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(54) **System for surface chemical or electrochemical treatment of small metal parts**

(57) A system for surface chemical or electrochemical treatment of small metal parts, comprising a frame supporting a plurality of tanks (2) arranged in succession, each associated with a corresponding receptacle (10) for containing the parts, each receptacle (10) being rigidly supported by a corresponding shaft (11) rotating about itself and having means for driving its rotation that can be switched between a first operating mode, in which they are programmed to carry out a reiterated oscillation of the shaft (11) with a first rotation angle (α) for subjecting the parts present in the receptacle (10) to mechanical shaking, and a second operating mode in which they are programmed to carry out a rotation of the shaft (11) with a second rotation angle (β) that is greater than the first rotation angle (α) so as to bring the receptacle (10) into a position for unloading the parts present therein.

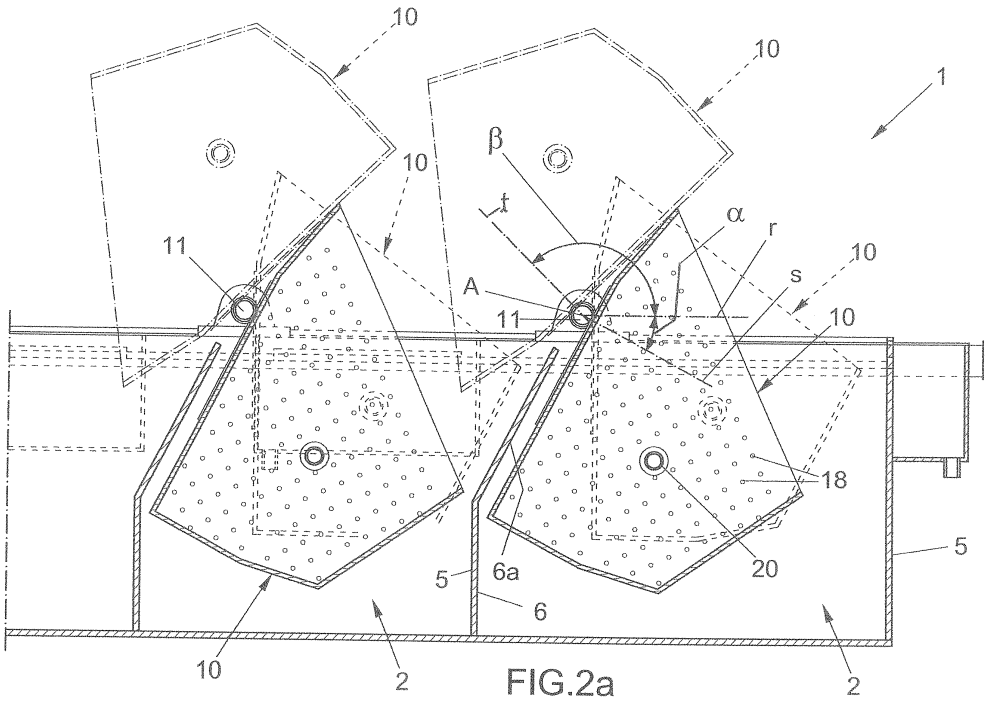

FIG.2a

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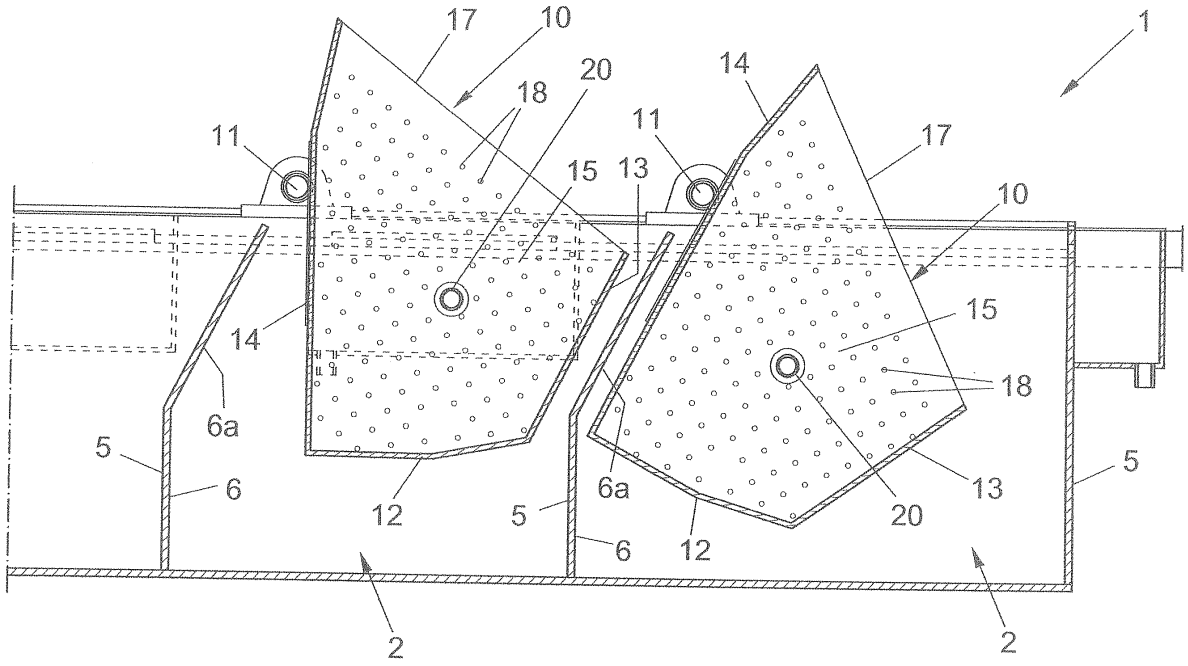
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FIG.2b

