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(73) Patenthaver: **Progress Maschinen & Automation AG, Julius-Durst-Strasse 100, 39042 Brixen, Italien**

(72) Opfinder: **Nussbaumer, Erich, St.-Vigil-Strasse 22, 39010 Nals, Italien**

(74) Fuldmægtig i Danmark: **Plougmann Vingtoft A/S, Rued Langgaards Vej 8, 2300 København S, Danmark**

(54) Benævnelse: **Fremgangsmåde til udvælgelse af forskallingsprofiler til fremstilling af en forskalling til et præfabrikeret betonbyggeelement og tilsvarende forskalling**

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US-A- 3 730 657

The invention relates to a method for the selection of formwork profiles which are arranged on a pallet for production of at least one formwork with a substantially closed inner circumferential edge for a polygonal, in particular rectangular concrete prefabricated building element, the formwork profiles to be positioned being selected according to the set value of their length which is determined in particular on the basis of a geometrical dataset for the concrete prefabricated building element to be produced.

In the methods known hitherto, to form for example a rectangular concrete prefabricated building element, fitting or overlong formwork profiles were selected for three sides, while for the fourth side, a formwork profile was selected, the standard length of which was slightly shorter than the side length to be formed, of the concrete prefabricated building element. The remaining gap was then filled with filler elements.

Apart from the enormous amount of time required for the manual production and positioning of the filler elements, when the concrete prefabricated building element is removed from the form, these filler elements also have to be removed manually, thereby resulting overall in an enormous time delay which is particularly disadvantageous if the concrete prefabricated building elements are produced in a production line.

DE 103 04 622 B3 and DE 101 16 230 C1 respectively disclose a method for erecting a formwork for precast concrete elements according to the preamble of claim 1, in which formwork profiles are arranged one after the other, and a formwork for a concrete prefabricated building element, to be produced on a pallet mould, according to the preamble of claim 9. To avoid curing of the precast concrete elements, a specific device is disclosed in each case, by which the formwork elements can be arranged one after the other without any gaps.

US 3, 730, 657 A discloses a device for pressing concrete which has not yet hardened, which device is also used as a formwork.

EP 1 273 407 A1 discloses a magnet positioning robot for the spatially positioned setting down and/or picking up of magnets to arrange formworks during the production of precast concrete elements, the magnet setting robot being able to pick up a plurality of magnets at the same time.

Proceeding from this prior art, the object of the invention is to provide a method for the selection of formwork profiles according to the teaching of claim 1, which method, while avoiding the above-mentioned disadvantages, allows a fast formwork erection and formwork removal and is particularly suitable for use in automated production lines.

The selection method according to the invention achieves this object and avoids the disadvantages associated with the methods known from the prior art, in that to configure at least one side of the formwork to be produced, at least two formwork profiles which are to be arranged one after the other in the longitudinal direction are selected.

Thus, with the method according to the invention, no longer is the closest fitting shorter standard length selected as before, but starting from the required side length for the concrete prefabricated building element to be produced, a combination of a plurality of formwork profiles having standard lengths is sought.

In this respect, the invention provides that the formwork profiles are selected such that the total amount of the longitudinal extensions of the at least two formwork profiles to be arranged one after the other is less than the length of the side of the formwork, to be produced.

In this respect, smaller spacings between the formwork profiles placed in series are not very significant. To prevent the concrete from flowing out, a further exemplary embodiment of the invention provides that the total amount of the longitudinal extensions of the formwork profiles to be arranged one after the other is smaller than the length of the side of the formwork to be produced by a value not exceeding f.

It has been found to be practical if f is characterised by the equation $f = (x + 1)$ times 1.5 cm, x representing the number of formwork profiles to be arranged one after the other and the distance between the single formwork profiles arranged one after the other is at most 1.5 cm and, a preferred embodiment provides that f is characterised by the equation $f = (x + 1)$ times 1 cm, x representing the number of formwork profiles to be arranged one after the other and the distance between the single formwork profiles arranged one after the other being at most 1 cm.

It has been found to be advantageous, particularly in the case of pallet circulation systems, in respect of reducing the working time at the formwork station if the formwork profiles are arranged on a pallet by a program-controlled robot.

A method is also provided for the production of at least one formwork for a polygonal, in particular rectangular concrete prefabricated building element from a plurality of formwork profiles, selected according to the invention, on a pallet of a pallet circulation system, according to which formwork profiles are exclusively used which are of a substantially identical configuration having standard lengths for building a substantially closed inner circumferential edge, the number of formwork profiles which are used being greater than the number of the sides of the polygonal concrete prefabricated building element to be produced.

