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(54) COMBINATION LOCK

(71) We, WALTER KIDDE & COMPANY, INC., a Corporation organised under the laws of the State of Delaware, United States of America, of 35 Market Street, Elmwood Park, New Jersey 07407, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to combination locks of the multiple-dial type, and is more particularly directed to improvements in combination locks of the type disclosed in British Patent No. 1,187,538.

In the combination lock disclosed in British Patent No. 1,187,538, a manually operable bolt member cooperable with a hasp has longitudinally spaced bars defining slots which receive respective rotatably mounted dials having indicia or numbers thereon, each dial having associated therewith a sleeve having a flange and a flat portion. When the device is in a locked condition or "off combination", a flange of a sleeve cooperates with one of the bars of the bolt member to block movement of the bolt member from a fastening position. When the device is in an open condition or "on combination", the sleeves are oriented with the flange portions out of blocking position in relation to the bars of the bolt member so that the bolt member can be moved between fastening and releasing positions. When the bolt member is in its releasing position, the bars cooperate with the flat portions of the sleeves to prevent their rotation and the rotation of the associated dials, thereby maintaining the lock on combination.

Combination locks made in accordance with British Patent No. 1,187,538 have been satisfactory for use in connection with luggage cases and the like. However, because the amount of travel of the bolt member between the fastening and releasing position is comparatively small (i.e., approximately equal to the thickness of the flat portion of a sleeve), the bolt member engages a cooperable hasp to this limited extent. It is desirable that the amount of travel of the bolt member be increased for thereby increasing the extent of

engagement of the bolt member with the hasp.

Accordingly, a principal object of the invention is to provide an improved combination lock of the type disclosed in the aforesaid British Patent No. 1,187,538 and, more specifically, to provide a combination lock in which the amount of travel of the bolt member is increased.

Another object of the invention is to provide a combination lock of the above-described type which is provided with longitudinally movable pullers for moving the bolt member from fastening to releasing position and from releasing to fastening position, respectively.

Another object of the invention is to provide a combination lock of the above-described type which may be aesthetically incorporated into the handle stud of a luggage case or the like.

According to the present invention, there is provided a combination lock comprising a plurality of dials which are rotatable about a longitudinal axis, a sleeve associated with each dial for rotation therewith; a plug movable longitudinally between a first position and a second position, each sleeve having means which co-act with the plug for releasably locking the plug in said first position when the dials are off combination; and a manually operable bolt member movable longitudinally between a fastening position and releasing position, the bolt member and the plug having interengageable parts for preventing movement of the bolt member to the releasing position when the plug is locked in its first position.

In the preferred embodiment, each sleeve has a flange and a flat portion and the plug has longitudinally spaced bars defining slots which receive respective dials, the flanges on the sleeve being co-operable with the bars for locking the plug in the first position when the dials are off combination. The bolt member, which is manually movable longitudinally to the fastening and releasing positions by means of first and second pullers, has a hook portion for engagement with a co-acting hasp.

When the lock is off combination, with the plug locked in said first position, one end of

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the plug is provided to co-act with an abutment surface on a wall at one end of the bolt member for preventing movement of the bolt member from its fastening position to its releasing position. However, when the dials are set on combination, the flanges are moved out of blocking relation with the bars on the plug so that the bolt member can be moved toward its releasing position by means of the first puller. During the first part of this movement, the abutment surface on the bolt member cooperates with an end of the plug to move the plug from the first to the second position. Then, co-acting cam surfaces provided by a frame of the combination lock and by the bolt member cause the abutment surface on the bolt member to then be shifted out of abutting relationship with the end of the plug so that the bolt member can then bypass the plug and be moved fully into its releasing position for disengaging the hasp. When the bolt member is in its releasing position, the bars of the plug cooperate with the flat portions of the sleeves to prevent rotation of the sleeves and their associated dials from the opening combination.

When it is desired to re-engage the hasp, the bolt member is moved in the opposite direction into the fastening position by means of the second puller. A surface on an up-standing wall at the other end of the bolt member during this motion acts against the corresponding end of the plug to return the plug to the above-described first position, in which position the plug may then be locked by rotating the dials from on to off combination.