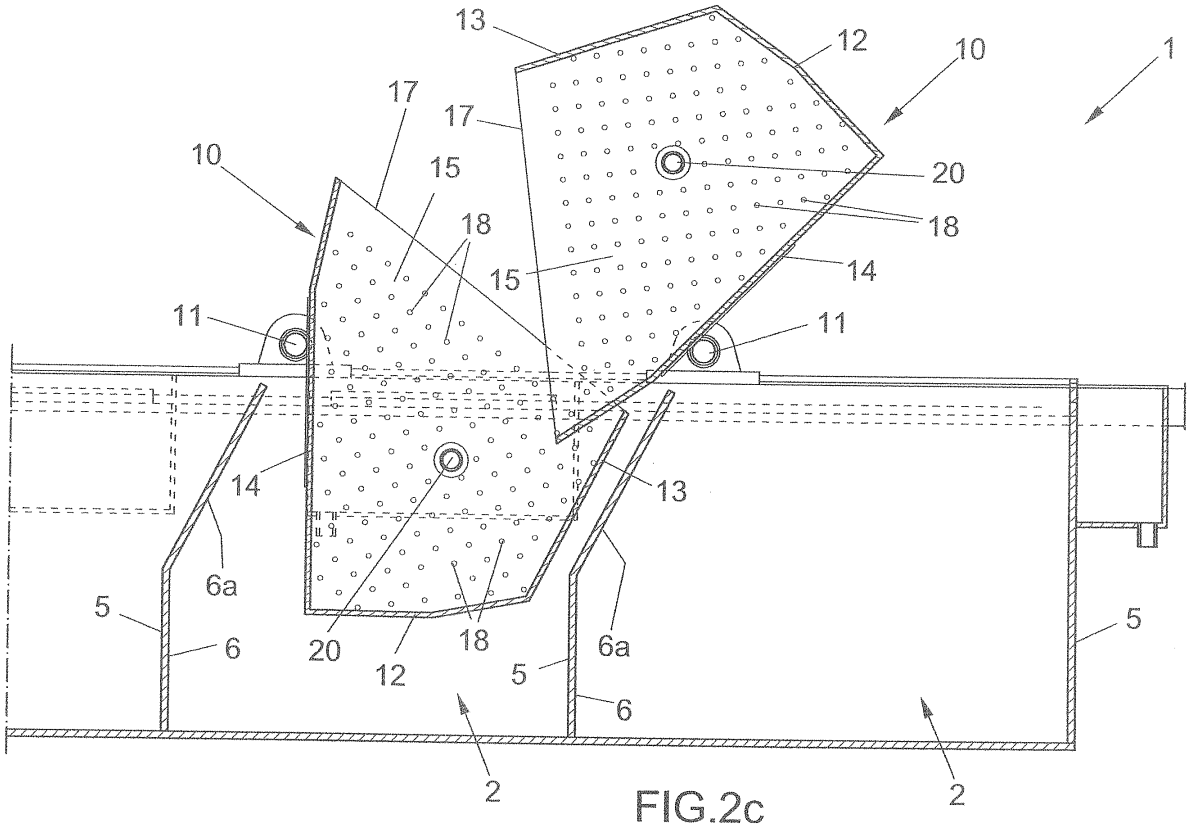
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FIG.2c

Description

[0001] The present invention relates to a system for surface chemical or electrochemical treatment of small metal parts, for example, but not necessarily, a cataphoretic and electrolytic electrodeposition system for small metal parts.

[0002] In a cataphoretic and electrolytic electrodeposition system, upstream of the electrodeposition station there is a series of treatment stations which subject the small metal parts to a succession of treatments serving to prepare the small metal parts for electrodeposition.

[0003] Such treatment stations, for example degreasing and washing stations, are defined by a succession of tanks which have a specific bath according to the type of pretreatment.

[0004] At present, in order to move the small metal parts from one tank to the next, the small metal parts are generally positioned in a perforated receptacle that is immersed in a tank for the period necessary for the required treatment and then transferred into the subsequent tank by means of a special robotized arm having two vertical and horizontal translation axes.

[0005] The receptacle is generally a cylindrical barrel with a horizontal axis positionable in the tanks, where it is rotatably supported on its axis so as to carry out a number of 360° rotations.

[0006] The barrel has a longitudinal mouth fashioned along its side wall for access of the parts, a removable cover for closing off its access mouth, and external rotation pins at its base which are engageable in a specific device for drawing it in rotation.

[0007] A system for feeding small metal parts such as the one described has several drawbacks.

[0008] Firstly, a considerable amount of the bath remains attached to the container extracted from the bath of a tank and the container carries it along with it and introduces it into the next tank, with a consequent consumption of the bath in the first tank and contamination of the bath in the next tank. In short, this makes it necessary not only to replenish the bath in the first tank but also to replace the bath in the next tank when the contamination exceeds a certain limit that undermines correct execution of the treatment. If the treatment consists in washing, this means a constant replenishment of water.

[0009] Secondly, the construction of the container is rather complicated because it necessarily requires a cover to prevent the parts from falling out during the complete rotation of the container, a system for closing the cover, and a system for coupling to the device for drawing it in rotation.

[0010] Thirdly, the inclusion of a robotized arm that moves vertically and horizontally along the feed direction of the parts leads to a further complication in terms of the system's construction and the availability of free space for carrying out the movements.

[0011] The technical task of the present invention is thus to provide a system for surface chemical or electrochemical treatment of small metal parts makes it possible to eliminate the aforementioned technical drawbacks of the prior art.

[0012] Within the scope of this technical task, one object of the invention is to provide a system for surface chemical or electrochemical treatment of small metal parts which enables a substantial reduction in the consumption of treatment baths and/or of water in the baths.

[0013] Another object of the invention is to provide a system for surface chemical or electrochemical treatment of small metal parts which is highly efficient and simple and economical in construction.

[0014] Yet another object of the invention is to provide a system for surface chemical or electrochemical treatment of small metal parts that is versatilely adaptable to applications of different types, particularly to particularly to coating by cataphoresis, treatments suitable for imparting corrosion resistance, brilliance, and abrasion resistance, and surface activation and passivation treatments.

[0015] The technical task, as well as these and other objects of the present invention are achieved by providing a system for surface chemical or electrochemical treatment of small metal parts, comprising a frame supporting a plurality of tanks arranged in succession, characterized in that each has associated with it a corresponding receptacle for containing the parts and having a plurality of passage holes for a treatment bath with which the tank can be filled, each receptacle being rigidly supported by a corresponding shaft rotating about itself and having means for driving its rotation that can be switched between a first operating mode, in which they are programmed to carry out a reiterated oscillation of the shaft with a first rotation angle for subjecting the parts present in the receptacle to mechanical shaking, and a second operating mode in which they are programmed to carry out a rotation of the shaft with a second rotation angle that is greater than the first rotation angle so as to bring the receptacle into a position for unloading the parts present therein.

