



EUROPEAN PATENT SPECIFICATION

Date of publication of patent specification :
22.12.93 Bulletin 93/51

Int. Cl.⁵ : **B05B 13/04, B05B 15/12**

Application number : **90310886.8**

Date of filing : **04.10.90**

Spray painting system.

Priority : **05.10.89 JP 260940/89**

Date of publication of application :
10.04.91 Bulletin 91/15

Publication of the grant of the patent :
22.12.93 Bulletin 93/51

Designated Contracting States :
DE ES FR GB

References cited :
EP-A- 0 084 523
GB-A- 2 098 578
GB-A- 2 180 173
US-A- 4 342 535
US-A- 4 630 567

Proprietor : **TAIKISHA, LTD.**
1-go, 6-ban, 2-chome, Nishi-shinjuku
Shinjuku-ku Tokyo (JP)

Inventor : **Soshi, Fujio**
1-go, 6-ban 2-chome, Nishi-shinjuku
Shinjuku-ku, Tokyo (JP)

Representative : **Gilmour, David Cedric**
Franklyn et al
POTTS, KERR & CO. 15 Hamilton Square
Birkenhead Merseyside L41 6BR (GB)

EP 0 421 791 B1

Note : Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid (Art. 99(1) European patent convention).

Description

The present invention relates to a spray painting system, and more particularly to a spray painting system of a continuous assembly line, the system including a plurality of work machines for spray painting disposed side by side along a direction for conveying a work object inside a spray painting booth.

With conventional spray painting systems of the above-described type, as illustrated in Fig. 5, inside a spray painting booth having a length ranging generally between 30 and 50 m, each of a plurality of work machines 6 is arranged movable within a predetermined distance l (usually about 1 m) in the object-conveying direction on a mounting frame fixed on a floor surface of the booth. As guide mechanisms for moving the respective machines differ from each other, it has been impossible to connect these guide mechanisms so that the machines may share one common guide mechanism.

In recent years; however, there often arises the necessity of adjusting the positions of the work machines beyond the predetermined movable distances in order to dispose each machine at the best position to cope with various changes in the kind or type of paint, spraying guns, the shape of the work object and the other working conditions. Obviously, the above-described conventional systems do not allow such work machine position adjustments beyond the predetermined ranges. Then, as a means to overcome this problem, it has been attempted to restrict the changes in the working conditions per se thereby restricting the amount of position adjustment required by the changes. Then, even after such modifications or arrangements in the work conditions, if the positions of the work machines still need to be adjusted beyond the adjustable range; then, the work machines are eventually dismounted from the floor surface and redispersed on new locations with appropriate reinforcement of the floor surface of these new locations as required for the machine installment. In such case, as the relocation work takes a considerable time, it is necessary to suspend not only the production line including these machines but also other production lines associated therewith for many days. Consequently, the production efficiency of the entire line suffers significantly.

In US-A-4342535 a paint robot 18 is disclosed displaceably mounted on guide rails 20 with the working area of the spray booth lower than the top of vehicle body 10 and accordingly is subject to a substantial spray mist environment. A single rail 20 on one side is illustrated having a carriage 32 mounted on edge portions between which a rack 26 is provided.

In GB-A-2098578 an industrial production system are disclosed a plurality of robotic operating arm structures 2 mounted on a single I sectioned rail 6 by means of carriages 8 with rail 6 being within the work-

ing environment space. Support rollers 40 roll on the top surface of rail 6 and guide rollers 41 roll on the vertical sides of rail 6 directly beneath rollers 40. Rail 6 is mounted along the top side edge of bench 7 which also supports workpieces.

According to the present invention there is provided a spray painting system having a plurality of work machines disposed side by side along the direction of conveyance of a work object to be sprayed inside a spray painting booth and having

an upper rail and a lower rail for guiding the work machines to move along said conveying direction, with each of the machines running on said upper rail

characterised by said upper rail being arranged in a region outwardly of the working area of said spray painting booth and positioned higher than at least said work object; said upper rail supporting the work machines so as to receive all the load therefrom, and

said lower rail guiding said work machines without receiving any load from said work machines.

