To all whom it may concern:

Be it known that I, GLENN A. COMPTON, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Collapsible Arch Forms; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

My present invention relates to improvements in collapsible arch forms, and is especially adapted for use in the construction of concrete bridges, culverts, conduits and the like.

To the above end, generally stated, the invention consists of the novel devices and combinations of devices hereinafter described and defined in the claims.

In the accompanying drawings, which illustrate the invention, like characters indicate like parts throughout the several views.

Referring to the drawings:

Fig. 1 is a view in transverse section showing the improved collapsible arch form assembled to form a semi-cylindrical or Roman arch;

Fig. 2 is a view corresponding to Fig. 1, with the exception that the parts are assembled to form a substantially rectangular arch or opening;

Fig. 3 is a fragmentary view in side elevation of the parts as assembled in Fig. 1;

Fig. 4 is a fragmentary detail view with some parts sectioned on the line 4—4 of Fig. 2;

Fig. 5 is a fragmentary detail view with some parts sectioned on the line 5—5 of Fig. 4;

Fig. 6 is a fragmentary detail view partly in plan and partly in horizontal section taken on the line 6—6 of Fig. 5; and

Fig. 7 is a perspective view of one of the supporting brackets.

Referring first to the improved collapsible arch form as assembled in Fig. 1, the numeral 8 indicates sills, as shown arranged in two laterally spaced aligned pairs, and to each of said sills is rigidly secured two longitudinally spaced bearing brackets 9. Each bearing bracket 9 includes an upwardly curved stop finger 10, a lug 11, having on its upper face a cam surface 12, which extends under said stop finger, and a pair of laterally projecting stop shoulders 13 on said lug located at the upper extremity of the cam surface 12 and below the free end of the stop finger 10. The stop finger 10 is notched outward of its free end to afford a seat 14, the purpose of which will presently appear. It is important to note that the bearing brackets 9, on each sill 8, are arranged with their stop fingers projecting in the same direction and longitudinally in respect to the sill, and that the aligned sills are arranged end to end so that the two pairs of stop fingers 10 project in opposite directions and outward in respect to the collapsible arch form.

Loosely supported on each laterally spaced pair of bearing brackets 9 is a semi-cylindrical arch bar 15, the ends of which rest on the horizontal flange of an angle tie-bar 16 and are riveted or otherwise rigidly secured to the vertical flange thereof. As best shown in Fig. 1, it will be noted that the ends of the tie-bar 16 are extended outward of the arch bar 15, and the upper edge of the vertical flange of said tie-bar is notched to afford seats 17 and bevel shoulders 18, the former of which are located close to the arch bar 15, and the latter of which are located at the outer extremities of said tie-bar. The horizontal flange of the tie-bar 16 is provided, just inward of the connected ends of the arch bar 15, with notches 19 of sufficient width to clear the stop shoulders 13, and said horizontal flange is further provided, at the intermediate portion of each notch 19, with a notch 20 of such depth as to expose the lower edge of the vertical flange of said tie-bar and of sufficient width to receive the pairs of stop shoulders 13.

To mount the arch bars 15 on the bearing brackets 9, the same are held in outwardly inclined positions with the notches 19 aligned with the pairs of stop shoulders 13, and the notches 20 aligned with the lugs 11. Then, by a downward movement of the arch bars 15, and at the same time moving the tops thereof inward to a height the same, the exposed lower edge of the vertical flange of the tie-bar 16 will be carried onto the cam surfaces 12. This upright movement of the arch bars 15 will carry one face of the vertical flange, of the tie-bar 16, against the
stop fingers 10 and the stop surfaces 21 against the under faces of the stop shoulders 13. It will thus be seen that the arch bars 15 are securely interlocked with the bearing brackets 9 against transverse movement and against inward tipping movement.

