July 27, 1954 H. AUGER 2,684,640

MECHANICAL STORAGE EQUIPMENT

Filed June 22, 1948 6 Sheets-Sheet 1

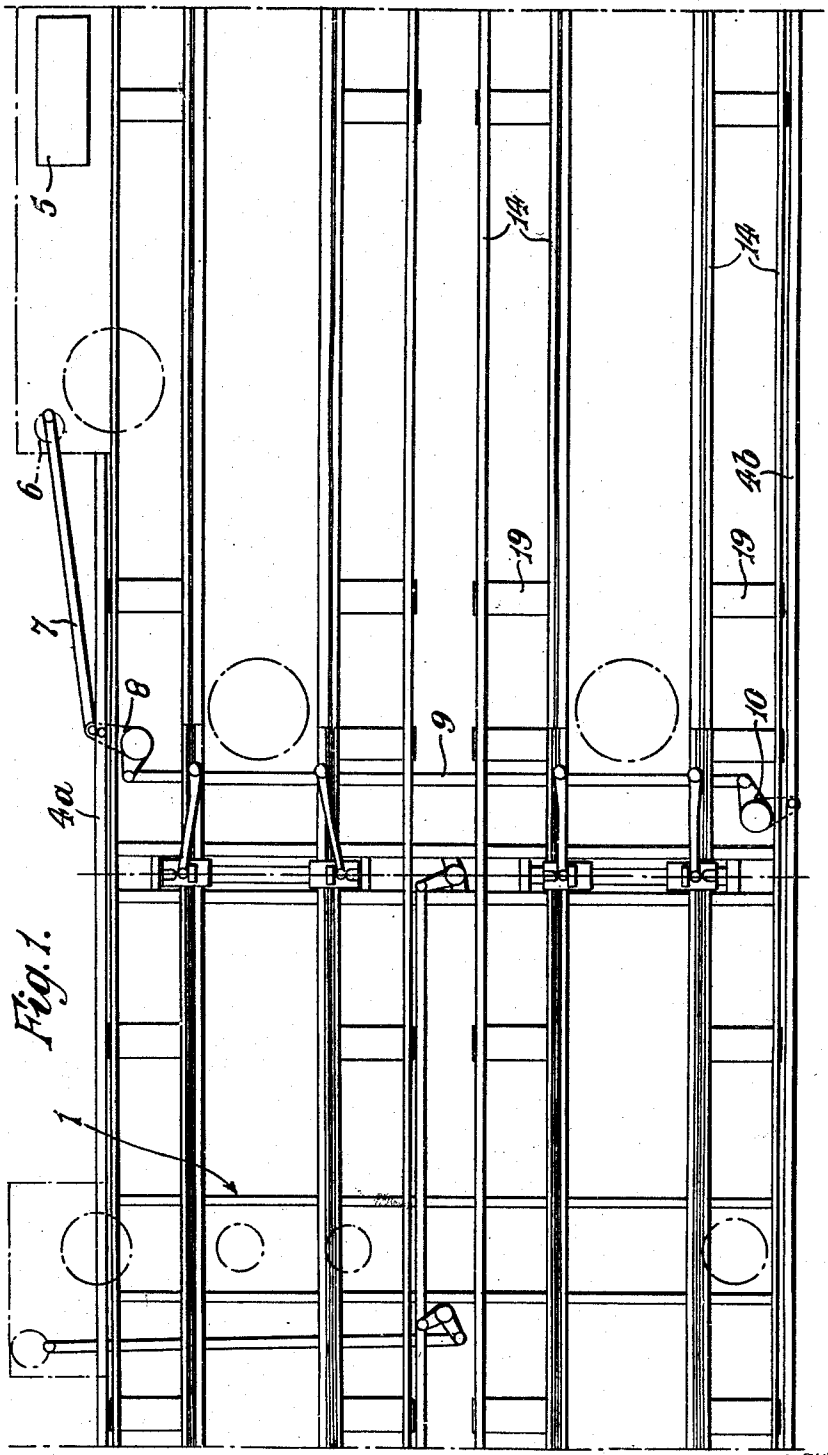

Fig. 1.

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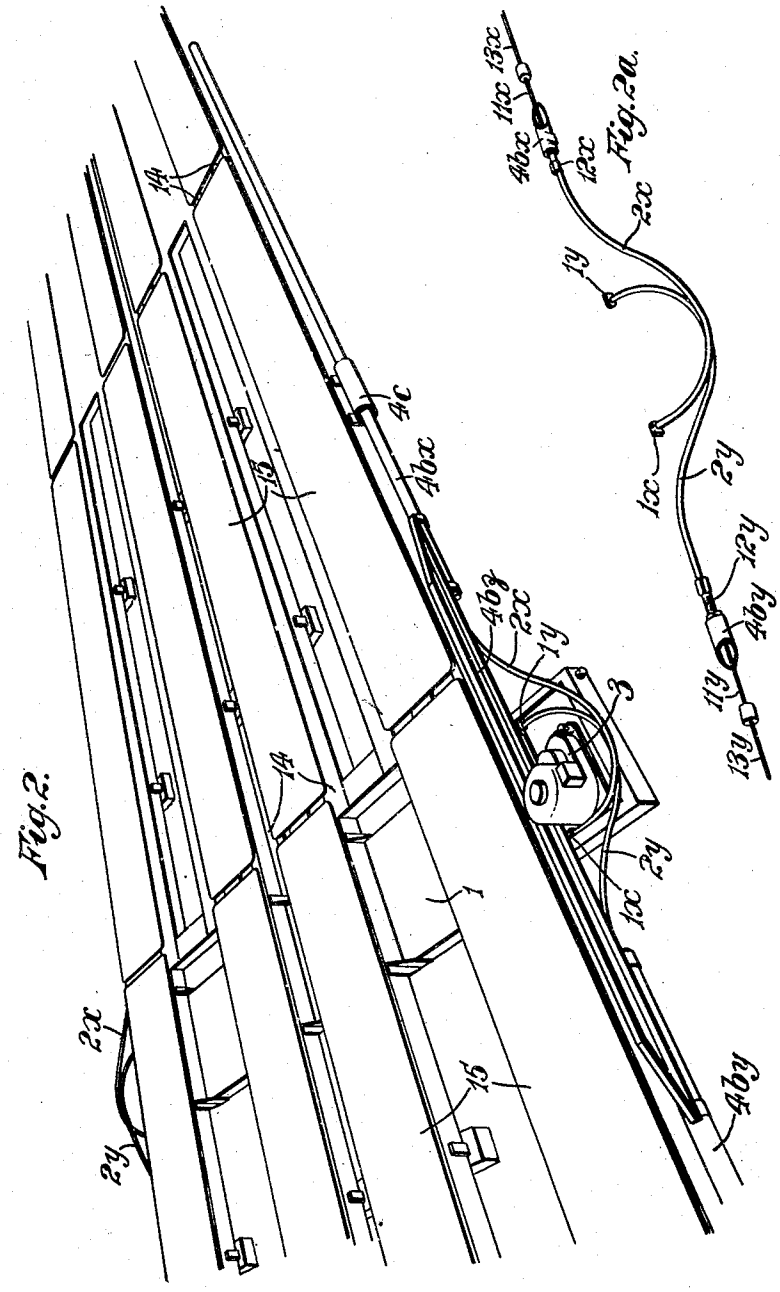
July 27, 1954 H. AUGER 2,684,640

