Feb. 14, 1939. F. C. VANCE 2,147,564

FOLDABLE STRUCTURE

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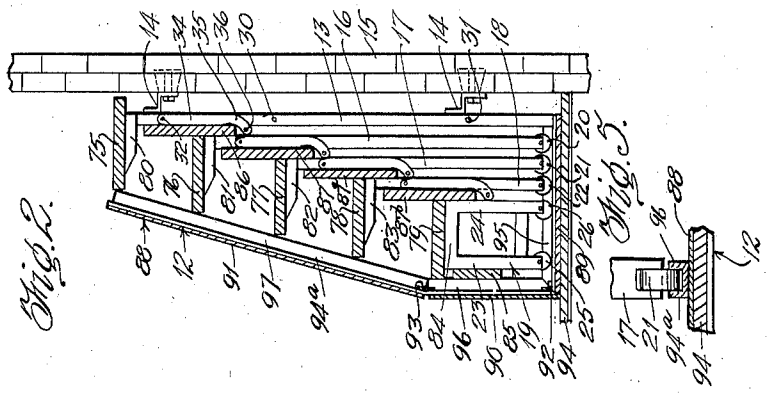


Fig. 2.

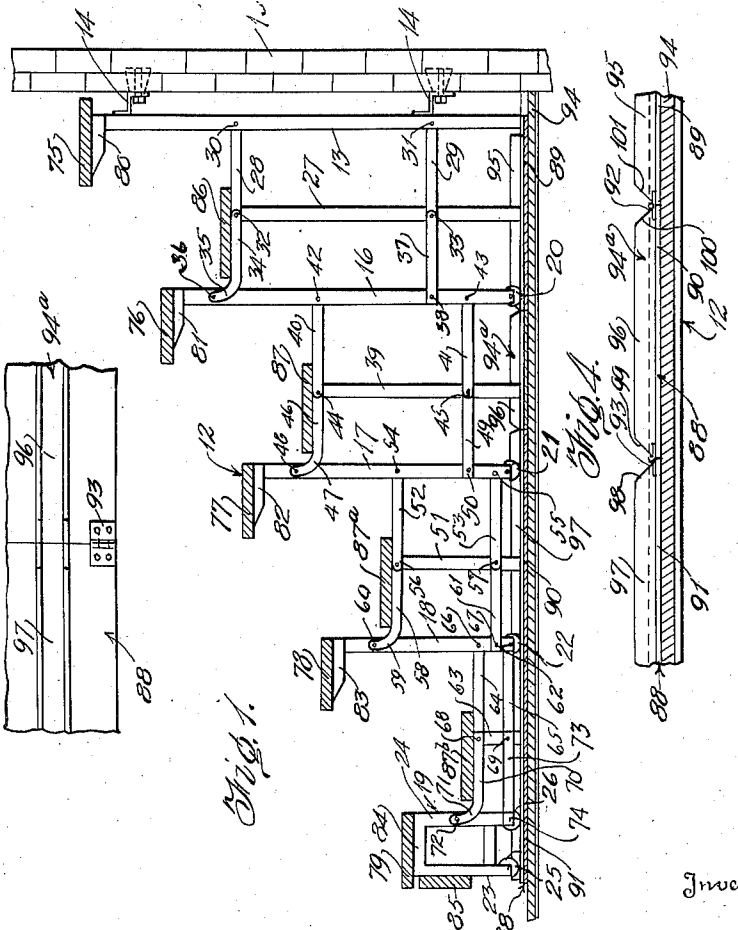


Fig. 1.

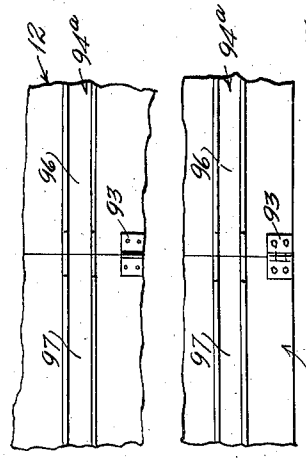


Fig. 3.

Fig. 4.

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FOLDABLE STRUCTURE

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Fig. 8.

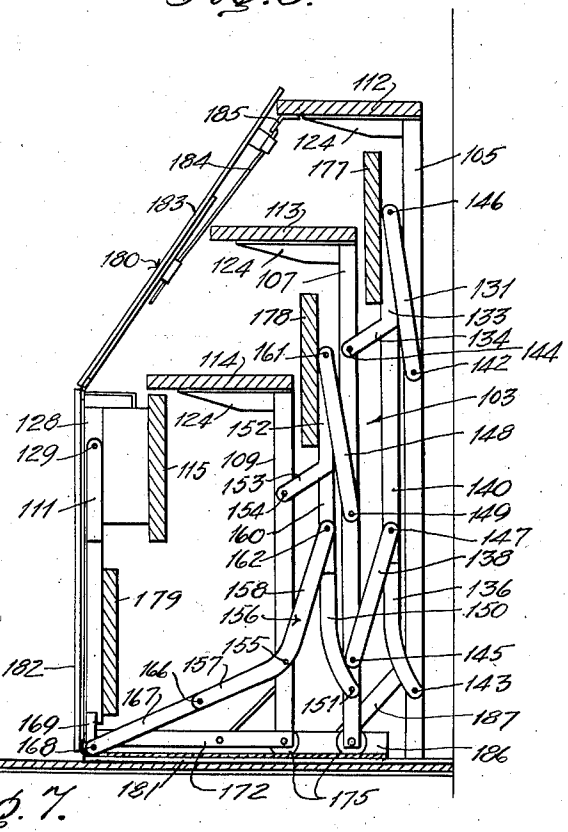


Fig. 6.

