March 1, 1966 G. DICKERSON 3,237,650

PROGRAMMER FOR EXTENSION OF DROP YARNS FOR WEAVING CONTOURED THREAD CONNECTED DUAL WALL INFLATABLE FABRIC

Filed June 1, 1964

3 Sheets-Sheet 1

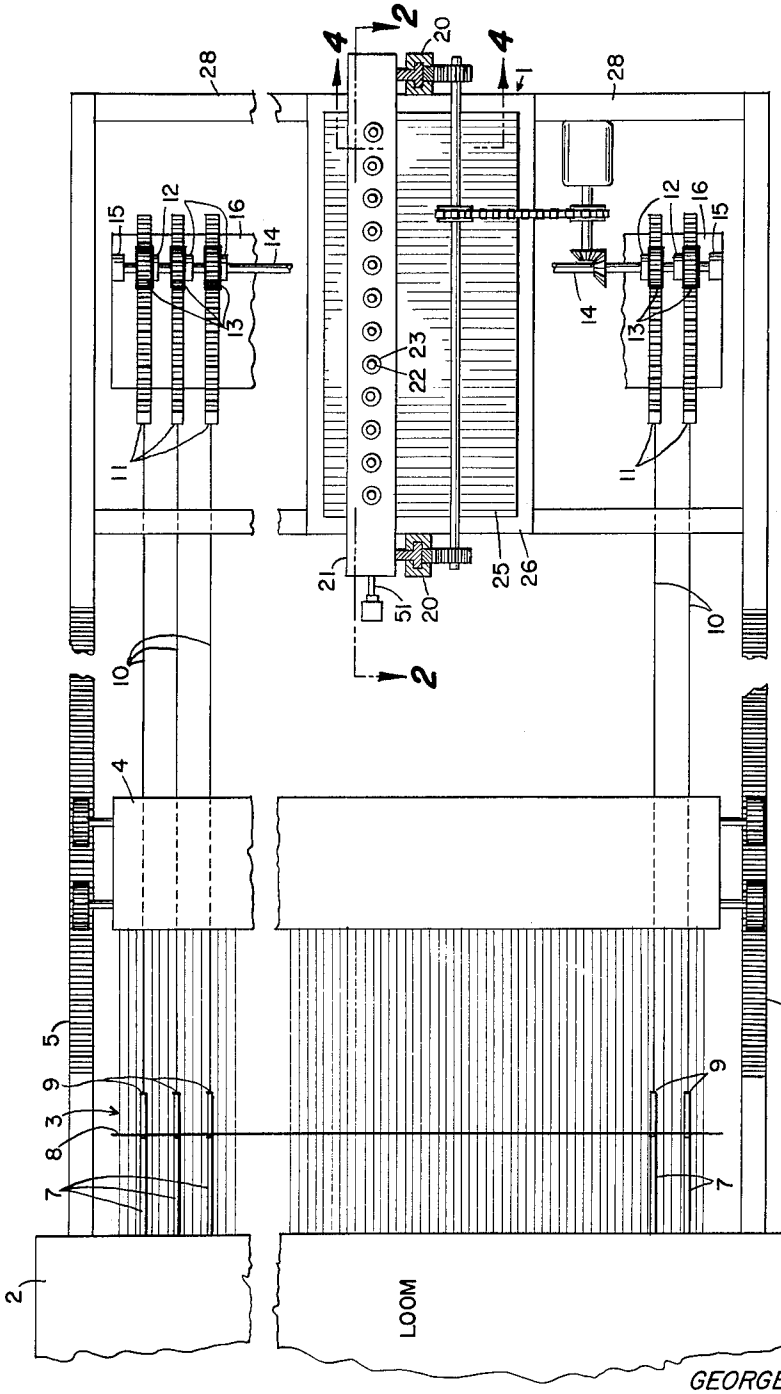


FIG. 1

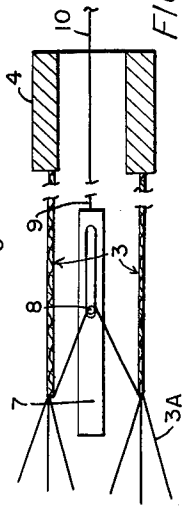


FIG. 1A

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Filed June 1, 1964 3 Sheets-Sheet 2

