May 2, 1950 C. F. STEIN 2,505,803

KNOCKDOWN PIANO AND UTILITY STRING CHASSIS THEREFOR

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FIG. 2

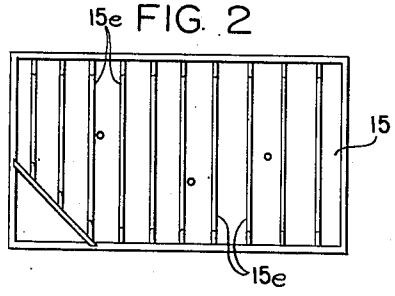
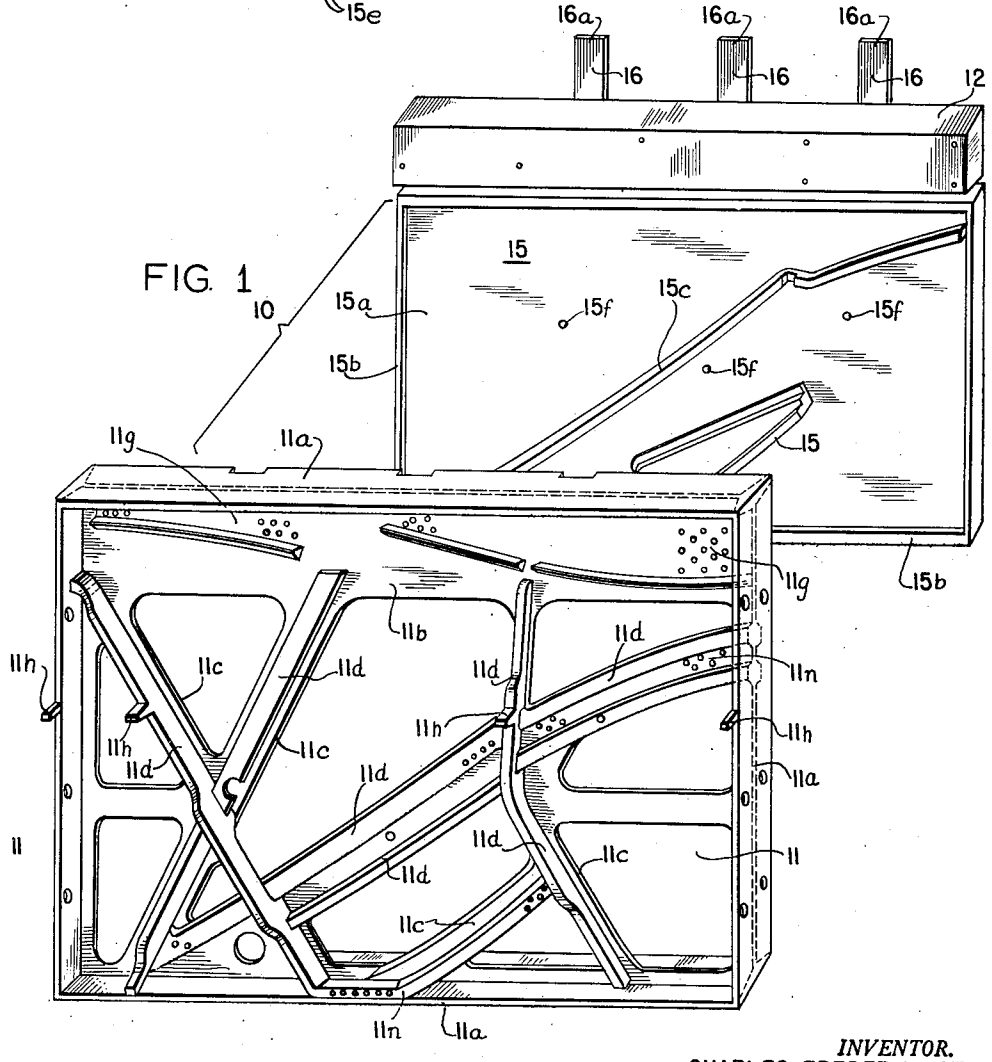


