April 27, 1965 E. H. BACHMANN 3,180,671

REINFORCING MAT HANDLING MEANS

Filed May 8, 1962 5 Sheets-Sheet 1

FIG. 1.

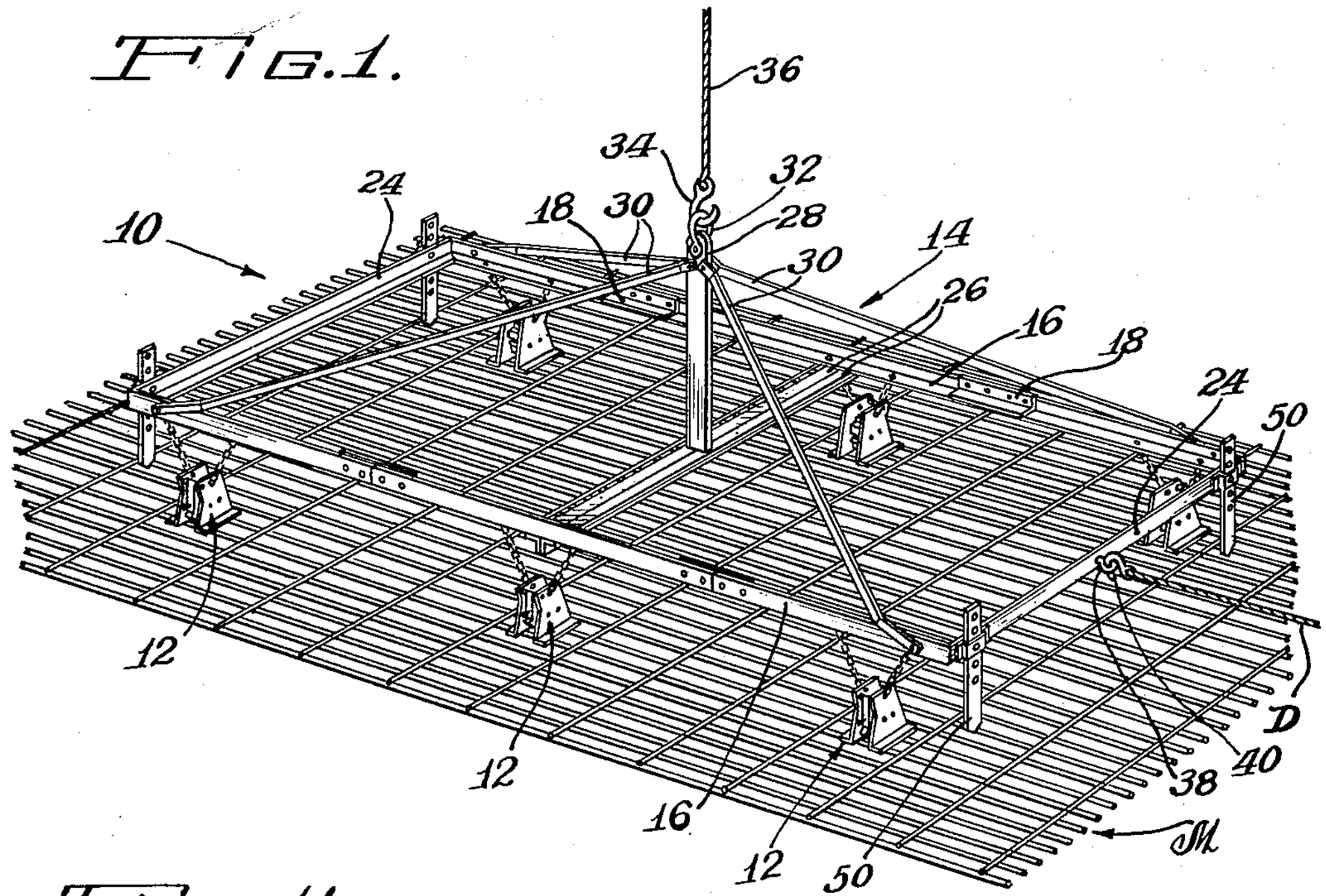


FIG. 11.