The invention is illustrated by way of example in the accompanying drawings in which,

Figure 1 is a perspective view of a combination lock in accordance with the invention incorporated into the handle stud of a luggage case;

Figure 2 is a top plan view of the lock of Figure 1, but with the luggage case handle omitted, this view showing the relationship of the bolt member to a hasp;

Figure 3 is a longitudinal cross-sectional view of the lock taken approximately in the plane of line 3—3 of Figure 2, this view showing the bolt member locked in a fastening position;

Figure 4 is a view similar to Figure 3, but with the bolt member shown in a releasing position;

Figure 5 is a transverse cross-sectional view taken approximately in the plane of line 5—5 of Figure 2;

Figure 6 is a top plan view of the lock of Figure 1, but with the handle stud and face plate omitted and with the pullers in cross section;

Figure 7 is a bottom view of the handle stud;

Figure 8 is a plan view of a frame, employed in the lock;

Figure 9 is a plan view of a plug employed in the lock;

Figure 10 is a plan view of a bolt member employed in the lock;

Figure 11 is a side elevational view of a dial employed in the lock; and

Figure 12 is a side elevational view of a sleeve associated with the dial of Figure 11.

Referring to the drawings, a combination lock A made in accordance with the invention is cooperable with a hasp B. Generally, the combination lock comprises a face plate C, a frame D, a shaft E, dials F and associated sleeves G, a plug H, a bolt member J, a cover plate K, left-hand and right-hand pullers L and R, and resilient means in the form of springs M and N acting upon and cooperating with the cover plate and the ends of the bolt member.

Referring to Figure 3, face plate C has a plurality of longitudinally spaced slots 12 (Fig. 7). Longitudinally extending shaft E is supported just below the face plate by the frame D so that the dials F, which are rotatably supported on the shaft with their associated sleeves G, extend partially through the slots 12. As shown in Figures 5 and 12, each sleeve G is provided with a flange 14 and a flat portion 16. The opposite ends of the shaft E are mounted in respective openings in vertical end wall portions 18 and 20 of the frame D. Lugs 22 and 24 provided at opposite ends of the frame are received by respective openings in horizontal end portions 26 and 28 of bottom cover plate K, which is held in position against the face plate by rivets 114, as described more fully hereinafter. As shown in Figure 8, frame D is further provided with longitudinally spaced slots 30 which receive respective dials F.

Supported by a horizontal central portion 32 (Fig. 8) of frame D for longitudinal movement between first and second positions shown in Figures 3 and 4, respectively, is the plug H, shown most clearly in Figure 9. Longitudinally spaced bars 34 and 36 define slots 38 which receive respective dials F. These slots are aligned with but are wider than the slots 12 in face plate C and slots 30 in frame D so that they can also receive the flanges 14 of the associated sleeves, as shown in Figure 3.

Referring to Figure 3, when the dials are off combination, one or more of the flanges 14 of the sleeves are received by slots 38 in the plug H so that the flange or flanges cooperate with bars 34 and 36 of the plug for maintaining the plug in the position shown in Figure 3. On the other hand, when the dials are set to the predetermined opening combination, as shown in Figure 4, the flanges are moved out of blocking relationship with the bars so that

the plug can be moved between the positions shown in Figures 3 and 4.

Positioned beneath frame D and plug H is the bolt member J which is supported for longitudinal movement between the fastening and releasing positions shown in Figures 3 and 4, respectively. Supported for longitudinal sliding movement on the face plate C are longitudinally spaced left-hand and right-hand pullers L and R which engage opposite ends of the bolt member for manually moving the bolt member from its fastening to its releasing position and from its releasing to its fastening position, respectively. Referring to Figure 3, the left-hand puller L has a projecting stud 40 which extends successively through a longitudinal slot 42 in the face plate (Fig. 7), an aligned slot 44 in horizontal left end portion 46 of frame D (Fig. 8), an opening 48 in the horizontal left end portion 50 of bolt member J (Fig. 10), the opening comprising part of a slot formed in the horizontal end portion 50 and in the vertical wall portion 78 of the frame, and through a longitudinal slot 52 in cover plate K. A washer 54 mounted at the end of the stud cooperates with the cover plate for holding the puller L in place against the face plate. Resilient biasing means in the form of coil spring M carried by the stud acts against the cover plate to urge end portion 50 of the bolt member against the underside of the face plate. In similar fashion, puller R has a projecting stud 56 which extends through a longitudinal slot 58 in the face plate, an aligned slot 60 in the horizontal right end portion 62 of the frame, an opening 64 in the horizontal right end portion 66 of the bolt member (formed in the same manner as opening 48), and through a longitudinal slot 69 in the cover plate, the end of this stud having a washer 71 fixed thereto for holding the puller in position against the face plate. Resilient biasing means in the form of coil spring N carried by stud 56 acts against the cover plate for urging end portion 66 of the bolt member upwardly against the face plate.

