Nov. 20, 1956 B. B. DEARDEN 2,771,279

CONCRETE VIBRATORS

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FIG. 1

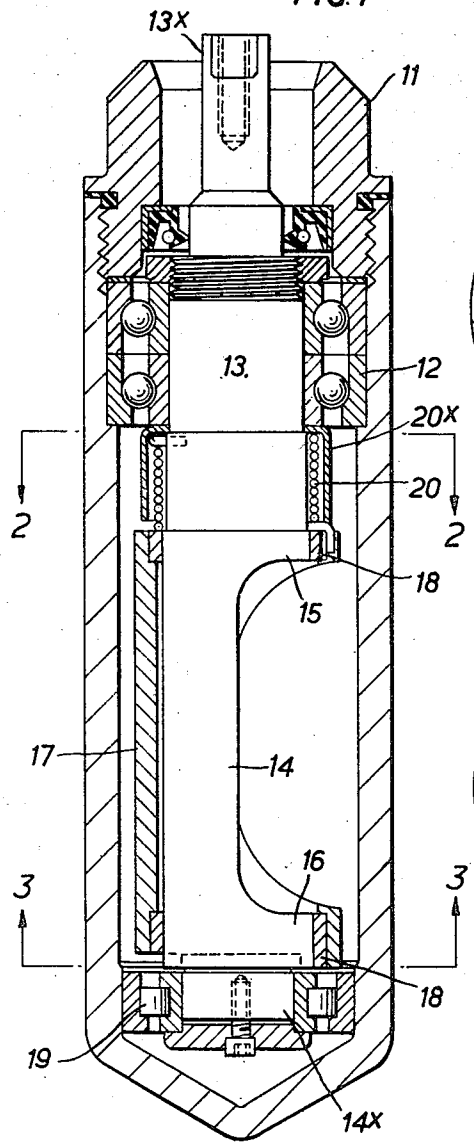


FIG. 2

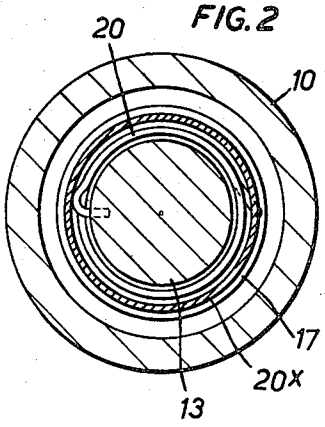
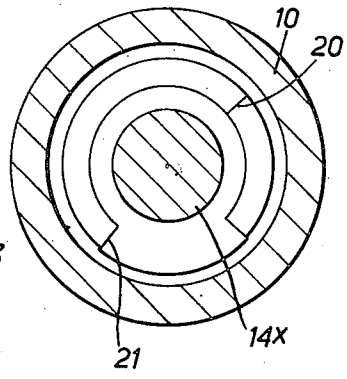


FIG. 3



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FIG. 4

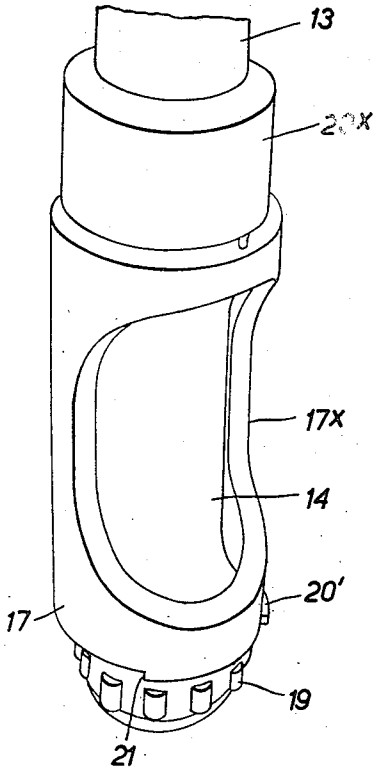


FIG. 5

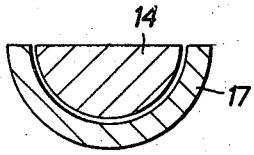


FIG. 6

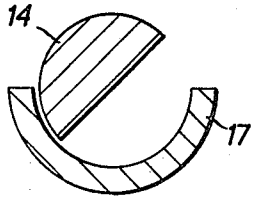
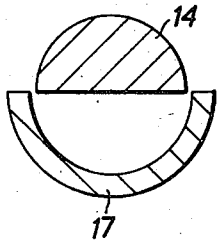


