April 2, 1929. R. T. WALES 1,707,420

CEILING MOLD

Filed July 28, 1925 2 Sheets-Sheet 1

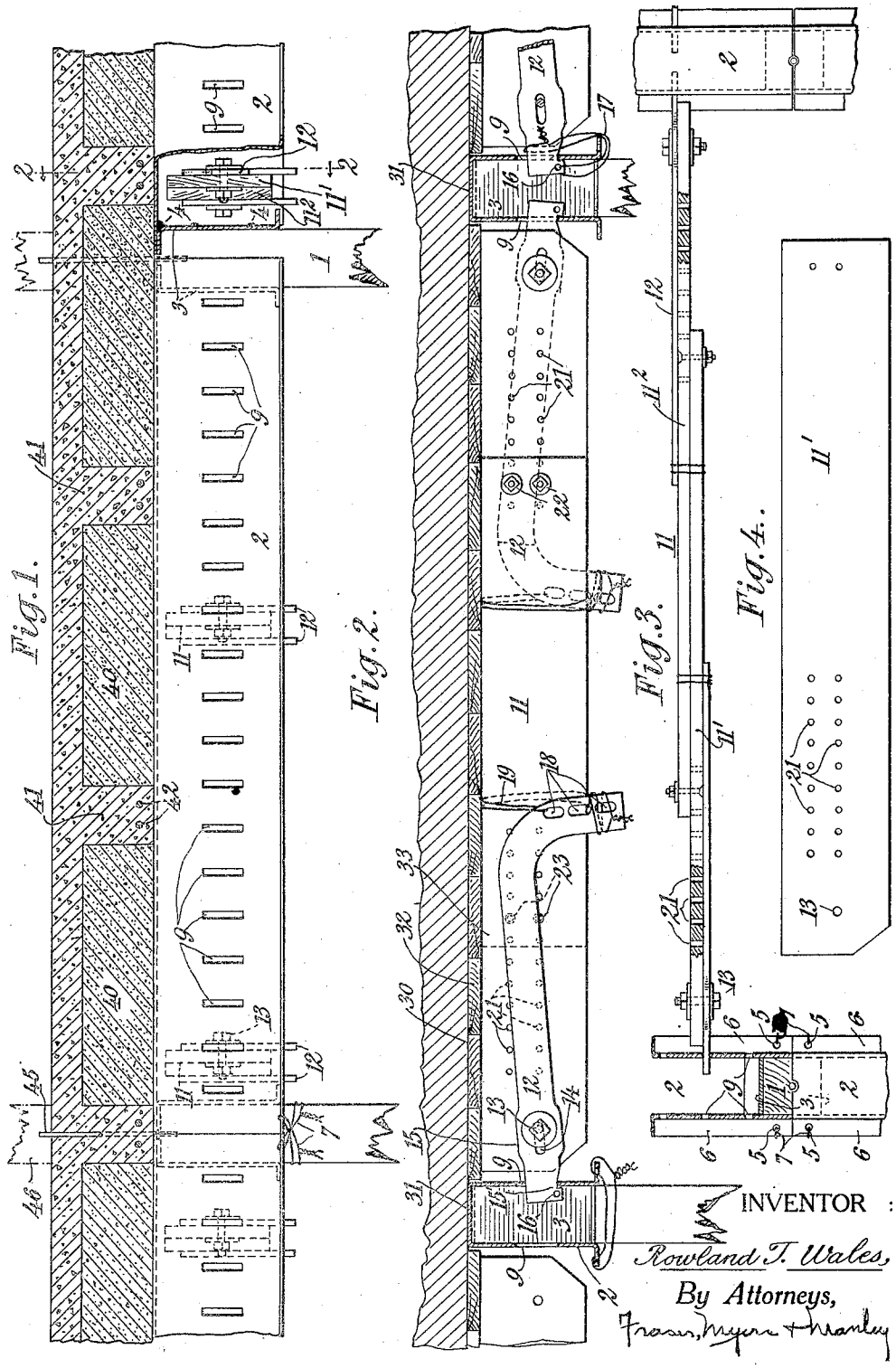


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

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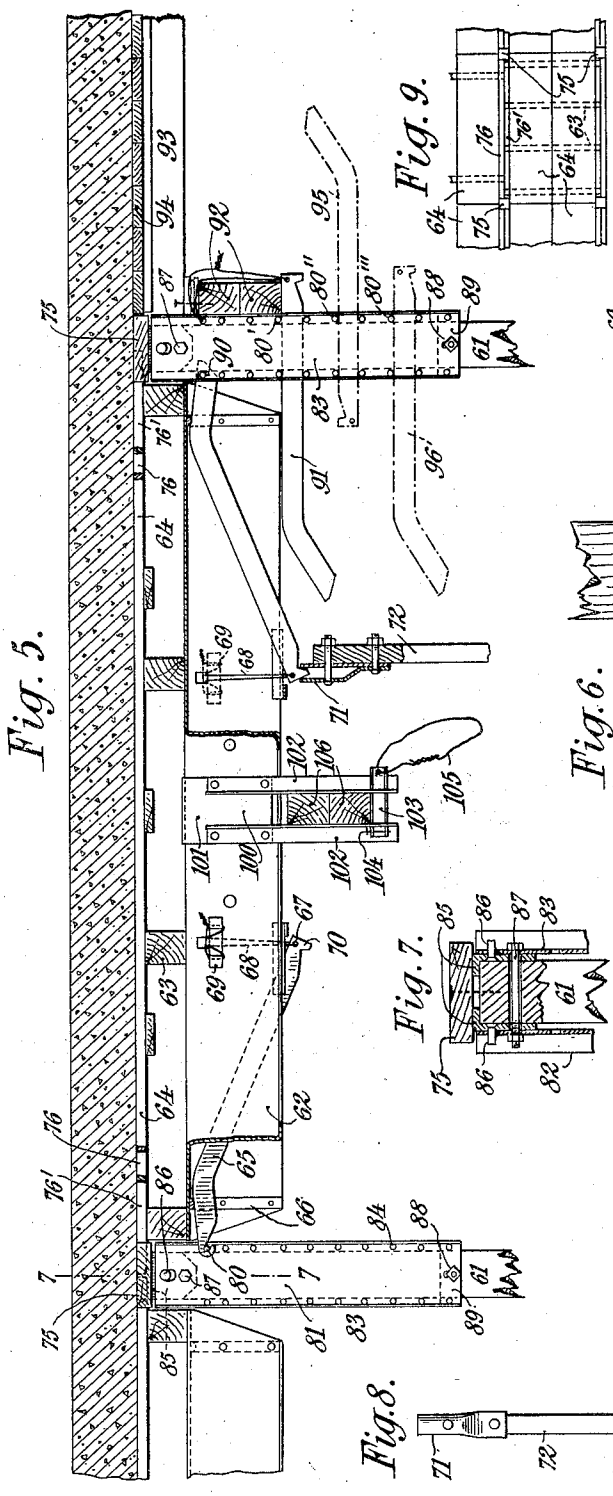


