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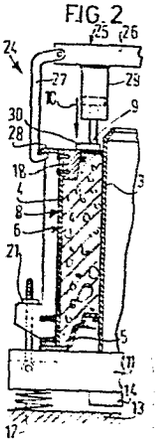
(54) Method, apparatus and mould for manufacturing concrete tubes.

(57) In a method of manufacturing concrete tubes (1) adapted to join one another by means of a sleeve-wedge joint, each time a tubular casting (8) is manufactured in a mould (2). Concrete mortar (7) having a high degree of moisture is densified in a mould cavity (6) by subjecting the mould (2) to vibrations. In order to densify the casting (8) at its top side unto a densifying degree, better corresponding to the densifying degree effected below in the casting, an upper mould part (9) is urged in axial direction of the mould cavity (6) unto its position bounding the mould cavity (6), whilst the mould (2) is subjected to vibrations.

FIG. 2



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Method, device and mould for the manufacture of concrete tubes.

The invention relates to a method of manufacturing concrete tubes of angular cross-section adapted to join one another by means of a sleeve-wedge joint, the tube being manufactured in the following steps:

A) assembling a mould comprising a core, a jacket and a bottom, said core, jacket and bottom bounding a mould cavity;
B) filling the mould cavity with concrete mortar and
C) densifying the concrete mortar to a casting, the mould being subjected to vibrations.

The tubes manufactured by said known method appear to be less strong on their top side than on their bottom side. Therefore, the concrete quality and hence the percentage of binder to be employed have to be chosen so that the top ends of the tubes are sufficiently strong, whereas the lower ends are stronger than is required.

The invention has for its object to reduce the difference in tube strength between top and bottom. For this purpose in step C) an upper mould part is pressed in the axial direction of the mould cavity into the position bounding

the mould cavity, whilst the mould is subjected to vibrations.

In this way the density obtained above and below in the mould cavity is more uniform because the lower static pressure prevailing below in the mould cavity is compensated by the pressing force of the top mould part, said pressing force having greater effect above in the mould cavity and gradually less further down in the mould cavity.

Preferably the upper mould part, which is pressed home during step C) is narrower than the wall thickness of the tube.

Particularly, when the mould is filled with concrete mortar up to an upper rim and subsequently an upper mould part narrower than the wall thickness of the pipe is pressed into its position bounding the mould cavity, the degree of filling can be better adjusted to be desired value, whilst the final, predetermined, preferred pressure force can be more readily obtained.

The invention relates to a method of manufacturing concrete tubes, each having a plurality of longitudinal channels in the tube wall, each tube being obtained in the following steps:

A) assembling a mould comprising a core, a jacket, at least one upper mould part, a bottom and recessing elements extending between the bottom mould part and the bottom, said core, jacket and bottom bounding a mould cavity accomodating the recessing elements;

B) filling the mould cavity with the concrete mortar and

C) densifying the concrete mortar.

In the known method the recessing elements are formed by lost casing elements, for example, of synthetic resin. These elements are expensive and can be positioned only with difficulty. The invention provides an improvement of the method in this respect. Herein during the consolidation of the concrete mortar the recessing elements are each resiliently supported between the bottom and the upper mould part.

The invention furthermore provides an improved me-

thod of removing a casting out of the mould with reduced risk of damage. According to the invention the jacket is removed from the casting by moving it upwards with respect to the casting, which is urged downwards during the first part of said relative movement by means of a pressing rim matching the top edge of the casting.

When during the curing period the casting is supported in a horizontal direction by means of a supporting rim covering the casting and having a side, preferably an inner and outer side supporting the casting in a horizontal sense, the supporting rim highly improves the deformation resistance of the casting. Preferably this supporting rim is arranged on the mould for transport to the curing space.

The invention furthermore provides a device and mould defined in the claims for carrying out the method embodying the invention.