FIG. 1



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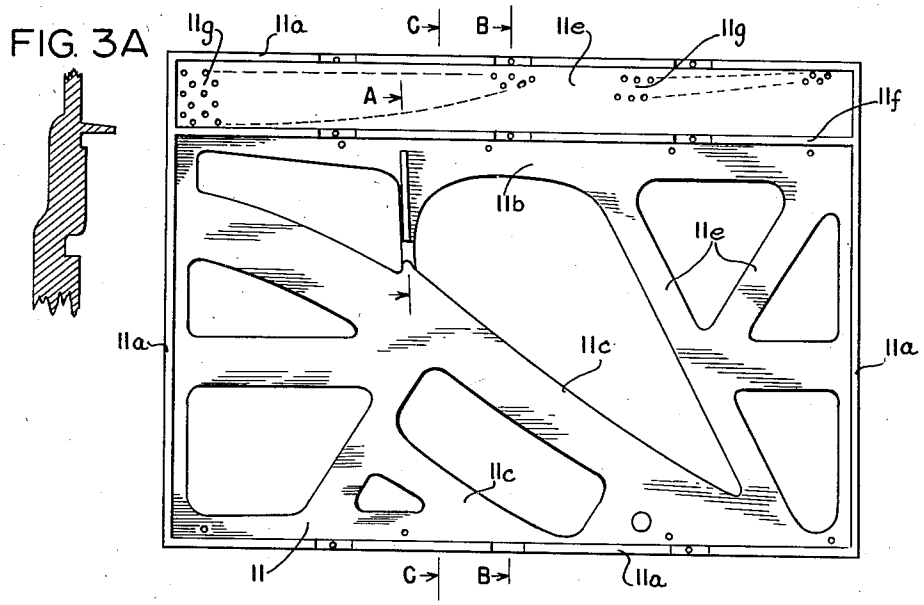
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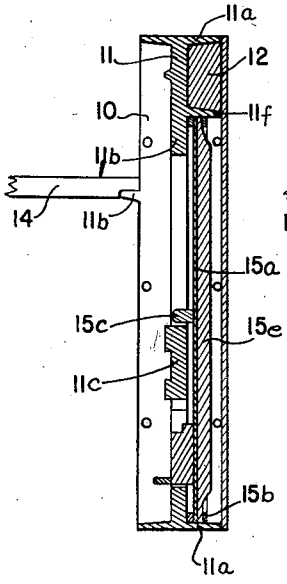
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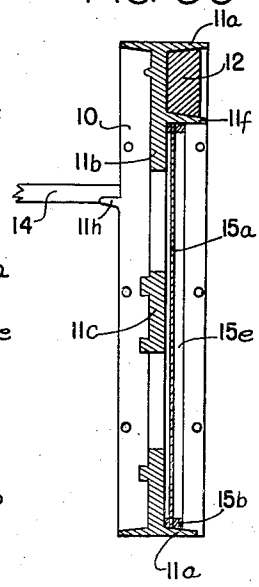
KNOCKDOWN PIANO AND UTILITY STRING CHASSIS THEREFOR

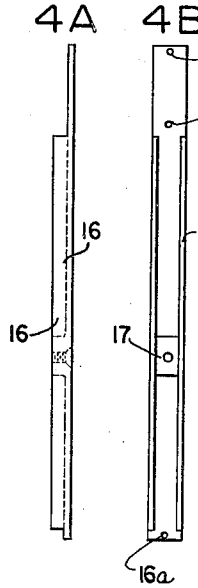
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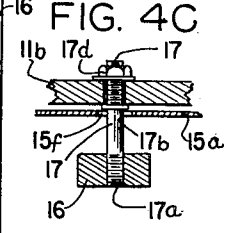
FIG. 3











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KNOCKDOWN PIANO AND UTILITY STRING CHASSIS THEREFOR

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FIG. 5A

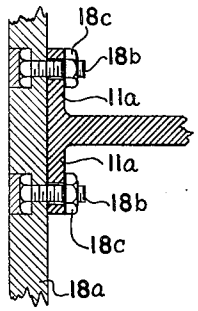
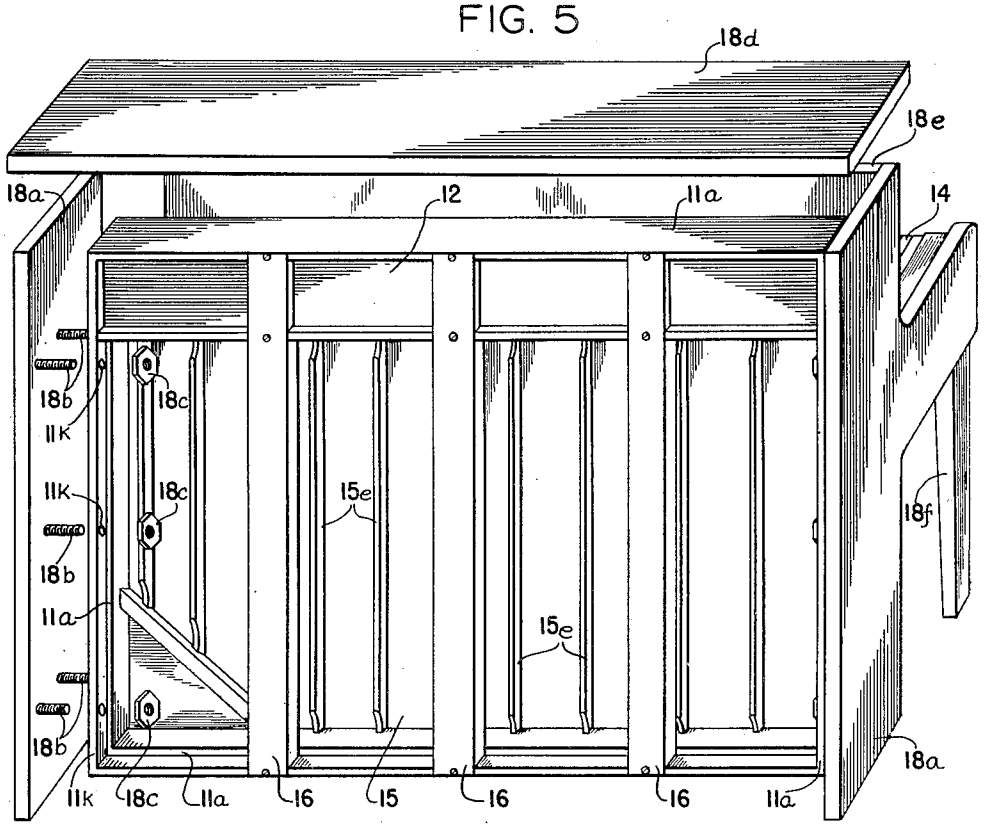