According to a preferred embodiment of the invention, the rails guide the movement of the machines along path of travel of the work objects with the machines supported on respective frames and each machine being detachably supported on the respective frame.

According to the present invention, the same upper and lower rails guide the movement of a plurality of work machines in the object-conveying direction with the machines running on the upper rail.

Therefore, when there arises the necessity of changing the positions of the work machines by a considerable amount to cope with changes in the work conditions such as the type of paint, the spray guns, the shape of the object to be spray-painted and so on, the position adjustment of the machines is readily possible without having to change the disposing order of the machines and by a sufficient range determined by the length of the rails.

Accordingly, the system of the invention can readily cope with frequent position adjustment operations of the machines as required and also substantial changes in the work conditions without requiring total relocation of the machines. Consequently, the spray painting system of the present invention has achieved significant reduction in the shutdown period of the production line which used to be required for troublesome position adjustment or total relocation of the work machines, thus improving the entire operation efficiency of the production line including this system as well as other lines associated therewith.

With the second characterizing features of the invention, through selective detachment of the machines each of which is detachably mounted on its frame, the system can change the disposing order of the work machines in the object-conveying direction.

Further and other objects, features and effects of the invention will become more apparent from the following more detailed description of the embodiments of the invention with reference to the accompanying drawings.

Accompanying drawings Figs. 1 through 4 illustrate a preferred embodiment of a spray painting system according to the present invention; in which,

Fig. 1 is a plane view of the entire system,

Fig. 2 is a cross sectional view of the system,

Figs. 3 and 4 are an enlarged side view and an enlarged front view showing a moving construction of the system, respectively.

Fig. 5 is a plane view showing a conventional spray painting system.

Preferred embodiments of the invention will now be described in particular with reference to the accompanying drawings.

Referring to Figs. 1 and 2, a tunnel-like spray painting booth 1 accommodates a conveyor device 1 for conveying an object 2 (an automobile body in the instant embodiment), an overhead outlet vent 4 for downwardly discharging a ventilation air and a demister 5 for eliminating spray mist contained in exhaust air by trapping the mist in cleaning water. Inside this booth 1, there are installed a plurality of work machines 6 for the spray painting, with the machines being disposed side by side along a direction of conveying the object 2 inside the booth.

The work machines 6 comprise various kinds such as one-hand robot 6a for opening and closing doors of the object 2, i.e. automobile body, a further one-hand robot 6b for controlling a spray gun 7a to spray-paint interior surfaces of the object 2, a side-face spraying machine 6c for vertically moving a spray gun 7b to spray-paint side outer surfaces of the object 2, an upper-face spraying machine 6d for controlling rotary, reciprocating and vertical linear movements of an arm 7d equipped with a spray gun 7c so as to spray-paint upper surfaces of the object, and a touchup spray painting, one-hand robot 6e for controlling a further spray gun 6e to effect a touchup spray-paint operation on the object.

These work machines, as shown in Figs. 3 and 4, are detachably mounted on frames 8 of identical construction; and each frame is movable by drive force along the object-conveying direction.

For moving the frames 8, as one common guide mechanism shared by and for independently guiding the movements of the frames 8, there are provided an upper rail 9a and a lower rail 9b at upper and lower portions of a side wall 1a of the booth. On the other hand, each frame 8 has a first roller 10a for rolling on an upper face of the upper rail 9a with the weight of the frame 8 being supported by the rail 9a, a pair of second rollers 10b lie astride the upper rail 9a and a pair of third rollers 10c lie astride the lower rail 9b.

Further, for a chain 11 layed along the upper rail

9a, the frame 8 also has a pair of free sprockets 12a engageable with the chain 11, a drive sprocket 12b which comes into engagement with an inner side of the chain 11 which is formed like a reversed letter U-shaped as being entrained about the two free sprockets 12a, and a motor 14 for driving the drive sprocket 12b via a reduction mechanism 13.

