United States Patent [19]

Newman

[11] **3,908,293**

[45] **Sept. 30, 1975**

[54] **SCREEN TENSIONING AND PRINTING FRAME**

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[73] Assignee: **Stretch Devices, Inc.,** Philadelphia, Pa.

[22] Filed: **Sept. 19, 1974**

[21] Appl. No.: **507,301**

[52] **U.S. Cl.** **38/102.91**

[51] **Int. Cl.²** **D06C 3/08**

[58] **Field of Search** 38/102–102.91; 101/127.1, 128, 128.1, 415.1; 69/19.1–19.3; 24/243.9, 243.10, 243.11

[56] **References Cited**

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1,546,400	7/1925	Nichols	38/102.5
2,832,171	4/1958	Batey	38/102.91
3,226,861	1/1966	Bird	38/102.91
3,482,343	12/1969	Hamu	38/102.5
3,601,912	8/1971	Dubbs	38/102.91
3,774,326	11/1973	Selden	38/102.4

Primary Examiner—Geo. V. Larkin
Attorney, Agent, or Firm—Seidel, Gonda & Goldhammer

[57] **ABSTRACT**

A screen tension and printing frame includes sets of parallel rollers coupled at their ends to corner members. Each roller is coupled to an edge portion of a screen. The screen is in sealing contact with a dam member located inwardly of the rollers. Means are provided to camber each of the rollers. Each roller is provided with means to facilitate selective rotation and the locking of the roller in a position so that a desired tension may be applied to the screen.

16 Claims, 9 Drawing Figures

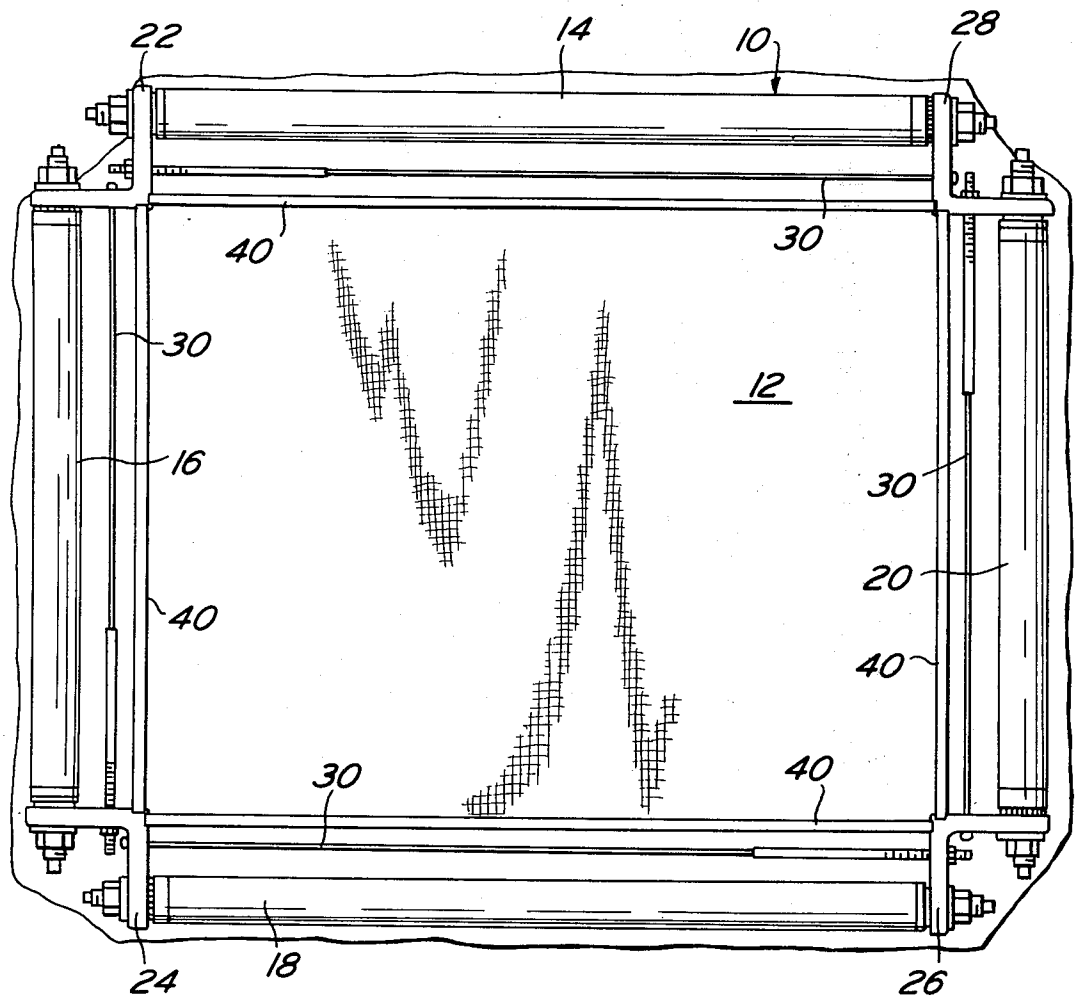
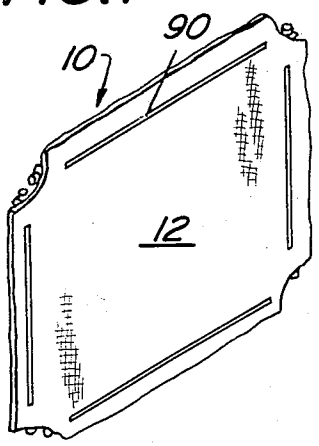