The aforesaid and further features of the invention will be described more fully hereinafter with reference to a drawing. The drawing schematically shows in:

Figures 1 to 6 vertical sectional views each of a fraction of a mould embodying the invention for the manufacture of concrete tubes in successive stages of the method in accordance with the invention, whilst a device embodying the invention is employed,

Figure 7 a plan view of a tube to be manufactured in accordance with the invention,

Figure 8 a vertical sectional view of the mould of Figures 1 to 6 taken on the line A-A in Figure 6 of the tube,

Figures 9 and 10 a different device and a different mould embodying the invention in two consecutive stages of the method in accordance with the invention and

Figure 11 on an enlarged scale detail XI of a casting of Figure 10 in a further stage of the method embodying the invention.

Referring to Figure 1, a vibrating table 11 provided with vibrators 14 bears through springs 12 on a floor 13. On the vibratory table 11 first a mould 2 is assembled, a core 3 of which is fastened by means of a flange 15 and bolts

16 to the vibratory table 11. Around said core is put a bottom 5, which joins the core 3 by means of a sealing ring 17 and which has at the top the configuration of a tube sleeve. Previously the required reinforcing elements (not shown) and the jacket 4 are arranged on the bottom 5. At the top end the jacket 4 has a top ring rigidly secured thereto by means of bolts 19 and forming an outer mould part 18 and having a downwardly converging shape. The jacket 4 is secured by means of high bolts 20 and nuts 21 to the vibratory table 11, whilst a flange 22 of the bottom 5 is clamped between. In the method embodying the invention the mould 2 is assembled in this way in the first step A), the core 3, the bottom 5, the jacket 4 and the top ring 18 thus bounding a mould cavity 6 corresponding to the configuration of an angular tube 1 shown in Figure 7.

In the next step B) this mould 2 is filled with concrete mortar 7 up to the top edge 3, said mortar having a high degree of moisture.

In the following step C) the concrete mortar 7 is densified to form a casting 8, whilst the mould 2 is subjected to vibrations by means of the vibrators 14 and an upper mould part 9 is urged by means of pressing means 25 in an axial direction of the mould cavity 6 in the direction of the arrow 10 into its position bounding the mould cavity 6 as is illustrated in Figure 2. The top ring 18 and the upper mould part 9 having a width g smaller than the wall thickness f of the tube 1 define in common the configuration of the wedge of the tube 1 so that identical tubes 1 having the conventional sleeve-wedge joint can join one another with the interposition of an elastic sealing ring to form a continuous pipeline.

The inner upper mould part 9 has a downwardly converging inner side 42 to form a bevelled top rim 43 of the casting 84.

The device 24 for manufacturing tubes 1 by the method according to the invention is provided, apart from the mould 2, with pressing means 25 consisting, as shown in Figure 2, of a pressing frame 26 to which traction means formed

by pivotable hooks 27 are suspended, said means gripping around the edges 28 of the jacket 4 and having fastened to them hydraulic rams 29, the feet 30 of which upon energization of the rams 29 press downwards the upper mould part 9 arranged around the core 3 until they come into contact with the top ring 18. Thus, in particular, the top zone of the concrete mortar 7 is densified so that the densification thereof corresponds more with the satisfactory densification below in the mould 2 enhanced by the higher hydrostatic pressure. The mould 2 may be vibrated already during step B).

Figure 8 shows that the mould 2 may comprise a plurality of recessing elements 31 for the formation of tensioning channels 32 (Figure 7). These recessing elements 31 extend between an outer upper mould part formed by the top ring 18 and the bottom 5. Each of them bears by means of an annular lower rim 33 on a conical supporting element 34 of the bottom 5. Each recessing element 31 is supported by spring means 35 on the top ring 18 since at the top end each of them has a shoulder 36 and a screwthreaded end 37 surrounded by pressurized helical spring 38 bearing on a stop plate 39 fastened to the top ring 18. By means of a nut 40 the recessing element 31 formed by a downwardly converging pin is loosely suspended to the top ring 18. Above the shoulder 36 this pin is closed by means of sealing rings 41 and slidably arranged in a lubricant containing chamber 62. In a simple manner the tensioning channels 32 can thus be recessed without additional manipulations.

