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(11) **EP 1 261 776 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:

23.03.2005 Bulletin 2005/12

(21) Application number: **00974268.5**

(22) Date of filing: **20.11.2000**

(51) Int Cl.7: **E02B 3/12**, E02B 3/00

(86) International application number:
PCT/CZ2000/000086

(87) International publication number:
WO 2001/036752 (25.05.2001 Gazette 2001/21)

(54) **METHOD FOR BUILDING-UP A FLOOD-PROTECTION SYSTEM**

VERFAHREN ZUM AUFBAU EINES SYSTEMS ZUM SCHUTZ VOR ÜBERSCHWEMMUNGEN

PROCEDE DE CREATION D'UN SYSTEME DE PROTECTION CONTRE LES INONDATIONS

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**

(30) Priority: **18.11.1999 CZ 408799**

(43) Date of publication of application:
04.12.2002 Bulletin 2002/49

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Description

Technical Field

[0001] Invention herein covers a construction method of levee/flood system, being utilized for consolidation and/or elevation of existing protective levees and/or seepage and leak prevention of afflux water to the territory adjacent to the watercourse. Furthermore the invention herein describes facilities necessary for application said construction method, as well.

Background Art

[0002] Watercourses flowing through the countryside have their riverbeds that have arisen mostly spontaneously during a period of many years. Riverbeds of watercourses were treated and river realignments (regulations) were done in certain locations. Protective levees of both earth dams and/or of different type of consolidation were built alongside one or both riverbanks where it was considered as needed. However these levees underwent in the course of time diverse repairs and treatments. Nevertheless free course was left to the rivers, brooks and streams in mountain and foothills areas, especially upon spontaneous establishment of new routes and riverbeds. But their flow through towns and municipalities is rather controlled. In case of increasing the water level due to higher rain activities the existing levees often are not capable to face the power of raised water flow. That is why they are unable to prevent flood of adjacent countryside as well as large damages, which took place the overall territory of Moravia in 1997, great part of Poland and Germany as well as Northern Bohemia in 1998, respectively.

[0003] Different facilities for construction and/or elevation of existing levees or other artificial anti-flood barriers belong among solution, demonstrating contemporary state of technique within said sphere. Technical solution described in the document No. WO 95/06169, regarding to the packing the outside surface of which was fitted with small hooks, whereas other surface was fitted with matched connecting elements may be listed as an example. When the packages filled with a special medium are located upwards and/or mutually each on the other, the hook elements at the surface of one of packages hereof are inserted in connecting elements located at the surface of one of other packages at least.

[0004] The patent application No. WO 95/24531 involves an invention, concerning the structure of formwork, especially for utilization in occupation of areas situated horizontally and/or of inclined ones. Formwork structure is shaped principally as a flat beg made from PVC and/or other suitable textile fabrics, consisting of the layer of upper fabric as well as that one of bottom fabrics, connected mutually via a weld seam and/or zip fastener. Several span pieces are located between the upper and bottom fabrics.

[0005] The invention described in the file No. WO 97/29246 concerns the soft package, consisting predominantly from textile fabrics, fitted with one hole for filling with bulk and/or partially consolidated material at least. Sand and soils are applied for construction of a body, used as the insert and/or levee foundation, embankment, bank consolidation, bulkhead or breakwater, for filling the holes or reservoirs, e.g. in the bed of a watercourse and/or for packing and storage of contaminated substances. Container is fitted with one filling hole at its upper side at least. Stitched seam or weld seam standing out longitudinally is arranged at the upper side of the container herein, interconnecting the textile fabrics face areas of top edges.

[0006] British patent application No. GB 2 299 606 A involves a barrier withstanding the action of the sea and/or other watercourse at the surface, consisting of a set of containers, located lines and fitted with the means for mutual securing the adjacent containers as well as surface reinforcement, e.g. of a seabed. Containers are perforated and fitted as whole or partially with suspendable substances, e.g. with sand, suspended concrete being located in container out of the earth, e.g. being pumped to the containers. Containers may be located at the surface and filled from the vessel, or filled on vessels and lowered to the bottom.

[0007] Levee bags for flood protection, well known from the application No. DE 44 02 458 A1 are based on the principle of over-dimensioned empty bags filled with rather heavy substance to achieve a capability of their sunk as well as small bags filled with a super-absorbent, being capable to absorb water in the amount of 100 fold of their own weight. However this small bag is of large volume type so that due to the change of its own volume extends the levee bag from its center causing this way self-sealing of the gaps. Water is here utilized so that that is self-seals the flood-levees simultaneously with raising water level at the site of location.

[0008] Concerning the method and facilities for construction of levee-flood dams made from the matter being enclosed in the fabric container, as per the file No. DE 44 17 672 A1 is assumed that several empty, parallel textile reservoirs are located to the guidance of the protective dam, at least. Such textile reservoirs hereof are simultaneously joined together into fabric tube, having one end enclosed and the other opened, that are filled with a substance inside, starting from enclosed end and step-by-step up to the opened one.