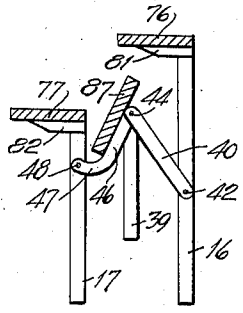
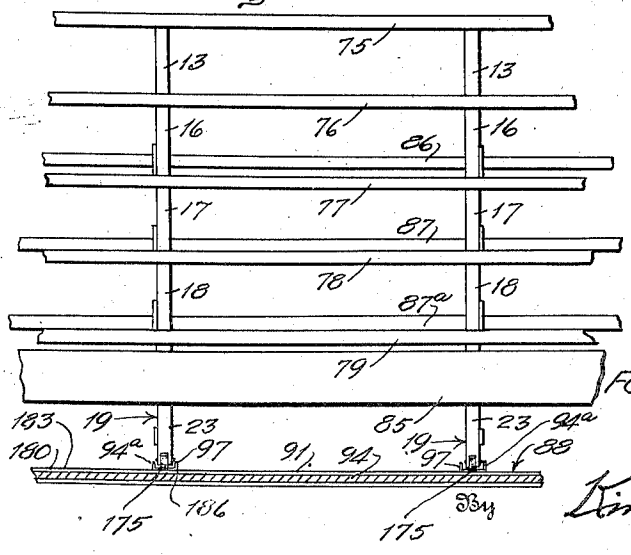


Fig. 7.



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FOLDABLE STRUCTURE

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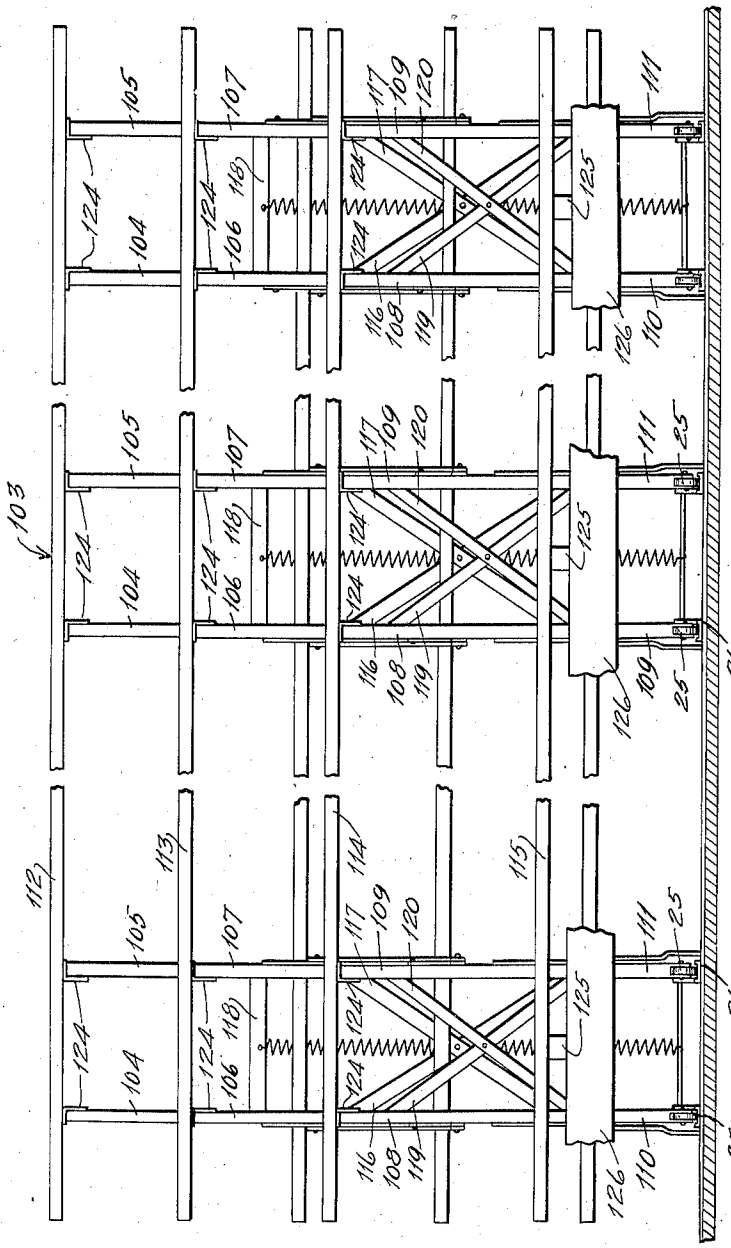


Fig. 9.