Thus in other words, more formwork profiles of a standardised length are used for the production of the formwork than the number of sides of the polygonal concrete prefabricated building element to be produced.

As a result, although a plurality of different lengths of standard profiles have to be kept in stock compared to the prior art, this disadvantage is more than compensated by the time which is saved during erection of the formwork and removal of the formwork, which due to the invention can now also be carried out entirely by a forming robot.

The invention further relates to a formwork for an, in particular, rectangular, concrete prefabricated building element to be produced on a pallet according to the teaching of claim 9, the substantially closed inner circumferential edge of which is confined by a plurality of longitudinal formwork profiles and at least one side of the inner circumferential edge of the formwork is formed by at least two substantially identical formwork profiles having standard lengths which are arranged one after the other in the longitudinal direction.

In known formworks, as many sides as possible of the concrete prefabricated building element to be produced are formed by formwork profiles of a standardised length. Since the standardised lengths of the formwork profiles are rarely equivalent to the side lengths of the concrete prefabricated building element to be produced, gaps which remain according to the prior art in the circumferential edge of the formworks are filled with so-called filler elements. These filler elements can be produced from Styropor or pieces of wood, for example, and during the production of the formwork are usually manually shortened to the required length and fitted.

However, if one side of the formwork is formed by at least two series-positioned formwork profiles of a standardised length, it is possible to completely dispense with the use of filler elements, thereby saving an enormous amount of time.

The invention now provides that for a formwork of this type, at least two of the formwork profiles which are arranged one after the other in the longitudinal direction and form one side of the inner circumferential edge are spaced apart from one another on the, and it has proved to be favourable if the distance is less than 1.5 cm, preferably less than 1 cm.

Due to the fact that a space is formed between the spacing profiles arranged in series, it is possible to minimise the number of different standard lengths which have to be kept in stock. Tests carried out by the Applicant have shown that it is easily possible to realise distances of up to 1.5 cm, i.e. in spite of the distance between the series-positioned formwork profiles, a substantially planar side surface of the concrete prefabricated building element to be produced is obtained. Depending on the quality of the concrete, even distances of up to 2.5 cm can be realised, although such great distances can require reworking of the set concrete prefabricated building element, which, in turn, has a negative effect on the working time.

An exemplary embodiment of the invention also relates to the use of an installation for the production of concrete prefabricated building elements, the installation having a production line in which the building elements are manufactured on pallets which successively pass through at least a demoulding station, a cleaning station, an, in particular, automatic formwork erection station, a concreting station, a reinforcing station and a hardening chamber of a production line in a method according to an exemplary embodiment.

Installations of this type are used for the production of planar concrete elements, in particular floor and wall elements. The concrete elements are produced on pallet moulds, also known as production pallets, which successively pass through a plurality of stations of a production line. In the production line, the concrete prefabricated building element is demoulded and the formwork profiles are removed from the pallet mould. The pallets are cleaned in a further station before they are provided with new formworks in the formwork erection station. After concreting and the introduction of the reinforcement, the pallet is fed to the hardening chamber in which the concrete is set.

In installations known hitherto, due to the varying duration of the production cycles in the individual stations, it is necessary to arrange buffer stations in which the pallet is removed from circulation. In other words, buffer zones in which the pallets can be parked until the next station in the production line is free, are provided after stations that have a relatively short cycle, for example the demoulding station pallets.

The total working time, which can only be calculated with great difficulty or not at all, for the passage of a pallet has been found to be a disadvantage of this prior art, as has the occurrence of production jams which can happen due to the irregular production cycles and the irregular feeds, associated therewith, of the pallet moulds.

Starting from this prior art, the object of the invention is to provide an improved installation of the type mentioned at the outset, with which the previously described disadvantages can be avoided and which allows in particular the calculation of a total working time for the passage of a pallet through the production line.

This object is achieved in that the pallets are fed synchronously from the demoulding station to the hardening chamber. Since the feed takes place simultaneously, it is possible to completely dispense with the arrangement of buffer stations and production jams can be avoided.

A further exemplary embodiment of the invention provides that one or a plurality of blind station(s) in which no working steps are carried out is (are) arranged in the course of the production line, tests by the Applicant having shown that an arrangement of a blind station between the cleaning station and the formwork erection station and/or between the formwork erection station and the concreting station is particularly advantageous for a steady passage of the pallet through the production line.