FIG. 5



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KNOCKDOWN PIANO AND UTILITY STRING CHASSIS THEREFOR

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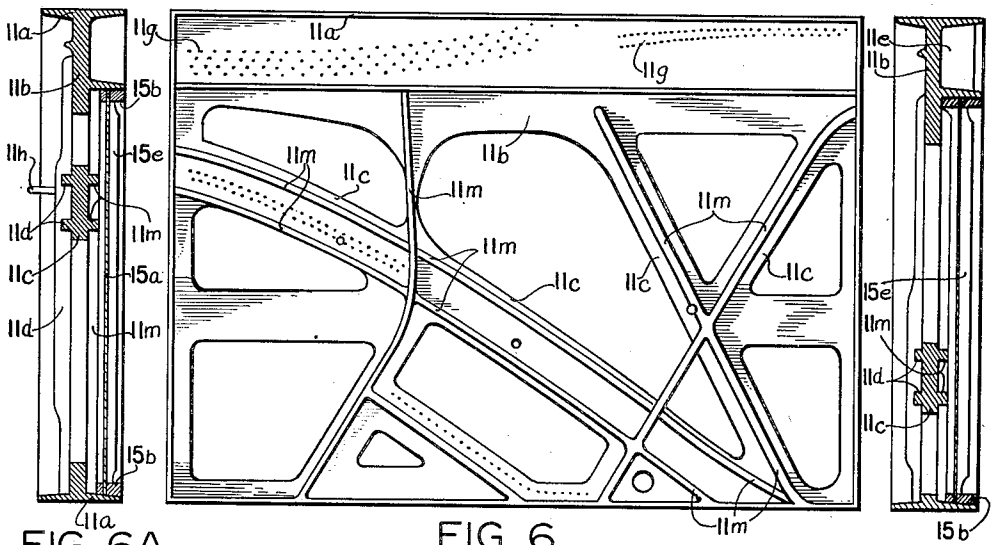