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FOLDABLE STRUCTURE

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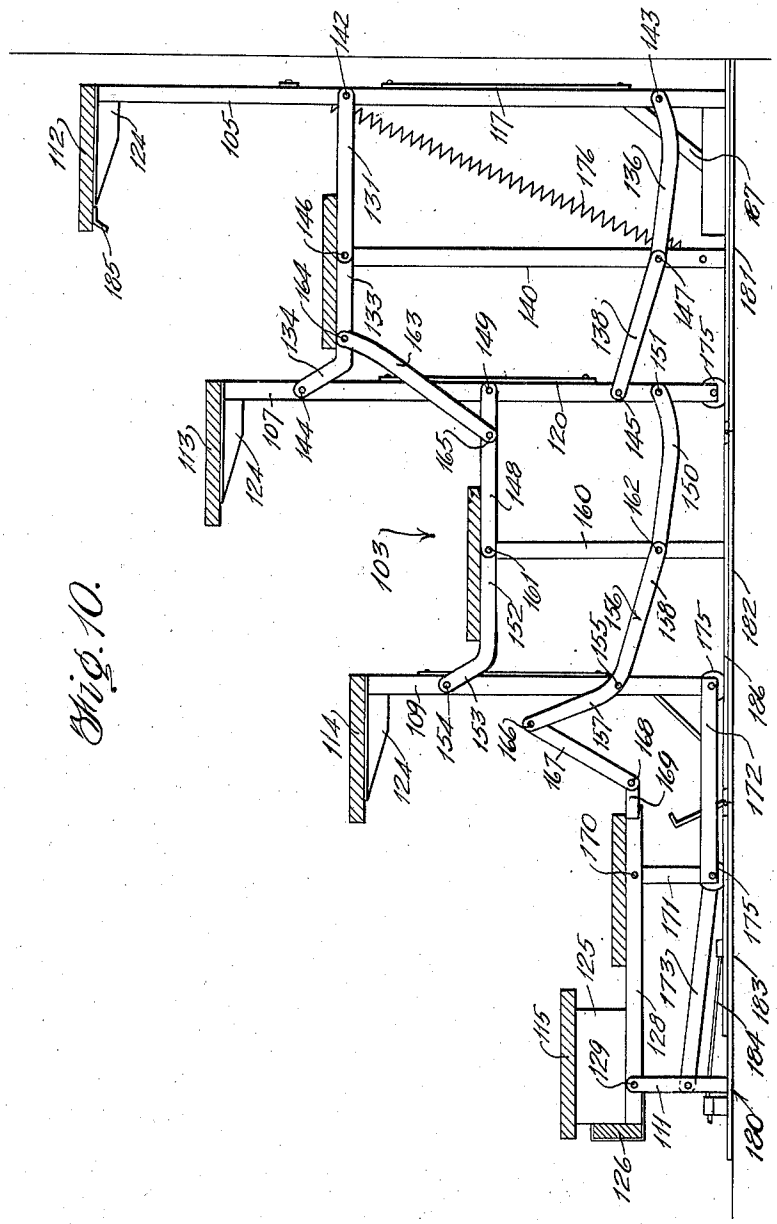


Fig. 10.

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FOLDABLE STRUCTURE

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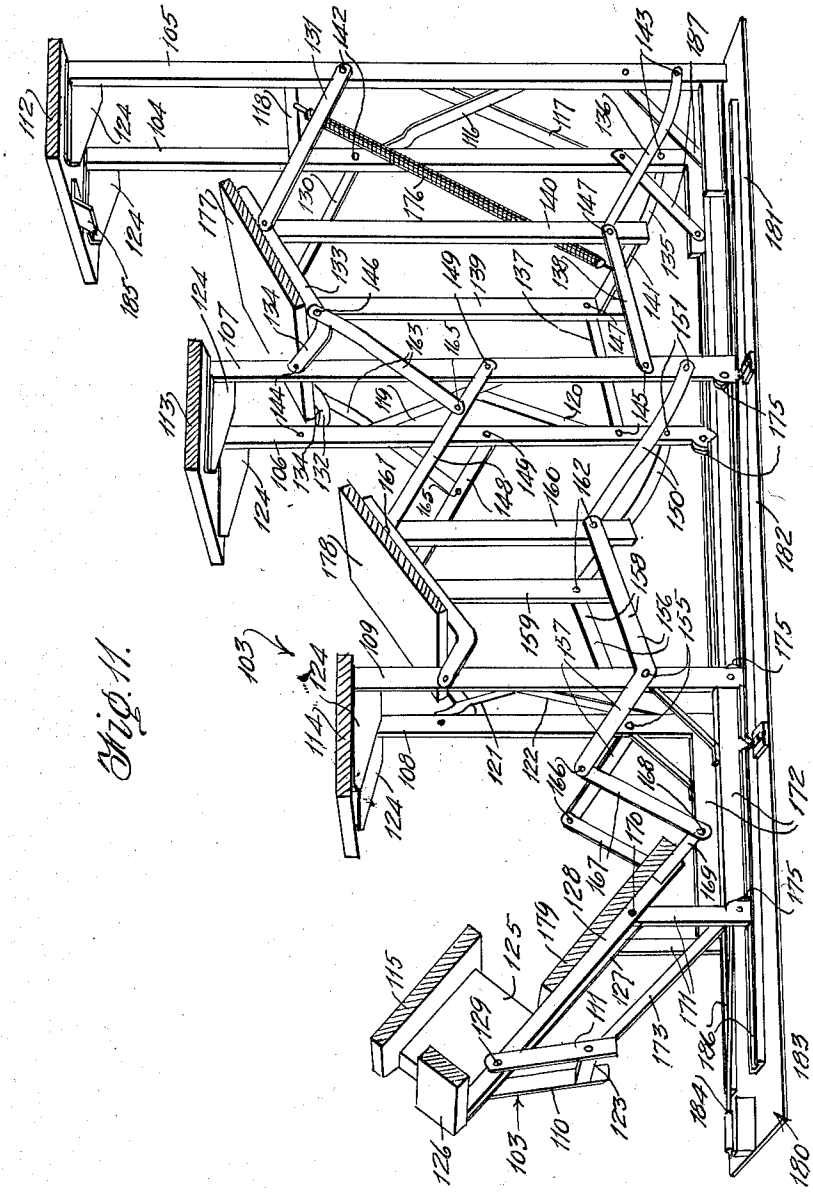