The blind stations in which no working steps are generally carried out are used to bridge relatively long path distances between two processing stations. This is necessary because, due to the synchronous feed of all the pallet moulds, a longer transportation time, caused by a longer path distance, between two stations would shorten the time available for managing the following cycle.

A preferred exemplary embodiment of the invention further provides that the pallets are fed to all the stations of the production line synchronously and it has been found to be advantageous if the pallets pass through the production line in a circulatory manner.

Thus, one aspect of the invention is to move the pallets synchronously, i.e. simultaneously at least from the demoulding station to the hardening chamber, preferably in all stations of the production line. In this respect, the cycle of the synchronous movement will depend on the time of the cycles at the individual stations and on the transportation time between the individual stations of the production line.

A first embodiment of the invention provides that the pallets are fed synchronously in regular time intervals, the cycle of the synchronous movement being fixed subject to a predetermined maximum time per cycle at the individual stations of the production line and subject to the transportation time of the pallets between the individual stations of the production line.

In other words, the cycle of the synchronous movement which corresponds to the time between the individual feeds, consists of the time of the cycles and of the transportation time between the individual stations.

In practice, this means that for the cycle of the most time-intensive station, a maximum time is predetermined, the transportation time between the individual stations is added to this maximum time for the slowest station and the resulting time span is the cycle of the synchronous movement.

An embodiment of the invention provides that the maximum time per cycle at the individual stations of the production line is less than 6 minutes, preferably less than 4.5 minutes, it being possible to achieve a particularly full utilisation of the production line when the maximum time is less than 4 minutes, and is preferably about 3.5 minutes. Due to a favourable arrangement of the individual stations of the production line, i.e. where possible, the distance between the individual stations should be kept small, it is also possible to shorten the cycle time of the synchronous movement and a further exemplary embodiment of the invention provides that the cycle time of the synchronous movement is between 3.5 and 5.5 minutes, and is preferably about 4.5 minutes.

Another embodiment of the invention provides that the pallets are fed synchronously in irregular time intervals, the synchronous movement being started subject to the time of the longest cycle of the individual stations of the production line.

This exemplary embodiment also starts from the time required for the cycle at the slowest station. In contrast to the previously described exemplary embodiment, a maximum time is, however, not calculated or previously determined for this most time consuming station, but the pallets are fed synchronously at the end of the cycle at the slowest station.

Irrespective of whether the pallets are fed synchronously in the production line in a regular or irregular cycle, the synchronous movement can be started automatically, preferably by an installation control means, or manually.

The production of concrete prefabricated building elements follows a completely new logic by the method according to one exemplary embodiment. Whereas according to the prior art, as many concrete prefabricated building elements as possible are produced on one production pallet, only one concrete prefabricated building element is now produced per pallet mould. The smaller utilised capacity of the individual pallets provides the advantage of a fixed maximum working time per cycle, thereby allowing a consequential automation of the production line, so that ultimately by means of the method, at least the same number of concrete prefabricated building elements can be produced within the same time as by the conventional methods.

However, the method according to the invention enables enormous savings to be made in terms of staff, due to the consequential automation, and thus the total cost can be reduced significantly. Furthermore, the maximum time per cycle makes it possible to calculate a passage time for a pallet through the production line, as a result of which production jams can be avoided.

As in the previously described exemplary embodiment, it is also possible here to completely dispense with the use of filler elements, in which case spacings of up to approximately 1 cm which may remain between the series-positioned formwork profiles can be accepted.

Further advantages and details of the invention will be described in more detail in the following description of the figures with reference to the embodiments illustrated in the drawings, in which:

Fig. 1 shows a first exemplary embodiment of a formwork according to the invention,

Fig. 2a-c show further exemplary embodiments of formworks,

Fig. 3 shows a pallet with two formworks arranged thereon,

Fig, 4a schematically shows a first exemplary embodiment of an installation for the production of concrete prefabricated building elements,

Fig. 4b shows the synchronous movement of the pallets in an installation according to Fig. 4a,

Fig. 4c shows the individual cycles between a synchronous movement,

Fig. 5 shows a further exemplary embodiment of an installation having a stacker crane,

Fig. 6 shows a third exemplary embodiment of an installation for the production of double walls, and

Fig. 7 shows a further exemplary embodiment of an installation for the production of floor slabs.