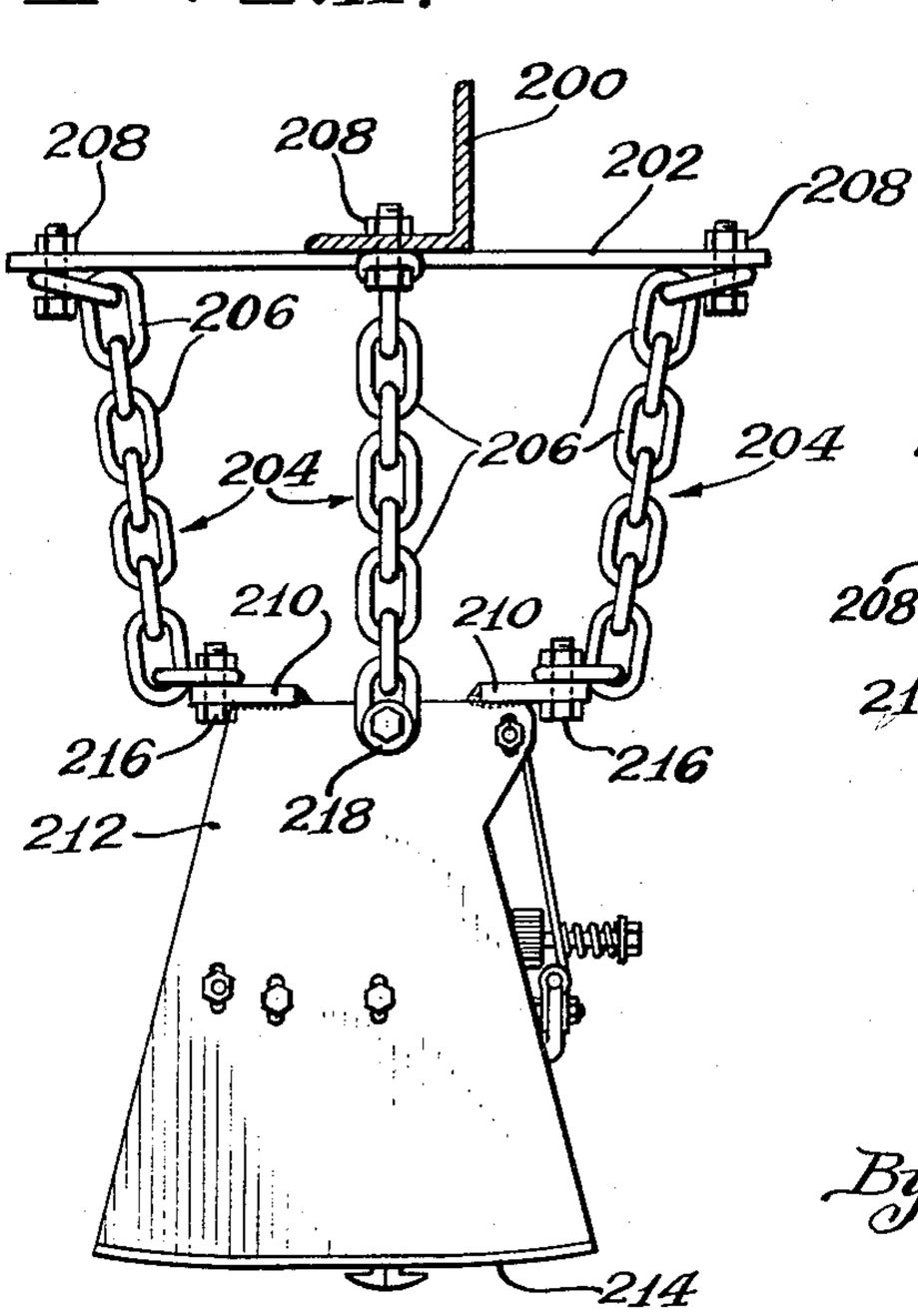
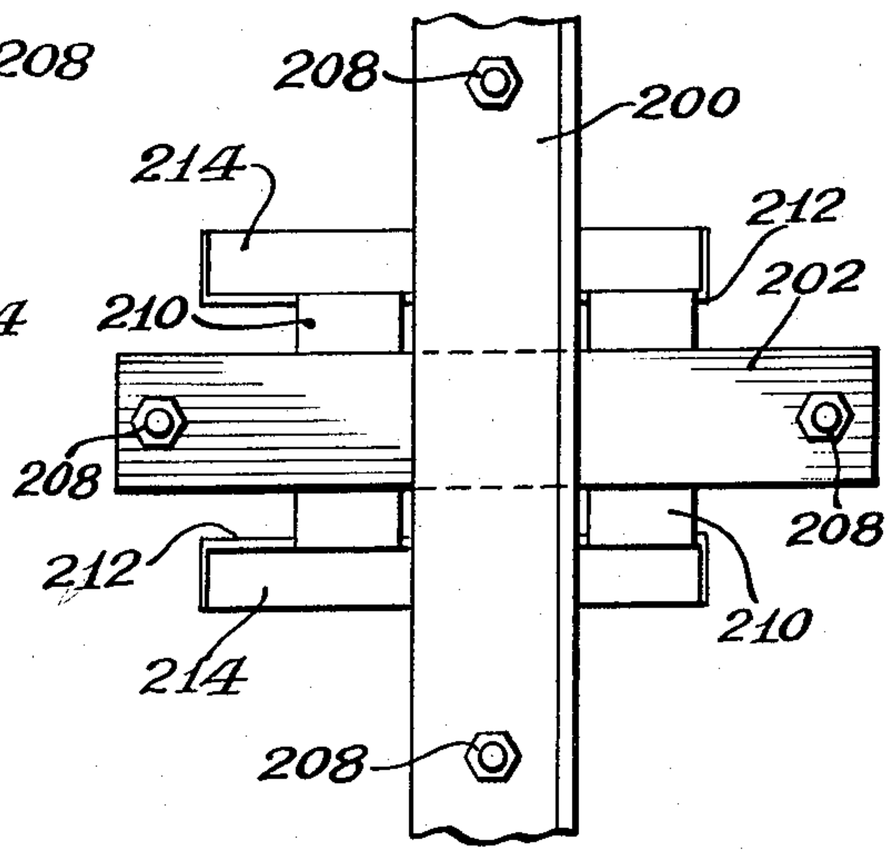


FIG. 12.



Inventor:
Einar H. Bachmann
By Horton, Davis, Brewer & Brugman
Attys.