Fig. 5.

Fig. 9.

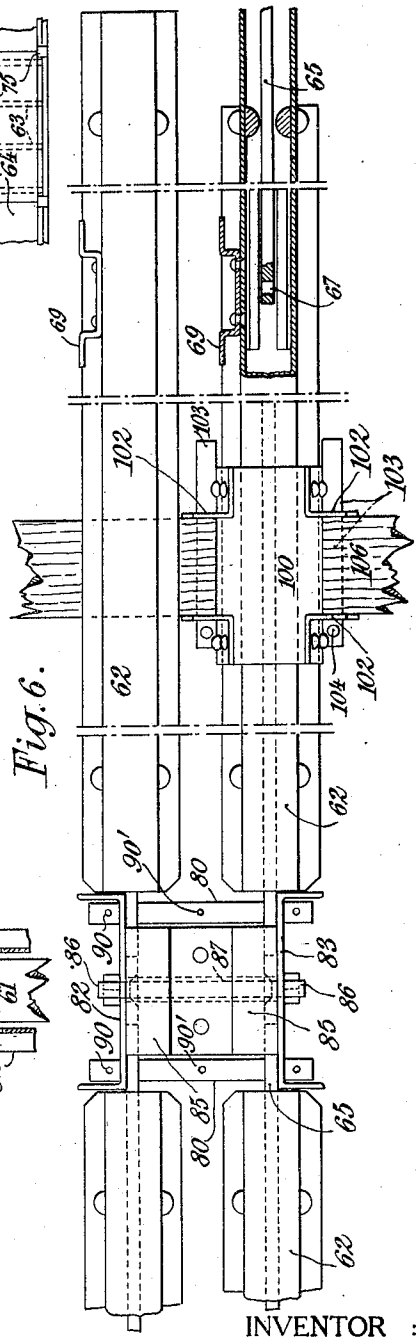


Fig. 6.

Fig. 7.

Fig. 8.

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UNITED STATES PATENT OFFICE.

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CEILING MOLD.

Application filed July 28, 1925. Serial No. 46,601.

This invention relates to ceiling molds, particularly of the type suitable for flat slab concrete ceilings.

The object of this invention is to provide a ceiling mold in which the major portion of the structural material employed may be safely released for use at other points considerably earlier than is possible in accordance with the best present practice. This obviously results in a reduction in the amount of such material required on a given piece of construction and a corresponding saving in capital investment.

A further object of this invention is to provide an improved ceiling mold structure whereby the necessity for re-posting or re-shoring of the partially hardened cast ceiling upon removal of the mold boards or panels, is eliminated. This capacity eliminates much of the risk incident to the present practice of stripping the ceiling mold structure while the concrete or other materials of which the ceiling is cast, is in a green or partially hardened state, and also incident to the subsequent re-posting of such areas to support them until the material of the ceiling has hardened sufficiently to safely support its own weight and whatever load it may be intended to carry.

A further object of the invention is to provide mold boards or panels and horizontal supporting members therefor which are readily removable and permit of stripping any desired portion of the ceiling mold without interfering in any way with the continuous support of the posts, which are always acting at least in part to support the green ceiling slab at suitable intervals and independently of the mold boards.

A further object of the invention is to provide a ceiling mold structure which is sectionally removable, whereby any desired portion of a ceiling may be stripped without interference with other sections of the mold and without cutting or in any way damaging any of the structural elements or materials of the ceiling mold.

A further object of the invention is to provide suitable standard structural elements for form construction which may be readily assembled and adjusted. The use of certain metal members in the forms is rendered economical because of the comparatively short time during which most of the mold parts are tied up.

The invention further provides novel means for largely eliminating posts ordinarily required for the shoring up of remnant areas.

According to the present invention, the posts or shores which ordinarily serve merely to support the structure which supports the mold boards and which must be removed in order to strip such boards from the ceiling are now disposed so as to support the material of the ceiling over suitably distributed supporting areas independently of the mold boards, whereby the necessity for re-posting is entirely eliminated. At the same time there is provided a releasable and also preferably adjustable support for the said mold boards and such horizontal structural elements as are necessary for immediately supporting them. The posts, according to the present invention, whether they be supporting the structure which supports the mold boards in position to receive the plastic ceiling material when it is first cast, or whether they serve to support the ceiling slab independently of such mold boards after the slab is partially hardened, occupy the same position and never need be disturbed until the necessity for supporting the ceiling has passed.