FIG. 1



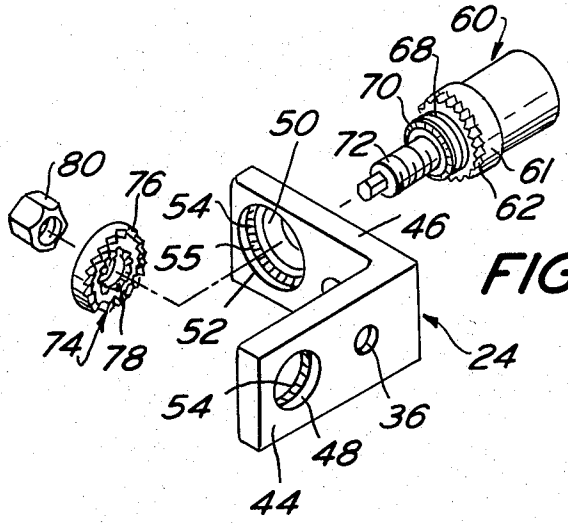
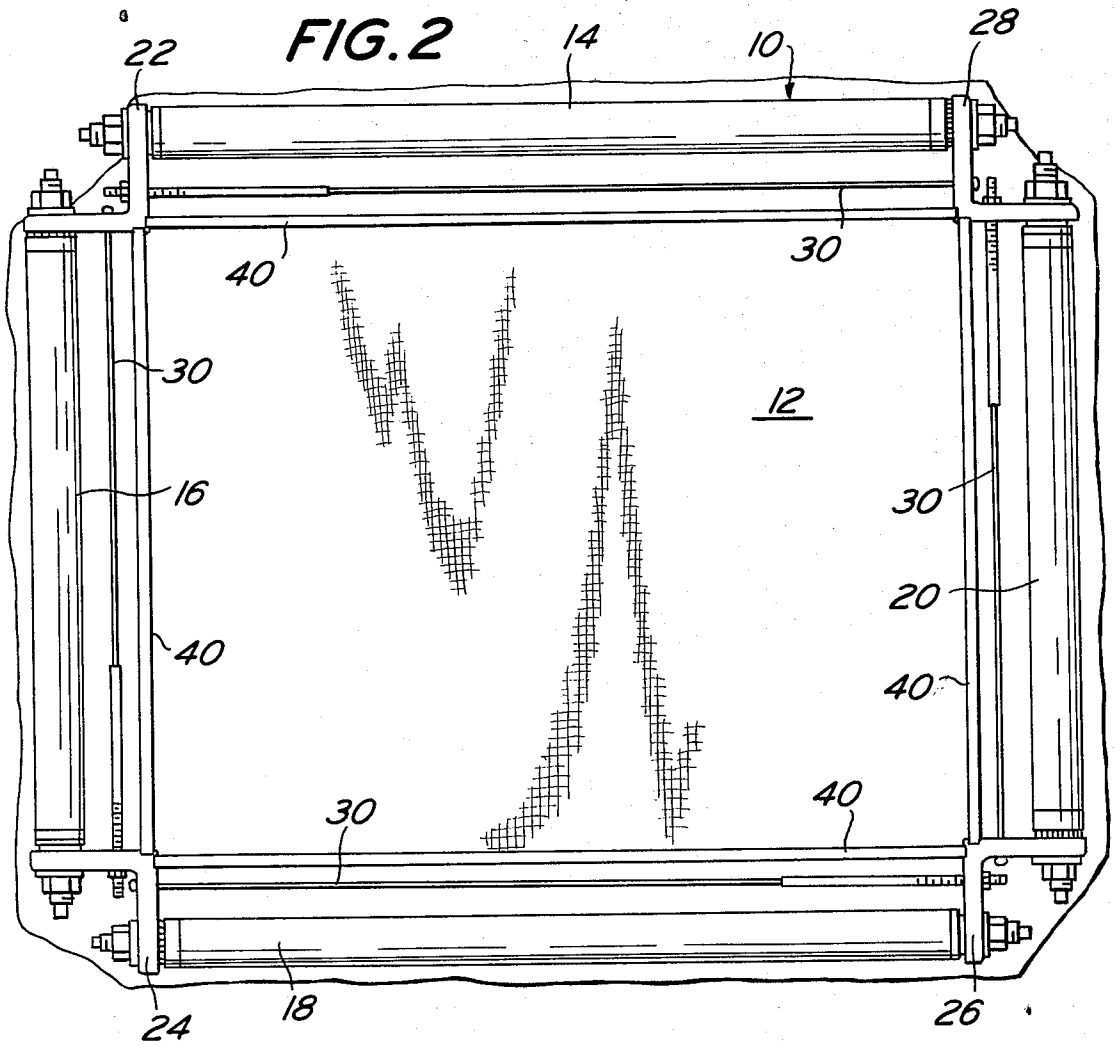


