Sept. 18, 1934. B. BAUER 1,973,742

ARCH CONSTRUCTION

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Fig. 4.

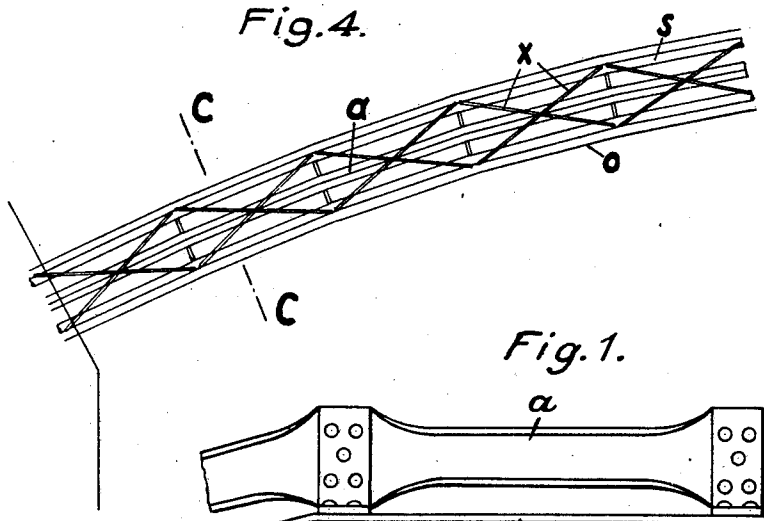


Fig. 1.

Fig. 5.

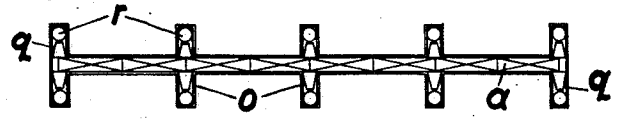
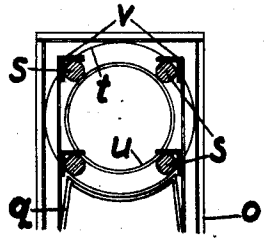


Fig. 6



Bruno Bauer
INVENTOR.
By [signature]
his Attorney.

Sept. 18, 1934.

B. BAUER

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Fig. 2.

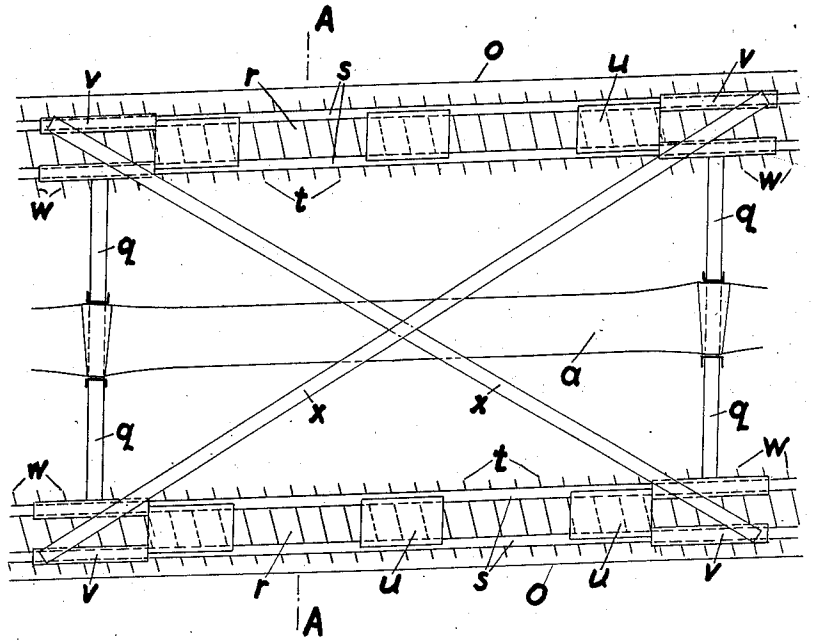
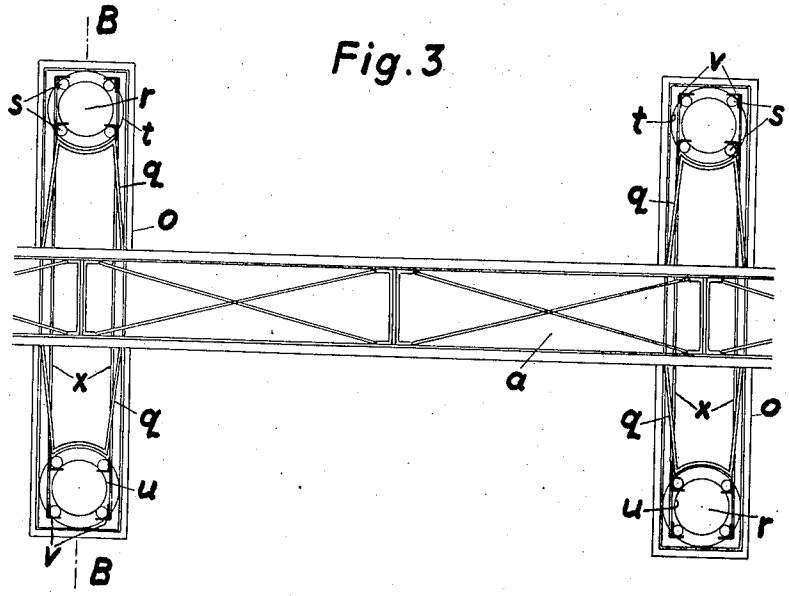


