To all whom it may concern:

Be it known that I, ADAM GEISEL, of the city of St. Louis, State of Missouri, have invented certain new and useful Improvements in Concrete Bridges, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part hereof.

My invention relates to concrete arch bridges; and it consists in the novel construction, combination, and arrangement of parts hereinafter shown, described, and claimed.

This application is supplementary to and should be read in connection with my application filed March 23, 1896, and serially numbered 584,439.

Figure 1 is a longitudinal sectional view of a bridge constructed in accordance with my invention. Fig. 2 is a horizontal sectional view on the line 2 2 of Fig. 1, and Fig. 3 is a vertical transverse sectional view on the line 3 3 of Fig. 1.

Referring by numerals to the accompanying drawings, the water 1 of the river rests on the bed 2 between the banks 3 and 4. In each of the banks 3 and 4 an excavation is made for the abutments 5 and 6 and the wing-walls 7, 8, 9, and 10 of the bridge. Piles 11 and 12 are sunk in these excavations until a solid foundation is reached. The upper ends of these piles are sawed off on a horizontal line about one foot above the bottom of the excavation. The ground plan of the abutments and wing-walls is shown in Fig. 3, the piling being shown in dotted lines.

After the piles have been driven and sawed off the excavations are cleaned out to the virgin earth. A layer of concrete about one foot in thickness is then placed in the excavation and thoroughly rammed around the heads of the piles. Similar layers of concrete are placed one on top of the other in the excavations until the abutments and wing-walls are of the desired height. Each layer is thoroughly sprinkled with water before another is added in order to form a thorough bond between the layers. When completed, the whole mass of each abutment and its wing-walls is a solid body of concrete. When the abutments and wing-walls get above the surface of the ground, suitable false work is erected to mold said abutments and wing-walls into the desired shape. After the concrete-work is finished the false work is left in position about three days or until the concrete has become sufficiently hardened to stand.

On the facing-walls of the abutments 5 and 6 are surfaces 13 and 14, forming the skewbacks, upon which the ends of the arch 15 are seated, the lines of said surfaces corresponding to the radial lines of the arch. The arch is in three pieces when the bridge is complete and consists of the two sides 15a and 15b and the keystone 15c.

A layer of lead or asphalt 18 is inserted between each end of the arch and the skewbacks, and a similar layer is inserted on each side of the keystone. The layers 18 should be at least one inch thick.

The side pieces 15a and 15b are each constructed in five sections 15a, 15b, 15c, 15d, and 15e. In constructing the arch I work from each end toward the center. The end section is cast, and before it has time to set the next section is cast and a bond forms between them, and so on until the pieces 15a and 15b are complete. At the boundary-line between the second and third sections from the outer ends of the pieces 15a and 15b the arch is between thirty-five and forty per cent. thicker than at the inner ends of said pieces and about ten per cent. thicker than at the outer ends. After placing a layer 18 of lead or asphalt against the upper end of the side pieces of the arch the keystone 15c is then cast in position between said layers 18.

The center of the arch should be elevated slightly above a true center (about one inch to forty feet) in order that it may form a true arc of a circle after the bridge is completed and settled. The false work used in casting the arch should be left in position about twenty days after the arch is closed or long enough to allow the concrete to set.

I omit the usual hunchings on top of the arch and in their place I insert concrete walls 16 in the form of right-angled triangles. The short side of the triangle rests against the vertical face of the abutment and the hypotenuse rests upon the upper surface of the arch, thus bringing the long side of the right angle
in a horizontal plane for the purpose of forming ribs to support the superstructure of the bridge. Similar walls 17 join with the wing-walls and the edges of the arch. There is no bond between the walls 18 and 17 and the arch. The space between these walls is filled with clean clay and rammed solid, after which the sidewalks and road-bed are laid in the usual way.

10 The distinguishing feature of my concrete arch-bridge is the joints in the arch and the substitution of the walls 16 and 17 for the usual haunchings, thus leaving the pieces of the arch free to expand or contract without cracking or breaking the arch and will also allow a settlement of the support of the arch without cracking the arch.

Where it is desired to build a bridge using a span or spans of from fifty to one hundred feet in length, the form of arch just described and shown in detail in Fig. 1 is sufficient and will prove very strong and durable.

20 The layers of lead or asphalt between the ends of the arch and the skewbacks form a joint between the arch and the abutments, which allows of sufficient action caused by expansion or contraction without cramping the parts of the arch and cracking or breaking the arch and abutments.