[0016] Advantageously, the successive tanks are separated by delimiting walls that have a base part and an upper part that is bent relative to the base part in a direction opposite the one in which the parts are fed through the succession of the tanks. Moreover, the rotation shaft of the receptacle is disposed above the respective tank in a rearward position relative to the base part of the delimiting wall.

[0017] Preferably, the rotation shaft of the receptacle is disposed substantially on the extension of the upper part of the delimiting wall.

[0018] Advantageously, the consumption of treatment liquid is extremely reduced due to the fact that each receptacle, in the unloading position, is not immersed in the subsequent tank, which simply has the receptacle positioned over it for the time necessary to complete the transfer of the parts to the subsequent receptacle. Fur-

thermore, preferably in the unloading position, the receptacle is also positioned over the corresponding tank into which, therefore, at least part of the treatment liquid remaining in the receptacle is conveyed as it drips through the holes of the receptacle.

[0019] The savings in the consumption of the treatment liquid used to treat the parts are twofold: the transfer, from one tank to another, of the treatment liquid - which impregnates the receptacle once it is extracted from the tank - is limited and the contamination of one bath with the treatment liquid of the upstream bath is limited. For example, if a first tank contains a degreasing bath and the subsequent tank a washing bath, the savings substantially derive from the fact of not immersing the receptacle impregnated with the degreasing solution in the washing bath, taking into account the fact that the receptacle generally has a considerable size and consequently a large surface area impregnated with the degreasing solution.

[0020] The special solution adopted makes it possible to avoid providing for a robotized arm and thus results in a simplification in the system's construction and a reduction in its overall dimensions and cost.

[0021] The productivity of the system is likewise improved thanks to the coordinated actuation of the shafts of the various tanks during the performance of the various treatments and for transferring parts from one receptacle to another.

[0022] Other features of the present invention are also defined in the claims hereunder.

[0023] Additional features and advantages of the invention will become more apparent from the description of a preferred, but not exclusive embodiment of the system for surface chemical or electrochemical treatment of small metal parts according to the invention, illustrated by way of non-limiting example in the appended drawings, in which:

figure 1 shows a rear schematic view of one part of the system;

figure 2a shows a side elevation view of the system part in figure 1,
from which part of the tank support frame has been removed for the sake of clarity, and in which the receptacles are illustrated in the various achievable operating positions;

figure 2b shows a side elevation view of the system part in figure 1, from which part of the tank support frame has been removed for the sake of clarity, during treatment of the parts in the containers positioned in the two adjacent tanks, wherein the receptacle on the right is at the initial end of its oscillation stroke in the first operating mode and the receptacle on the left is at the final end of its oscillation stroke in the first operating mode;

figure 2c shows a side elevation view of the system part in figure 1, from which part of the tank support frame has been removed for the sake of clarity, in which the receptacle is at the terminal end of its rotation in the second operating mode and the receptacle on the left associated with the subsequent tank is at the terminal end of its oscillation stroke in the first operating mode, in a suitable position for receiving parts from the upstream receptacle;

figure 3 shows a perspective view of a specific construction for a receptacle.

[0024] With reference to the aforementioned figures, only one part of a system for surface chemical or electrochemical treatment of small parts is shown, for example, but not necessarily, a galvanic treatment system.

[0025] In particular, there is shown a section of the system upstream of the station for galvanically treating the parts, where the parts are prepared for the galvanic treatment by means of treatments, in sequence, of degreasing, washing, activation and phosphating, which can be performed by conveying the parts forward through a plurality of open-top tanks arranged in succession, each fillable with a specific treatment liquid.

[0026] The treatment bath in one tank can be the same as or different from the treatment bath in the tank adjacent.

[0027] Of the treatment tanks, only 2 adjacent ones are illustrated by way of example in the drawings.

[0028] The number of tanks can obviously vary according to need, as can the treatment baths.

[0029] All of the tanks 2 are supported by a frame which has a horizontally disposed longitudinal resting base 3 for the tanks and vertical shoulders 4, 4' that extend along the longitudinal sides of the resting base 3.

[0030] All of the tanks in the system are entirely confined within the longitudinal compartment delimited between the shoulders 4, 4' of the frame and in particular they follow one another in a straight line in the longitudinal direction of this compartment.

[0031] The tank 2 comprises a rear vertical wall 5 oriented transversely to the longitudinal axis of the frame, a front vertical wall 6 opposite the rear wall 5 and oriented transversely to the longitudinal axis of the frame, a first lateral vertical wall 7 oriented parallel to the longitudinal axis of the frame, a second lateral vertical wall 8 opposite the first side wall 7 and oriented parallel to the longitudinal axis of the frame, and a quadrangular bottom wall 9 from whose perimeter sides the walls 5, 6, 7 and 8 extend.

[0032] The front wall 6 has an upper part 6a bent toward the rear wall 5. The front wall 6 of one tank 2 coincides with the rear wall 5 of the subsequent tank 2. The side walls 7 of the tanks 2 are mutually coplanar and of equal height, just as the side walls 8 of the tanks 2 are mutually coplanar and of equal height.

[0033] Each tank 2 has associated with it a corresponding receptacle 10 for containing the parts.

[0034] Each receptacle 10 is rigidly supported by a corresponding shaft 11 rotating about itself.

[0035] Each receptacle 10 comprises, specifically, a quadrangular bottom wall 12 from whose perimeter sides

extend a rear wall 13, a front wall 14, and two opposite side walls 15 and 16.

[0036] The rear wall 13 has a lower height than that of the front wall 14 relative to the bottom wall 12. The side walls 15, 16 are vertical and parallel to the longitudinal axis of the compartment defined by the frame.

[0037] The free edge of the walls 13, 14, 15 and 16 delimits a mouth 17 for loading and unloading the parts.

[0038] The walls 13, 14, 15 and 16 have a plurality of calibrated holes 18 passing through their thickness to permit the passage of the treatment liquid from the inside to the outside of the receptacle 10 and vice versa.

[0039] The holes 18 can be distributed over the entire extent of the walls 13,14, 15 and 16 or located in some areas thereof.

[0040] Each shaft 11 has corresponding means for driving its rotation that can be switched between a first and a second operating mode.

[0041] The driving means preferably comprise a gear motor 19 connected to one end of the shaft 11.

[0042] In first operating mode the driving means are programmed to carry out a reiterated oscillation of the shaft 11, with a first rotation angle α, between two angular reference positions identified by planes r and s passing through the geometric axis A of the shaft 11, so as to subject the parts present in the receptacle 10 to mechanical shaking.