Coupling rods 22, having T-heads 23 at their ends, releasably connect the arch bars 15 and are detachably secured thereto by bifurcated hook-like coupling brackets 24 rigidly secured to the intermediate portions of said arch bars. It will be noted that each end arch bar 15 has only one coupling bracket 24, and that each intermediate arch bar 15 has two coupling brackets 24, which extend in opposite directions. By reference to Figs. 1 and 2, it will be noted that the coupling rods 22 extend between the prongs of the brackets 24 to hold said rods against lateral movement, and that the T-heads 23 extend transversely through said brackets and lock said coupling rods thereto against endwise movement. It will be noted, by reference to Fig. 3, that the intermediate coupling rod 22 holds the two intermediate arch bars 15 against outward swinging movement away from each other against the action of the cam surfaces 12.

To release the intermediate coupling rod 22 and thereby allow the connected arch bars 15 to fall outward in opposite directions, there is intermediately fulcrumed to one of said intermediate arch bars a lever 25 having at its inner end a striking or lifting head 26 located directly under one end of the intermediate coupling rod 22. The outer end of the lever 25 is curved downward and has attached thereto an operating cable 27, which, in actual usage, will be of sufficient length to extend considerably outward over one end of the arch form. The striking head 26 is of such weight as to hold the lever 25 in a position with said head in its lowermost position, so that a pull on the operating cable 27 will lift the head 26 and cause the same to engage the coupling rod 22 and lift the same out of the respective coupling bracket 24.

Removably supported on the arch bars 15 is a plurality of longitudinally extended slats 28, on which the material X, from which the arch is formed, is placed or poured. Each slat 28 has, at one of its longitudinal edges, a channel 29, at its other longitudinal edge an inwardly turned flange 30, and at its transverse center, it is bent outward to form a longitudinally extended reinforcing rib 31. The slats 28 are loosely held on the arch bars 15 in the first layer ends two said slats on the shoulders 18 by means of their channels 29 and with their flanges 30 bearing against the outer longitudinal edges of the sills 8 to prevent inward swinging movement thereof. Two other slats are then placed on the arch bars 15 with their flanges 30 seated in the channels 29 of the first two slats 28. The remaining slats are then secured on the arch bars 15 in the same manner that the last two slats are secured thereto. When all of the slats 28 have been placed on the arch bars 15, there is a relatively narrow opening left therebetween, at the top of said arch bars, and this opening is closed by a ridge plate 32 having at one of its longitudinal edges an inwardly turned flange 33 adapted to be seated in the channel 29 of one of the uppermost slats 28. This ridge plate 32 is identical with the slats 28, with the exception that it has no channel 29, and its longitudinal edge opposite from the flange 33 loosely rests on the underlying slat 28.

When the collapsible form is properly set up and the arch X built thereover, said form is left a sufficient length of time to permit the material, from which the arch is constructed, to set. The collapsible form is then removed from the arch by first drawing on the cable 27 to cause the head 26 to engage the intermediate coupling rod 22 and lift the respective end thereof from the coupling bracket 24, with which it is interlocked, as previously described. When the coupling rod 22 is released, the intermediate arch bars 15 simultaneously move downward away from the arch, due to the action of the cam surfaces 12 on their tie-bars 16, and, at the same time, the stop fingers 10 cause said arch bars to swing outward. The releasing of the intermediate coupling rods 22 also releases the outer coupling rods 22, as they are anchored to the intermediate arch bars 15, and thereby allows the outer arch bars 15 to move downward and swing outward with said intermediate arch bars. In case any of the slats should adhere to the formed arch, they may be easily detached therefrom.