FIG. 4

FIG. 2



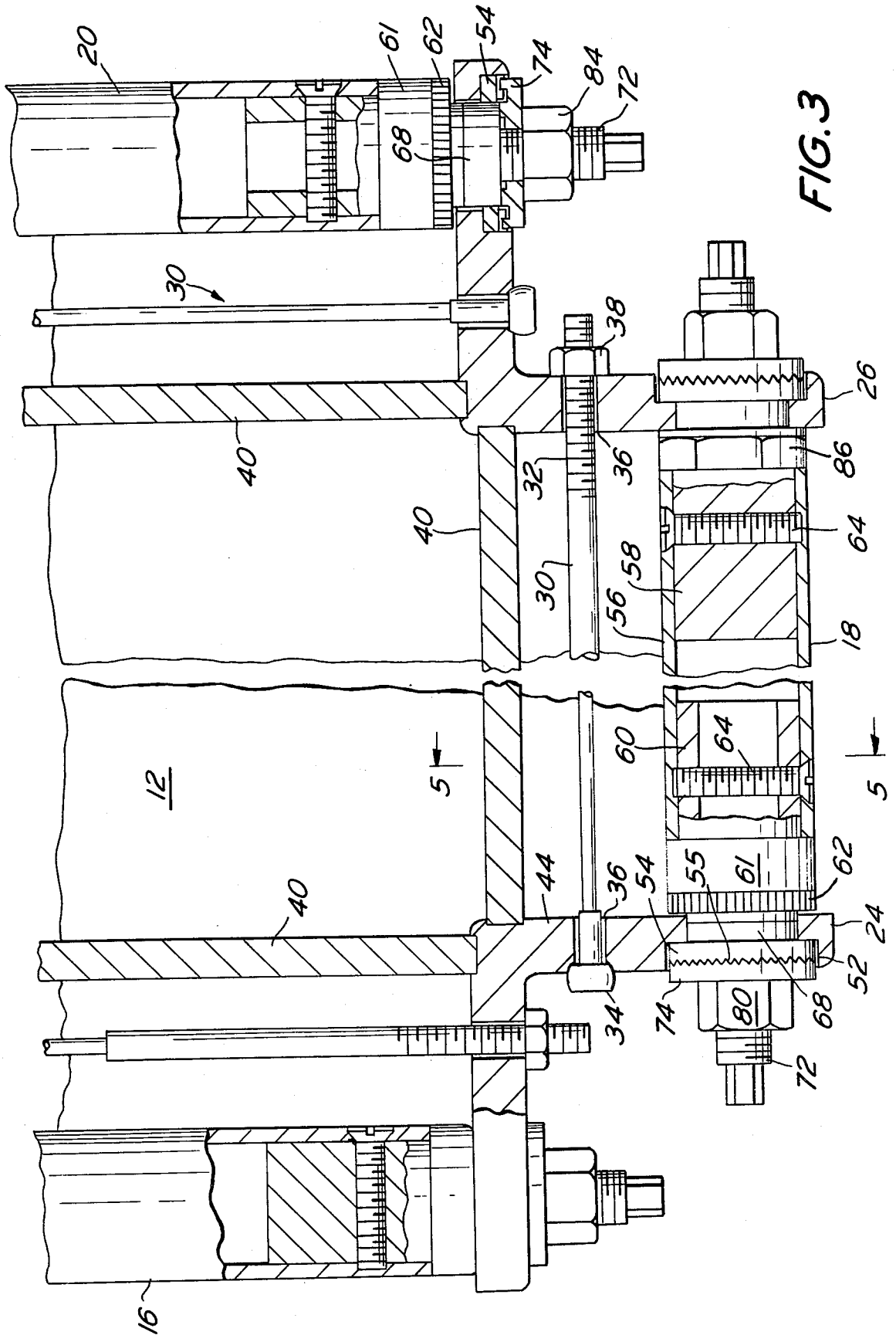
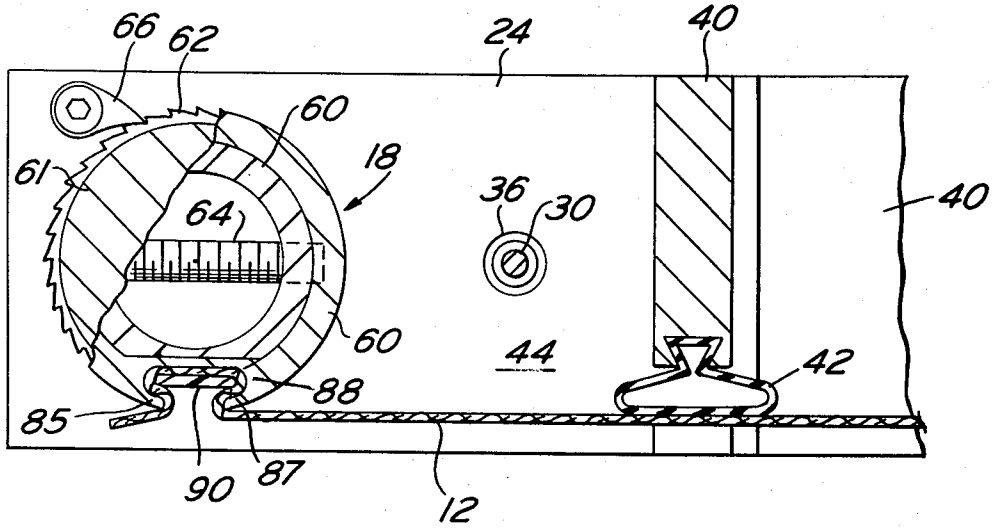

20
61
62
54
74
84
72
68
30
38
26
40
32
36
86
40
64
30
58
56
18
12
5
60
64
5
44
36
54
55
61
62
40
24
52
34
74
80
68
72
16

