

[54] **CONCRETE REINFORCEMENT AND METHOD OF AN APPARATUS FOR MAKING SAME**

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[21] Appl. No.: **269,744**

Related U.S. Application Data

[63] Continuation of Ser. No. 887,110, Dec. 22, 1969, abandoned.

[52] U.S. Cl. **52/669, 52/687**

[51] Int. Cl. **E04c 5/01**

[58] Field of Search 52/664, 669, 662, 600, 52/665, 650

[56] **References Cited**

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Attorney, Agent, or Firm—Karl F. Ross

[57] **ABSTRACT**

A succession of concrete-reinforcing rods are fed one by one into an attaching station to which are fed several base strips. The rods are positioned across the base strips and a holding strip is laid over the rod opposite each base strip, and this holding strip is welded in a loop to the base strip. Thence the strips, with the rod attached, are rolled up, and another rod is connected between them as above. The mat thus formed has a changeable shape since the rods remain slidable between the strips so that they can be longitudinally displaced or wholly removed to fit the mat to virtually any configuration. The strips can be made of metal, synthetic resin, textile, rubber, or the like and the holding strips can be applied as a plurality of separate ties, clips or straps to the base strips over the rods.

3 Claims, 19 Drawing Figures

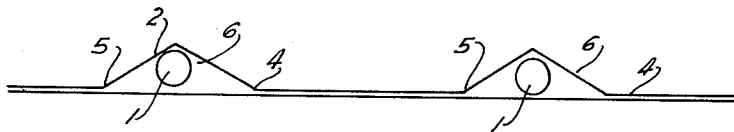


FIG. 1

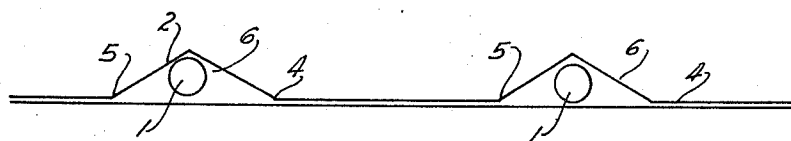


FIG. 2

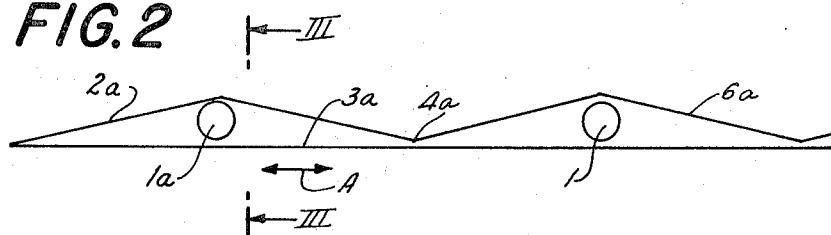


FIG. 3

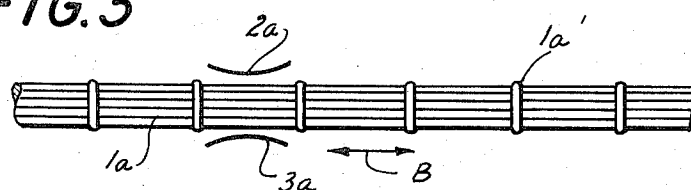


FIG. 10

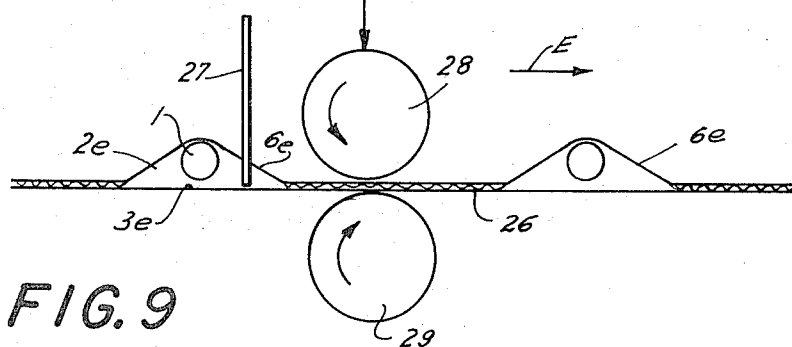
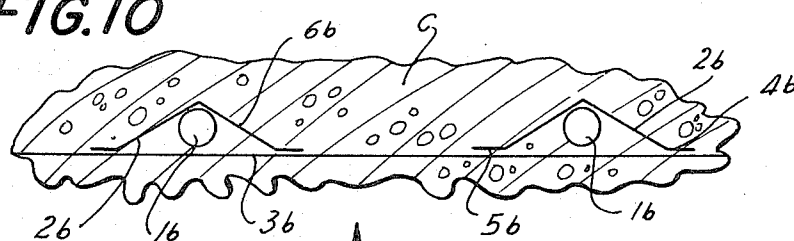


