June 8, 1971 W. DICKINSON ET AL 3,583,046

MANUFACTURE OF STRUCTURAL MEMBERS

Filed Nov. 7, 1968

3 Sheets-Sheet 1

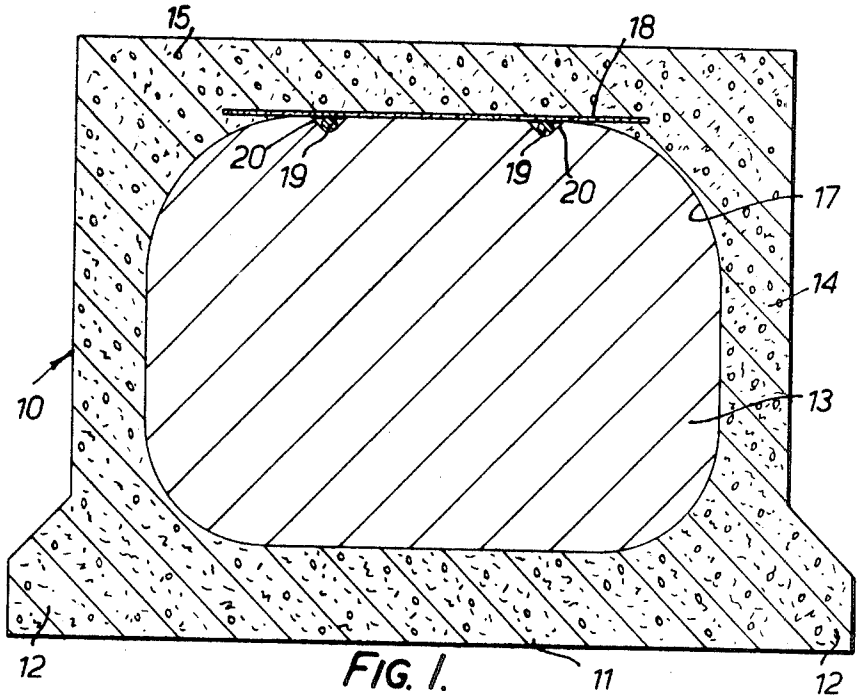

FIG. 1.

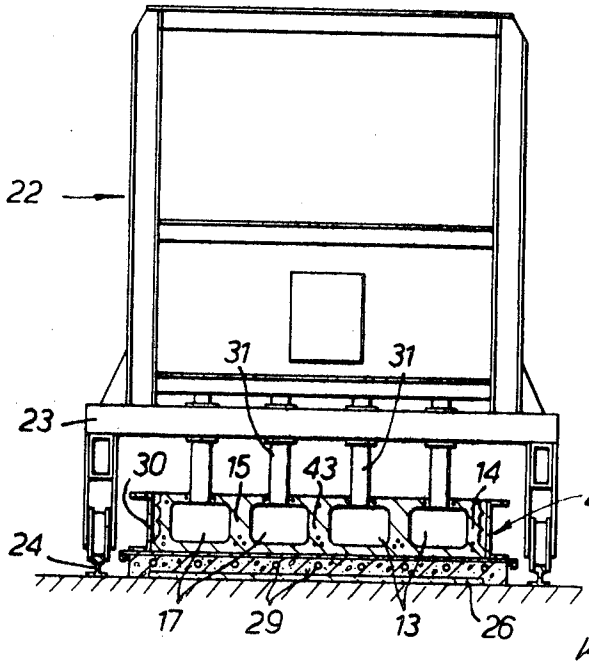

FIG. 4.