As shown in Figures 4 and 6, the right end portion 66 of the bolt member is provided with a pair of laterally spaced camming surfaces 68 (Fig. 10) which are urged into engagement with a pair of co-acting camming surfaces 70 on the frame (Fig. 8) by spring N and provide detent means for resiliently maintaining the bolt member in the respective fastening and releasing positions.

As shown in Figure 10, the bolt member has a hook portion 72 for engaging a co-acting hook portion 74 of hasp B (see Fig. 2) when the bolt member is releasably locked in the fastening position (shown in Fig. 3) by plug H, as described hereinafter.

When plug H is locked in the position shown in Figure 3 by one or more flanges 14 of sleeves G (i.e., when the dials F are off

combination), bolt member J cannot be moved rightwardly into its releasing position by pushing on puller R. The bolt member can be moved rightwardly, as viewed in Figure 3, only a short distance between abutment surfaces 76 provided by the left vertical wall 78 of the bolt member are brought into contact with the left end surfaces 80 of the plug which provide stop means, as shown in Figures 3 and 6. This prevents further movement of the bolt member towards its releasing position. During this limited movement, camming surfaces 70 and 68 on the frame and the bolt member, respectively, cooperate to cause the right end portion 66 of bolt member J to be moved downwardly relative to face plate C against the force of coil spring N. Thus, when the manual pressure applied to puller R is thereafter released, the coil spring and camming surfaces cooperate to return the bolt member to the fastening position shown in Figures 2, 3 and 6.

When it is desired to disengage the combination lock from the hasp, the dials are rotated to the opening combination so that the flanges 14 of the sleeves G are removed from the slots 38 and clear bars 34, 36 of the plug. Longitudinal rightward movement of the bolt member towards its releasing position by means of puller R brings abutment surfaces 76 of the bolt member into contact with end surfaces 80 of the plug, as described previously. However, referring to Figure 3, because the flanges 14 on the sleeves are moved out of blocking relationship with the bars on the plug, further movement of the bolt member toward its releasing position is permitted, which causes the upstanding abutment surfaces 76 to carry and shift the plug longitudinally with the bolt member until the plug nearly contact dials F, as shown in Figure 4. Just before the plug is carried fully into this position by the bolt member, the left end portion 50 of the bolt member is brought into engagement with a pair of transversely spaced camming surfaces 82 provided adjacent the left end portion 46 of the frame (Fig. 6) for causing the left end of the bolt member to be moved downwardly from face plate C against the action of biasing spring M. Thus, the abutment surfaces 76 on the bolt member are moved transversely out of abutting relation with end surfaces 80 of the plug. This enables the abutment surfaces of the bolt member to bypass the end surfaces of the plug so that the bolt member can be moved fully into the releasing position shown in Figure 4. Because the plug and the bolt member each have a dead bolt action, camming surfaces 68 and 70, provided by the bolt member and the frame, respectively, in cooperation with springs M and N on the pullers resiliently maintain the bolt member in its releasing position. Thus, when the bolt member is in its releasing position, the plug

is in the position shown in Figure 4 and bars 34 and 36 on the plug cooperate with flat portions 16 on the sleeves for preventing rotation of the sleeves and their associated dials from the predetermined opening combination.

Due to the ability of the bolt member to bypass the plug for a portion of its movement, the total travel of the bolt member between fastening and releasing positions may be about 0.25 inch, for example, which is considerably greater than the total longitudinal movement of the plug, which may be about 0.10 inch, for example. This increased travel provides for more positive engagement of the hook portion 72 of the bolt member with hook portion 74 of the hasp, compared with that provided by British Patent No. 1,187,538 hereinbefore referred to.