MECHANICAL STORAGE EQUIPMENT

Filed June 22, 1948 6 Sheets-Sheet 2



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July 27, 1954 H. AUGER 2,684,640

MECHANICAL STORAGE EQUIPMENT

Filed June 22, 1948 6 Sheets-Sheet 3

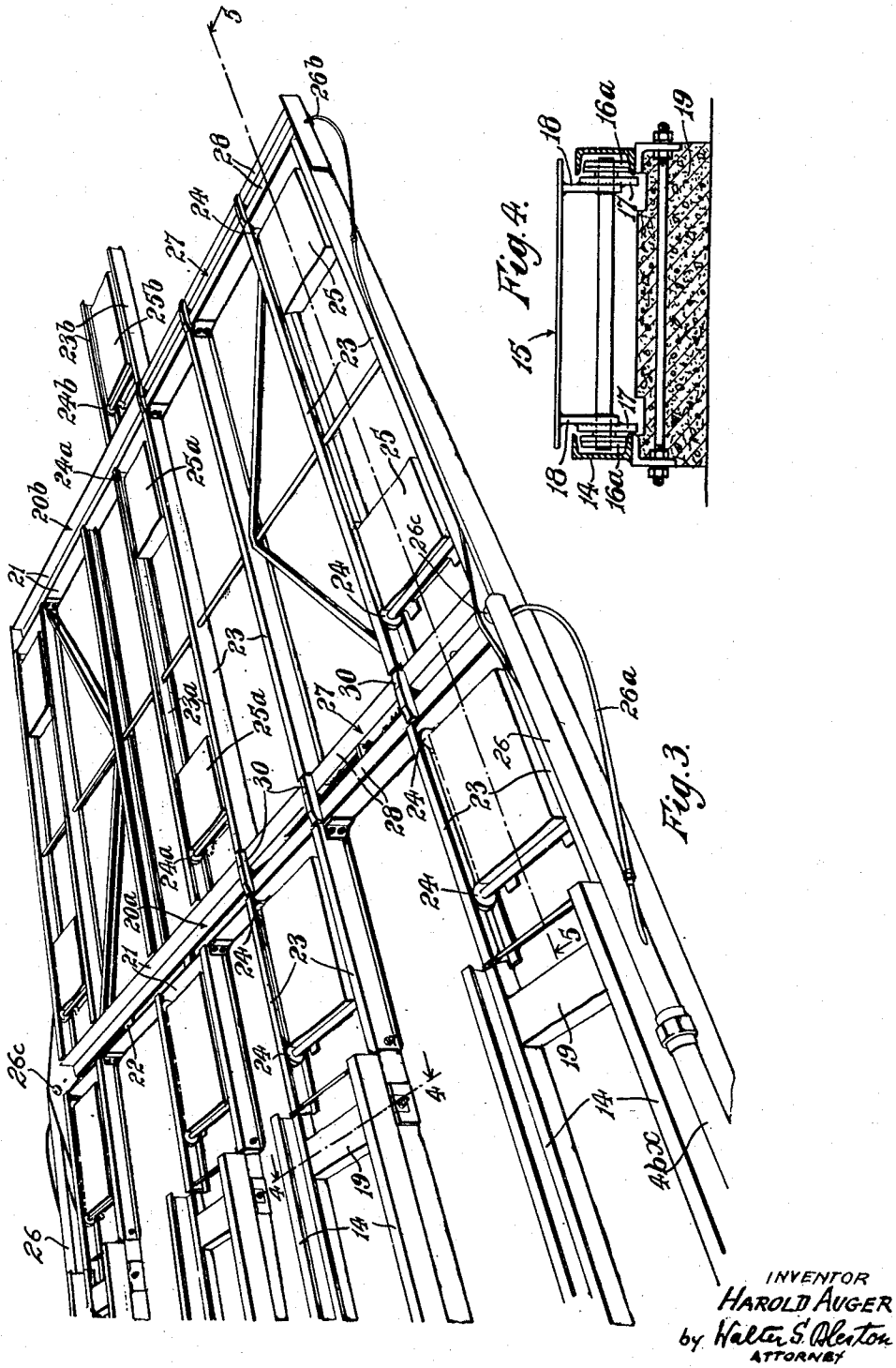

Fig. 3.

Fig. 4.

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July 27, 1954 H. AUGER 2,684,640

MECHANICAL STORAGE EQUIPMENT

Filed June 22, 1948 6 Sheets-Sheet 4

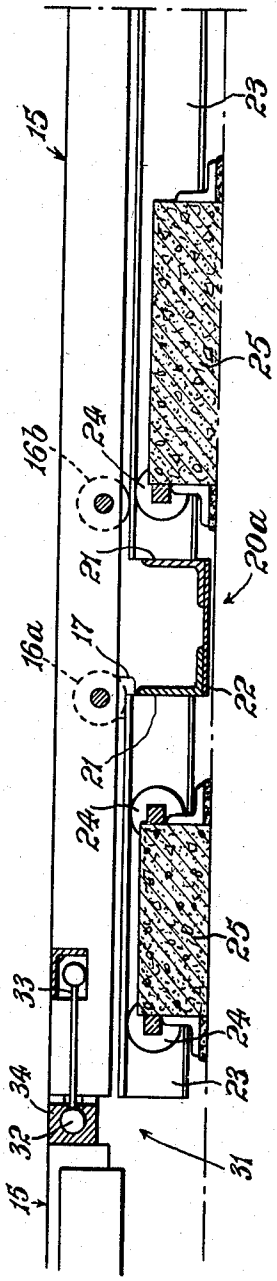

Fig. 5a.