25 Within reasonable limits a layer of lead or asphalt when securely confined within the prescribed limits and subjected to great pressure will gradually change its form as the relative position or point of the greatest pressure changes. Within reasonable limits a layer of lead or asphalt resembles a pneumatic or hydraulic cushion in this quality of changing its shape to conform to the change of the conditions to which it is subjected. In warm weather when the haunches of the bridge expand the center of the arch will raise and the greatest pressure will be thrown upon the upper edges of the layers of asphalt or lead which are between the lower ends of the haunches and the skewbacks, and said upper edges will be compressed to some extent, and the material which is pressed out of said upper edges will pass downwardly and expand the lower edges of said layers, thus tending to keep the shape of the layer in conformity with the shape of the space which it occupies between the haunches and the skewbacks, and when the weather becomes cold again the haunches will contract, the center of the arch will be lowered, and the pressure will be removed from the upper edges of the layers of asphalt or lead and transferred to the lower edges of said layers, and the form of said layers will again change to suit the new conditions.

Thus it will be seen that by adopting my invention a concrete arch-bridge may be built having spans from fifty to one hundred feet in length which could not be done by any known process.

A complete concrete arch constructed in accordance with my invention herein described comprises three pieces and four joints. Each of the pieces are cast in position, as heretofore suggested. In making these castings the section to be constructed is subdivided to suit the exigencies of the case. After work commences on one of these subdivisions that subdivision must be finished before the work is discontinued for the noon hour or for the night in order that there may be no divisions or cracks in the subdivision caused by the hardening of one part of the concrete before the next part is added. When the subdivision is completed, the templates to which the subdivision has been cast are left in position until the workmen are ready to begin the next subdivision. Then the templates are removed and the exposed surface of the completed subdivision to which it is proposed to join the new subdivision is thoroughly scratched with an iron brush and cleaned off with water, and a thick coat of mortar is spread all over said surface in order to prepare it for taking a bond with the completed subdivision, and this process is repeated until the entire section is completed.

In constructing the arch as hereinbefore described I use concrete prepared as follows: Take one part of Portland cement, three parts of sand, and five parts of Macadam by measurement. Mix the sand and cement thoroughly together while dry. Then add a good sprinkling of water. Mix again until a stiff mortar is formed. Then spread the Macadam all over the mortar and turn the whole mass over three or more times and until the spalls are all covered with mortar. Then place the concrete so formed immediately in position and ram the same until the water flushes to the surface, after which the concrete is not to be disturbed. In order not to disturb the newly made subdivision of the section by expansion of the false work from the moisture or dampness of the fresh concrete which is to form the next adjoining subdivision, the false work is thoroughly soaked for at least two days before the concrete-work commences, and then the sheeting of the false work is covered with waterproof paper, so that no additional moisture can come in contact with said false work.

An arch consisting of only three members constructed in accordance with my invention is strong enough to carry almost any weight, and supplemental haunches, which are matters of necessity for either stone or brick arches, are not required in my bridge. This omission takes a large weight off of the foundations of the bridge, or, in other words, the foundations for an arch of my construction do not need to be as heavy as for the old-style stone and iron arch.

In the place of the usual supplemental haunches I make the arch thicker at the breaking-point, which is about one-third of the length of the span from the skewbacks, and from the breaking-point the segments of the arch taper both ways, being thinnest at the point next the keystone. The walls 16
are not a necessary part of the arch, but may be inserted or left out, as desired. When inserted, these walls form a convenient and effective support for the roadway, sidewalks, or whatever superstructure there may be above the arch.

I claim—

1. A concrete bridge, consisting of abutments, skewbacks formed upon said abutments, voussoirs of lead or asphalt upon said skewbacks, and voussoirs bonded together inserted between said voussoirs of lead or asphalt, substantially as specified.

2. A concrete bridge, consisting of abutments, skewbacks formed upon said abutments, voussoirs of lead or asphalt resting upon said skewbacks, voussoirs of concrete bonded together resting upon said voussoirs of lead or asphalt, voussoirs of lead or asphalt against the inner ends of said voussoirs of concrete, and a keystone between the last-mentioned voussoirs of lead or asphalt, substantially as specified.

3. A concrete bridge, consisting of abutments, skewbacks formed upon said abutments, voussoirs of lead or asphalt resting upon said skewbacks, voussoirs of concrete bonded together resting upon said voussoirs of lead or asphalt, voussoirs of lead or asphalt against the inner ends of said voussoirs of concrete, a keystone between the last-mentioned voussoirs of lead and asphalt, and walls on top of said voussoirs, said walls being unbonded to said voussoirs and to said abutments, substantially as specified.

In testimony whereof I affix my signature in presence of two witnesses.

ADAM GEISEL.

Witnesses:

E. E. LONGAN,
MAUD GRIFFIN.