Oct. 25, 1955 C. MACKINTOSH 2,721,353

CONCEALED HINGE

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FIG. 1.

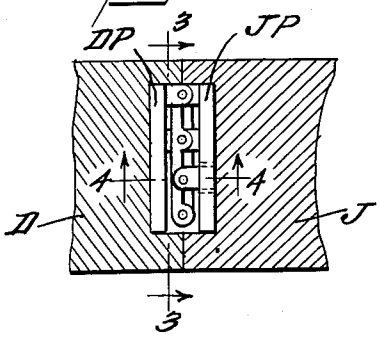


FIG. 2.

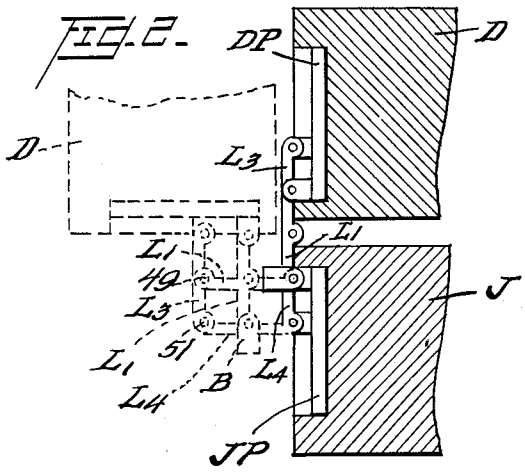


FIG. 3.

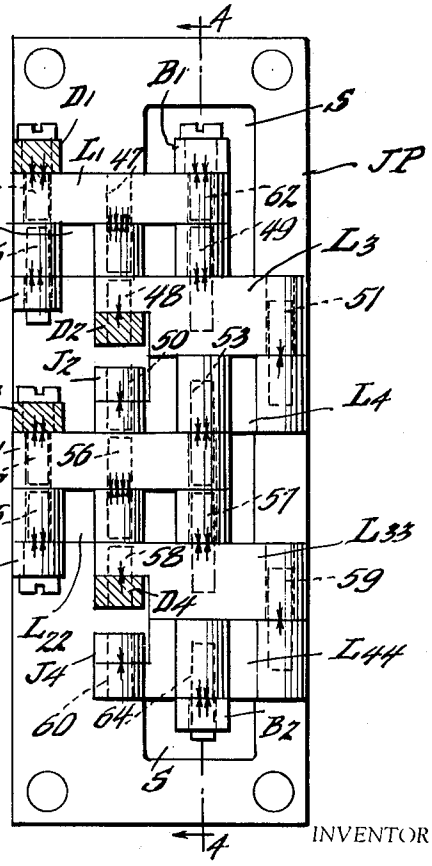


FIG. 13.

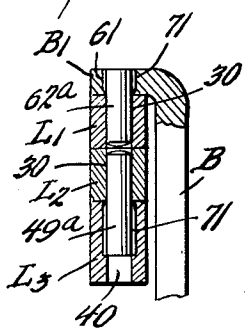


FIG. 14.

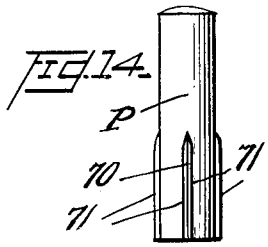


FIG. 15.

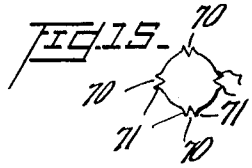
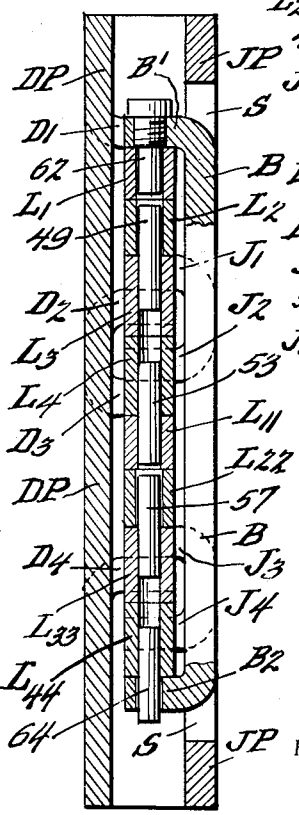


FIG. 4.



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FIG. 5.