[0009] Subject matter of the invention as per the file No. DE 197 38 216 represents a levee module, needed for reinforcement, elevation and/or new construction of protective levees and dams. To establish such levee module hereof, the levee/dam would be reinforced, elevated and/or newly constructed via a simple method, using standard machinery, e.g. excavators, trucks, etc. Otherwise quite new protective levee may be built up, where open flexible container for trapping the filling substance is located on the considerably oblong skeleton.

Said container is to be made from textile fabrics, rupture resistant, especially from geo-textile, non-woven textile, woven, knitted and/or fibrous material, e.g. from canvas fabrics and/or foil, reinforced with plastic fibers.

[0010] File No. WO 97/39192 describes inflatable body, made from parts enabling change of their volume, like blowing pipe part fastened to the bottom so that may become blown up very during a short time on condition of jeopardizing.

[0011] Invention as per No. EP 0 721 028 A2 relates to the emergency weir fitted with certain number of flexible hoses, which may be filled with a fluid, whereas the hoses hereof are interconnected during the state of being filled with a fluid. In case that those hoses are located in layers put each on the other, at least two of the hoses herein are interconnected mutually at the longitudinal side. During the non-filled state the above hoses are fastened especially in depressions of the bed and may be covered with a lid.

[0012] Bag as per the published description to the patent application No. GB 2 297 343 A for an arrangement of the levee would filled with sand and stones. This bag involves a tube body, fitted with the inlet and outlet. Two surrounding loops ensure both inlet and outlet to achieve the above inlet and outlet flowing to the tube elements. Inlet is adapted for filling with sand and stones to the bag while the outlet is ready for draining the water from the bag.

[0013] Invention as per the file No. DE 197 54 340 A1 concerns the flood-protective facility applied in the back-water areas. This facility consists of waterproof hoses of different size, which remain filled in the water and by means of insignificant overpressure are stable from the point of view of their shape. This fact enables them to serve as temporary tide barriers.

[0014] Facility described in the file connected with the patent application No. EP 0 636 748 A1 secures the slopes endangered with bank sapping as well as maintenance of bound bank sappings up to the total low grain size soils. Said facility consists of one complete hole drilled from the top, or from the bottom, and/or from the side of sliding slope. Hole would be of controlled course type, being bored first at one site at least, out of the area of slope endangered with sapping and/or out of the sapping area. Subsequently a complete borehole of controlled type would be drilled out at previously chosen site, through the sliding surface susceptible to the sapping and after its completion the borehole would be injected with a suitable injection agent to consolidate the surrounding earth area.

[0015] Patent file No. US 5,669,732 describes a bag, closing automatically based on the pressure of the substance filled in it. Bag herein consists of openable, overlapping elastic structure, where the elastic material is arranged, enabling complete covering of the bag hole.

[0016] Facility for flood and erosion damages prevention, published within the file No. EP 0 952 259 consists of one or more closing compartments in the upper area

of which a hose like part with a cubic capacity body would be fastened at its upper part. Above body, a closing apron is located on it, consists of compartments for caught of the load. Closing compartments may be connected either separately, either within a bundle at the dam crest and/or embankment part flooded with water and are anchored via the fastening piles. This way the dam crest and/or grass at the embankment are effectively prevented from the underwashing.

[0017] A solution of DE-A-34 12 300 describes an embankment protection against the floods that is in place of future use where it does not interfere with normal traffic and is taken into operation when flood is starting or is expected. This protective means consists of a hose in a rolled or folded state that is taken into operation by filling it up with gas or fluid. This protective means is not mobile and must be embedded in the endangered embankment.

[0018] A solution of US-A-4,728,221 describes an inflatable and collapsible dam arrangement including a flexible membrane weir element positioned so that when it is inflated, it will block a flow of water. The control chamber for the weir is divided into upper and lower sections. The upper section has at least a portion above ground and contains an apparatus for inflating the dam and making the weir element self-supporting. The lower control section includes at least a portion positioned underground and includes an apparatus for collapsing the dam. Again, this protective means is not mobile and must be embedded in the endangered embankment.

[0019] Above mentioned examples for solution of crisis states during the floods shown, that except from the proper solution of particular bodies, establishing and/or reinforcing, consolidating, or elevating existing levees does not exist any uniform technical-organizational system, enabling immediate reaction to arisen flood disaster and inundation situations.

Disclosure of the Invention

[0020] Above-mentioned disadvantages overcome a method for creation of the flood-protection system based on the invention herein. The matter of the invention has been founded on the principle, that bases on the hydraulic engineering model of flood protection, where minimum one preparation station, joined via a transport system with the protective means and their components, would be established in the center of endangered area. Especially large cubic capacity bags and/or filling mixture for them belong among the protective means. Above-mentioned transport system subsequently transports these protective means, especially large cubic capacity bags, to the jeopardized water-course embankments for establishment and/or reinforcement of the protective flood-levee.