FIG. 7



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FIG. 9

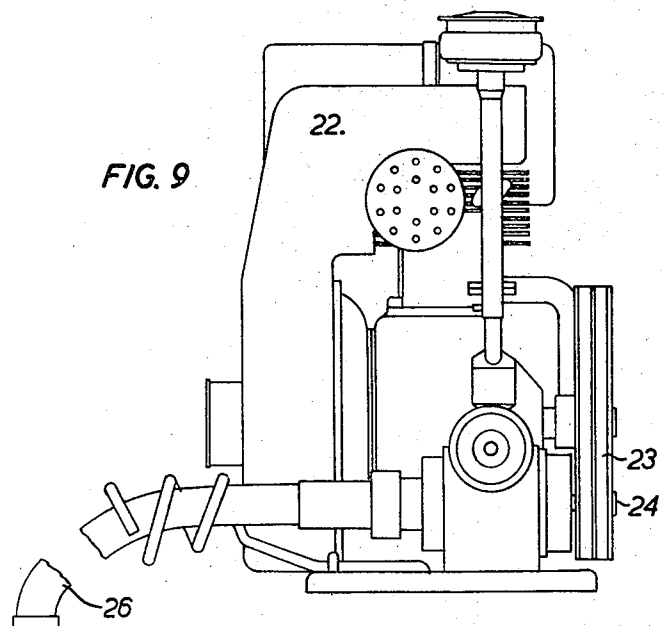
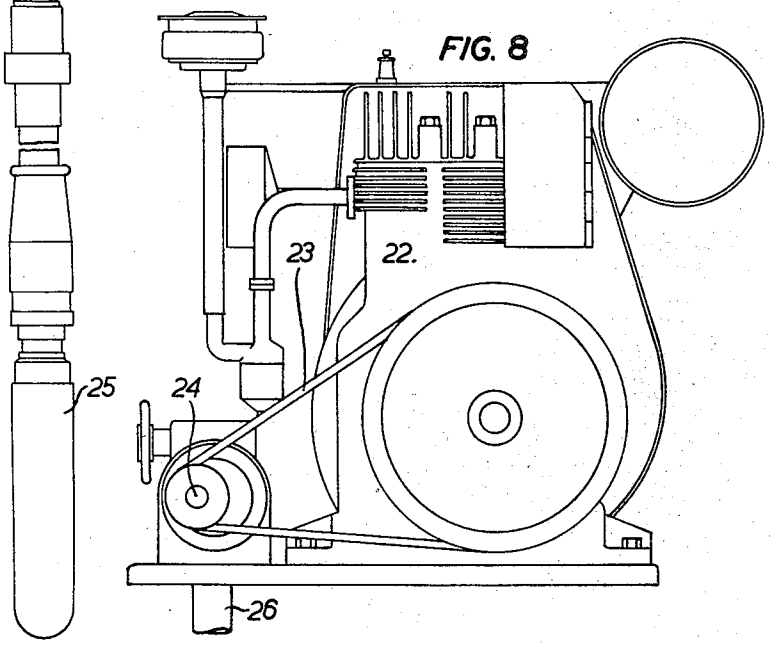


FIG. 8



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2,771,279

CONCRETE VIBRATORS

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Application April 8, 1955, Serial No. 500,177

10 Claims. (Cl. 259—1)

This invention relates to concrete vibrators of the type known in the trade as the "internal" type. These machines usually comprise a power unit, which may be either an internal combustion engine or of the compressed air, hydraulic or electrically operated type, and a vibrating unit, the latter usually comprising a rotatable out-of-balance shaft or weight enclosed in a suitable housing, and adapted to be immersed in a concrete mix to cause it to flow and settle by the breaking down of internal friction in the mix, thereby causing the mix to become more dense and enabling dryer and stiffer concrete mixes to be placed in forms, moulds and the like.

