Dec. 22, 1970 J. L. DURKEE ET AL 3,548,432

SUSPENSION BRIDGE CABLE ANCHORAGE

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Fig. 1

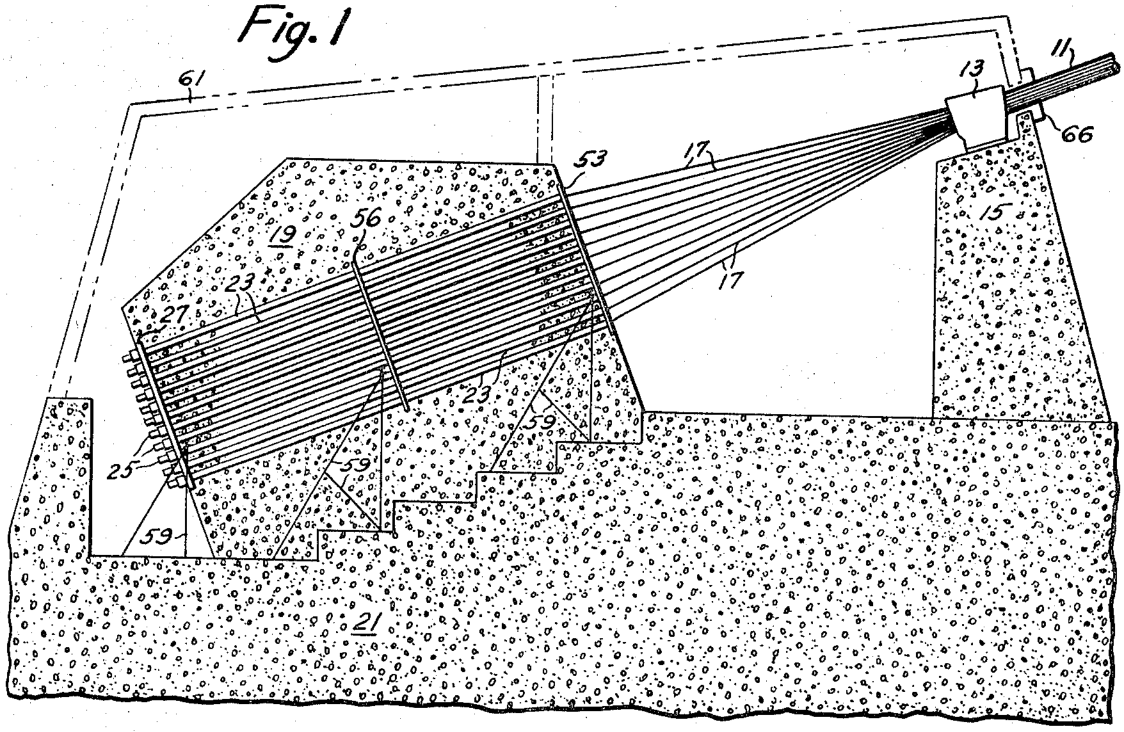
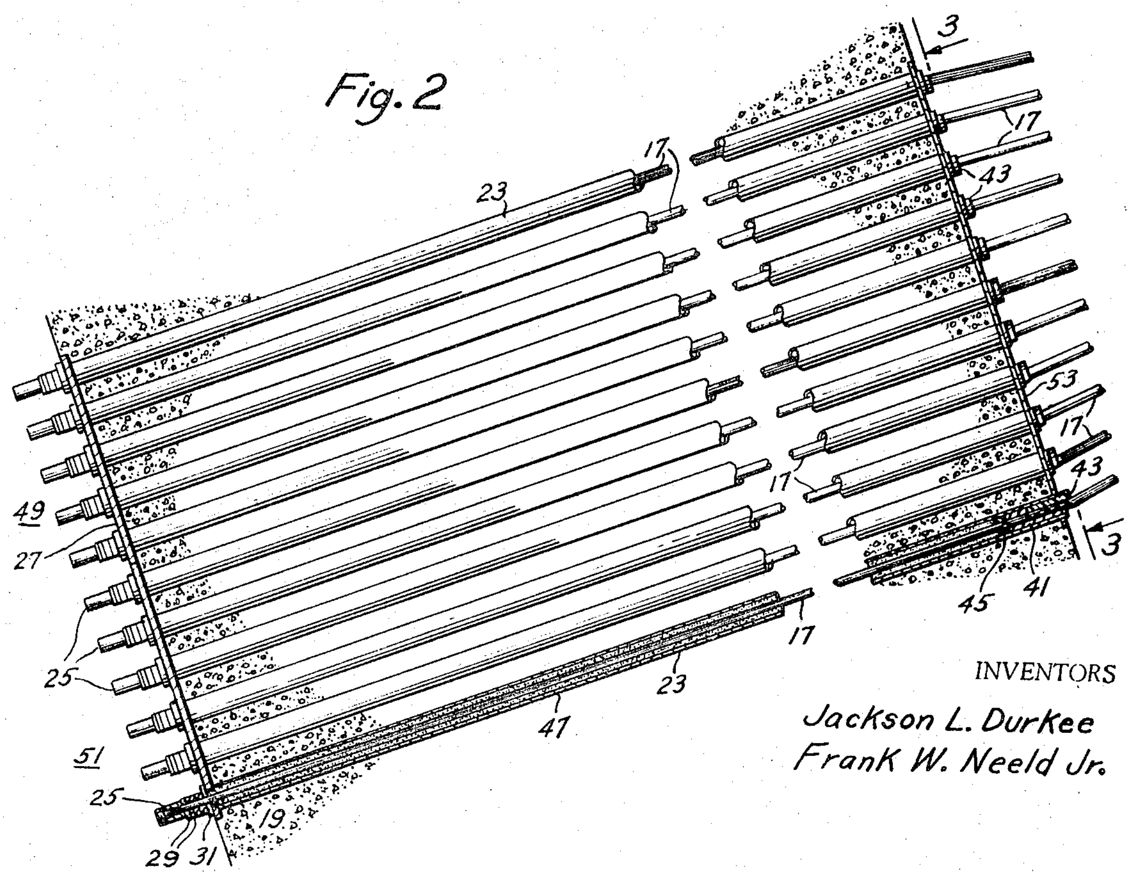