In the exemplary embodiment of a formwork 11 according to the invention shown in Fig. 1, three sides of the circumferential edge U_a are formed by formwork profiles 10 of a standardised length. Unlike the exemplary embodiments according to Fig. 2a to 2c, the fourth side of the formwork 11 with side length L is not formed by a projecting formwork profile 10, but instead by two series-positioned formwork profiles 10. With a corresponding grid of different standard lengths of formwork profiles 10, almost all required side lengths L of a concrete prefabricated building element to be produced can be formed by this method exclusively using formwork profiles 10 of a standardised length. In this respect, shorter distances between the series-positioned formwork profiles 10 are not very significant, although the distance between the individual formwork profiles should not be greater than 1.5 cm in order to prevent the concrete from flowing out.

In other words, when selecting the formwork profiles, the following formula should be observed:

$$\sum_{i=1}^{N} L_1 + f = L; \; f \leq (N + 1.5) * 1\,cm$$

Thus, expressed in words, the sum of the longitudinal extents (L_1) of the formwork profiles to be arranged one after the other is less by the value f than the longitudinal extent of the side (L) to be produced of the formwork, where the value f can be at most the same as the number N of the formwork profiles + 1.5. The value of 1.5 which is added to the number N corresponds to the desired distance between the series-positioned formwork profiles, i.e. with a desired distance of, for example, 1 cm, f must satisfy the equation $f \leq (N + 1) * 1$ cm.

Fig. 2a to 2c show further exemplary embodiments of formworks 11 which are arranged on a pallet 21. In these exemplary embodiments, at least three of the formwork profiles 10 forming the formwork 11 project beyond the outer circumferential edge U_a, more specifically in each case by the portion A.

The outer circumferential edge U_a is defined by the longitudinal sides, opposite the formwork surfaces 24, of the formwork profiles 10 and is geometrically similar to the inner circumferential edge U_1.

In other words, the circumferential edge of the formwork 11 is formed by the formwork profiles 10, the formwork surfaces 24 of the formwork profiles 10 forming the inner circumferential edge U_1, while the sides of the formwork profiles 10 opposite the formwork surfaces 24 are part of the outer circumferential edge U_A.

In this respect, in Fig. 2a all the formwork profiles 10 project beyond the outer circumferential edge U_A, while in Fig. 2b and 2c, only three formwork profiles 10 project beyond the outer circumferential edge U_A.

The advantage of this arrangement of the formwork profiles 10 is that it is possible to completely dispense with the use of filler elements, since the inner circumferential edge U_1 is substantially completely delimited by formwork profiles 10 of a standardised length.

In these exemplary embodiments illustrated in Fig. 1 and 2a to 2c, the formwork profiles 1 can be positioned entirely by a forming robot 8, in which case it has been found to be a particular advantage if only precisely one formwork is arranged per pallet 21, since then the centre point M of the pallet 21 can be used as a reference point for the forming robot 8. This measure overall achieves a very short time requirement for the forming of the concrete prefabricated building element, as a result of which by and large a short cycle time for the synchronous movement and a particularly efficient automation of the pallet circulation system can be achieved.

These advantages can also be achieved with an arrangement of two (Fig. 3) or three formworks on one pallet mould.

The installation 1 illustrated in Fig. 4a to 4c comprises a plurality of stations which are arranged such that the pallets 21, on which the concrete prefabricated building elements are produced, pass through these stations, particularly in a circulatory manner, in the sense of a production line.

This production line comprises a demoulding station 2, in the region of which a demoulding crossbeam 3 is arranged. Following on from the demoulding station 2 is a formwork removal station 4 in which the formwork profiles 10 are removed from the pallet 21. Thereafter follows the cleaning station 6, with which a cleaning and oiling device 5 is associated.

The pallets 21 are conveyed from the cleaning station 6 to the formwork erection station 7. In the formwork erection station 7, the concrete prefabricated building elements are formed by a forming robot 8 which removes the formwork profiles 10 from the formwork store 9 and positions them on the pallet 21 located in the formwork erection station 7. After the formwork profiles 10 have been removed from the pallet 21 in the formwork removal station 4, they pass through a transportation and cleaning line 22 before they are deposited in the formwork store 9.

A blind station 12 in which no work is carried out follows the formwork erection station 7.

Thereafter follows the concreting station 14 with which the concreting device 13 is associated, by which the concrete is introduced into the formwork 11. Following the concreting station 14 is another blind station 12 and then the reinforcing station 15 in which a positioning device 16 introduces the reinforcements prepared in the reinforcement preparation station 18 into the concrete prefabricated building element which has already been concreted, but has not yet set.

The collection station 17 and optionally a further blind station 12 follow the reinforcing station 15.