Fig. 11.

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Patented Feb. 14, 1939

2,147,564

UNITED STATES PATENT OFFICE

2,147,564

FOLDABLE STRUCTURE

Forrest C. Vance, Champaign, Ill.; Ella M. Vance executrix of said Forrest C. Vance, deceased

Application August 11, 1937, Serial No. 158,621

1 Claim. (Cl. 20—0.5)

This invention relates to a new and useful improvement in foldable structures, more particularly, to a structure of such class designed for use as foldable grandstands in gymnasiums, public halls, at courts and playing fields, and of that type including a plurality of longitudinally extending seats, each capable of holding a number of persons, the seats when in use being disposed one below and in advance of the other and each being associated with a corresponding foot board or foot rest.

The invention has for its object to provide, in a manner as hereinafter set forth, a foldable and extendible structure for the purpose referred to which may be expeditiously folded and extended at will and, when folded, will be arranged in a compact manner and occupy a relatively small area.

A further object of the invention is to provide, in a manner as hereinafter set forth, a foldable structure capable of being arranged at any desired point with respect to a playing field or court and out of the way of the athletes on the field and court, and further capable of being extended to constitute a grandstand formed with a step-like arrangement of seats, and still further of being expeditiously folded in a compact manner to occupy a relatively small area.

A further object of the invention is to provide, in a manner as hereinafter set forth, a structure for the purpose referred to including seats supported by uprights provided at their lower ends with rollers, and to further provide the structure with tracks upon which these rollers operate so as to prevent any twisting strain being applied to the seats when the structure is extended or folded.

A further object of the invention is to provide, in a manner as hereinafter set forth, a structure for the purpose referred to including a sectional base capable of being folded and extended and with the base including track sections for endwise aligning when the base is extended.

A further object of the invention is to provide, in a manner as hereinafter set forth, a structure for the purpose referred to including foot boards or foot rests which will be supported entirely from the base of the structure, when the latter is in its extended position.

Further objects of the invention are to provide, in a manner as hereinafter set forth, a foldable and extendible structure for the purpose referred to which is comparatively simple in its construction and arrangement, strong, durable, thoroughly efficient in the use intended thereby, conveniently extended and folded when occasion requires, readily assembled and comparatively inexpensive to set up with respect to structures now employed for the same purpose.

With the foregoing and other objects which may hereinafter appear, the invention consists of the novel construction, combination and arrangement of parts as will be more specifically referred to and illustrated in the accompanying drawings wherein is shown embodiments of the invention, but it is to be understood that changes, variations and modifications may be resorted to which fall within the scope of the invention as claimed.

In the drawings:

Figure 1 is a longitudinal sectional view of the foldable structure extended,

Figure 2 is a longitudinal sectional view of the structure when folded,

Figure 3 is a fragmentary view broken away in top plan, of the base or floor of the foldable structure upon an enlarged plan.

Figure 4 is a fragmentary view in longitudinal section of the base or floor of the foldable structure,

Figure 5 is a sectional detail illustrating the construction of the track elements employed,

Figure 6 is a fragmentary view in longitudinal section illustrating the structure partly folded,

Figure 7 is a fragmentary view in front elevation of the foldable structure when extended,

Figure 8 is an end elevation of a modified form of foldable structure when folded and with the seat members and foot boards in transverse section,

Figure 9 is a frangmentary view in front elevation of the structure shown in Figure 7 extended,

Figure 10 is a longitudinal sectional view of the modified form of the foldable structure when extended, and

Figure 11 is a fragmentary view in longitudinal section of the modified form of the folding structure when the latter is partly extended.

With reference to Figures 1 to 7 both inclusive, the foldable and extendible structure which is termed a grandstand includes seat members and foot boards or rests of any desirable length and said members and boards will be of like length. As illustrated the grandstand, indicated generally at 12 is shown by way of example as including five seat members and four foot boards or rests. It is to be understood that the number of seat members and foot boards may be as de-

sired, but the number of foot boards will be one less than the number of the seat members.