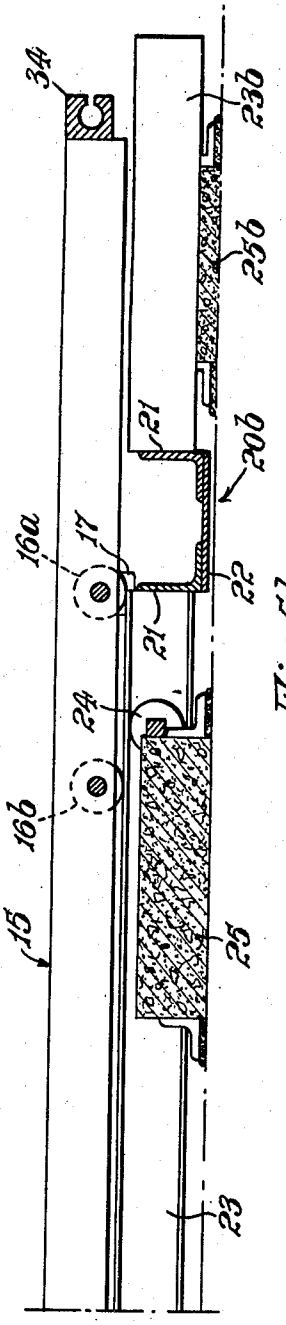

Fig. 5b.

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July 27, 1954 H. AUGER 2,684,640

MECHANICAL STORAGE EQUIPMENT

Filed June 22, 1948 6 Sheets-Sheet 5

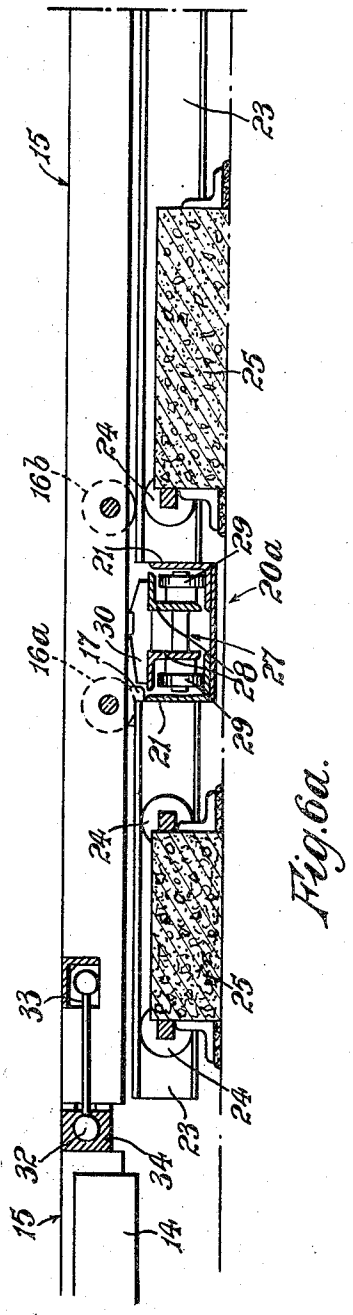

Fig. 6a.

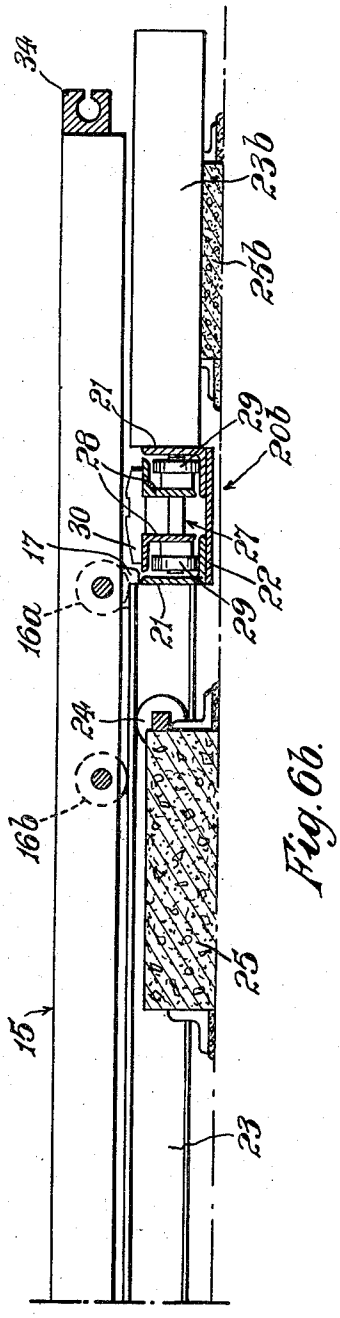

Fig. 6b.

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July 27, 1954 H. AUGER 2,684,640

MECHANICAL STORAGE EQUIPMENT

Filed June 22, 1948 6 Sheets-Sheet 6

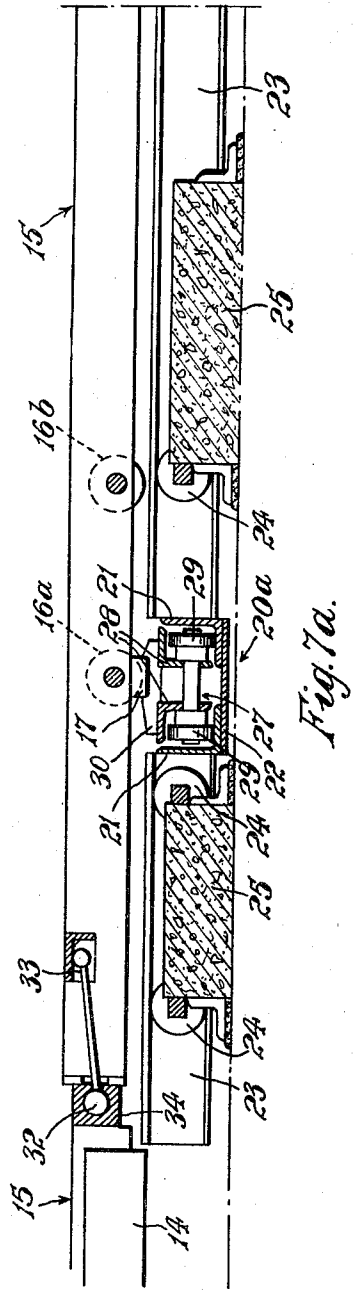

Fig. 7a.