FIG. 6A FIG. 6 FIG. 6B

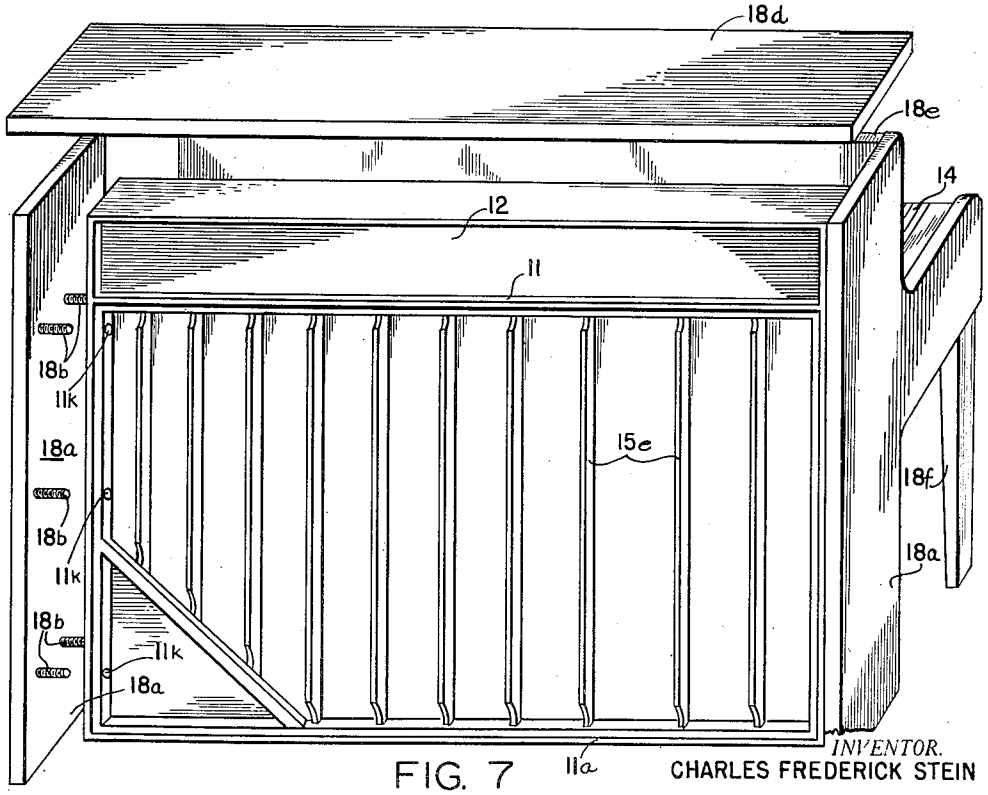


FIG. 7

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KNOCKDOWN PIANO AND UTILITY STRING CHASSIS THEREFOR

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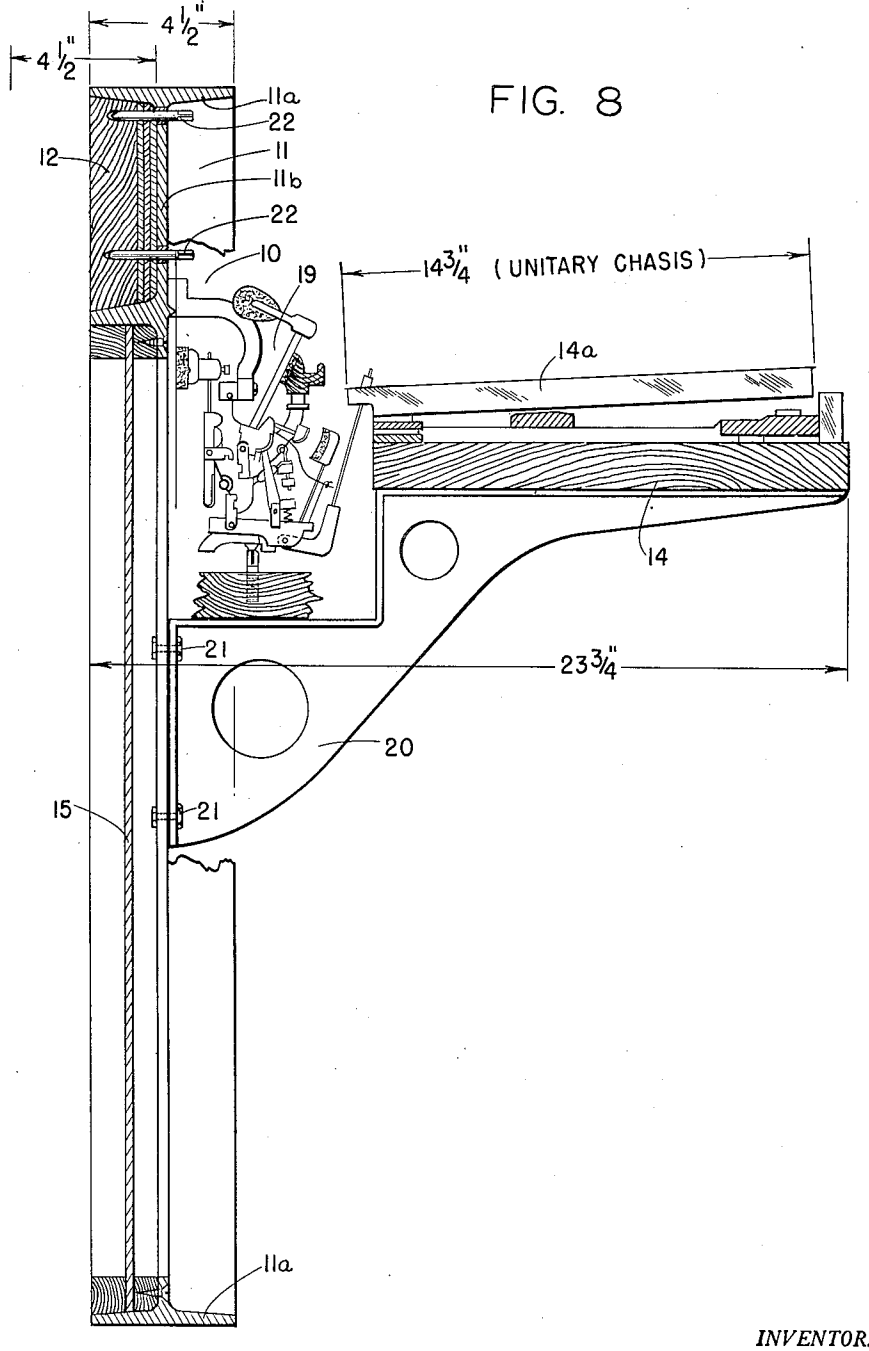