Fig. 3



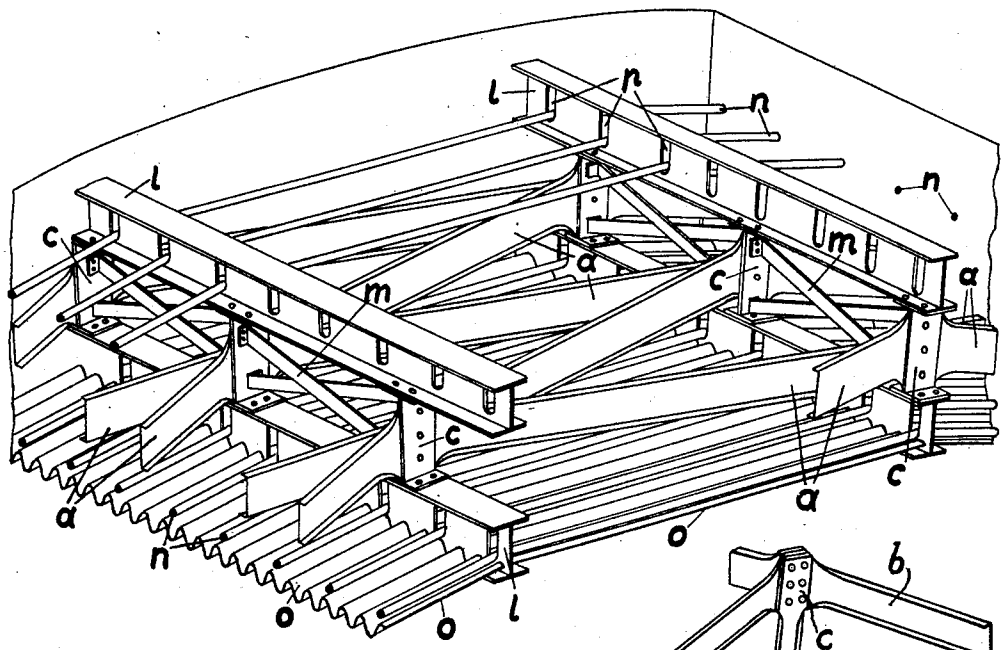
Bruno Bauer
INVENTOR.
By
his Attorney.