Fig. 2



INVENTORS
Jackson L. Durkee
Frank W. Neeld Jr.

Dec. 22, 1970 J. L. DURKEE ET AL 3,548,432

SUSPENSION BRIDGE CABLE ANCHORAGE

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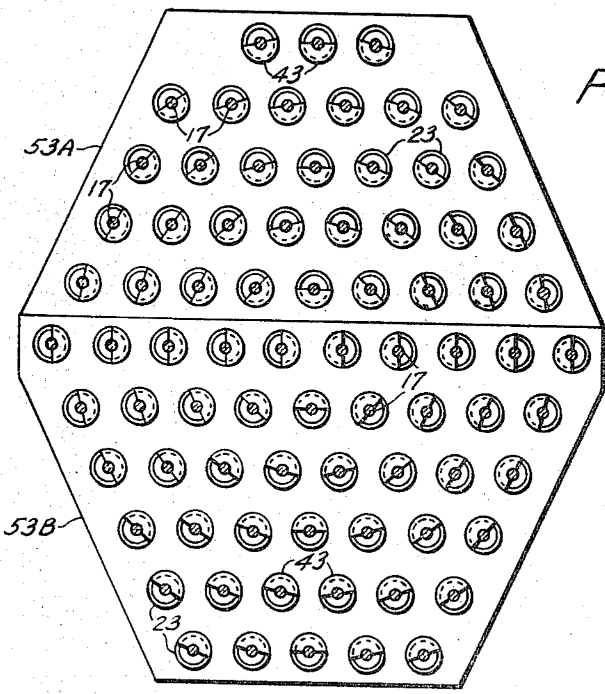