A stacking device 19 collects the pallets 21 from the collection station 17 or from the subsequent blind station 12 and the pallets 21 are introduced into the hardening chamber 20 where the concrete prefabricated building element hardens with the supply of hot air. After the concrete has set, the pallet 21 is transferred from the hardening chamber 20 into the demoulding station 2 and there begins a new circuit through the production line.

Fig. 4b shows the transportation paths between the individual stations of the production line in a synchronous movement. In the illustrated exemplary embodiment, the pallets 21 are moved from one station to the next within one minute, the movement taking place synchronously.

In other words, the pallets 21 are simultaneously moved from the hardening chamber 20 to the demoulding station 2, from the demoulding station 2 to the formwork removal station 4, from the cleaning station 6 to the formwork erection station 7, from the formwork erection station 7 to the first blind station 12, from the concreting station 14 to the second blind station 12, from the second blind station 12 to the reinforcing station 15 and from the reinforcing station 15 to the collection station 17, from where they are collected by the stacking device 19.

Fig. 4c shows the individual working processes which have to be carried out during one cycle, the maximum production time of which in the illustrated exemplary embodiment is fixed at 3.5 minutes. Once again, simultaneously the concrete prefabricated building element is demoulded in the demoulding station 3, the formwork profiles are removed in the formwork removal station 4, the pallets 21 are cleaned in the cleaning station 6, the formwork 11 is produced using the formwork profiles 10 in the formwork erection station 7, the concrete prefabricated building element is concreted in the concreting station 14 and possible reworking can be carried out in the blind station 12, the reinforcements are introduced in the reinforcing station 15, while possible special reinforcements can be introduced in the collection station 17.

Thus, in this exemplary embodiment, the cycle of the synchronous movement consists of the maximum production time of 3.5 minutes and of the transportation time of 1 minute, i.e. the pallets 21 are moved every 4.5 minutes between the synchronously connected stations of the production line.

The pallets 21 used in this exemplary embodiment are approximately 8 m long and 3 m wide, approximately 88 pallets passing through the production line in one shift. With a pallet layout of 11.25 m^2, which corresponds to a concrete prefabricated building element having a length of 4.5 m and a width of 2.5 m, the installation 1 can achieve a production of approximately 1,000 m^2 per shift with a period of 8 working hours. In this respect, the effective production time during one shift is 7 hours, while the cleaning time takes 1 hour. With the installation 1, it is possible for the number of staff required for supervising the installation to be reduced to 3 persons, whereas in prior art installations in which the pallets were not fed synchronously, sometimes as many as 20 members of staff were required.

The further exemplary embodiments shown in Fig. 5 to 7 of installations 1 differ from the exemplary embodiment according to Fig. 4a to 4c only by the local arrangement of the individual stations of the production line, and in the exemplary embodiment according to Fig. 5, the stacking device 19 is in the form of a stacker crane.

The exemplary embodiment illustrated in Fig. 6 shows an installation 1 which can produce double walls in addition to floor slabs. For this purpose, arranged after the concreting station 14 is a blind station 12, associated with which is a turning arrangement 23 with a turning frame and suction cups. The mode of operation of turning frames of this type is known per se, thus a description thereof is not provided here.

The exemplary embodiment illustrated in Fig. 7 differs from the example illustrated in Fig. 3 only in that a turning arrangement 23 of this type is not provided, i.e. the installation according to Fig. 7 is used for the production of planar floor slabs.

The illustrated exemplary embodiments of installations and formworks for the production of concrete prefabricated building elements as well as the described examples of possible production methods should naturally be understood as being non-restrictive.

Patentkrav

1. Fremgangsmåde til udvælgelse af forskallingsprofiler (10) der er anbragt på en palle (21) til fremstilling af mindst én forskalling (11) med en i det væsentlige lukket indre periferisk kant til et polygonalt, især rektangulært præfabrikeret betonbyggeelement, hvor udvælgelsen af forskallingsprofilerne (10) der skal positioneres finder sted ifølge til den fastsatte værdi af deres længde der især bestemmes på basis af et geometridatasæt for det præfabrikerede betonbyggeelement der skal fremstilles, hvor til produktionen af mindst én side (L) af forskalling en (11) der skal fremstilles vælges mindst to forskallingsprofiler (10) til at blive arrangeret efter hinanden i længderetning, **kendetegnet ved at** udvælgelsen af forskallingsprofilerne (10) udføres sådan at summen af længdeudstrækninger af de mindst to forskallingsprofiler (10) arrangeret efter hinanden er mindre end længden af siden (L) af forskallingen (11) der skal fremstilles.