In operation, with the drive of the motor 14, the frame 8 (i.e. the work machine 6 mounted on this frame) is self-movable along the object-conveying direction within the range determined by the length of the upper and lower rails 9a and 9b, while the chain 11 acting as resistance against reaction force associated with the movement of the frame 4. In this way, if the setting position of the work machine 6 has been changed to cope with various changes in the operating conditions such as in the type of paint, the spray guns 7a, 7b, 7c and 7e and/or in the shape of the object 2, i.e. the automobile body, the position adjustment is readily possible by selectively and independently causing the machines 6 to self-move along the object-conveying direction.

Moreover, as described hereinbefore, since the work machines 6 are detachably mounted on the respective self-propelling type machine frames of the identical construction, re-arrangement of disposing order of the machines 6 in said direction is also readily possible by selectively replacing or relocating the machines 6 relative to the frames 8.

On a lateral side of the spray painting booth 1, an operator box 15 having a length extending over the entire length of the rails 9a and 9b is integrally attached to the booth side wall 1a; and the booth side wall 1a has a window 16 for allowing an operator inside an operator chamber 15a of the box 15 to inspect and watch the spray painting operation taking place inside the booth.

Inside the operator box 15, a partition 11 is provided for forming an upper section 15b separately from the operator chamber 15a. The upper section 15b accommodates paint hose-cable means 18 such as paint hoses, electric cables and pressure-air hoses for feeding paint, electricity and pressure air to the respective work machines 6; flexible means 19 such as flexible cable racks for allowing movements of the work machines 6 along the conveying direction and further the upper rail 9a and the chain 11.

The upper section 15b further accommodates a shaft 14a for operatively connecting the motor 14 and the drive sprocket 12b and an opening S for inserting the hose-cable means 18 therethrough.

Inside the operator chamber 15a, there is provided a remote control panel 22 for remote-controlling the work machines 6. At a lower section 15c sectioned by the partition 23 from the operator chamber 15a inside the operator box 15, there are accommodated control panel means 24 such as electric control panels and pressure-air control panels.

The operator chamber 15a is connected with a duct 21 having a dumper 20 for forcibly introducing ventilatin air from a air feed chamber 4a through the overhead outlet vent 4 into the chamber 15a.

Numeral 25 denotes a grating floor used for e.g. a system maintenance operation. This grating floor 25 is provided only at a certain region inside the booth along the object-conveying direction. For maintenance operations of the work machines 6, the machine 6 to be maintained is driven to self-move to the region of the grating floor 25.

That is, since the grating floor 25 is provided only at a certain region inside the booth, cleaning operation of this grating floor 25 to eliminate excess paint adhered thereto is required less frequently than the conventional system in which the grating floor is provide over the entire booth floor.

Further, it is also conceivable to render this grating floor 25 movable in the object-conveying direction. In this case, the setting location of the grating floor 25 can be changed in accordance with the necessity and convenience.

The types of the work implements used for spray painting operation are not limited to those described in the foregoing embodiment.

Further, the object 2, in place of the automobile body, can be any kind such as a casing of a home electric appliance or a train body and so on.

The invention may be embodied in other specific forms without departing from the essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being defined by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

Claims

1. A spray painting system having a plurality of work machines (6) disposed side by side along the direction of conveyance of a work object (2) to be sprayed inside a spray painting booth (1), and having an upper rail (9a) and a lower rail (9b) for guiding the work machines (6) to move along said conveying direction, with each of the machines (6) running on said upper rail (9a); characterised by said upper rail (9a) being arranged in a region outwardly of the working area of said spray painting booth (1) and positioned higher than at least said work object (2); said upper rail supporting the work machines (6) so as to receive all the load therefrom, and said lower rail (9b) guiding said work machines (6) without receiving any load from said work machines (6).

2. A spray painting system according to claim 1, characterized in that said rails (9a,9b) guide the movement of the machines (6) in the object-conveying direction with said machines (6) supported on respective frames (8), each machine (6) being detachably supported on the respective frame (8).

3. A spray painting system according to claim 2, characterized in that said frame (8) includes a first roller (10a) for rolling on an upper face of said upper rail (9a) with the weight of the frame (8) being supported by said upper rail (9a), a pair of second rollers (10b) which strides across said upper rail (9a) and a pair of third rollers (10c) which strides across said lower rail (9b).