The advantages of a ceiling mold according to the present invention are numerous. Obviously, all the dangers incident to the ordinary re-shoring method have been done away with, because of the fact that the ceiling, while it is in a green state, is never for a moment left unshored nor are the posts in any way disturbed by the removal of the mold boards as in the ordinary process of stripping. The stripping of the present molds may be carried out with safety considerably earlier than would be possible in the ordinary re-shoring system. This has two marked advantages, one being that the mold boards or panels and the materials of the horizontal supporting structure immediately supporting the same may be released for use at other points considerably earlier than is possible according to the usual methods employed, with a consequent saving on the investment represented in the tying up of such materials for long periods; the second advantage is that because of the mold boards being removable comparatively early, and with safety, due to the fact that at no time is any considerable portion of the ceiling unposted, the ceiling surface, because of its relatively green condition, may be

more easily dressed. If the mold facing were required to be kept in place until the material of the ceiling had sufficiently hardened to permit the safe removal of the posts in order to strip the mold from the ceiling in the ordinary way, the ceiling material would be too hard to permit of ready dressing of the concrete surface. Because of the fact that small sections of the ceiling mold may be removed independently of and without disturbing adjacent mold sections, certain areas near the permanent columns and walls of the building may be stripped even earlier than the central areas of the concrete slab between the columns, or, as is generally said, the center of the bays (a bay being the area between four permanent columns in the usual flat slab concrete construction). Because of this facility for earlier stripping of certain portions of the ceiling mold, the dressing of the concrete at points where this is permissible may be very easily accomplished.

The comparatively few elements of the ceiling mold according to the present invention are simple and extremely rugged in construction and may be standardized so as to be absolutely interchangeable, thus permitting a relatively small equipment of mold parts to do a given amount of work.

A given piece of concrete construction can be carried out with the molds herein described with considerably less manual labor than would be required where the ordinary type of ceiling mold construction is used, for the reason that the major part of the work of erecting the mold structure is now mainly that of assembling standard mold parts, comparatively little actual carpentry being required. Furthermore, men will not be delayed as they sometimes are, because of the materials, for form construction, being tied up for long periods of time, much of the material of the mold structure according to the present invention being releasable considerably earlier than is ordinarily possible.

Further features will be set forth in the detailed description of the invention following herewith, reference being had to the accompanying drawings, in which:—

Figure 1 is an elevation of the preferred embodiment of the invention taken parallel to the ledger or permanent beam line and shows the complete mold assembly as it would be used in actual service to support a concrete floor when first poured.

Fig. 2 is an elevation taken at right angles to the view shown in Figure 1 and along the line 2—2 of said figure, the ledgers and mold facing being shown in section.

Fig. 3 is a plan view showing in fragmentary section parts of the ledgers and the posts and a complete adjustable temporary sustaining beam, or spreader.

Fig. 4 is a longitudinal elevation of the left-hand section of the beam proper shown in Fig. 3.

Fig. 5 is an elevation taken parallel to a line of posts supporting the ceiling mold and shows a modified form of mold structure.

Fig. 6 is a somewhat enlarged plan view of the adjustable beams and post supporting the left-hand end of beam thereof shown in Fig. 5, three longitudinal sections having been removed from the beam, as indicated by dotted lines, to reduce the overall length of the figure while maintaining the scale sufficiently large to show the necessary details.

Fig. 7 is an enlarged central, vertical section of the upper end of one of the supporting posts and elements of the mold structure attached thereto shown in Fig. 5, the section being taken along the line 7—7 of that figure.

Fig. 8 is a front elevation of the lever-adjusting pole shown in Fig. 5.

Fig. 9 is a plan view of the mold surface as placed on the modified mold structure shown in Fig. 5.

The invention in its preferred embodiment preferably comprises vertical posts 1, (often spoken of as shores). After a pair of such posts are erected, the inverted U-beam 2 is placed between them, approximately half the width of the posts, fitting within the ends of the beam 2, as shown. The top surface of the inverted U-beam lies over the top of the post and the weight of the beam and any load thereon is transmitted to the post at this point. The ends of the beam may be reinforced in any suitable manner, a plate 3 in the form of a Z and arc welded at points 4 within the channel of the beam, as indicated in the fragmentary section shown at the right of Figure 1, being a desirable construction.

This form of reinforcement has the additional advantage of forming a stop to accurately position a post in relation to the end of the beam, and also constitutes something in the nature of a guide surface whereby the post may be guided to a true vertical position. It will be observed that when a post is inserted between the ends of two beams 2, 2 having reinforcing members 3, 3 set in their ends as above described, the end of the post is held virtually within a nicely fitting square socket formed by the beam ends and transverse reinforcing plates 3, 3. After erection, successive beams joining on top of posts are temporarily fastened together by any suitable means, holes 5 in the flanges 6 of the beams near the ends thereof, and through which wires 7, 7 may be threaded from one beam to the next, serving conveniently for this purpose. Separate wires may be employed for each beam end, each wire being threaded through the

holes 5 and around the face of the post extending beyond the beam end. In this way each beam is individually made fast to the posts on which it rests independently of another beam resting on either of its posts. Beam 2 will hereinafter be referred to as a semi-permanent beam or ledger, the latter term being common in the art for a horizontal supporting member occupying a position somewhat analogous to that of the member referred to.

The inverted U-beam or ledger 2 is formed, as shown, with a plurality of vertical slots 9 spaced at frequent intervals centrally along both sides of the beam. A three inch spacing for these slots has been found suitable, this arrangement affording a sufficiently close adjustment of the transverse beams 11 supported in said slots to permit of their proper disposition with respect to the mold boards or facing, which they, in turn, sustain. The transverse sustaining beams 11 or spreaders, as they are usually called, will now be described.