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Fig. 7



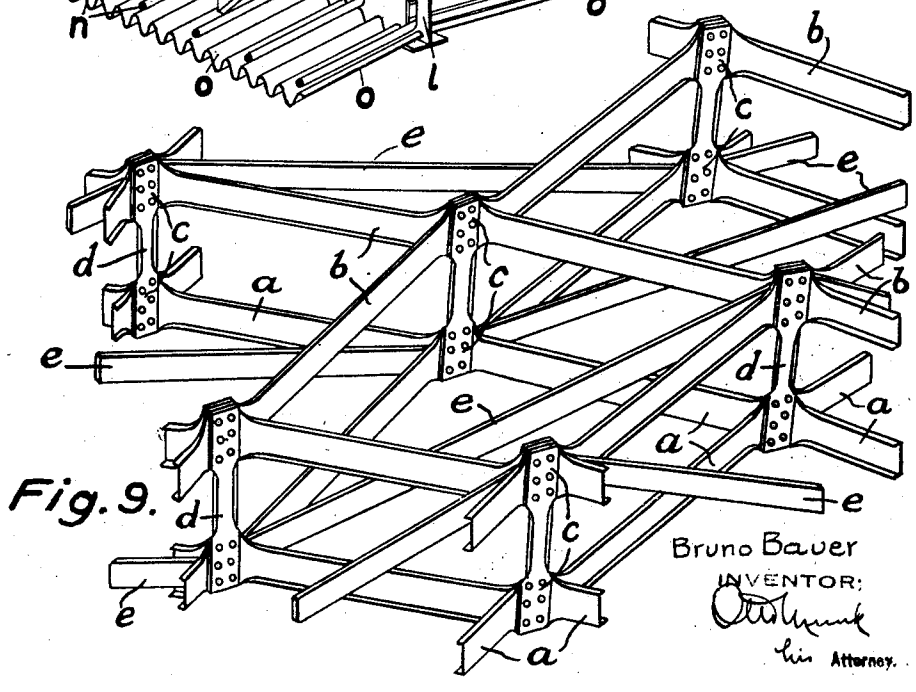


Fig. 9.

Bruno Bauer
INVENTOR:
his Attorney.

