently, more oil flows from the pump **28** to the ram unit **23**. The upward speed of the tube forming unit will be consequently increased and after a short time will reach a steady value in harmony with the decreased rate of supply of concrete.

With the help of the regulating valve a constant supply pressure is maintained for the hydraulic motor so that there is a constant degree of compaction of concrete during the formation of the tube. Since this pressure depends upon the setting of the spring **38**, adjustment of the spring setting or bias by means of the screw can be used to set the supply pressure of the motor **30** at a higher or lower level, so that, in effect, the screw for setting the spring can be used to set the degree of compaction of the concrete.

Instead of the hydraulic motor used as a drive motor in the embodiment described, it is also possible to use an electric motor. In this case the instantaneous power level of the electric motor is measured and caused to operate a moving coil regulator taking the place of the hydraulically controlled regulating valve. Since, however, this arrangement is generally more elaborate than the hydraulic arrangement the latter is preferred.

I claim:

1. In a method for producing concrete tubes comprising the steps of:

(a) supplying unset concrete into a tubular mold defining a female mold onto an impeller located in such tubular mold;

(b) rotating the impeller about a substantially vertical axis to thereby propel the concrete centrifugally into a circular formation against an inner surface of the tubular mold;

(c) maintaining the concrete in tubular formation while internally working it under the action of a circular piston-like pressing device defining a male mold rotating about a vertical axis within the circular concrete formation while such male mold is simultaneously moving upwards within the female mold; and

(d) automatically regulating the speed of upward movement of the pressing device during the production of the concrete tubes such that said speed is reduced when the torque required to rotate the pressing device decreases owing to decrease in the supply of concrete to the impeller, while increasing the speed of upward movement of the pressing device when such torque increases to obtain a substantially constant compaction of the concrete throughout the length of the concrete tube thus formed.

2. The method as defined in claim 1, further including the step of rotating the impeller at a greater rotational speed than that of the pressing device.

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U.S. Cl. X.R.

25—36; 264—312