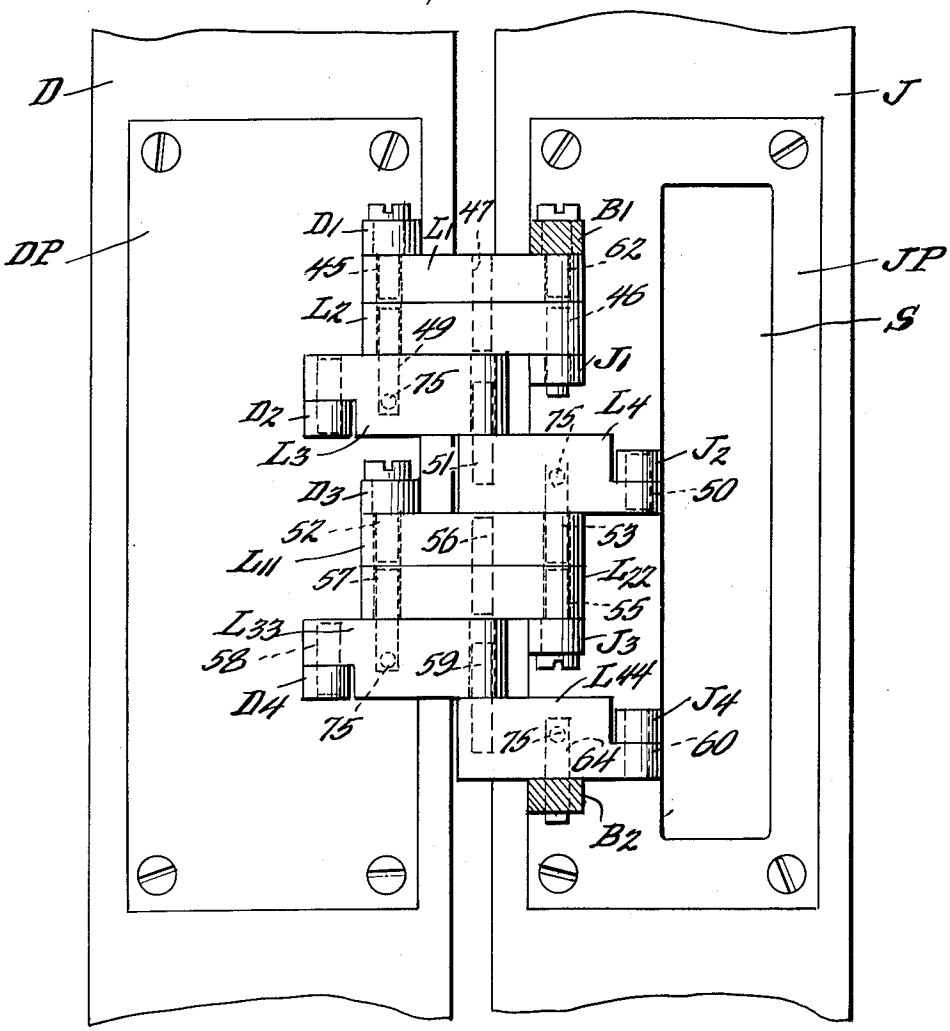


FIG. 12.



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FIG. 6.

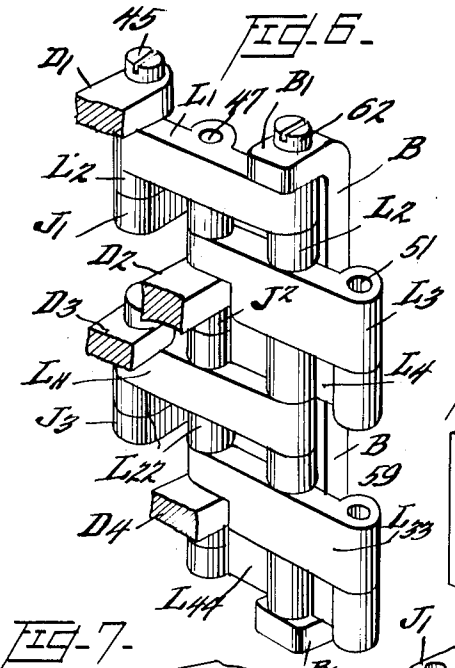


FIG. 9.

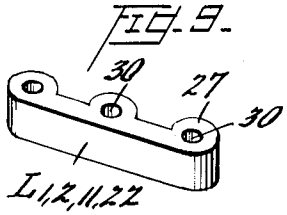


FIG. 10.

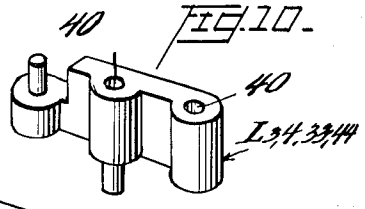


FIG. 8.

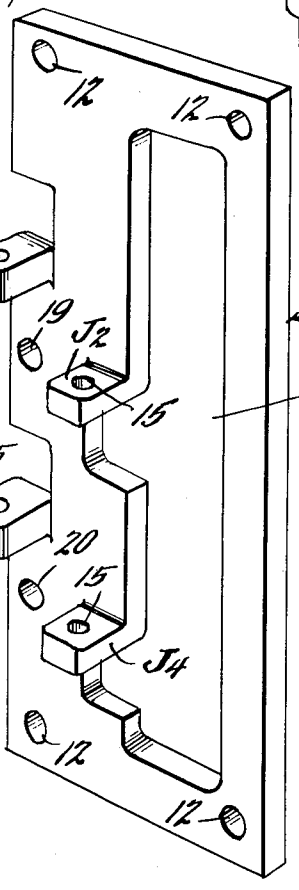


FIG. 11.

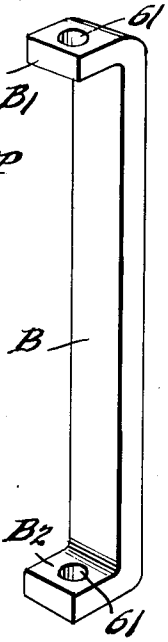
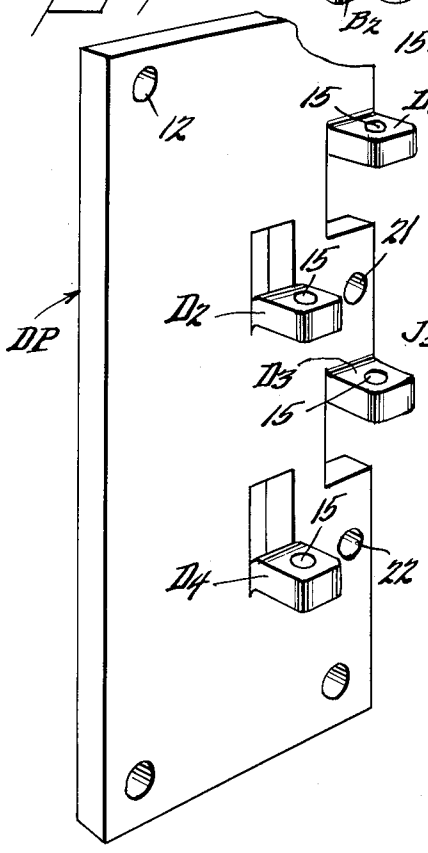


FIG. 7.



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FIG. 16.