The grandstand 12 includes a set of spaced parallel vertically disposed stationary rear supports 13 of any suitable number provided with superposed means as at 14 for detachably connecting them to and spaced forwardly from a wall or fence 15. As shown the means 14 is in the form of an angle-shaped bracket.

The grandstand 12 includes a set of spaced parallel vertically disposed slidable supports 16 corresponding in number to that of the supports 13. The supports 16 are of less height than, arranged forwardly of and align with the supports 13.

The grandstand 12 includes a set of spaced parallel vertically disposed slidable supports 17 corresponding in number to that of the supports 16. The supports 17 are of less height than, arranged forwardly of, and align with the supports 16.

The grandstand 12 includes a set of spaced parallel vertically disposed slidable supports 18 corresponding in number to that of the supports 17. The supports 18 are of less height than, arranged forwardly of and align with the supports 17. Each of the supports 13, 16, 17 and 18 is in the form of a single upright or post.

The grandstand 12 includes a set of spaced parallel vertically disposed slidable supports 19 of inverted U-shape and which correspond in number to that of the supports 18. The supports 19 are of less height than, arranged forwardly of and align with the supports 18.

The supports 16, 17 and 18 have attached to their lower ends rollers 20, 21 and 22 respectively. The lower ends of the sides 23, 24 of each support 19 are provided with rollers 25, 26 respectively.

Arranged between a support 13 and a support 16 which aligns with said support 13 is an upstanding holder bar or intermediate vertical support 27 of less height than the said supports 13, 16. Extending forwardly from the said support 13 is a pair of superposed links 28, 29 pivotally connected at their rear ends, as at 30, 31 to the support 13 and at their forward ends to the bar 27 by pivots 32, 33 respectively. Extending rearwardly from the said support 16 in proximity to the upper end of the latter is a lever or arm 34 having its forward end terminal portion 35 curved upwardly and which is pivotally connected at its forward end as at 36 to the said support 16. The rear end of lever 34 is mounted on the pivot 32 for the link 28. Extending rearwardly from the said support 16 is a link 37 which has its rear end mounted on the pivot 33 for the link 29. The forward end of link 37 is pivotally connected to the said support 16 as at 38.

Arranged between a support 16 and support 17 which aligns with the said support 16 is an upstanding holder bar 39 of less height than the said supports 16, 17 and of less height than the bar 27. Extending forwardly from the said support 16 is a pair of superposed links 40, 41 pivotally connected at their rear ends as at 42, 43 respectively to the said support 16 and at their forward ends to the bar 39 by the pivots 44, 45. Extending rearwardly from the said support 17 in proximity to the upper end of the latter is a lever 46 having its forward end terminal portion 47 curved upwardly and which is pivotally connected at its forward end as at 48 to the said support 17. The rear end of lever 46 is mounted on the pivot 44 for the link 40. Extending rearwardly from said support 17 is a link 49 which has its rear end mounted on the pivot 45 for the link 41 and has its forward end pivotally connected to said support 17 as at 50. Arranged between a support 17 and a support 18 which aligns with the said support 17 is an upstanding holder bar 51 of less height than supports 17, 18 and of less height than the bar 39. Extending forwardly from the said support 17 is a pair of superposed links 52, 53 pivotally connected at their rear ends as at 54, 55 respectively to the said support 17 and at their forward ends to the bar 51 by the pivots 56, 57 respectively. Extending rearwardly from the said support 18 in proximity to the upper end of the latter is a lever 58 having its forward end terminal portion 59 curved upwardly and which is pivotally connected at its forward end as at 60 to the support 18. The rear end of lever 58 is mounted on the pivot 56 for the link 52. Extending rearwardly from the said support 18 is a link 61 which has its rear end mounted on the pivot 57 for the link 53 and its forward end pivotally connected to the said support 18 as at 62.

Arranged between a support 18 and the side 24 of a support 19 which aligns with the said support 18 is an upstanding holder bar 63 of less height than the said supports 18 and 19 and of less height than the bar 51. Extending forwardly from the said support 18 is a pair of superposed links 64, 65 pivotally connected at their rear ends as at 66, 67 respectively to the said support 18 and at their forward ends to the bar 63 by the pivots 68, 69 respectively. Extending rearwardly from the side 24 in proximity to the upper end of the latter is a lever 70 having its forward end terminal portion 71 curved upwardly and which is pivotally connected at its forward end as at 72 to the side 24 of the said support 19. The rear end of lever 70 is mounted on the pivot 68 for the link 64. Extending rearwardly from the side 24 of the said support 19 is a link 73 which has its rear end mounted on the pivot 69 for the link 65 and its forward end pivotally connected to the side 24 of the said support 19, as at 74.

The link 28 and lever 34 are arranged above the link 40 and lever 46. The link 52 and lever 58 are arranged below the link 40 and lever 46 and the link 64 and lever 70 are arranged below the link 52 and lever 58. The links 29, 37 are arranged above the links 41 and 49. The links 53, 61 are arranged below the links 41 and 49 and the links 65, 73 are arranged below the links 53, 61.