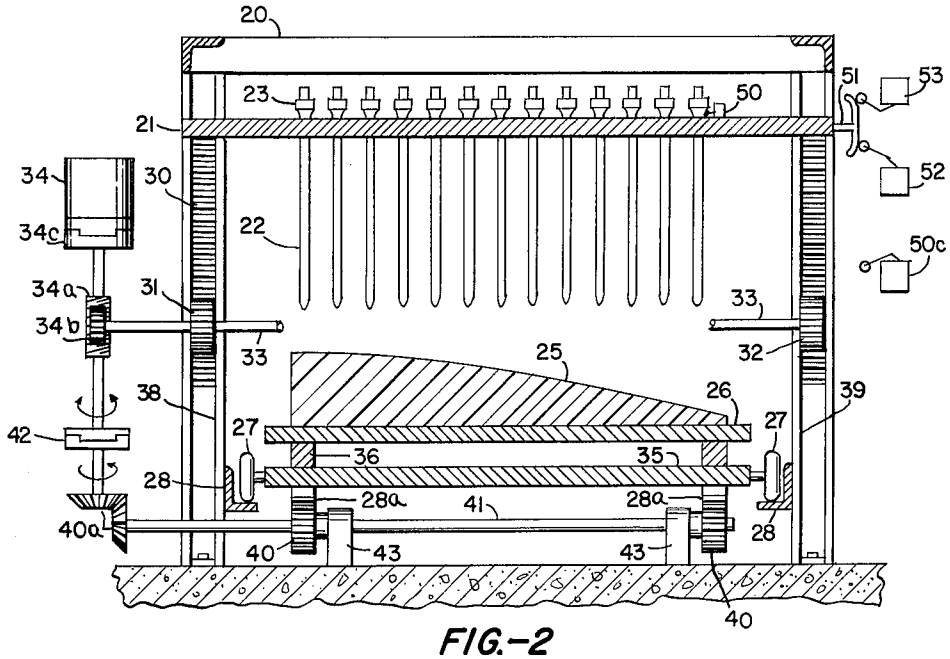


FIG.-2

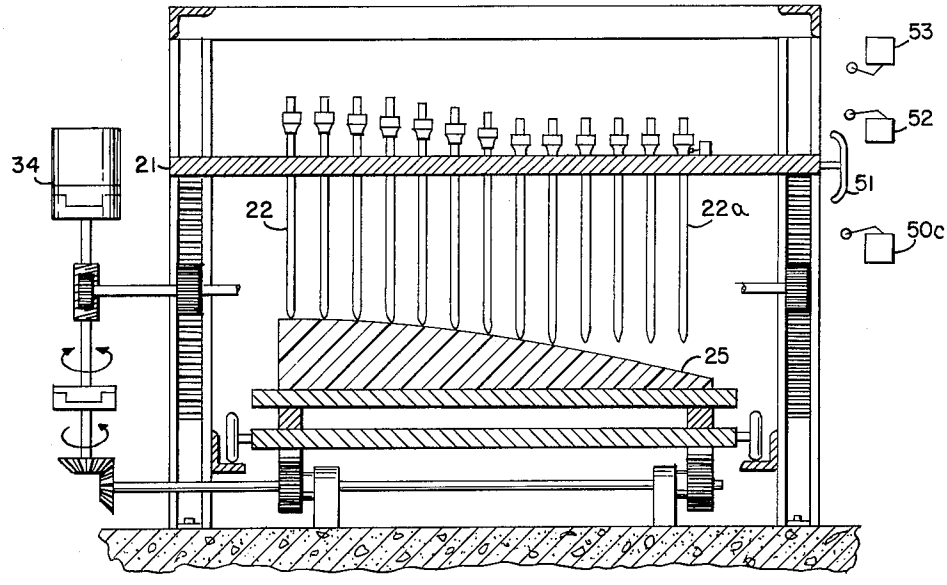


FIG.-3

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PROGRAMMER FOR EXTENSION OF DROP YARNS FOR WEAVING CONTOURED THREAD CONNECTED DUAL WALL INFLATABLE FABRIC