[0043] In the second operating mode, the driving means are programmed to carry out a rotation of the shaft 11, with a second rotation angle β that is greater than the first rotation angle α, between the angular reference position identified by the plane r and an angular reference position identified by a plane t passing through the geometric axis A of the shaft 11, so as to bring the receptacle 10 into a position for unloading the parts present therein.

[0044] In the specific case illustrated, the angular reference position of the shaft 11 identified by the plane r represents the starting end for executing both the first rotation angle α and the second rotation angle β. The first rotation angle α, and the second rotation angle β are thus executed with an opposite direction of rotation starting from the angular reference position identified by the plane r.

[0045] The shaft 11 is disposed in such a way that irrespective of the angular position assumed during execution of the first rotation angle α, the corresponding receptacle 10 is positioned in the corresponding tank 2 with the loading and unloading mouth 17 above the bottom wall 12.

[0046] The shaft 11 is also disposed in such a way that, on completion of the second rotation angle β, the corresponding receptacle 10 will assume a tipped over position wherein the mouth 17 is below the bottom wall 12 and set over the subsequent tank 2 so as to transfer the parts by a gravity-induced fall into the receptacle 10 of the subsequent tank 2.

[0047] In the tipped over position assumed upon completion of the second rotation angle β, the receptacle 10 will be completely outside the corresponding tank 2.

[0048] Each shaft 11 is orientated horizontally and transversely to the direction of alignment of the tanks 2.

[0049] Each shaft 11 is in particular disposed above the tank 2 of the receptacle 10 it is associated with, in a position adjacent to the subsequent tank 2.

[0050] All of the shafts 10 are fixed to the shoulders 4, 4' of the support frame and all lie in a same horizontal plane.

[0051] Each the shaft 11 is positioned externally to the corresponding receptacle 10 and, more precisely, has a fastening plate 21 for the side wall 14 of the corresponding receptacle 10.

[0052] The disposition of the shaft 11 is such that, in the tipped over position assumed upon completion of the second rotation angle β of the shaft 11, the corresponding receptacle 10 has one part positioned over the corresponding tank 2 and one part, including the mouth 17, positioned over the subsequent tank 2.

[0053] In the specific constructive solution adopted for the receptacle 10, a perforated pipe 20 is provided inside it for loading the treatment bath, connected to a line for recirculating the treatment bath the tank is filled with.

[0054] The perforated pipe 20 is supported between the shoulders 15, 16 of the receptacle and extends rectilinearly in a direction parallel to the shaft 11.

[0055] The receptacle 10 also has associated with it an internal compressed air nozzle (not shown) to assist the mechanical shaking of the parts during the treatment in the treatment bath and detachment from the walls of the receptacle during unloading. Different constructive solutions are obviously conceivable for the receptacle 10, all falling within the scope of the present invention.

[0056] For example, the treatment bath can also be loaded into the receptacle 10 through the holes 18 of the walls 12, 13, 14, 15, 16 of the receptacle 10, as occurs for unloading.

[0057] The operation of the system is briefly as follows.

[0058] Initially, the first receptacle 10 associated with the first tank 2 in the succession of tanks 2 is set in a parts loading position in which the corresponding shaft 11 is stationary in the angular reference position indicated by the plane r. A suitable external hopper (not shown) loads the parts into this first receptacle 10.

[0059] After the parts have been loaded, the driving means of the rotation shaft 11 of the first receptacle 10 are activated in the first operating mode, wherein the rotation shaft 11 of the first receptacle 10 rotates from the angular reference position indicated by the plane r to the angular reference position indicated by the plane s, then carries out a reverse rotation from the angular reference position indicated by the plane s to the angular reference position indicated by the plane r, and repeats this oscillation cycle a certain number of times. In this first operating mode, the amplitude of the angular oscillation of the first receptacle 10 is such that the first receptacle 10 remains partially immersed below the level of the liquid the first tank 2 is filled with and maintains the mouth 17

always above the bottom wall 12 in such a way as to subject to the parts contained inside it to mechanical agitation without the risk of them falling out while they are immersed in the treatment bath. In order to best exploit all of available space inside the tank 2, in the angular reference position of the shaft 11 identified by the plane s, the receptacle 10 is positioned with its front wall 14 adjacent to the inner side of the bent part 6a of the front wall 6 of the tank 2 so as to amplify the first oscillation angle α, and hence the effect of mechanical agitation on the parts, to the maximum degree.

[0060] By way of example, the first rotation angle is comprised between 20° and 40°.

[0061] At the end of the time required to carry out the treatment in the bath of the first tank 2, the driving means of the rotation shaft 11 of the first receptacle 10 switch to the second operating mode and are activated, moving the rotation shaft 11 of the first receptacle 10 from the angular reference position indicated by the plane r to the angular reference position indicated by the plane t, in which the rotation shaft 11 of the first receptacle 10 remains stationary for the time necessary to unload the parts.

[0062] In the angular reference position of the rotation shaft 11 of the first receptacle 10 identified by the plane t, the first receptacle 10 is positioned with its front wall 14 adjacent to the outer side of the bent part 6a of the front wall 6 of the corresponding tank 2 so as to make it possible for the parts to be unloaded in the front area of the subsequent tank 2.

[0063] By way of example, the second rotation angle is comprised between 130° and 140°.

[0064] In the angular reference position of the rotation shaft 11 of the first receptacle 10 indicated by the plane t, the first receptacle 10 is tipped over with its mouth 17 set over the subsequent second tank 2. In this phase, the rotation shaft 11 of the subsequent second receptacle 10 associated with the subsequent second tank 2 remains stationary in the angular reference position indicated by the plane r, in which the second receptacle 10 receives the mouth 17 of the first receptacle 10 in its own mouth 17 so that the transfer of the parts from the first receptacle 10 to the second receptacle 10 can take place by a gravity-induced fall: in particular, the falling parts slide along the front downward-inclined wall 14 of the first receptacle 10 and then along the rear wall 13 of the second receptacle 10, which is also inclined downward.

[0065] After the transfer of the parts, the driving means of the rotation shaft 11 of the first receptacle 10 are activated so as to rotate it in the opposite direction up to the angular reference position for receiving a load of new parts to be treated, identified by the plane r, while the driving means of the rotation shaft 11 of the second receptacle 10 are activated in the first operating mode, wherein the rotation shaft 11 of the second receptacle 10 rotates from the angular reference position indicated by the plane r to the angular reference position indicated by the plane s, then carries out a reverse rotation from the angular reference position indicated by the plane s to the angular reference position indicated by the plane r, and repeats this oscillation cycle a certain number of times so as to subject the parts previously treated in the first tank 2 to the second treatment in the second tank 2.