FIG. 8

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Patented May 2, 1950

2,505,803

UNITED STATES PATENT OFFICE

2,505,803

KNOCKDOWN PIANO AND UTILITY STRING CHASSIS THEREFOR

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Application March 27, 1945, Serial No. 585,053

3 Claims. (Cl. 84—177)

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This invention relates to knock-down pianos and to unitary string chassis therefor and, while it is of general application, it is particularly adapted for embodiment in relatively low cost pianos which can be fabricated on an assembly production basis while attaining uniform tonal and performance characteristics.

Heretofore, it has been customary to manufacture pianos largely on an individual custom basis. This has been due primarily to the nature of commercial piano construction and to the difficulty in procuring, in such construction, the desired uniformity of tonal quality and performance. In general the prior commercial piano constructions have comprised a harp or frame, usually of cast iron, on which the strings are stretched. It has been found that if such a harp or frame is made sufficiently rigid and massive to be entirely self-supporting so that it does not require supplementary elements or parts to prevent it from buckling and cracking, it becomes intolerably heavy. Therefore, it has been customary to make the harp lighter than necessary for such self-support and to anchor it rigidly to a stiff massive wooden back, thus forming a composite structure considerably lighter than a cast iron structure designed for the same rigidity, and yet together constituting very heavy and cumbersome parts for assembling with the remaining structure of a piano.

It has also been customary to attach the sounding board carrying the string bridges directly and firmly to the rigid back, as by gluing. Finally, it has been customary to support the composite harp and back and sounding board structure by a rugged supporting casing and to support the keys and keybed, the piano action, the pedals and the pedal action from the back and the casing, arranging the moving parts to operate on the strings in a known manner. The ruggedness of the casing necessary to support the massive frame assembly and the other elements has contributed to the undesirably high overall weight of the piano instrument, an undesirable characteristic commonly recognized.

It is an object of the invention, therefore, to provide a new and improved knock-down piano which obviates one or more of the above-named disadvantages and limitations of the prior art piano constructions and which is at the same time simple, economical and rugged in construction.

It is another object of the invention to provide a new and improved knock-down piano embodying one or more of the following advantageous

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characteristics: extreme ruggedness, light weight, and adaptability to manufacture by assembly production methods with a high degree of uniformity of tonal quality and performance.

It is another object of the invention to provide a new and improved unitary string chassis suitable for use in pianos of the type described and one which is completely self-contained and self-supporting and adapted to support or to be supported by the piano casing structure.

In accordance with the invention, a knock-down type of piano comprises a casing and a unitary string chassis including a rigid self-supporting metal frame member having an integral wide peripheral flange and a web portion, and a sounding board supported from the frame and forming with the frame means for stretching the piano strings. The flange and the piano casing include registering provisions for forming supporting connections between such casing and the chassis frame.

Further, in accordance with the invention, there is provided a unitary string chassis for use in a piano of the type described comprising a rigid self-supporting metal frame member having an integral wide peripheral flange and a web portion, and a sounding board supported from the frame and forming with the frame means for stretching the piano strings. The flange of the frame member of the string chassis includes provisions for forming supporting connections with a piano casing.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawings while its scope will be pointed out in the appended claims.

Referring now to the drawings, Fig. 1 is an exploded perspective front view of a unitary string chassis embodying a feature of the invention; Fig. 2 is a back view of the sounding board to be assembled in the chassis of Fig. 1; Fig. 3 is a back view of the harp or frame of the chassis of Fig. 1; Fig. 3A is a fragmentary cross-sectional view along the lines A—A of Fig. 3; Figs. 3B and 3C are cross-sectional views along the lines B—B and C—C of Fig. 3; Figs. 4A and 4B are side and front views, respectively, of the bracing posts embodied in the chassis of Fig. 1; Fig. 4C is a cross-sectional detailed view of a structure for anchoring the posts of Figs. 4A and 4B to frame of the chassis; Fig. 5 is an exploded perspective view showing the assembly of the chassis and the piano casing; Fig. 5A is a cross-sectional detailed

view of an anchoring means for the chassis and piano casing; Fig. 6 is a back view of a modified form of harp or frame for embodiment in the chassis of the invention by means of which the stiffening posts may be omitted; Figs. 6A and 6B are cross-sectional views of a complete unitary string chassis embodying the frame of Fig. 6 and taken along lines A—A and B—B, respectively, of Fig. 6; Fig. 7 is an exploded perspective view showing the assembly of the chassis embodying the frame of Fig. 6 and a piano casing; while Fig. 8 is a cross-sectional view of a low-upright piano action and string chassis assembly and illustrating the increase in key length for given overall dimensions.