Filed June 1, 1964 3 Sheets-Sheet 3

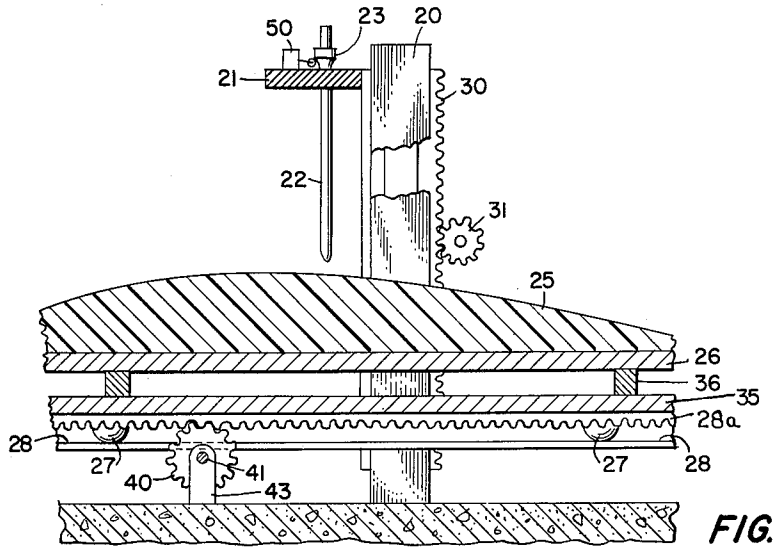


FIG.-4

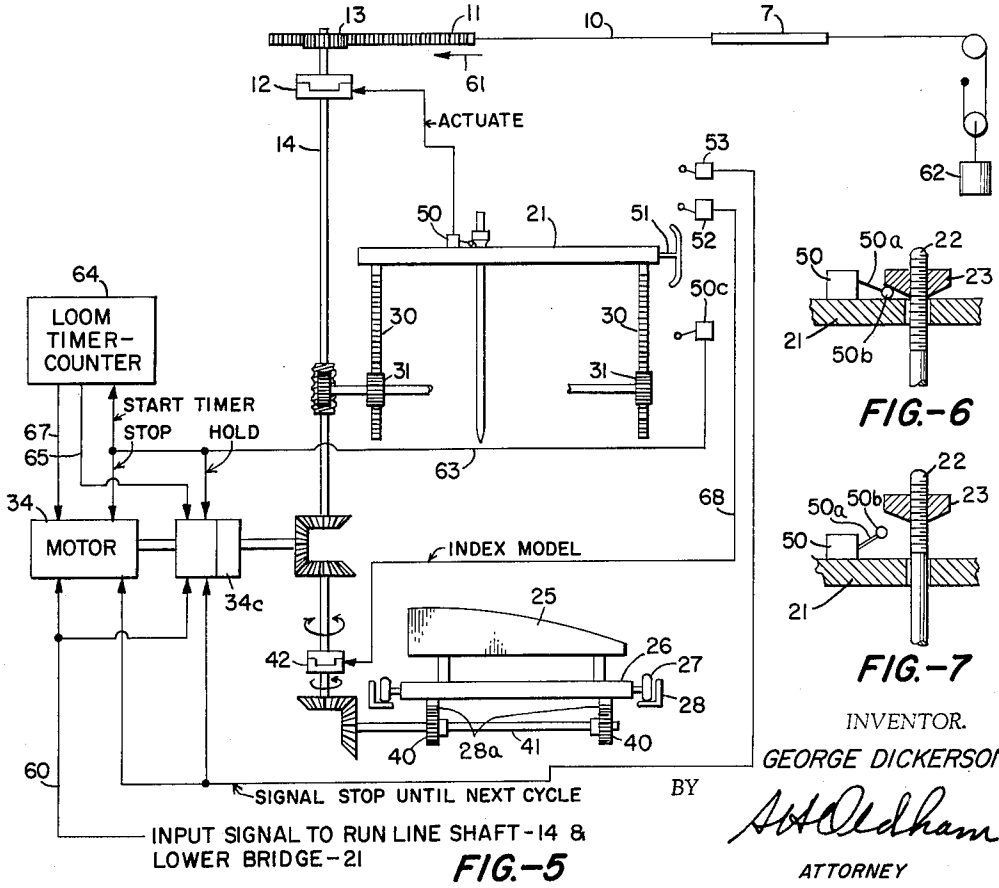


FIG.-5

FIG.-6

FIG.-7

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United States Patent Office 3,237,650
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3,237,650

PROGRAMMER FOR EXTENSION OF DROP YARNS FOR WEAVING CONTOURED THREAD CONNECTED DUAL WALL INFLATABLE FABRIC

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Filed June 1, 1964, Ser. No. 371,294
12 Claims. (Cl. 139—35)

This invention relates to a programmer to provide extension of drop yarns for weaving contoured thread connected dual wall inflatable fabric, and more particularly to a programming apparatus to quickly and accurately determine the proper lengths of extension for drop-yarns between dual fabrics to provide a proper contour and depth between the top and bottom fabrics when the fabrics are moved apart to the length of the drop yarns.

The art of double fabric weaving utilizing a double fabric plush or carpet loom is well known wherein the drop-yarns are generally made from a tufted yarn so that the fabrics may be split down the center of the drop-yarns to form piled carpet. However, where it is desired to vary the spacing between the upper and lower fabrics to achieve desired contours, the art is lacking because there are no means known to properly vary the length of the drop yarns universally in both warp and fill directions. A means to quickly and accurately program the desired extended length of the drop yarns is needed by the art. These requirements cannot be met with the known art of double-shuttle or double fabric plush or carpet looms. Loom apparatus, and the method of drop yarn extension as well as extension apparatus are shown and described in co-pending application Serial Nos. 328,874, filed Dec. 9, 1963; 329,043, filed Dec. 9, 1963; 341,719, filed Jan. 31, 1964; 353,795, filed Mar. 23, 1964, Patent No. 3,216,460; and 354,018, filed Mar. 23, 1964, Patent No. 3,217,752, also assigned to Goodyear Aerospace Corporation. However, a method of programming the desired drop yarn extension is needed in conjunction with these above mentioned applications.

Thread-connected dual wall inflatable fabric is manufactured and sold by Goodyear Aerospace Corporation of Akron, Ohio., under the trademark "Airmat" registered in the U.S. Patent Office.

Thread-connected dual wall inflatable fabric, hereinafter for simplicity called inflatable fabric, has been made with threads sometimes called drop-yarns, of fine steel wire or of light but strong natural or synthetic fibers or filaments connecting the two fabrics. Specifically, application Serial Nos. 328,874; 354,018; 353,795; and 341,719 describe methods and apparatus for extending drop yarns. However, application Serial No. 341,719 specifically sets forth with reference to FIGURE 7 an apparatus for extension where an extension bar **55** is properly contoured to the desired position by means of a plurality of elongated gages which are individually controlled by separate mechanism. The programming apparatus of this invention provides that mechanism.