Fig. 3

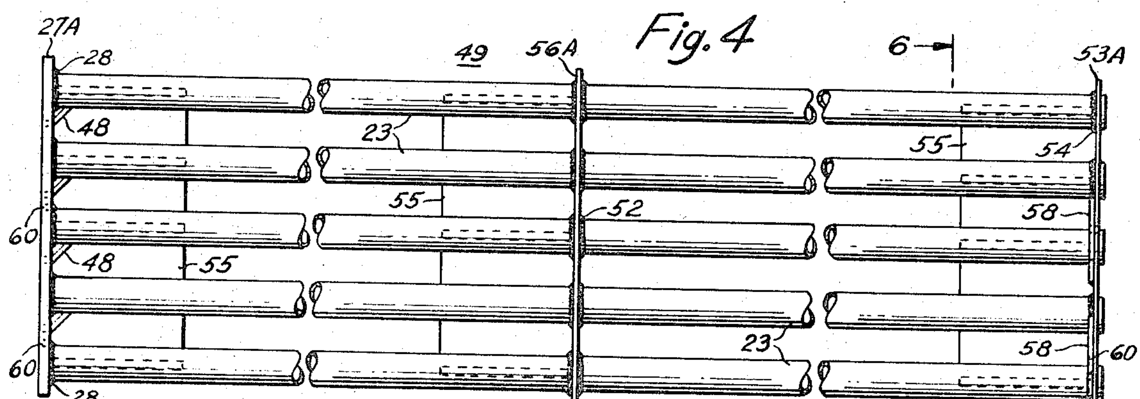

Fig. 4

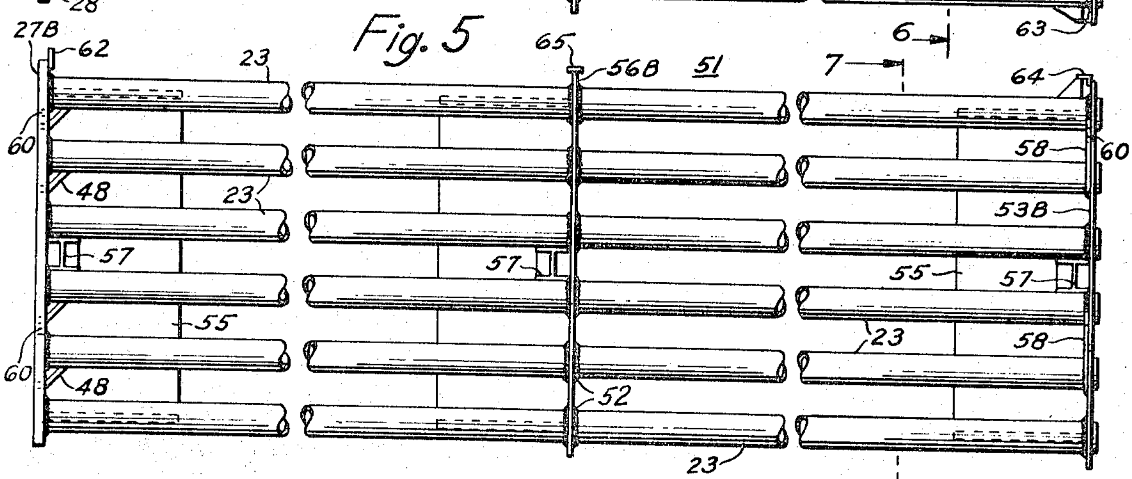

Fig. 5

INVENTORS
Jackson L. Durkee
Frank W. Neeld Jr.

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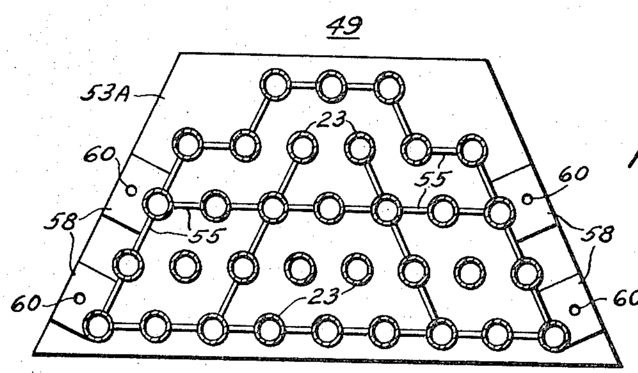