The grandstand 12 includes seat members 75, 76, 77, 78 and 79. Said members when the grandstand is extended are positioned in a manner whereby member 76 is arranged below the member 75, member 77 below member 76, member 78 below member 77 and member 79 below member 78. The lower face of member 75 is provided with spaced parallel depending brackets 80 which are secured to the upper ends of the supports 13 whereby member 75 is anchored to the supports 13. Said member 75 extends forwardly with respect to the upper ends of the supports 13.

The lower face of member 76 is provided with spaced parallel depending brackets 81 which are secured to the upper ends of the supports 16 whereby member 76 is anchored to the support 16. Member 76 extends forwardly with respect to the upper ends of the supports 16. The lower face of member 77 is provided with spaced parallel depending brackets 82 which are secured to the upper ends of the supports 17 whereby mem-

ber 77 is anchored to the supports 17. Said member 77 extends forwardly with respect to the upper ends of the supports 17. The lower face of member 78 is provided with spaced parallel depending brackets 83 which are secured to the upper ends of the supports 18 whereby member 78 is anchored to the supports 18. Said member 78 extends forwardly with respect to the upper ends of the supports 18. The member 79 is secured to and on the tops 84 of the supports 19. The supports 19 are secured together by a plank or bar 85 arranged forwardly of and suitably anchored to the sides 23 of the said supports 19.

Secured upon and bodily carried with the levers 34 and extended on the links 28 when the structure is extended, is a foot board or rest 86 for the occupants of the seat member 75. Secured upon and bodily carried with the levers 46 and extended on the links 40 when the structure is extended is a foot board or rest 87 for the occupants of the seat member 76. Secured upon and bodily carried with the levers 58 and extended upon the links 52 when the structure is extended is a foot board or rest 87^a for the occupants of the seat member 77, and secured upon and bodily carried with the lever 74 and extended upon the links 64, when the structure is extended, is a foot board or rest 87^b for the occupants of the seat member 78. The foot rest for the occupants of the seat member 75 is provided by a base, platform or flooring 88 forming an element of the grandstand and which will hereinafter be termed a base.

The base 88 includes a rear section 89, an intermediate section 90 and a forward section 91. The section 90 is of less length than the section 89 and the latter is of less length than the section 91. The sections 90 and 91 are foldable relatively to the section 89. The section 89 is hinged to the section 90 as at 92 and the section 90 is hinged to the section 91 as at 93. When the grandstand is in a non-extended position, such as shown in Figure 2, the sections 90 and 91 will be arranged in the manner as shown in Figure 2. The supports 13 permanently rest on the section 89 of the base 88 and are fixedly secured therewith in any suitable manner. The ground or support upon which the grandstand is positioned is indicated at 94.

A set of spaced parallel hinges 92 is employed for connecting the sections 89 and 90 together. A set of spaced parallel hinges 93 is employed for connecting sections 90 and 91 together.

The base 88 lengthwise thereof has secured upon its upper face a series of spaced parallel tracks 94^a lengthwise thereof. The number of tracks correspond in number to that of the supports of each set. Each track consists of a rear section 95, an intermediate section 96 and a forward section 97. When the base 88 is extended to the position shown in Figure 1 the sections of each track align. The track sections 96 and 97 correspond in length to the base sections 90, 91 respectively. The track sections 95 are of less length than the base section 89. The rear ends of the track sections 97 are bevelled as at 98. The forward ends of the track sections 96 are bevelled as at 99 but the bevel extends in an opposite direction with respect to the bevel on the rear ends of the track sections 97. The rear ends of the track sections 96 are bevelled as at 100. The forward ends of the track sections 95 are bevelled as at 101 but the bevel extends in an opposite direction with respect to the bevel on the rear ends of the track sections 96. The bevel of the track sections in the manner as stated provides for them to assume the position shown in Figure 2 when the grandstand is folded. Each of the track sections consists of a channel-shaped member 102 of the form shown in Figure 5. The rollers on the lower ends of the supports 16, 17, 18 and 19 travel in the tracks 94. When the grandstand is in a non-extended position, the rollers on the lower ends of the supports 16, 17, 18 and 19 are arranged in the sections 95 of the tracks 98 and in this connection attention is directed to Figure 2. When the grandstand is in a non-extended position, the foot rests 86, 87, 87^a, 87^b are disposed on one of their lengthwise edges and the levers 34, 46, 58 and 70 are vertically arranged, such as shown in Figure 2. When the grandstand is extended, the holder bars 27, 39, 51 and 53 seat in the tracks 94. When the grandstand is in a non-extended position, the links and levers are folded upwardly and carry the holder bars therewith, and further the base section 90 abuts the plank 85 and the base section 91 abuts the seat members 75, 76, 77 and 78. Any suitable means may be employed for detachably connecting the base section 91 to the seat member 75.