[0066] The parts are thus made to advance from one tank 2 to the subsequent tank 2 and up to the last tank 2, from which they are transferred to the station where the galvanic treatment will take place.

[0067] The treatment tanks and associated receptacles as described above can also obviously be downstream of the galvanic treatment station.

[0068] It should be noted that the system achieves a considerable reduction in the consumption of treatment baths and washing water, with a consequent decrease in supply, purification and disposal costs.

[0069] The sequential treatment of small metal parts through the tanks of the system of the present invention can be easily automated and managed without complex, careful checks by specialized personnel. To this end it is simply necessary to coordinate the treatment, loading and unloading times among the various tanks and to coordinate, accordingly, the programming of the driving means in rotating the rotation shafts of the receptacles.

[0070] The cost of treatment is extremely lower than with traditional treatments, also by virtue of the decrease in the cost of labour tied to a simpler management of the system.

[0071] Advantageously, the same system can be used, with the sole replacement of the treatment baths, in various types of applications that involve a chemical or electrochemical treatment of small metal parts.

[0072] The system for surface chemical or electrochemical treatment of small metal parts thus conceived is susceptible of numerous modifications and variants, all falling within the scope of the inventive concept; moreover, all the details may be replaced with technically equivalent elements.

[0073] In practice, all of the materials used, as well as the dimensions, can be any whatsoever according to need and the state of the art.

Claims

1. A system for surface chemical or electrochemical treatment of small metal parts, comprising a frame supporting a plurality of tanks (2) arranged in succession, each tank (2) being associated with a corresponding receptacle (10) for containing the parts and having a plurality of passage holes (18) for a treatment bath with which the tank (2) can be filled, each receptacle (10) being rigidly supported by a corresponding shaft (11) rotating about itself and having means for driving its rotation, **characterized in that** said rotation driving means can be switched between a first operating mode, in which they are programmed to carry out a reiterated oscillation of

the shaft (11) with a first rotation angle (α) for subjecting the parts present in the receptacle (10) to mechanical shaking, and a second operating mode in which they are programmed to carry out a rotation of the shaft (11) with a second rotation angle (β) that is greater than the first rotation angle (α) so as to bring the receptacle (10) into a position for unloading the parts present therein, and **in that** the successive tanks are separated by delimiting walls (6) that have a base part and an upper part (6a) that is bent relative to the bottom part in a direction opposite the one in which the parts are fed through the successive tanks (2), the rotation shaft (11) of the receptacle being disposed above the respective tank (2) in a rearward position relative to the base part of the delimiting wall (6).

2. The system for surface chemical or electrochemical treatment of small metal parts according to the preceding claim, **characterized in that** the rotation shaft of the receptacle is disposed substantially on the extension of the upper part (6a) of the delimiting wall (6).

3. The system for surface chemical or electrochemical treatment of small metal parts according to either one of the preceding claims, wherein the receptacle (10) has a bottom wall (12) and a mouth (17) for loading and unloading parts opposite the bottom wall (12), **characterized in that** in the first operating mode said receptacle (10) is disposed in the tank (2) with which it is associated with its mouth (17) above the bottom wall (12).

4. The system for surface chemical or electrochemical treatment of small metal parts according to the preceding claim, **characterized in that** in the second operating mode, upon the completion of said second rotation angle (β) of the shaft (11), said receptacle (10) assumes a tipped over position wherein its mouth (17) is below the bottom wall (12) and set over the subsequent tank (2) so as to transfer the parts by a gravity-induced fall into the receptacle (10) of the subsequent tank (2).

5. The system for surface chemical or electrochemical treatment of small metal parts according to the preceding claim, **characterized in that** in said tipped over position assumed upon the completion of said second rotation angle (β), said receptacle (10) is positioned completely outside the tank (2) it is associated with.

6. The system for surface chemical or electrochemical treatment of small metal parts according to any preceding claim, **characterized in that** the tanks (2) follow each other in a horizontal straight line.

7. The system for surface chemical or electrochemical treatment of small metal parts according to the preceding claim, **characterized in that** said shaft (11) is orientated horizontally and transversely to the direction of alignment of the tanks (2).

8. The system for surface chemical or electrochemical treatment of small metal parts according to any preceding claim, **characterized in that** the shaft (11) is disposed externally to the receptacle (10).

9. The system for surface chemical or electrochemical treatment of small metal parts according to any preceding claim, **characterized in that** said receptacle (10) internally supports a perforated pipe (20) for loading the treatment bath, said loading pipe (20) being connected to a recirculation line for the treatment bath the tank (2) is filled with.

10. The system for surface chemical or electrochemical treatment of small metal parts according to any preceding claim, **characterized in that** said driving means comprise a gear motor (19) connected to one end of said shaft (11).

11. The system for surface chemical or electrochemical treatment of small metal parts according to the preceding claim, **characterized in that** said receptacle (10) has associated with it an internal compressed air nozzle to assist the mechanical shaking of parts during treatment in the treatment bath.