[0021] Method of construction the flood-protection system herein may be performed advantageously using large spatial bags for building or fortification of protec-

tive levee of an endangered embankment of a water course so that according to a hydraulic engineering model of the flood protection

- at least one preparation and control station is established in the center of the endangered territory into which components of filling mixture for the large spatial bags are consecutively transported, said filling mixture being then subsequently produced of said components,
- at least one transport pumping station is established in the center of the endangered territory,
- on the endangered embankment or levee of the water course empty large spatial bags are placed,
- said empty large spatial bags are then coupled through a pipeline main with the transport pumping station,
- the filling mixture prepared in the preparation station is then transported from the preparation station by a mobile conveyor to the transport pumping station, and
- said mixture is filled by a transport pump and through the pipeline main into the large spatial bags.

Brief Description of Drawings

[0022] Substance of the method and facilities as per the invention herein are furthermore explained in detail via the description of their exemplary workmanships, represented in their simplified fashion on the enclosed drawings, where

Fig. 1 shows a schematic diagram of the preparation station with the control dispatching and pouring systems. Above systems, connected to the mixing plant as well as the transport system utilizing the mobile agitation truck and the transport system, are ensuring the haulage of filling mixture to the site of destination, i.e. to endangered embankment of the watercourse

Fig. 2 presents a schematic diagram of mobile mixing plant for receiving the filling material together with the transport system ensuring the haulage of filling mixture to the site of destination

Fig. 3 shows the schematic axonometric projection of exemplary workmanship of the large cubic capacity bag in a form of simple, longitudinally unlimited and closed tube

Fig. 4 shows simplified axonometric projection of the exemplary workmanship of the large cubic capacity bag in a form of double tube, whereas

In Fig. 5, there has been drawn in the same projection the exemplary workmanship of the large cubic capacity bag as a triplet of mutually kinematical bound tubes

Fig. 6 represents a schematic axonometric projection of the multiple large cubic capacity bag the cen-

tral part of which was made in the shape of block and if compared with the side tubes, it is considerably bigger and

Fig 7 represents schematic axonometric projection to a part of stationary levee, consisting of several kinds of large cubic capacity bags, being mutually kinematical bound.

Mode for Carrying Out of the Invention

[0023] Facilities as per the Fig 1 consists of the preparation station 1 connected with the control dispatching 11, which controls the pouring system 2 and the transport station 5 via the connection marked with dashed line. Pouring system 2 consists of mobile chargers 21 and/or of charging conveyor 22. Charging conveyor 22 and the mobile charger 21 are subsequently guided to the hopper 23, fitted with the dosing equipment 24. Underneath the hopper 23 is located the discharge conveyor 25. Mobile charger 21 and charging conveyor 22 are both predetermined for supplying with the components of the filling mixture, which is not represented here, transported to the agitator 32, which is located at the mixing plant 3. To the agitator equipment 32 would be furthermore connected a water main branch 31 and the hopper 321. For transport of ready filling mixture are incorporated to the hopper 321 the mobile conveyors 4 and/or the transport station 5. Transport station 5 than consists of the transport pump 52, to which is connected the pipeline main 53. To this pipeline main 53 is furthermore connected the aggregate for generation of the pressurized air 51. Above-mentioned pipeline main 53 outlets to the large cubic capacity bag 7, located at the flat dam crest 81 of the protective levee 8, which in the same time establishes the inclined embankment 6 of the watercourse 61.

[0024] In Fig. 2 is shown a mobile mixing plant 3' with the equipment of agitator 32', which is filled with mobile chargers 21. To the agitator 32' is than connected the water main 31' and the hopper 321'. For transport of ready filling mixture is arranged to the hopper 321' the transport station 5'. Transport station 5' furthermore consists of the transport pump 52' and of the aggregate 51' for generating the pressurized air, which are connected to the pipeline main 53'. Filling mixture would be transported to the endangered embankments 6 of the watercourse 61 for filling the large cubic capacity bags 7 and for the construction and/or reinforcement of the protective dam/levee 8. Filling would be done either directly from the transport station 5 or from the transport station 5', whereas the large cubic capacity bags 7 may be anchored in the bank 6 and/or to the bottom of the watercourse 61, or to the embankment protective dam/levee 8, as well. At least one of the large cubic capacity bags 7 would be than partially filled at least and located longitudinally at the dam crest 81 of protective levee 8.

[0025] To the input of control dispatching 11 as per the Fig. 1 and 2, pertinently to the input of their proces-

sors 9 would be linked an output of the sensor 91, located at the endangered area. This area was not drawn here or specified in detail, of the watercourse 61, e.g. in the territory of its upper stream with respect to the territory, where are disposed and/or embedded large cubic capacity bags 7. First output of the processor 9 is linked via the conductive connection with the means 92 for automatic telecommunication connection establishment, which is represented here with the sign of stationary extension phone. Another outlet of the processor 9 is linked with the means 93 for automated transmission of the status message. Such a means, which in described example involves the equipment for wireless transmission, enables the connection with at least one of terminals 94 for electronic communication. Such a mean may be represented with e.g. facility for radio and TV transmissions, cable, data communications and transmissions as well as transmissions via the Internet and/or other computer network.. (Represented here with a TV set and a computer, receiving the data signal via a data transmission network unspecified and non-represented here in detail.) Third output of the processor 9 is linked with the means 95 for transmission of direct alarm signaling, especially into the immediate territory of the protective levee 8 at the embankment 6 of the watercourse 61 within the jeopardized territory. This signaling would be performed predominantly through the means for optical and/or acoustic signaling of the critical state, as is represented in the scheme at described Fig. 1 and 2. Except of the above-mentioned parts the control dispatching involves another means, non-described here in detail, enabling manual and/or automated control of the operation of preparation station 1, mobile conveyors 4 and/or of transport station 5, pertinently of mobile mixing plant 3' and the transport station 5'.