April 27, 1965 E. H. BACHMANN 3,180,671

REINFORCING MAT HANDLING MEANS

Filed May 8, 1962 5 Sheets-Sheet 2

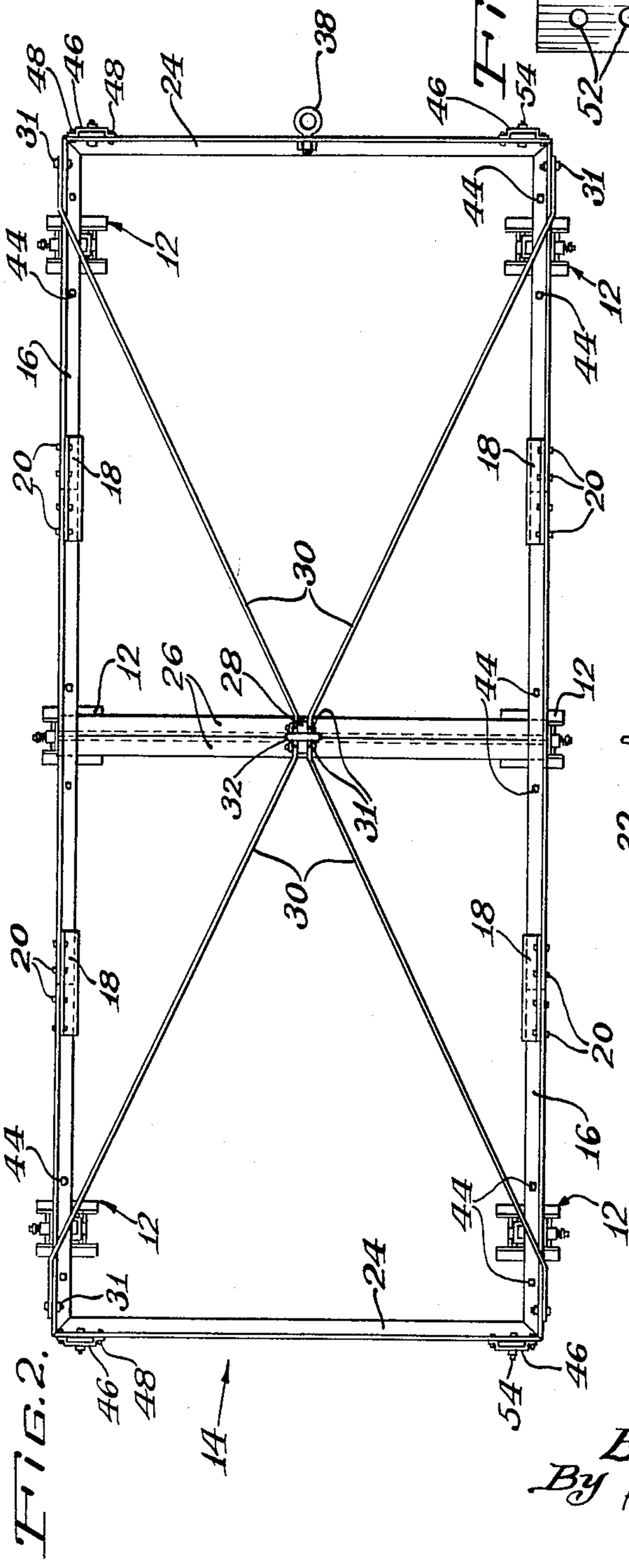


FIG. 2.

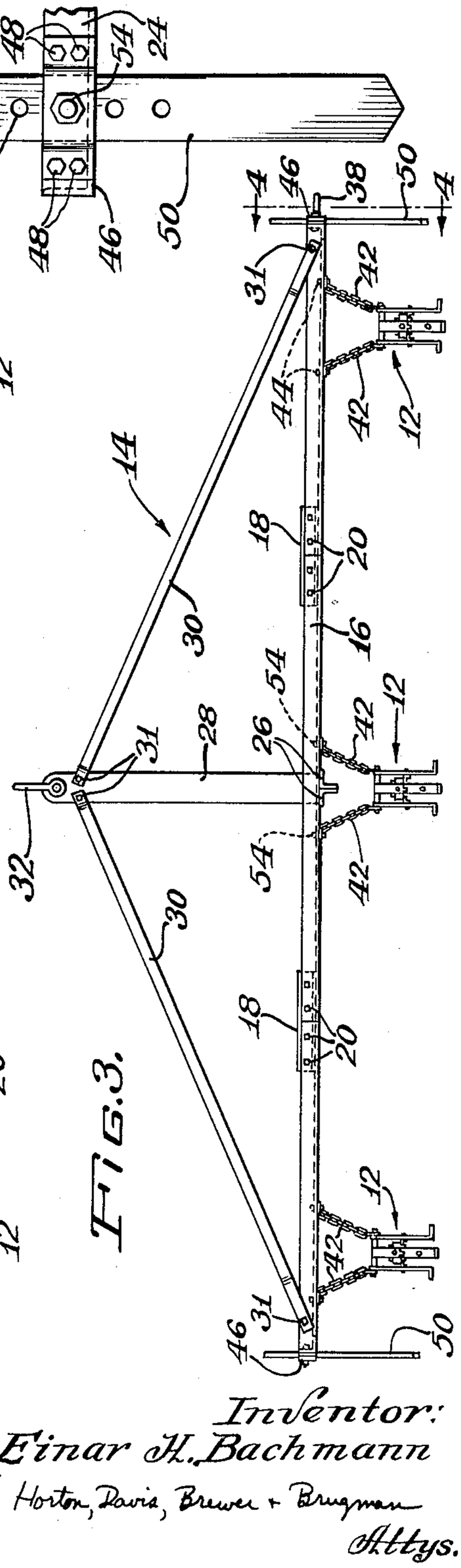


FIG. 3.

Inventor:
Einar H. Bachmann
By Horton, Davis, Brewer & Brugman
Attys.