FIG. 9

FIG. 4

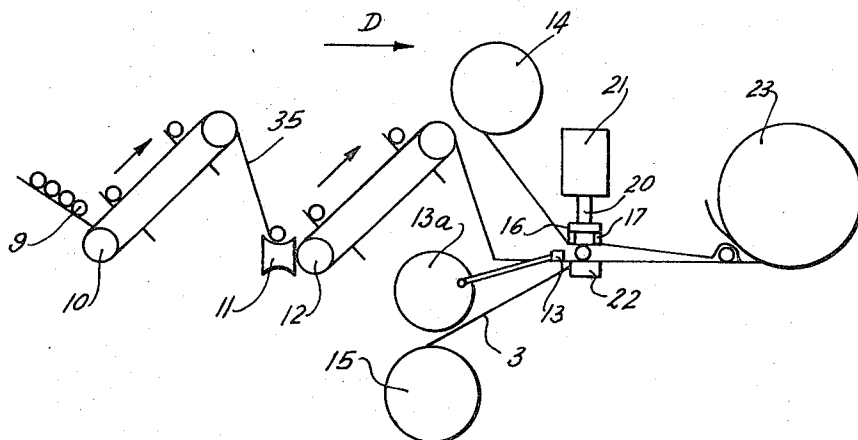


FIG. 5

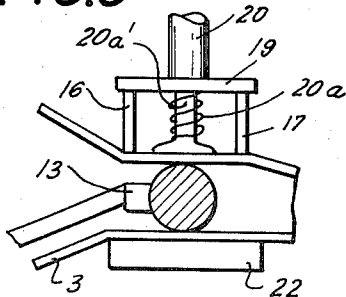


FIG. 7

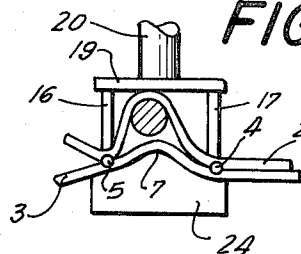


FIG. 6

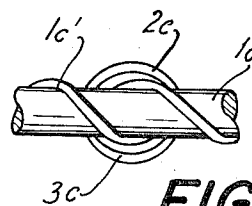
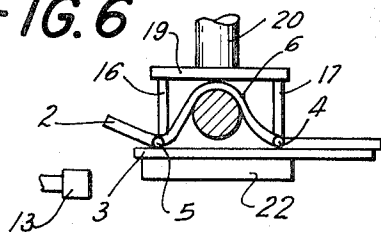


