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(71) Applicant: **Ing. A. RUSSO & C. S.a.s., Via Santacroce, 64 A, I-80129 Napoli (IT)**

(72) Inventor: **Russo, Antonio, Via Santacroce 64B, I-80129 Napoli (IT)**

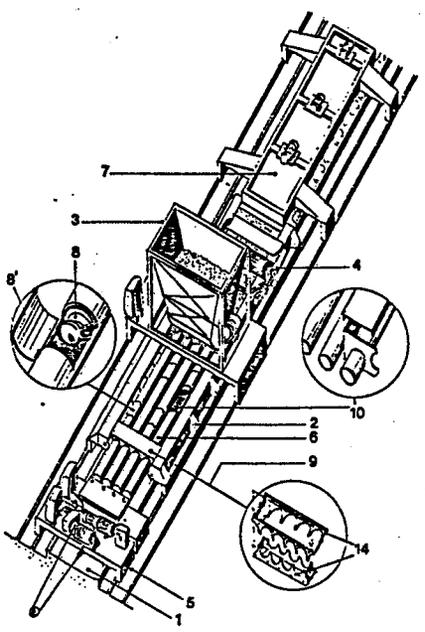
(74) Representative: **Mascioli, Alessandro, Prof.Dr., c/o A.N.D.I. Associazione Nazionale degli Inventori Via Lima, 35, I-00198 Roma (IT)**

## (54) A system for the strip-production of pit-panels of pre-compressed or partially pre-compressed reinforced concrete or with slow reinforcement, being extended to the lower and upper surfaces and to the ribs, and end product thereof.

(57) The system according to the present invention allows the realization of a new process for the production of pit-panels (P) of high resistance reinforced concrete, that may be installed also in those areas with a high earthquake percentage.

The system consists in a strip (1) provided with a movable carriage (3), selfmoving or towed, for the throw and distribution of the concrete, and with a carriage (5), selfmoving or towed, to which are connected the lateral wall sides (2), the forming tubes (6) – representing the extractable cores – as well as a metal plate (7), acting as a cope to be placed on the upper face of the throw.

Said panels (P) are separated in the sense transversal to the strip by means of separating elements (9) that may be fixed to said strip, wherein the face being in direct contact with the throws is conveniently provided with holes so as to reproduce the section of the forming tube, thus allowing the flow thereof.

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"A SYSTEM FOR THE STRIP-PRODUCTION OF PIT-PANELS OF PRE-COMPRESSED OR PARTIALLY PRE-COMPRESSED REINFORCED CONCRETE OR WITH SLOW REINFORCEMENT, BEING EXTENDED TO THE LOWER AND UPPER SURFACES AND TO THE RIBS, AND END PRODUCT THEREOF".

Soc. Ing. RUSSO & C S.a.s. - ITALY

The present invention concerns a system for the production of a new kind of pit-panel according to an original process which, even if maintaining all the positive features of the known pre-compressed pit-panels, strip-produced by vibratory finishing machines by forming or extruding (said features being e.g. self-lift, the low unitary weight, cheapness, quick production and the great resistance to stresses that allows the use of thicknesses uo to 75% less than other materials), eliminates all objections to this material.

It is known that the main objection relates to the impossibility of introducint metal reinforcements into both faces and into the ribs of the pit-panels being strip-produced by means of the various kinds of vibratory finishing machines.

It is means, by means of said objection, that weak areas would arise in the panel (those lacking of reinforcement), causing a small resistance to eventual repeated and dynamic stresses, like those of an earthquake.

Furthermore, the impossibility of connecting the metal reinforcements of contiguous panels eliminates the possibility of making use of the pit-panels until now produced in those

areas, where earthquakes are more frequent, as in those areas a connection of this kind is compulsory.

A further objection concerns the fact, that it is impossible to make project, from the head of the panel, irons for the eventual connection with other casted parts of the structure in which the pit-panel enters like a component. On the other hand, the process of realizing, on the upper face of the panel, millings for the housing of an additional reinforcement provided for absorbing negative moments, is not always accepted.