April 27, 1965 E. H. BACHMANN 3,180,671

REINFORCING MAT HANDLING MEANS

Filed May 8, 1962 5 Sheets-Sheet 3

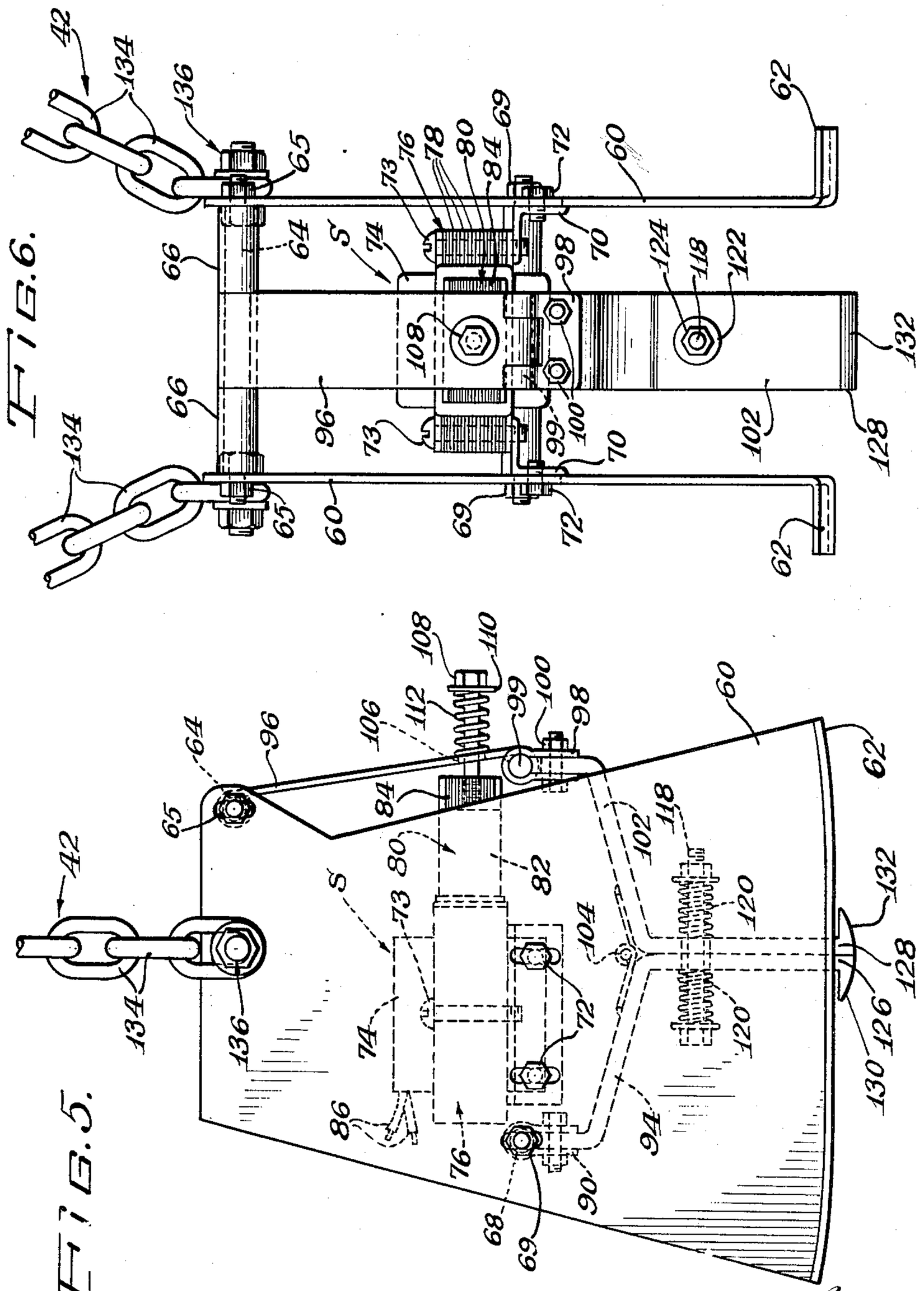


FIG. 6.

FIG. 5.

Inventor:
Einar H. Bachmann
By Horton, Davis, Brewer & Brugman
Attys.

April 27, 1965 E. H. BACHMANN 3,180,671

REINFORCING MAT HANDLING MEANS

Filed May 8, 1962 5 Sheets-Sheet 4

FIG. 8.

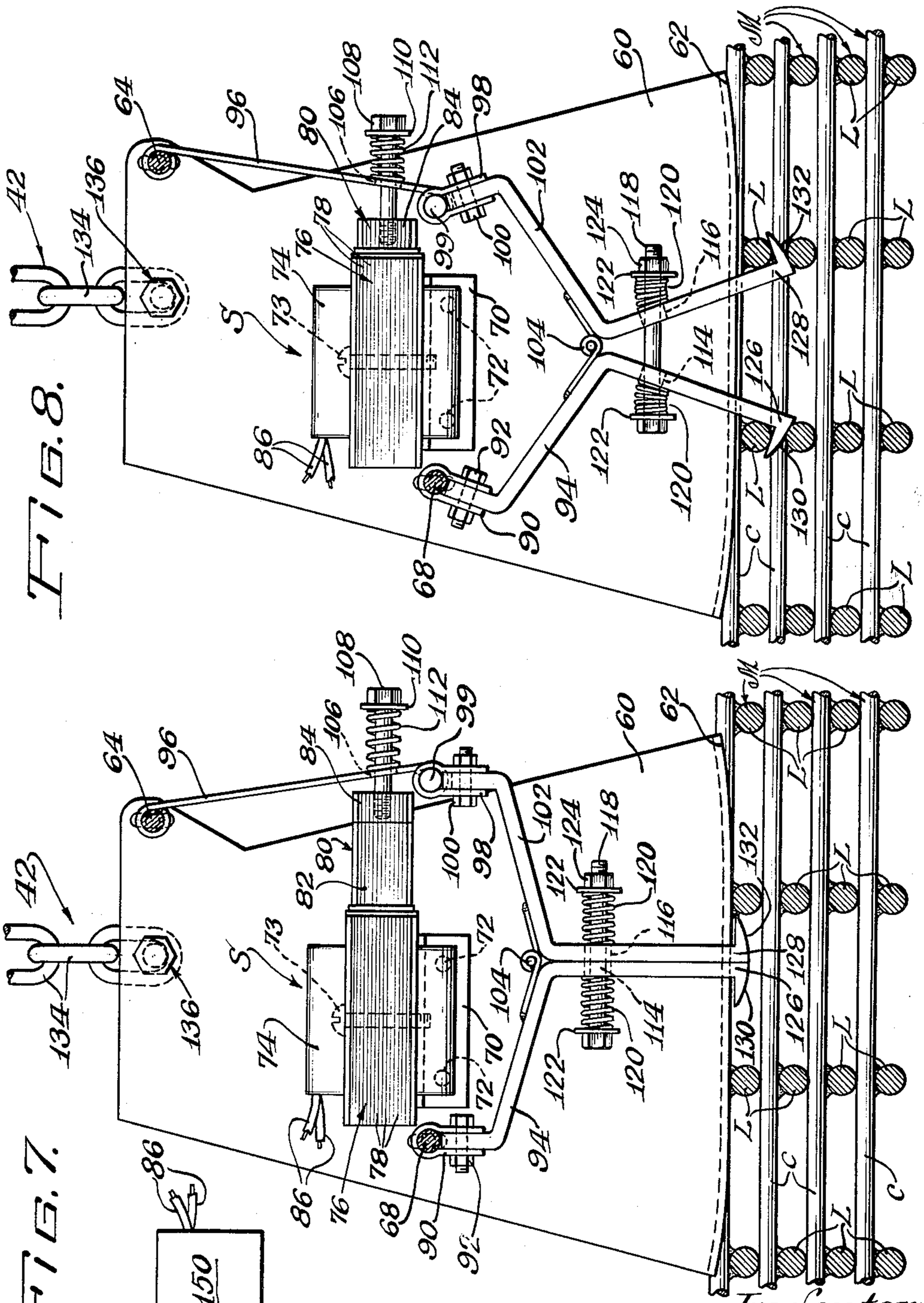


FIG. 7.

Inventor:
Einar H. Bachmann
By Horton, Davis, Brewer & Brugman
Attys.

April 27, 1965

E. H. BACHMANN

3,180,671

REINFORCING MAT HANDLING MEANS

Filed May 8, 1962

5 Sheets-Sheet 5

FIG. 9.