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Fig. 10

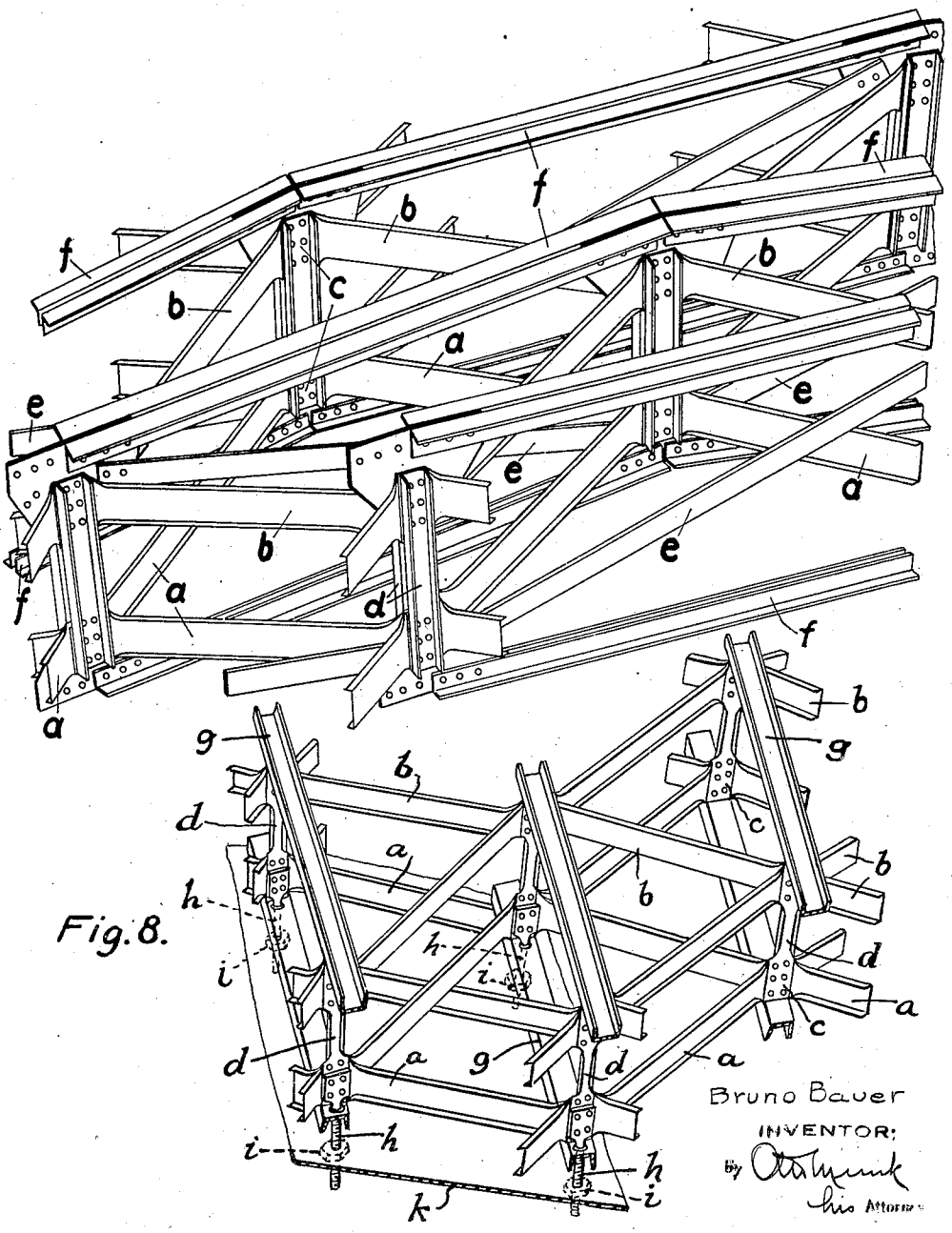


Fig. 8.

Bruno Bauer
INVENTOR:
By Otto Munk
his Attorney

Patented Sept. 18, 1934 1,973,742

UNITED STATES PATENT OFFICE

1,973,742

ARCH CONSTRUCTION

Bruno Bauer, Vienna, Austria

Application July 9, 1932, Serial No. 621,594
In Austria July 14, 1931

4 Claims. (Cl. 72—71)

This invention relates to a new and improved method of erecting arches. Although it is an indisputable and generally recognized fact that the erection of a plain non-reinforced vaulted arch or arched span is the most advantageous method of bridge construction, nevertheless this type of bridging has to a constantly increasing extent been supplanted by bridges constructed of iron or of ferro-concrete. Yet the simple non-reinforced arched span, which the Romans are known to have built in concrete, is very considerably less sensitive and more resistant to the strains to which it is normally subjected, and which especially in recent years are perpetually on the increase in consequence of growing traffic loads, than bridge constructions of iron or ferro-concrete, in consequence of its great inherent weight relative to the traffic load. Innumerable arched bridges, which were built hundreds of years ago, are still in service unaltered to-day, and will carry the heaviest motor trucks and tanks, whereas iron bridges erected at enormous expense scarcely 20 or 30 years ago demand replacement or strengthening. In spite of these facts the building of non-reinforced concrete bridges has gone almost completely out of recognized practice, and that more particularly for the reason that their erection calls for expensive scaffolding and falsework which must be charged to overhead costs, and which often account for more than half the building costs.

It has therefore become the practice to build bridging arches of reinforced concrete. This method of construction permits of very considerable reduction of the dead weight of the structure and therefore also of the outlay for scaffolding and falsework, or even permits, as in the case of reinforcement according to the Melan system, of scaffolding being entirely dispensed with and of the falsework sheeting being suspended from the reinforcing framework. Ferro-concrete arches erected and reinforced in this manner are dimensioned, however, like iron bridges, merely for the traffic load for which they are calculated, and thus form bridge constructions which have no traffic load reserve. The constructions built according to the Melan system have the further disadvantage of being very expensive, since their cost is made up of two components each of which alone almost amounts to the cost of a bridge construction. The iron framework embedded in the Melan arch would not require to be strengthened very much to constitute in itself an iron bridge. The necessary cost of strengthening would probably as a rule be even less than the additional cost of embedding the iron framework in concrete as primarily intended, more particularly since with the Melan arch the embedded iron framework must be so dimensioned that the weight of the not yet hardened concrete does not subject it to a total strain greater than 600 kg/cm², in order that, after hardening of the concrete, this framework may be effective as reinforcement with the remaining 600 kg/cm² of its total resistance to stress.