FIG. 3

FIG.5



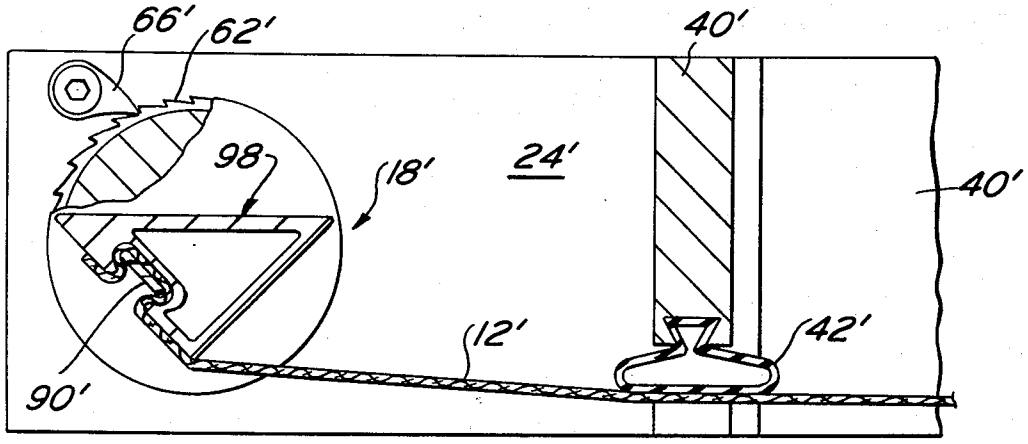


FIG.6

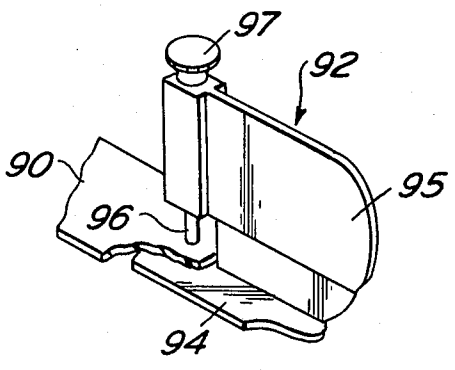


FIG.7

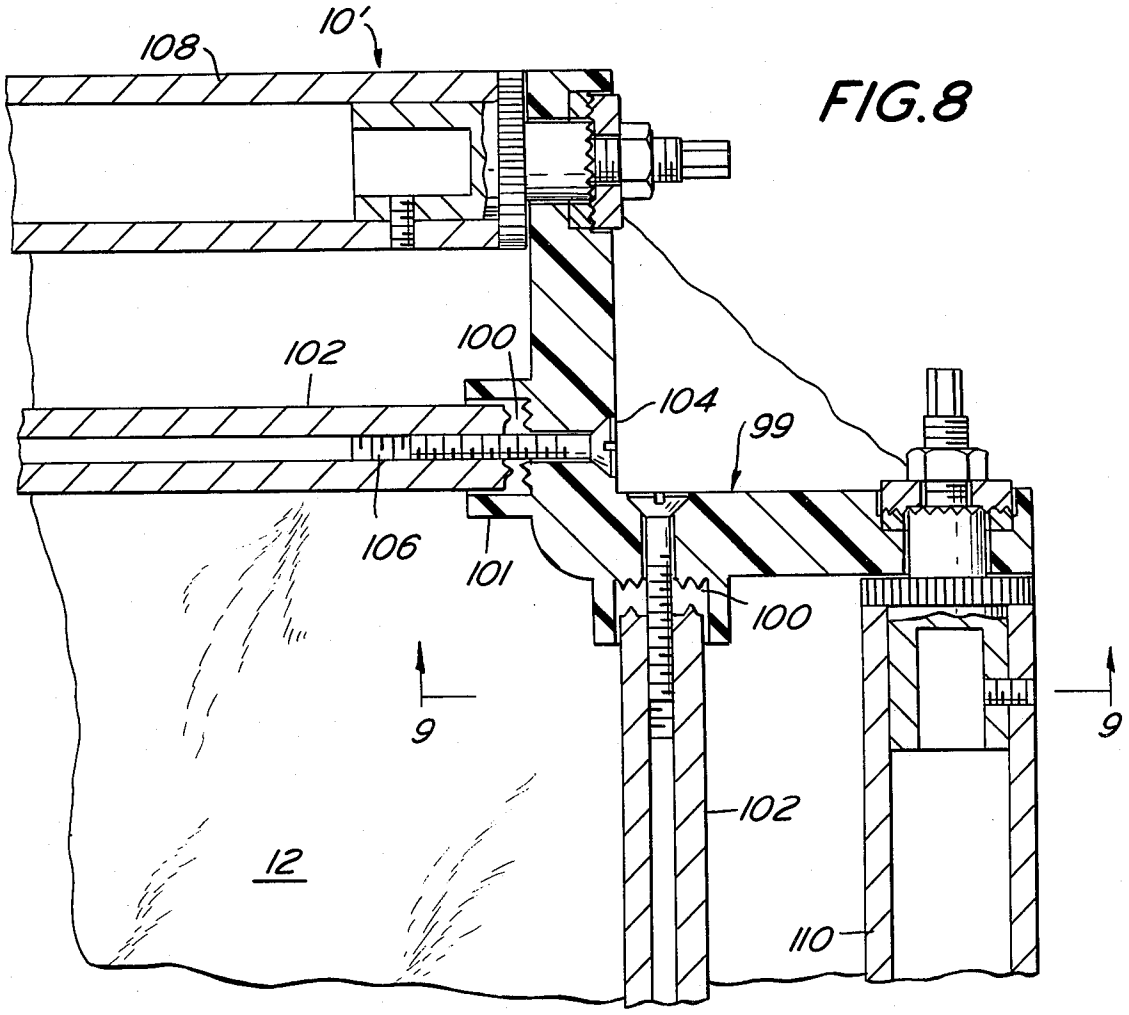

10'
108
102
100
104
99
106
101
100
9
9
102
12
110

FIG.8

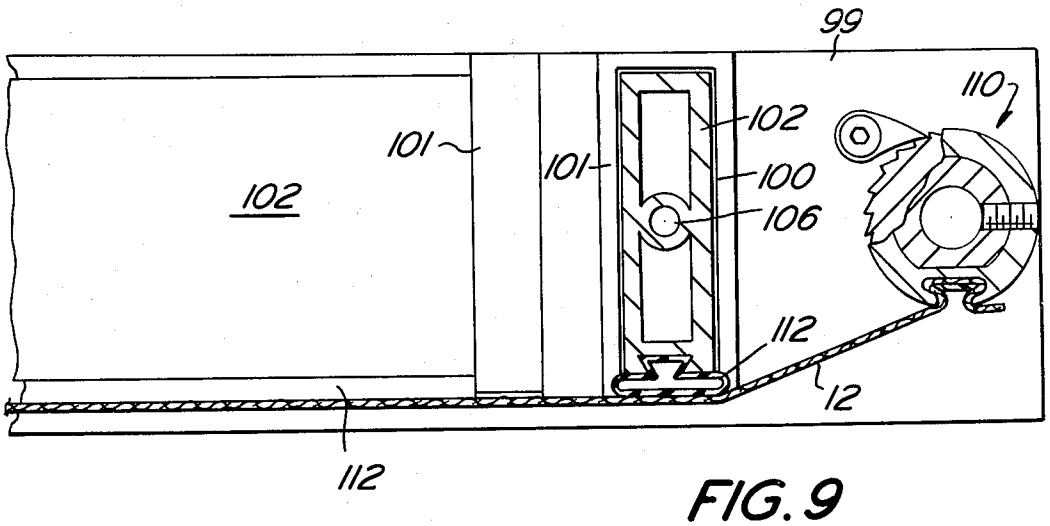

99
110
101
101
102
102
100
106
112
12
112

FIG.9

SCREEN TENSIONING AND PRINTING FRAME

BACKGROUND

This invention relates to screen printing frames for supporting and stretching a printing screen of flexible fabric. The devices disclosed in U.S. Pat. Nos. **1,546,400; 3,601,912** and **3,482,343** are representative of the prior art.