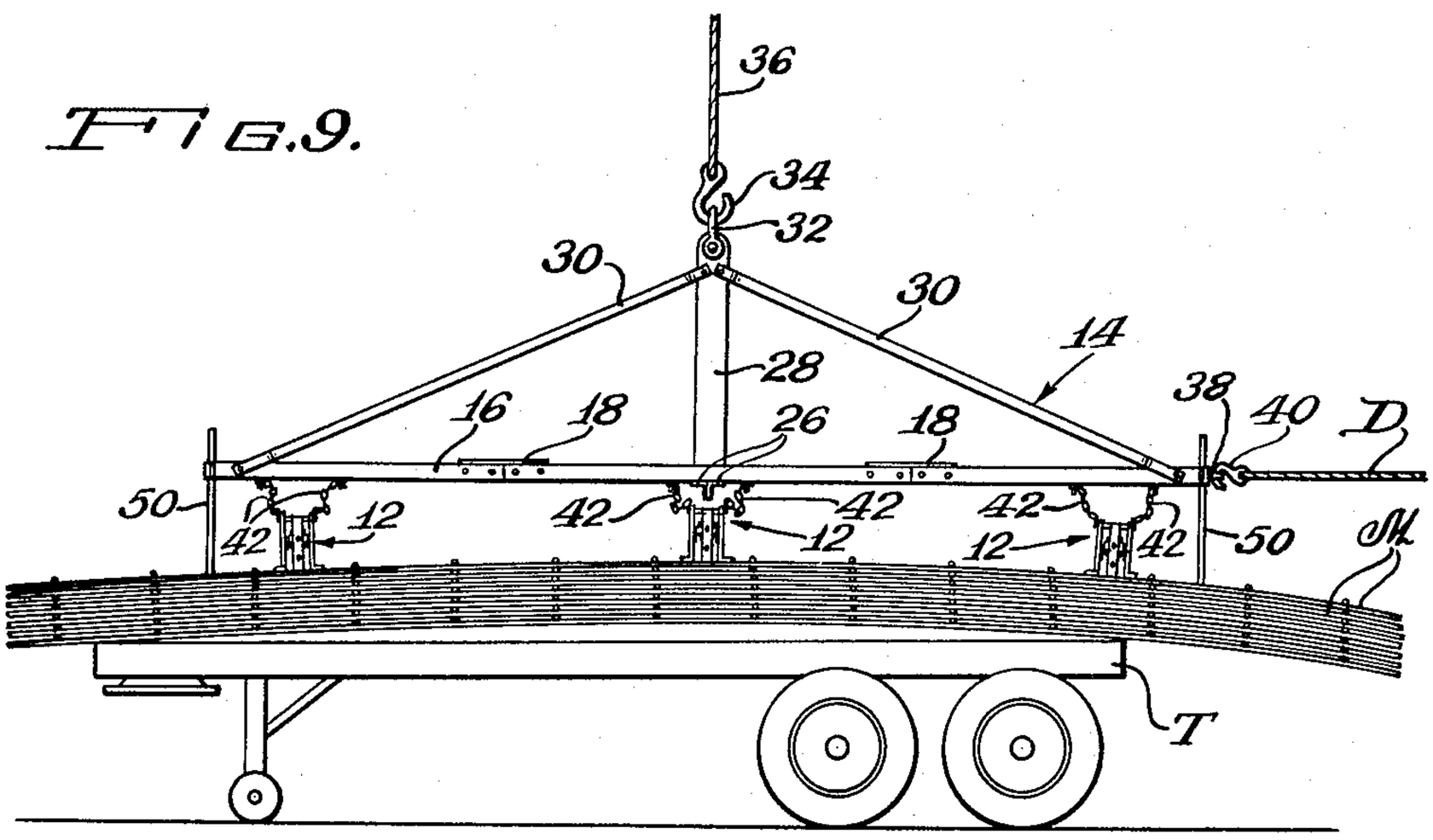


FIG. 10.

Inventor:
Einar H. Bachmann
By Horton, Davis, Brewer + Brugman
Attys.

United States Patent Office

3,180,671

Patented Apr. 27, 1965

3,180,671
REINFORCING MAT HANDLING MEANS

Einar H. Bachmann, 1515 Gregory St., Wilmette, Ill.

Filed May 8, 1962, Ser. No. 193,228
5 Claims. (Cl. 294—81)

This invention relates to novel means for grasping, lifting and manipulating steel reinforcing mats.

Steel reinforcing mats are embedded in the concrete of most heavy-duty concrete roadways and highways and in most airport runways. So also are such mats utilized in providing high strength concrete floors for factories and the like. Many reinforcing mats weigh hundreds of pounds each. Because of that and because of their great widths and lengths they are extremely difficult to handle and manipulate. Typical reinforcing mats which are used in airport runways and superhighways weigh in excess of 700 pounds and are frequently 11½ by 24 feet in size. Thus it is obvious that if mats such as those are to be manipulated manually, a number of men are necessary to handle them. And of course manual manipulation is necessarily slow and expensive.

The invention to be described herein obviates the necessity of having a large number of men available to remove reinforcing mats from trucks and other vehicles and to place them in their desired positions with respect to the ground base of concrete floors, roads and runways. It renders manipulation and handling of mats an easy, inexpensive and rapid operation and enables a single operator to remove large mats from trucks and stacks and to place them in desired locations. It facilitates the positive removal of a single mat from stacks of such mats.

This invention contemplates the use of a lifting device suspendible from an overhead carriage such as a crane. The lifting device includes a plurality of depending individual gripping units each of which is adapted to grasp selectively a predetermined number of reinforcing mats at locations spaced from each other so that the predetermined number of mats may be lifted from a stack, may be suspended by the lifting device through the intermediary means of the gripping units, and may be moved to a desired location, at which time the individual gripper units are adapted to release the mats selectively grasped.

Therefore it is a principal object of this invention to provide novel means for manipulating steel reinforcing mats.

It is a further object of this invention to provide a novel lifting device suspendible from an overhead carriage means, said lifting device including a plurality of novel gripping units which are adapted to grip a reinforcing mat at a plurality of spaced locations so that the mat may be elevated and moved thereby.

A still further object is to provide a novel gripping device for gripping, holding and facilitating manipulation of steel reinforcing mats.

Further objects, advantages and purposes of this invention will become apparent from the following description and drawings of which:

FIGURE 1 is a perspective view of one embodiment of the lifting device of this invention;

FIG. 2 is a plan view of the lifting device of FIG. 1 including certain details not shown in FIG. 1;

FIG. 3 is a side elevation of the lifting device of FIG. 2;

FIG. 4 is an enlarged side elevation of stop means taken substantially along the line 4—4 of FIG. 3;

FIG. 5 is an enlarged side elevation of one of the gripper units of FIG. 1;

FIG. 6 is a front elevational view of the gripper unit of FIG. 5 looking at the unit from the right side of FIG. 5;

FIG. 7 is a detailed view of the gripper unit of FIG. 5 having one of the frame plates removed and showing the gripper unit adjacent a stack of reinforcing mats;

FIG. 8 shows the gripper unit of FIG. 7 in a mat gripping relationship to a stack of mats;

FIG. 9 shows the lifting device of FIGS. 2 and 3 in mat gripping relationship to a stack of reinforcing mats;

FIG. 10 shows the lifting device of FIG. 9 after it has removed a mat from the stack of mats;

FIG. 11 is a partial side elevational view of a modified suspension means for the individual gripper units; and

FIG. 12 is a partial plan view of the modification of FIG. 11.