The present invention provides a method of construction which is calculated to reestablish the practical significance of the non-reinforced arched bridge which has been thrust into the background of modern practice, and thereby to afford the possibility of employing arched bridges which have very large reserves of bearing strength, and which can therefore be erected to stand for longer periods than the so rapidly ageing iron and ferro-concrete bridges. The present invention makes it unnecessary to incur heavy costs which ordinarily accompany the construction and erection of scaffolding and other arrangements for the purpose of supporting the weight of the fresh concrete during its setting and shaping operations. It is precisely this necessity for making the scaffolding and falsework absolutely proof against deformation and shifting which gives rise to their enormous cost, more particularly in view of the necessity for their erection in running water.

The constructional method according to the present invention enables the bridging work to be carried out in stages, with the aid of easily mounted metal sheets, commencing in narrow strips, the procedure being such that a self-supporting, stable, and rigid templet mould formed of steel is provided, before the concreting work is begun. Although the supporting structure for the iron templet mould remains in the completed structure, it cannot be regarded as reinforcement, and still less be separately charged for, since in the interests of easy and cheap building it must be so lightly dimensioned that its carrying strength is just sufficient to support one or two longitudinal sections of arching before setting. Only after the setting of such section or sections, which form but a fraction of the full breadth of the bridge, is the remainder of the bridge built. For this purpose the carrying capacity of the sections first built is utilized in conjunction with the templets of the not yet embedded trellis-work of the carrying construction which project bracket-fashion from the already set arch section or sections. The principle of this progressive method

of construction can be compared to that of the method by which heavy mooring ropes or chains are brought on land from ships. For this latter purpose a wooden ball is first thrown out to which there is attached a thin cord. To this cord there is then tied a heavier rope, and to this rope there is finally fastened the mooring chain which is to be hauled on land. By the method indicated above, and to be described in detail below, it is possible to erect without scaffolding, i. e. in suspension, a relatively very light and cheap bridging in the form of sheet metal falsework which gradually loses its carrying capacity completely as the concreting work proceeds by stages, while the carrying capacity of the bridging arch itself arises by the same stages.

It is immaterial to the principle of the invention whether the portion of the arch first produced is a longitudinal section or strip bounded by vertical planes or an arch shell of a thickness equal to a fraction of the thickness of the finished arch. In every case the section or shell of the arch first made by the pouring of concrete or by the laying of cut stone or bricks is utilized in conjunction with the trellis-work as a carrying structure for the templeting for the remaining sections or shells of the arch.

Since, according to the span of the bridge, it will not always be sufficient to use a single trellis-work of the type already known from the Junkers system of roof construction, it will be necessary under certain circumstances to provide three-dimensional trellis-work. The three-dimensional trellis-work provided for this purpose by the present invention represents in itself a new invention.

Several forms of construction embodying the invention are illustrated, by way of example, in the accompanying drawings, in which:—

Fig. 1 shows diagrammatically, and in longitudinal section, an element of the network with the templet sheeting attached thereto.

Fig. 2 is a section taken on the line B—B of Fig. 3 through a part of the erecting equipment, corresponding to the length of the reinforcing skeleton for the bridge arch.

Fig. 3 is a transverse section taken on the line A—A of Fig. 2.

Fig. 4 is a side elevation of a portion of the arc-shaped erecting equipment.

Fig. 5 is a section taken on the line C—C of Fig. 4.

Fig. 6 is a cross-section through a reinforcing skeleton with the connection through the trusses, on an enlarged scale.

Fig. 7 shows diagrammatically, and in perspective view, a simple network of sheet steel strips, the possibly necessary reinforcing members and also the templet sheeting being indicated.

Fig. 8 is a perspective view of a three-dimensional trellis-work of strips, the points of support of the two superposed courses of sheet steel strips being interconnected, and arrangements being made for the mounting of the templet sheeting to be adjustable in a vertical direction.