Therefore, it is the general object of the present invention to meet the requirements of the art particularly in conjunction with the above-identified pending applications by providing a programming apparatus which properly extends drop yarns between two fabric layers during weaving of contoured thread connected dual wall inflatable fabric.

A further object of the invention is to provide a programmer which utilizes a reduced size scale model of the top surface of the completed inflated design to accurately and quickly determine the exact amount of drop yarn extension of a plurality of spaced intervals across the width of the woven fabric.

A further object of the invention is to provide a mechanical programmer wherein the extension of drop yarns is achieved by an extension bar which is programmed to contour at spaced intervals across the width of the fabric to provide proper extension of the drop yarns across the entire width of woven fabric, and which apparatus further maintains the drop yarns in extended position until they are securely woven in place.

A further object of the invention is to provide a programmer which not only controls the contour between the fabrics, but also the depth or distance between the fabrics.

Another object of the invention is to provide a programmer to determine the extended length of drop yarns in inflatable fabric which is timed with the weaving sequence to quickly and accurately determine proper extension of drop yarns for any weaving sequence, and which apparatus is mechanically simple, extremely reliable, and generally low in cost.

The aforesaid objects of the invention and other objects which will become apparent as the description proceeds are achieved by a programmer to provide desired extensions of drop yarns in contoured thread connected dual walled inflatable fabric which includes the combination of a scale model form having a top surface of the desired shape of the fabric when inflated, bridge means operatively mounted over the form, means to provide sequential relative horizontal and vertical movement between the form and the bridge means, a plurality of rods slidably received through horizontally aligned vertically directed holes in the bridge means, separate collar means secured to one end of each of the rods limiting the maximum vertical downward movement thereof, separate contact switch means operatively mounted to the bridge adjacent each separate collar means so that each respective switch means is actuated upon the engagement of its respective rod to effect movement to its respective collar means with the form, and separate means providing the extension of the drop yarns with each connected to a respective contact switch means and selectively energized by their respective switch means.

For a better understanding of the invention reference should be had to the accompanying drawings wherein:

FIGURE 1 is a partially broken away plan view of a loom and take off apparatus which incorporates a preferred embodiment of the programming apparatus of the invention;

FIGURE 2 is a vertical cross sectional view of the essential components of the programming aparatus taken on line **2—2** of FIGURE 1;

FIGURE 3 is a vertical cross sectional view similar to FIGURE 2 wherein the programmer has been partially actuated;

FIGURE 4 is a vertical cross sectional view of the programmer taken from the end on the line **4—4** of FIGURE 1;

FIGURE 5 is a schematic block diagram of the electrical system and sequence cycle in the operation of the programmer;

FIGURE 6 is an enlarged broken away vertical cross sectional view of a contact switch associated with a collar and rod in the deactuated position; and

FIGURE 7 is an enlarged broken away vertical cross sectional view of the switch of FIGURE 6 in the actuated position.

While it should be understood that the programmer is adaptable for use with any type of extension mechanism for drop yarns, it is particularly adaptable for utilization with the movable gage extension mechanism described in FIGURE 7 of pending application Serial No. 341,719 and hence it has been so illustrated and will be so described.

General description

With reference to FIGURE 1 of the drawings, the numeral 1 indicates generally a programmer comprising a preferred embodiment of the invention. The programmer 1 is adapted for use in conjunction with a loom 2 weaving a dual wall fabric 3 received by a take off mechanism 4 all in a manner more particularly described in pending patent application Serial No. 328,874. The take off mechanism 4 rides on parallel tracks 5 and 6 which extend the length of the loom apparatus. As set forth in application Serial No. 341,719, a plurality of gages, indicated generally by numeral 7 slidably mount an easily deformable rod 8 used as an extension bar. The gages 7 are slidable longitudinally in parallel relationship with the side frames 5 and 6. The purpose of this invention is to accurately determine the extension distance thereof.

FIGURE 1A more clearly shows the relationship of the fabric 3 to the gages 7 and the rod 8. More particularly, each layer or wall of the fabric 3 is made by separately weaving warp and weft yarns, with interconnection between layers by crossing over drop yarns 3A. The programmer of the invention is to provide for the extension of the drop yarns 3A between the fabric layers.

In order to provide extension of the gages 7, each gage is individually connected at its outward end, all ends indicated generally by numeral 9, by a small cable, all cables indicated generally by numeral 10, which preferably is nylon coated to eliminate any possible cutting action on the wires or fabrics contacting therewith. The cables 10 are mounted to slidable gear racks, all racks indicated generally by numeral 11, which are operatively driven by individual electric clutches, all clutches indicated generally by numeral 12, operating through spur gears, all gears indicated generally by numeral 13. The clutches 12 and gears 13 are all mounted on what may be considered a single shaft 14 which may comprise several interconnected pieces which is supported by blocks 15, which although indicated only at the ends thereof actually support the shaft 14 throughout its length. The blocks 15 are operatively supported by a frame 16. The gear racks 11 are generally made slidable in complementary undercut receiving slots in the frame 16. Although the invention contemplates that the frame 16 will be mounted in fixed relation to the loom 2, the frame 16 may be mounted so as to be axially movable in relation to the take off mechanism 4 so as to help provide drop yarn extension.