[0026] As per the hydraulic engineering model of flood protection in the center of the endangered area would establish at least one preparation station 1 with the control dispatching 11. Dispatching herein reacts to the requirements of the flood control center. Dispatching ensures the aid to the territories jeopardized with flood and backwater by means of production and haulage of the filling mixture to be charged in large cubic capacity bags 7. These bags would be utilized for reinforcement and/or construction of the protective dam/levee 8 at endangered embankment 6 of the watercourse.

[0027] Particular components of the filling mixture, non-represented here, are transported during the operation of facilities, as indicated in the Fig. 1, to the agitator 32 of the mixing plant 3 and here are they mixed and agitated either by means of mobile charges 21 and/or via the charging conveyor 22. To acquire the paste-like state of the filling mixture the water would be added to the agitator, by means of connected water main branch 31. Filling mixture is subsequently transported to the endangered embankment 6 to fill out the large cubic capacity bags 7 and to construct and/or consolidation of the protective levees 8 by means of transport pump 52

and pipeline main 53. In case of bigger distance of the jeopardized embankment 6 of the watercourse, simultaneously accessible for the mobile charges 21, would be established an independent mobile mixing plant 3', indicated in the Fig 2. This mixing plant 3' would involve the water main branch 31', as well, connected to the equipment of agitator 32'. Agitator 32' would be charged up with the components of filling mixture by means of mobile charges 21. Filling mixture will be subsequently transported to the endangered embankments 6 of the watercourse 61 to fill the large cubic capacity bags 7 and to construct and/or reinforce the protective dams/levees 8 by means of transport pump 52' and an independent branch of the pipeline main 53'. At the jeopardized embankment 6 of the watercourse 61 would the filling mixture be charged into the large cubic capacity bags 7 by means of which the protective dam/levee 8 is constructed and/or consolidated.

[0028] Fig. 3 represents simplified axonometric projection of the large cubic capacity bag 7, worked in the shape of simple, longitudinally limited and closed tube, made from elastic material, e.g. from non-woven geotextile, and involving the filling hole 711 and the discharge hole 712 opposite to it.

[0029] Fig. 4 represents exemplary workmanship of the large cubic capacity double bag 71, established as the parallel pairs of cinematic mutually bound, longitudinally limited and enclosed tubes, joined mutually alongside with the coupling 75. Overall double bag was made from one elastic unit, whereas both parallel tubes and the intermediate coupling 75 are mutually separated via stitching and/or weld seam. Each of tubes is furthermore fitted with one filling hole 711 and opposite located discharge one 712.

[0030] Fig. 5 shows exemplary workmanship of the multiple bags 72, made as a triplet of mutually parallel located, longitudinally limited and enclosed tubes. Tubes are made from elastic material. Their mutual position with centers of longitudinal axes located at the vertices of equilateral triangle is secured with intermediately seated and fastened coupling 75, made with the cross section of "T" shape, turned by 180°. Each of the tubes of multiple bag 72 manufactured such a way, would be fitted with a filling hole 712. The said filling hole 712 herein would allow e.g. filling of each of the tubes with a filling mixture in a different period, especially with respect to the development of the flood and/or other dangerous situation. Pertinently each of tubes may be charged with a mixture of other material composition.

[0031] Fig. 6 shows other example of the multiple bag workmanship 72, consisting of a triplet of mutually connected, longitudinally limited and enclosed tubes, whereas the central one, dominating through its dimensions, is of block shape 73. Each of the tubes is fitted with one filling hole 711 and one discharging one 712, as well. Particular tubes are separated through stitching with at least one seam, parallel to the longitudinal axis of the multiple bags 72.