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3 Sheets-Sheet 2

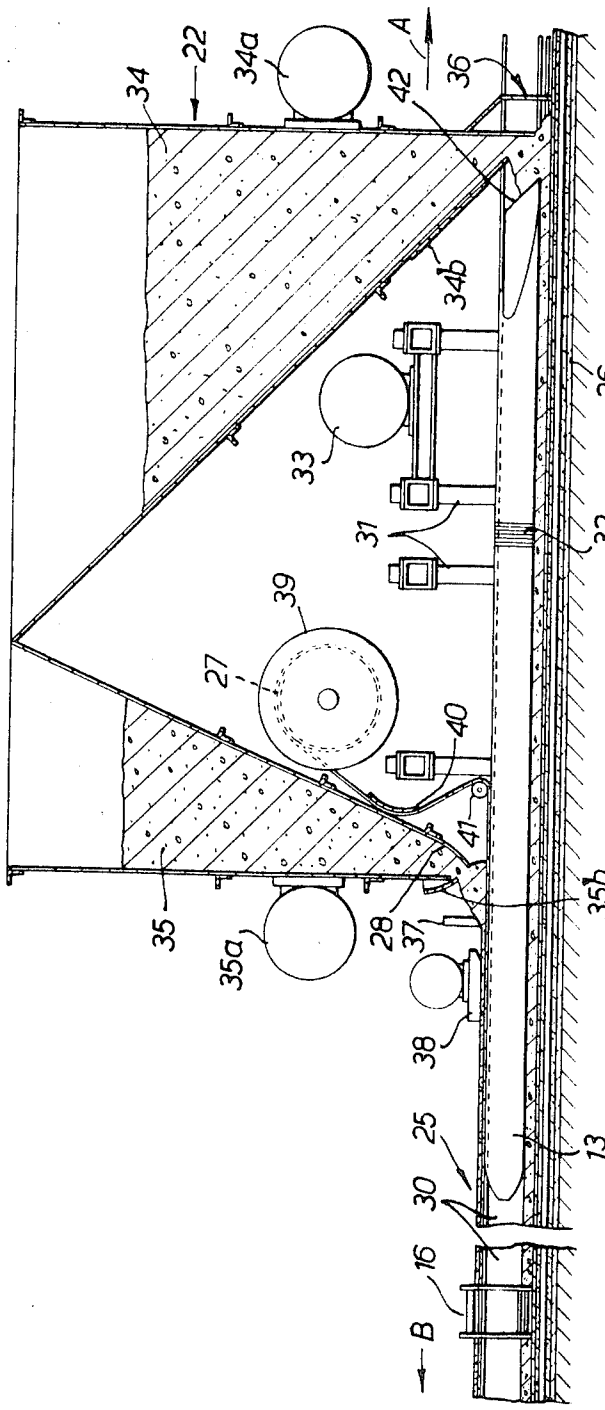

FIG. 2.

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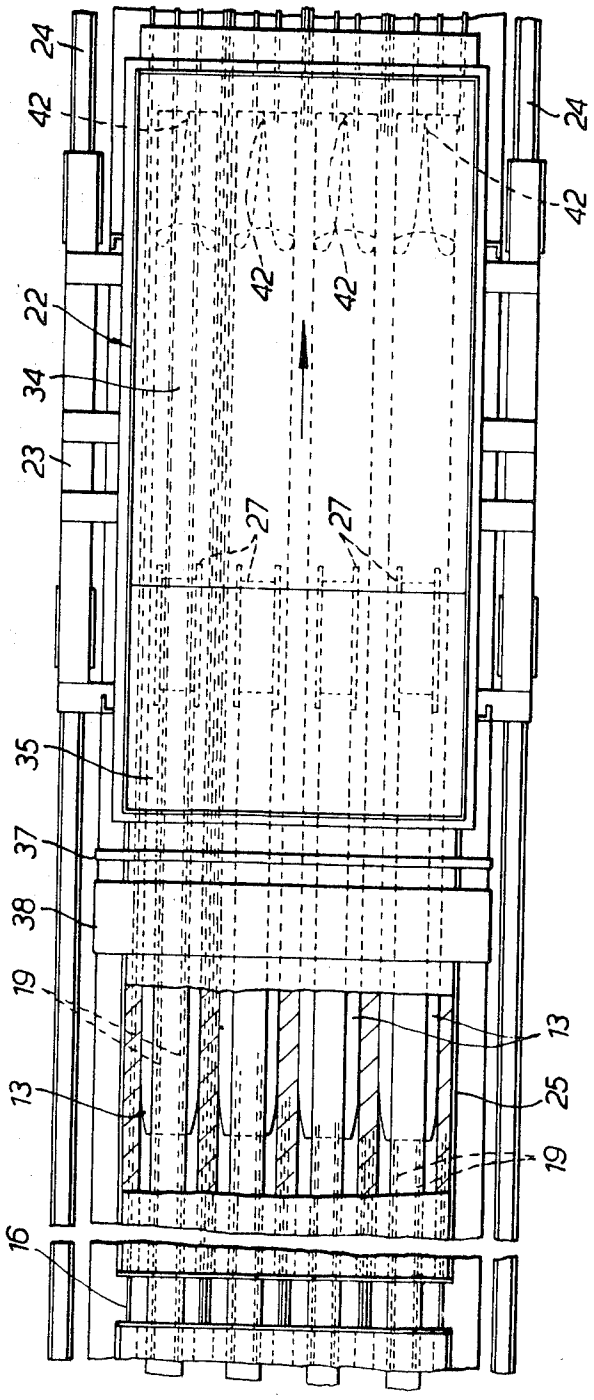

FIG. 3.