It should be understood that actuation of the clutches 12 driving the spur gears 13 will move the gear racks 11 in one direction or another thereby adjusting the position of the gages 7 which are counter-weighted to urge them back towards an initial position in relation to the loom 2. Thus the cables 10 are always maintained in a taut relationship. It is generally contemplated that the cables 10 will pass through the take off mechanism 4 and between the two fabrics in the dual fabric 3 to attach at points 9 to the gages 7.

Programming mechanism

The actual programming mechanism 1 comprises a centrally mounted frame 20 which operatively supports and slidably receives a bridge 21. The bridge 21 slidably receives a plurality of rods, each rod indicated generally by numeral 22, which are in horizontal alignment and vertically slidable. The rods 22 are held from dropping clear through the vertically directed receiving holes in the bridge 21 by means of enlarged collars, each collar indicated generally by numeral 23. The collars 23 are threaded to the rods 22 so as to provide a precision adjustment of rod length. The essence of the bridge and rod construction will be more fully described with reference to FIGURES 2 through 4.

In order to utilize the relationship between the bridge 21 and the rods 22, a scale model form 25 having at least a top surface corresponding to the desired surface of the completed inflatable fabric is operatively mounted to a supporting frame 26 so as to be positioned substantially below and directly under the bridge 21. The supporting frame 26 is mounted basically to a plurality of rollers 27 which are carried in parallel tracks 28. A pair of parallel gear racks 28*a* are adapted to drive the frame 26 in relation to the bridge 21 in a direction normal or perpendicular to the horizontal alignment of the rods 22. Therefore, it should be understood that the frame 20 and bridge 21 are mounted beneath the frame 16 in a fixed manner with the frame 26 supporting the form 25 movable relative thereto in a direction perpendicular to the rods 22 along tracks 28. Actually, the relative relation between the bridge 21 and the movable form 25 is an essential feature of the invention while the relation of these components to the frame 16 or side rails 5 and 6 is generally only for convenience.

FIGURE 2 illustrates a schematic view looking in at the programmer 1 along the line 2—2 of FIGURE 1. The programmer is in the non-actuated condition in FIGURE 2 so that the bridge 21 is in an upward position and all the rods 22 are resting on their collars 23 clear of the form 25 mounted on the movable supporting frame 26. It is an important feature of the invention that the bridge 21 be vertically movable with relation to the frame 20, and to this end the bridge 21 is operatively anchored to vertically downwardly extending gear racks 30 which are operatively driven by spur gears 31 and 32 mounted in fixed relation to a shaft 33 driven through a worm 34*a* and worm gear 34*b* by a motor 34 incorporating a clutch 34*c*. Thus, it is seen that rotation of the shaft 33 by the motor 34 will drive the bridge 21 in a vertical direction.

The frame 26 mounting the form 25 is adjustably mounted with relation to a lower frame 35 and held in position by blocking 36. Adjustable screws could be used. The lower frame 35 operatively mounts a pair of gear racks 28*a* thereby making both frames 26 and 35 movable on the tracks 28 by means of rollers 27 between a pair of side bars 38 and 39 of the frame 20 supporting the bridge 21. Spur gears 40 operatively mounted in fixed relation to a shaft 41 are driven by the motor 34 operating through bevel gears 40*a* to provide the relative movement of both frames 26 and 35 with respect to the rods 22. A single one way indexing clutch 42 may be provided to insure a single revolution one way index to the shaft 41 to position the frames 35 and 26 for the next extension as more fully described below. The shaft 41 may be supported along its length by braces 43. Therefore, it is seen that a two way relative movement between the rods 22 and the form 25 is provided. Namely, vertical by means of the motor 34 driving through gears 31 and racks 30, and horizontal by means of the motor 34 driving through one way clutch 42 and shaft 41. These respective relative movements are an important feature of the programming assembly.

In order to begin programming at the start of weaving, a form having at least a top surface to an exact scale of the desired finished inflatable dual wall fabric is provided, which is represented by the form 25 in FIGURE 2. This scale model form 25, as viewed in FIGURE 2, represents the width configuration of the top surface of the desired resultant fabric. Therefore, each rod 22 represents a certain space across the width, and it should be understood that as the bridge 21 is lowered towards the form 25, the rods 22 will engage the top surface of the form 25 successively from the left as seen in FIGURE 2.

Each rod 22 is provided with a contact switch, each switch indicated generally by numeral 50, mounted on the bridge 21. This combination of respective rod 22 and contact switch 50 comprises a switch means which operates as a unit to achieve the objects of the invention, so that the contact switches 50 are energized as soon as

each respective rod tip engages the outer surface of the form **25** to raise the respective collar **23** off the bridge **21**. Each contact switch **50** energizes a respective clutch **12** to provide drop yarn extensions as more fully described hereinafter. The relationship of a respective contact switch **50** to its rod **22** and collar **23** is better seen with reference to FIGURES 6 and 7. The switch **50** has an actuating arm **50***a* with a roller **50***b* on the tip. The arm **50***a* is normally urged in the up direction to actuate the switch. The lower surface of the collar **23** is slightly conically shaped to provide a cam like surface for the roller **50***b*. FIGURE 6 represents the rod **22** in the deactuated position. As rod **22** engages the surface of the form **25** it is forced upwardly thereby allowing the arm **50***a* to move to the actuate position as roller **50***b* rides on the lower surface of the collar **23**. Thus, FIGURE 7 represents the actuated position for the switch **50**. Of course, as soon as the collar returns to its initial position the switch **50** will be deactuated.