Fig. 6

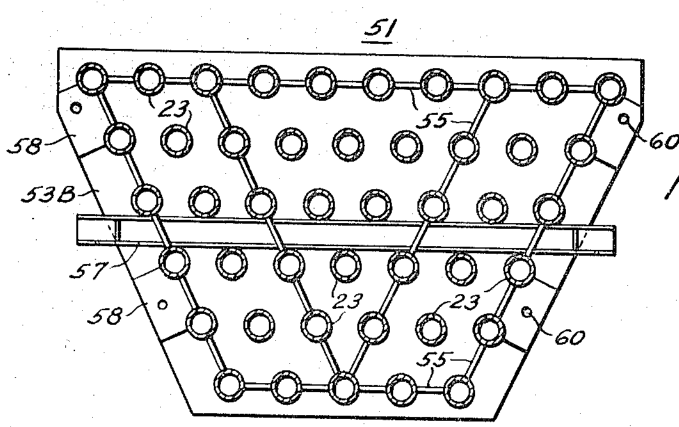


Fig. 7

Fig. 8

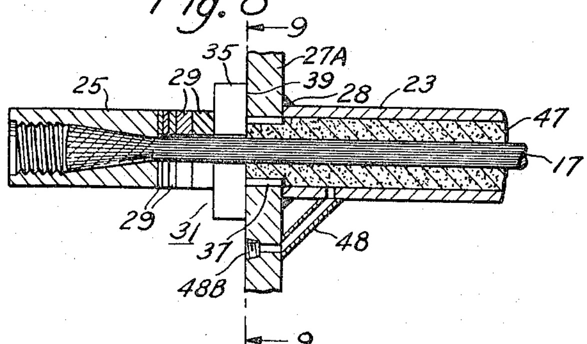


Fig. 9

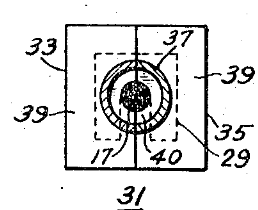
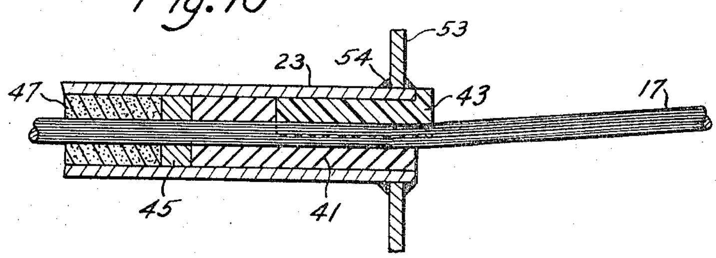


Fig. 10



INVENTORS
Jackson L. Durkee
Frank W. Neeld Jr.

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SUSPENSION BRIDGE CABLE ANCHORAGE