To return the bolt member to its fastening position for engaging the hasp, puller L is manually moved leftwardly as viewed in Figure 4. Referring to Figure 6, during this motion surfaces 84 (Fig. 10) on the vertical right end wall 86 of the bolt member are brought into contact with end surfaces 88 (Fig. 9) of the plug for returning the plug to the position shown in Figure 3. The dials and their associated sleeves may then be rotated from on to off combination to lock the plug in that position, thereby locking the bolt member in its fastening position.

In the preferred form of the invention, the sleeves G are separable from their associated dials F, the sleeves and dials having co-acting means for releasably keying them together to permit the selection of a combination of one's own choice. For example, each sleeve G may have a pair of teeth 90 (Fig. 12) which are receivable by notches 92 in dials F (Fig. 11). As shown in Figure 4, a spring P is provided around the end of the shaft E opposite the end which carries a shift lever Q, the spring serving to normally urge the sleeves into keyed relationship with their respective dials. The lever Q is rotatably mounted on the shaft E and extends between the right end portions 94 of the plug (see Fig. 9) and through aligned longitudinal slots 96, 98 and 100 in the frame (Fig. 8), the bolt member (Fig. 10), and the cover plate, respectively. The lever may be rotated and then pushed against the force of spring P to disengage the sleeves from their associated dials for enabling the dials to be rotated to different circumferential positions relative to the sleeves for thereby establishing a combination of one's choice.

In the illustrated form of the invention there are three separate sleeves and three associated dials. The three dials each have ten indicia or numbers thereon so that there are 1,000 different combinations available. It will, of course, be understood that any de-

sired number of dials may be used to furnish the desired number of combinations. A spring T (see Figs. 4 and 5) is formed to enter spaced recesses in the periphery of the dials so that the dials are releasably maintained in selected circumferential positions.

Also, in the preferred and illustrated form of the invention, the combination lock has visual indicator means of the type disclosed in U.S. Patent No. 3,416,338. As shown in Figure 3, the flat portion 16 of each sleeve G has indicator means, such as a slot 102 (see Fig. 12), located so as to be viewed or felt through the slots 38 in the plug H and aligned openings 104, 106 and 108 in frame D, bolt member J, and cover plate K, respectively. This enables the sleeves to be rotated to the positions shown in Figure 4 to establish the opening combination of the lock in the event that the opening combination is lost while the bottom side of the lock is still accessible.

The combination lock A and the hasp B may be secured to the parts which they are intended to lock together in any suitable manner. For example, as illustrated in Figures 1—5, the combination lock and hasp are applied to a luggage case wherein the face plate C comprises part of a handle stud W to which a handle X is suitably connected. Referring to Figure 4, where the handle stud is a die-cast part, as preferred, it is provided with longitudinally spaced, integral, hollow connecting studs 110 which are received by aligned openings 112 providing in a male valance V which is mounted on a luggage case shell S, as shown in Figure 5. End portions 26 and 28 of cover plate K are provided with openings through which tapered rivets 114 are extended into the bores of the connecting studs 110 to connect the handle stud and the cover plate to the balance V. As shown in Figure 5, the major part of the height of the lock is extended through an opening 116 in valance V with the longitudinal edges 118 of the handle stud resting on the valance V adjacent the opening.

Referring to Figure 5, the hasp B is secured to a female valance V¹ carried by the opposing case shell S¹ by any suitable means, such as headed rivets 120. As shown in Figure 2, the engageable faces of the hook portion 72 of the bolt member and hook portion 74 of the hasp are matingly angled to facilitate the drawing together of the luggage case shells S and S¹ when the combination lock A and the hasp B are used for luggage application as herein illustrated. Moreover, when the lock of the invention is incorporated into the handle stud of a luggage case, as illustrated in Figures 1—5, the left and right ends of the pullers L and R can be conveniently actuated by thumb pressure from the left and right hands, respectively, of an operator to provide a solid, positive fastening and releasing action. To ensure proper manipulation of the pullers,

the leftmost face of the left-hand puller L is received by a recess 122 in the handle stud and the rightmost face of the right-hand puller R is received by a recess 124 in the handle stud, as shown in Figure 3.