[0032] Fig. 7 shows simplified axonometric projection of the cross section through the compartment of protective levee **8**. Said cross section is established with inclined embankment **6** of the watercourse **61** one surface, on which seats a system, represented with large cubic capacity bag **7**, large cubic capacity bag **71** and intermediate seated mattress bag **74**. Large cubic capacity bag **7**, shown in detail in the Fig 3, is seated in the lower part of inclined surface of the side wall of protective dam/levee **8** at the water level of the watercourse **61**. This bag **7** is fitted with a filling hole **711** and a discharge one **712**. On the flat horizontal dam crest **81** of the protective dam/levee **8** seats large cubic capacity double bag **71**, fitted with the filling holes **711** and discharge ones **712**, as well. Both tubes of the bag are kinematic bound via the coupling **75**, and as it was mentioned above within the part of description workmanship example of the invention herein in the Fig. 4. Mattress bag **74** is kinematic bound seated between the large cubic capacity double bag **71** and a large cubic capacity bag **7** by means of the elements non-indicated here. This bag **7** is fitted with an inner labyrinth of compartments **741** marked with a dashed line. Said labyrinth either guides the direction of flowing the filling mixture during the filling operation, represented by the arrows, either prevents from pertinent shape deformations, resulting from the pressure being generated by the filling mixture and effecting to the inner surfaces of the walls. Mattress bag **74** is furthermore fitted with a filling hole **711** and a discharging one **712**. Thickness of the above mattress bag **74** may be in some cases of the invention workmanship considerably lower, if compared with the diameter of the large cubic capacity bag **7** hoses and a double bag **71** ones. Reason is that the mattress bag **74** may have a task to prevent from water leakage from the watercourse **61** through the levee **8**, especially for earth dams, non-compacted ones, and/or partially mechanically disturbed levees **8**. That is why in such cases the demands for its mechanical ruggedness are not put higher. Otherwise the mattress bag **74** may be applied as a support plate the task of which covers leveling of the terrain excrescencies underneath other large cubic capacity bags **7**, pertinently large cubic capacity double bag **71**.

Industrial applicability

[0033] Method of construction the flood-protection system may be utilized advantageously everywhere takes place a need to reinforce and/or to elevate existing embankments and levees of the watercourses and/or for building of new ramparts and barriers. Utilization of the method herein is advantageous especially in case of acute danger overtopping the dam and/or flood levee with the flood wave as well as in case of threat danger of their break.

Claims

1. A method of building-up of a flood protection system using large spatial bags for building or fortification of protective levee of an endangered embankment of a water course, **characterized in that** according to a hydraulic engineering model of the flood protection
 - at least one preparation and control station is established in the center of the endangered territory into which components of filling mixture for the large spatial bags are consecutively transported, said filling mixture being then subsequently produced of said components,
 - at least one transport pumping station is established in the center of the endangered territory,
 - on the endangered embankment or levee of the water course empty large spatial bags are placed,
 - said empty large spatial bags are then coupled through a pipeline main with the transport pumping station,
 - the filling mixture prepared in the preparation station is then transported from the preparation station by a mobile conveyor to the transport pumping station, and
 - said mixture is filled by a transport pump and through the pipeline main into the large spatial bags.

Patentansprüche

1. Verfahren zum Aufbau eines Schutzsystems gegen Überflutungen mittels großvoluminöser Säcke zum Aufbau oder zur Verfestigung des Schutzdammes eines gefährdeten Wasserlaufufers, **dadurch gekennzeichnet,** **daß** nach einem hydrotechnischen Modell des Überflutungsschutzes im Zentrum des gefährdeten Gebietes zuerst einerseits zumindest eine Vorbereitungsstelle mit einer Steuerdispatchinganlage errichtet wird, zu welcher die Komponenten, aus welchen nachfolgend die Füllmischung der Großvolumensäcke hergestellt wird, durchlaufend zugeführt werden, und andererseits zumindest eine Förderpumpenstation errichtet wird, wobei an die gefährdeten Ufer oder den Damm des Wasserlaufes leere Großvolumensäcke angeordnet werden, die nachher mittels eines Rohrleitungsnetzes mit der Förderpumpenstation verbunden werden, wonach die hergestellte Füllmischung aus der Vorbereitungsstelle mittels eines mobilen Transportmittels in die Förderpumpenstation zugebracht wird, durch welche die Großvolumensäcke mittels einer Pumpenanlage und des Rohrleitungsnetzes gefüllt werden.

Revendications

1. Procédé de création d'un système de protection contre les inondations utilisant de grands sacs spacieux pour la construction ou fortification d'une levée protectrice d'une digue menacée d'un cours d'eau, **caractérisé en ce que** selon un modèle d'ingénierie hydraulique de la protection contre les inondations
- au moins une station de préparation et de contrôle est établie au centre du territoire menacé dans laquelle des composants de mélange de remplissage pour les grands sacs spacieux sont transportés coup sur coup, ledit mélange de remplissage étant alors produit par la suite à partir desdits composants,
 - au moins une station de pompage de transport est établie au centre du territoire menacé,
 - sur la digue menacée ou la levée du cours d'eau, de grands sacs spacieux vides sont placés,
 - lesdits grands sacs spacieux vides sont alors couplés par une conduite maîtresse à la station de pompage de transport,
 - le mélange de remplissage préparé dans la station de préparation est alors transporté de la station de préparation par un convoyeur mobile à la station de pompage de transport, et
 - ledit mélange est amené par une pompe de transport et par la conduite maîtresse dans les grands sacs spacieux.