4. A spray painting system according to Claim 3, characterized in that said frame (8) is driven via a chain (11) layed along said upper rail (9a).

Patentansprüche

1. Farbsprühsystem mit einer Vielzahl von Arbeitsmaschinen (6), die nebeneinander entlang der Förderrichtung eines Arbeitsgegenstandes (2) angeordnet sind, der innerhalb einer Farbsprühkabine (1) besprüht wird, und mit einer oberen Schiene (9a) und einer unteren Schiene (9b) zur Führung der Arbeitsmaschinen entlang dieser Förderrichtung, wobei jede der Arbeitsmaschinen (6) auf der oberen Schiene (9a) läuft, dadurch gekennzeichnet, daß die obere Schiene (9a) außerhalb des Arbeitsbereichs der Farbsprühkabine und oberhalb zumindest des Arbeitsgegenstandes (2) angeordnet ist, wobei die obere Schiene (9a) die Arbeitsmaschinen (6) in dem Sinne aufnimmt, als sie deren gesamtes Gewicht trägt, und die untere Schiene (9b) zur Führung der Arbeitsmaschinen (6) dient, ohne von diesen gewichtsbelastet zu sein.
2. Farbsprühsystem nach Anspruch 1, dadurch gekennzeichnet, daß die Schienen (9a,9b) die Arbeitsmaschinen (6) in der Förderrichtung des Arbeitsobjektes (2) führen, wobei die Arbeitsmaschinen (6) jeweils von Rahmen (8) aufgenommen werden, in denen sie abnehmbar gehalten sind.
3. Farbsprühsystem nach Anspruch 2, dadurch gekennzeichnet, daß der Rahmen (8) eine erste Rolle (10a) zum Abrollen auf der oberen Seite der oberen Schiene (9a) beinhaltet, wobei das Gewicht des Rahmens (8) von der oberen Schiene (9a) aufgenommen wird, sowie ein Paar von

zweiten Rollen (10b), die beidseitig die obere Schiene (9a) beaufschlagen und ein Paar von dritten Rollen (10c), die beidseitig die untere Schiene (9b) beaufschlagen.

5

4. Farbsprühsystem nach Anspruch 3, dadurch gekennzeichnet, daß der Rahmen (8) mittels einer Kette (11) angetrieben wird, die entlang der oberen Schiene (9a) verläuft.

10

Revendications

1. Un système de peinture par pulvérisation, présentant une pluralité de machines de travail (6) disposées côte-à-côte dans la direction d'acheminement d'un objet de travail (2), destiné à être peint par pulvérisation à l'intérieur d'une cabine de peinture par pulvérisation (1), et présentant un rail supérieur (9a) et un rail inférieur (9b), pour guider les machines de travail (6) en vue de les déplacer dans ladite direction d'acheminement, chacune des machines (6) se déplaçant sur ledit rail supérieur (9a), caractérisé par le fait que ledit rail supérieur (9a) est agencé dans une zone située à l'extérieur de la zone de travail de ladite cabine de peinture par pulvérisation (1) et disposée plus haut qu'au moins ledit objet de travail (2), ledit rail supérieur supportant les machines de travail (6), de manière à recevoir toute la charge depuis ces dernières et ledit rail inférieur (9b) guidant lesdites machines de travail (6) sans recevoir aucune charge desdites machines de travail (6).
2. Un système de peinture par pulvérisation selon la revendication 1, caractérisé en ce que lesdits rails (9a, 9b) guident le mouvement des machines (6) dans la direction d'acheminement de l'objet avec lesdites machines (6) montées sur des cadres (8) respectifs, chaque machine (6) étant montée de façon amovible sur le cadre (8) respectif.
3. Un système de peinture par pulvérisation selon la revendication 2, caractérisé en ce que ledit cadre (8) comporte un premier rouleau (10a) pour rouler sur une face supérieure dudit rail supérieur (9a), le poids du cadre (8) étant supporté par ledit rail supérieur (9a), un couple de deuxièmes rouleaux (10b) qui chevauchent ledit rail supérieur (9a) et un couple de troisièmes rouleaux (10c) qui chevauchent ledit rail inférieur (9b).
4. Un système de peinture par pulvérisation selon la revendication 3, caractérisé en ce que ledit cadre (8) est entraîné à l'aide d'une chaîne (11) disposée le long dudit rail supérieur (9a).