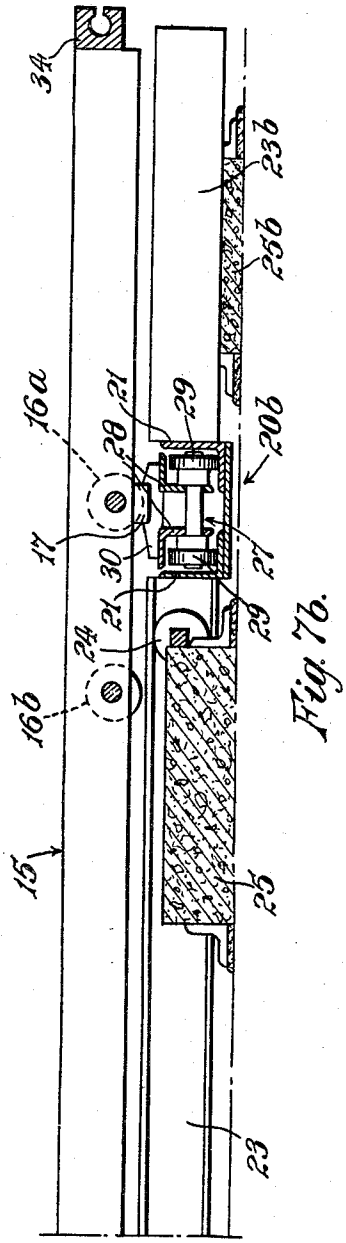

Fig. 7b.

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UNITED STATES PATENT OFFICE

2,684,640

MECHANICAL STORAGE EQUIPMENT

Harold Auger, Maidenhead, England

Application June 22, 1948, Serial No. 34,534

Claims priority, application Great Britain June 25, 1947

20 Claims. (Cl. 104—48)

1

The present invention relates to improvements in equipment for storing motor cars or other large objects, of the type in which the cars or the like are carried on platforms (or sets of platforms) arranged in ranks side by side, the cars or the like being circulated by shifting the platforms or sets in the ranks and transferring them between the ranks by means of one or more cross-overs which may most conveniently be disposed at the end or ends of the ranks; the invention being particularly concerned with such cross-overs and the actuation thereof.

In previously proposed equipment of the type just stated, where only one or two vacant spaces are left for the maneuvering of the platforms or sets, a platform or set, after acceptance onto a cross-over from one of the ranks, is loaded onto traversing means by causing relative vertical shifting between the supports of the platform or set and such traversing means, prior to operation of the latter and opposite relative vertical shifting at the conclusion of traversing ready for delivery into another rank. In this way it is made possible for the traversing means to operate unloaded whilst one or more platforms or sets are actually on the cross-over, and in particular for the said traversing means to return unloaded to pick up another platform or set whilst that just previously traversed in the same direction is waiting to be shifted into the appropriate rank.

According to the present invention, traversing means of the cross-over, preferably comprising one or more cross carriages, is itself relatively shifted with respect to the platforms or sets, so that the latter can thereby be brought either onto and off the said traversing means or onto and off non-traversing parts. The shifting of the traversing means is hereinafter sometimes referred to as "setting" the traversing means or "setting" the cross-over structure. This shifting or "setting" preferably takes place longitudinally of the ranks to bring the traversing means into position for operation alternatively loaded and unloaded. Where traversing is effected by means of one or more cross-carriages or equivalent part or parts, the term "traversing means" is to be understood in this connection to denote such carriage or carriages in assembly with its or their track or tracks and consequently to include any gap or gaps which may be needed for the carriage or carriages to move into. Such gap or gaps can be avoided by using a traversing means of endless band type.

The traversing means may be set horizontally, whereby it is made possible for a platform unit

2

to be loaded onto and unloaded from the said traversing means without substantial change of level, and for the cross-over if desired to accept and offer delivery of platform units from and to the ranks directly either onto and from the traversing means or onto and from non-traversing parts, although as mentioned below it is preferred to phase the movement so that it is the setting of the traversing means which loads and unloads platform units, when longitudinally stationary, onto and off said traversing means.

Since engagement of the platform units with and disengagement thereof from the non-traversing parts can be considerably facilitated by a change of level, even if quite small, it is preferable for the said relative shifting to be carried out in such a way that the platform units thereby become lifted for traversing and lowered at the conclusion of traversing. In this form, the cross carriages or the like may be so formed on top that the platform units become lifted in being loaded onto them and lowered in being unloaded from them. Alternatively, the cross carriages or their runways can become correspondingly lifted and lowered.

Setting of the traversing means longitudinally of the ranks, i. e. of the platform units, can readily be carried out simultaneously with delivery of a platform unit from and to the ranks instead of such delivery onto the cross-over having to be completed before traversing begins and traversing completed before delivery off the cross-over begins, as when using a lift mechanism which requires pauses whilst it is being actuated. In the cross-over of the present invention on the other hand, the setting thereof can proceed simultaneously with the shifting of the platform units in the ranks to deliver them onto and off the cross-over. The setting movement can last the whole of the time occupied in completely delivering or withdrawing a platform unit or, in view of the relatively small amplitude of such movement, may take place during just part of the platform shift. In either case, the same prime mover can be used, both for shifting the platform units in the ranks as well as for cross-over setting, the latter operation being effected through suitable reduction or lost motion gearing. The setting is preferably in the same direction as one of the ranks which is being simultaneously operated, but may be in the reverse direction.