The "internal" type concrete vibrators are constructed in various forms, the vibrating unit being in driving connection with the power unit either through a stiff or flexible drive shaft, or the power unit may be located within the vibrating unit housing. Whatever the construction, the present invention is applicable to any of the above-mentioned alternatives.

A desirable feature of internal vibrating units is that they should vibrate with a large amplitude during the initial phases of settlement of the concrete mix, due to wider spacing of the ingredients, but (*a*) as the concrete mix settles and becomes more dense the ingredients become more closely pushed together, and (*b*) such increase in density creates a larger resistance to the vibrator thereby causing an increase in power consumption. Consequently the two factors (*a*) and (*b*) make it desirable for the amplitude of the vibrator to be progressively reduced as compaction of the concrete proceeds.

However, a still further point (*c*) of a practical nature arises, in that a high frequency unit operating at say 10,000 cycles per minute, or even more, with a large amplitude, causes severe splashing just as the vibrating unit is inserted in and removed from the concrete mix, causing inconvenience to the operator.

One object of the present invention is to provide a vibrating unit for an internal concrete vibrator wherein two rotatable out-of-balance elements are mounted preferably co-axially so as to be angularly adjustable relative to each other and having means for effecting such adjustment of the elements whereby the amplitude of vibration generated as the elements rotate can be varied.

A further object of the invention is to provide a vibrating unit wherein the out-of-balance elements are interconnected by flexible means through which the drive imparted to one element is passed on to the other, said flexible means allowing relative angular movement to take place automatically as the torque to the said one element is varied.

According to a still further object of the invention, the two out-of-balance elements are mounted co-axially and annularly arranged and rotate at different radii, the driving torque from the power unit being imparted to the inner element and the latter being in driving connection with the outer element by means of a torsional spring whose resilience allows the elements automatically to adjust themselves angularly relatively to each other to vary the amplitude of vibration generated proportional to the variation of the driving torque and power consumption of the vibrator unit.

A still further object is to provide a vibrating unit wherein the torsional spring and out-of-balance weights may be so constructed and arranged that the amplitude of vibration is initially quite small, gradually building up to a maximum, and then gradually decreasing to comply in succession with conditions (*c*), (*a*) and (*b*) previously outlined, the variations in the amplitude of vibration being varied according to the torque applied.

In the accompanying drawings is illustrated one embodiment of the invention wherein the vibrating unit gives maximum vibration when running under light load and gradually decreasing to a minimum as compacting progresses, and in said drawing:

Fig. 1 is a longitudinal sectional elevation of the unit;

Fig. 2 is a cross section on the line **2—2**, Fig. 1;

Fig. 3 is a cross section on the line **3—3**, Fig. 1;

Fig. 4 is a perspective view of the two out-of-balance elements when in a state of rest and over-lying each other;

Figs. 5, 6 and 7 are detail sectional views showing the relative dispositions of the out-of-balance elements when the vibrations imparted by the unit have respectively a maximum, intermediate and minimum value.

Fig. 8 is a side elevation of a power unit comprising an internal combustion engine; whilst

Fig. 9 is an end view of Fig. 8 with the vibrator unit in driving engagement therewith.

In the example illustrated, the vibrating unit, which is constructed to comply with conditions (*a*) and (*b*) outlined above, comprises an outer stationary casing **10** connected in usual manner to the outer casing **11** of a flexible driving shaft (not shown) driven by an internal combustion engine. Within the vibrating unit casing and adjacent the end of the flexible driving shaft is an anti-friction bearing **12** in which is journalled the trunnion-like end **13** of an inner out-of-balance element in the form of an unbalanced rotor or shaft **14**. Each end of the inner element has concentric cylindrical portions **15**, **16** on which is journalled an outer out-of-balance element **17**. As illustrated in Fig. 4, the element **17** comprises a sleeve-like member having a portion of its curved surface cut away at 17^x to render same out-of-balance relative to its mounting on and co-axially with the rotor **14**. Although the outer element **17** is shown as mounted on the inner element through the intermediary of bushes **18**, **18** of anti-friction metal, the bushes may be replaced by a ball or roller bearing. The end of the inner element **14** remote from the flexible driving shaft is provided with a trunnion 14^x journalled in an anti-friction bearing **19** located in the casing **10**. The outer element is connected to the trunnion **13** of the inner element by a torsion spring **20** which provides a flexible driving connection between the two elements, said spring being housed in a masking sleeve 20^x and embracing the trunnion, the latter having a reduced portion 13^x by which it is connected to the flexible driving shaft (not shown). Mechanical stops **20'**, **21** are mounted respectively on the inner and outer out-of-balance elements, such stops being 120° apart and limiting the relative angular movement between said elements.