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MANUFACTURE OF STRUCTURAL MEMBERS

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U.S. Cl. 25—41R 5 Claims

ABSTRACT OF THE DISCLOSURE

Means for producing hollow structural element which includes positioning a strip of non-structural sheet material on stressed wires above a core or cores which are drawn through settable material such as concrete, previously fed into a mould, the stressed wires and strip of sheet material supporting the upper wall of the settable material whilst it is setting.

This invention relates to methods of and apparatus for making structural members, in particular hollow section beams and decking sections of concrete.

In the manufacture of long hollow section beams, or of hollow decking sections having internal webs separating elongated voids, it is conventional to employ collapsible or otherwise removable cores which support the top concrete surface during setting to form the voids. However, this procedure is slow, since the concrete must be left to set for a considerable time before it is safe to remove the cores. The beams are normally used in combinations of single-, double- and quadruple widths to span, and provide a decking between the frame members of a building.

In order to reduce the cost of such a beam, it is necessary to reduce to a minimum, consistent with providing the necessary strength, the amount of concrete used, and also to reduce the time and labour in manufacture.

According to the invention, there is provided a method of making a hollow structural member, comprising the steps of forming a layer of settable material on the bed of a mould, positioning a core or cores above said layer of material, supporting a non-structural strip of sheet material on stressed metal wires positioned above the upper surface of said core or each of said cores and extending longitudinally thereof, pouring settable material into said mould to cover the top and sides of said core or cores and the sheet material positioned thereabove, moving said core or cores relative to said mould to draw said core or cores through the settable material to form a void or voids in the structural member formed thereby whilst leaving the strip or strips of sheet material in position to support the upper wall of said structural member while the settable material is setting.

The invention also includes an apparatus for making a hollow structural member by the above defined method, said apparatus comprising a mould, one or more cores arranged to be positioned above the bed of said mould and movable relative to said mould in a direction parallel to and longitudinally of said mould, means for forming a layer of settable material on the bed of the mould, stressed metal wires positioned above said core or cores and extending longitudinally thereof to support a strip of sheet material above the top surface of said core or each of said cores, and means for feeding a settable material into said mould around said core or cores after the layer of material has been formed on the bed of the mould and after the strip of material has been positioned on said stressed metal wires above said core or cores.

The invention will now be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a cross-section of a single-width, prestressed concrete beam or decking section of hollow section made in accordance with the invention;

FIG. 2 is a part sectional side elevation of an apparatus for making the beam or decking section shown in FIG. 1;

FIG. 3 is a plan view of FIG. 2; and

FIG. 4 is a sectional view on the line II—II in FIG. 2.

FIG. 1 shows a more or less conventionally shaped beam or part of a decking section **10** which is manufactured to a width modulus of 12", is of any desired length and formed from a settable material such as concrete. The beam **10** has a base **11**, base flanges **12**, a longitudinal void whose outline is shown at **17**, side walls **14** and a top wall **15**. The void is made as large as possible consistent with providing a beam of adequate strength and is defined about a rigid core **13** as hereinafter more fully described. During the manufacture of the beam the top wall **15** is supported, during setting of the concrete, by a continuous strip of sheet material **18**, such as waterproof kraft paper, which may be obtained as an industrial by-product and is thus extremely cheap, said strip of sheet material being itself supported by stressed metal wires **19** positioned in longitudinal grooves **20** in the upper surface of the core **13**.