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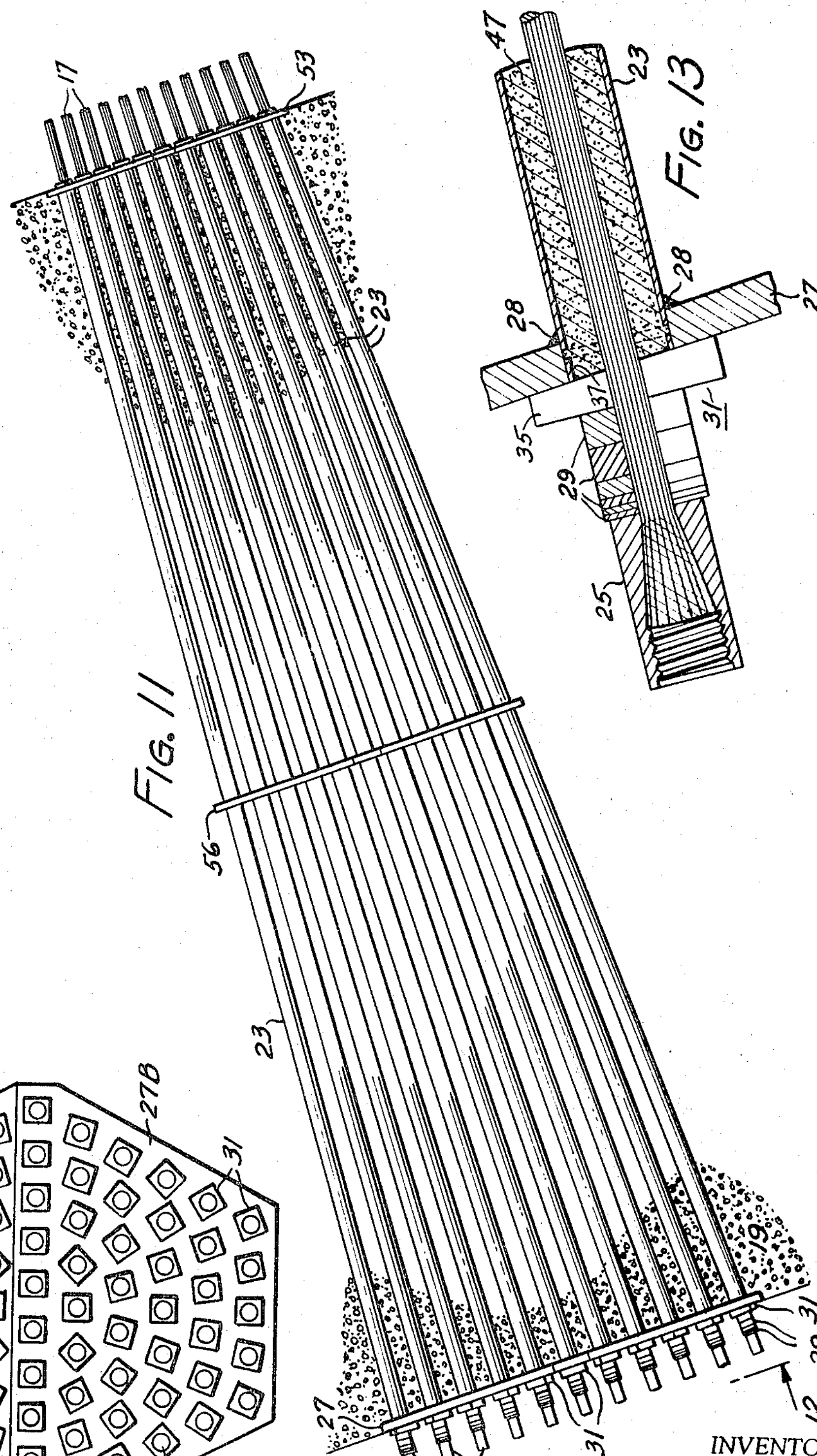

FIG. 13

FIG. 11

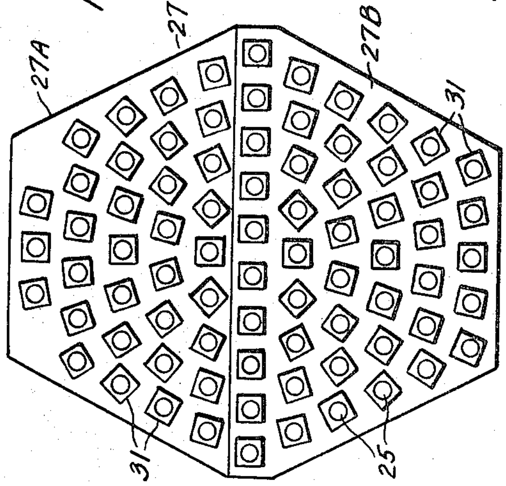

FIG. 12

INVENTORS

Jackson L. Durkee

Frank W. Neeld Jr.

United States Patent Office 3,548,432
Patented Dec. 22, 1970

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3,548,432
SUSPENSION BRIDGE CABLE ANCHORAGE

Jackson L. Durkee, Bethlehem, and Frank W. Neeld, Jr., Riegelsville, Pa., assignors to Bethlehem Steel Corporation, a corporation of Delaware

Filed Feb. 8, 1967, Ser. No. 614,651
Int. Cl. E01d *11/00*
U.S. Cl. 14—21 3 Claims

ABSTRACT OF THE DISCLOSURE

An anchorage for prefabricated strands of suspension bridge cables wherein a series of adjacent hollow cylindrical members are integrally attached to a heavy backing plate to form a unitary anchorage means which is then embedded in a concrete anchorage block. Individual strands of the suspension cable are passed through the cylindrical members and secured against the backing plate so that the tension of the strands is uniformly transferred throughout the anchorage block by the backing plate and the cylindrical members.