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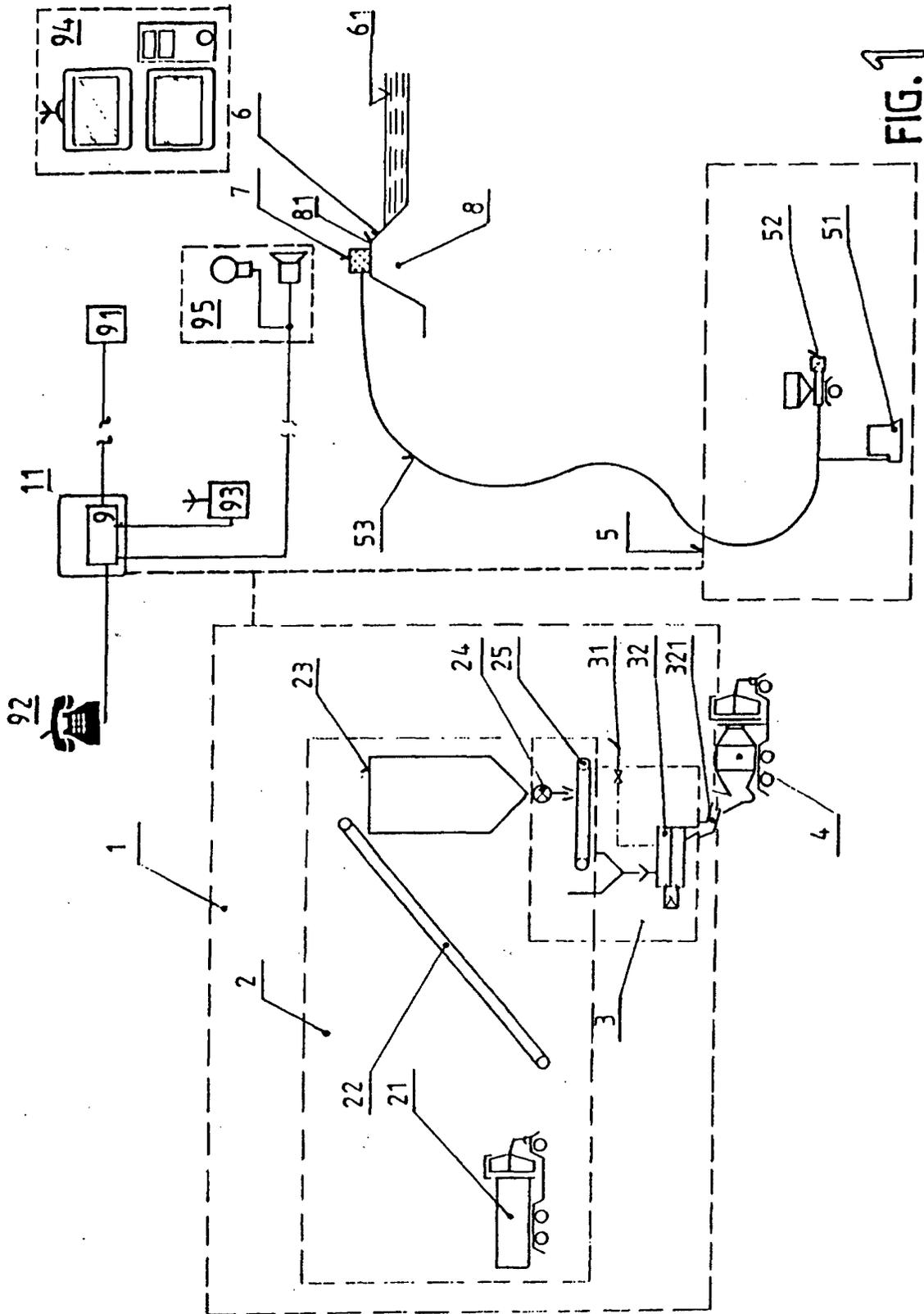