Referring now to the collapsible arch form as assembled in Figs. 2, 4, 5 and 6, there is added to each arch bar 15 an angle bracket 34, preferably having obtuse corners, to form a substantially rectangular arch Y. Each angle bracket 34 is formed, as shown, from an angle bar, the flanges of which are indicated by the numerals 35 and 36. The flanges 35 extend outward of the arch bar 15, to which they are applied, and the flanges 36 extend substantially parallel thereto. The lower ends of the flanges 35 terminate short of the corresponding ends of the flanges 36 to afford supporting shoulders 37 adapted to enter the seats 17 and 120 support the angle brackets 34 from the arch tie-bar 16. On the inner edges of the flanges 36, at the lower ends thereof, are extensions or lugs 38 arranged to enter the seats 14 for engagement with the tie-bar 16 and stop 125 fingers 10 to hold the angle brackets 34 in upright positions on the arch bars 15.

The upper ends of the flanges 35 overlap one another at the crown of the arch bar 15, and the upper ends of the flanges 36 termi-
nate short of the corresponding ends of the flanges 35 to clear the coupling brackets 24 and also permit said flanges 35 to be aligned.

The slots 28 and 32 are secured to the angle brackets 34 in the same manner that said slots are secured to the arch bars 15. In collapsing the arch form just described, the downward and outward movements of the arch bars 15 will release the angle brackets 34 and allow the same to fall inward toward each other and away from the slots 28 and 32.

In Figs. 1 and 2, wooden forms Z are provided and spaced outward of the collapsible arch forms to determine the thickness of the arches and hold the materials X and Y while setting. These wooden forms form no part of my present invention, and may be dispensed with. In some instances, the concrete may be poured directly against cut banks between which the collapsible arch form is placed, or the concrete may be mixed dry and spread over the slats when forming an arch of the type shown in Fig. 1.

When I claim is:

1. A collapsible form for use in the construction of arches including a pair of laterally spaced bearing brackets having stop surfaces and incline cam surfaces, and an arch bar supported on the cam surfaces and held in an upright position at the upper extremities thereof by said stop surfaces, said arch bar having interlocking engagement with the bearing brackets to hold the same against tipping movement toward the stop surfaces.

2. A collapsible form for use in the construction of arches including a pair of laterally spaced bearing brackets having stop surfaces and incline cam surfaces, and an arch bar supported on the cam surfaces and held in an upright position at the upper extremities thereof by said stop surfaces, said arch bar having interlocking engagement with the bearing brackets to hold the same against tipping movement toward the stop surfaces.

3. A collapsible form for use in the construction of arches including longitudinally spaced bearing brackets arranged in laterally spaced pairs, each of said bearing brackets having a stop surface and an inclined cam surface, an arch bar supported on the cam surfaces of each laterally spaced pair of bearing brackets, said arch bars being held in upright positions on the upper extremities of the cam surfaces by the stop shoulders and having interlocking engagement with the bearing brackets to hold the arch bars against tipping movement toward the stop surfaces, the laterally spaced bearing brackets being turned in opposite directions with their cam surfaces facing outward, and a coupling rod connecting the arch bars for holding the same against tipping movement away from the stop surfaces.

4. A collapsible form for use in the construction of arches including longitudinally spaced bearing brackets arranged in laterally spaced pairs, each of said bearing brackets having a stop surface and an inclined cam surface, an arch bar supported on the cam surfaces of each laterally spaced pair of bearing brackets, said arch bars being held in upright positions on the upper extremities of the cam surfaces by the stop shoulders and having interlocking engagement with the bearing brackets to hold the arch bars against tipping movement toward the stop surfaces.

5. A collapsible form for use in the construction of arches including longitudinally spaced bearing brackets arranged in laterally spaced pairs, each of said bearing brackets having a stop surface and an inclined cam surface, an arch bar supported on the cam surfaces of each laterally spaced pair of bearing brackets, said arch bars being held in upright positions on the upper extremities of the cam surfaces by the stop shoulders and having interlocking engagement with the bearing brackets to hold the arch bars against tipping movement toward the stop surfaces.