In order to control the length of the drop yarn extension and thus the depth or distance between fabrics while the remaining rods **22** control the contour thereof, a limit contact switch **50***c* actuated by an arm **51** extending from the bridge **21** is electrically connected to the motor **34** to stop all movement of the bridge **21** and hence all drop yarn extension resultant, as more fully explained with reference to FIG. 5 hereinafter. The invention contemplates that the position of switch **50***c* can be varied to control the length of time that the switches **50** associated with the rods **22** will be energized, to thereby control the extension of the drop yarns and the depth of the inflatable fabric. It is apparent that other convenient adjustable limiting switch means could be used in place of the switch **50***c*. The invention contemplates only that there be some limiting switch to stop the downward movement of the bridge **21**.

FIGURE 3 is essentially similar to FIGURE 2 except that it illustrates that the motor **34** has been actuated driving the bridge **21** downwardly and forcing approximately ⅔ of the rods **22** into engagement with the top surface of the form **25**. Note how the rods **22** slide upwardly with relation to the bridge **21** as they make their engagement. At this point it should be understood that each contact switch **50** mounted to the bridge **21** is electrically connected as the actuating mechanism for one of the respective clutches **12** illustrated in FIGURE 1. Thus, the switch **50** associated the far left rod **22**, as seen in FIGURE 3, may actuate the clutch **12** at the far side of the end of the frame **16** adjacent to the side rail **5**, as seen in FIGURE 1. Each successive rod **22** will actuate an adjacent clutch **12** of FIGURE 1. In this manner, each cltuch **12** is selectively and successively driven a predetermined period of time dependent upon the length of contact of the rod **22** with the surface of the form **25**. In FIGURE 3, it can be seen that four rods **22** on the right hand side of the figure have not yet engaged the surface of the form **25**, and thus their respective clutches have not yet been actuated. Likewise, the arm **51** has not engaged the limit switch **50***c*, and hence the bridge **21** is still moving downwardly and all clutches which have been actuated are driving and providing extension of their respective gages.

After the limit switch **50***c* has limited the downward movement of the bridge **21** and the extended drop yarns have been woven into place, as more fully described hereinafter, the bridge is moved back to its initial position by reversing the direction of the drive motor **34**. As the bridge **21** moves back to position the arm **51** actuates a microswitch **52** which energizes the clutch **42** to index the form **25** to the next position. A top limit switch **53** is adapted to be engaged by the arm **51** to limit the maximum upward movement of the bridge **21**.

FIGURE 4 is an end vertical cross sectional view of the programmer **1** taken on the lines **4**—**4** of FIGURE 1, and this shows more clearly the relationship of the gear rack **30** supporting the bridge **21** and carrying the rods **22**. Note that the form **25** may also have a complex curvature in this dimension. This is important as this feature means that the weaving of the inflatable fabric will be contoured not only across its width but also along its length. The invention contemplates that the form **25** will remain in a stationary position as the bridge **21** is lowered as described with reference to FIGURES 2 and 3 to provide the width contour, but that inbetween each successive extension, the form **25** will be indexed or moved a slight distance longitudinally with respect to the rods **22**, corresponding to the amount of fabric woven so that each successive extension will be determined by the contour of the form **25** both in a longitudinal and lateral direction. Note that for stability the bottom frame **35** is mounted on a plurality of rollers **27**, but still is driven only by the motor driven spur gear **40**.

Sequence of operations

In order to understand a preferred sequence of operations within the programmer, reference should be had to FIGURE 5. For reference, the programmer sequence will be asumed to start when the drop yarns have been crossed between fabrics as described in any of the previously cited pending applications and bar **8** has been inserted so that extension of the drop yarns is now desirable and necessary. This condition may then be provided to create an input signal **60** adapted to begin to drive motor **34** which operates through the brake and clutch unit **34***c* to simultaneously drive the spur gear **31** and rack **30** to commence lowering of the bridge **21** and hence the rods **22**, and rotates the shaft **14** carrying the clutches **12**. As soon as a first rod **22** hits the surface of the form **25** respective switch **50** is actuated to engage its respective individual clutch **12** to the rotating shaft **14** which thereby drives its respective spur gear **13** causing movement of its respective rack **11** in a direction indicated by the arrow **61** causing this movement to the movable gage **7** through the actuating cable **10** against the bias of a counterweight **62**. This motion to the gage **7** will continue until the arm **51** has engaged the bottom limit switch **50***c* which thereby sends a hold signal **63** to the brake and clutch **34***c*, and stops the drive motor **34**. It is desirable that the brake and clutch **34***c* actually be locked in position by the signal **63** which thereby locks all apparatus in position and holds the movable gage **7** in the desired location. Note that the individual clutches **12** remain energized. This is necessary to allow the loom apparatus to then continue weaving to weave the extended drop yarns into a secured position in both the top and bottom fabrics.