A major disadvantage of the prior art such as the device in U.S. Pat. No. **1,546,400** is the inability to stretch the screen fabric uniformly. In said device, rollers engage the fabric at spaced points defined by pins.

In prior art devices exemplified by U.S. Pat. No. **3,482,343** the frame is channel-shaped so as to receive a smaller cross-sectioned channel which reciprocates by means of a plurality of screws. Devices as disclosed in said patent are not sufficiently stable to do precision printing, such as printed circuit boards, unless the frame is welded at the corner joints. Such frames lack versatility such that they can only be utilized with one size screen fabric, and cannot be disassembled for purposes of storage or shipment. Other deficiencies of devices as disclosed in said patent include an inherent limit to the extent of tensioning due to the limited travel distance of the reciprocating bar. Deep channels are required for the frame in order to provide space for the reciprocating bars, and thus the deep channel frame is inherently torsionally unstable. In order to compensate for this instability, the channel frame is composed of exceedingly thick wall sections. This increases cost and weight.

The prior art devices as exemplified by U.S. Pat. No. **3,601,912,** involve use of rollers which constitute the tensioning mechanism and the structural frame. The mechanical means for stopping rotation of the roller depends upon friction in an axial direction of the roller and hence the frame, under a sufficient load, can be caused to shift out of its original plane. Also, the frame in said patent does not include any structure or mechanism independent of the rollers for orientating the frame in a specific plane. The frame takes its orientation in the plane solely from the surface that the frame is lying on. Other disadvantages of devices shown in said patent include the lack of any provision for providing for an ink dam other than the roller itself, as well as the excessive time and difficulty involved in the insertion of the strip that locks the fabric to the roller.

The screen tensioning and printing frame of the present invention includes rollers interconnected at their ends by corner members. Each roller is rotatably supported for rotation about its longitudinal axis by two adjacent corner members. Each roller has a shallow channel for receiving and retaining an edge portion of a screen fabric.

In the frame of the present invention, a means is associated with each corner member for selectively rotating and locking the associated roller so that a desired tension may be applied to the screen fabric. Further, a means is provided between adjacent corner members for applying a camber to the associated roller, and an ink dam means is provided on the frame inwardly of the rollers for sealing contact with the screen fabric.

Frames constructed in accordance with the present invention overcome various defects of the prior art while at the same time can be an inexpensive mass-produced frame which will be perfectly square and flat. The frames of the present invention may be substantially lighter in weight than prior art frames such as those having channel-shaped frame members.

The frame of the present invention has the advantage of continuous take-up for tensioning of the screen fabric whereby the screen fabric may be stretched to any desired tension for flat printing or contour printing. The frame utilizes interchangeable components so that the size of the frame may be enlarged or diminished as desired, given a small assortment of roller lengths. The rollers which are the structural component of the frame can be pre-stressed so as to develop an outward camber, whereby increased tension may be applied to the screen fabric, while the rollers still remain undeflected by the increased load applied by the fabric. This maintains the parallel alignment of all of the fibers that reside in the same direction.

The locking coupling at the end of each roller assures that the frame is perfectly flat in the plane, as well as square. This registration in the plane is done independently of any external jigs or templates. These couplings also assure slip free adjustment of the rollers. Assembly and use of this frame was designed so as to require no special skills or talents. Assembly of the frames with their pre-set flat alignment in the plane is accomplished within one or two minutes for any size frame.

Other objects and advantages will appear hereinafter.

For the purpose of illustrating the invention, there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIG. **1** is a perspective view of a frame in accordance with the present invention having a screen fabric applied thereto.

FIG. **2** is a plan view of the frame shown in FIG. **1** but on an enlarged scale.

FIG. **3** is an enlarged detail view of a portion of FIG. **2.**

FIG. **4** is a perspective exploded view of a corner member and roller end plug.

FIG. **5** is a sectional view taken along the line **5—5** in FIG. **3.**

FIG. **6** is a view similar to FIG. **5** but showing another embodiment of the present invention with respect to the cross-section of the roller.

FIG. **7** is a perspective view of a hand tool for use in inserting the retainer.

FIG. **8** is an enlarged detail view of one corner of another embodiment of the present invention.

FIG. **9** is a sectional view taken along the line **9—9** in FIG. **8.**

Referring to the drawing in detail, wherein like numerals indicate like elements, there is shown in FIGS. **1** and **2** a screen tensioning and printing frame **10** in accordance with the present invention. A screen fabric **12** is applied to one face of the frame **10** in a manner to be described in detail hereinafter.