Figure 3 to 5 illustrate the successive manipulations for removing the core 3 and the jacket 4 from the casting 8 (Figure 6) during step D). Figure 3 shows the removal of the core 3. By lifting means 45 comprising a lifting frame 46 with pivotable hooks 47 and hydraulic rams 48 the casting 8 is lifted from the core 3 whilst the pivotable hooks 47, the bolts 20 being loosened, grip below the bottom 5 and the pressing rods 49 of the rams 48 exert heavy pressure on the upper mould part 9. The casting 8 free of the core 3 is put down, as shown in Figure 4, with its bottom 5 on a floor 50 of a steam chamber. Then the pivotable hooks 47 are hooked

below a collar 51 of the jacket 4 and the jacket 4 together with the outer upper mould part 18 is removed from the casting 8 by drawing it upwards with respect to the casting 8 with the aid of the hooks 47, whilst during the first part of this relative movement the casting 8 is subjected to downward pressure via a pressing ring matching the top edge 52 of the casting 8 and formed in this case preferably by the upper mould part 9. When the first part of this relative movement is performed and the jacket 4 smoothly slides along the casting 8, pressure need no longer be exerted so that the pressing rods 49 disengage the upper mould part 9. The casting 8 is left on the floor 50 of the steam chamber as is shown in Figure 6. The upper rim 43 remains satisfactorily supported in a radial direction by means of the upper mould part 9, which covers, like a supporting rim, the casting 8 and supports the upper rim 43 of the casting 8 by means of an inner side 42 and an outer side 54.

In order to restrict the number of solid, expensive mould parts 9 in the case of series production of tubes 1 they are preferably replaced after the stage illustrated in Figure 6 by less expensive rings 55, an example of which is shown in Figure 11. The casting 8 thus supported is little susceptible of deforming during the subsequent step E) of steam curing the casting 8, in which additional moisture from the steam chamber is imparted to the fairly dry concrete mortar 7.

Figures 9 and 10 show how with the aid of a different lifting device 56 an integral upper mould part 57 is urged into its position bounding the mould cavity. Pivotable hooks 58 grip below the bottom 5 and whilst turning, each hook 58 engages an angle lever 59, which is energized by a hydraulic ram 60. The angle lever 59 and the pivotable hooks 58 are proportioned and the angle lever 59 is journalled on a pressure frame 61 so that upon energization of the ram 60 the upper mould part 57 rigidly connected with the pressure frame 61 is pressed into its position bounding the mould cavity. Then by means of lifting members (not shown) the pressure frame 61 together with the mould parts 4, 5 and 57 can be

lifted from the core 3.

Referring to Figure 11 the ring 55 has a configuration matching the casting 8 of Figures 9 and 10 i.e. the upper mould part 57.

CLAIMS

1. A method of manufacturing concrete tubes (1) of angular cross-section adapting to join one another by a sleeve-wedge joint, each tube being manufactured in the following steps:

A) assembling a mould (2) comprising a core (3), a jacket (4)and a bottom (5), said core (3), jacket (4) and bottom (5) bounding a mould cavity,

B) filling the mould cavity (6) with concrete mortar (7) and

C) densifying the concrete mortar (7) to a casting (8) whilst the mould (2) is subjected to vibrations ;

characterized in that during step C) an upper mould part (9) is urged in the axial direction of the mould cavity (6) into its position bounding the mould cavity (6), whilst the mould (2) is subjected to vibrations.

2. A method as claimed in claim 1, characterized in that the upper mould part (9) urged into its position during step C) is narrower than the thickness (f) of the wall of the tube (1).

3. A method as claimed in claim 2, characterized in that the mould (2) is filled with concrete mortar (7) up to

the top edge (23) and subsequently an upper mould part (9) being narrower than the wall thickness (f) of the tube (1) is pressed into its position bounding the mould cavity (6).