FIG. 1

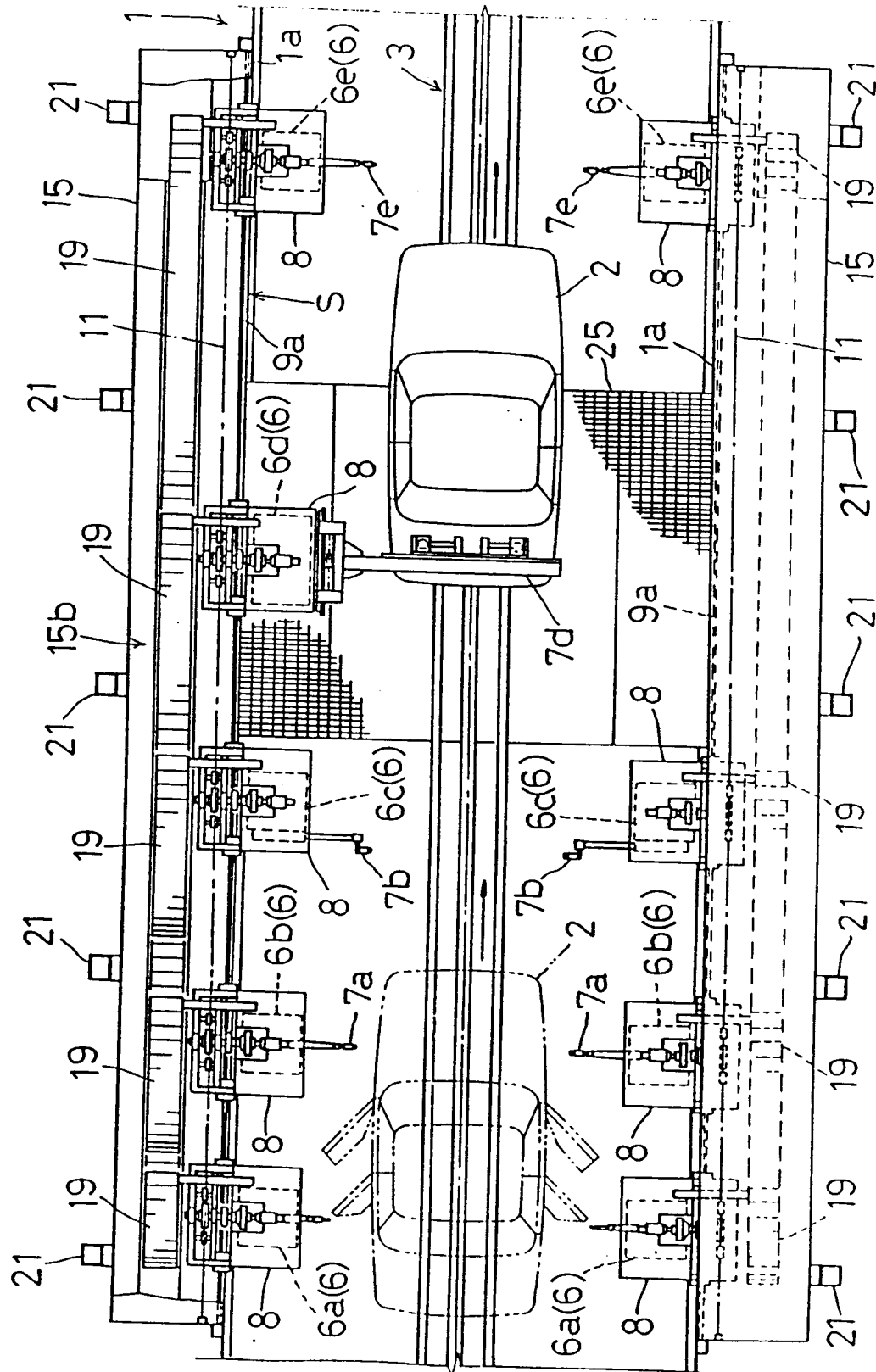