With reference to Figures 8 to 11, the grandstand is generally indicated at 103 and by way of example, it is shown with four seat members and three foot boards or rests, but it is to be understood that the number of seat members and foot boards may be increased. However, the number of the seat members will be greater by one than the number of the foot rests. The grandstand 103 will include a set of pairs of upstanding supports for each seat member. The number of pairs of upstanding supports of a set may be as desired and is shown by way of example as each set consisting of three pairs of supports. The supports of each pair of a set are of the same height and are arranged in parallel spaced relation. The space between the supports of a pair is of less width than that of the space between the pairs of supports of a set. As shown, the grandstand 103 includes respectively a rear set of spaced pairs of supports and the supports of each pair of supports of said rear set are indicated at 104, 105; forward and rear intermediate sets of spaced pairs of supports, the supports of each pair of supports of the rear intermediate set being indicated at 106, 107 and the supports of each pair of supports of the forward intermediate sets are indicated at 108, 109; and a front set of spaced pairs of supports and the supports of each pair of supports of the front set are indicated at 110 and 111. The supports of a rear set are of greater height than the supports of the rear intermediate set. The supports of the forward intermediate set are of less height than the supports of the rear intermediate set, and the supports of the front set are of less height than the supports of the forward intermediate set. The supports of the rear set are stationary. The supports of the intermediate sets are movable towards and from the supports of the rear set. The supports of the front set are vertically movable and are shiftable towards and from the front intermediate set. The supports of the rear and intermediate sets align. The supports of the front set align with the supports of the other set when the supports of the front set are in active and inactive positions. Secured respectvely with the upper ends of and extending forwardly from the supports of the rear set is a seat member 112; with the upper ends and extending forwardly from the supports

of the rear intermediate set is a seat member 113; and with the upper ends of and extending forwardly from the supports of the forward intermediate set is a seat member 114. The supports of the front set are pivotally connected with a seat member 115.

The supports of each pair of supports of the rear set are connected together by oppositely extending inclined cross braces 116 and 117 and a transverse bar 118. The supports of each pair of supports of the rear intermediate set are connected together by oppositely extending inclined cross braces 119, 120. The supports of each pair of supports of the forward intermediate set are connected together by oppositely extending inclined cross braces 121, 122, and the supports of each pair of supports of the front set are connected together by a transverse brace 123.

The seat members 112, 113 and 114 are provided on their lower faces with depending spaced parallel brackets 124 which are fixed to the upper portion of the supports of the said rear and intermediate sets. The seat member 115 has depending therefrom spaced blocks 125 which are anchored together at their fronts by a coupling bar 126, common to all of said blocks. Each block 125 is arranged over a pair of spaced parallel arms or levers 127, 128 anchored at their forward ends to the bar 126. The upper ends of the supports 110, 111 are pivotally connected as at 129 to the arms 127, 128 in proximity to their forward ends.

Each pair of supports of the rear set is connected to a pair of supports of the rear intermediate set. Each pair of supports of the rear intermediate set is connected to a pair of supports of the forward intermediate set and each pair of supports of the forward intermediate set is connected to a pair of supports of the front set. The manner in which the aligned pairs of supports of the said sets are connected together will now be referred to. Extending forwardly from the supports 104, 105 is an upper pair of straight links 130, 131 respectively and extending rearwardly from the supports 106, 107 is a pair of levers 132, 133 respectively formed with upwardly extending curved forward end terminal portions 134. Extending forwardly from the supports 104, 105 is a lower pair of curved links 135, 136 respectively and extending rearwardly from the supports 106, 107 is a pair of straight links 137, 138 respectively. Arranged between the supports 104, 106 is an upstanding holder bar 139. Arranged between supports 105, 107 is an upstanding holder bar 140 disposed in parallel spaced relation to the bar 139. The bars 139, 140 in proximity to their lower ends are connected together by a cross brace 141. The rear ends of the links 130, 131 are pivoted to the supports 104, 105 as at 142. The rear ends of the links 135, 136 are pivotally connected to the supports 104, 105 as at 143. The end terminal portions 134 of the levers 132, 133 are pivotally connected to the supports 106, 107 as at 144. The forward ends of the links 137, 138 are pivoted to the supports 106, 107 as at 145. The upper ends of the bars 139, 140 carry pivots 146 for the levers 132, 133 in proximity to the rear ends of said levers and for the forward ends of the links 130, 131. The bars 139, 140 in proximity to their lower ends carry pivots 147 for the forward ends of the links 135, 136 and for the rear ends of the links 137, 138. Extending forwardly from the supports 106, 107 are a pair of upper links 148 which are pivotally connected at their rear ends as at 149 to the supports 106, 107. The links 148 are straight and are arranged below the levers 132, 133. Extending forwardly from the supports 106, 107 is a pair of curved lower links 150 which are pivotally connected at their rear ends, as at 151 in proximity to the lower ends of the supports 106, 107. Extending rearwardly from the supports 108, 109 is a pair of levers 152 having upstanding forward end terminal portions 153 pivotally connected as at 154 to the supports 108, 109. Pivotally connected to the supports 108, 109 below the levers 153 as at 155 is a pair of double-arm levers 156. One of the arms of each lever 156 is indicated at 157 and the other arm is at 158. The arms 157, 158 are disposed at opposite inclinations. The arm 157 is of less length than the arm 158. Arranged between the supports 106 and 108 is a holder bar 159. Arranged between the supports 107 and 109 is a holder bar 160. The bars 159, 160 are upstanding and are arranged in parallel spaced relation. The bars 159, 160 are provided at their upper ends with pivots 161 for the rear ends of the levers 153 and the forward ends of the links 148. The bars 159, 160 in proximity to their lower ends are provided with pivots 162 for the rear ends of the arms 158 of the levers 156 and the forward ends of the links 160. The levers 132, 133 have depending therefrom curved links 163. The upper ends of the links 163 are pivotally connected, as at 164 to the levers 132, 133. The lower ends of the links 163 are pivotally connected, as at 165 to the links 148.