Referring now to Figs. 1, 2, 3 and 3A–3C, there is illustrated a string chassis adapted to be mounted in the piano casing to provide the knock-down type piano of Fig. 5. The piano comprises a unitary string chassis 10 including a rigid self-supporting cast metal frame member 11 having a wide peripheral flange 11*a* and a planar web portion 11*b* disposed throughout its entire extent approximately centrally of the flange 11*a* and preferably including the median plane of the member; that is the flange 11*a* extends approximately equally on either side of the entire web portion 11*b*. The web portion comprises a series of bracing struts 11*c* having cutouts therebetween in order to lighten the weight of the frame member, the struts 11*c* preferably being provided with stiffening ribs 11*d* on the front faces thereof as indicated in Fig. 1, the back faces being unribbed as indicated in Fig. 3. The struts 11*c* are disposed to aid the frame in withstanding the enormous stresses of the strings and to provide intermediate supports of the proper contour for banks of fixed string pins. The stiffening ribs 11*d* are positioned so that channels are provided therebetween on the front face of the frame member in which the strings may be positioned in the usual crossed or "over-strung" construction (Fig. 1). The strings are positioned adjacent to the web portion of the frame member so that the piano action can extend into the cavity formed by the flange 11*a* and the plane of the strings as will be further explained.

The frame member 11 has a channel-like recess 11*e* along its upper side and at the back thereof, formed by the upper flange 11*a* and a second integral flange 11*f* parallel with the peripheral flange 11*a*. A wooden pin block 12 is tightly fitted in the recess 11*e* and secured thereto by screws or bolts (not shown) extending through the web portion 11*b* of the frame. A series or bank of holes 11*g* is formed in the bottom of the recess 11*e*, that is in the web 11*b*, adapted to register with the string pins (not shown) mounted in the pin block 12 and to allow the pins to protrude through the front face of the web 11*b* and yet to be supported by the web 11*b* where they pass therethrough so that the pins will not split or pull out of the wooden pin block. Groups of fixed string pins 11*n* are also mounted in certain of the struts 11*c*, as shown in Fig. 1, to cooperate with the adjustable string pins in the pin block 12 in supporting the piano strings mounted thereon.

The frame member 11 is preferably constructed of a high tensile strength, light metal alloy such as an aluminum-copper-magnesium alloy commercially available as "Duralumin" or an alloy of magnesium, aluminum and manganese and zinc commercially available as "Dowmetal." In any event the member 11 should be constructed of a material and with a cross-sectional moment of inertia resulting in a rigidity for a given weight substantially higher than that of the composite cast iron frame and wooden back of conventional pianos. Preferably the material of the frame member 11 should have a ratio of Young's modulus to specific weight greater than 3×10^6 and preferably of the order of 3.75×10^6. This ratio may be termed the "factor of merit" and is an index of the rigidity per pound of metal of the chassis member for any given size and any given cross-sectional configuration. In other words, a string chassis of given dimensions made of a metal with a high ratio will have a higher rigidity for any given weight or will be lighter in weight for any given rigidity than one made of a metal having a lower ratio. A mean value for this ratio for aluminum alloys of the type mentioned is 3.89×10^6, while a typical value for magnesium alloys of the type mentioned is 3.57×10^6.

The frame member 11 may be provided with a plurality of integral piano-action supporting brackets 11*b* which, as indicated in Figs. 3B and 3C, are adapted to support the piano action and keybed, a fragment of which is shown at 14.

The unitary string chassis of the invention also includes a sounding board 15 supported from the frame 11, specifically being fitted within the peripheral flange 11*a* at the back of the frame. As indicated in Fig. 1, the sounding board comprises a web 15*a*, preferably of plywood, rigidly supported in a peripheral frame 15*b* and including the median plane thereof so that the frame 15*b* spaces the web 15*a* suitably from the web 11*b* of the frame member 11 and also from the back face of the frame member 11. The frame 15*b* may be rigidly secured in any suitable fashion to the web portion 11*b* of frame 11, as by screws (not shown) passing through the web 11*b*, or through the flange 11*f* prior to the mounting of the pin block 12. The sounding board 15 is also provided with suitable string bridges 15*c* and 15*d* secured to the front face thereof and projecting through the cutouts of the frame member 11 to form with the frame 11 provisions for stretching the piano strings. The sounding board 15 is provided with a plurality of stiffening ribs 15*e* rigidly secured to its rear face to increase its rigidity and improve its tonal qualities.