FIG. 11

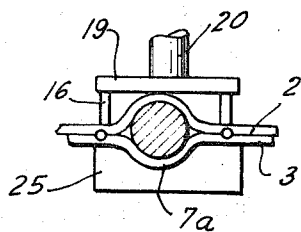


FIG. 8

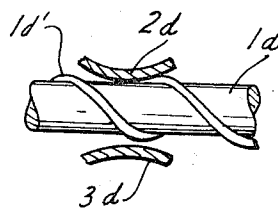


FIG. 12

FIG. 13

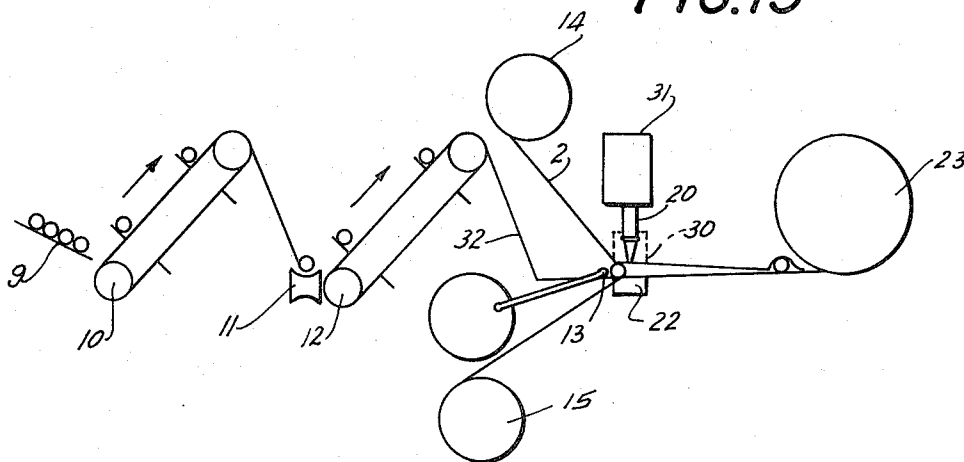


FIG. 14

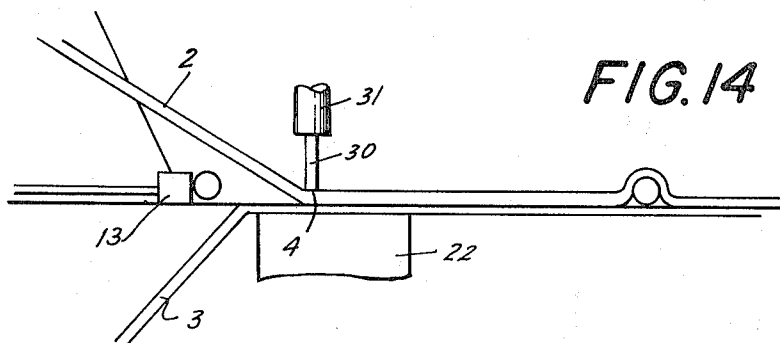


FIG. 15

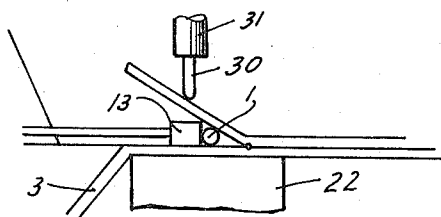
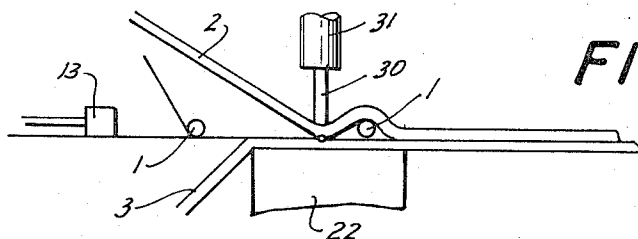


FIG. 16



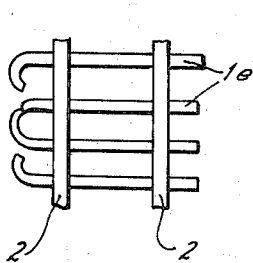
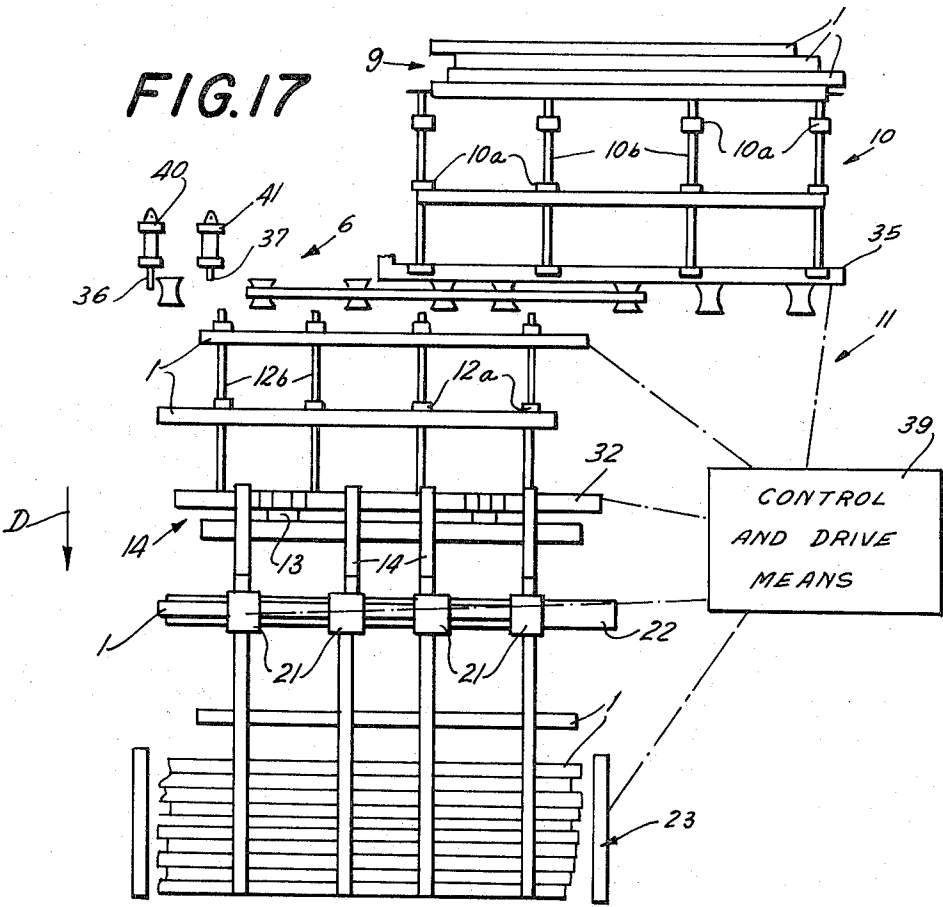