FIG. 1

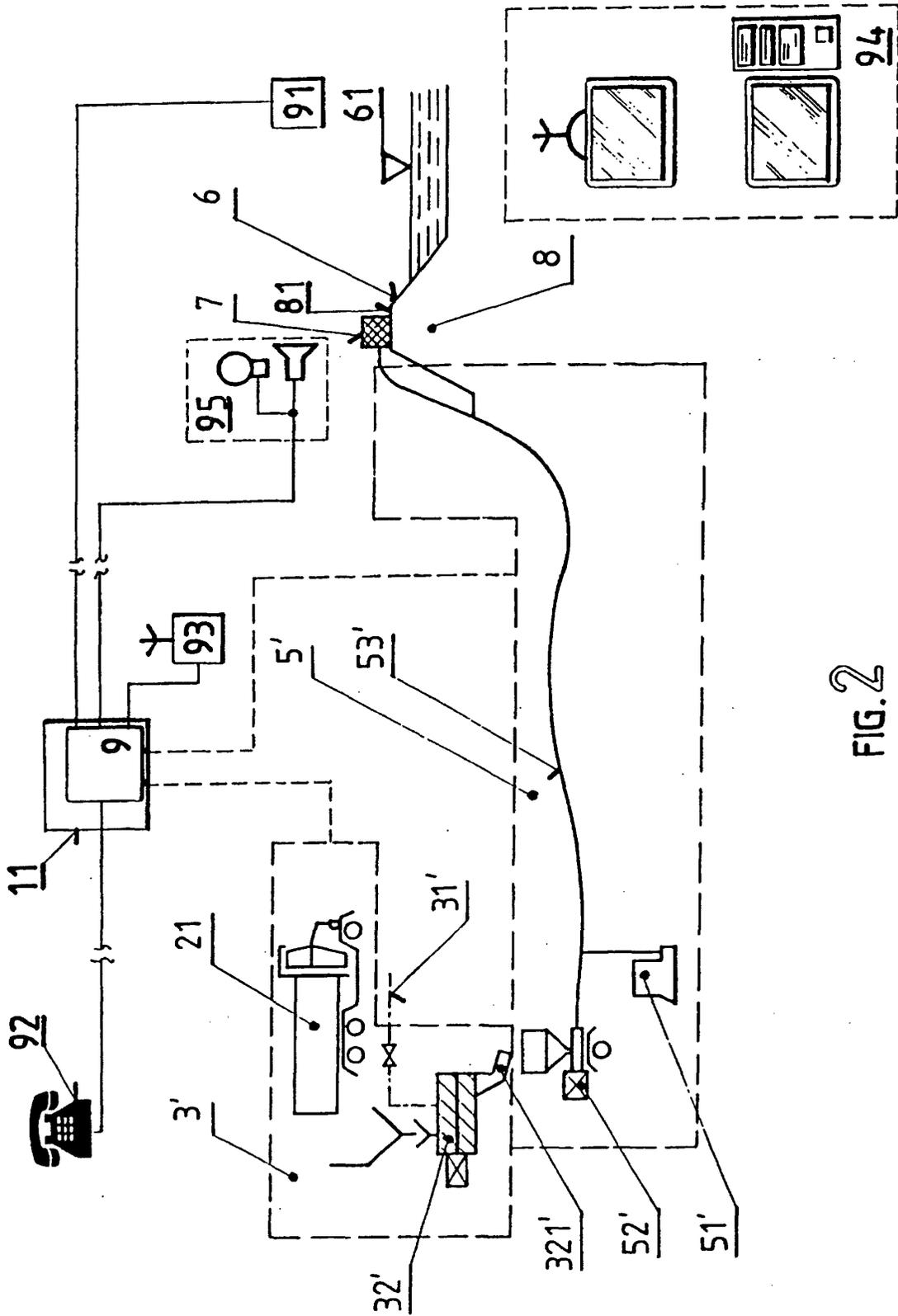


FIG. 2

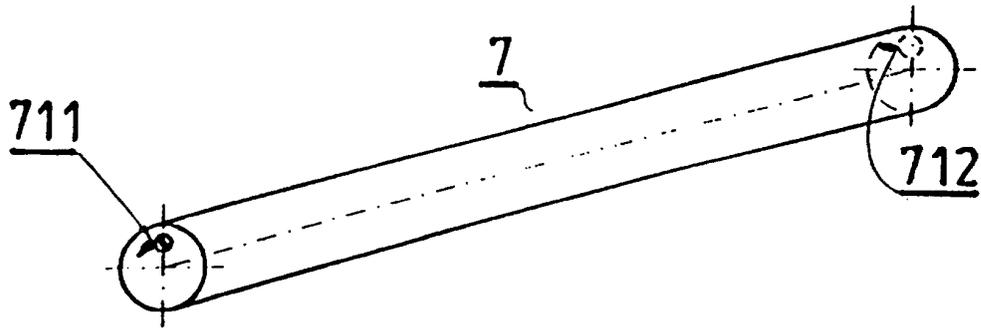


FIG. 3

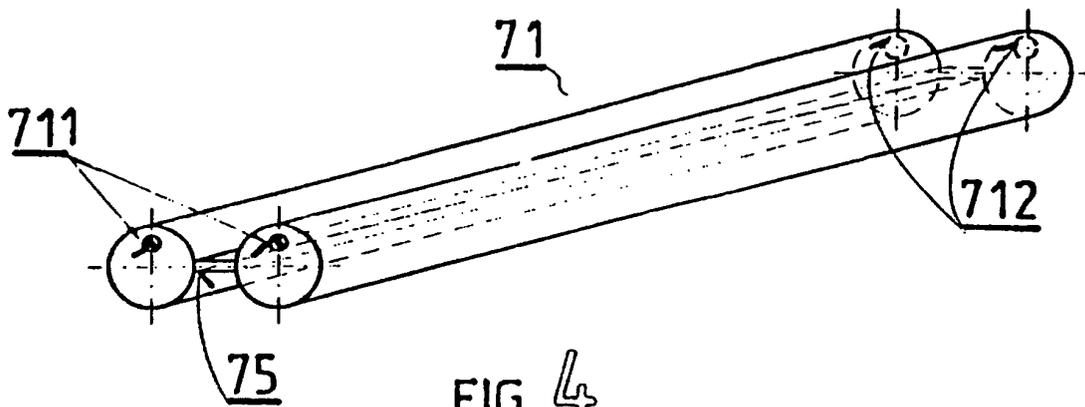