Referring now to FIGS. 2, 3 and 4 there is shown apparatus for making beams or decking sections as above described in continuous lengths of, for example, 200 ft. The apparatus shown is in fact for producing a concrete decking section having four voids, rather than a beam having a single void. Basically the apparatus comprises a two-part hopper **22** mounted on a wheeled carriage **23** which moves on rails **24** above a concreting bed of a mould **25**. The bed has heating pipes **29** below it, with insulation **26** below said pipes. The carriage **23**, which is preferably electrically driven, also supports a number (in this case four) of steel cores **13** which project about 12'6" behind the carriage relative to its direction of travel (indicated by the arrow A in FIG. 2). The cores **13** are rigid and provide temporary support for the top wall **15** of the beam or decking section while being steadily and continuously pulled by the carriage **23** in a direction parallel to and longitudinally of the mould through the concrete in the mould, the said cores being supported above the bed **25** of the mould by a distance corresponding to the thickness of the lower wall **11** of the beam or decking section being formed.

The carriage also carries rolls **27** of the sheet material **18** as described above, one above each core **13**. These rolls unreel, as the carriage moves, to feed the strips onto the top surface of the cores **26** in advance of a main chute **28** of chamber **34** from which concrete flows from the hopper **22** on top of the strip of sheet material **18**. One end of each of the roles **27** is fixed at the left hand end of the concreting bed of mould **25**. A conventional vibrator **38** follows the carriage to compact the concrete from above.

Side shuttering **30** is provided to form the longitudinal side walls of the mould and stop ends **16**, comprising sheet metal members, are provided to form the end walls of the mould and several such stop ends may be provided intermediate the ends of the mould to divide the 200 ft. length into shorter sections by insertion of such stop ends at the appropriate positions, transversely of the mould. The stop ends must be of the correct shape to interrupt the concrete over substantially the whole cross-section of the concrete beam and will be inserted behind the roll **27**, so as not to interrupt the cardboard strips, but in front of the point where the concrete actually falls from the chamber **34** of the hopper. This may require that the stop

ends be in two parts with one above the cores **13** and another below.

Extending longitudinally of the mould stressed metal wires **19** are positioned in longitudinal grooves **20** formed in the upper surface of each core **13** and connected to each end of the mould. In order to prevent the stressed wires **19** from sagging where they are not supported by the cores **13**, electromagnets may be positioned above the mould at suitably spaced intervals longitudinally thereof.

The cores **13** are supported on the carriage **23** by supporting legs **31** and each core **13** may be formed in two parts connected by a damper **32** with a vibrator **33** acting through the supports **31** on that part of the core in advance of the damper **32** considered in the direction of travel of the cores.

The hopper **22** is formed in two parts, that is it is provided with first and second chambers **34** and **35**. The first hopper chamber **34** feeds a layer of concrete mix onto the bed of the mould in front of the advancing cores **13** prior to the sheet material **18** being laid on top of the rear ends of the cores **13** whilst the second hopper chamber **35** feeds the concrete mix into the top of the mould after the sheet material is laid on top of the rear ends of the cores. Adjacent to the outlet of the chamber **34** there is a baffle **36** for preventing liquid concrete from flowing too far in advance of the cores **13**. Adjacent to the outlet of the hopper chamber **35** is a levelling screed **37** for levelling the concrete feed into the top of the mould and behind said levelling screed **37** is a vibrator screed **38** for consolidating the concrete in the top of the mould. On the housing of each of the hopper chambers **34** and **35** is mounted conventional vibrators **34***a* and **35***a* respectively for facilitating the flow of concrete from the hopper chambers.

Within the hopper housing a drum **39** is rotatably mounted above each of the cores **13**, said drum carrying a roll of kraft paper or other suitable sheet material which passes over a guide plate **40** and under a guide roller **41** and extends above the core **13**, the free end of the strip of sheet material being suitably attached to the rear end of the mould.