FIG. 18

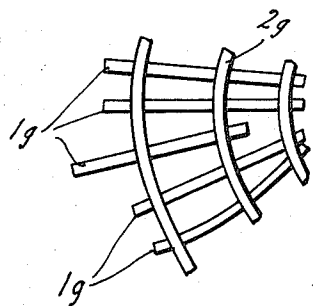


FIG. 19

CONCRETE REINFORCEMENT AND METHOD OF AN APPARATUS FOR MAKING SAME

This is a continuation of application Ser. No. 887,110, filed Dec. 22, 1969, now abandoned.

The present invention relates to a concrete-reinforcing mat and a method of and apparatus for making such a mat.

As the number of extremely large buildings and other structures made of reinforced concrete increases, the importance of efficient methods of handling and making reinforcing material also augments. The concrete is usually poured over skeletons or mats of steel rod, but in some cases, the mats or skeletons are submerged in the fresh concrete. For both cases, it is of great importance that the reinforcing assemblies be readily erected and easy to use.

Unfortunately, earlier reinforcing webs, skeletons, and mats had invariably to be custom-made for the particular job. Due to irregularities in the structure and a multitude of other factors, each mat or reinforcing latticework must be built for each particular purpose. This, of course, entails a great deal of time and energy which would best be spent elsewhere on the job.

Some attempts have been made to provide ready-made mats which can be used to form the skeletons desired. These mats, however, are entirely unsatisfactory since they are difficult to transport, being bulky in the extreme, and even then rarely are just what was needed for the particular job.

It is, therefore, an object of the present invention to provide an improved mat adapted for use in reinforced concrete.

Another object is to provide an improved method of making such a mat and to provide a particular method of using such a mat.

Yet another object is to provide an improved apparatus for making such a mat.

A further object is to provide a concrete-reinforcing structure which is cheaper than any known heretofore, easy to transport, and is particularly easy to adapt to any particular work requirements.

The above objects are obtained by a mat which comprises an array of spaced rigid concrete-reinforcing bars or rods, an array of spaced apart flexible base elements (other than the rods and of a much smaller cross-section) extending across and engaging the rods along one side of the rod array, and retaining means including respective, preferably flexible, holding elements connected to the base elements along each side of each of the rods for retaining the rods in light frictional contact with the elements so that they can slide between the elements.

According to another feature of the present invention, the holding and/or base elements are thin continuous strips of a material, such as iron, steel, or a thermoplastic synthetic resin, which can be welded together.

In accordance with the method features of the present invention, a succession of spaced apart rigid concrete-reinforcing rods are fed to an attaching station where a plurality of flexible spaced apart base elements are applied across one side of them and a plurality of flexible holding elements are positioned over them on the other side and connected to the base elements. The holding and base elements are tensioned so that the rods can slide longitudinally between the elements. The

holding or retaining strips or ties may be continuous (along one base element) or individual to each of the rigid rods.