Storage equipment of the type here concerned may operate with a single empty vehicle space ("single space working or operation") or with two empty spaces ("double space working or

operation"), which will result in characteristic differences in the pattern of the circulation cycle and the speed of circulation. The preferable phasing in single space working is such that platform delivery always takes place onto or off that side of the cross-over from which the cross carriages are absent, and that the carriages are moved up to or away from the side on which the rank is stationary. This phasing is especially desirable where the top of the cross carriages or the like is modified for lifting, since it enables running of the platform units over the shaped tops of the carriages, as would be required in the aforementioned direct delivery operation, to be avoided.

The body of the cross-over may consist of a large frame comprising non-traversing parts such as longitudinal track rails in line with the rails of the ranks, for engagement by rollers on the platform units, and traversing means consisting for example of a number of transverse runways for the cross carriages or the like. The non-traversing parts and the traversing means may then be shifted together to bring one or other into operative position. Setting of the cross-over as by shifting such a frame horizontally in its own plane and longitudinally of the ranks, may be effected by thrust members which can be conveniently disposed extending along either side of the ranks and powered by means located down the ranks from the cross-over, so that a single such means, which may be disposed intermediately near the middle of the ranks, can serve cross-overs at each end of the latter simultaneously through mechanical or other suitable, e. g. hydraulic, transmissions, the power source in question preferably being the prime mover already mentioned which is used for rank shifting. In single space operation the frames of cross-overs at both ends of the ranks may be set always in the same direction, so that one is projected whilst the other is drawn in and vice versa. In these circumstances, the frames move together and the thrust members can extend right through from one frame to the other. Platform rollers, which can conveniently be termed the rollers used for traversing, thus become transferred from the longitudinal track rails of the frames to the cross carriages or the like and vice versa.

The movement of the cross-over frame away from the ends of the track rails of the ranks creates a break in the continuity of the track; and the same is true at the traversing means, when the cross carriages or the like are absent from the side of the cross-over to or from which a platform or set is being delivered, as in the preferred phasing for single space operation already mentioned. In order to permit full support of the platform units on the cross-over in any relative position between them as well as smooth running of the units, irrespective of these gaps in the track, each unit may also be provided with supplementary rollers, by which it remains supported by the track when the rollers used for traversing are over the gaps and vice versa. After a platform unit is fully projected onto the cross-over and the frame set for unloaded traversing, so that its traversing means is clear of any of the rollers of the said unit, the cross carriages can be run in from the side under the latter. Preparatory to loaded traversing, the frame is then set longitudinally to move the carriages beneath rollers used for traversing. The engagement of the last mentioned rollers by the cross carriages is preferably of a positive character laterally, i. e. in the direction across the ranks, and locating means guarding against longitudinal movement when the platforms are on the cross carriages, for example slight depressions in the supporting surfaces of the latter, are also an advantage. To obtain the aforesaid positive lateral engagement with the cross carriages, the rollers used for traversing may be flanged or associated with fixed guide pieces. These flanges or guide pieces also serve to engage against the longitudinal track rails of the frames so that the platform units are laterally restrained at times when the rollers used for traversing are not on the cross carriages. The supplementary rollers cannot be relied on for this purpose, unless setting of the frame involves very considerable lifting of the platform units, because these supplementary rollers are essentially required to permit, without interference, lateral displacement off, over and onto the longitudinal track rails during traversing.

Instead of the track rails of the cross-over being made movable lengthwise with the traversing means, as preferred, an alternative possibility is for such rails to be fixed and gapped sufficiently to allow of the required shift of the traversing means only. However, this arrangement would result in wider individual gaps than when the rails are also made shiftable.

The present invention also provides means whereby the traversing means, which is itself shiftable relative to the platform in order to set the cross-over as already described, is operated from a fixed actuator that effects the required cross movement of the traversing means from one rank to another. Moreover, since the transmission for this purpose enables such an actuator to be made effective at a considerable distance down the ranks from the cross-over, a single such actuator, which may be disposed intermediately near the middle of the ranks, can serve the traversing means of cross-overs at each end of the latter simultaneously through mechanical or other suitable, e. g. hydraulic, transmissions. These may, at least in part, be of the core and reaction sheath type, so as to accommodate the aforesaid relative shifting.

The actuator is preferably one capable of providing full modulation as set forth in the specification of my copending prior patent application Serial No. 29,913, filed May 28, 1948, and may be disposed transversely of the ranks as therein suggested, with its collector movable between limits spaced apart a distance equal to the required traverse of the cross-carriages or the like and capable of pulling the carriages over positively in both directions. The transmissions to the carriages are connected to the collector according to the required phasing, so that the carriages will move either in the same direction as the collector or oppositely, or even, if desired, one way in one cross-over and simultaneously and oppositely in the other cross-over. In the preferable phasing for single space working, however, the traversing means of both cross-overs are required to operate simultaneously in the same direction. The aforementioned thrust members by which the cross-overs are set may be made tubular and, in spite of their reciprocation, be used to house these transmissions. Flexibility is of particular advantage in this case between the fixed actuator and these thrust tubes movable longitudinally past it, which tubes may be broken into in the neighbourhood of the actuator for coupling

transmissions inside the tubes with flexible core and reaction sheath drives of sufficient length to cover such relative movement of the tubes with respect to the actuator. The lengths of flexible sheath between the actuator and the respective thrust tubes may each at one end be fixed by a suitable union to one of these tubes and at the other end to the casing of the actuator to provide the required reaction, no matter what the relative position of the tube with respect to the said casing may be.

The cross-over construction herein described enables pits in the foundation for accommodating lift mechanism, according to previous proposals, to be avoided, and the depth required to house the equipment therefore to be considerably reduced. It is in fact adapted to operate in association with platform ranks which are operated as set forth in my aforesaid prior specification, and within substantially the same very considerably reduced overall depth. Moreover, the cross-over arrangements according to the present invention share the further advantage of the invention according to that specification in that the driving of the whole equipment is enabled to be carried out as completely as possible from a particular section, preferably the middle part of the rank trackways.

The invention will now be described by way of example with reference to the accompanying drawings, whereof:

Figure 1 is a plan view (without the platforms) of that part of a storage or vehicle parking equipment according to the invention, in which are accommodated the mechanisms for setting and actuating the traversing means of the cross-over or cross-overs, whereby platform units shiftable in two main ranks are transferred between the ranks.