FIG. 2

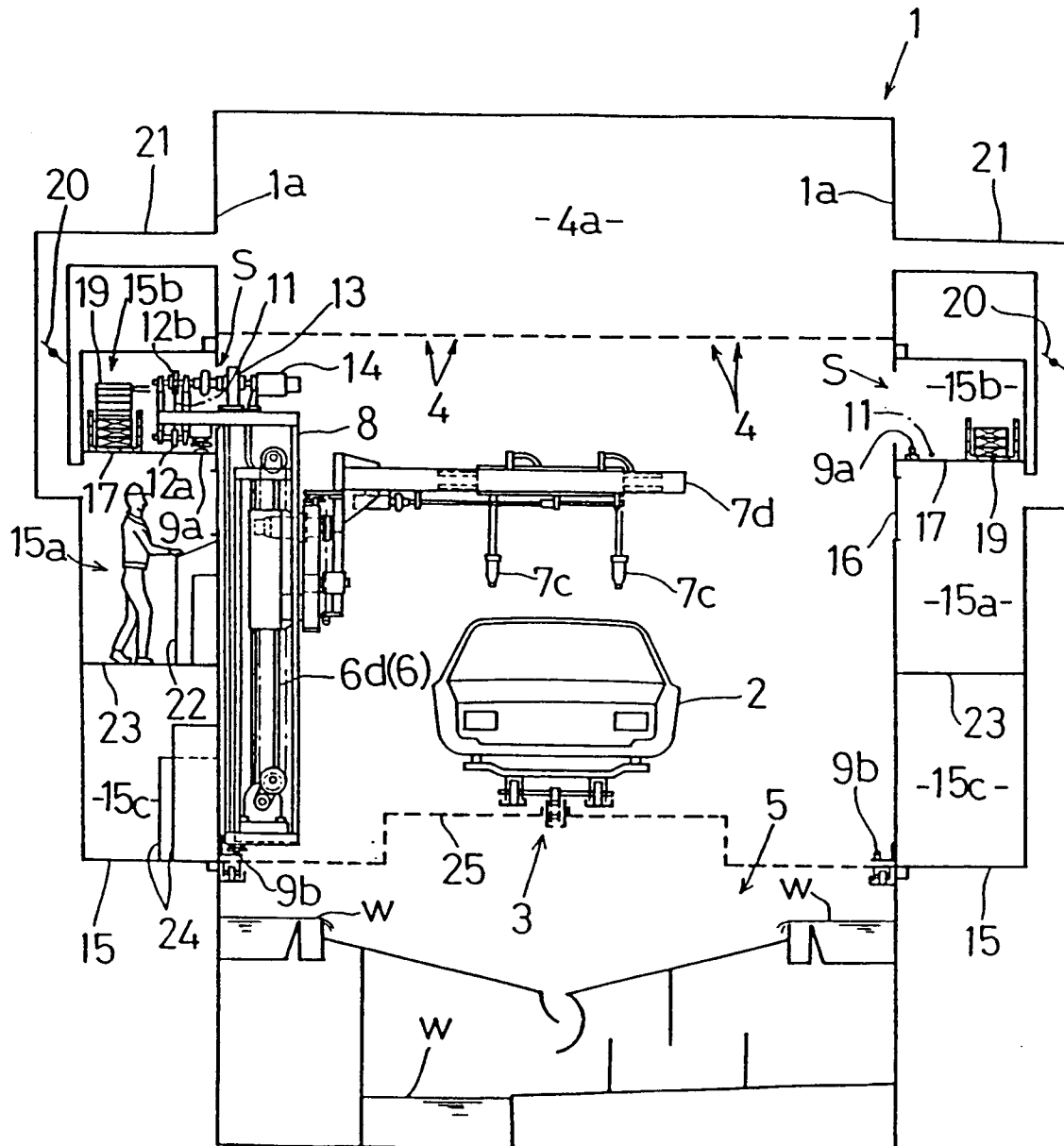