2. Fremgangsmåde ifølge krav 1, **kendetegnet ved at** summen af længdeudstrækninger af forskallingsprofilerne (10) arrangeret efter hinanden er mindre end længden af siden (L) af forskalling en (11) med en værdi der ikke overstiger f.

3. Fremgangsmåde ifølge krav 2, **kendetegnet ved at** f opfylder ligningen f = (x + 1) gange 1,5 cm, hvor x karakteriserer antallet af forskallingsprofilerne (10) der skal arrangeres efter hinanden.

4. Fremgangsmåde ifølge krav 3, **kendetegnet ved at** afstanden mellem de enkelte forskallingsprofiler (10) anbragt efter hinanden er højst 1,5 cm.

5. Fremgangsmåde ifølge krav 2, **kendetegnet ved at** f opfylder ligningen f = (x + 1) gange 1 cm, hvor x karakteriserer antallet af forskallingsprofilerne (10) der skal arrangeres efter hinanden.

6. Fremgangsmåde ifølge krav 5, **kendetegnet ved at** afstanden mellem de enkelte forskallingsprofiler (10) anbragt efter hinanden er højst 1 cm.

7. Fremgangsmåden ifølge et af kravene 1 til 6, **kendetegnet ved at** forskallingsprofilerne (10) er anbragt på en palle (21) ved hjælp af en program-styret robot.

8. Fremgangsmåde til fremstilling af mindst én forskalling til et polygonalt, især rektangulært præfabrikeret betonbyggeelement med flere forskallingsprofiler på en palle i et pallecirkulationssystem, idet forskallingsprofilerne vælges ifølge fremgangsmåden ifølge et af kravene 1 til 7, **kendetegnet ved at** der udelukkende anvendes forskallingsprofiler som er af en essentielt identisk konfiguration med standardlængder til bygning af en essentielt lukket indre periferisk kant (U_i), hvor antallet af de anvendte forskallingsprofiler (10) er større end antallet af siderne (L) af det præfabrikerede betonbyggelement, der skal fremstilles.

9. Forskalling til et i det væsentlige rektangulært præfabrikeret betonbyggeelement der skal fremstilles på en palle, idet forskallingens i det væsentlige lukkede indre periferiske kant er begrænset af flere langsgående forskallingsprofiler, hvor mindst én side af forskallingens indre periferiske kant er dannet af mindst to forskallingsprofiler med standardlængder og er af en i det væsentlige identisk konfiguration der er anbragt efter hinanden og fremstilles ved hjælp af fremgangsmåden ifølge et af kravene 1 til 8, **kendetegnet ved at** mindst to af forskallingsprofilerne (10) anbragt efter hinanden i langsgående retning danner den ene side (L) af den indre periferiske kant (U_i), er adskilt fra hinanden på pallen (21) og **ved at** summen af længdeudstrækninger af de mindst to forskallingsprofiler (10) arrangeret efter hinanden er mindre end længden af siden (L) af forskallingen (11) der skal fremstilles.