Fig. 9 shows a further form of trellis-work in which diagonal ties are provided for joining the points of support of the two lattices in a three-dimensional sense.

Fig. 10 shows a further modification of the trellis-work, in which the opposite corners of the rhombi formed by the network are connected by ties.

In the form shown in Fig. 1 the network *a* carries merely the templet sheeting *o* for the concrete.

In the form of construction shown in Figs. 2 to 6 there are attached to a network *a* of sheet steel strips by means of trusses *q* reinforcing skeletons *r* of the type shown, for instance, in Austrian Patent No. 112,261. These reinforcing skeletons consist of longitudinal reinforcing bars *s* with an encircling tie *t* which are held by distancing or spacing members *u* and connected by means of butt straps *v*. At the butting points the interrupted encircling ties are bridged over by means of tie straps *w*.

Reinforcing skeletons *r* are preferably attached to the network *a* of sheet steel strips both on the upper and on the lower side. The upper reinforcing skeletons are connected to the lower reinforcing skeletons by means of bracing *x*. The templet sheeting required for the concrete work is denoted by *o*.

In the forms of construction shown in Figs. 7 to 10, the lower or only network is denoted by *a*, the upper network by *b*, the nodes or points of support by *c*, and the substantially vertical stay strips for the interconnection of superposed points of support by *d*. The three-dimensionally diagonal ties used in the forms of construction shown in Figs. 9 and 10 are denoted by *e*, and the diagonal ties disposed in the plane of the rhombi of the network by *f*.

If desired, special reinforcing irons can be provided which are disposed in the direction of the axis of the bridge.

A form of construction of this nature is illustrated diagrammatically in Fig. 7. The connecting or supporting points *c* are tied on the one hand to double-T girders *l*, and on the other hand to stays *m*. The girders *l* are provided with longitudinal slots *p* in which reinforcing irons *n* are inserted. In this manner it becomes possible to set the reinforcing irons in the required position determined by leveling.

As templet sheeting corrugated sheet *o* is used which is likewise preferably arranged to be adjustable as to level.

In the form of construction shown in Fig. 8, the supporting points of the two superposed networks are connected on the upper side and on the under side with plain U-section irons *g*. In order to enable the templet sheeting *k* to be adjustable as to level, screw-threaded spindles *h* are provided on the fish-plates joining the strips at their points of mutual contact, and nuts *i* are provided on these spindles. The templet sheeting *k* rests upon these nuts and can be raised and lowered thereby. Separate reinforcement is unnecessary in this form.

In accordance with the invention the trellis-work supporting the sheeting is made only of such dimensions as are required to enable it to carry the dead weight of the wet concrete.

The described trellis-work is suitable for use in connection with simple concrete work, for ferro-concrete arching, and also for arch construction in stone.

The erection of the alternative for scaffolding and falsework provided by the present invention is effected by assembling one half of the span on each bank of the river or the like to be bridged, swinging the two parts towards each other by means of suitable tackle, and connecting them up in the middle. The assembling can also be effected from three separate parts. The trellis-work constitutes the carrier for the sheeting which is preferably made of chequer plating, corrugated sheet, or the like. The sheeting, which can be cleaned either before mounting or after dismant-

tling, is suitably attached to the lattice-work so as to be adjustable, and that preferably in a vertical sense. When the sheeting has been positioned the preparations for the pouring of the concrete are completed.

I claim:

1. In an arch construction, a templet, and a carrier for said templet, both forming a permanent part of the construction, said carrier consisting of a trelliswork of sheet metal strips supported edgewise and each of said strips having its upper and lower edges bent over at right angles.

2. A templet carrier according to claim 1, characterized by a plurality of superimposed trelliswork having nodes, and stay strips interconnecting the nodes of said trelliswork.

3. A templet carrier according to claim 1, characterized by a plurality of superimposed trelliswork, and diagonal stiffening ties connected with diagonally opposite nodes of the trelliswork.

4. A templet carrier according to claim 1, characterized by a plurality of superimposed trelliswork, and slotted girders above and below said trelliswork and parallel with the axis of the arch, and reinforcing irons passing through the slots in said girders.

BRUNO BAUER.