During assembly of the two out-of-balance elements **14**, **17** they are so arranged and the stiffness of the spring so selected that when at rest or running under light load, the torsion spring will cause the outer element **17** to overlie the inner element **14** (see Fig. 5) so that the total unbalanced mass is at a maximum and therefore the amplitude of vibration generated will also be at maximum value. The spring will therefore ensure that the two elements

remain in their initial position imparting maximum vibration to the concrete mix during the early stages of compaction of the concrete mix, but as compacting progresses and the driving torque increases, the inherent resistance of the spring will be overcome and the inner element will take an angular lead over the outer element (see Fig. 6) which lead will gradually increase to a maximum, as illustrated in Fig. 7. As the out-of-balance elements now tend to balance each other, the amplitude of vibration will gradually decrease, thus keeping the power consumption of the vibrator fairly constant throughout the compacting operation, and also satisfying the conditions of (*a*) and (*b*) described above.

The stop means **20'**, **21** are embodied in the construction to prevent the lead between the two elements becoming greater than predetermined for efficient operation.

As illustrated in Figs. 8 and 9, the power unit may comprise an internal combustion engine **22**, which by means of a V-belt **23** drives a countershaft **24**, the gear ratio being so proportioned as to give a maximum shaft speed of approximately 10,000 R. P. M. The drive from the countershaft **24** to the vibrating unit **25** is by means of a flexible shaft **26**.

In an alternative construction (not illustrated), in order to comply with condition (*c*) in addition to (*a*) and (*b*), the out-of-balance elements are so arranged that when at rest one element has a lead over the other, and in addition a torsion spring is selected having two rates of loading.

In this latter arrangement, the initial amplitude of vibration is small, gradually building up to maximum as the elements approach a point where they coincide, and gradually decreasing as the elements again move angularly relative to each other as the mix becomes more compact and the torque increases. The torsional spring would, during the first 180° of relative movement between the two out-of-balance elements, give only a very light resistance, which would increase during the second 180° of relative movement. Thus, when running light or in air, the vibrating unit would have a small amplitude, but the application of a small load would cause the inner rotor to advance in relation to the outer one, so that on first immersing in the uncompacted concrete mix, the amplitude would increase rapidly to its maximum, and thereafter progressively decrease as previously described.

Similarly, on removing the vibrating unit from the concrete after compaction, vibration at the point of removal would be reduced and splashing avoided.

In a further modification, instead of using a single torsion spring having two rates of loading, two separate torsion springs may be used each having different rates of loading. In such case, in order that the first part of the movement raises the amplitude of vibration from minimum to maximum on insertion of the vibrating unit into the concrete mix, a spring of lighter loading is arranged to operate during such movement. As the concrete is compacted and the amplitude must be reduced, a stiffer torsion spring comes into operation. The two springs would be so selected and arranged, that minimum amplitude is reached at the point of highest power consumption, whilst the increase from minimum to maximum amplitude only requires a small increment of power consumption.

What I claim is:

1. A vibrating unit for an internal concrete vibrator comprising a casing in which two out-of-balance elements are mounted co-axially and annularly arranged so that they rotate concentrically one within the other, means for imparting rotary motion to the inner element, and a torsional spring interconnecting said elements and providing a resilient driving connection between said elements automatically to allow them to adjust themselves angularly relative to each other to vary the amplitude of vibration generated, the outer out-of-balance element being journalled on the inner out-of-balance element.