In operation the hopper chambers **34** and **35** are filled with a suitable concrete mix and the carriage **23** carrying the hopper **22** and cores **13** is moved to the rear end B of the mould. The free end of the roll **27** of sheet material is then attached to the rear end of the mould. Valve means **34***b* and **35***b* at the outlets of the hopper chambers **34** and **35** respectively are then opened to permit concrete mix to flow out of said outlets and the various vibrator means **35***a*, **38**, **33** and **34***a* set into operation and the carriage **23** is driven towards the forward end of the mould, i.e. in the direction of arrow A. During the travel of the carriage the sheet material is wound off the rolls **27** and laid on top of the stressed wires **19** above the cores **13** and concrete mix is fed through the outlet at the lower end of hopper chamber **34** into the mould **25** to form a layer of concrete (subsequently to form the bottom wall of the concrete beam or decking section) on the bed of the mould and partly between the side walls **30** and the sides of the cores **13**. In order to assist in distribution of the concrete mix the front end of each core is provided with a plough share device indicated at **42**, said device being so shaped as to guide the concrete mix below the core and at least partly between the side walls of the cores and the side wall of the mould. During this operation the front parts of the cores, that is the parts in advance of the dampers **32**, are vibrated by the vibrator **33** to consolidate the concrete in the bottom of the mould. As the carriage and with it the cores **13** advance concrete mix is fed from the hopper chamber **35** into the top of the mould on top of the sheet material, previously positioned on top of the cores **13** and the sheet material and between the cores and side walls **30** of the mould, thereby forming the side walls **14**, webs **43** and top wall **15** (FIG. 4) of the beam or decking section.

As carriage **23** with the cores **13** advance the cores are continuously withdrawn through the concrete filled into the mould thereby forming the voids **17** in the beam or decking section. When the cores **13** have thus been withdrawn the top wall of the beam or decking section is supported by the strips of sheet material which are themselves held in position by the stressed wires **19**. Thus by means of the present invention the output of concrete beams and decking sections per time unit is considerably increased since it is unnecessary to keep the cores in position while the concrete sets. Furthermore, relatively long beams and decking sections can be produced with relatively short cores.

In order further to increase the speed of setting of the concrete, various heating means can be applied other than those described above, for example, the cores **13** can themselves be heated or the concrete may be heated in the hopper **22**, or the top surface of the cast beam or decking section may be heated by radiant heat from above. Further, to assure success with this kind of continuous casting it is advantageous to employ high quality concrete mix of consistent constitution. This avoids uneven setting which gives rise to uneven pre-stressing of the finished concrete member. It also ensures that the member is generally of the highest quality.

It must be understood that means may be provided for adjusting the height of the cores **13** above the bed of the mould, for example the cores may be supported on the carriage **23** by threaded rods rotatable in threaded collars fixed in the carriage. Alternatively, the supports **31** (FIG. 4) may be slidably mounted in the carriage **23** with means, such as lock nuts, for fixing them in any adjusted vertical position.

It will also be understood that the invention is not limited to the particular embodiment herein described but may be modified in various ways without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. Apparatus for manufacturing a hollow structural member, comprising:

a horizontal open-topped mold (**25**) having bottom and opposed longitudinal side walls;

core means including at least one horizontal core (**13**) arranged longitudinally within and spaced from the walls of said mold;

stationary stressed wire means (**19**) extending longitudinally of said mold immediately above said core;

means (**39, 40, 41**) for depositing a horizontal strip of sheet material longitudinally of the mold in supported relationship on said wire means;

carriage means (**23**) for transporting said core longitudinally of said mold in a given first direction relative to said stressed wire means and said horizontal strip; and

hopper means (**22**) carried by said carriage means for depositing settable material in said mold around said core, said hopper means including a first chamber (**34**) arranged adjacent the forward end of the carriage for depositing the settable material onto the bottom wall of the mold in advance of said core, and a second chamber (**35**) arranged rearwardly of said first chamber for depositing settable material onto said strip material and into the lateral spaces in said mold between said mold side walls and said core, whereby during longitudinal travel of said carriage means relative to the mold, settable material is deposited in the mold completely around said core.

2. Apparatus as defined in claim **1**, wherein said carriage means includes means for vertically adjusting the height of said core relative to the bottom wall of said mold.

3. Apparatus as defined in claim **1**, and further wherein said core has at its forward end a plow-shaped configuration.

4. Apparatus as defined in claim 1, and further including means for heating the material to enhance the setting thereof.

5. Apparatus as defined in claim 1, wherein said core means includes a plurality of generally coplanar longitudinally extending horizontal cores arranged in laterally spaced relation within said mold; wherein said stressed wire means extends longitudinally above each of said cores; and further wherein said strip depositing means is operable to deposit strips of sheet material on said wires above each of said cores, whereby upon transport of said carriage means longitudinally of said mold, the settable material is deposited on said strips of material and in the spaces between said cores and between said cores and the walls of said mold, thereby to produce a molded product containing a plurality of longitudinal cavities.

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25—41J, 41G