The sustaining beams or spreaders 11 are preferably constructed of wide boards placed edgewise, as shown, for the sake of securing maximum rigidity in the support of vertical loads. At both ends of the beam or spreader 11 are pivoted adjusting levers 12, the ends of which, projecting beyond the ends of beam 11, enter the previously described slots 9 in the ledgers 2, as shown. The levers 12 are intended to be mounted permanently on the beams or spreaders 11 so that on any given piece of concrete construction such spreaders may be used at one point, taken down, and erected at another point on the job, with the adjusting levers 12 always in place. In shipping quantities of the mold parts it will be found generally desirable, because of conserving space, to detach the levers from the spreaders 11.

The levers 12 are pivoted towards each end of a spreader 11 on a bolt 13 passing through the board comprising the beam, and provided with suitable washers to hold the lever securely. The bolt 13 passes through a longitudinal slot 14 centrally formed, as shown, to provide an element of longitudinal adjustability in the lever whereby to accommodate itself to various distances between the rows of ledgers, and to be engaged and disengaged therefrom, as will hereinafter be more fully described. The adjusting levers are suitably formed of steel flat bar stock, a bar 2½ inches wide and ⅜ths of an inch thick being strong enough for general use. The slot 14 is preferably formed by a hot punching process, whereby, instead of removing any appreciable amount of material, the sides of the bar 12 are swaged out or expanded, as shown at 15, so that the total cross section of the bar is not materially reduced. The end of the bar which enters a slot 9 may have formed on its lower edge a notch or hook 15′, which, when it drops over the inside edge of the channel wall in which the slots 9 are situated, will tend to prevent the pulling out or displacement of the lever 12 from the slot 9. Such displacement may be further safeguarded against by providing a hole or eye 16 in the end of the lever projecting within the wall of channel 2, through which may be threaded a locking wire 17, as shown on the lever at the extreme right of Fig. 2, the ends of the wire being brought out of the channel and carried around the lever before being twisted together.

It is to be particularly observed that the two levers 12 carried at opposite ends of the spreader 11 are disposed on opposite sides thereof. By such a disposition of the levers the line of support of the spreader will pass through the load center thereof, so that any evenly distributed weight placed on top of the spreader will have no tendency whatever to turn it as a whole, out of a true vertical position.

The object of the lever 12 is twofold. It serves as a ready means for locking the sustaining beam or spreader 11 in place to carry the mold facing when the concrete is poured and to release the spreader so that the mold facing may be removed when the material of which the ceiling is formed is partially hardened or cured, accomplishing both of these results without in any way disturbing the posts or ledgers supported thereby and which remain permanently in place under the cast ceiling until the material has hardened for a sufficient length of time to render the removal of the shoring entirely safe. The lever 12 also serves as an adjusting means whereby the mold facing carried by the spreaders 11 may be trued up with respect to the permanent members of the mold structure through the vertical adjustment of the spreaders.

The adjustment of lever 12 is effected by moving the operating end of the lever which carries a plurality of adjusting holes 18 to the desired level whereby the temporary mold facing 30 will be brought into proper alignment with the permanent ceiling supporting area 31 on the upper side of the inverted U-beam 2, herein referred to as a ledger. The lever 12 is then secured in place by tightening up the tie wire 19 which has previously been passed through one of the holes 18 and over the top of spreader 11. The ends of tying wire 19 are wrapped one or more times around the downwardly projecting end of the lever and then securely twisted together. One or both ends of the wire may be passed through one of the adjusting holes 18 in the operating arm of the

lever 12 lying below the edge of the spreader before the ends are made fast, as shown to the left in Fig. 2.

The spreader 11 is preferably constructed in two sections longitudinally adjustable with respect to each other, whereby the length of the spreader may be varied to provide for different spacings of the ledgers which may be required in various forms of constructions. To this end the spreaders may be constructed of two boards 11^1 and 11^2 approximately one inch thick and from seven to ten inches wide, this being ordinary stock lumber which is readily available. These boards may be made in every way exactly alike, as shown, so that only the left-hand board 11^1 need be further described. Fig. 4 shows one-half of the composite wooden beam stripped of all accessory parts. The board 11^1 is provided with a plurality of adjusting holes 21 arranged at regular intervals in two rows longitudinally of said board, the holes in each row being spaced approximately $1\frac{1}{2}$ inches apart and the rows being separated a sufficient distance to secure the maximum strength of the composite beam when the two boards 11^1 and 11^2 are bolted together through said adjusting holes. The holes should be bored to snugly receive plow bolts of adequate strength, iron bolts of $\frac{5}{16}$ths inch diameter being suitable for the purpose. Only four of such bolts are required to fasten the two boards together, though more may be used in cases where the composite beam thus formed may be required to carry unusual loads. The line of adjusting holes 21 extends from a point close to the adjusting lever pivot bolt 13 previously described, over a distance of at least one foot, and preferably more, towards the opposite end of the board, the range of adjustment of the composite beam being governed by the length of the line of adjusting holes 21. Two bolt holes are provided towards the end of the boards away from the pivot bolt 13 and vertically disposed one above the other in such manner as to exactly register with any chosen vertical pair of adjusting holes in the second board with which it is mated. The second board carries two similar bolt holes registering with the adjusting holes of the first-mentioned board. Pairs of bolts 22 and 23 respectively are set with their heads flush in adjusting holes which will give approximately the desired length of composite beam, and the pairs of bolts are then passed through the bolt holes above referred to near the ends of the two boards, opposite the adjusting lever pivots 13, and nuts applied with suitable washers underneath to protect the boards. By this construction there is afforded a spreader or temporary sustaining beam which is adjustable in length over a range of at least one foot and in steps of not more than one and one-half inches, which distance represents the chosen spacing of the adjusting holes. This spacing may obviously be varied. Accurate adjustments of the effective length of the spreader may, according to the present construction, be made to a small fraction of an inch by first choosing the adjusting hole 21 nearest to the desired length of beam, bolting the two halves of the beam or spreader together, and then sliding the adjusting levers 12 horizontally along the pivot bolt 13 passing through slot 14 of the lever until the projection of said lever beyond the end of the board gives exactly the desired overall span for the spreader.