The frame **10** has its main structural element comprised of a plurality of rollers, namely rollers **14** and **18** parallel to each other and rollers **16** and **20** which are parallel to each other. Roller **14** is mutually perpendicular with respect to rollers **16** and **20.** The rollers **14–20** are rotatably supported at their ends by corner members **22, 24, 26** and **28.**

The rollers **14–20** are preferably hollow rollers made of light weight, noncorrosive material such as alumi-

num. The corner members 22–28 are rigid members made from a light weight noncorrosive material such as aluminum. A pre-stressing means extends between adjacent corner members for applying a camber to the associated roller. As shown more clearly in FIGS. 2 and 3, such tension applying means includes a cable 30 having threads 32 at one end and a head 34 at the other end. Head 34 is sufficiently large so that it cannot pass through hole 36 in a corner member. A nut 38 is provided with an opposite corner member for cooperation with threads 32. Each head 34 is nonrotatable with respect to its associated hole 36 whereby rotation of nut 38 will apply a camber to the associated roller whereby the center portion of the roller will be bowed outwardly.

Each corner member is provided with notches on mutually perpendicular faces for receiving a dam member 40. Each dam member 40 is removably received in oppositely disposed notches on the corner members 22–28. The lowermost surface of each dam member is in sealing contact with a major face of the screen fabric 12. In a preferred embodiment, the sealing contact is preferably attained by means of an inflatable or hollow seal 42 made from an elastomeric or polymeric plastic material. As shown in FIG. 5, seal 42 is removably retained on a lower surface of the dam member 40 by way of a notch.

All of the corner members 22–28 are identical. Hence, only corner member 24 will be described in detail. Corner member 24 has legs 44 and 46 which are mutually perpendicular. Each leg contains a hole 36 through which cable 30 may extend. Also, each leg of the corner member 24 is provided with a hole larger in diameter than the hole 36 for rotatably supporting one end of an adjacent roller. In this regard, leg 44 is provided with a hole 48 and leg 46 is provided with a hole 50.

The holes 48 and 50 are of the same diameter and are identical. Hole 50 is provided with a counter sink 52 so as to define a ledge on which is fixedly secured a ring 54. Ring 54 has radially disposed serrations or teeth 55 which face outwardly. See FIGS. 3 and 4. The inner diameter of ring 54 is slightly larger than or the same as the diameter of hole 50. Hole 48 is similarly constructed and provided with a ring 54.

Each of the rollers 14–20 is identical. Hence, only roller 18 will be described in detail. Referring to FIG. 3, it will be noted that the roller 18 is a hollow tube 56 closed at opposite ends by end plugs 58 and 60. The end plugs 58 and 60 are identical. The end plugs 58 and 60 are removably attached in a nonrotative manner to the ends of the tube 56 by means of screws 64 or the like.

The end plug 60 includes an enlarged diameter portion 61 which is of the same diameter as tube 56 and adjacent thereto there is provided a ratchet gear 62 concentric with the tube 56. A ratchet pawl 66 is pivotably secured on an interface of the leg 44 for cooperation with the ratchet gear 62. See FIG. 5.

Adjacent the ratchet gear 62, the end plug 60 has a reduced diameter portion 68 which extends through the hole 50 and on its end face has radially disposed serrations or teeth 70. Teeth 70 are concentric with and radially inwardly from the teeth 55 on ring 54.

The end plug 60 terminates in a threaded portion 72 on which is mounted a nut 80. Between nut 80 and ring 54, there is provided a ring 74. Ring 74 has an inner set of radially disposed serrations or teeth 78 which mate with teeth 70. Ring 74 also has an outer set of radially disposed serrations or teeth 76 which mate with the teeth 55 on ring 54. See FIG. 3. When the teeth on ring 74 are mated with the teeth 55 on ring 54 and the teeth 70 on portion 68, the roller 18 is prevented from rotating about its longitudinal axis and is thereby locked in a predetermined orientation.

The end plug 58 is telescoped into the opposite end of tube 56 and removably retained therein by a screw 64 or similar device. End plug 58 has an enlarged diameter wrench head 86 engaging an end face of the tube 56. End plug 58 on roller 18 is releasably locked to corner member 26 in the same manner as described above. Head 86 is of hexagonal or other shape where it can cooperate with a wrench or similar tool to facilitate rotation of the roller 18 about its longitudinal axis. The portion 61 of end plug 60 could be fashioned as a hex to cooperate with a wrench instead of wrench head 86 if so desired.

Each of the rollers 14–20 releasably retains one edge portion of the screen fabric 12 by means of a shallow channel 88 defined by a flat bottom wall and flanges 85, 87 which project toward one another. A flexible retainer 90 of plastic, metal or the like overlies an edge portion of the screen fabric 12 in each channel 88 and retains the edge portion locked to the associated roller. See FIG. 5. Flanges 85, 87 may be of the same size but preferably flange 87 is longer than flange 85.

The retainer 90 is preferably insertable into the channel 88 only at one end of the channel. To facilitate rapid insertion of retainer 90, there is illustrated in FIG. 7 a tool designated generally as 92. Tool 92 includes a plow 94 adapted to move through the channel 88 together with an upstanding rib 95 to facilitate manual manipulation of the tool 92. The tool 92 is releasably attached to one end of the retainer 90 by means of a set screw 96 which is rotated by manipulation of the head 97. The tool 92 facilitates pulling the retainer 90 along the channel 88 with ease beginning at one end of the channel 88. If desired, a spring clip may be utilized to retain temporarily the screen fabric 12 in one end of the channel 88 while the retainer 90 is being inserted from the opposite end of the channel.

In FIG. 6, there is shown a cross-sectional view similar to FIG. 5 but of another embodiment of the present invention which is identical with that described above except as will be made clear hereinafter. Thus, the only significant different between the embodiment in FIGS. 1–5 versus the embodiment of FIG. 6 is the roller 18'. Roller 18' utilizes a tube 98 which is triangular in cross-section instead of being round in cross-section as described above in connection with tube 56. The end plugs associated with tube 98 are round but have a triangular shape portion which telescopes into the tube 98. All other corresponding elements illustrated in FIG. 6 are provided with corresponding primed numerals.