Figure 2 is a perspective view of those parts of the main ranks of platforms in which the transversely arranged actuator of the traversing means of the cross-over or cross-overs is accommodated, also showing one of the thrust and transmission tubes of the setting mechanism on the near side of the ranks.

Figure 2*a* is a view showing the flexible cables only of Figure 2 and their connections with the transmissions within the near side thrust tube.

Figure 3 is a general perspective view of an end cross-over (without the platforms).

Figure 4 is a section on the line **4**—**4** of Figure 3 across a platform unit and its track.

Figures 5*a*—5*b*, 6*a*—6*b* and 7*a*—7*b* are composite sections along the line **5**—**5** of Figure 3 (with a platform unit in place) showing the cross-over frame set in three of its typical operative positions.

A full description of the part of the mechanism shown in Figures 1 and 2 is given in my aforesaid prior specification. Accordingly, only such particulars are repeated herein as to enable the operation of the cross-over mechanism to be understood. The present invention is not essentially concerned with the internal details of the actuator **1**, whereby the cross carriages of the cross-overs are traverse, since any mechanism embodying a reciprocable element to which the cores of the flexible core and reaction sheath driving cables **2***x* and **2***y* on both sides of the ranks can be attached and providing stops **1***x* and **1***y* for the reaction sheaths, might be employed. However, the transverse drive modulating mechanism as set forth and suggested for the purpose in my aforesaid prior specification is preferred, since it provides a fully modulated drive for the said cross carriages. It should be noted that in Figure 2, the means for operating the coupling stations of the ranks from the prime mover **3** of actuator **1** has been omitted, as the present invention is not concerned with that feature.

Turning now to the consideration of the setting of the cross-over or cross-overs, this is effected through the longitudinally reciprocable pair of thrust tubes **4***a* and **4***b*, one on either side of the ranks supported from the side edge rails of the ranks in brackets **4***c*. Since the setting is required to take place in phase with the shifting of the platforms in the ranks, it may conveniently be powered from the prime mover **5** of the rank shifting mechanism through gearing **6**, connecting rod **7**, bell crank **8**, making driving connection with thrust tube **4***a*, thence through a transverse coupling rod **9** to another bell crank **10**, making driving connection with the second thrust tube **4***b*.

Figures 2 and 2*a* clearly show the manner in which the thrust tubes **4***a* and **4***b*, independently and in spite of their setting movement, can be made available to carry the transmissions from the actuator **1**, tube **4***b* which appears in these figures being seen to comprise two aligned parts **4***bx* and **4***by* with a rigid bridging member **4***bz* between them. Tube **4***a* is similarly made composite. In cases where the operation requires simultaneous withdrawal and projection of the cross-overs at both ends of the ranks, the bridging members would be omitted, and the two parts of each tube separately actuated to thrust them apart and draw them together. The tension core members of the respective flexible drives **2***x* and **2***y* appear at **11***x* and **11***y* in Figure 2*a* within the thrust tube parts **4***bx* and **4***by*, only the broken ends of which, adjacent the coupling unions **12***x* and **12***y*, are shown in that figure. Beyond the limits of the required movement, the tension core members can be continued up the tubes by non-flexible rods **13***x* and **13***y*.

In Figure 3, which shows one of the end cross-overs of the equipment, the extremities of the inwardly facing channel track rails **14** for the platform units **15** when in the ranks, also appear. These units are arranged in two main ranks, the units in each of which are associated in pairs, with one component of each pair in each of two subordinate ranks, requiring altogether four pairs of the rails **14**. The manner in which the units engage the rails can best be understood from the typical cross view of one subordinate rank in Figure 4, wherein the platform rollers **16***a* appearing in this figure are one of the pairs used for traversing, as will later be described, and are therefore associated with guide pieces **17** depending fixedly from the platform frame **18** below the rollers. The platform units are also provided as shown in Figure 5 with pairs of supplementary rollers **16***b* resembling rollers **16***a*, except that they do not have such guide pieces beside them. One of the tied concrete sleepers **19** for supporting the track rails is also shown in Figure 4.

The main body of the cross-over consists of the large frame extending across the whole width of the ranks as shown in Figures 3 and 5. Owing to its size, only the component parts of this frame can be designated by references. It comprises two transverse runways **20***a* and **20***b*, each composed of a pair of angle irons **21** held apart by appropriate bottom spacers **22**. Extending in

line with each rail 14 of the ranks, the cross-over frame is also provided with a longitudinal track rail 23 for the rollers of the platform units, which rails are gapped to accommodate the inner transverse runway 20a. Track rails 23 of the cross-over frame differ essentially from rails 14 of the ranks in that they offer no obstacle to lateral movement of the platform units. Accordingly, in order to prevent unwanted movement of this kind whilst the units are on the cross-over, reliance is placed on the engagement of the guide pieces 17 thereof, with the inner sides of the rails 23. The transverse rails 21 and the longitudinal rails 23 are all secured together to produce a frame structure having the maximum possible rigidity, and mounted so as to be freely mobile horizontally and longitudinally with respect to the ranks, so that it can be shifted from a drawn in limiting position (as shown in Figures 3 and 7) in which there is no appreciable gap between the adjacent ends of rails 14 and 23, and another projected limiting position (shown in Figures 5 and 6) sufficiently to move the platform rollers 16a used for traversing from positions in which they rest on portions of rails 23 just clear of runways 20a and 20b to positions in which they rest on the cross-carriages. To permit this floating of the frame, the rails 23 take the form of channels on edge, like rails 14, but at a lower level where their upper flanges are adapted to rest on pairs of rollers 24 which are engaged within the channels and whose axles are mounted in the sides of concrete blocks 25 projecting upwardly from the foundation. Since so far as the running of the platforms over them is concerned, it is immaterial to which side the channels of rails 23 face, sections of the inner pair of rails 23a are oppositely turned, with their channels towards one another, to accommodate pairs of rollers 24a on central foundation blocks 25a. The platform rollers never being required to travel farther than the outer transverse runway 20b, it is unnecessary for rails 23a to be continued as trackways beyond the said runway. However, rail sections 23b running on rollers 24b mounted on block 25b are provided in line with the pair of central sections 25a to the far side of that runway for the purpose of balancing the support of the outer end of the frame.