The advantages and improved results afforded by the combination lock of the present invention will be apparent from the foregoing detailed description of a preferred embodiment thereof. Various changes and modifications may be made to the preferred embodiment of the invention as hereinbefore described without departing from the scope of the invention as defined in the following claims.

WHAT WE CLAIM IS:—

1. A combination lock comprising a plurality of dials which are rotatable about a longitudinal axis, a sleeve associated with each dial for rotation therewith; a plug movable longitudinally between a first position and a second position, each sleeve having means which co-act with the plug for releasably locking the plug in said first position when the dials are off combination; and a manually operable bolt member movable longitudinally between a fastening position and releasing position, the bolt member and the plug having interengageable parts for preventing movement of the bolt member to the releasing position when the plug is locked in its first position.

2. A combination lock as set forth in claim 1, wherein the plug has longitudinally spaced bars defining slots which receive the respective dials, and wherein each of the sleeves has a flange and a flat portion, the flanges engaging with the bars of the plug for locking the plug in said first position when the dials are off combination and disengaging to permit the plug to be moved between said first and second positions when the dials are on combination.

3. A combination lock as set forth in claim 1 or claim 2, wherein the interengageable parts comprise stop means formed on the plug which co-act with an abutment surface on the bolt member; and wherein the lock further comprises means which cause the abutment surface on the bolt member to bypass said stop means when the plug is not locked in said first position so that the bolt member can be moved into releasing position.

4. A combination lock as set forth in claim 3, wherein the means which cause the abutment surface to bypass the stop means comprises a camming surface which co-acts with the bolt member to move the abutment surface of the bolt member out of abutting relationship with said stop means.

5. A combination lock as set forth in claim 3, wherein the abutment surface and the stop means co-operate to shift the plug from said first position to said second position as

the bolt member is moved from its fastening position to its releasing position, and wherein the plug and the bolt member have means which co-act to return the plug to said first position when the bolt member is moved from its releasing position to its fastening position.

6. A combination lock as set forth in any preceding claim, including means for resiliently maintaining the bolt member in its fastening and releasing positions.

7. A combination lock as set forth in any preceding claim, wherein the plug and the bolt member each have a dead bolt action.

8. A combination lock as set forth in any preceding claim, wherein the bolt member has manually operable first and second pullers engaging therewith for moving the bolt member from its fastening to its releasing position and from its releasing to its engaging position, respectively.

9. A combination lock as set forth in any preceding claim, wherein the bolt member has a hook portion for engaging a co-operable hasp when the bolt member is in said engaging position.

10. A combination lock as set forth in any one of claims 2 to 9, wherein the sleeves are separable from their associated dials, and wherein the lock further comprises means for changing the circumferential positions of the dials relative to their respective sleeves.

11. A combination lock as set forth in any one of claims 2 to 10, including a face plate having longitudinally spaced slots, the plug being positioned beneath the face plate, the plug having longitudinally spaced bars defining slots in alignment with, but of greater width than, that of the face plate slots, and a longitudinally extending shaft, the dials being rotatably mounted on the shaft and positioned in the slots.

12. A combination lock as set forth in claim 11, wherein the plug and the bolt member are elongated, one end of the plug being arranged to co-act with an abutment surface provided by a vertical wall at the corresponding one end of the bolt member for preventing movement of the bolt member to its releasing position when the plug is locked in said first position, and wherein the lock further comprises a camming surface which co-acts with said corresponding end of the bolt member for moving the abutment surface transversely out of abutting relationship with said one end of the plug as the bolt member is moved from its fastening position to its releasing position when the plug is not locked in said first position, detent means co-operable with the other end of the bolt member for resiliently maintaining the bolt member in its fastening and releasing positions, and biasing means for urging said one end and said other end of the bolt member into engagement with said camming surface and said detent means.

13. A combination lock as set forth in



the leftmost face of the left-hand puller L is received by a recess 122 in the handle stud and the rightmost face of the right-hand puller R is received by a recess 124 in the handle stud, as shown in Figure 3.

The advantages and improved results afforded by the combination lock of the present invention will be apparent from the foregoing detailed description of a preferred embodiment thereof. Various changes and modifications may be made to the preferred embodiment of the invention as hereinbefore described without departing from the scope of the invention as defined in the following claims.