4. A method of manufacturing concrete tubes (1), each having in a wall a plurality of longitudinal channels (32), each tube being manufactured in the following steps:
A) assembling a mould (2) comprising a core (3), a jacket (4), at least one upper mould part (18), a bottom (5) and recessing elements (31) extending between the upper mould part (18) and the bottom (5), said core (3), jacket (4) and bottom (5) bounding a mould cavity (6) accomodating the recessing elements (31),
B) filling the mould cavity (2) with concrete mortar (7), and
C) densifying the concrete mortar (7);
characterized in that during the consolidation of the concrete mortar (7) the recessing elements (31) are each resiliently supported between the bottom (5) and the upper mould part (18).

5. A method of manufacturing concrete tubes (1) adapted to join one another by a sleeve-wedge joint, each tube (1) being manufactured in the following steps:
A) assembling a mould (2) comprising a core (3), a jacket (4), a bottom (5) and at least one upper mould part (9), said core (3), jacket (4), bottom (5) and upper mould part (9) bounding a mould cavity (6),
B) filling the mould cavity (6) with concrete mortar (7),
C) densifying the concrete mortar (7) for manufacturing a casting (8),
D) removing the core (3) and the jacket (4) from the casting (8) and
E) curing of the casting (8);
characterized in that during step D) the jacket (4) is removed from the casting (8) by moving it upwards with respect to the casting (8), whilst during the first part of this relative movement the casting (8) is subjected to downward pressure through a pressure ring (9) matching the upper rim (52) of the casting (8).

6. A method as claimed in claim 5, characterized in

that in step D) a downward pressure is exerted on the casting (8) by means of a pressing rim (9), which is narrower than the wall thickness (f) of the casting (8), whilst an upper mould part (18) together with the jacket (4) is removed from the casting (8).

7. A method as claimed in anyone of the preceding claims, characterized in that during curing of the casting (8) the casting is supported in a horizontal direction by means of a supporting rim (55) covering the casting (8) and having at least one side supporting the casting (8) in a horizontal direction, preferably an inner side (42) and an outer side (54).

8. A device (24) for the manufacture of concrete tubes (1) of angular cross-section, said device (24) comprising at least one mould (2) and vibrating means (14) causing the mould (2) to vibrate, said mould (2) comprising a core (3), a jacket (4), a bottom (5) and at least one upper mould part (9) bounding a mould cavity (6), characterized by pressing means (25) urging the upper mould part (9) into its position bounding the mould cavity (6).

9. A device (24) as claimed in claim 8 characterized in that the pressing means (25) comprise a pressure frame (26), which urges downwards the upper mould part (9) through energizing means (29) and which engages a further mould part (4) through traction means (27).

10. A device (24) as claimed in claim 9 characterized in that the traction means (27) engage the jacket (4).

11. A mould (2) for the manufacture of concrete tubes (1) having each in a tube wall a plurality of longitudinal channels (31), said mould (2) comprising a core (3), a jacket (4), a bottom (5), at least one upper mould part (18) and the bottom (5), said core (3), jacket (4), bottom (5) and upper mould part (18) bounding a mould cavity (6), characterized in that the recessing elements (31) bear by spring means (35) on the upper mould part (18) and the bottom (5).

12. A mould (2) as claimed in claim 11, characterized in that the recessing elements (31) each bear by means of an annular lower rim (33) on a conical supporting element

(34) of the bottom (5).

13. A mould (2) as claimed in claim 11 or 12 characterized in that each recessing element (31) is slidably arranged by means of sealing means (41) in sealing relationship in the upper mould part (18).

14. A mould (2) as claimed in claim 13, characterized in that the sealing means (41) seal the mould cavity (6) with respect to an oil-containing chamber (62).

15. A mould (2) as claimed in anyone of claims 11 to 14 characterized in that the recessing elements (31) are formed by conical pins.

16. A mould (2) as claimed in anyone of claims 11 to 15, characterized in that the mould cavity (6) of the mould (2) is bounded on the top side by an outer upper mould part (18) and an inner mould part (9) fastened to the jacket (4) and located inside the latter respectively, the inner part (9) being displaceable in an axial direction with respect to the outer mould part (18).