10. Forskalling ifølge krav 9, **kendetegnet ved at** afstanden er mindre end 1.5 cm.

11. Forskalling ifølge krav 9 eller 10, **kendetegnet ved at** afstanden er mindre end 1 cm.

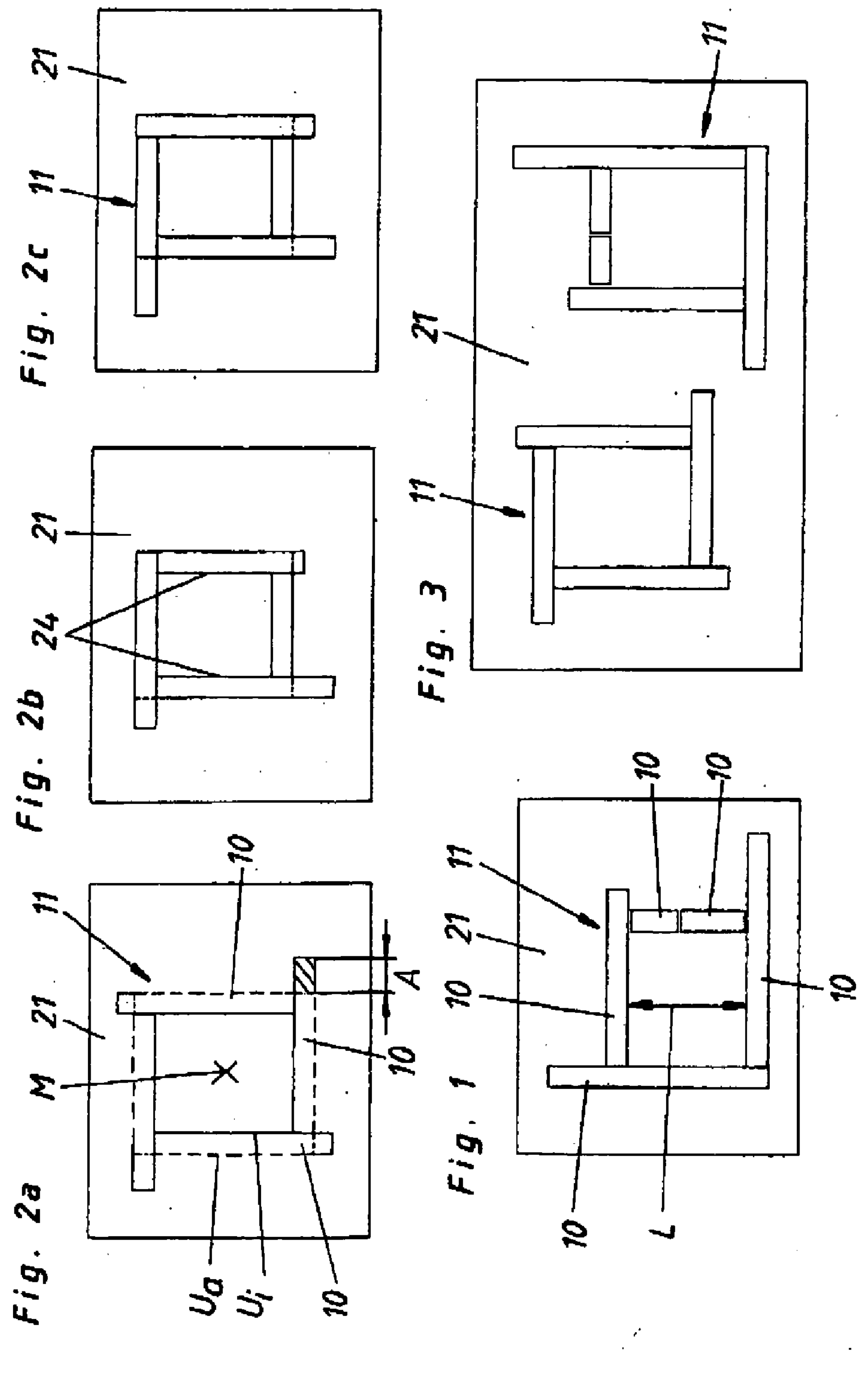
Fig. 2c
21
11
Fig. 2b
21
24
Fig. 2a
M
21
11
10
A
Ua
Ui
Fig. 3
Fig. 1
L