WHAT WE CLAIM IS:—

1. A combination lock comprising a plurality of dials which are rotatable about a longitudinal axis, a sleeve associated with each dial for rotation therewith; a plug movable longitudinally between a first position and a second position, each sleeve having means which co-act with the plug for releasably locking the plug in said first position when the dials are off combination; and a manually operable bolt member movable longitudinally between a fastening position and releasing position, the bolt member and the plug having interengageable parts for preventing movement of the bolt member to the releasing position when the plug is locked in its first position.

2. A combination lock as set forth in claim 1, wherein the plug has longitudinally spaced bars defining slots which receive the respective dials, and wherein each of the sleeves has a flange and a flat portion, the flanges engaging with the bars of the plug for locking the plug in said first position when the dials are off combination and disengaging to permit the plug to be moved between said first and second positions when the dials are on combination.

3. A combination lock as set forth in claim 1 or claim 2, wherein the interengageable parts comprise stop means formed on the plug which co-act with an abutment surface on the bolt member; and wherein the lock further comprises means which cause the abutment surface on the bolt member to bypass said stop means when the plug is not locked in said first position so that the bolt member can be moved into releasing position.

4. A combination lock as set forth in claim 3, wherein the means which cause the abutment surface to bypass the stop means comprises a camming surface which co-acts with the bolt member to move the abutment surface of the bolt member out of abutting relationship with said stop means.

5. A combination lock as set forth in claim 3, wherein the abutment surface and the stop means co-operate to shift the plug from said first position to said second position as

the bolt member is moved from its fastening position to its releasing position, and wherein the plug and the bolt member have means which co-act to return the plug to said first position when the bolt member is moved from its releasing position to its fastening position.

6. A combination lock as set forth in any preceding claim, including means for resiliently maintaining the bolt member in its fastening and releasing positions.

7. A combination lock as set forth in any preceding claim, wherein the plug and the bolt member each have a dead bolt action.

8. A combination lock as set forth in any preceding claim, wherein the bolt member has manually operable first and second pullers engaging therewith for moving the bolt member from its fastening to its releasing position and from its releasing to its engaging position, respectively.

9. A combination lock as set forth in any preceding claim, wherein the bolt member has a hook portion for engaging a co-operable hasp when the bolt member is in said engaging position.

10. A combination lock as set forth in any one of claims 2 to 9, wherein the sleeves are separable from their associated dials, and wherein the lock further comprises means for changing the circumferential positions of the dials relative to their respective sleeves.

11. A combination lock as set forth in any one of claims 2 to 10, including a face plate having longitudinally spaced slots, the plug being positioned beneath the face plate, the plug having longitudinally spaced bars defining slots in alignment with, but of greater width than, that of the face plate slots, and a longitudinally extending shaft, the dials being rotatably mounted on the shaft and positioned in the slots.

12. A combination lock as set forth in claim 11, wherein the plug and the bolt member are elongated, one end of the plug being arranged to co-act with an abutment surface provided by a vertical wall at the corresponding one end of the bolt member for preventing movement of the bolt member to its releasing position when the plug is locked in said first position, and wherein the lock further comprises a camming surface which co-acts with said corresponding end of the bolt member for moving the abutment surface transversely out of abutting relationship with said one end of the plug as the bolt member is moved from its fastening position to its releasing position when the plug is not locked in said first position, detent means co-operable with the other end of the bolt member for resiliently maintaining the bolt member in its fastening and releasing positions, and biasing means for urging said one end and said other end of the bolt member into engagement with said camming surface and said detent means.

13. A combination lock as set forth in 130

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claim 12, further comprising manually operable first and second longitudinally movable pullers slidably supported by the face plate and each having a projection extending through respective openings in the face plate and engaging said one end and said other end, respectively, of the bolt member for moving the bolt member from its engaging to its releasing position and from its releasing to its engaging position, respectively.

14. A combination lock as set forth in claim 13, wherein the projections extending through the openings in the face plate comprises first and second studs which are re-

ceived by openings in said one end and said other end, respectively, of the bolt member, and wherein said biasing means comprises first and second coil springs carried by said first and second studs, respectively.

15. A combination lock, substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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