It is the aim of the present invention to realize a production system for the realization, on a strip, of pit-panels of reinforced concrete, that will eliminate all above mentioned objections relating to the already known products.

The aim set forth is reached by means of the system according to the present invention for the realization of a new process, mainly consisting in throwing concrete having the appropriate slump features onto a long strip, on which the pre-stretched or slow reinforcements have been laid, or even both in case of partial pre-compression.

Said strip is provided iwth lateral edges, while in the sense of the length thereof separators are placed at the desired distances, having such shapes as to serve for the cutting of the panel according to the length thereof as well as for the resting of the vibrating metal cores provided in the number

and at the distance desired within the width of the strip.

The concrete throw completely covers said cores which are kept in vibration until the whole of the material has not been uniformly distributed.

Now, a cope, also vibrating, is applied to the upper face of the throw, said cope ahving the function of completing the superficial vibration of the panel and to keep on cohesion the mass of fresh concrete during the immediately following extraction of the cores, that takes place making the same slide away from the housings provided in the separator sections and transfering them therefore along the strip in the space prepared for the next casting.

At last, the cope is lifted, i.e. it will slide on the throw, or it may slide together with the cores at the moment of the extraction thereof.

The use of the cope depends on the kind of concrete being produced, which means that in the case of concrete with particularly positive slump it is not necessary to use the cope, at least in the realization of panels of little thickness.

The pit-panels realized by means of the process according to the present invention show the following advantages:

- resistance to eventual seismical or torsional stresses due to the presence of metal reinforcements between contiguous panels;
- possibility of connection with other casting parts of the

structure due to the presence of eventual irons projecting form the heads of the panels.

The present invention will be described more in detail hereinbelow referring to the attached drawings showing a preferred embodiment.

Figure 1 shows an axonometric, partially transparent view of a pit-panel obtained with the process according to the present invention.

Figure 2 shows an axonometric view of the production strip.

Figure 3 shows a complete plant, with enlarged details, for the strip-production of pit-panels.

Relating now to the details shown in the figures, the strip for the production of the pit-panels according to the present invention shows a metal bottom 1 or a concrete bottom 1', eventually provided with any heating system 3' (warm water, steam, diathermic oil), however prodived for the accelerated maturation of the materials. This means that also those strips already realized for the use of vibratory finishing machines, provided with the appropriate modifications, may be used.

It shall be underlined that the use of a strip instead of other possible solutions, as e.g. a carousel of planes, is mainly imposed by the chance of obtaining the maximum flexibility in the production of the panels for what concerns the length thereof, and therefore the best use of the casting surface available in a plant. Furthermore, the less expense

for the plant, the maintaining and the use of a strip with respect to any other solution is well known.

Furthermore, with a deck-system different from the one of a long strip it is practically impossible - i.e. extremely expensive - to perform the stretching and hooking of the pre-compression cables.

The strip shall be at least one hundred meters long: this reduces the displacement frequency of the production device from a strip to the other. The width of the strip will be determined according to the form chosen for the panel. As the form usually chosen (also for transport reasons) actually is of 1.20 meters, a preferred embodiment of the strip may be realized in a width of 1.20 meters or 2.40 meters, wherein, in this last case, the strip may be devided in two half-strips by placing an appropriate separator. This does not means that strips with different forms may not be used, especially if they are already existing for other constructing purposes. It is also possible to realize strips up to 3.60 meters width: in this case, special transport carriages will be used.

The strip shall be provided with appropriate rails R on which the casting devices and the devices for the forming of the materials shall run.

The devices for the production of panels P by means of the plant and the process according to the present invention

are the following:

- a movable carriage 3 for the casting and the distribution of the concrete on the strip;
- a movable carriage 5 on which are connected the form-tubes 6 representing the extractable cores that will form the pits, as well as the sliding edges 2 for containing the concrete castings along the edges of the strip, and finally a metal plate 7 to lay onto the casting during the extraction of the cores;
- a plurality of casting separators 9 to be inserted between one panel P and the other, according to the length of the panels bein realized and to the shape of the heads thereof.