FIG. 4

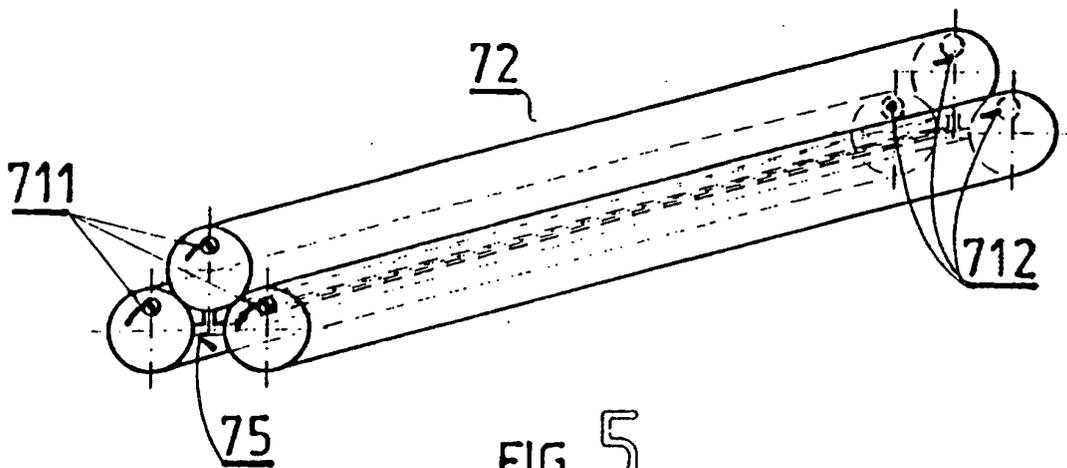


FIG. 5

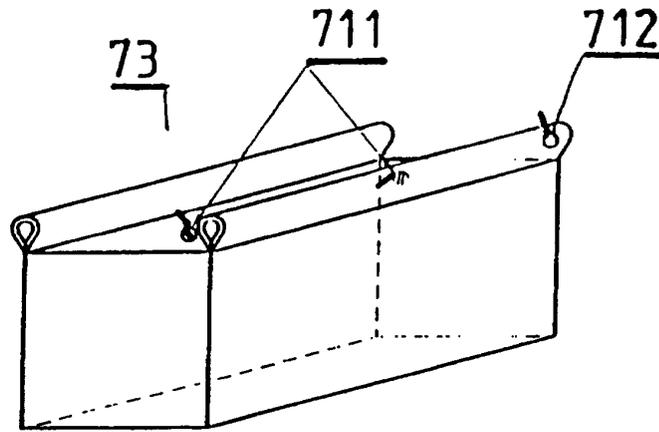


FIG. 6

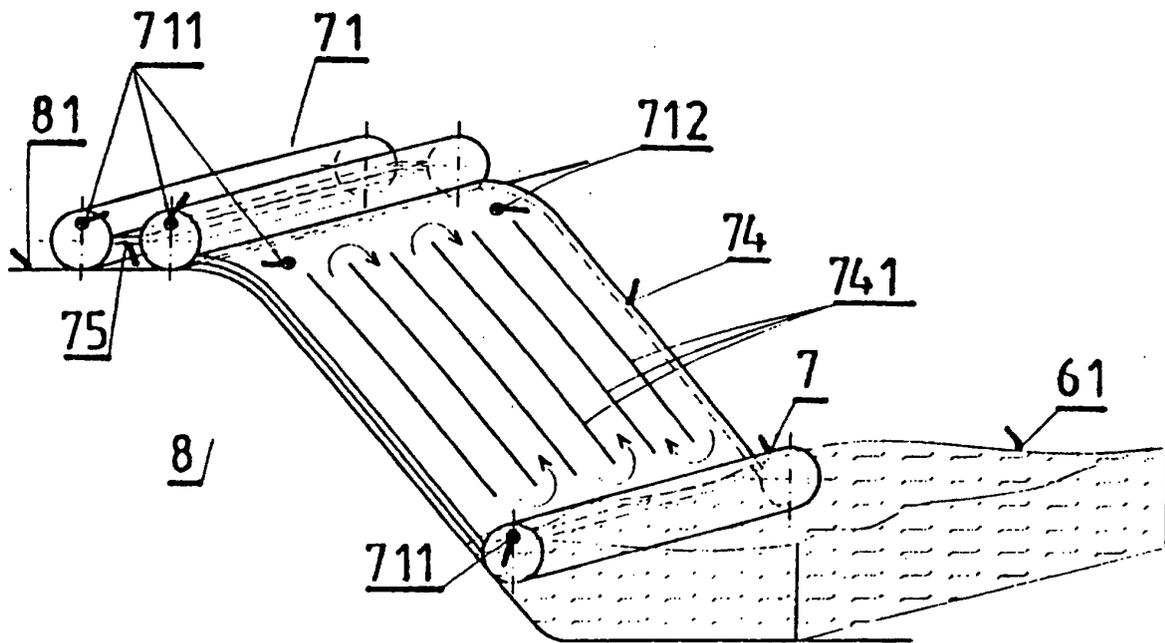


FIG. 7