On top of the described vertically adjustable sustaining beam or spreader 11 is placed, in process of erecting the mold structure, a suitable mold facing which may be of any known form and made of metal or wood, as desired. A very satisfactory type of mold facing which may be readily handled and erected is made up in the form of wooden panels 32, approximately 22 inches wide and ten feet long. The material used is stock $\frac{7}{8}$ths inch matched boards held together by a number of transverse cleats or battens securely fastened on the under side of said panels. The standard panels, being of uniform dimensions, may be rapidly fitted together without any special carpentry to form large and continuous areas of mold facing. There will, of course, in certain locations be remnant areas into which the standard panels above described cannot be fitted, and as a result such areas must be provided with mold facing fitted by carpenters in the usual way. Such remnant areas, however, would never represent more than a small fraction of the total mold facing in a piece of concrete construction of any appreciable magnitude, and by far the greater part of the mold facing could always be erected by the simple and inexpensive process of assembling the standard mold parts hereinbefore described.

The order and method of erecting the ceiling mold according to the present invention, is as follows: The posts 1 are placed in a substantially vertical position with center to center distance being equal to the length of ledgers to be employed. This may vary with different types of construction, but ledgers five feet long are suitable for general use. A ledger of this length, while formed of metal of ample gauge to render the beam entirely safe, is sufficiently light to be readily handled by one man. Second, the inverted U-beams or ledgers 2 are placed over the tops of the posts, the ends of a beam projecting over the post substantially to the center line thereof, the ledgers being then securely tied to the post or to each other by means of tie wires 7, as hereinbefore described. Third, the vertically adjustable

and releasable spreaders or horizontal mold facing sustaining members 11 are then, after being adjusted to the proper length to extend from one line of ledgers to another, set up by engaging the flat adjusting levers 12 in the vertical slots 9. Because of the vertical height of said slots and the fact that the adjusting levers projecting therein fit the slots with practical accuracy, the spreaders 11 to which the adjusting levers are clamped by pivot bolt 13 will be maintained in a true vertical position in which they afford the maximum resistance to bending strains imposed on them.

If the line of posts carrying the ledgers 2 are temporarily rigidly braced in a vertical position by suitable stay pieces (not illustrated) in accordance with the common practice of erecting such posts, in order to place the spreaders between the ledgers, it may be desirable to loosen one of the pivot bolts 13 and retract one of the adjusting levers 12 to a point where, with the opposite adjusting lever engaged in its proper slot in, let us say the right hand ledger, the free end of the spreader may be swung up into a horizontal position between the aforesaid parallel lines of ledgers. The adjusting lever 12 to the left of the spreader 11 is then extended by slipping it along the lever slot 14 until it properly engages the slot 9 of the second ledger. If the slots 9 of the ledger 2 are long enough the lever 12 may be swung into a vertical position before the spreader 11 is placed; then the spreader may be inserted between two ledgers and the lever 12 swung to engage a slot in the ledger without sliding the said lever on the bolt 13. Locking wires 17 are then passed through the eyes 16 in the ends of the levers and fastened, as previously described. The lever arms may be temporarily secured in rough adjustment by wrapping the tie wires 19 which pass through one of the holes 18 in the operating end of the lever and over the spreader 11, as shown, around the downwardly projecting end of the levers which extend below the bottom edge of the spreaders. Some of the mold facing is then put in place. Wherever possible, it is desirable to choose the spacing of the parallel rows of ledgers so that a desired number of standard panels will exactly fill the gap between them. In the structure illustrated three standard panels completely fill the space between the ledgers.

After a part of the mold facing has been laid on the spreaders, the levers 12 are adjusted to true up the surface of the facing with respect to the tops 31 of the ledgers, which tops constitute auxiliary ceiling engaging areas forming part of the continuous mold surface and which should therefore be in substantially perfect alignment with the main areas of mold facing. When the spreader has been correctly adjusted, the levers 12 are then secured in place by taking up on the tie wires 19 and securely fastening them, as heretofore described. The pivot bolts 13 should be tightened to insure rigid clamping of the adjusting levers to the spreaders 11 to prevent the latter members from tilting out of a true vertical plane.

The remnant areas which cannot be filled by the use of the above described standard mold parts are then filled in by carpenters in the usual way and the mold structure is ready to receive the ceiling material.

The ceiling is poured in the usual manner and may have incorporated in it any desired system of reinforcement. The mold structure, according to the preferred embodiment of the invention which has been described, is particularly suited to a type of ceiling construction in which instead of a simple continuous slab of ceiling material being poured, structural blocks of relatively light weight are first laid upon the mold facing in regular rows and at a sufficient distance apart to permit of plastic material which will ultimately constitute the major support of the ceiling as well as its upper surface (the floor of the story above), being flowed over and between them to form in effect beams of considerable depth. A floor of this type is shown in section in Figure 1. The structural blocks 40 illustrated represent cinder blocks which are highly porous and have a maximum of voids, whereby the weight of the ceiling is reduced to a minimum. Any other light weight structural block may be employed, such, for example, as hollow tile. The blocks 40, as shown, are spaced apart a sufficient distance to permit molding between them continuous beams 41 of adequate dimensions to support, when hardened, the weight of the floor, which, because of its peculiar construction through the use of relatively light filling blocks, is not very great. Near the bottoms of beams 41 are placed substantial reinforcing members 42 in accordance with regular practice in forming concrete beams. The plastic material of the ceiling is flowed over the blocks to a sufficient depth to bind the upper part of the ceiling into a rigid and continuous slab when the material has set. A ceiling of the type above described is less expensive than one of simple flat slab construction and weighs very much less than the latter. And yet, because of its reinforced beam construction, it is amply strong for many structural purposes.