On carriage 3, selfmoving or towed, the bucket full of concrete is resting, coming form the beton central, provided with a device with variable opening for the dosed outlet of the concrete, and preferably provided with an Archimedean screw or any other device that will facilitate the uniform distribution of the concrete onto the strip.

The moving of the distribution carriage may take place by means of an electric or hydraulic motor, or also by a motor operated by compressed air. Finally, it is possible to connect the movement of this carriage to the one of carriage 5 for the moving of the cores, the edges etc.

Said carriage 3 may be carrying a rotating roller 4 or a vibrating shaft, adjustable in the sense of the height, for

the levelling of the concrete at a determined height, thus performing a further finishing of the distribution as well as the eventual elimination fo the excess material.

Said carriage may also be equipped for other functions, like the temporary resting of the additional metal reinforcements, the eventual installation of hardening devices with compressed air, mono or three-phase electric energy with different voltages, plugs for movable vibrators, etc, and thus become a real polivalent service carriage.

According to the present invention, the moving of carriage 5 may be determined by the connection thereof, by means of metal ropes of chains, to a winch placed at one of the ends of the strip. Said winch will be provided with an appropriate speed reeducer and eventually also with a speed variator. The towing winch may also be located on the same carriage, wherein the towing cable shall be hooked to one end of the strip.

In a variant of the system according to the present invention, a different moving may also be provided, by means a motor of the known kind placed on the same carriage; but in this case the rail shall be provided with an appropriate rack-rail for preventing an eventual slipping of the wheels of carriage 5, if the whole is not otherwise provided with appropriate weights for obtaining the requested adherence.

Carriage 5, on which alloperation switches are provided,

shows at the head thereof a device that allows the hooking of form-tubes 6, representing the extractable cores that will form the pits A of panels P. Said cores may have sections of any shape and dimension, said sections being determined by the project of panel P to be obtained, being in turn mainly conditioned by the less weight of the material itself, by the resistance that is to be given to the same and finally by conditions concerning thickness and capacity imposed by actual or future laws.

It may be generally said that the most frequently used section is the circular one, being also the one that allows, due to the symmetry, the greatest core extraction facility. Furthermore said section - in case of limited thickness of the panel - may be the one that does not mean the less weight of the material, and therefore it may be more convenient to use another kind of section for the form-tube (oval, polygonal with round off corners, quadrilateral with round off corners, etc.), keeping in mind that it is not appropriate to go over 12 cm of width of the pit so as to prevent the formation of eventual undulations in the upper surface of the panel.

The length of the cores is related to the maximul length obatinable for each thickness of panel, which in turns is determined by the regulation ordinances.

It is obvious that the maximum length may be obtained in

a panel out of pre-compressed reinforced concrete.

In this case, as it is possible to take into consideration a limit relationship thickness/light around 1/40, the maximum lengths may be provided for the extractable cores according to the thicknesses of the panel to be obtained. Therefore, as said cores may reach the length of 14 meters, they may be realized in such a way that various elements may be added until reaching the length requesting, in the production phase of a determined panel length.

Furthermore, it is essential that the various form-tube elements representing the core be perfectly coaxial once jointed.

The cores are inwardly provided with a series of vibrators 8, which start working successively, once the concrete casting performed by the distribution device reachs the position of each vibrator inside the form-tube 6. It is obvious that the vibration system shall be arranged in such a way that the vibration wave emitted by a vibrator does not interfere with the one of the adjacent vibrator, up to a possible reciprocal anulment of the vibration effect.

Each vibrator is covered with an external plate 8' easily removable, so as to make possible a quick replacement in case of damage. A possible damage to one of the vibrators should appear on the switch board of the carriage.