Referring first to FIGURES 1 to 3 particularly, the lifting device 10 of this invention is seen to comprise a plurality of individual gripper units 12 mounted on frame 14 for gripping and lifting a reinforcing mat M. Mat M comprises spaced parallel longitudinal rods L and spaced parallel connecting rods C disposed perpendicular to rods L. Frame 14 includes a rectangular frame portion made up of sectional longitudinal frame members 16 joined by frame expansion members 18 connected to the longitudinal frame members by nuts and bolts 20 which pass through suitable holes in members 16 and 18. The frame 14 also includes transverse frame members 24 and central reinforcing ribs 26. All of the frame members and the central reinforcing ribs may be of standard angle stock.

A central upstanding support column 28 is welded to the central reinforcing ribs. Tension reinforcing rods 30 are attached adjacent the top of column 28 by nuts and bolts 31. At their other ends tension rods 30 are attached near the ends of longitudinal frame members 16 by nuts and bolts 31. A pivotally mounted support hook 32 is located at the top of central support column 28. Support hook 32 is adapted to be engaged by a depending hook 34 which is suspended from a hoist line 36. The overhead carriage from which the hoist line depends is not shown.

Attached adjacent the center of one of the transverse frame members is a dragline eyebolt 38. Dragline eyebolt 38 is adapted to be engaged by a dragline hook 40 which in turn is connected to a dragline D also operable from the overhead carriage (not shown). Manipulation of the dragline enables more accurate angular orientation of lifting device 10. Each of the gripper units 12 is connected to the longitudinal frame members 16 by flexible connector members 42 which are attached thereto by nuts and bolts 44 which pass through suitable holes in longitudinal frame members 16.

As best seen in FIGS. 2 to 4, each end of each of the transverse frame members 24 is provided with a bracket 46. Brackets 46 are attached to transverse frame members 24 by nuts and bolts 48 which pass through both the brackets and the frame members 24. Brackets 46 are proportioned and adapted to slidingly receive vertical stop members 50. Vertical stop members 50 are provided with a plurality of vertically spaced holes 52 for a purpose to be described. Nut and bolt means 54 which pass through frame members 24, brackets 46 and holes 52 serve to lock vertical stop members 50 to brackets 46 and thus maintain them in a fixed predetermined vertical relationship with respect to transverse frame members 24.

FIGURES 5 to 8 inclusive, show gripper units 12 in greater detail. Gripper units 12 include frame plates 60 which terminate at their lower edges in outwardly extending flange portions 62 having slightly upwardly tapered forward and rearward edges. Frame plates 60 are maintained in a fixed predetermined parallel relationship by suitable spacing elements.

One of those spacing elements is upper pivot rod 64

reduced diameter end portions of which pass through vertically elongated openings in frame plates 60. The reduced diameter end portions are threaded. The elongated openings in frame plates 60 are sufficiently narrow so that only the reduced diameter portion may pass therethrough. Thus when bolts 65 are tightened on the threaded portions of the rod 64, frame plates 60 are immovably held between the shoulders of the larger diameter portion, that is the central portion, of rod 64, and bolts 65. Slidably mounted on upper pivot rod 64 are upper pivot rod sleeves 66 which serve to center, orient and minimize lateral movement of the gripper elements and the upper pivot arm, about which members more will be said.

Another of the spacing elements for maintaining frame plates 60 in their desired parallel orientation is lower pivot rod 68. Threaded reduced diameter ends of lower pivot rod also pass through elongated vertical openings in frame plates 60, bolts 69 serving to interconnect frame plates 60 in the same manner as described in connection with bolts 65. Sleeves similar to sleeves 66 may also be provided on lower pivot rod 68.

Frame plates 60 are adapted to support a solenoid S between them. Mounting angles 70 are connected to frame plates 60 by bolts 72, and solenoid S is bolted to the mounting angles by bolts 73. Bolts 72 pass through vertical slots in plates 60 which permits a degree of vertical adjustment of solenoid S. When bolted securely, solenoid S and angles 70 also assist in spacing frame plates 60.

Solenoid S comprises a winding 74, a U-shaped magnetically permeable frame 76 which is constructed of a plurality of U-shaped stampings 78 held together by rivets (not shown), and a T-shaped plunger 80 assembled from a plurality of T-shaped stampings held together by rivets (not shown). T-shaped plunger 80 includes a plunger section 82 and a head section 84. Conductors 86 leading to the winding 74 are connected to a suitable source of electrical current to operate solenoid S.

A first generally U-shaped pivot strap 90 is mounted to oscillate on lower pivot rod 68. Pivot strap 90 is connected by nuts and bolts 92 to a first gripper element 94.

On the upper pivot rod 64, and between the upper pivot rod sleeves 66, there is oscillatably mounted an upper pivot arm 96. A second generally U-shaped pivot strap 98 is pivotally connected to the lower end of upper pivot arm 96 by a pivot pin 99. Pivot strap 98 is connected by nuts and bolts 100 to a second gripper element 102. Gripper elements 94 and 102 are pivotally interconnected in their central regions by a hinge 104. The arms of hinge 104 are welded to gripper elements 94 and 102.

Upper pivot arm 96 is provided with a vertically elongated slot 106 through which passes a solenoid plunger bolt 108. Solenoid plunger bolt 108 is threadingly received in head section 84 of plunger 80. Adjacent its enlarged end, plunger bolt 108 contacts a washer 110 against which bears one end of plunger compression spring 112. The other end bears against upper pivot arm 96 adjacent slot 106.

First and second gripper elements 94 and 102 are provided with axially spaced enlarged openings 114 and 116. Through these openings a compression bolt 118 passes. Concentrically mounted on bolt 118 are two gripper element compression springs 120, two gripper washers 122 and finally compression bolt nut 124 which is threadingly received by bolt 118. Nut 124 can be utilized to adjust the pressure exerted by springs 120. Gripper elements 94 and 102 terminate at their lower ends in hooks 126 and 128 having arcuate feet 130 and 132 respectively.