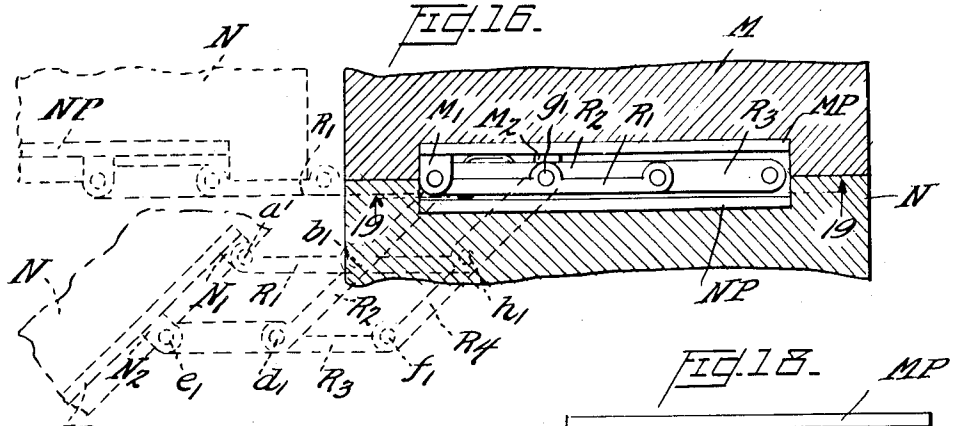


FIG. 18.

FIG. 19.

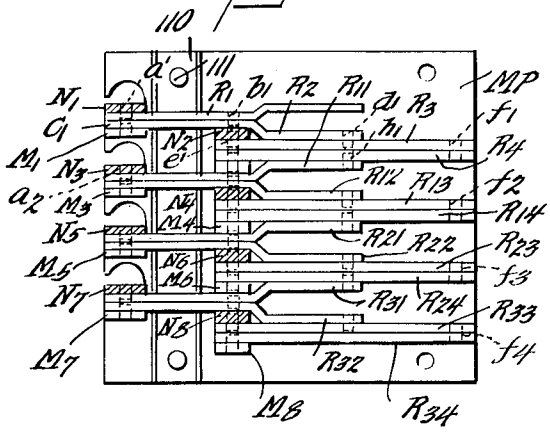


FIG. 17.

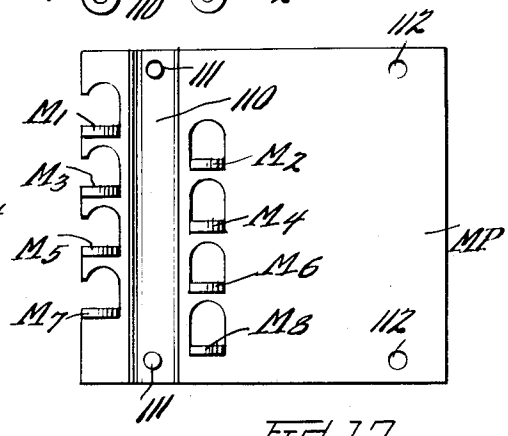


FIG. 21.

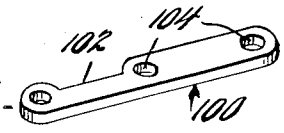
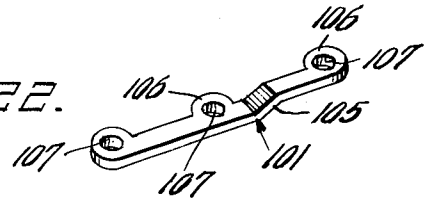


FIG. 22.



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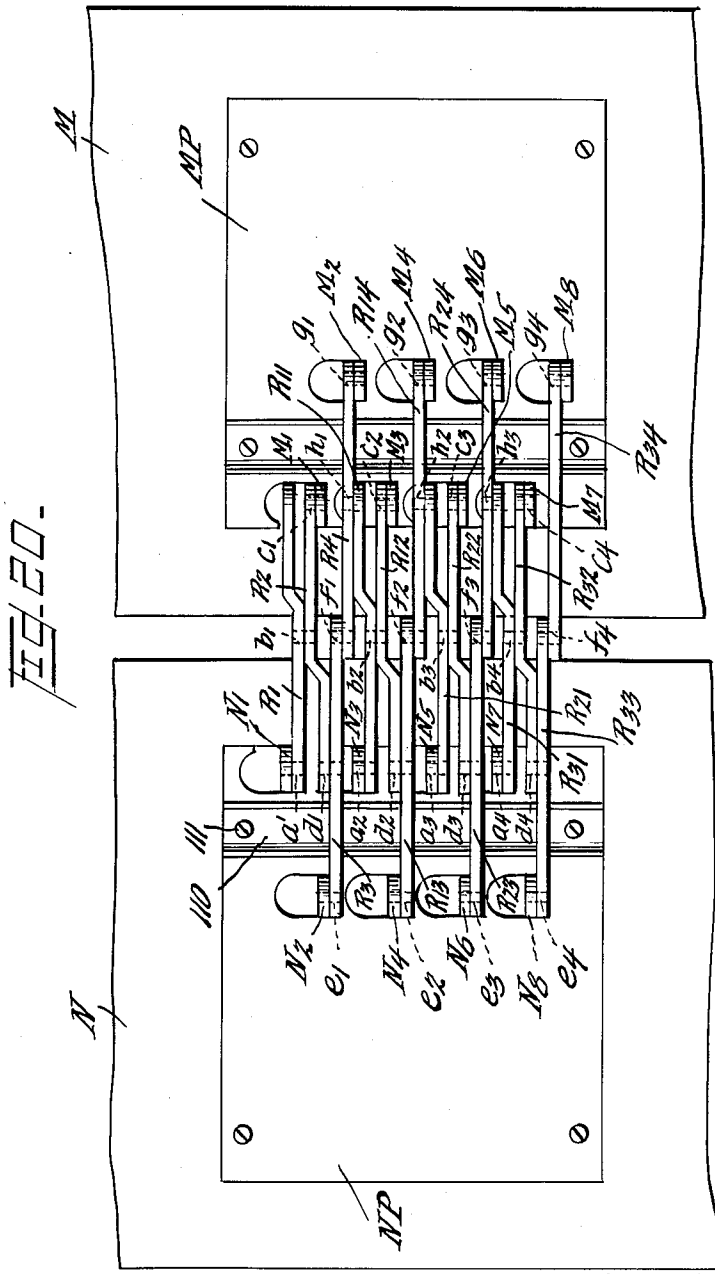
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FIG. 20.