It is also possible to introduce inside the form-tube, instead of the vibrators, a rod carrying cams at due distances

whereby said rod also may be jointed in correspondence with the form-tube elements and be placed into rotation at the due speed by an electric motor mounted at one end of the form-tube so that the vibration is obtained by the rotation of said cams.

That end of the form-tube 6 not being connected to the carriage rests, during rotation, in the apposite sliding housing provided in separator 9 mounted between one panel and the next one, while the other end is connected to the carriage by means of a device that allows, at the moment of extraction, not to make move all tubes together. Furthermore, the device for connection to the carriage is of the quick kind for the easiest removing of the tube in case of damage of any of the vibrators thereof.

Edges 2 are also connected to the carriage, said edges having the function of containing the concrete at the lateral edges of the strip. The edges must have the same length than the cores used for the panel to be produced, be easily removable from the carriage in case of modification of the thickness of the panel to be obtained, and finally they may be provided or not with vibrators.

Also edges 2 may consist in a plurality of jointable elements and are shaped according to the production requests.

It is possible, by mounting on the edges 2 rotating half-rollers 11 or similar, to obtain that the external face of the

panel be shaped with alternated profiles and emptinesses 12, which facilitates the adherence and the resistance of the sealing throws between the panels.

It is essential that the edge shows appropriate housings for inserting shaped projecting irons 13, necessary for the horizontal connection of the panels and also for the lifting thereof from the strip and the further moving thereof.

The edges 2 are moved by means of the same device moving the cores.

It is possible to connect the edges with strip 1 instead with the movable carriage, moving the same by means of manual or hydraulic devices.

The separation of each panel P from the contiguous ones takes place, according to the present invention, by means of the series of casting separators 9, each of them showing the most different shapes and dimensions, and usually consisting in two overlapping boxes 14, wherein the two faces thereof being in contact with the casting repeat the shape of half of the section of the form-tube 6 representing the extractable core.

The lower half of separator 9 will be fixed to the strip at a desired distance according to the length of the panel P to be obtained.

The upper half will be fixed to the lower one before starting the casting of a strip and after the core sliding device

has been arranged along said strip.

On that face of the separator being in contact with the casting holes are provided for the passing through of pre-compression cables (where existing) as well as of the irons eventually projecting from the heads of the panels. Said faces may be shaped according to all requests of the heads of the panels to be obtained (inclined in the transversal as well as in the longitudinal sense; with grooves on the lower and eventually also on the upper face for the resting on metal profiles; with special shapes of any form for resting or connection with other materials, etc).

The shapes in which the sliding of the extractable cores takes place may be provided or not with gaskets of rubber, neoprene or plastic so as to facilitate the moving of the form-tubes as well as their free movement during the vibration.

Furthermore, boxes should be provided having heads shaped according to the sections of the form-tubes, to be inserted for the eventual forming of empty spaces in the panels for the passing of cables and tubings.

Submultiples of the form chosen may be obtained temporarily replacing one or more form-tubes special shapes for the separation of the castings in the longitudinal sense.

The moving of the described elements from one strip to the other may take place by means of bridge cranes.

For the managing of a plant with at least six strips (which is indicated as optimal) of a length from about 100 meters to about 140 meters, the bridge cranes used should be at least two, with appropriate speed and carrying, to be employed one for the casting and the other one for the delivery operations.

Elevator carriages, i.e. the same bridge cranes, may provide for the stockage of the panels.

At last, the plant must be provided with a thermic plant (should an accelerated maturing system be adopted), with an electric energy distribution net in B.T. by means of plugs, with a section for the working and stockage of metal reinforcements, while it may be suggested to be provided also with a compressed air distribution net.

For what concerns the devices of the plant according to the presnet invention, for the production process of pit-panels P, the strip may show a metal bottom 1 or a concrete bottom 1'; at both sides thereof, metal edges 2', appropriately shaped, are placed, said edges serving for containing the concrete as well as for the sliding of the movable edges 2.

The strip may be provided or containing or not housings for accelerated warm maturing devices 3' of the concrete.