17. A mould (2) as claimed in claim 16, characterized in that the outer upper mould part (18) has a downwardly converging shape.

18. A mould (2) as claimed in anyone of the claims 11 to 17, characterized in that the inner mould part (9) has a downwardly converging inner side (42).

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AMENDED
CLAIMS

CLAIMS 1 and 8

1. A method of manufacturing concrete tubes (1) adapted to join one another by a sleeve-wedge joint, each tube being manufactured in the following steps:
A) assembling a mould (2) comprising a core (3), a jacket (4) and a bottom (5), said core (3), jacket (4) and bottom (5) bounding a mould cavity,
B) filling the mould cavity (6) with concrete mortar (7) and
C) densifying the concrete mortar (7) to a casting (8) whilst the mould (2) is subjected to vibrations and whilst an upper mould part (9) is urged in the axial direction of the mould cavity (6) into its position bounding the mould cavity (6), characterised in that during step C) the inner upper edge of the casting is additionally densified by means of a downwardly converging inner edge side (42) of the upper mould part (9).

8. A device (24) for the manufacture of concrete tubes (1), said device (24) comprising at least one mould (2) and vibrating means (14) causing the mould (2) to vibrate, said mould (2) comprising a core (3), a jacket (4), a bottom (5), at least one upper mould part (9) bounding a mould cavity (6) and pressing means (25) urging the upper mould part (9) into its position bounding the mould cavity (6), characterized in that the upper mould part (9) has a downwardly converging inner edge side (42).

"1/2"

FIG.1

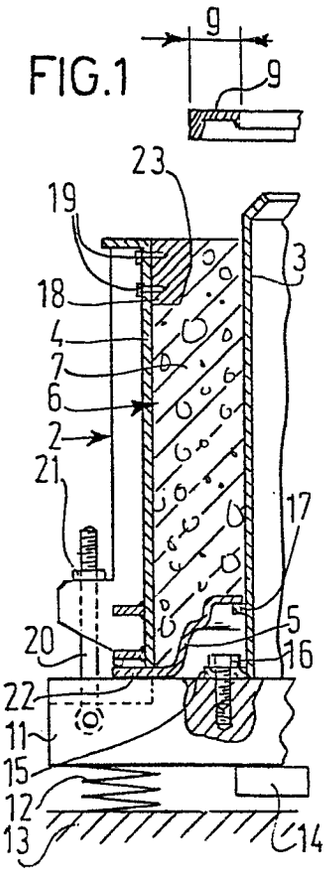


FIG. 2

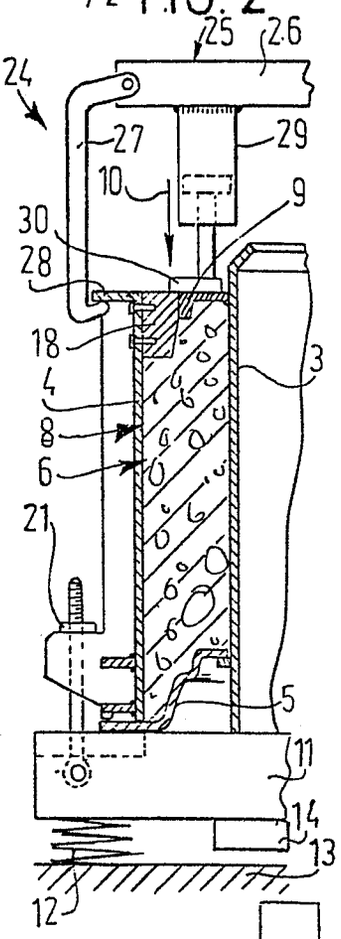
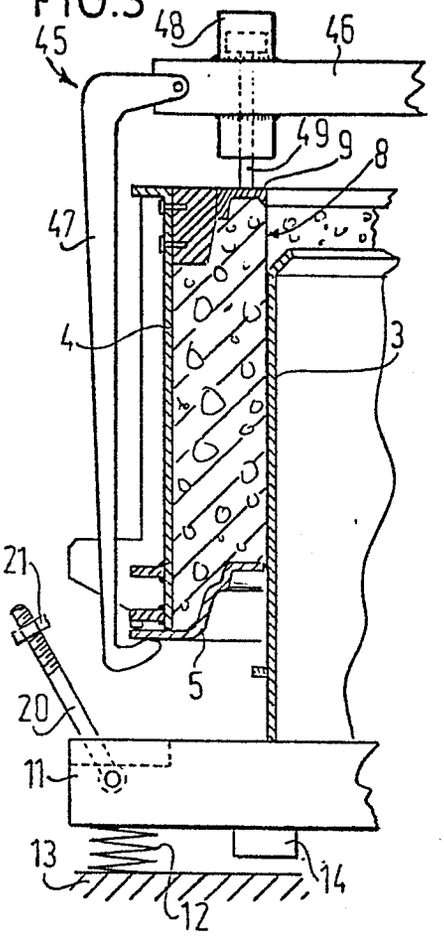