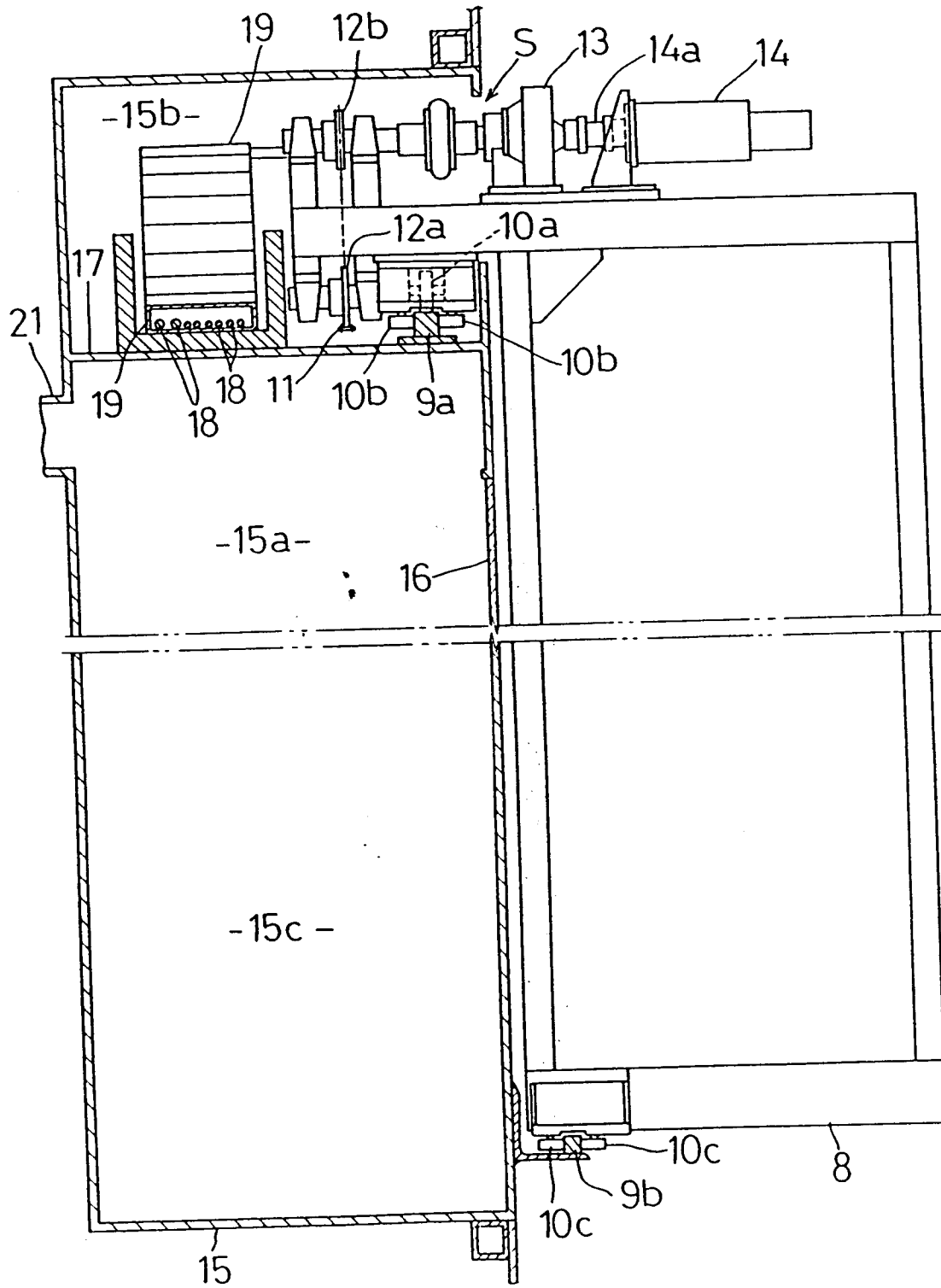