Said egdes 2 may be part of said strip and therefore the moving thereof may take place manually or by means of hydraulic pistons.

The width of the strip is determined according to the form

chosen in the project for the panel P to be obtained. Once the form has been chosen, the strip may be of equal, twice or multiple width.

The length of strip depends on the space available when it is mounted but it should be possibly not below 80 meters nor above 160 meters.

At the sides of the strip or on the same rails R for the running of the movable devices are fixed.

The strip may be autoreacting to the pre-stretching of the harmonic steel cables or strands, or independent from the hookings provided for the same.

If the strip is of metal and supported by devices for an accelerated maturing 3' by heating, the same may not be autoreacting, and the sliding thereof due to dilatation will be assured preferably fixing the same at the centre and arranging apparatuses for the free sliding of the two resulting half-strips.

The means for the casting and the distribution of the concrete on the strip consist in a movable carriage 3, selfmoving or towed, carrying a bucket containing the concrete taken from the beton plant.

The carriage moves along the strip onto which the bucket discharges and distributes the concrete.

Once tha casting has been completed in the quantity requested for the formation of the panel to be obtained, as well as the relative vibration, the carriages moves back operating a rotating roller 4 that completes the finishing of the upper face and at the same time eliminates the excess concrete.

In a variant of said movement, said rotating roller 4 may act at the same time of the distribution and if the same is really well dosed, it may also be eliminated. However, the roller is necessary for a quick and sure calibration of the thickness of the panel.

Said roller may be replaced by a vibrating rod.

The carriage may be equipped also for other services requested along the strip, like the support of additional reinforcements, electric current plugs of different amperage, voltage and phase number, equipment for welding, connections for additional vibrators, connections for compressed air and similar.

The means for the formation of panels P consist in a movable carriage 5, selfmoving or towed, to which the lateral edges 2 are connected, as well as the form-tubes 6 representing the extractable cores, and a metal plate acting as cope 7 to be placed onto the upper face of the casting once the same has been finished and levelled by said rotating roller 4 or by the sole vibration.

The lateral edges 2 may or may not be provided with a half-

roller 11, rotating, of variable section, for the realization of alternated profiles and empty spaces 12 on the lateral faces of the panels, as well as of housings for the insertion of projecting irons 13.

Said form-tubes 6 have sections according to the panel project. The maximum length of the same depends on the maximum light granted to the panel of the same thickness to be obtained.

The form-tubes 6 may also consist in various jointable elements, which however must al be strictly coaxial.

Inside the same, one or more vibrators 8 (or, as a variant, a rotating rod carrying cams that may produce vibrations) that start their action as soon as they are covered by the concrete and continue their action until said concrete has not been sufficiently vibrated.

After the passing of the rotating roller 4, i.e. after having obtained the levelling of the concrete of the upper face by means of one single vibration, the metal plate 7 will be laid on the upper face of the casting, said plate being provided with further vibrators that complete the vibration of the contact surface.

Once the vibrators stop, the casting is placed in a closed box, from which the cores are immediately extracted, while the lateral edges (if movable) slide together with the same.

The metal plate 7 having the function of a cope for the casting is lifted, or made slide, or even may itself slide together wil the cores.

The panels of lower thickness may also do without the cope, if the quality of the concrete casting has been particularly careful.

The panels are limited, in the transversal sense of the strip, by separator elements 9 that may be fixed to said strip, whereby the face thereof being in contact with the casting is appropriately provided with holes so as to facilitate the sliding thereof.

Said faces are also provided with holes for the passing of cables or strands for the pre-compression, or of projecting reinforcement irons. The faces may be shaped or inclined in all senses according to the production requests, be toothed or step-shaped or in any other way.

For obtaining submultiples of the form determined for the panel the mounting of one or more of the series form-tubes may be omitted, replacing the same with special form-tubes that may act like separators in the longitudinal sense of the panel.

The same, should the request arise to create empty spaces in the panel for the passing of tubings or cables, it is possible to make use of special shaped basins 10 that will allow the sliding of the moving form-tubes.