FIG.3



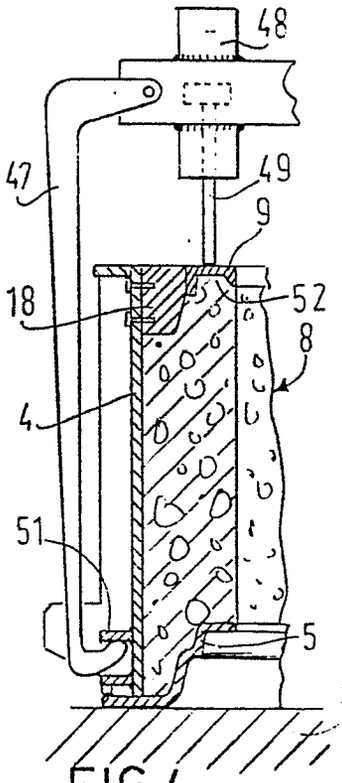


FIG.4

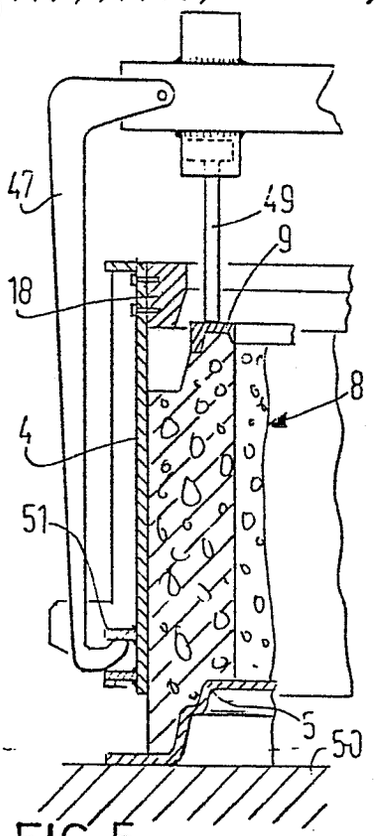


FIG.5

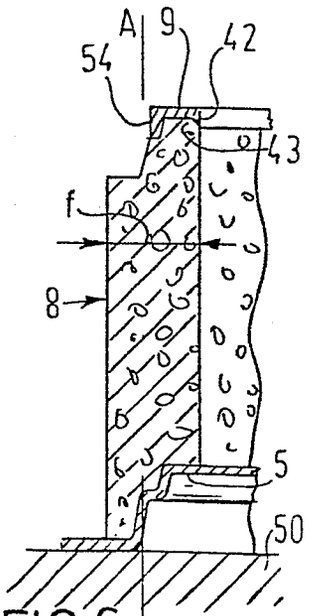


FIG.6

FIG.8

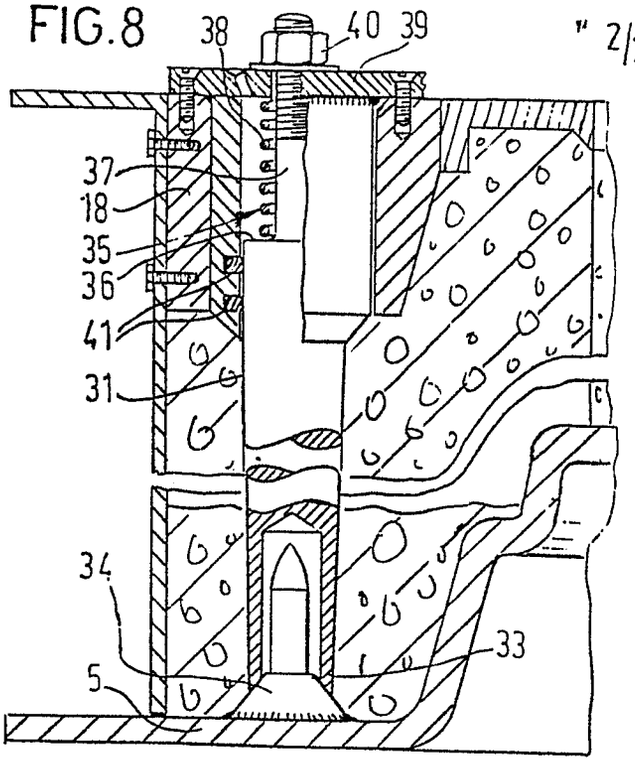


FIG.11

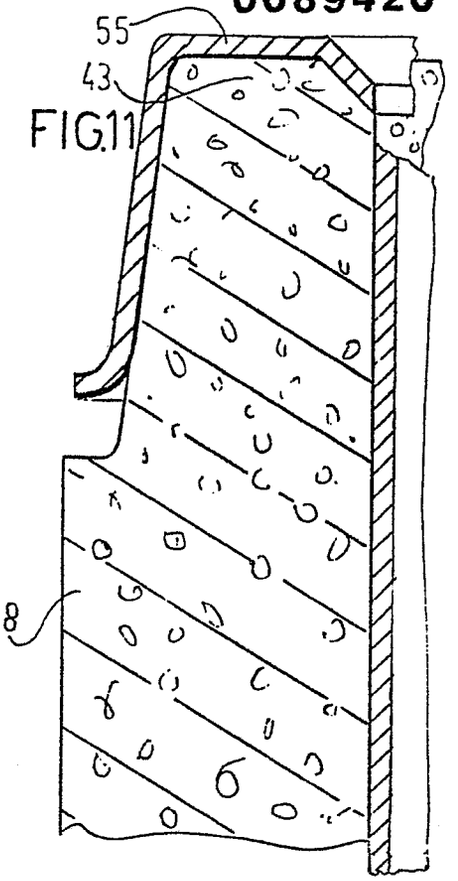


FIG.9

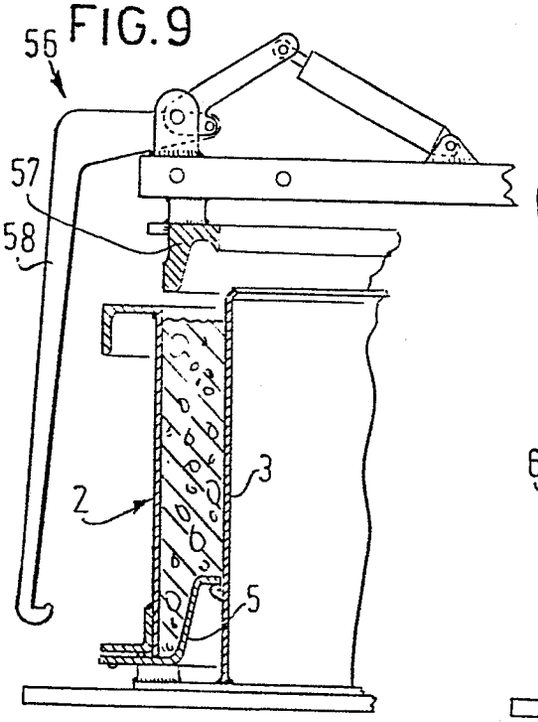
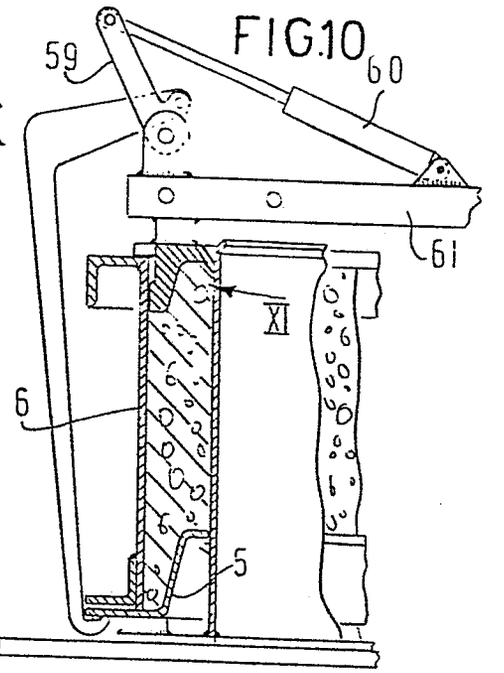


FIG.10



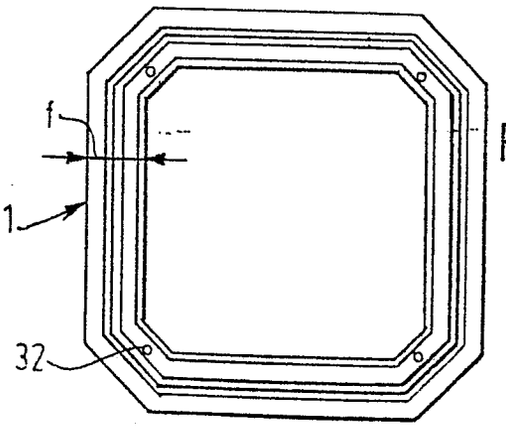


FIG. 7

European Patent Office

EUROPEAN SEARCH REPORT

0089420
Application number

EP 82 20 0354

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	GB - A - 2 061 178 (AB SKANSKA CEMENTGJUTERIET) * page 3, lines 39-103; figure 2 *	1-3,16	B 28 B 21/10 21/86 21/90 21/76
X	GB - A - 1 037 564 (J. DAVRON) * page 2, lines 63-99; figures 1,2 *	1,5,8	