The side edge rails of the frame are rigidly connected at 26c to the outer ends of the thrust tubes 4a and 4b through extensions 26 of the said tubes, whereby the aforementioned reciprocation of the tubes is imparted to the frame to shift and set it. In the forward end of the tube part 4bx (appearing in Figure 3) the tension rod 13x (shown in Figure 2a) terminates in a union to which are connected cables within sheaths 26a and 26b, the cables themselves being in turn connected to the cross carriages 27 of the respective transverse runways 20a and 20b. It is not necessary for these sheaths to be flexible, since they have no relative movement to accommodate as do the cables 2x and 2y adjacent the actuator. As there are similar tension cables on each side of the equipment, the movement of the cross-carriages is positive in both directions, and in complete synchronism with the central actuator, no matter what the setting of the cross-over frame may be.

The cross-carriages 27 are similar, being long enough to cover the width of one of the main ranks, i. e. two pairs of the longitudinal rails 23 of the frame. Each carriage (see Figures 3 and 6) comprises two inverted angle irons 28 with their top flanges outwardly directed horizontally. Their depending flanges carry the axles of pairs of rollers 29, engaging rails 21 of the transverse runways. On top of each carriage are fixed four track blocks 30, which can be brought into line either with the respective rails 23 on one side of the cross-over opposite one of the main ranks, or with the similar rails on the other side of the cross-over opposite the other main rank. These blocks are able in effect to render one or other of these sets of rails continuous, and if level therewith would make it possible for the platform units to run over them without jolting. However, it is preferred instead to hump them and to operate the parts in such sequence that it is the setting movement of the frame which brings the blocks and removes them from under the platform rollers used for traversing, rather than delivery of the platform units from and to the ranks directly onto and from the blocks after the latter have been already set. Each block 30 is formed at the top of its ramp with a slight depression sufficient just to locate the roller longitudinally on the summit of the block during traversing.

The preferred phasing for single space work involves four operations, the typical positions at the ends of the second, third and fourth of which on one side of the cross-over are shown in Figures 5 to 7 respectively. In the first position, which is not included among these sectional views, but in which the frame is drawn in adjacent the ends of the rank track rails 14 as shown in Figure 3, a set of platform units is waiting to be delivered onto the frame in the particular main rank to which the sections relate. Then, whilst this platform set is being completely delivered onto the cross-over, the frame is simultaneously set by being projected away from the ranks to form gap 31, so that at the end of this operation the parts are in the position shown in Figure 5. On the other side of the cross-over this movement has resulted in unloading of the platform set from the cross-carriages. The cross-carriages thus released are now traversed in from the other side as shown in Figure 6. This movement has previously been referred to as unloading traversing. There then follows another setting of the frame, this time towards the ranks, to the position shown in Figure 7, wherein the platform rollers 16a used for traversing have become seated on the blocks 30 with the guide pieces 17 in lateral engagement with the blocks, the platform or set thus being ready for transfer to the other rank. It should be observed that this last mentioned setting of the frame has been accompanied by delivery of the platform set off the other side of the cross-over, leaving an open space there ready to receive the set shown loaded in Figure 7. Finally there is the loaded traversing movement to the first mentioned position. This sequence can, of course, be carried out in either direction, according to requirements. It will be observed that each pair of the rollers 16a is associated with a pair of the rollers 16b spaced therefrom towards the middle (in the longitudinal sense) of the platform unit sufficiently to ensure that at the variable gaps 31 and also at the crossing of the inner transverse runway, the unit remains always fully supported on rollers of one or other pair.

The end couplings between the platform units when in the ranks is such as I have previously proposed, permitting lateral separation for transfer between the ranks. Such a coupling has to

allow of any raising and lowering of the platform units taking place on the cross-over with consequent flexing whilst the units are still interconnected, as well as engagement and disengagement laterally even when the platforms are thus relatively displaced, although the amount of movement thus to be accommodated is relatively slight in accordance with my present proposals. The coupling comprises at one end of each platform unit a horizontally disposed transverse cigar-shaped male part **32** on a pivotal mounting **33** adapted to engage a female socket part **34** with flared end openings, at the opposite end of the unit. The vertical displacement shown in Figure 7 is somewhat exaggerated for convenience in illustration, although if desired it could be considerably greater, in which circumstances the rollers **16***b* might also be flanged or associated with guide parts, providing the blocks **30** were able to impart sufficient lift to the platform units to clear any such flanges or guides from rails **23**.

I claim:

1. In storage apparatus of the type including a platform adapted to carry a load and displaceable along a plurality of ranks, the combination of a cross-over comprising extensions of said ranks and driven traversing mechanism adapted to transfer said platform from one of said ranks to another along a predetermined path, a way defining said path, said traversing mechanism and said way being so constructed and arranged as to be reciprocably shiftable with respect to said platform and said ranks for a predetermined distance along another predetermined path extending longitudinally of said ranks, and said traversing mechanism including a platform support thereon which is adapted to load and unload said platform on and from said traversing mechanism by said shifting of the latter, and a reciprocating drive adapted to so shift said traversing mechanism in a predetermined sequence.

2. A combination in accordance with claim 1, in which said second path is substantially horizontal.

3. A combination in accordance with claim 1, in which each rank includes a platform runway having a bearing surface adapted to accommodate said platform, and said platform support includes a bearing surface substantially coplanar with the bearing surface of said runway.

4. A combination in accordance with claim 1, in which said platform support includes a fixed cam member which is adapted to lift said platform in loading it upon said traversing mechanism and to lower it in unloading it therefrom.

5. A combination in accordance with claim 1, including a reciprocating drive adapted to move said platform along said ranks and into and out of said cross-over at predetermined intervals, said last drive and said drive adapted to shift said traversing mechanism being so phased as to shift said traversing mechanism while said platform is moved into or out of said cross-over.