BACKGROUND OF THE INVENTION

This invention is directed to simplified, more efficient and economical anchorages for prefabricated strands in suspension bridge cables.

In the past, suspension bridge anchorages for prefabricated strands have generally involved structural members partially embedded in concrete, to the protruding portions of which structural members the strands are secured in various manners. Typical of such anchorages are those shown in Pats. 1,852,683 to Sunderland and 2,178,147 to Moisseiff. While these anchorages have been found to adequately anchor the cable, they have certain disadvantages. The metal anchor bars stretch under load and there is a tendency for a progressive breaking of the bond with the concrete beginning at the point of entry of the bar into the concrete at the forward face and working towards the rear of the anchorage. This causes cracking of the concrete, and such cracks at the front face of the anchorage create points of water entry. In order to overcome these objections the prestressed type of anchorage has been developed and used. These anchorages, while effective, are considerably more expensive because of the complicated prestressing components and procedures, the complicated tension linkages at the front of the anchorage, and for other significant reasons.

Attempts have been made to provide a simpler anchorage for structural cables by passing the cable through an opening in an anchorage block and securing the cable at the rear of the block. A specialized form of such an anchorage arrangement is shown in Pat. 2,914,783 to Hoyden et al. Such anchorages are not completely satisfactory, however, as they do not uniformly distribute the load throughout the anchorage concrete, and, depending upon the particular design, may also experience difficulty due to poor bond of metalwork with concrete.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a simplified bridge cable anchorage which distributes the load uniformly throughout the anchorage and preserves the integrity of the concrete, and which is, at the same time, cheaper, simpler, and faster to construct than anchorages heretofore known.

We have discovered that the foregoing object can be attained by providing a rigid prefabricated assembly comprising a plurality of hollow cylindrical members secured at their lower ends to a heavy bearing slab having openings therethrough in registry with the cylindrical members, embedding the said assembly in a concrete anchorage block, passing the ends of the strands to be anchored through the orifices in the anchorage block provided by the hollow cylindrical members, and seating the strand end fittings against the bearing slab adjacent the lower end of each cylindrical member by any suitable means so that the tension in the strand is taken against the bearing slab and transferred uniformly in compression into the anchorage concrete.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional elevation of a bridge anchorage according to the present invention.

FIG. 2 is a detailed longitudinal section through the embedded portion of the anchorage shown in FIG. 1.

FIG. 3 is an end view of the embedded section along line 3–3 of FIG. 2.

FIGS. 4 and 5 are respectively elevations of an upper and a lower section of an anchorage assembly before embedment.

FIGS. 6 and 7 are respectively transverse sections along lines 6—6 and 7—7 of FIGS. 4 and 5.

FIG. 8 is a detail of the bearing end of a portion of the anchorage assembly.

FIG. 9 is a section of the bearing assembly of the anchorage of the present invention, along line 9–9 of FIG. 8.

FIG. 10 is a detail of the splay end of a section of the anchorage assembly.

FIG. 11 is a detailed longitudinal section through the embedded portion of an anchorage having diverging anchorage cylinders.

FIG. 12 is an end view of the embedded section of FIG. 11 along line 12–12 of FIG. 11.

FIG. 13 is a detail of the bearing end of a portion of the anchorage of FIG. 11.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the draings, as shown in FIG. 1 a suspension bridge cable **11** formed from a plurality of prefabricated strands, which strands may be either the well-known helical-wire strands or the more modern shop-fabricated parallel-wire strands, passes through an anchorage saddle **13** supported on a portion **15** of the bridge structure, from which saddle **13** the individual component strands **17** diverge from each other at predetermined splay angles to anchorage block **19**. Anchorage block **19** may be part of anchorage foundation **21** of the bridge. Hollow anchorage cylinders **23** are embedded in anchorage block **19** to provide tubular orifices passing from one end of anchorage block **19** to the other. Strands **17** pass through anchorage cylinders **23**, and sockets **25** on the ends of the strands are abutted against a heavy bearing slab **27** firmly secured to the rear of anchorage cylinders **23** and partially embedded in anchorage block **19**. Referring to FIG. 2, tension on strands **17** is taken in compression through shims **29** and bearing assembly **31** into bearing slab **27**, and also into anchorage cylinders **23**, which components then transfer the strand forces into the concrete of anchorage block **19**.