In cases where the special beam and block construction above referred to is employed, it will be necessary to erect the mold structure in such manner as to position the ledgers 2 substantially at right angles to the reinforced concrete beams 41 formed between the filler blocks 40. This is for the reason

that a beam and block ceiling formed as described has practically no structural strength along lines transverse to the reinforced beams. The strength in this direction is only sufficient for the short span between two concrete beams which are near together. These concrete beams should be individually supported by the mold structure until they become of sufficient strength. Therefore, the ledgers run transversely of them, passing under every reinforced beam and serving almost as effectively to support the ceiling structure as if posts were introduced underneath each of the said beams. The posts 1 and ledgers 2 are left in place a sufficient length of time to insure the hardening of the ceiling to a point where it can safely sustain its own weight, and hence these elements are referred to as semi-permanent posts, semi-permanent ledgers, or generically, as semi-permanent mold members. The word semi-permanent is here used to indicate that members so described are to be left in position as long as the ceiling requires some form of external support. The mold facing and horizontal sustaining members or spreaders 11 being removable within a comparatively short time after the ceiling has been poured, will be referred to as temporary ceiling carrying members. The fact that such temporary members may be readily removed without disturbing the semi-permanent ceiling supporting members and after a relatively short period of hardening or curing of the ceiling material, renders the use of the ceiling molds according to the present invention very economical, as the amount of mold material tied up in any given piece of concrete construction is very greatly reduced as compared with the usual practice in constructing ceiling molds. In addition to this, as has been hereinbefore clearly pointed out, the green ceiling is at no time left unshored, and the difficult and hazardous work of reshoring, commonly resorted to at the present time, is entirely eliminated.

In from three to five days the temporary mold members are stripped by simply cutting the wire 19 tying the end of one of the adjusting levers 12, and lowering the spreader 11 by swinging the lever downwardly. The nut on pivot bolt 13 may then be loosened and the adjusting lever pulled out of the ledger slot 9 by sliding the lever along the pivot bolt which passes through the longitudinal slot 14 in the lever. If the slots 9 of the ledger 2 are long enough the bolt need not be loosened. Simply swing the lever 12 down far enough to disengage it from the slot 9. The end of the spreader 11 thus freed from the ledger, is then swung down and the lever at the opposite end of the ledger disengaged by simply pulling the spreader carrying such lever away from the ledger supporting the end thereof. The spreaders are preferably removed progressively from both ends of a section of standard panels so that the last remaining spreader will be somewhere near the center of the group of panels. By lowering the said last remaining spreader, the entire group of panels, which would be three in number according to the arrangement illustrated, will simultaneously be released.

In practice it will be found that because of the proximity of walls of the building or columns forming a permanent part of the concrete structure, certain of the so-called semi-permanent posts and ledgers may be removed earlier than those supporting ceiling areas in the clear. The builder will naturally avail himself of the ability to remove such semi-permanent parts of the mold structure while certain other parts are still required to be kept in place, for the reason that that much mold material is released for use at other points, and also because, as mentioned, the early removal of ceiling supporting members permits of better and easier dressing of the comparatively green ceiling surface.

The posts preferably employed are stock 4 x 4 wooden timber and may be provided with any known means of vertical adjustment whereby the ceiling mold may be trued up into a perfectly horizontal plane. In common practice the vertical adjustment of the posts is accomplished by means of pairs of co-operating wedges underneath the foot of the post. In removing the ledgers, the posts supporting them are first lowered sufficiently to free the ledgers from contact with the ceiling, after which a line of ledgers may be taken down by alternately removing a post and then the ledger which it supported.

A modified form of the invention is illustrated in Figs. 5, 6 and 7. This second form differs from the first hereinbefore described in that the capacity for vertical adjustment and release of the mold facing resides in the ledgers instead of in the spreaders, the spreaders in the modification now to be described being simple wood beams or joists which are laid on top of the ledgers and are not necessarily in any way fastened thereto. The only semi-permanent members of a mold structure, according to the present modification, are the posts 61, the hangers 85 and caps 75. The metal ledgers 62 and wooden spreaders 63 being releasable, are removed together with the mold facing or panels 64 when the concrete has partially hardened. The ledgers, spreaders and panels may be, therefore, referred to as the temporary members of the mold structure now described.

In regular flat slab ceiling construction, the entire ceiling being formed of a continu-

ous reinforced concrete slab with no filler blocks or other discontinuity in the ceiling material, the permanent posts 61 afford ample support for the partially hardened concrete because such a ceiling has considerable structural strength in every direction, unlike the block and beam type hereinbefore referred to, which should be supported under each of the concrete beams.

The panels employed in the modified construction may be identical with those described in connection with the preferred embodiment of the invention or of any other convenient size. These panels are laid, as shown, immediately on top of spreaders 63, which in turn, are carried by the adjustable ledgers 62. These ledgers preferably depend for their vertical adjustment upon a lever system, in principle substantially equivalent to that previously described in connection with the vertically adjustable spreaders 11 (Fig. 2). The present ledger 62 is in form an inverted U-beam preferably pressed from sheet steel. The adjusting levers 65 operate within the walls of said U-beam, each lever being bent as shown, to engage the beam or ledger 62 near its upper surface to support it, a reinforcing U-piece 66 being placed within the ledger to receive the sustaining force of the adjusting lever 65 and also to serve as an effective guide for said lever, the opening between the arms of the said reinforcing U-piece 66 being just sufficient to permit the free movement of the lever therebetween. The operating arm of the lever is adjusted in the manner heretofore described in connection with levers 12 in the form of the invention first discussed, the end of the lever 65 being provided, as shown, with an eye 67 through which a tie wire 68 is threaded. When the lever has been correctly adjusted to true up the mold facing, the tie wire 68 which passes through the upper part of the beam wall is looped around a cleat 69 fastened to the said wall, the two ends of the wire being then twisted together to guard against accidental release of the levers.