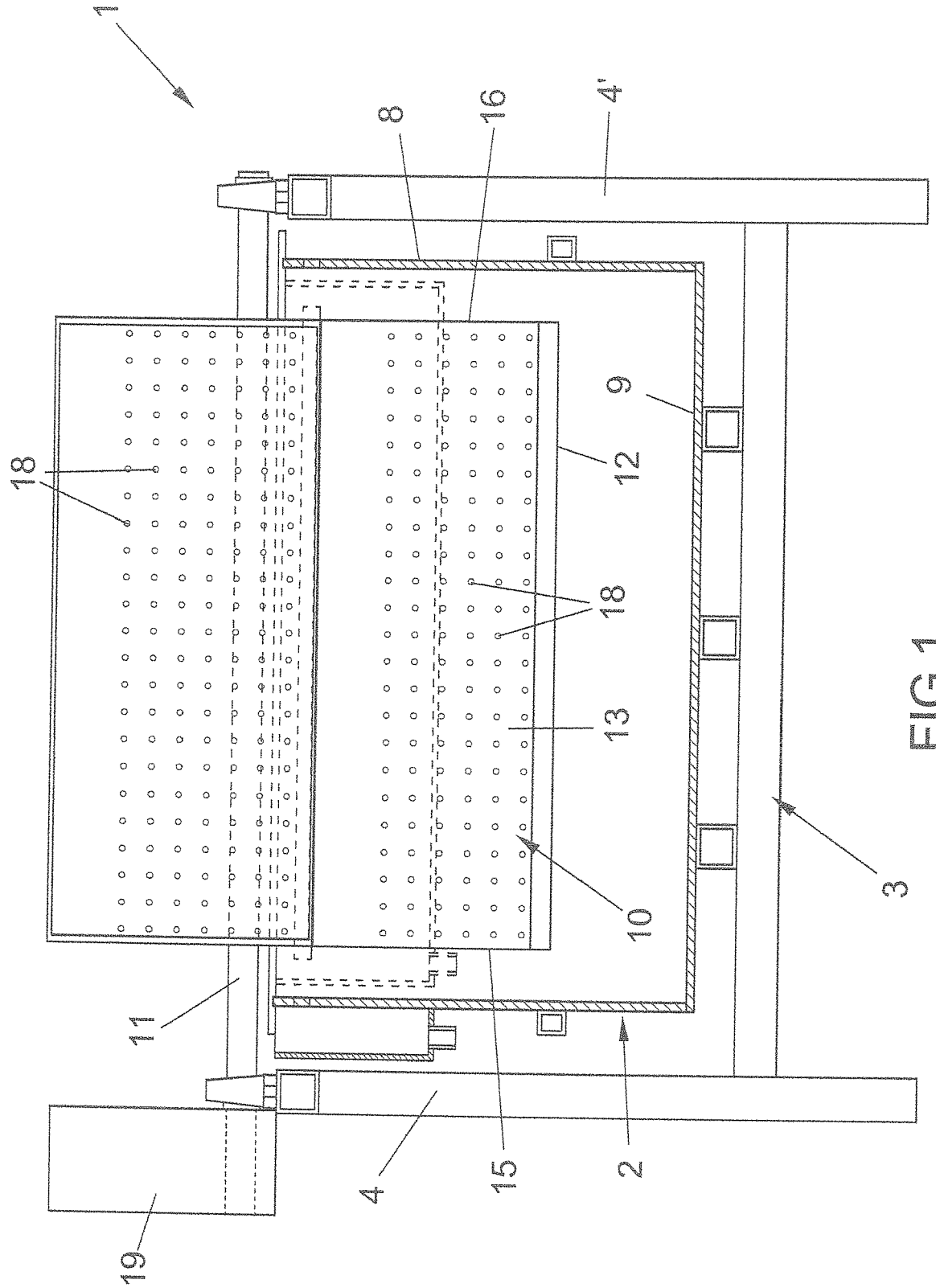

FIG.1

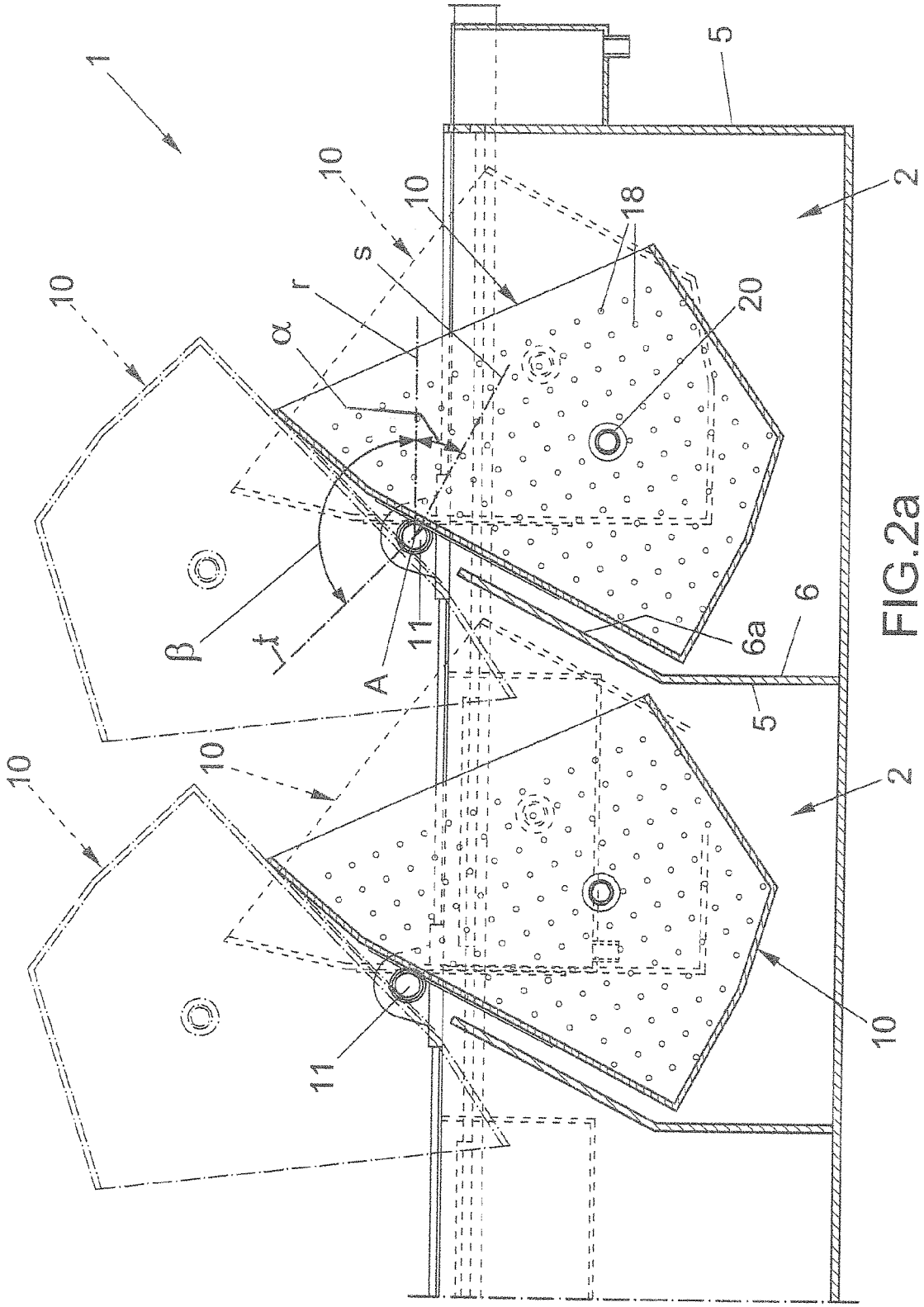

FIG.2a

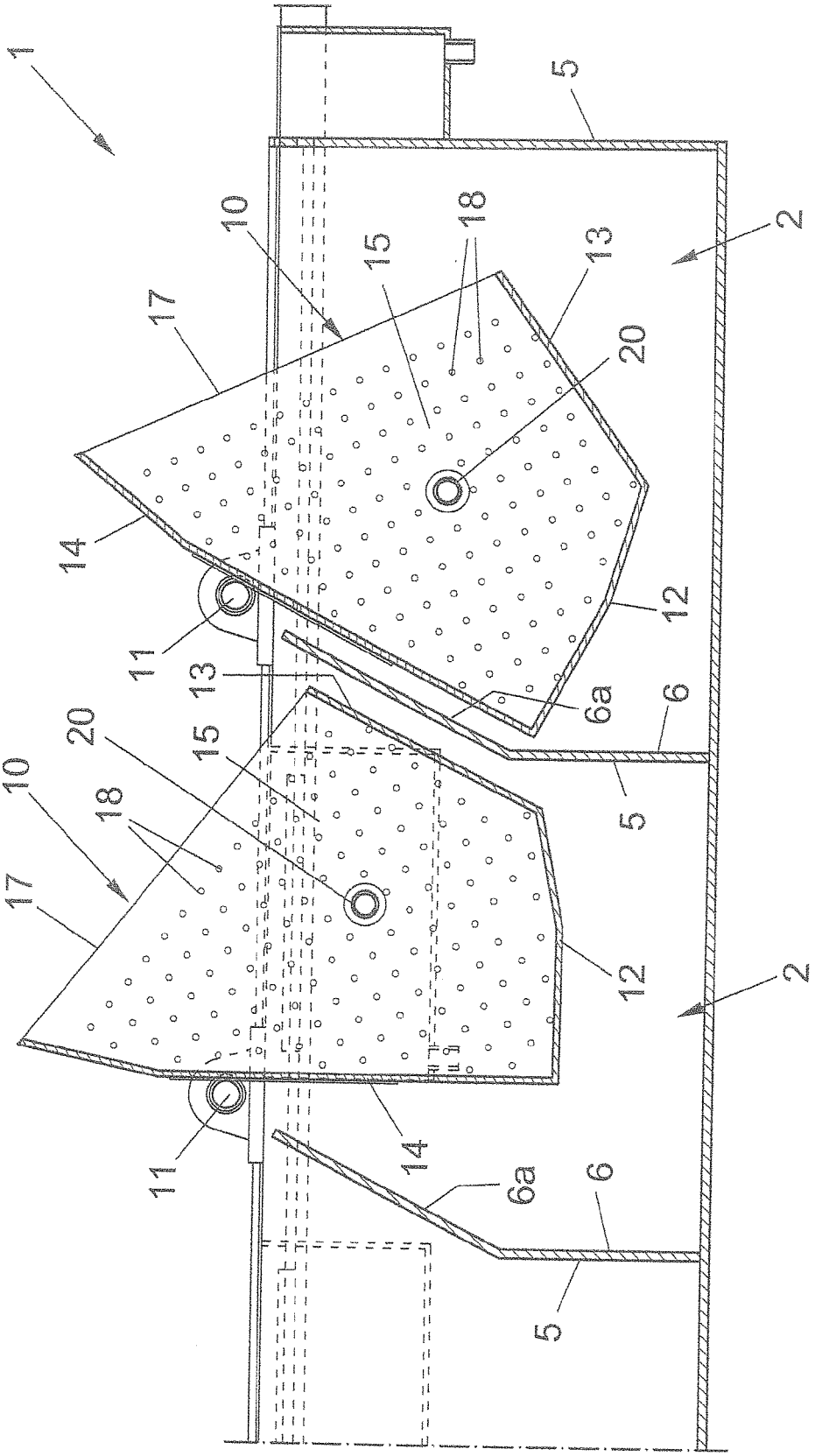

FIG.2b

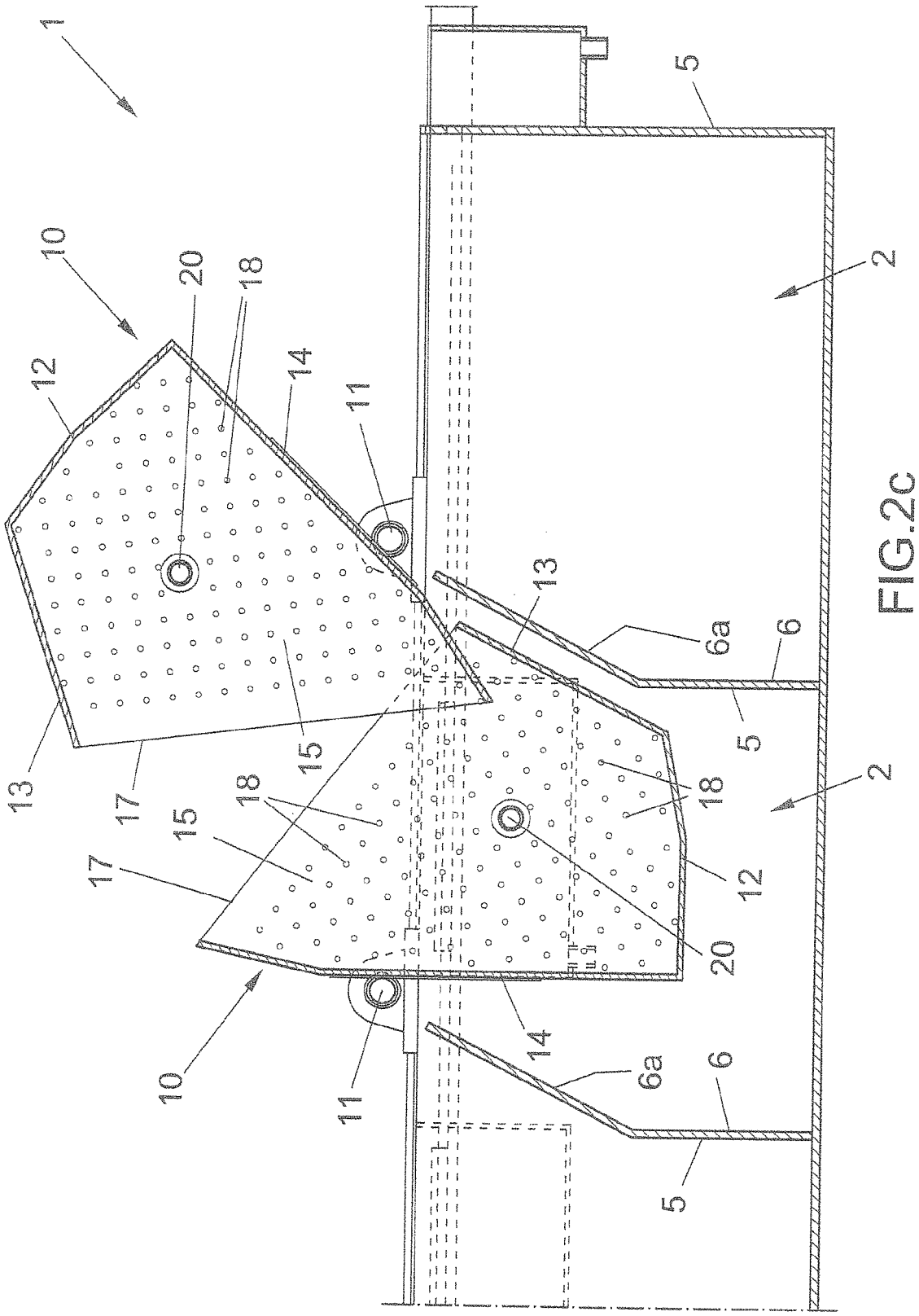

FIG.2c

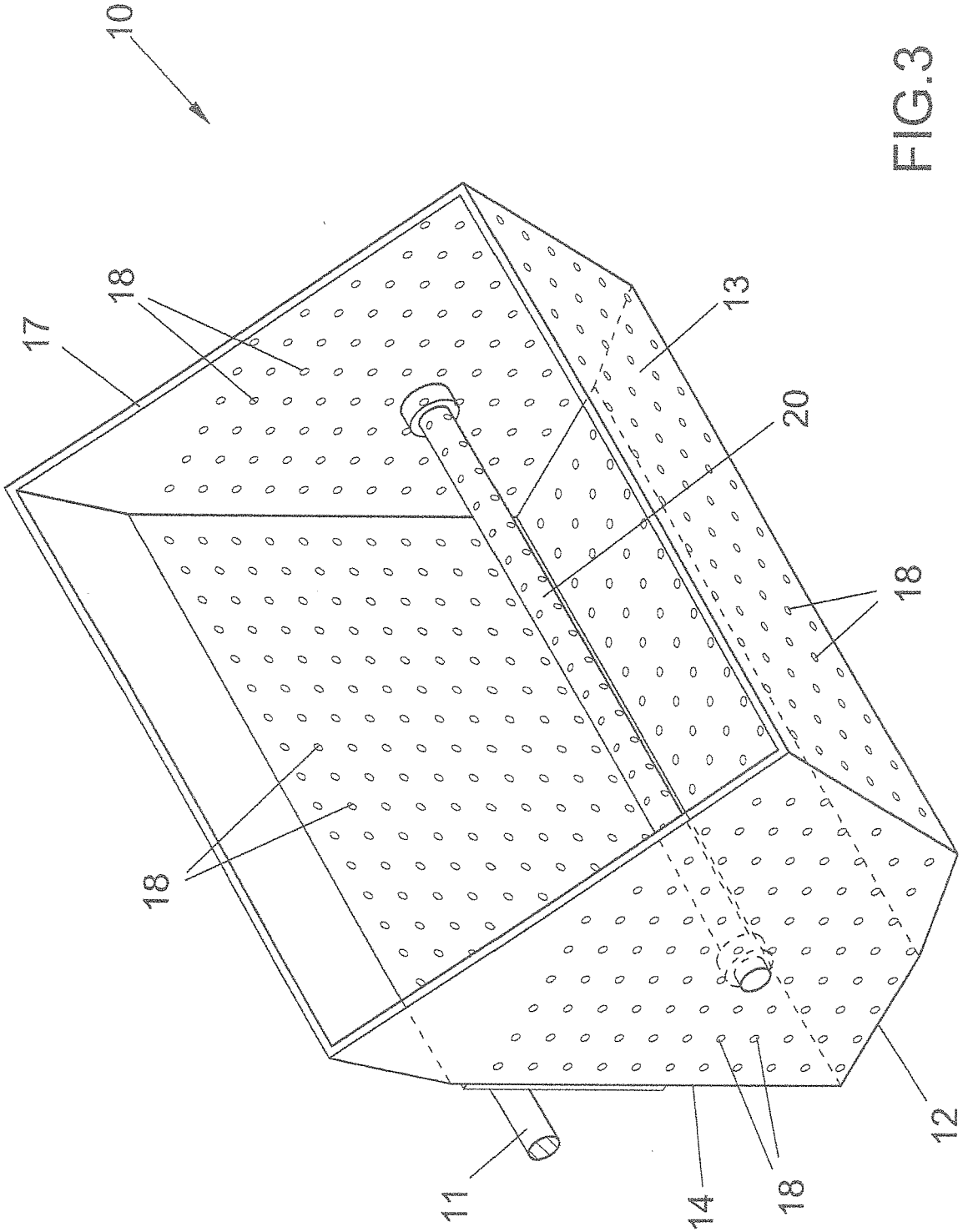

FIG.3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 14 19 0019

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 3 844 542 A (STRECKE H) 29 October 1974 (1974-10-29) * column 1, line 5 - column 1, line 26; figures 9-11 * * column 2, line 49 - column 2, line 51 * * column 3, line 20 - column 3, line 26 * -----	1-11	INV. C25D17/26 C25D17/02 B08B3/04
A	GB 2 018 824 A (SCHERING AG) 24 October 1979 (1979-10-24) * abstract; figure 2 * * page 1, lines 7-14 * * page 2, lines 18-34 * * page 2, lines 81-92 * * page 2, lines 119-129 * -----	1-11	

TECHNICAL FIELDS SEARCHED (IPC)

C25D
B65G
B65D
B08B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 November 2014	Telias, Gabriela

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 19 0019

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28-11-2014

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