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United States Patent Office

2,721,353

Patented Oct. 25, 1955

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CONCEALED HINGE

Charles Mackintosh, Los Angeles, Calif.

Application March 17, 1952, Serial No. 277,051

11 Claims. (Cl. 16—164)

This invention relates to hinges and more particularly to concealed hinged of the multiple linkage type for doors or other closures.

The general object of the invention is the provision of new and improved hinges of the type described; which are sturdy and strong and capable of supporting doors or closures of considerable weight; which are compact in construction and arrangement whereby they may be housed within comparatively shallow recesses in the relatively movable swinging members; and which may be easily and economically manufactured and installed.

The novel hinges are especially useful in connection with doors or heavy closures which are adapted to be hung vertically and swung in the horizontal direction.

Other features which contribute to the attainment of the objects of the invention include the provision of concealed hinges with multiple linkages connecting the leaves, which linkages are adapted to be stacked in vertical planes in both the closed position of the closure and the position in which the closure and support have been swung relatively to each other from said closed position through an angle of 180°. Also, in the preferred embodiments of the invention, the construction is such that the pintle pins sustain practically no tension or shearing stresses, but the door-supporting stresses are resolved into compression bearing stresses between the superposed linkages, the pins merely serving to guide the movements of the linkage and the door and preventing the door from falling away from its proper erect position.

The invention also contemplates the provision of resilient means for urging the hinge mechanism away from dead center at its 180° open position, when it is desired to close the door.

Other objects and features of novelty will be apparent from the following specification when read in connection with the accompanying drawings in which certain embodiments of the invention are illustrated by way of example.

In the drawings:

Figure 1 is a fragmentary view in transverse section through portions of a door or other closure and a jamb with which it is associated, and showing somewhat diagrammatically a hinge embodying the principles of the invention, the door being in closed position in alignment with the jamb;

Figure 2 is a similar view showing in solid lines the position of the hinge when the door is fully opened at an angle of 180° with respect to the jamb, and indicating in broken lines the position of the door at 90° or half open;

Figure 3 is a vertical sectional view taken on line 3—3 of Figure 1, and showing one of the two hinge leaves and the linkage system in elevation, as they appear in door-closed position;

Figure 4 is a vertical sectional view taken on line 4—4 of Figures 1 and 3;

Figure 5 is a view in elevation of the hinge installation when the door is in the wide open position shown in full lines in Figure 2;

Figure 6 is a fragmentary perspective view of the novel multiple linkage arrangement of the hinge assembly, in door-closed position;

Figures 7 and 8 are views in perspective of the two hinge plates, one of which is fastened to the edge of the door and the other to the jamb;

Figures 9 and 10 are perspective views of certain connecting links adapted to be pivotally attached to the projecting ears or lugs of the hinge plates or leaves;

Figure 11 is a view in perspective of a binding cleat or bar for strengthening and rigidifying the hinge linkage structure, and providing a fulcrum agent for the levering actions of the various linkages;

Figure 12 is a view in elevation of one of the resilient plugs or rubber spring elements which serve to urge the linkage assembly away from dead center when the door is in 180° open position;

Figure 13 is a fragmentary vertical sectional view through a linkage connection showing a drive-pin pintle which may be employed in any or all of the embodiments illustrated instead of the screw or bolt pintles such as shown in Figures 4, 5 and 6;

Figures 14 and 15 are side and end views respectively of one type of drive-pin used;

Figure 16 is a fragmentary transverse sectional view through the adjacent portions of a door and a jamb illustrating another form of hinge included within the broad scope of the present invention, the closed position of the parts being illustrated in solid lines, and a partly open and a fully open position being indicated by broken lines;

Figure 17 is a view in elevation of a jamb plate forming a part of the hinge;

Figure 18 is an edge view of the same plate;

Figure 19 is a view in vertical section taken on line 19—19 of Figure 16;

Figure 20 is a view in elevation of the adjoining portions of the door and jamb in wide open position, and showing very clearly the positions of the various linkages of the hinge assembly; and

Figures 21 and 22 are perspective views respectively of two of the connecting links employed.

The embodiment of the invention illustrated in Figures 1–15 of the drawings will now be described in detail. Probably the best approach to an understanding of this construction will be through an examination of Figures 5, 7, and 8 of the drawings. The door element which represents generally the closure of the hinged system is designated in these figures by the reference character D, and the supporting member or jamb is designated J. Each hinge assembly or installation comprises two leaves or plates one of which is secured within a recess **10** within the edge portion of the jamb J and the other within a similar recess **11** within the edge of the door D. The jamb plate or leaf is designated JP and the plate or leaf which is secured to the door is designated DP. Suitable fastening means such as screws may pass through the openings **12** in these plates to secure them to the jamb and door edges. In the preferred construction, the appropriately designated plates are secured to the corresponding elements of the closure arrangement, but under certain circumstances, it would be possible to reverse the plates with respect to the jamb and door elements.

The jamb leaf JP shown in Figure 8 of the drawings is of rectangular configuration and is provided with an elongated longitudinally extending slot S for a purpose which will be described presently. At spaced points along the inner margin of the leaf JP lugs or ears J_1 and J_3 are struck from the plate and bent outwardly as

clearly shown in Figure 8. These lugs are provided with vertical openings 15 through which pintle elements may be passed as described in connection with other figures. Another pair of lugs J_2 and J_4 are struck from the plate JP at the left-hand margin of the slot S as viewed in Figure 8. These lugs or ears also have pintle receiving openings 15 provided therein. The plate JP is also provided near its inner or left-hand margin with recesses or sockets 19 and 20 for the reception of certain resilient elements or plugs to be described later.