Anchorage cylinders **23** are secured not only to bearing slab **27** but also to an intermediate embedded diaphragm plate **56** and a front diaphragm plate **53** which together with the bearing slab **27** tie the entire fabricated assembly together into a rigid structural unit. (Refer to FIGS. 3, 4 and 5). Other suitable structural members may be secured to the anchorage cylinders as may be necessary to tie them together in a unit, either in addition to or in place of plates **53** and **56**. It is important that bearing slab **27** be present, however, to transfer the initial bearing of the strands uniformly into the rear face of the anchorage concrete as well as into anchorage cylinders **23**. Various concrete engaging means may be welded as may be necessary to the anchorage cylinders or provided as an integral part of the outer surfaces thereof in order to increase the interlocking of the cylinders and the assembly as a whole with the concrete of the anchorage.

In FIG. 2, which shows a detail of the anchorage assembly, it is seen that end fittings or sockets **25** are spaced from bearing slab **27** by slotted shims **29** which seat on bearing assembly **31** shown in detail in FIGS. 8 and 9. Bearing assembly **31** is made in two halves **33** and **35** each comprising a flat plate **39** each with a cutout section defining, when placed around strand **17** as shown in FIG. 9, a tight fitting round hole **40** through which the strand passes. To each plate is attached a half section of a tubular element **37** concentric with hole **40**.

Strands **17** will normally have end fittings **25**, of any suitable kind such as poured-zinc-type sockets, already secured on the ends before they are transported to the bridge site. When the strands **17** are erected the ends with fittings **25** are pulled through anchorage cylinders **23**, the two halves **33** and **35** of bearing assembly **31** are placed around each strand **17**, and each assembly is placed against bearing slab **27** with the small tubular elements **37** positioned inside the slab orifice. A fairlead **43** of nylon, zinc, or other suitable material is inserted in the opposite or upper end of the anchorage cylinder **23** and adjusted radially to support and direct strands **17** toward the splay point at anchorage saddle **13**.

After the full dead load of the bridge is in place and the strands are fully tensioned, a stopper plug **45** of a suitable caulking material such as rubber may be cast or placed near the upper end of anchorage cylinder **23**, and a filling **47** of a moisture excluding material such as chloride-free cement grout or plastic foam forced into anchorage cylinders **23** through access pipes **48** and taps **48B** to provide a seal around the strands **17**. Stopper **45** limits the flow of filling **47** near the upper end of anchorage cylinder **23**. Lastly, special sealing plug **41** of rubber of other suitable dense material may be cast-in-place at the upper end of the anchorage cylinder as a means of preventing any water entry.

FIGS. 4 through 7 show an anchorage assembly before it is embedded in anchorage block **19**. This assembly may be fabricated in portions such as two halves **49** and **51** for convenience in shipping and erection. Anchorage cylinders **23** in both sections are welded to heavy bearing slab sections **27A** or **27B** at one end by means of welds **28**, and to diaphragm plate sections **53A** and **53B** at the other end by welds **54** with a small section of anchorage cylinders **23** protruding through plates **53A** and **53B** so that any moisture that may subsequently run down the front face of the anchorage housing will be deflected away from the strands in the completed anchorage. Stiffening webs **55** are welded between anchorage cylinders **23** to provide additional rigidity to the entire assembly. One or more intermediate diaphragm plate sections **56A** and **56B** secured by welds **52** to cylinders **23** may be used to give the assembly portions additional rigidity.

Assembly half **51** has three I-beams or support members **57** secured to it to provide attachment means for supporting it on supporting frameworks **59**, as shown in FIG. 1, prior to the time that the concrete of anchorage block **19** is placed. Holes **60** for lifting the assemblies are supplied in plates **27A** and **27B**, and **53A** and **53B**, reinforced with plates **58** as may be required. Bearing slabs **27A** and **27B** and diaphragm plates **53A** and **53B** conveniently serve as partial concrete forms for the anchorage block **19** during its formation.