CLAIMS

1. A system for the strip-production of pit-panels of pre-compressed or partially pre-compressed reinforced concrete or with slow reinforcement, being extended to the lower and upper surfaces and to the ribs, characterized in a strip (1) equipped with means (3) for the casting and the distribution of the concrete, in means (5) for the forming of panels (P) to which form-tubes (6) are connected representing the extractable cores for the formation of the pits (A), with sliding edges (2) for containing the concrete casting at the edges of the strip and with a metal plate (7) to be applied onto the casting during the extraction of the cores, in a plurality of casting separators (9) to be inserted between one panel (P) and the other according to the length and the shape of the heads thereof so as to allow the sliding of the moving form-tubes (6).

2. A system for the strip-production of pit-panels according to claim 1, characterized in that said equipped strip with a metal (1) or concrete (1') bottom, shows shaped metal edges (2') for the limiting of the material as well as for the support and sliding of movable edges (2), being manually or hydraulically moved, with rotating rollers (11) for the realization of alternated profiles or empty spaces (12) on the outer face of said panel (P), and housings for the insertion of projecting shaped irons (13) for the connection of one panel with the contiguous, and further characterized in devices (3') for the accelerated hot maturing of the concrete.

3. A system for the strip-production of pit-panels according to claim 1, characterized in that the means for the casting and the distribution of the concrete onto the strip consist in a movable carriage (3), self-moving or towed, carrying a bucket from which the concrete for the forming of the panel (P) is discharged, said carriage (3) being able to return by operating a rotating roller (4) for the finishing of the upper face of the panel or to act contemporarily to the distribution.

4. A system for the strip-production of pit-panels according to claim 1, characterized in that the means for the forming of panel (P) consist in a movable carriage (5), self-moving or towed, to which lateral edges (2) as well as the form-tubes (6), representing the extractable cores, are connected, as well as a metal plate (7) acting as a cope, that will be placed onto the upper face of the casting after the same has been finished and levelled by said rotating roller (4) or by the sole vibration.

5. A system for the strip-production of pit-panels according to claims 1 and 4, characterized in that said lateral edges (2) are provided with a turning half-roller (11) of variable section, for the creation of alternated empty spaces or profiles (12) on the lateral faces of the panels, as well as of housings for the isnertion of projecting irons (13).

6. A system for the strip-production of pit-panels according to claims 1 and 4, characterized in that said form-tubes (6) consist in a plurality of jointable elements which however shall all be strictly coaxial.

7. A system for the strip-production of pit-panels according to claims 1 and 6, characterized in that inside said form-tubes (6) one or more vibrators (8) are placed, each covered by an outer plate (8') for the access to the inside, that start working as soon as they have been covered by the concrete and continue their work until said concrete has not been sufficiently vibrated.

8. A system for the strip-production of pit)panels according to claims 1 and 7, characterized in that after the passing of rotating roller (4), i.e. after having obtained the levelling of the concrete of the upper face by means of the sole vibration, the metal plate (7) will be applied to the upper face of the casting, said plate carrying further vibrators that complete the vibration of the surface in contact so that, once the vibrators stop, the casting is in a closed box from which the cores are immediately extracted, while the lateral edges (if movable) slide together with the same.

9. A system for the strip-production of pit-panels according to claim 1, characterized in that said panels (P) are limited, in the transversal sense of the strip, by separa-

rator elements (9) that may be fixed to the same strip, u - sually consisting in two overlapping boxes (14) the face thereof being in contact with the casting being provided with holes so as to reproduce the form-tube's section, so as to allow the sliding thereof, said faces having also holes in correspondence with the provided passages of cables or strands for the pre-compression or of projecting reinforcement irons.

10. A system for the strip-rpoduction of pit-panels according to claims 1 and 3, characterized in that said movable carriage (3) is equipped also for other service requested along the strip, like the support of additional reinforcements, current plugs of various amperage, voltage and phase number, equipment for welding, connections for additional vibrators, connections for compressed air and similar.