According to another feature, one of the elements, preferably the base elements, is held straight in the attaching station and the other element is laid over both it and the rods and is formed into loops over these rods. Thus, when the base strip is tautened, the rods can still slide, since the openings formed by the loops in the holding strips and the straight base strips are not drawn out.

A mat according to the invention can be rolled up, or all of the rods can be pushed together for transport. In use, the bundle or roll can be opened out and easily placed. Should one or more of the rods project too far, or interfere with some part of the structure, this rod or rods can simply be pulled partially out of the mat, or even entirely out of the mat. Similarly, if the density of the mats is too great, a certain number of the rods can be pulled out and used elsewhere. Of course, two mats can be rolled out with the rods in different directions if desired. Thus the reinforcement consists of an assembly of steel reinforcement bars tied together side-by-side in spaced relation by flexible bands which allow the assembly to be rolled up or the bars to be gathered together in parallel and each bar to be longitudinally displaced and rotated in the assembly without major frictional resistance. The reinforcement bars are held between two flexible bands which are bonded or fastened together on each side of the bars in such manner that one of the bands embraces each rod in a relatively loose loop, whereas the other band takes up the tensile forces that arise during production and during the placing of the reinforcement. The band forming the loose loops consists of individual sections, each section forming one loop or two bands are continuously fastened or bonded together between consecutive loops, preferably by welding or with an adhesive. In either case the flexible spacing bands are arched about their longitudinal axis. The bands are concavely arched at least where they cross the reinforcement bars or are convexly arched at least where they cross the reinforcement bars.

The bands may be constituted of a soft, ductile and weldable steel, of a textile material, of a synthetic resin material, and/or of an elastically stretchable material, such as rubber or a rubber-like material. Moreover wires, preferably weldable wires, cords or the like take the place of the bands.

The above and other objects, features, and advantages will become more apparent from the following description, reference being made to the accompanying drawing, in which:

FIG. 1 is a side view of a first embodiment of the mat according to the present invention;

FIG. 2 is a side view of a second embodiment of the mat according to the present invention;

FIG. 3 is a section taken along line III — III of FIG. 2;

FIG. 4 is a schematic side view of a first embodiment of an apparatus according to the present invention;

FIGS. 5 and 6 are side views, in enlarged scale, of a detail of the first embodiment of the invention, in open and closed different work positions, respectively;

FIGS. 7 and 8 are views similar to FIG. 6 of alternative embodiments of details of the apparatus of the invention;

FIG. 9 is a side view of a second embodiment of the apparatus according to the present invention;

FIG. 10 is a side view similar to FIGS. 1 and 2 showing a third embodiment of the mat according to the present invention here imbedded in concrete;

FIGS. 11 and 12 are sectional views of fourth and fifth, respectively, embodiments of the present invention;

FIG. 13 is a schematic side view of a third embodiment of the apparatus according to the present invention;

FIGS. 14, 15, and 16 are side views, in enlarged scale, of a detail of the third embodiment of the apparatus, in three different work positions;

FIG. 17 is a top view of the apparatus shown in FIG. 4; and

FIGS. 18 and 19 are top views of sixth and seventh, respectively, embodiments of the mat according to the present invention.

FIG. 1 shows a portion of a mat having rods 1 held between a holding element or strip 2 and a base element or strip 3. The rods 1 are made of steel, such as bismuth or thorium alloy steels or the steel known under the European trade names as "Bistahl," a steel element formed by two rods linked in a ladder arrangement, or "Thorstahl," or are simple deformed bars of intermediate-grade steel. The strips 2 and 3 are made of iron, the strip 3 being around 1 centimeter wide and 0.2 millimeters thick. The holding strip 2 is slightly narrower and thinner. Weld joints 4 and 5 are formed to each side of each rod 1 as will be described below, with a loop 6 formed in the strip 2 between them and the rods 1 being received in these loops 6. It is clear from the drawing that, should the strip 3 be pulled taut, the size of the loop 6 will not be affected so that the rod 1 can continue to slide therethrough under light pressure.

FIG. 2 shows rod 1a held between plastic strips 2a and 3a which are joined at a single point 4a between them. These rods 1 are received in loops 6a which are relatively long, since only one joint 4a is between them, so that the bars 1 can slide from one side to the other of these loops 6a, as shown by the arrow A. FIG. 3 shows how the strips 2a and 3a are somewhat U-shaped in profile and open away from the rods 1, to allow these rods 1a to slide in the direction shown by arrow B, despite the circumferential ridges 1a' formed on them.