The door leaf DP is also provided with inner marginal ears which are struck from the face of the plate and these ears are designated D_1 and D_3. Other staggered lugs are struck from the intermediate portion of the plate DP as indicated at D_2 and D_4 in Figure 7. These lugs are also provided with pintle receiving openings 15. Spring plug receiving sockets 21 and 22 are also provided to the plate or leaf DP.

Referring now more particularly to Figures 5 ,9, 10, and 11 of the drawings, it will be seen that a vertical series of links are provided for connecting and supporting the closure and jamb members and these links are of two general configurations, as shown respectively in Figures 9 and 10, the shapes of the link elements making them readily adapted to be economically manufactured by extrusion processes. The links are designated in order of their occurrence from top to bottom of the assembly as follows: L_1, L_2, L_3, L_4, L_{11}, L_{22}, L_{33}, L_{44}. The links L_1, L_2, L_{11} and L_{22} are of the construction and configuration shown in Figure 9 in which three bosses 25, 26, and 27 are formed on each link and each boss provided with pintle receiving openings 30. The links L_3, L_4, L_{33} and L_{44}, shown in Figure 10, are of almost twice the height of the links illustrated in Figure 9 and one end of each of these links is notched out as at 32 to approximately halve the height of the link at that end. The links shown in Figure 10 are provided with bosses 35, 36, and 37 and each of these is provided with the pintle receiving openings 40.

Coming back to Figure 5, it will be seen that the uppermost link L_1 is disposed immediately below the lug D_1 of the door plate DP with its opening 30 in registry with the pintle opening 15 of the lug whereby the two elements are connected by the pintle bolt 45. Immediately below the link L_1 is disposed the similar link L_2, the right-hand end of which rests upon the lug J_1 of the jamb plate JP and the respective openings 30 and 15 are in registry and receive the pintle pin 46. The intermediate boss portions of the links L_1 and L_2 are pivotally connected by means of the pin 47.

Below the link L_2 there is disposed the link L_3 which conforms to the shape of the one shown in Figure 10 but is disposed in an inverted position. The narrowed portion of the link L_3 rests upon the lug D_2 of the door leaf or plate and is pivotally connected thereto by means of the pintle pin 48. The intermediate lug 36 of the link L_3 receives a pin 49 which extends upwardly into the opening 30 of the left-hand end portion of the link L_2. Below the link L_3 and extending in the opposite direction therefrom is the link L_4 which has its narrowed end portion positioned below the jamb jug J_2 and pivotally connected thereto by means of the pin 50. The right-hand end of the link L_3 and the left-hand end of the link L_4 are pivotally connected by means of the elongated pintle pin 51.

Below the link L_4 the pattern of linkages is substantially repeated, the link L_{11} (corresponding to the link L_1 at the top of the system) is pivotally connected at its left-hand end to the door plate lug D_3 by means of the pintle bolt 52 and at the right-hand end being pivotally connected with the intermediate portion of the superposed link L_4 by means of the pin 53. The next link L_{22} is pivoted by means of the pintle bolt 55 to the jamb lug J_3 and is also pivoted at its intermediate point to the central portion of the link 11 as by means of the pin 56.

The left-hand end of the link L_{22} is pivotally connected with the intermediate portion of the link L_{33} as by means of the pin 57.

In a similar fashion to the corresponding element L_3 of the upper series of links, the link L_{33} is pivotally connected by means of the pin 58 to the lug D_4 of the door plate and has its intermediate portion pivotally connected by means of the pin 59 to the left-hand end portion of the link L_{44} next below. The right-hand cut-away end of the link L_{44} is pivotally connected by means of the pin 60 to the jamb lug J_4. This completes the connection of the links with the jamb and door leaves.

For the purpose of binding the linkage system together and establishing the proper continuity of transfer of compression forces throughout the system, there is provided a binding cleat or bar B which is illustrated in elemental form in Figure 11 of the drawings. The upper and lower ends of the bar or strap B are bent at right angles to form the lugs or ears B_1 and B_2, which are pierced with pintle receiving openings 61. As most clearly shown in Figures 4 and 6 of the drawings, the bar B is fitted around the linkage system so as to clamp the superposed links together and occupies a position in which the upper lug B_1 of the bar overlies the right-hand end of the link L_1 and is pivotally connected therewith by means of the pintle bolt 62. The lower ear or lug B_2 of the connecting or clamping bar underlies the intermediate portion of the lowermost link L_{44} and is pivotally connected thereto by means of the pin 64.

It is believed that the position of the various elements in wide open condition as shown in Figure 5 will be clearly understood, and reference is now made to Figures 3, 4, and 6 of the drawings in which the parts are illustrated as occupying the door-closed positions. In moving to this position, the parts pass through the position shown in solid lines in Figure 2 of the drawings and it is interesting to note the parallelogram configuration of the linkages in this intermediate or half-open position. The links L_1 and L_{11} which extend from the door plate lugs D_1 and D_3 cross the links L_2 and L_{22} which extend from the inner lug J_1 of the jamb and are pivoted at the intermediate points 47 and 56 respectively. The links L_1 and L_{11} extending from the door plate lugs and the links L_2 and L_{22} extending from the inner jamb plate lugs are prolonged to a point where their outer ends may be pivotally connected to the intermediate portions of the links L_3 and L_{33} on the one hand and the links L_4 and L_{44} on the other hand. The links L_3 and L_{33} extending from the lugs D_2 and D_4 of the door plate are prolonged until their outer ends register with the outer ends of the links L_4 and L_{44} respectively which extend from the jamb lugs J_2 and J_4. This extreme outer meeting point is occupied by the superposed pivots 51 and 59. The position of the clamp bar B is clearly shown in Figure 2 as occupying a position intermediate the ends of the link L_4 and at the terminals of links L_1 and L_{11}.