Flexible connectors 42 consist of chain links 134, and are attached to gripper units 12 by nut and bolt means 136.

FIGS. 11 and 12 show a modified means for supporting the gripper units of this invention from a frame member 200 which might be one of the longitudinal frame members 16 of FIG. 1.

A support bar 202 disposed normal to frame member 200 is welded thereto. Flexible connectors 204 consisting of a plurality of chain links 206 are connected to frame member 200 and support bar 202 by nuts and bolts 208. Connector plates 210 are welded to the upper edges of frame plates 212 of the gripper unit. Frame plates 212 terminate at their lower edges in flanges 214 having slightly tapered forward and rearward edges. Nuts and bolts 216 connect two of the flexible connectors 204 to connector plates 210 and nuts and bolts 218 connect frame plates 212 of gripper unit to the other two flexible connectors 204.

Operation

The invention herein is adapted to handle reinforcing mats of varying lengths, widths and meshes. Thus, the frame 14 of FIG. 1 has been shown to be expandible in length by making use of expansion members 18 of different lengths. If for any reason it is necessary to increase the effective length of sectional longitudinal frame members 16, expansion members 18 may be removed and expansion members of greater lengths may be inserted. If that is done it will become necessary to increase the effective length of tension rods 30 also and to accomplish that, new tension rods of greater lengths may be substituted for the old. Of course it is possible to increase the effective length of tension rods 30 by severing them and inserting an expansion member in a manner similar to that shown for increasing the length of longitudinal frame members 16. It is to be understood, although it is not shown, that the transverse frame members 24 as well as ribs 26 may be sectional to allow for increases in the width of frame 14.

The distance the gripper units are spaced apart may also be varied, if desired, consistent with the size of the mats to be handled, by providing additional holes in longitudinal frame members 16 through which gripper unit connecting nuts and bolts 44 may be attached to the longitudinal frame members.

All adjustments should take into consideration the fact that lifting device 10, when elevated, should lie in a generally horizontal plane.

The lifting device 10 of this invention may have a frame 7 by 17 feet which is a convenient size for handling reinforcing mats 11½ x 24 feet when the gripper units are spaced on seven foot centers. The mats M illustrated are of that size and are constructed of ½" steel longitudinal rods L spaced on three inch centers and are welded into a mesh by 5/16" steel connector rods C spaced on twelve inch centers.

When the frame and the gripper units have been arranged to handle mats of the size to be manipulated, a crane or other suitable overhead support means is caused to engage support hook 32, to elevate lifting device 10 thereby, and then to move the lifting device until it overhangs the mats. It is then lowered until each of the gripper units engages the top reinforcing mat of a stack of reinforcing mats. To mtaintain the proper angular orientation, in a horizontal plane, of the lifting device, dragline D is connected to frame 14 by eyebolt 38 and dragline hook 40. The dragline may be connected to and manipulatable from the overhead support means.

FIGURE 9 illustrates the lifting device in juxtaposition to a bowed stack of mats which has been brought to the construction site on a truck T. Shown are the gripper units 12 in contact with the top mat. It should be observed that vertical stop members 50 are also in engagement with the top mat. The function of the vertical stop members 50 is to prevent frame 14 from descending far enough to allow the longitudinal frame members 16 to contact the tops of gripper unit frame plates 60. As best seen in FIG. 4, vertical stop members 50 have tapered lower ends and are sufficiently wide so that they

will not pass between longitudinal rods L when lowered into engagement with the mats, thereby preventing frame **14** from descending too far. The downward extent of stop members **50** will depend in large measure upon the length of flexible connectors **42** and the vertical extent of gripper units **12** and may be adjusted by making use of the holes **52** provided in stop member **50**.

A study of FIG. 9 particularly will show why flexible connectors **42** are used. Since mats M very frequently are stacked in other than a true planar orientation, such as in the bowed configuration shown in FIGS. 9 and 10, or in other than a true horizontal plane, a certain degree of flexibility in the lifting device is desirable. For that reason flexible connectors **42** comprising links **134** are used, although it is apparent that cables or other means affording similar flexibility may be utilized. Although the flexible connectors **42** of FIG. 9 are all of the same length (see FIG. 10), certain of their effective lengths as seen in FIG. 9 vary. Thus, the flexible connectors **42** of the centermost gripper units are shown to have the shortest effective length, that is, the gripper units supported by them are closest to the frame **14**. Also, the outermost flexible connectors of the outside gripper units have a somewhat greater effective length than the inside flexible connectors of the same gripper units, that is, the upper edge of the outermost frame plate **60** of the outside gripper units is farther from the frame than is the upper edge of the innermost frame plate.

Referring now to FIG. 7, it will be observed that the feet **130** and **132** of hooks **126** and **128** are arcuate. That shape is provided so that if the hooks of a gripper unit descend into contact with a longitudinal rod L of mat M the hooks will be self-orienting. That is, they will tend to slide to one side or the other and as such will not remain on dead center. And too, as best seen in FIGS. 7 and 8, the frame plate flanges **62** are long enough to lie across several longitudinal rods L thereby acting as a self-stabilizing base on which the gripper units **12** will be seated on mats M. The upwardly tapered forward and rearward edges of frame plate flanges **62** facilitate smoothness and ease of seating of the gripper units **12**.

When suitably seated on the mats, gripper units **12** are ready to be activated and caused to be moved from an inactive closed position shown in FIGS. 5 to 7 to the active open mat gripping position of FIG. 8. As is seen in FIGS. 5 to 7, compression springs **120** normally maintain hooks **126** and **128** of gripper elements **94** and **102** in a closed adjacent inactive position.

When solenoid S is actuated plunger section **82** of T-shaped plunger **80** is drawn inwardly of winding **74** until head section **84** of plunger **80** stops that motion. As seen in FIG. 8, when plunger **80** moves to the left, upper pivot arm **96** moves in a clockwise direction pivoting on pivot rod **64**. Sleeves **66** orient pivot arm **96**, hence gripper elements **94** and **102**, and prevent any substantial movement of pivot arm **96** axially of pivot rod **64**. When pivot arm **96** moves in a clockwise direction that causes gripper elements **94** and **102** to pivot about lower pivot rod **68**, pivot pin **99** and hinge **104**, and forces hooks **126** and **128** downwardly and apart against the forces exerted by compression springs **120**. Spring **112** serves to maintain positively the upper pivot arm **96** in either the inactive position of FIG. 7 or the active position of FIG. 8.