Since it is preferable to use standard rectangular mold panels, the mold facing is assembled as shown in Fig. 8. To fill the space between certain rows of panels necessitated by the interposition of the post caps 75, standard facing strips 76 and 76′ are provided. These strips are preferably of wood cut to correct length to just fit between successive post caps and are conveniently made one-half the width of the post caps so that the two strips 76 and 76′ will fill the gap between rows of panels. These strips are preferably tacked down to each wood spreader 63 with a small nail to hold the latter from being displaced along the ledgers.

The operating ends of the adjusting lever 65 are preferably formed with a projection 70 which may be securely engaged by a socket member 71 carried on the end of an adjusting pole 72, whereby the adjustment of the levers may be readily effected by a man standing on the floor below. The adjusting pole referred to is shown in section engaging the lever to the right in Fig. 5, and again in Fig. 8, the socket portion consisting of a section of pipe flattened at its lower end and bolted to the upper end of the pole. The short arm of the adjusting lever engages a pin 80 carried by a supporting member 81 mounted on post 61.

It will be understood that the ends of the ledger 62, the adjusting lever 65, supporting members 81 and the posts upon which such members are mounted, are all similar in every respect to other like elements found throughout the mold structure. The following description, therefore, will suffice for all.

The supporting member 81 comprises two metal channels 82 and 83 respectively, each carrying near its edges a plurality of corresponding holes 84. The metal channels 82 and 83 are hung on opposite sides of the post 61 on hangers 85, the said hangers having on their sides lugs 86 adapted to pass through the center of channels 82 and 83 and near their upper ends, as shown. Only posts 61, hangers 85 and the square post caps 75 resting on top of the said hangers, remain permanently in place, the supporting member 81 being removable with the temporary mold structure. The hangers 85 consist of flat metal bar stock approximately four inches wide and of suitable thickness, bent at right angles to form hooks. The hangers 85 being disposed between the surfaces of the post and channels 82 and 83 are clamped in position and prevented from slipping off the top ends of the post by a tie bolt 87 which passes through a hole in the post and draws the channels on opposite sides thereof together. The lower ends of the channel members are secured to the post by a similar bolt 88, a distance piece 89 shown in dotted lines in Fig. 5, being introduced underneath each channel member to maintain the said channels spaced apart from the faces of the post and parallel thereto for the purposes that will presently be described.

The series of uniformly spaced holes 84 formed in channels 82 and 83 are adapted to receive pins 80′ and 80″ &c., which pass through corresponding holes in the two channel to form supporting rungs for various purposes. The pin shown at 80 serves as the pivot or fulcrum for the adjusting lever 65, the lever being formed with an eye or hook in its end to receive pin 80. The pins, when they have been put in place, are secured against displacement by nails or other suitable locking pins 90 passing through holes in the ends of said first-men-

tioned pins 80. The pins 80 may also be provided with an additional hole 90′ through which a wire loop may be passed to facilitate carrying a number of such pins from place to place. The end of each lever 65 is permitted to extend beyond the face of post 61 by virtue of the fact that the channel plate 83 is spaced apart from the post by the thickness of hangers 85 and distance pieces 89, which space is slightly wider than the thickness of the adjusting lever. This permits of the pins 80 being located close to the posts without interfering with the operation of the levers.

The spacing of the channels 82 and 83 away from the faces of the post which support them affords other advantages. As shown to the right in Fig. 5, four pins 80′ may be placed, as shown, to form a supporting frame for a bar 91. For the sake of convenience, this bar may be an adjusting lever similar to 65, and which, positioned as shown, is entirely suited to the purpose here intended. The bar 91 is passed between the upper and lower pins, the spacing of which is very slightly greater than the width of the bar, and, as before explained, the space between the channel 83 and the face of the post is just slightly greater than the thickness of bar 91; such bar is accordingly effectively supported against rocking or tilting in either direction. A bar 91 positioned as shown, may be used to support special beams 92 adapted to carry special spreaders 93 used to support mold facing 94 over remnant ceiling areas where space does not permit of the use of the standard ledgers, spreaders and mold boards. Bars 95 and 96 are similar to bar 91, and as before stated, lever bars 65 may be used in any of these places. By arranging a group of four pins in the form of a box, as shown, supports may be provided for bars at any desired height along the channels 83. These various positions in which the bars may be set are found useful in the support of various special mold elements where the standard mold parts cannot be employed.

Another support for certain mold elements is provided in the special stirrup 100 which is adapted to be hung from the ledger 62. This stirrup comprises a U-plate 101 bent to conform to the outside dimensions of the ledger. From the four edges of said plate angle bars 102 project downwardly, as shown. Rectangular holes are punched in the lower ends of such bars to receive cross bars 103, which latter are preferably formed of light channel material. The cross bars are held in place by a locking pin 104 and locking wire 105, the ends of which wire may be tied together to form a loop which is useful in carrying a number of the cross bars, or hanging them up so that they will not be lost when not in use. The cross bars are of sufficient strength to carry special beams 106, upon which short posts or other special mold members may be mounted to carry various remnant areas of the mold facing. The use of special stirrups 100 will in many instances avoid the necessity for placing various shores which otherwise would have to extend upward from the floor below. Such stirrups may be placed at various points along the ledgers, and for this reason readily lend themselves to a number of special uses, as will be apparent to one skilled in the art. Drop panels, for example, or other portions of the ceiling which are required to project below the general ceiling level may be supported by members carried on the aforesaid special stirrups 100.