Splice plates **62** attached to the upper portion of bearing slab section **27B** provide attachment means between slab sections **27A** and **27B** following assembly at the bridge site. Stiffened bearing and connecting angles **63** and **64** provide a bearing surface and attachment means between diaphragm plates **53A** and **53B**. Aligned bolt holes, not shown, through angles **63** and **64** facilitate connection of the assemblies. A small bearing bar **65** at the top of intermediate diaphragm plate **56B** provides support for matching diaphragm plate **56A** following erection at the bridge site. It may be desirable at times to securely weld the two halves **49** and **51** of the anchorage assembly together at the bridge site in order to provide a rigid unitary whole.

The entire anchorage is customarily enclosed in a weather structure **61** as shown in dotted outline in FIG. 1, with a sealing hood **66** provided to prevent water access into the achorage.

If a larger anchorage block **19** and anchorage assemblies **49** and **51** are not detrimental, the anchorage members **23** instead of being assembled in parallel relationship to each other may be assembled in diverging relationship, at the same angle as the splay angles of the respective strands **17** which pass therethrough. In this manner fairleads **43** to direct a change in direction of the strand may be eliminated and the strands **17** directed in a straight line from the splay point or anchorage saddle to a curved or stepped bearing surface at the rear of the anchorage, which surface would have to be suitably equipped with bearing slab means to transfer the stress into the concrete.

FIGS. 11, 12 and 13 show such a diverging anchorage assembly. The parts are designated by the same numerals as used in FIGS. 1 through 10. A stepped bearing surface is provided at the rear of the anchorage by the use of beveled bearing assemblies **31** composed of half sections **33** and **35** which bearing assemblies **31** are, as seen in FIG. 12, arranged so that the bevel of each assembly compensates for the various diverging angles of the anchorage cylinders **23** with respect to the flat bearing plate or slab **27**. For convenience of fabrication the ends of the anchorage cylinders **23** are cut off square and welded at an angle within the orifices in bearing plate or slab **27**. As an alternative the anchorage cylinders could also be cut on a bevel and butted directly against the bearing slab **27** as shown in FIG. 8.

By the arrangement of this invention there is provided an economic and convenient bridge anchorage wherein the tension of the suspension strands is taken in direct compression on the rear surface of the anchorage and is dispersed uniformly throughout the anchorage block to secure the strength and safety of a prestressed embedded type anchorage without the expense and complications of such anchorages.

We claim:

1. An anchorage for bridge strand in a suspension bridge comprising:

(a) a concrete anchorage block at one end of the bridge span,

(b) a plurality of hollow cylindrical members arranged in a pattern adjacent to each other in a substantially parallel relationship embedded in said anchorage block,

(c) a perforated bearing slab mounted against one end of said concrete anchorage block,

(d) the end portions of said cylindrical members being secured to said bearing slab in registry with the perforations in said bearing slab,

(e) a plurality of bridge strands extending through said cylindrical members,

(f) means secured to the ends of said bridge strands and bearing against said bearing slab, and

(g) a fairlead at the upper end of each hollow cylindrical member on the inside of any curvature of the strand leaving the hollow member to direct the strand to a splay point where the strands are brought together to form a bridge suspension cable comprised of the said strands.

2. An anchorage for bridge strand in a suspension bridge comprising:

(a) a concrete anchorage block at one end of the bridge span, said block having a lower face,

(b) a perforated metal bearing plate bearing against the lower face of the anchorage block,

(c) a perforated metal support plate spaced from said bearing plate,

(d) a plurality of rigid hollow metal cylindrical members arranged in a pattern adjacent to each other, embedded in said anchorage block, and fixedly secured at their outer ends to the bearing plate and the support plate in registry with the perforations therein;

(e) a plurality of bridge strands extending through said cylindrical members, and

(f) means secured to the ends of said bridge strands and bearing against said bearing plate.

3. A prefabricated anchorage assembly for embedment in a concrete anchorage block of a bridge comprising:

(a) a perforated metal bearing plated adapted to bear against a lower face of said anchorage block,

(b) a perforated metal support plate spaced from said bearing plate,

(c) a plurality of rigid hollow metal cylindrical members arranged in a pattern adjacent to each other and fixed secured at their outer ends to the bearing plate and the support plate in registry with the perforations therein.

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U.S. Cl. X.R.

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