2. A vibrating unit for an internal concrete vibrator, comprising a casing in which is journalled an inner out-of-balance rotor element having concentric portions at each end thereof, means for imparting rotary motion to said rotor element, an outer sleeve-like out-of-balance element surrounding said inner element and journalled on the concentric portions thereof, said sleeve-like member having a portion of its curved surface cut away to render it out-of-balance relative to its mounting, and a torsional spring interconnecting said elements and providing a resilient driving connection therebetween to allow them automatically to adjust themselves angularly relatively to each other to vary the amplitude of vibration generated.

3. A vibrating unit according to claim 2, wherein the torsional spring is located on the inner element with one end attached to the inner element and the other end engaging the outer element, said elements having complementary abutments to limit their relative angular movement.

4. A vibrating unit for an internal concrete vibrator comprising a casing in which out-of-balance inner and outer elements are mounted coaxially and annularly arranged so that they rotate concentrically one within the other, means for imparting rotary motion to the inner element, and a torsional spring interconnecting said elements and providing a resilient driving connection between said elements to automatically allow them to adjust themselves angularly relative to each other to vary the amplitude of vibration generated, said outer out-of-balance element being journalled on the inner out-of-balance element.

5. A vibrating unit for internal concrete vibrator comprising a casing in which out-of-balance elements are rotatably mounted relatively co-axially so as to be angularly adjustable relative to each other, means for imparting rotary motion to one of said elements, and flexible means interconnecting said out-of-balance elements through which the drive imparted to the driven element is conveyed to the other element, said flexible means allowing relative angular movement between the elements to take place automatically to vary the amplitude of vibration generated as torque imparted to the driven element is varied.

6. A vibrating unit for an internal concrete vibrator comprising a casing in which two rotatable out-of-balance elements mounted relatively co-axially are annularly arranged so that they rotate concentrically one within the other, means for imparting rotary motion to one of said elements, and a torsional spring interconnecting said elements by which the drive imparted to the driven element is conveyed to the other element, said torsional spring allowing said elements automatically to adjust themselves angularly relative to one another to vary the amplitude of vibration generated as torque imparted to the driven element is varied.

7. A vibrating unit for an internal concrete vibrator comprising a casing in which is rotatably mounted an inner out-of-balance element having an outer out-of-balance element journalled thereon, means for imparting rotary motion to the inner element, and flexible means interconnecting said elements and providing a resilient driving connection therebetween to allow them automatically to adjust themselves angularly relative to each other to vary the amplitude of vibration generated.

8. A vibrating unit for an internal concrete vibrator comprising a casing in which is rotatably mounted an inner out-of-balance element having an outer out-of-balance element journalled thereon so that said elements rotate concentrically one within the other, means for imparting rotary motion to the inner element, a torsion spring interconnecting said elements and providing a driving connection between said elements to allow them automatically to adjust themselves angularly relative to each other to vary the amplitude of vibration generated as torque imparted to the driven element is varied.

9. A vibrating unit for an internal concrete vibrator

comprising, an elongated hollow casing, an elongated inner out-of-balance element in said casing having opposite ends rotatably mounted in said casing, means for imparting rotary motion to said inner element, an elongated outer out-of-balance element having opposite ends thereof journalled on opposite end portions of said inner element for rotary motion thereof relative to said inner element, and a torsional spring interconnecting corresponding end portions of said elements providing a resilient driving connection therebetween to automatically allow them to adjust themselves angularly relative to each other to vary the amplitude of the vibration generated thereby.

10. A vibrating unit for an internal concrete vibrator comprising, an elongated hollow casing, an elongated inner out-of-balance element in said casing having opposite ends rotatably mounted in said casing, means for imparting rotary motion to said inner element, an elongated outer out-of-balance element having opposite ends thereof journalled on opposite end portions of said inner element for rotary motion thereof relative to said inner element, and a torsional spring interconnecting corresponding end portions of said elements providing a resilient driving connection therebetween to automatically allow them to adjust themselves angularly relative to each other to vary the amplitude of the vibration generated thereby, and engageable stops carried by said elements to limit relative rotative movements thereof.

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