In FIGS. 8 and 9, there is illustrated another embodiment of the present invention designated generally as 10'. The frame 10' is the same as the frame 10 except as will be made clear hereinafter. Each corner member 99 on the frame 10' may be made from a rigid polymeric plastic material. Like corner members 22–28, some flexibility is present in the legs of the corner members 99 to facilitate the application of an outwardly directed camber on the rollers 108 and 110. It

will be appreciated that the frame **10'** has four rollers similar to the rollers **14–20** described above.

Each leg of the corner member **99** has a pair of ribs **101** which define a channel **100** therebetween. A dam member **102** extends between the adjacent channels **100** on adjacent corner members. The length of the dam member **102** is less than the distance between the adjacent corner members **99** as will be apparent from FIG. **8.** The dam members **102** perform the additional function of accommodating the means to apply a camber to the rollers **108, 110.**

As shown more clearly in FIG. **9,** the dam members **102** are generally rectangular in cross-section, are hollow, and include a threaded bore **106.** A screw **104** extends through a hole in each leg of the corner members **99** and is engaged with the threaded bore **106.** Rotation of screws **104** on opposite ends of a dam member **102** applies a camber to the adjacent roller parallel thereto. A seal **112,** similar to seal **42,** is provided on the lower surface of the dam members **102** for sealing contact with the screen fabric **12.** The frame **10'** is otherwise identical as that described above.

Member **102** and cable **30** both perform the same prestressing function. Rotation of the screw **104** and nut **38** both cause elongation in member **102** and cable **30** respectively. Such elongation applies tensile forces to member **102** and cable **30.** For equilibrium of the system, the tensile forces cause corresponding compressive forces in their associated rollers **108** and **14.** The combination of tensile and compressive forces apply bending moments to the angle legs causing them to rotate thereby introducing an outward deflection in the rollers **108** and **14.** All rollers on each frame operate in the same fashion. Screws **104** and nuts **38** are adjusted so that all rollers remain straight (undeflected) after loading, thus counteracting the opposing forces applied by the tensioned fabric.

In each embodiment, there is provided a plurality of corner members each of which rotatably supports one end of mutually perpendicular rollers. A means extends between adjacent corner members for applying a camber to the roller supported by the adjacent corner members. A means is provided for positively locking a roller in any particular rotative position by means of a locking portion such as teeth. Thus, maintenance of any particular tension of the screen fabric does not rely on friction or solely on a pawl associated with a ratchet whereby the frame may be stored in a horizontal, vertical, or upside down position without disturbing the tension of the screen fabric. Since rotation of the rollers is attained by means of a wrench cooperating with the wrench head **86,** use of a torsion wrench facilitates application of accurate uniform tension on the screen fabric **12.**

Before adjusting a roller such as roller **18,** nut **80** is backed off and ring **74** is moved along the axis of rotation to separate teeth **76** and **78** from their complementary teeth. Thereafter, wrench head **86** may be rotated. Pawl **66** will retain the roller **18** in the desired position until the locking ring **74** is applied as shown in FIG. **3.**

The teeth on the ratchet gear **62** are of the same pitch as the teeth **70, 78.** Teeth **76** and **55** have the same pitch. Teeth **76** and **55** can be of the same pitch as the teeth on ratchet gear **62** and the teeth **70,** and **78,** but it is not necessary. The commonality of these respective pitches assures that ring **74** will always nonrotatably couple plug **60** to corner member **24** at every position for ratchet gear **62** caused by the engagement of pawl **66.** One advance step on ratchet gear **62** will cause one advance of teeth **70.** The teeth **55, 70, 76** and **78** are preferably straight V-shaped teeth but other configurations are possible such as involute.

For the maximum stability of the frames and most precise orientation in its plane, the leading point of the teeth **70** should not contact the root diameter of the teeth **78** and vice versa. The same is true for mating teeth **76** and **55.** This arrangement will cause the mating teeth to bear and wedge against their inclined sides, thus eliminating any relative movement between rollers and corner members when under load, that would otherwise occur if clearance was allowed to remain between mating teeth.

Teeth **78** could be axially disposed on the inner periphery of ring **74** with the complementary teeth **70** being axially disposed on the outer peripheral of portion **68.** Further, teeth **76** could be on the outer periphery of ring **74** with teeth **55** being on the inner periphery of ring **54** which would then surround ring **74.**

The frame of the present invention is readily assembled or disassembled for purposes of minimum storage, ease of shipment, and ease of adjustment. Substitution of longer or shorter rollers, dam members and tensioning members facilitates changing the size of the frame for use with a larger or smaller screen fabric. Each dam member is adapted to be sealed with respect to the screen fabric **12** so that ink or other printing medium applied to the upper surface of screen fabric **12** in FIG. **5** will not flow directly to components located outwardly of the dam members. Thus, the dam members define the operative portion of the screen fabric **12.**

The means for applying a camber to the rollers offsets any tendency of the rollers to bow inwardly as higher tensions are applied to the screen fabric **12.** Each retainer strip **90** increases its retention effect on an edge portion of the screen fabric **12** as the tension in the screen fabric **12** increases while at the same time retaining uniformly the entire length of the edge portion of the screen fabric **12** within the shallow channels **88.** The channels **88** are shallow to the extent that in most embodiments they are equal to or less than **0.0625** inches deep whereby they do not interfere with the closed chamber within the rollers. Hence, the rollers have maximum bending strength so that they may perform their function as the major structured component of a frame. At the same time, it will be noted that the rollers facilitate continuous take up so that the screen fabric **12** may be stretched to any desired tension.

It is very desirable to have channels **88** which are shallow and have flanges **85, 87** for cooperation with the retaining strip **90** as described above. Otherwise, the main structural components of the frame, namely rollers **14–20,** would be altered. As the depth of channel **88** increases. the cross sectional shape of the rollers approaches the shape of the cross-section of the torsionally unstable frame members of U.S. Pat. No. **3,482,343.**

The dam members **40, 40'** may be inexpensive replaceable slats of wood, plastic, aluminum, etc. Dam members **102** are preferably made from a light weight noncorrosive material such as aluminum. Each dam member may be sealed to the screen fabric **12** in a manner other than by use of the flexible seals **42, 42'** and **112.** Each dam member has its ends located at or adjacent the intersection of the legs on its corner members.