The unitary string chassis also includes a series of posts 16, preferably of channel cross-section as illustrated, extending between and bracing the opposed flange 11*b* and lower peripheral flange 11*a* of the frame 11. These posts may be secured to the flanges 11*a* and 11*f* by screws or bolts passing through the holes 16*a* registering therewith. The posts 16 are proportioned to fit closely over the pin block 12 and to aid in retaining it firmly within the recess 11*e* of the frame member.

In order to aid in stiffening the frame member 11, the posts 16 are anchored to the web portion 11*b* thereof at desired intermediate points. To this end there are provided a plurality of anchor bolts 17 shown in detail in Fig. 4C. The bolt 17 has a head 17*a* threaded into or otherwise rigidly secured to the web of a post 16. The shank of the bolt 17 is provided with a shoulder 17*b* beyond which projects a threaded portion 17*c* on which is disposed a nut 17*d* for drawing up the web 11*b* of the frame member against the shoulder 17*b*, thus securely anchoring the post 16 to the web portion 11*b* of the frame member. It will be understood that the bolts 17 pass through suitable apertures 15*f* in the web portion 15*b* of the sounding board.

In Fig. 5 there is shown in perspective the manner in which the unitary string chassis is assembled with a casing. The flanges 11*a* of the frame member 11 and the side members 18*a* of a casing 18 include registering provisions for forming supporting connections between the frame 11 and the piano casing; for example, for supporting the casing from the frame, in the event that the casing is of the non-supporting type, or for supporting the frame from the piano casing structure including the keybed 14 and piano legs 18*f* in the event the casing structure is of the supporting type. Specifically, the side members 18*a* of the casing have a plurality of supporting bolts 18*b* which may be mounted with their heads imbedded in the casing member 18*a* as shown in Fig. 5A. The flanges 11*a* are provided with a plurality of bolt holes or apertures 11*k* disposed to register with the bolts 18*b* and the bolts 18*b* are provided with suitable nuts 18*c* for engaging and securing the flanges 11*a* to the casing members 18*a*. The piano casing may also include a conventional top member 18*d*, a front member 18*e* and the legs 18*f*. As indicated in Fig. 5 the unitary string chassis of the invention, when included in a piano of the upright type, also forms a back for the piano.

In Figs. 6, 6A and 6B and Fig. 7 are illustrated a modified form of the invention in which the posts 16 of the previously described structure are omitted and the bracing struts 11*c* of the frame member 11 are provided with additional integral stiffening ribs 11*m* on their back faces so that these struts have cross sections in the nature of I-beams as indicated in Figs. 6A and 6B. The additional rigidity provided by this construction avoids the necessity for the bracing posts 16 of the previously described construction. In other respects the construction of the piano and of the unitary string chassis of Figs. 6 and 7 is similar to that described above.

In Fig. 8 there is illustrated a piano assembly including a unitary string chassis embodying the invention in a drop-type piano action suitable for low-upright pianos. In this assembly the keybed 14 and the action mechanism 19, which may be of conventional construction, are supported from brackets 20 attached to the frame member 11 by bolts 21 or equivalent. In this type of piano, the action mechanism 19 is behind the keys 14*a* rather than above them, as in the high-upright piano. Therefore, for a given overall width of piano, the maximum permissible length of key is decreased. As a result, the keys have a leverage considerably less than that of the keys of high-upright and grand pianos and require a considerably greater operating force for a given intensity hammer blow; that is the action tends to be stiff and unnatural.

By the use of the invention, however, the space within the flanges 11*a* and in front of the web portion 11*b* comprises a cavity into which the piano action may extend, which cavity is of a depth equal to nearly one-half the overall width of the frame member 11. This permits the construction of a more shallow piano with the piano action and keybed extending into the frame cavity or, for a piano of given depth, it permits the use of a longer key leverage. Considering specific typical dimensions, it is customary to limit the overall width of a piano to 24 inches to permit maneuvering it through a standard 30 inch doorway. In the piano illustrated the overall width is 23¾ inches. In the assembly including the unitary string chassis having an overall width of 4½ inches and with the piano action 19 extending into the front cavity of the chassis, there is left 14¾ inches for the keys 14*a*. With the same assembly but with the substitution of a conventional composite back and frame also 4½ inches in width but with the action 19 entirely in front of the frame, the key length is reduced to 12¼ inches; that is, the use of the string chassis of the invention has increased the permissible key length by 2½ inches or slightly more than 20 percent. This very substantial increase in the length of the keys is sufficient to convert an action which would be unacceptably stiff and unnatural to an acceptable one.