In passing from the half-open position indicated in Figure 2 to the closed position indicated in Figures 3, 4, and 6, the successive horizontal links are stacked substantially in a plane marking the line of separation between the door and the jamb as shown in Figure 1 of the drawings, this stacking of the links being slightly narrower in lateral extent than the stacking arrangement shown in Figure 5 where the door is in opened position, but all of the links, bearing one upon the other, adequately sustain the weight of the door, in all positions of the latter. As most clearly shown in Figures 3 and 4 the clamp bar or cleat B moves into the plane of the jamb plate JP and occupies the cut-out portion or slot S formed in the plate.

Both the clamp bar B and the extension of the links L_3, L_4, L_{33} and L_{44} to the apexes represented by the pintles 51 and 59, contribute toward making the hinge capable of carrying heavy door loads satisfactorily. Most hinges of this type in the prior art omit the exten-

sions represented by the outer ends of links L_3 and L_4 and the pintle **51**, and the corresponding elements of the lower portion of the hinge, and terminate the outermost links at the intermediate points represented by the pintles **49** and **62** and in such arrangements the shear strength is very small and is so unsatisfactory that it renders the hinge almost useless for practical purposes. In the absence of the apex hinge pintles, what shear strength there is depends upon the pintle pins and the binding of the members, which obviously soon wears the hinge out.

With the hinge points **51** and **59** provided by the prolongation of the links or arms L_3, L_4, L_{33} and L_{44} the links or arms act as miniature beams, which give a very high readily calculable strength. The stresses on the various elements have been carefully worked out by the applicant and are represented by the small arrows applied to Figure 3 which indicate the places where the members of the hinge bear one upon the other. Two arrows indicate twice as much bearing stress as one arrow and four arrows indicate four times as much bearing stress as one arrow. Thus, if one hinge link or arm (L_3, L_4, L_{33} and L_{44}) has one unit of bearing stress on each end, it has two units of bearing stress in the center of the respective links, but in the opposite direction. This means that these links will be taking bending loads, i. e. loads which would produce bending of the links. Links L_1, L_2, L_{11} and L_{22} each have two units of bearing stress at each end of the links, and four units in the opposite direction at the centers of the respective links. Therefore, these links also are balanced and under bending stress. On the mounting plates JP and DP there are two units of bearing stress at two of the ears on the respective plates in one direction and one unit of stress at two of the ears in the opposite direction, leaving two units of stress as the actual shear value from the door to the jamb or vice versa for the bearing and bending stresses recited above.

The above mentioned calculable strength of the hinge with the additional apex pintle point is made possible by the continuity obtained by the use of the binding cleat or bar B. In fully open or fully closed position all of the links occupy the same plane and bear directly upon one another through a substantial portion of their lengths. However, when in an intermediate position it is necessary to use the binding cleat B to "close the circuit" so to speak, the binding cleat enclosing the two complete sets of linkages and exerting clamping contact over the link L_1 and under the link L_{44}.

In developing the present invention, it was found that the hinge could be strengthened and tension on some of the pintle pins removed by eliminating filler blocks in association with the links and making the links L_3, L_4, L_{33} and L_{44} wider than links L_1, L_2, L_{11} and L_{22} and then notching out a corner of the widest links as shown in the detail view in Figure 10. The pintle pins, in this construction, do not carry any shear load due to the weight of the door and their principal functon is to guide the door during the folding and unfolding of the linkage systems and to prevent the door from falling away from its erect position. There is no tension on the pintle pins, and they may therefore be merely press-fitted into one of the two members which are connected by each pin.

In this connection it is well to mention that the screw pintles **45**, **62**, **52**, and **55** may be replaced by drive pins such as illustrated in Figures 14 and 15 of the drawings where the pins P are provided through a portion of their length with an annular series of grooves **70** which are so cut into the periphery of the pin P as to raise a pair of cutting edges **71** alongside of each groove, which cutting edges embed themselves in the walls of the opening into which they are driven and rigidly retain the pin within said openings. The positioning and functioning of these pins are clearly shown in Figure 13 of the drawings where two of the drive pins P are installed at ***62a*** and ***49a*** in the assembly in substitution for the earlier described screw pins and plate drive pins. It will be seen how the burrs provided by the cutting edges **71** embed themselves in the walls of the openings **61** in the bar lug B_1 and **40** of link L_3, while the smooth portions of the respective pins ***62a*** and ***49a*** are rotatably received within the openings **30** of the links L_1 and L_2.

In Figure 12 of the drawings there is illustrated a small bullet-shaped plug **75** which is preferably made of rubber or some similar resilient plastic material and provided with a nose **76** and the similarly shaped recess **77** in the other end thereof. One of these small rubber spring elements is inserted in each one of the sockets **19**, **20**, **21**, and **22** of the hinge leaves JP and DP and it will be readily seen, from an inspection of Figure 5, how the projecting ends of these spring elements are contacted and compressed by the links L_3, L_4, L_{33} and L_{34} when the door is in the wide open position. These springs being under tension, they serve to urge the linkages away from dead center position when the door starts to move toward closed position. The hollowed end portions **77** of the spring plug **75** provides for the necessary displacement of the material in the forward end of the plug when it is under compression by contact with the links. The rubber or other material of which the spring is composed is therefor largely stressed in shear and should maintain its resiliency for a great length of time. If desired, a small helical spring made of metal might be substituted for the rubber plug **75**.

In the manufacture of the hinges the plates or leaves JP and DP and the bar B should be steel stampings of a most inexpensive composition. The links shown in Figures 9 and 10 may also be made of steel and plated, but they should preferably be made from extruded brass since in this form the cost of manufacture is relatively small.