More dimensional stability is imparted to the frame when and if dam members **102** bottom out so that its teeth engage mating teeth on corner member **99.** Thus, a dimensionally stable frame which is flat with adjacent dam members being mutually perpendicular is attained.

The present invention is primarily useful in printing by the silk screen method. However, it should be readily apparent that the present invention may be utilized in any one of a wide variety of industries wherein tensioning of a screen fabric, woven or nonwoven, is desired in conjunction with the various features and advantages of the frame of the present invention.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

I claim:

1. Apparatus comprising a screen tensioning and printing frame, said frame having a plurality of rollers coupled together by corner members which support the rollers for rotation about their longitudinal axes, each roller having a longitudinally extending channel on its periphery, a retainer for each channel to retain an edge portion of a screen fabric in each channel, means associated with each corner member for locking each roller in a predetermined rotative position so that a desired tension may be applied to a screen fabric, means for applying a camber to each roller, and a dam member associated with each roller, each dam member being inwardly of its associated roller and extending between adjacent corner members so that the dam members and corner members form a dam for a printing medium to be applied through a screen fabric.

2. Apparatus in accordance with claim **1** wherein said means for locking each roller includes a ring having teeth engageable with teeth on a juxtaposed surface of its associated corner member.

3. Apparatus in accordance with claim **2** wherein said ring teeth include first and second concentric sets of teeth on a side face of the ring.

4. Apparatus in accordance with claim **1** wherein said camber applying means is an adjustable means extending between adjacent corner members so as to be parallel to its associated roller and inwardly of its associated roller.

5. Apparatus in accordance with claim **4** wherein said adjustable means for applying a camber is associated with each dam member, each dam member being hollow at least in part for accommodating an element to effect such adjustment of the camber of a roller associated with each dam member.

6. Apparatus in accordance with claim **1** including a flexible seal carried by each dam member on a surface thereof for sealing contact with a screen fabric.

7. Apparatus comprising a tensioning frame having a plurality of rollers coupled together by corner members which support the rollers for rotation about their respective longitudinal axes, each roller having a means on its periphery to releasably retain an edge portion of a layer of flexible fabric, means associated with each corner member for locking each roller in a predetermined rotative position so that a desired tension may be applied to a fabric, said locking means including a discrete element associated with at least one end of each roller, each of said elements having a locking portion which engages complementary locking portions on its associated roller and corner member, said locking elements being rings, each ring having teeth which constitute the locking portion of the ring, the complementary locking portions on said corner members and rollers including teeth for cooperative engagement with the teeth on said locking rings.

8. Apparatus in accordance with claim **7** wherein said teeth on said rings include concentric sets of teeth on a side face thereof.

9. Apparatus in accordance with claim **7** including means extending parallel to each roller between adjacent corner members for applying a camber to each roller.

10. Apparatus in accordance with claim **7** including a dam member inwardly of each roller, each corner member including mutually perpendicular legs, each dam member having an end disposed at or adjacent the intersection of the legs on each corner member associated therewith.

11. Apparatus in accordance with claim **7** wherein said fabric retaining means includes a shallow longitudinally extending channel having oppositely disposed flanges at the mouth of the channel for retaining therein a retainer strip which is wider than the distance between the flanges.

12. Apparatus in accordance with claim **7** wherein said locking elements are sufficient in number so that each end of each roller is selectively locked to its associated corner member.

13. Apparatus comprising a dimensionally stable screen tensioning and printing frame, said frame having a plurality of dam members coupled together by corner members, a roller generally parallel to each dam member, the rollers being supported for rotation about their longitudinal axes by said corner members, each roller having a longitudinally extending channel on its periphery, a retainer foreach channel to retain an edge portion of a screen fabric in each channel, means associated with each corner member for locking each roller in a predetermined rotative position so that a desired tension may be applied to a screen fabric, each dam member being inwardly of its associated roller and extending between adjacent corner members so that the dam members and corner members form a dam for a printing medium to be applied through a screen fabric.

14. Apparatus for comprising a tensioning frame having a plurality of rollers coupled together by corner members which support the rollers for rotation about their respective longitudinal axes, each roller having a means on its periphery to releasably retain an edge portion of a layer of flexible fabric, means associated with each corner member for locking each roller in a predetermined rotative position so that a desired tension may be applied to a fabric, said locking means including a discrete element associated with at least one end of each roller, each of said elements having a locking portion which engages complementary locking portions on its associated roller and corner member, said locking elements being rings, each ring having teeth which constitute the locking portion of the ring, the complementary locking portions on said corner members and rollers including teeth for cooperative engagement with the teeth on said locking rings, and each roller being provided with a plurality of discrete faces so as to be non-circular cross-sectioned.

15. Apparatus comprising a tensioning frame having a plurality of rollers coupled together by corner members which support the rollers for rotation about their respective longitudinal axes, each roller having a means on its periphery to releasably retain an edge portion of a layer of flexible fabric, means associated with each corner member for locking each roller in a predetermined rotative position so that a desired tension may be applied to a fabric, said locking means including a discrete element associated with at least one end of each roller, each of said elements having a locking portion which engages complementary locking portions on its associated roller and corner member, each roller being a hollow cylindrical tube, an end plug fixedly secured to and closing each of the tubes, each end plug cooperating with a separate one of the corner members to facilitate rotation of its associated tube about the longitudinal axis thereof, and said locking means cooperating with at least one end plug of each roller and the associated member.

16. Apparatus in accordance with claim 1 wherein said channels are shallow, each channel having oppositely disposed flanges at the mouth of the channel for retaining therein the retainer associated therewith, each retainer being wider than the distance between the flanges of its channel.

* * * * *