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FIG.1

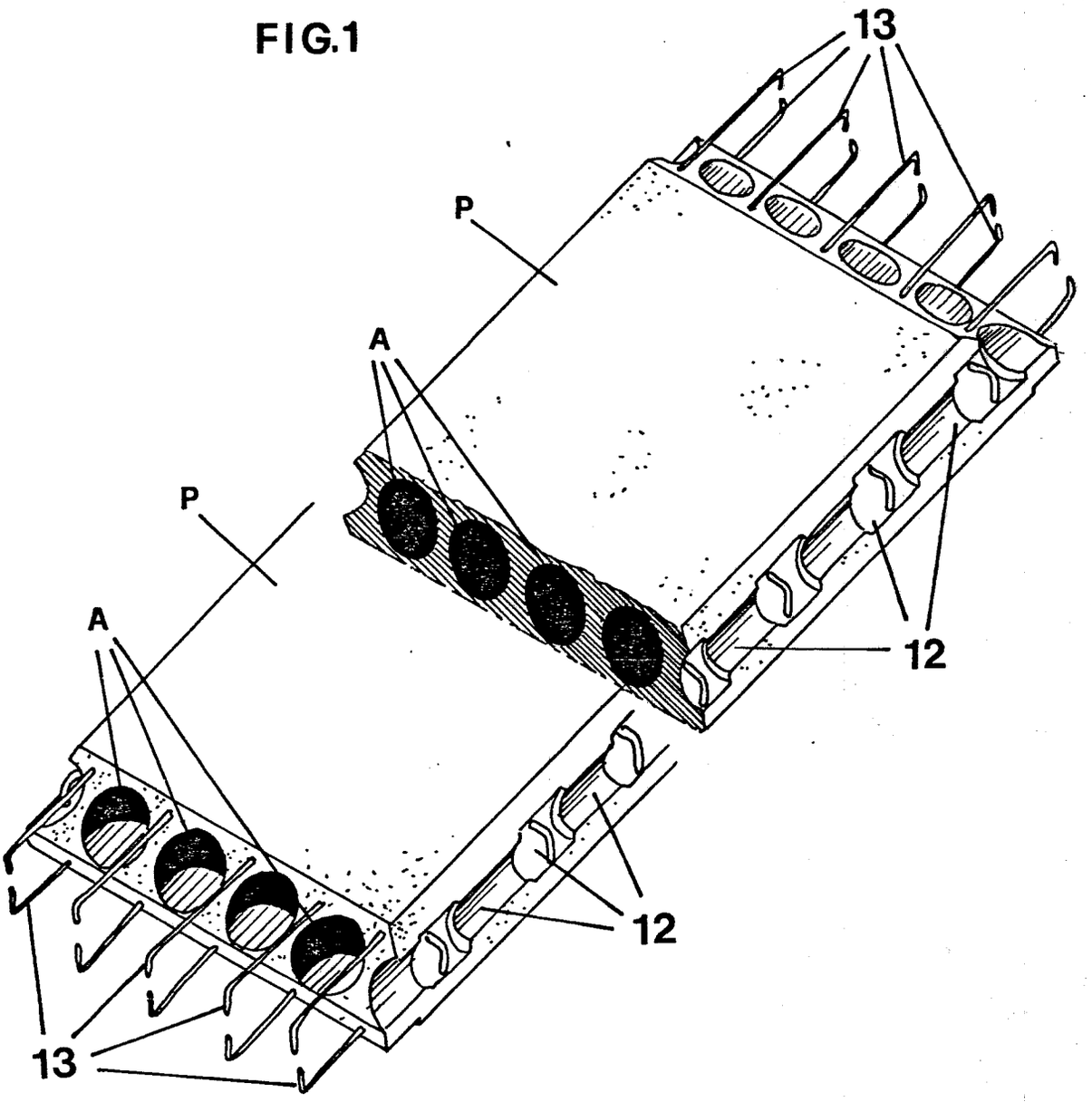