The process of installation of the hinges is is also quite simple when pursued according to the following sequence of operations. Referring to Figure 3 of the drawings it is suggested that the parts be assembled in the following order. With the door plate or leaf DP as a basis, the link L_{33} may be connected with the lug D_4, the link **22** next applied and then the link **11**, whereupon the screw bolt **52** is inserted to connect the last-named link with the lug D_3. Then link L_4 is applied to the assemblage. The screw lug **55** may then be applied to connect the link L_{22} to the lug J_3. Next the links L_3, L_2 and L_1 are superposed in the stated order and the screw pintle **45** employed to attach the link L_1 to the lug D_1. Then the link L_{44} is inserted and the bar B applied to the end links L_1 and L_{44} and pinned into position.

In Figures 16–22 inclusive of the drawings there is illustrated another embodiment of the invention in which are employed flat horizontally disposed links connecting the jamb and closure leaves of the hinge assembly, these plates being arranged to be stacked in a common plane in the fully closed and fully opened positions of the mechanism, just as in the case of the previously described embodiment. However, certain differences in details of the two embodiments will appear as the description proceeds.

In these figures, the jamb or support member of the combination is designated by the reference character M and the swinging door or other closure is designated N. The respective abutting edge portions of these two members are provided with shallow recesses for the reception and complete concealment of the hinge assembly when the door is in closed position. The hinge proper comprises the plate or leaf MP secured to the jamb M and the plate NP adapted to be secured to the door or closure.

Two series of link supporting ears or lugs are struck from the plate MP, the first series being provided along the inner edge of the plate and the second series cut and bent outwardly from an intermediate portion of the plate. The lugs comprising the first series are designated M_1,

M_3, M_5, M_7 while those of the second series are indicated by the reference characters M_2, M_4, M_6, M_8.

The door plate or leaf NP is similarly provided with two series of lugs N_1, N_3, N_5, N_7, N_2, N_4, N_6, N_8 occupying corresponding positions on the door leaf.

The connecting links which are pivotally secured to the lugs and also to adjacent links are of two types, one being indicated generically by the numeral 100 in Figure 21 and the other by the numeral 101 in Figure 22. The links **100** are of full width for somewhat more than half of their length and are narrowed for a portion of their extent as at **102**. Intermediate and end pintle-receiving openings **104** are provided in the link **100**. The link **101** is provided with an intermediate angular portion **105** which serves to offset an end portion of the link from the remainder thereof. This link is somewhat narrower than the widest portion of the link **100**, the width of the greater portion of the link corresponding approximately to that of the narrower part **102** of the link **100**. The link **101** is provided with rounded end and intermediate portions **106** through which pintle-receiving openings **107** are made.

Referring now to Figures 19 and 20, the arrangement and connections of the various linkages will be described. The first link, counting from the top of the assembly, is of the generic type **101** and is designated R_1, the left-hand end of the link being pivotally connected with the ear N_1 of the door plate NP by means of a pintle or rivet a_1. The opposite offset end of this particular arm R_1 is not attached, and could be dispensed with if desired, but is shown as used intact since it is probably more economical to make all of the links of each type in a uniform manner regardless of their particular position in the assembly.

The intermediate portion of the link R_1 is pivoted by means of the pin or rivet b_1 to the intermediate portion of the next lower link R_2. One end of the link R_2, that is the straight or non-offset end, is pivotally secured to the ear M_1 by means of the pin c_1 and the remote or offset end of the link R_2 is pivoted by means of the rivet or pin d_1 to the intermediate portion of the straight link R_3 of the type generically represented in Figure 21 at **100**. One end of the link R_3 is pivoted to the door plate ear N_2 by means of the pin e_1 and this straight link or bar R_3 has its opposite end pivoted to the end of the similar mating straight bar R_4 by means of the pin f_1. The opposite end of the link R_4 is pivotally connected by means of the pin g_1 to the ear M_2. The intermediate portion of the straight bar R_4 is pivotally connected by means of the pin h_1 to the offset end of the next link R_{11}, and these connections complete one cycle or series of connections, the remaining links being pivotally attached to each other and to the hinge plates or leaves in exactly the same way throughout each of four series. The links or bars themselves are designated R_{11}, R_{12}, R_{13}, R_{14}; R_{21}, R_{22}, R_{23}, R_{24}; and R_{31}, R_{32}, R_{33}, R_{34}, and the pins or rivets connecting the various linkages are designated a_2–h_2; a_3–h_3; and a_4–g_4, for the remainder of the series of linkages.

From an inspection of Figure 16 particularly the arrangement of the parts in the intermediate or half opened position, it will be seen how the linkages assume the parallelogram or lazy-tong configuration in exactly the same manner as the embodiment of the invention first described. The straight bars R_3, R_4, R_{13}, R_{14}, R_{23}, R_{24}, R_{33}, R_{34}, pivotally connected at f_1, f_2, f_3, f_4, provide the outermost linkages which meet at the apex represented by the rivets of the series f_1–f_4. The position of the intermediate bars or links R_1, R_2 and similarly designated units, is also shown in Figure 16 as well as the intermediate pivot points b_1, d_1 and h_1. The pivotal connections of the various linkages with the ears on both the jamb plate and the door plate are shown at a_1, c_1, e_1, and g_1.

For urging the stack of linkages away from the wide open dead-center position shown in Figure 2 of the drawings, resilient means are provided including the arcuate elongated spring elements **110**. The bowed intermediate portions of these springs are secured to the plates MP and NP as by means of the screws **111** which may also serve, together with the screws **112**, to secure the plates to the jamb and door edges within the recesses provided therefor. It will be readily seen that when the linkages are in the dead-center position shown in Figure 20 the edges of the springs **110** will be contacted by the bars R_3—R_{33} and R_4—R_{34} and will be placed under stress and when the door is started toward closed position, the springs will serve to urge the linkages outward and break any dead-center detention which might occur.