The forward ends of the arms 157 of the levers 156 are pivotally connected as at 166 to the upper ends of a pair of depending links 167. The lower ends of the links 167 are pivotally connected as at 168 to the rear ends of extensions 169 formed on the rear ends of the arms 127, 128. Pivotally connected at their upper ends to the arms 127, 128, as at 170, is a pair of parallel upstanding supports 171 which are connected to the supports 108, 109 by braced coupling pieces 172. Connected with the supports 171 is a forwardly extending bar 173 pivotally connected with the brace 123. The lower ends of the supports 106, 107, 108, 109 and 171 are provided with rollers 175 which travel in tracks to be referred to. Secured at its upper end to the cross brace 118 and at its lower end to the cross brace 141 is a depending forwardly inclined coiled spring 176 acting to assist the folding up of the grandstand.

Secured upon the levers 132, 133 and projecting upon the links 130, 131 is a foot board or foot rest 177 for the occupants of the seat member 112. Secured upon the levers 152, and extending upon the links 148 is a foot board or foot rest 178 for the occupants of the seat member 113. Secured upon the arms 127, 128 and projecting upon the extensions 169 is a foot board or foot rest 179 for the occupants of the seat member 114. The foot rest for the occupants of the seat member 115 is provided by a base, platform or flooring 180 forming an element of the grandstand and which will hereinafter be termed a base.

The base 180 includes a rear section 181; an intermediate section 182 and a forward section 183. The base 180 is of the same form as the base 80 with the exception that the forward section is provided with a releasable latching structure 184 for coaction with the keeper 185 carried by the seat member 112 for the purpose of latching the forward section of the base to seat member 112 when the grandstand is in non-extended or folded position, such as shown in Figure 8. Secured

upon the upper face of the base 180 are sectional tracks 186 corresponding in number to the number of supports of a set. The tracks 186 are constructed in the same manner as the tracks 102 referred to in connection with the structure shown by Figures 1 and 2. When the grandstand 103 is extended the supports 110, 111 are arranged forwardly of the tracks 186. The rollers 175 carried by the supports 106, 107, 108, 109 and 171 travel in the tracks 186. The lower ends of the supports 104, 105 are provided with braced coupling pieces 187 which are anchored to the section 181 of the base 180.

When the grandstand 103 is folded, it will assume the position as shown in Figure 8. The sections of the base 180 are hinged together in the same manner as the sections of the base 88.

It will be seen that in either form of the grandstand, all of the forward seat members are folded compactly below the rearmost seat member. This makes it possible to nest the seat members in a relatively small space. Furthermore, it will be seen that the weight of the seat members is never lifted from the base, but at all times supported by the supports which carry them, moving rectilinearly upon the track sections and thus there is no danger of the seat members falling down due to broken springs or defective parts. When a grandstand is folded up all of the forward supports for the seat members are shifted rearwardly towards the rearmost supports for the seat members and which is due to the moving upwardly and rearwardly respectively of the intermediate and forward base sections. On the lowering of the forward and intermediate base sections, the seating structure is extended to the position shown in Figure 1 or 10.

The link and lever mechanisms between one set of supports and an adjacent set of supports are termed coupling structures which function as foot rests or foot board supports. These latter are foldable with the coupling structures.

Each grandstand includes a group of spaced parallel sets of upstanding supports, the sets of said group progressively increasing in height from the front to the rear of the group.

The base of the grandstand is so constructed that the forward and intermediate sections thereof are foldable relatively to each other and to the rear section of the base.

What I claim is:

In a foldable and extendible seating structure, a group of upstanding opposed bodily shiftable sets of spaced slidably mounted supports, an upstanding set of spaced stationary supports opposing the rear set of said group, a continuous seat forming member secured upon the upper ends of the supports of each set, sets of spaced levers having straight rear parts and upturned front parts, the front parts being pivotally connected at their forward ends to one side of the forward sets of supports below the seat members, sets of forwardly extending upper links having their rear ends pivotally connected to one side of the rear sets of supports below the seat members, sets of rearwardly extending forward lower links pivotally connected to said side of the forward sets of supports in proximity to the lower ends of the latter, sets of forwardly extending rear lower links having their rear ends pivotally connected to said side of the rear sets of supports in proximity to the lower ends of the latter, sets of upstanding bars aligning with the supports of said sets and pivotally connected respectively at one side of their upper ends to one side of the rear parts of said sets of levers and to one side of the upper sets of links and at said side thereof in proximity to their lower ends to one side of the sets of lower forward and lower rear links, and continuous foot rest members, each having the major portion of its width fixedly secured on the rear parts of a set of levers, the remaining portion of its width of each foot rest member seating on the forward end terminal portions of an upper set of links when the structure is extended.

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