FIG.2

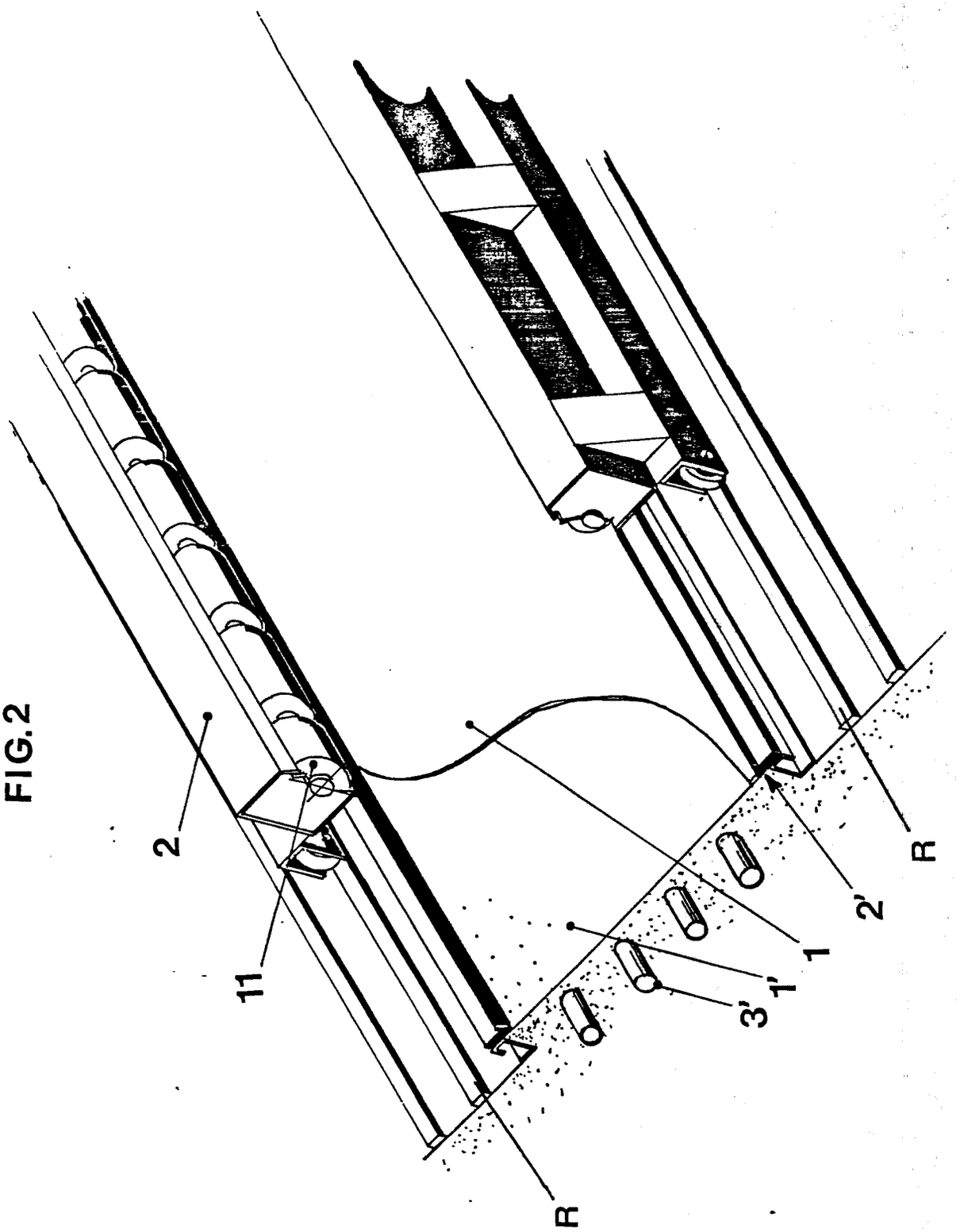

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FIG.3