In Fig. 8 also is illustrated the manner of mounting string pins 22 in the pin-block 12, the shanks of the pins 22 being provided with wooden bushings where they pass through the apertures 11*g*, thus being supported by the web 11*b*. This support of the pins 22 by the web 11*b* minimizes splitting of the pin-block 12 and pulling out of the pins 22.

Thus it is seen that the piano construction and the unitary string chassis construction of the invention described have a number of distinct advantages not found in the prior art pianos. Among these may be mentioned that the unitary string chassis is essentially a rectangular frame of I-beam section and is extremely rigid and rugged, avoiding warping. In this construction, also, the strain of the strings is exerted substantially in the plane of the web 11*b*, that is in the median plane of the chassis, avoiding any substantial torsional stresses on any part of the string chassis. This construction further avoids separation of cast iron frame and wooden back frequently encountered in the conventional prior art composite structure. Further, the unitary string chassis is considerably lighter than such prior composite structure. As a result of the reduction in weight, the unitary string chassis may be readily moved about in the initial preassembly of the unit itself, in any preassembly of the piano in the factory, in shipping, and in the final assembly in a home or showroom. In any assembly operation, the wide flanges of the frame provide adequate bearing and supporting surfaces for connection to the piano casing, while the fastening bolts are readily accessible in front of the strings and back of the sounding board so that the chassis and the casing can be readily disassembled without interference with the strings. Furthermore, the overall cross-section of the frame member 11*a*, which must resist the tremendous aggregate tension of the piano strings, has a balanced moment of inertia, thereby procuring the maximum rigidity for any given cross-sectional area.

While there have been described what are at present considered to be the preferred embodiments of the invention, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit or scope of the invention.

I claim:

1. A piano structure for use in an enclosing case, said piano structure comprising a single integral metal frame including a vertically extending web structure and flanges extending on the front and back sides of said web structure at the bottom and sides of said frame, said bottom flange supporting said piano structure at the floor, said side flanges including provisions for individually supporting parts of a separable piano case, said frame including a top flange on said front side of said web structure which forms

with said bottom and side flanges a cavity on the front side of said web structure, piano strings, means for supporting said piano strings on said frame within said cavity, said frame including an additional flange on said back side of said web structure and spaced downwardly from the top of said frame, a sounding board positioned on said back side of said web structure in the cavity formed by said additional flange and said bottom and side flanges, a pair of brackets, means for supporting said brackets on said frame on said front side of said web structure adjacent said side flanges, a piano action, means carried by said frame and said brackets for supporting said piano action in operating relation with said strings with a portion of said action extending into said cavity on said front side of said web structure, piano keys, and means for supporting said piano keys on said brackets in operating connection with said action.

2. A piano including an operating structure and an enclosing case, said operating structure comprising a single metal frame, a sounding board, piano strings, a piano action, and piano keys, said frame having peripheral flanges and a web structure integrally connecting said flanges and substantially in a single plane centrally of said flanges, means rigidly securing said sounding board to said web structure on one side thereof and within the limits of said peripheral flange, means for mounting said piano strings on the other side of said web structure in the cavity formed by said web structure and the adjacent peripheral flange and at a distance from said web structure less than the width of said adjacent peripheral flange, means for mounting said piano action on said frame with a portion of said action within said cavity in cooperative relation with said strings, means for supporting said piano keys in operative relation with said action including brackets extending out from said other side of said web structure, means for securing said brackets to said frame substantially at the flanges on opposite sides thereof, said enclosing case including a plurality of separable parts, said frame having provisions on the flanges on the sides thereof for removably positioning and supporting parts of said case thereon.

3. A piano including an operating structure and an enclosing case, said operating structure

comprising a sounding board, piano strings, a piano action, piano keys, and a single metal frame having said sounding board, strings, action and keys mounted thereon, said frame being made of a material having a ratio of Young's modulus to specific weight greater than 3.0×10^6 and including integral peripheral flanges and a web structure connecting said flanges and substantially in a single plane centrally of said flanges, whereby cavities are formed on each side of said web structure by said flanges, means for supporting said sounding board on said frame in said cavity formed by said peripheral flange on one side of said web structure, means for supporting said piano strings, piano action and piano keys on said frame on the side of said web structure opposite to said one side, with said strings, action, and keys being in operating position with respect to each other and with said strings and a portion of said action extending in said cavity formed by said peripheral flange on said opposite side of said web structure, said operating structure including provisions for removably supporting said case on said operating structure.

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