After a pre-determined interval, a loom timer-counter **64** will substantially simultaneously (1) send a release signal **65** to the brake and clutch **34***c* and (2) send a reverse raise signal **67** to the motor **34** causing it to drive in the reverse direction through the spur gear **31** and rack **30** to raise the bridge **21** back to its initial starting position. At the same time the gear racks **11** will be started back toward their initial position with the counterweight **62** completing the job as soon as the respective clutch **12** is deenergized. As the bridge **21** moves upwardly toward its initial starting position, the arm **51** engages micro-switch **52** to send an index signal **68** to the one way clutch **42** causing the form **25** to be moved a pre-determined distance longitudinally relative to the rods **22**. The engagement of arm **51** with limit switch **53** stops the upward movement of the bridge **21**. This completes a programmed extension cycle, and the programmer is in position and ready to again begin programmed extension operation upon an input signal **60**.

Thus, it is seen that the objects of the invention are achieved by a simple mechanical programming structure incorporated with a simple electrical actuation circuit to accurately and reliably control the actuation to a series of individual clutches. The clutches drive to selectively

and successively move gages which extend drop yarns to provide desired lateral and longitudinal surface contours in an inflatable fabric, as well as providing a desired depth between the outer contoured fabric walls. It should be understood that the form **25** can be of any desired shape as long as it is made to a complementary scale with the weaving loom and programming apparatus. The invention contemplates that about a ¼ scale would be most desirable, although any convenient scale could be utilized. In the actual apparatus, forty-two separate extensions at six-inch intervals are used with the racks **11** being about six feet long thereby providing for ample contour and depth between the outer fabrics. However, according to the specific embodiment of the invention, any convenient and suitable dimensions could be utilized.

While in accordance with the patent statutes, only one best known embodiment of the invention has been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby, but that the inventive scope is defined in the appended claims.

What is claimed is:

1. In a programmer to provide extension of drop yarns during weaving of contoured thread connected dual wall inflatable fabric the combination of

an easily deformable extension rod positioned between the walls of the fabric,

a plurality of counterweighted gage means engaging the rod across the width of the fabric to provide movement thereof to effect extension of the drop yarns,

separate clutch means operatively driving each gage means against its counterweight,

separate contact switch means operatively energizing each clutch means,

separate rod means operatively associated with and adapted to actuate each switch means,

bridge means mounting said rod means for substantially vertical sliding movement and limiting the maximum vertical downward movement thereof,

form means movable beneath the bridge means, said form means being a scale model of at least the contoured top surface of the final inflated shape desired for the inflatable fabric,

means to uniformly lower the bridge means so that as the rod means engage the surface of the form means the switch means associated therewith actuate their respective clutch means, and

a limit switch actuated by the downward movement of the bridge means to terminate movement of the bridge means and to lock the clutch means in position.

2. In a programmer to provide extension of drop yarns for weaving contoured thread connected dual wall inflatable fabric the combination of

an elongated deformable rod means,

a plurality of first means spaced across the fabric and engaging the rod means to provide movement thereof and effect extension of the drop yarns,

separate clutch means operatively driving each of said first means,

separate contact switch means operatively energizing each clutch means,

separate rod means operatively mounted adjacent to each switch means and providing actuation thereof,

bridge means slidably mounting said rod means and limiting the maximum sliding movement thereof,

form means movable substantially parallel and relative to the bridge means,

means to uniformly move the bridge means towards the form means so that as the rod means engage the surface of the form means the switch means associated therewith actuate their respective clutch means, and

means to limit the downward movement of the bridge means and to lock the clutch means in position.

3. In a programmer to provide extension of drop yarns for weaving contoured thread connected dual wall inflatable fabric the combination of

a rod means,

a plurality of separate engaging means spaced across the width of the fabric and engaging the rod means to provide movement thereof to effect extension of the drop yarn,

separate means operatively driving each respective engaging means,

separate means operatively energizing each respective driving means,

separate means operatively associated with each respective energizing means,

frame means resiliently mounting each respective associating means,

a scale model form means having at least a top surface of the desired resultant inflatable fabric,

means to uniformly move the frame means towards the form means so that as each respective associating means engages the form means its respective energizing means actuates its respective engaging means, and

means to terminate movement of the frame means and to lock the engaging means in position.

4. In a programmer to provide desired extensions of drop yarns in contoured thread connected dual wall inflatable fabric the combination of

a form having a top surface to scale of the desired shape of said fabric when inflated,

bridge means operatively mounted over said form,

means to provide substantially parallel and horizontal relative movement between the form and the bridge means,

means to provide substantially vertical and closing relative movement between the form and the bridge means,

a plurality of rods slidably received through aligned vertically directed holes in said bridge means,

separate collar means secured to one end of each of said rods limiting the maximum vertical downward movement thereof,

separate contact switch means operatively associated with the collars of said rods so that said switch means are actuated when the rods engage said form,

a rod positioned between the walls of the fabric, and

separate means providing movement of selected portions of the rod as determined by the energization of respective switch means thereby providing the individual extension of each respective drop yarn according to such movement.