It should be borne in mind continually that the broad principles of the present invention may be applied to hinge assemblies for the closures of boxes, chests, or other containers, where the closures may at times occupy horizontal planes and may swing in vertical planes. However, for the sake of brevity and clearness of terminology, the closure will be referred to in the claims as a "door," and the relatively fixed body to which it is hinged will be designated a "jamb."

For certain purposes a hinge might be made up of linkages of one series or cycle only, for example, links L_1–L_4 inclusive.

Various changes and modifications may be made in the embodiments illustrated and described without departing from the scope of the invention as determined by the subjoined claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a concealed butt hinge assembly for doors and other closures of the class described, in combination, a jamb leaf and a door leaf adapted to move about a pivot axis exterior of the closure through an angle of approximately 180° from a door-closed position, in which they are disposed in close parallel relationship, to a door-open position, in which the leaves are in substantial alignment; at least one pair of vertically staggered lugs projecting from each of said leaves, at least one first pair of links pivotally connected together substantially at their respective midpoints and having two opposed ends, one on each link, pivotally connected to the innermost lug of each of said pairs, at least one second pair of links having their adjacent ends pivotally connected together and having their remote ends pivotally connected to the outermost lug of each of said pairs, one of said second pair of links being pivotally connected at an intermediate point to a free end of one of said first pair of links, said links being stacked vertically and having their upper and lower surfaces at least in the region of the pivotal connections in bearing contact with the next adjacent link, said links being all of substantially the same length, whereby the bearing forces applied to the hinge assembly of the door when supported by the jamb longitudinally of the hinge assembly are substantially entirely sustained by stress on the links and lugs with substantially no bending or shearing stress on the pivotal connections, the axes of pivotal connection lying within a common vertical plane when the door is both in fully opened and fully closed positions.

2. The hinge assembly of claim 1 including a clamping bar independent from said leaves and embracing all of said links, said bar being pivotally connected to and bearing upon the free end of the other of said first pair of links and that link in the assembly most remote from said other of said first pair of links whereby there is obtained a balance circuit of stress throughout the entire linkage system.

3. The hinge assembly of claim 1 in which the stacking plane of the links in both door-open and door-closed positions is closely adjacent the plane of the door and jamb leaves, whereby a shallow recess in the door edge and/or the jamb edge will accommodate and conceal

the hinge; and in which when the door is fully open the pivotal axes of said second pair of links are aligned in dead center position, there being provided upon at least one of said leaves inwardly of an outer lug and in horizontal alignment with one of the links of said second pair a spring projection which is contacted and placed under resilient stress by said last mentioned link when the door is in fully open position to break said pair of links from its dead center position and urge the linkage toward door-closed position.

4. The hinge assembly of claim 1 in which said lugs are provided with aligned vertical apertures at the points of pivotal connection and a pintle pin is tightly received by one of said apertures and loosely received by the other to thereby provide said pivotal connection.

5. The hinge assembly as in claim 1 in which said links comprise longitudinal elements having appreciable thickness in the dimension transverse to and co-planar with the longitudinal axis of the elements, and having the same general horizontal cross-sectional configuration, said elements being laterally enlarged at at least the ends and intermediate portions thereof to provide bosses, the upper and lower surfaces of which are adapted for bearing contact with corresponding surfaces of adjacent links.

6. The hinge assembly set forth in claim 1 in which certain of the links are bent between their intermediate and end pivot points to provide an offset portion in order to avoid conflict with the leaf lugs.

7. The hinge assembly as set forth in claim 3 in which the spring projection comprises a compressible lug of rubber-like material set in an opening in the leaf and projecting therefrom.

8. The hinge assembly as set forth in claim 3 in which the spring projection comprises an elongated strip of thin spring metal secured medially to one of said leaves, extending longitudinally of the assembly, and having its lateral edges curled outwardly to project into the plane of the stacked links.

9. In a concealed butt hinge assembly for doors or other closures of the class described, in combination, a jamb leaf and door leaf adapted to move about a pivot axis exterior of the closure through an angle of approximately 180° from a door-closed position, in which they are disposed in close parallel relationship, to a door-open position, in which the leaves are in substantial alignment; two transversely spaced series of lugs projecting from each of said leaves, one of said series adjacent the pivot edge of each leaf and the other remote from said edge; a series of links vertically stacked in bearing contact each with the next adjacent link; the links being all of substantially the same length and arranged in pairs of adjacent similarly shaped and positioned links; a first pair of said links each having one of its ends pivotally pinned to a lug in the series further from the edge of the door leaf and the jamb leaf respectively which is adjacent the pivot axis of the closure and having its other end pivotally connected to the opposite overlapping end of its mating contacting link; a second pair of said links each having one of its ends pivotally connected to a lug in the series nearer the pivot edge of the door leaf and the jamb leaf respectively, and its intermediate point pivotally connected to the intermediate point of its mating link; the intermediate point of at least one of the links of said first named pair being pivotally connected to an end of the one of the links of said second named pair next adjacent thereto; the bearing forces applied to the hinge assembly by the door when supported by the jamb longitudinally of the hinge assembly being substantially entirely sustained by stresses on the links and lugs with substantially no bending or shearing stress on the pivotal connections, each link comprising a simple lever and the stresses on each of the links being balanced symmetrically thereof; and a clamp bar independent from said leaves embracing the series of links and bearing upon and pivotally pinned at its respective ends to the outer sides of the outermost links of the series, in order to complete the balanced circuit of stresses throughout the entire linkage system.

10. The hinge assembly as set forth in claim 9 in which no two lugs on both of the leaves taken together are in transverse alignment and in which certain of the links have an end portion partially cut away to provide space for certain of the lugs, whereby the bearing contact between those links and the next adjacent ones may be maintained.

11. The hinge assembly as set forth in claim 9 in which the pattern of linkage construction and arrangement is repeated serially longitudinally of the assembly, and a single clamp bar is employed, said bar embracing and contacting the uppermost link of the first series and the lowermost link of the last series.

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