In FIG. 10 a straight base strip 3b of textile material carries rods 1b which are held thereon by clips formed by short textile holding strips 2b. These strips 2b are glued at 4b and 5b with a quick-setting cement and form loops 6b receiving the rods 1b. The entire mat of FIG. 10 is shown imbedded in a concrete mass C.

FIG. 11 shows a rod 1c formed with a helical ridge 1c' and having a base strip 3c and a holding strip 2c, both of U-profile. The U of the strips 2c and 3c, however, is open toward the rod 1c. FIG. 12 shows a rod 1c with a helical ridge 1c' and U-profiled holding and base strips 2d and 3d respectively, both open away from the rod 11d.

In FIGS. 4 and 17 there is illustrated an apparatus for making a mat as shown in FIG. 1. Bars 1 are taken one-by-one off a supply stack 9 by stops 10a on chains 10b of a chain conveyor 10. These stops are spaced so that one rod 1 is taken at a time and is thence dropped down a slide 35 at regular intervals, the drive speed of this conveyor 10 being regular. At the base of the chute 35

each rod 1 comes to rest on several driven hyperboloidal rollers 11 which move it transversely in the direction shown by arrow C until the end of the rod comes to rest against a stop 36 or 37, as will be described below.

A second rising chain conveyor has stops 12a mounted on chains 12b to pick the rod 1 up off the rollers 11, pull it up and release it at the top of the slide 32. A large crank 13a bearing a plurality of pushers 13 is constantly driven at a regular speed so that the pushers 13 periodically engage a rod 1 at the base of the slide 32 and displace it to the right in FIG. 4.

A plurality of welding devices 21 are arranged upstream of the slide 32. Above the material flow path is arranged a holding-strip feed or with four spools 14 of the narrow steel holding strips 2. A similar set of spools 15 below the path holds the thicker base strips 3. Both the spools 14 and 15 can rotate freely, and are spaced transversely of the flow direction shown by arrow D so that they line up with the welders 21.

Upstream of the welding station formed under the welders 21 is a large driven take up spool 3 on which the finished mats are rolled in a long band.

FIGS. 5 and 6 show how the strips 2 and 3 are attached together in the welding station. Mounted below the spot welding arrangements 21 is a long metal plate 22 serving as counter electrode for four pairs of electrodes 16 and 17 mounted on respective plates 19 carried by respective rams 20 each connected to one of the welders 21. Also mounted on each ram 20 is an arm 20a which is downwardly biased by a spring 20a' and is engageable with a rod 1 to clamp it against the block 22 during welding.

As shown in FIG. 5, the pusher 13 pushes the rod 1 in between the two strips 2 and 3 under the plate 19 and between the electrodes 16 and 17. Then, as shown in FIG. 6, the pusher 13 is withdrawn and the ram 20 forces the electrodes 16 and 17 down, pushing the strip 2 down on each side of the rod 1 to form the loop 6 and then spot welding the strips 2 and 3 together at 4 and 5. Since the block 22 is flat, a mat identical to that shown partially in FIG. 1 will be produced.

A control and drive arrangement 39 is coupled to all the conveyors 10 and 11, to the welders 21, to the rollers 11, and to the mat take-up 23. Similarly, it alternately actuates two cylinders 40 and 41 controlling the stops 36 and 37, respectively, so that a mat with staggered bars is produced, as is clearly visible from FIG. 17. The spool 23 is rotated in steps to draw off the required amount of strip material from the spools 14 and 15, so that the right spacing between neighboring bars is established.

FIGS. 7 and 8 show structure for binding the rods which, in principle, is essentially the same as that of FIGS. 5 or 6, with like reference numerals referring to like elements. In FIG. 7 a block 24 is provided having a central hump 7. Such an arrangement produces a loop in the strip 2 which is elongated, allowing lateral shifting of the rod 1 therein. The block 25 of FIG. 8 is formed with a semicylindrical depression 7a, and the plate 19 is arranged to abut the tape 2 and thereby form a third electrode. This latter embodiment produces a rod which is snugly and fixedly held between the strips 2 and 3.