5. In a programmer to provide desired extensions of drop yarns in contoured thread connected dual wall inflatable fabric the combination of

a form having a top surface of the desired shape of said fabric when inflated,

a plurality of resiliently mounted aligned contact switches means positioned in substantially adjacent relation across the width of the form and parallel thereto,

means to move the switches and the form relatively towards each other while maintaining the parallel relation so that each respective switch is actuated when it engages said form,

separate means providing the individual extension of each respective drop yarn energized by a respective contact switch means, and

means to simultaneously limit the relative movement between the switches and the form, lock the extension means and deenergize the switches to complete the cycle.

6. A programmer according to claim 5 where the contact switches are mounted adjacent the bases of rods which rods are slidably received in vertically directed holes in a vertically adjustable bridge, and where said rods are limited in their maximum vertically downward sliding movement with said switches being actuated whenever its respective rod is moved away from the maximum downward position.

7. A programmer according to claim 5 including means to move the switch means back to the original starting position after the drop yarn extensions have been woven into position, and means to drive the form in a pre-determined stepped movement parallel and relative to the switches before the beginning of the next cycle to determine longitudinal contour.

8. In a programmer to provide desired extensions of drop yarns in weaving contoured thread connected dual wall inflatable fabric the combination of

a scale model form having at least the contoured top surface of the desired shape of said completed fabric when inflated,

a plurality of contact switch means in an initial position resiliently mounted in aligned adjacent relation so they are substantially parallel to the lateral dimension of said form and disengaged from the outer surface thereof,

means to move the switch means in the same relative parallel relation toward the form so that each respective switch means is actuated when it engages the surface of said form,

a plurality of separate clutch means providing the extension of said drop yarns each energized by their respective switch means, and

means to limit the relative movement between the form and the switch means and lock the clutch means to hold the extended drop yarns in position.

9. A programmer according to claim 8 where the clutch means are locked in position for a pre-determined weaving period to allow the extended drop yarns to be securely woven into place.

10. A programmer according to claim 8 where the clutch means are locked into position for a pre-determined weaving period to allow the extended drop yarns to be securely woven into place, timing means to essentially simultaneously release the clutch means, and return the switch means to their initial position, and means to subsequently provide relative movement of the form longitudinally with respect to the switch means a predetermined distance, so the next programmed extension of the drop yarns with respect to the lateral dimension of the form will represent a successive longitudinal position thereon.

11. In a programmer apparatus for extending drop yarns in weaving contoured thread connected dual wall inflatable fabric the combination of

an elongated deformable rod positioned between the walls of the fabric,

a plurality of separate gage means equally spaced across the width of the fabrics engaging the rod to effect movement thereon to provide extension of the drop yarns therebetween,

an individual clutch means operatively driving each respective separate gage means, and

means to actuate each individual clutch means to drive for a pre-determined time interval dependent upon the lateral cross section configuration desired for the fabric at that particular longitudinal location, said means including

a scale model form of at least the contoured top surface of the desired fabric in its completed and inflated condition,

contact switch means resiliently positioned in alignment across the width of the form and substantially parallel to the plane thereof, each switch means connected to a respective clutch means to drive a respective gage means that essentially corresponds in relation to the fabric as the switch is in relation to the form,

means to move the switch means and the form toward each other while still retaining the relative parallel relationship so that each switch means is actuated when it engages the top surface of said form to individually energize its respective clutch means, and

means to limit the relative movement between the forward and the switch means at a pre-determined interval after all switches have been actuated which simultaneously stops and locks the clutch means in position.

12. In a programmer to determine drop yarn extension in weaving contoured thread connected dual wall inflatable fabric the combination of

a readily deformable drop yarn extension rod across the width of the fabric,

movable gage means spaced across the width of the fabric to control the shape of the rod and effect movement thereof to provide drop yarn extension,

separate cable means connected to each respective gage means to control the position thereof,

a programmer to control the cable means which comprises

a scale model of the top surface of the desired inflated finished fabric,

a bridge positioned in substantially parallel relation to the surface of said model,

a plurality of rods slidably carried by said bridge and directed substantially normal to said surface of said model,

separate switch means operatively mounted by said bridge associated with each respective rod actuated upon engagement of said rod with said surface,

means to move said bridge toward said model while maintaining the parallel relationship therebetween,

a separate cable drive means for each cable means actuated by a respective switch means, and

means to limit the movement of the bridge toward the model and simultaneously deactuate all the cable drive means.

References Cited by the Examiner

UNITED STATES PATENTS

289,671	12/1883	Lister et al.	139—21
2,025,866	12/1935	Holmes	139—20
2,247,760	7/1941	MacDonald	139—11
2,318,080	5/1943	Keen	139—21
2,732,865	1/1956	Neisler	139—20
2,848,018	8/1958	Neisler	139—410
3,048,198	8/1962	Koppelman et al.	139—384
3,132,671	5/1964	Koppelman et al.	139—11

FOREIGN PATENTS

847,787	7/1939	France.
69,100	12/1951	Netherlands.

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