X	US - A - 2 823 439 (H.H. SCHMID-GALL) * the whole document *	1,5,8	
X	US - A - 3 584 356 (C.R. JOELSON) * column 7, lines 23-50; figures 10,12,13 *	1,5,8	TECHNICAL FIELDS SEARCHED (Int. Cl. ³) B 28 B B 29 C
X	GB - A - 910 067 (H. WACKER) * the whole document *	1,8-10	
X	DE - C - 815 171 (K.B. JIDELL) * the whole document *	1,8	

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~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
The Hague	16-02-1983	BOLLEN

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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European Patent Office

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid,

namely claims:

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

X LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions,

namely:

1. claims 1-3,5,6,8-10,16-18: densifying concrete in a mould for tubes and removing the tube by exerting a downward pressure on an upper mould part.
2. claims 4,11-15: recessing elements for longitudinal channels in a concrete tube.
3. claim 7: rim supporting a tube during curing.

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☒ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid,

namely claims: 1-6,8-18

☐ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims,

namely claims:

European Patent Office

EUROPEAN SEARCH REPORT

0089420
Application number

EP 82 20 0354

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	US - A - 2 602 979 (M. VAN BUREN) * the whole document *	4,11	
A	FR - A - 538 726 (CALICE & AUBIN) * the whole document *	4,11	
			TECHNICAL FIELDS SEARCHED (Int. Cl.³)