6. In storage apparatus of the type including a platform adapted to carry a load and displaceable along a plurality of ranks, the combination of a cross-over comprising extensions of said ranks and traversing mechanism adapted to transfer said platform from one of said ranks to another along a predetermined path, a way defining said path, said traversing mechanism and said way being so constructed and arranged as to be reciprocably shiftable with respect to said platform and said ranks for a predetermined distance along another predetermined path, said

second path extending longitudinally of said ranks, and said traversing mechanism including a platform support thereon adapted to load and unload said platform on and from said traversing mechanism by said shifting of the latter, and a reciprocating drive adapted to so shift said traversing mechanism in a predetermined sequence timed to effect said shift only when one of said platforms is at rest in said cross-over and is aligned with one of said ranks.

7. In storage apparatus of the type including a platform adapted to carry a load and displaceable along a plurality of ranks defined by spaced rank rails, the combination of a cross-over comprising extensions of said ranks, a runway transverse to said ranks and defining a predetermined path from one rank to another and a cross carriage accommodated on and adapted to move along said runway, said runway and said carriage being so constructed and arranged as to be reciprocably shiftable with respect to said platform and said ranks, for a predetermined distance along another predetermined path, said second path extending longitudinally of said ranks, and said carriage including a platform support thereon adapted to load and unload said platform on and from said carriage by said shifting of the latter, and a reciprocating drive adapted to effect said shift of said runway and said carriage in a predetermined sequence.

8. A combination in accordance with claim 7, in which said second path is substantially horizontal.

9. A combination in accordance with claim 7, in which each said rank rail includes a bearing surface adapted to accommodate said platform, and said platform support includes a bearing surface substantially coplanar with the bearing surfaces of said rank rails and adapted to support said platform when said runway and said carriage have been so shifted in one direction.

10. A combination in accordance with claim 7, in which each said rank rail includes a bearing surface adapted to accommodate said platform, and said platform support includes a bearing surface which is at a level above the bearing surfaces of said rank rails and which is adapted to support said platform when said runway and said carriage have been so shifted in one direction.

11. A combination in accordance with claim 7, in which said platform support on said cross carriage comprises an upwardly inclined cam face and a bearing surface which is at a level above the bearing surface of said rank rails, said support being adapted to lift and support said platform as said runway and said carriage are so shifted in one direction, and in which combination said platform carries a vertical guide member adapted to bear against said support when said platform is loaded upon said carriage, whereby lateral movement of said platform relatively to said carriage while so loaded is restrained.

12. A combination in accordance with claim 7, in which said rank extensions in the cross-over include rails forming extensions of said rank rails, and in which said rank rail extensions are interrupted in the vicinity of said runway, thereby leaving gaps in said rail extensions, said cross carriage comprises a plurality of said platform supports thereon, spaced apart and reproducing the spacing of said rank rail extensions, and said supports comprise bearing surfaces which are at a level above the bearing surfaces of said rank rail extensions, said supports being movable

through said gaps as said carriage moves along said runway, and said supports being adapted to support said platform when said runway and said carriage have been shifted in one direction

13. A combination in accordance with claim 7, in which said platform is carried on wheels running on said rank rails, said cross carriage comprises a wheeled frame including a plurality of said platform supports, spaced apart thereon and reproducing the spacing of said rank rails in a rank and registrable with said platform wheels, said supports having upwardly inclined cam faces and also having bearing surfaces located above the bearing surfaces of said rank rails, and said supports being adapted to lift and support said wheels above the bearing surfaces of said rank rails when said runway and said carriage are shifted in one direction, and to lower said wheels to said rail bearing surfaces and free said wheels from said supports when said runway and said carriage are shifted in the opposite direction.

14. A combination in accordance with claim 7, in which said drive adapted to shift said runway comprises rigid arms disposed along said ranks and drivably connected to said runway, and a reciprocating actuator drivably connected to said arms.

15. A combination in accordance with claim 7, in which said drive adapted to shift said runway comprises rigid hollow arms disposed along said ranks and drivably connected to said runway, and a first reciprocating actuator drivably connected to said arms, and said combination also includes a second drive which is adapted to move said cross carriage along said runway, said second drive comprising a second reciprocating actuator and members capable of transmitting substantial energy only in tension, and said members being connected between said second actuator and said carriage and being housed in part at least within said arms.

16. A combination in accordance with claim 7, including a reciprocating drive adapted to move said cross carriage along said runway, said last-mentioned drive comprising a reciprocating actuator and a flexible member, said flexible member being capable of transmitting substantial energy only in tension and being connected between said actuator and said carriage.

17. A combination in accordance with claim 7, including a reciprocating drive adapted to move said cross carriage along said runway, said last-mentioned drive comprising a reciprocating actuator and drive members, said drive members being capable of transmitting substantial energy only in tension and being connected between said actuator and said carriage, one of said drive members leading from one end of said actuator and leading to said carriage at one end thereof, and another of said drive members leading from another end of said actuator and leading to said carriage at an opposite end thereof, whereby one of said drive members is adapted to drive said carriage during alternate strokes of said actuator in one direction and another of said members is adapted to drive said carriage during the intervening strokes of said actuator in the opposite direction.

18. In storage apparatus of the type including a platform adapted to carry a load and displaceable along a plurality of ranks defined by spaced rank rails, each of said rails comprising a main rail and a cross-over rail forming an extension of its corresponding main rail, the combination of a cross-over comprising said cross-over rails and traversing mechanism extending transversely of said cross-over rails, said traversing mechanism being adapted to transfer said platform from one of said ranks to another, and said cross-over rails and said traversing mechanism being so constructed and arranged as to be reciprocably shiftable with respect to said platform simultaneously and in the same direction between two predetermined positions, and said cross-over including a platform support having an inclined cam face adapted to load and unload said platform on and from said traversing means as the latter is so shifted, and a reciprocating drive adapted to so shift said cross-rails and traversing mechanism simultaneously in a predetermined sequence.

19. A combination in accordance with claim 18, in which said traversing mechanism includes a runway extending transversely of said cross-over rails and a cross carriage accommodated on and adapted to move along said runway, said cross-over also comprises a frame structure including said cross-over rails and said runway, and said drive adapted to shift said cross-over rails and traversing mechanism is drivably connected to said frame.

20. A combination in accordance with claim 18, in which, in one of said positions, said cross-over rails substantially abut their corresponding main rails and said platform is loaded on said traversing mechanism, and in the other of said positions said cross-over rails are projected from their corresponding main rails and said traversing mechanism is freed from said platform.

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