FIG. 3



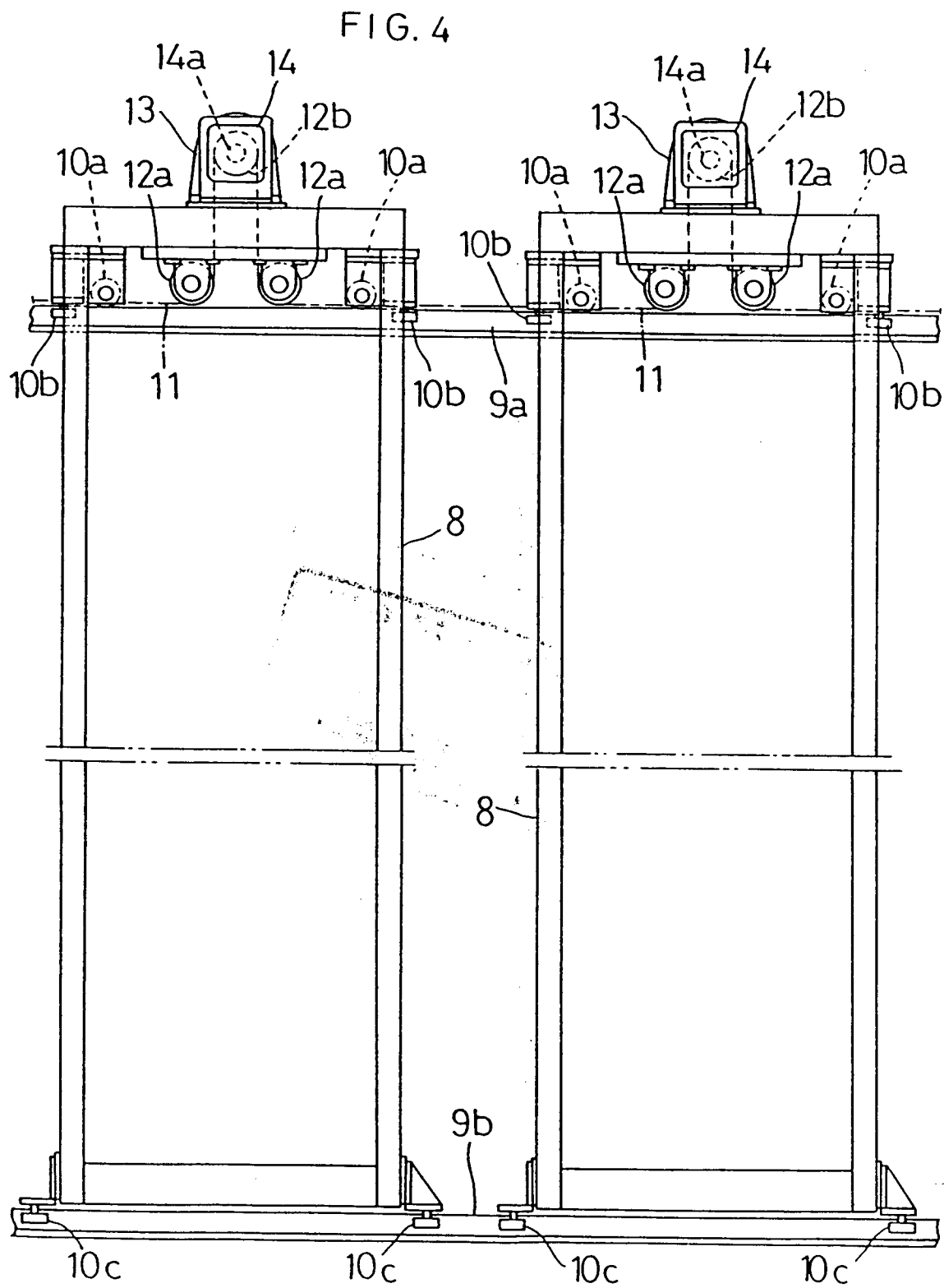


FIG. 5 (PRIOR ART)