Fig.4a

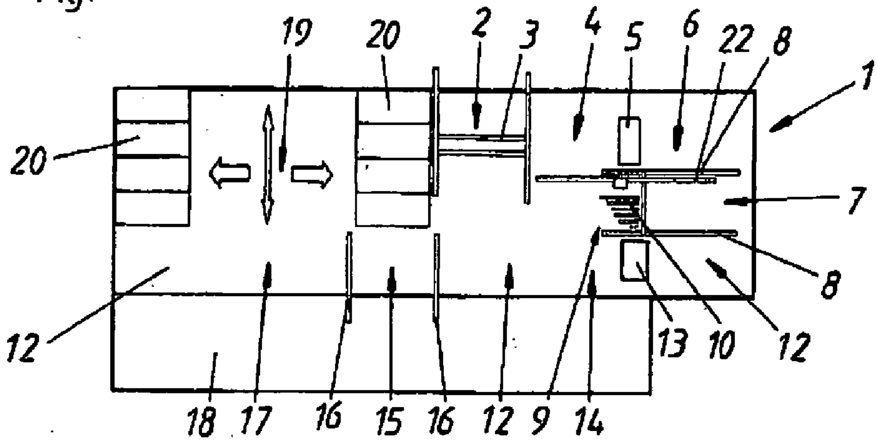

Fig.4b

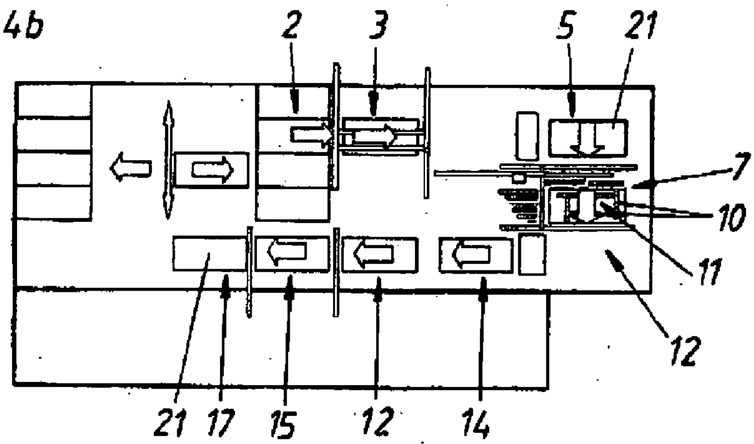

Fig.4c

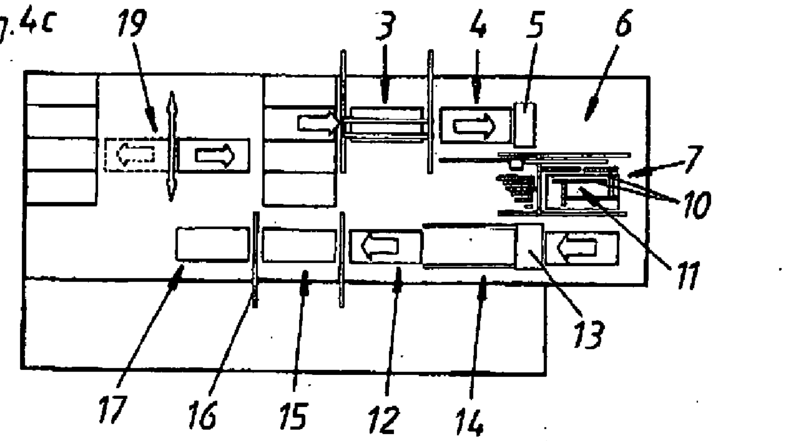

Fig. 5

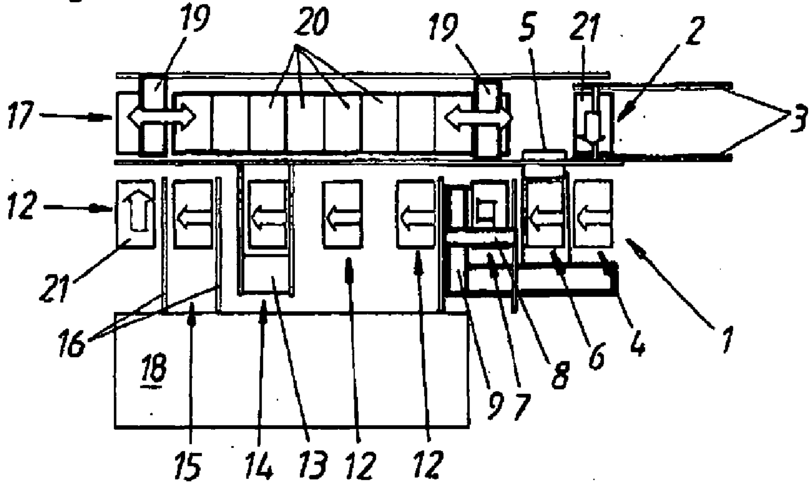

Fig. 6

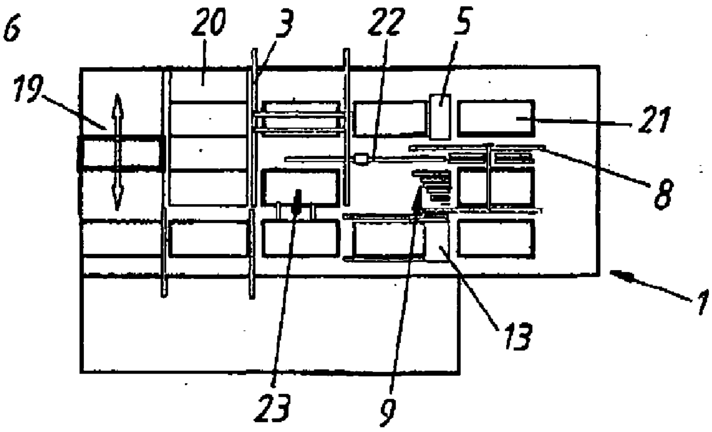

Fig. 7