The embodiment of the invention illustrated in Figs. 5 and 6 contemplates the use of two parallel ledgers 62 supported side by side on a common pin 90 carried by supporting plates 83 and 82. By such a construction the weight of the ledgers need only be half as great as if a single ledger were required to support the ceiling over the span which they cover, and in cases where the ceiling is wholly to one side of the line of ledgers, as, for example, would be the case if the ledgers were placed close to a wall of the building, only one of such elements would be required, thereby releasing the other for use elsewhere. A further very considerable advantage of such an arrangement is that the mold facing to one side of the line of ledgers may be removed without disturbing the mold facing lying to the other side, the ledger supporting the facing which it is desired to remove being freed therewith and available at once for erection at another point.

In the usual flat slab ceiling construction as has already been pointed out, when the ceiling has sufficiently hardened to require only the support of posts at suitable intervals, all the ledgers and mold facing which they support may be removed and immediately re-erected elsewhere, leaving nothing but the posts, the caps 75 and hooks 85 to support the green concrete until it has hardened sufficiently to be self-supporting.

In conclusion, it is to be observed that the entire process of erecting and taking down the mold structure, according to the present invention, is accomplished without the destruction of any material whatever, no large nails being required at any point to injure the posts or other structural elements, the few connections where strength is necessary, being effected by the use of wire. The mold structure can be erected by workmen with very little skill, the parts being all standard and interchangeable, making it possible to erect large areas of the ceiling mold by the simple process of assembly in which all special carpentry work is avoided. Because of the fact that certain semi-permanent parts

of the mold structure are always left to support the green concrete, the major portion of the mold materials may be removed much earlier than is ordinarily possible, and so made available for further mold construction, which would be impossible with the same amount of mold material used in the ordinary way.

While two embodiments of the invention have been illustrated and described, the invention may obviously be otherwise embodied and modified without departing from the spirit thereof, as set forth in the following claims.

What I claim is:

1. A ceiling mold structure comprising semi-permanent posts, semi-permanent ceiling supporting beams carried by said posts, mold facing adapted to carry the main ceiling areas, and adjustable lever means disposed entirely below the molding face, said means being supported by said beams and adapted in one position to hold said mold facing at the level of the ceiling and in another position to release said facing.

2. An adjustable horizontal support for a ceiling mold structure having both semi-permanent and temporary ceiling carrying members, said adjustable support comprising a beam adapted to sustain said temporary carrying members, and adjusting levers supporting said beam and supported by said permanent members.

3. A semi-permanent shoring structure for a cast ceiling, said structure comprising substantially vertical posts, and inverted U beams adapted to be laid over the said posts, at least a part of the tops of the posts lying within the walls of the beam, said inverted U beams forming a continuous lineal support for the ceiling.

4. A semi-permanent shoring structure, according to claim 3, further characterized in that the said inverted U beams are provided with positioning means adapted to prevent the longitudinal displacement of the said posts along the beams.

5. A semi-permanent shoring structure, according to claim 3, further characterized in that the said inverted U beams are provided with fixed transverse vertical plates removed from either end of the beam by substantially one-half the thickness of one of said posts, whereby when two beams are placed together end to end, a rectangular closure is provided to surround the top of a post placed between them.

6. A ceiling mold structure including posts, ledgers supported by said posts and provided with longitudinal series of slots, spreaders transverse to said ledgers and mold facing mounted on and sustained by said spreaders, the said spreaders being supported by height adjusting levers pivoted towards either end thereof, the ends of said levers projecting beyond the ends of the spreaders and engaging said slots in the ledgers to adjustably support the spreaders.

7. A ceiling mold structure including horizontal beams, mold facing carried thereby, semi-permanent posts, levers fulcrumed at one end below the molding face and adapted as levers of the second class to support said beams at points near the ends thereof and to transmit the weight of the beam to said posts and releasable fastening means adapted to fasten the free operating end of said levers to said beams.

8. A ceiling mold structure including horizontal beams, mold facing carried thereby, posts, and levers transmitting the weight from the beams to the said posts and being adjustable to vary the height of a beam, said levers being disposed entirely below the molding face.

9. A ceiling mold structure including horizontal beams, mold facing carried thereby, posts, levers transmitting the weight from the beams to the said posts and being adjustable to vary the height of a beam, said levers being disposed entirely below the molding face, and adjustable fastening means adapted to hold said levers in a desired position.

10. A ceiling mold structure comprising mold facing, spreaders, levers disposed entirely below the molding face, ledgers and semi-permanent posts, the mold facing being supported by spreaders, the spreaders being supported by the said levers, the levers being supported by the said ledgers, and the ledgers being supported by the said semi-permanent posts.

11. In a ceiling mold structure a plurality of posts, a ledger comprising an inverted U beam, the vertical walls of which fit over the ends of said posts and are slotted to receive at desired intervals the end portion of temporary spreaders.

12. An adjustable ceiling mold sustaining structure comprising a beam, height adjusting means therefor comprising a supporting lever co-operating with said beam, said lever having an extended flat surface bearing against a vertical surface of said beam, and supporting means co-operating with said lever and adapted to receive one end thereof between two vertical lines of support whereby the lever and beam will be securely held in a vertical plane.

13. The structure according to claim 12, further characterized in that a supporting lever is provided at each end of the said beam and on opposite sides thereof whereby the beam will be supported symmetrically with respect to its center line.

14. The structure according to claim 12, further characterized in that the said sup-

porting lever has a pivot hole in the form of a slot, a pivot pin being provided passing through said slot and connecting said lever and beam together whereby the extension of the lever beyond the end of the beam may be varied.

15. The structure according to claim 12, further characterized in that the said lever is adjustably secured in position to maintain the desired elevation of the said beam by means of flexible tying means.

In witness whereof, I have hereunto signed my name.

ROWLAND T. WALES.