When in the active mat gripping position of FIG. 8, hooks **126** and **128** extend below the bottom surface of frame plate flanges **62** a distance sufficient to engage the longitudinal rods L of the top mat but insufficient to grasp more than a single mat. That is accomplished by properly proportioning the various parts of the gripper units. It is to be noted that a certain degree of adjustment in the extent to which the hooks will move downwardly below frame plate flanges **62** is possible. The elongated vertical openings through which upper and lower pivot rods **64** and **68** extend permits upward and downward movement of the gripper elements **94** and **102**. If such an adjustment is to be made it may also be necessary to adjust solenoid S vertically by moving mounting angles **70** either up or down. Very slight vertical adjustments in pivot rods **64** and **68** may not require movement of mounting angles **70** because of elongated vertical slot **106** in upper pivot arm **94**. The provision of structure for effectuating vertical adjustment means that mats M having longitudinal or connecting rods of different diameters may be conveniently handled by the same gripping units and that any tendency of the gripper elements to bind in contacting the mats because the clearance is insufficient may be compensated for.

It is to be noted that the vertical plane in which the axis of hinge **104** lies changes between the closed position of FIG. 7 and the active mat gripping position of FIG. 8. To accomplish the desired gripping it may be necessary for the whole gripper unit **12** to be displaced slightly so that the axis of the hinge **104** can be oriented properly between the vertical planes in which lie the axes of the longitudinal rods L grasped. The flexible connectors **42**, in addition to the earlier-mentioned functions, also serve to permit any such minor movement of the gripper units, as well as such other minor movements which might be necessary.

A solenoid S is provided for each gripper unit. While each may be operated individually, it is preferable that they be operable simultaneously and remotely, such as from the cab of the overhead support device or crane from which hoist line **36** and dragline D are also operated. Electrical conductors **86** which carry the current to each solenoid winding **74** may be disposed adjacent flexible connectors **42**, frame members **16** and **18**, and **24**, and then may be led up column **28** along hoist line **36**, or instead may lie adjacent dragline D, thence to a suitable source of power **150** (see FIG. 7). Power source **150** is adapted to operate all of the solenoids S simultaneously by supplying current to all of them through conductors **86** simultaneously. Suitable switches are provided.

Once the solenoids S of gripper units **12** have been actuated and each of the gripper units has assumed the mat gripping disposition of FIG. 8, the lifting device may be elevated from the position shown in FIG. 9 to that of FIG. 10 wherein the mat lies in a substantially horizontal plane. Thus disposed, the mat may be moved by the overhead carriage means to the location where the mat is to be utilized, such as in the roadway, runway or the like, be placed in position, and then be released by de-energizing the solenoids. When de-energization occurs springs **120** cause gripper elements **94** and **102** to return to the closed inactive position of FIGS. 5 to 7, thereby releasing the mat. The lifting device **10** may then be elevated and returned to grip and remove another mat M from a stack of mats.

As a safety feature, gripper units **12** may be constructed so that if de-energization of the solenoids S occurs while the mats gripped are suspended in the air, the mats will not be released. As seen in FIG. 8, when in mat gripping position, hooks **126** and **128** cradle the gripped longitudinal bars L. The compressive strength of springs **120** may be so regulated that the weight of mat M, when suspended from frame **14** by gripper units **12**, is insufficient to overcome the efforts of the springs to cause gripper elements **94** and **102** to close. However, when all or a portion of the weight of the mat is removed from hooks **126** and **128**, such as when the mat is lowered to the ground or into position in the roadway or the like, springs **120** will once again cause the gripper elements to close.

The modification of FIGS. 11 and 12 illustrates means for providing a more stable flexible connector system where such is found to be desirable. However, for general use it is contemplated that the two member flexible connector system illustrated in FIGS. 1 to 10 should provide ample stability and flexibility.

I do not intend to be limited to the embodiments disclosed and described herein, except insofar as may be necessary in view of the appended claims.

I claim:

1. In combination with at least one generally rectangular reinforcing mat comprised of a first plurality of spaced parallel coplanar elongated rods and a second plurality of spaced parallel coplanar elongated rods disposed at an angle to and interconnected with said first plurality of rods, said first and second plurality of rods defining an open meshwork comprising a plurality of openings, a device for lifting and suspending a predetermined number of said reinforcing mats at a plurality of widely spaced openings in said meshwork, said device comprising an enlarged frame including means for suspending said frame from an overhead support structure, a plurality of gripper units suspended from said frame and disposed at said plurality of widely spaced openings in said meshwork, each of said gripper units including a housing, gripping means extending downwardly from said housing and into one of said widely spaced openings in said meshwork and means for moving said gripping means between an active rod supporting position to support and suspend said predetermined number of mats and an inactive position in which said gripping means do not support said predetermined number of mats, each of said gripper unit housings including means for seating and stabilizing said gripper unit upon the rods of a mat in said inactive position and being proportioned, together with said gripping means, to provide supporting engagement of said rods at one of said plurality of widely spaced openings in said meshwork by said gripping means to grip for suspension and support said predetermined number of mats.

2. The combination of claim 1 wherein said frame includes means connected thereto which limits the extent to which said frame may be moved downwardly from said overhead support structure into contact with a reinforcing mat.

3. The combination of claim 1 wherein each of said gripper units is independently suspended from said enlarged frame by flexible connector means and wherein each of said gripping means includes a pair of pivotally mounted gripper elements, the means for moving said gripping means of each of said gripper units being simultaneously actuatable.

4. The combination of claim 1 wherein each of said gripping means comprises a pair of hook elements, and wherein said means for moving said gripping means to said active rod supporting position comprises a separate solenoid means in each of said gripper units, said hook elements being proportioned to maintain gripping contact with said mat when said mat is suspended therefrom and when said solenoids are de-energized.

5. The combination of claim 1 wherein each of said gripper units is suspended from said frame by connector means comprising a pair of flexible connector elements connected at one end to said frame and at the other end to said gripper unit housings.

References Cited by the Examiner

UNITED STATES PATENTS

3,064,855	11/62	Fischer	294—97 X
3,075,800	1/63	Rowekamp	294—88
3,078,115	2/63	Harlander	294—67
3,090,502	5/63	Gunzelmann	294—63 X

SAMUEL F. COLEMAN, *Primary Examiner.*

ANDRES H. NIELSEN, *Examiner.*