6. A collapsible form for use in the construction of arches including longitudinally spaced bearing brackets arranged in laterally spaced pairs, each of said bearing brackets having a stop surface and an inclined cam surface, an arch bar supported on the cam surfaces of each laterally spaced pair of bearing brackets, said arch bars being held in upright positions on the upper extremities of the cam surfaces by the stop shoulders and having interlocking engagement with the bearing brackets to hold the arch bars against tipping movement toward the stop surfaces.

7. A collapsible form for use in the construction of arches including longitudinally spaced bearing brackets arranged in laterally spaced pairs, each of said bearing brackets having a stop surface and an inclined cam surface, an arch bar supported on the cam surfaces of each laterally spaced pair of bearing brackets, said arch bars being held in upright positions on the upper extremities of the cam surfaces by the stop shoulders and having interlocking engagement with the bearing brackets to hold the arch bars against tipping movement toward the stop surfaces.
the coupling rod and lift one end thereof from the respective coupling bracket, and an operating cable attached to the lever.

7. A collapsible form for use in the construction of arches including a pair of laterally spaced bearing brackets having stop surfaces and inclined cam surfaces, an arch bar supported on the cam surfaces and held in an upright position at the upper extremities thereof by the said stop surfaces, said arch bar having interlocking engagement with the bearing brackets to hold the same against tipping movement toward the stop surfaces, and corner brackets loosely applied to the arch bar and held in position thereon between said arch bars and the bearing brackets.

8. A collapsible form for use in the construction of arches including a pair of laterally spaced bearing brackets having stop surfaces and inclined cam surfaces, an arch bar supported on the cam surfaces and held in an upright position at the upper extremities thereof by the said stop surfaces, said arch bar having interlocking engagement with the bearing brackets to hold the same against tipping movement toward the stop surfaces, and corner brackets having their lower ends loosely supported on seats on the arch bar with their upper ends in overlapping arrangement on the arch bar and held in position on the arch bar between said arch bars and the bearing brackets.

9. A collapsible form for use in the construction of arches including longitudinally spaced outer and intermediate bearing brackets arranged in laterally spaced pairs, an arch bar supported on each laterally spaced pair of bearing brackets for compound downward and outward swinging movements, an intermediate coupling rod connecting the two intermediate arch bars, and coupling rods connecting the end arch bars with the intermediate arch bars.

10. A collapsible form for use in the construction of arches including longitudinally spaced outer and intermediate bearing brackets arranged in laterally spaced pairs, an arch bar supported on each laterally spaced pair of bearing brackets for compound downward and outward swinging movements, an intermediate coupling rod connecting the two intermediate arch bars, and coupling rods connecting the end arch bars with the intermediate arch bars, and means for releasing the intermediate coupling rod from one of the intermediate arch bars from a distant point.

11. A collapsible form for use in the construction of arches having in combination, an arch bar, spaced bearing brackets supporting the ends thereof, said brackets having inclined cam surfaces on which said bars are normally supported, said brackets having means engaging the sides of said arch bar to hold the same against tipping movement on said brackets.

12. A collapsible form for use in the construction of arches having in combination, an arch bar having an angle with horizontal and vertical flanges secured to its ends, spaced bearing brackets supporting the ends of said angles, each comprising a cam surface on which the vertical flange of said angle is normally supported and said brackets having opposite portions engaging the sides of said vertical flange, and the top of said horizontal flange to prevent tipping of said arch bar on said brackets.

13. A collapsible frame for use in the construction of arches having in combination, an arch bar having an angle with horizontal and vertical flanges secured to its ends, spaced bearing brackets supporting said angles, each comprising cam surfaces on which the vertical flange of said angle is normally supported, said brackets having a portion engaging the outer side of said vertical flange and an opposed T-headed portion engaging the top of said horizontal flange and the inner side of said vertical flange.

14. The structure set forth in claim 13, said horizontal flange having notches in its edge of sufficient width to pass over the cross member of said T-head, and a notch extending from said notch centrally thereof of sufficient width to pass over the vertical portion of said T-head.

In testimony whereof I affix my signature.

GLENN A. COMPTON.