The apparatus shown in FIG. 13 is essentially identical with that of FIGS. 4 and 17, except that welders 31 each having a ram 20 carrying a respective electrode

5

30 are provided. FIGS. 14, 15, and 16 show how the electrode 30 is first dropped to form a spot weld 4 in the two strips 2 and 3. Then (FIG. 15) it is raised and the pusher 13 slides a bar 1 in between the two strips, right up to the weld 4, with the electrode 30 raised and the strips advanced slightly. Subsequently, the pusher 13 is withdrawn (FIG. 16) and the electrode 30 drops again to form a spot weld 5 downstream of the rod 1. Then the process is repeated for another rod 1.

For both embodiments of the apparatus, it is of course to be understood that, although only one operation is described, these operations follow one another closely, allowing mats to be made in an endless band at a very rapid rate.

FIG. 9 shows another method of making the mat. Here two synthetic-resin strips 2e and 3e are formed with rods 1 into a mat virtually identical to that of FIG. 1, except that a glued area 26 extends between the two loops 6e in the strip 2e. This glued area is made as the tapes 2e and 3e are advanced in the direction shown by arrow E, with the lower base strip 3e riding on a roller 29. A probe 27 injects glue in between the strips 2e and 3e, while a vertically displaceable roller 28 serves to compress the two strips 2e and 3e together. Both rollers 28 and 29 are heated to speed the hardening of the glue. When the probe 27 is contacted by a rod 1 as the tapes 2e and 3e are advanced in direction E the flow of glue is momentarily shut off while the rod 1 passes, and then the roller 28 is automatically similarly raised to allow the rod to pass.

In FIG. 18 there is shown a mat made with J-shaped bars 1f. As is clearly visible, these rods can turn and lie flat for transport, and then be arranged as desired at the site. The same principle applies to curved rods. In prior-art ready-made mats wherein the rods cannot slide or twist transporting the mats to the site is very difficult.

FIG. 19 shows a plurality of straight rods 1g which are arranged as radii of an imaginary circle on rubber strips, of which only the holding strip 2g is visible. These rods are also advantageously curved so that the finished mat, a segment of which is shown here, can advantageously be used to make a dome or the like. One of the rods 1g is shown shifted outwardly, e.g., to clear a projection or an opening of the structure to be reinforced. The rubber strips 2g allow the entire array to be very easily rolled or folded up for transport.

In order to make an array as shown in FIG. 19, the

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row of welding devices 21 and the take-up roll 23 both extend at an angle to the flow path, with, for example, special rollers provided to advance the tapes on one side more than those on the other side. These welding devices can be high-frequency welders as are well known per se for welding synthetic resin strips.

The welding devices 21 and spools 14 and 15 furthermore, are displaceable transverse to the transport path so that the equipment can be set up for bars 1 of different lengths. No resetting is necessary for bars of greater diameter since the distance between the electrodes 16 and 17 is greater than the largest diameter which is to be encountered, and the loop formed in the tape 2 is automatically correctly dimensioned as these electrodes descend. Of course, the welding device shown in FIG. 13 is clearly usable with bars 1 of any diameter, since the loop is automatically formed as above when the strip 2 is pressed down over the rod 1.

What is claimed is:

1. A rollable concrete-reinforcing mat comprising a generally planar array of spaced apart, mutually parallel rigid concrete-reinforcing rods;

a plurality of mutually parallel flexible but inextensible support strips underlying said array at locations therealong spaced apart along said rods, said strips lying in a plane parallel to the plane of said array and extending substantially rectilinearly; and respective retaining strips overlying each of said support strips and exclusively forming loops around each of said reinforcing rods while being anchored to the respective support strip, said retaining strips being flexible and hugging said reinforcing rod with friction contact to enable selective rods to be shifted relative to other rods of said array whereby said shifted rods are retained in position by friction between said strips, said strips being flat bands.

2. The mat defined in claim 1 wherein said retaining strips are anchored to the respective support strips at a single point between each pair of said rods.

3. The concrete reinforcing mat defined in claim 1 wherein said retaining strips are each anchored to the respective section at two transversely spaced locations between each pair of rods of said array, one of said locations being close to one rod of each pair and the other of said locations being close to the other rod of each pair.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,797,193

Dated 19 March 1974

Inventor(s) Hans HALLER, Erwin WENDL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading , after line [21] insert:

-- [30] Foreign Application Priority Data

23 December 1968 Austria A 12560/68

29 April 1969 Austria A 4162/69

23 September 1969 Austria A 9017/69 -- .

Signed and sealed this 1st day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents