Sept. 23, 1969 H. ROLAUFFS 3,468,268

EMBROIDERY FRAME ADJUSTING ARRANGEMENT

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Fig.1

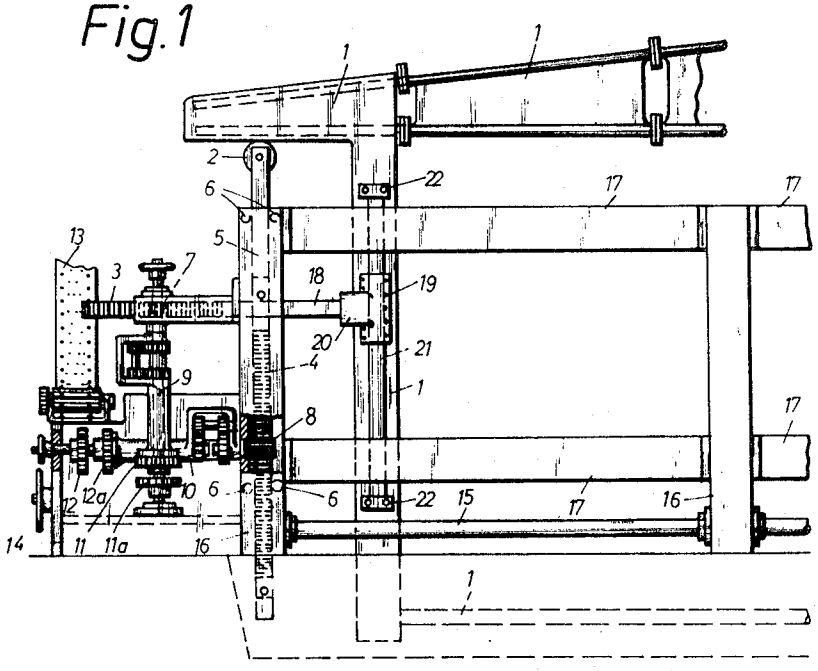

Fig.2

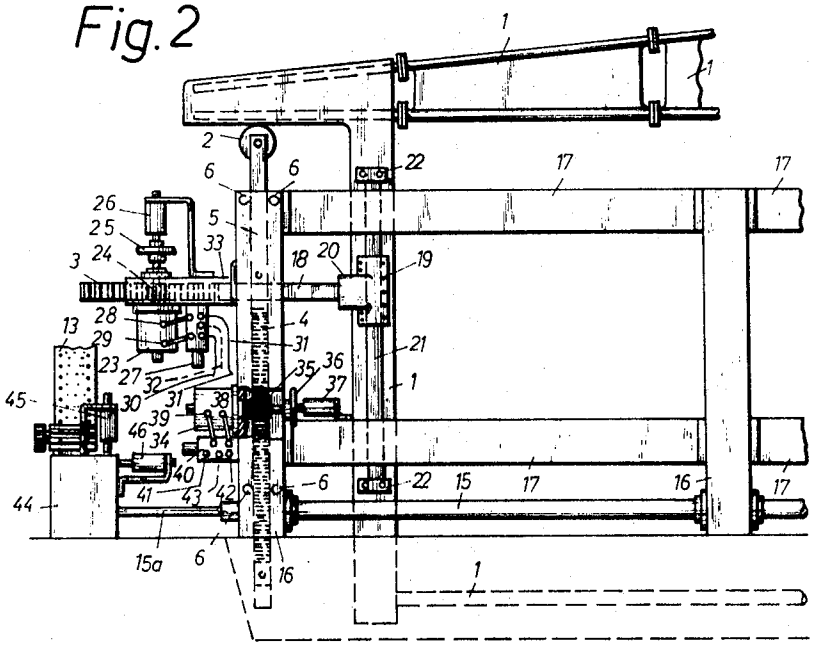

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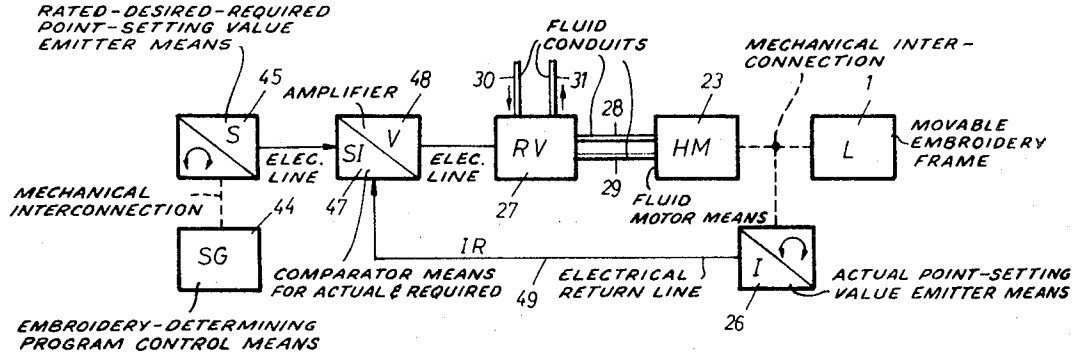
Fig. 3



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EMBROIDERY FRAME ADJUSTING ARRANGEMENT

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U.S. Cl. 112—86 10 Claims

ABSTRACT OF THE DISCLOSURE

A drive system for an embroidery machine having an embroidery frame movable in two angularly related directions and respective directional drive means for the embroidery frame for each direction of movement thereof in combination including hydraulically operable motor means connected mechanically to the embroidery frame, electrohydraulic control valves for the hydraulically operable motor means, and an electric amplifier connected to each of the electrohydraulic control valves. The embroidery frame is movable on a support provided by the embroidery machine and has direction, magnitude and time of adjustment determined by electrohydraulic valve control of the hydraulically operable motor means. The drive system combination further includes an embroidery-determining-program control means receiving a perforated strip portion and mechanically connected to a desired-required point-setting emitter means which produces the desired-required point-setting analog electric values transferred electrically to a comparator means connected to the electric amplifier and also receiving point-setting actual values returned electrically from an emitter mechanically joined to the embroidery frame driven by the hydraulically operable motor means.

The present invention concerns an adjusting arrangement for adjusting the embroidery frame of automatically operating embroidery machines. Ever since changing over from manual adjustment of the embroidery frame in embroidering machines to an automatically controlled drive at the start of this century, it is customary to produce by means of rotary movements of pinions or worm shafts the adjusting movements for the embroidery frame as they are recorded in punchcards employed by punchcard-controlled adjusting automats. These automats must on one hand introduce the adjusting strokes of the creel at a very high precision and on the other hand must be built rather strong in view of the considerable adjusting forces required by the embroidery frames of modern automatic shuttle embroidery machines. These requirements make the production of automats rather expensive and on the other hand limit the further increase of the adjusting speed of the embroidery frames for increasing the output of the machines, because the adjusting forces will with the same or increasing embroidery frame weight and with increasing adjusting acceleration become greater and greater while the adjusting automats cannot be reinforced to the same extent.

It is, therefore, an object of the present invention to provide an adjusting drive for embroidery frames which will overcome the above mentioned drawbacks.

It is another object of this invention to provide an adjusting drive for embroidery frames which will make it possible considerably to increase the adjusting speed of the embroidery frame.

It is still a further object of this invention to provide an adjusting drive for embroidery frames which will make it possible to replace the expensive control automat by a simple device controlled by the punchcard, which device

will introduce only the rated values for the embroidery frame adjustment but will no longer have to furnish the adjusting forces for the embroidery frame.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

FIG. 1 is a view of the front portion of an automatic shuttle embroidery machine for the present state of the art in the adjustment of embroidery frames.

FIG. 2 is a view of the front portion of an automatic shuttle embroidery machine with an embroidery frame drive according to the invention.

FIG. 3 is a block control diagram of the electrohydraulic control according to the present invention for the adjustment of an embroidery frame.

The problem underlying the present invention has been solved according to the invention by providing means which convey the adjusting movement of the embroidery frame in horizontal as well as in vertical direction by hydraulic control drives which are adapted to be controlled by a punchcard controlled rated value emitter or desired-required value point-setting means through the intervention of electrohydraulic control valves. According to a practical embodiment of the invention, the hydraulic control drives may be formed by rotary hydraulic motors or by double-acting hydraulic cylinder piston systems.

Referring to FIG. 1 illustrating the prior art, it will be noted that the embroidery frame **1** journalled at both ends on rollers **2** so as to be able to carry out a horizontal movement, is driven in horizontal direction by a rack **3** and in vertical direction by a rack **4**. The rack **4** for the vertical drive is connected to a carriage **5** which is movable in vertical direction and which is guided between rollers **6** mounted on the frame. This vertically movable guiding carriage **5** is also located on the right-hand end (not shown) of the machine for supporting the right-hand embroidery frame section (not shown). These guiding carriages are, as a rule, operatively interconnected by steel bands or rollers which see to it that said guiding carriages will carry out movements of identical magnitude. The steel bands and rollers have been omitted in order not to interfere with the clarity of the drawing. Moreover, the steel bands and rollers are not necessary for the understanding of the invention.

The racks **3** are adjusted toward the right or left and in downward or upward direction by means of pinions **7** and **8** which are in positive engagement with the racks **3** and **4** and are driven by differential drives **9** and **10**. Controlled by a punchcard **13**, the gears **11** and **11***a* and **12** and **12***a* are by means of a well known non-illustrated Jacquard attachment and a likewise well known non-illustrated pivotal lever-rack drive subjected to different rotary movements of different strokes which in the subsequent differential transmissions are added and through gears **7** and **8** are conveyed to the racks **3** and **4**. These transmissions of the adjusting automats **14** receive their energy through corresponding transmissions from the rotating main shaft **15** of the machine which shaft is driven by an electric motor. The main shaft **15** is journalled in frame wall **16** which together with supports **17** form the embroidery machine frame proper. The vertical movements of the embroidery frame which are conveyed by pinion **8** onto rack **4**, are by means of carriages **5** and rollers **2** conveyed to the embroidery frame **1**.

The horizontal movement which is conveyed to the rack **3** by the pinion **7** is through a pipe **18** coupled to the rack **3** and through a crosshead **20** equipped with longitudinal ball bearings **19** conveyed to a guiding pipe **21** which by means of bearings **22** is firmly connected to the embroidery frame **1**. The crosshead **20** is provided with

longitudinal ball bearings in order to be able easily movably to guide the embroidery frame **1** in the crosshead **20** in vertical direction.

An embodiment of the present invention is illustrated in FIG. 2 according to which those machine elements which are identical with the corresponding elements of the prior art as shown in FIG. 1 are designated with the same reference numerals. A hydraulic motor **23** is provided for the adjustment of the horizontal embroidery frame. Motor **23** has the extension of its drive shaft provided with a pinion **24** which positively engages the rack **3**. An extension of the drive shaft is equipped with a handwheel **25** and an electric actual value emitter or actual value selsyn point-setting means **26** which is firmly mounted on the frame. Time and direction of rotation and magnitude of the rotary angle of the hydraulic motor **23** are determined by a hydraulic control valve **27** which through the intervention of conduits **28** and **29** is connected to the hydraulic motor and through conduits **30** and **31** as well as through a leakage conduit **32** is connected to means for placing the oil under pressure. The hydraulic motor **23** is connected to a beam **33** of the frame wall **16** in which also the rack **3** is guided.

The vertical drive of the embroidery frame is effected by hydraulic motor **34** which has the extension of its shaft provided with a pinion **35** for the rack **4**, a handwheel **36** and an actual value emitter or actual value selsyn point-setting means **37** which is firmly connected to the frame for the vertical adjustment. The hydraulic motor **34** communicates through conduits **38** and **39** with an electrohydraulic control valve **40** which in its turn through conduits **41** and **42** and a leakage oil conduit **43** communicates with means not shown for placing the oil under pressure.

A control device **44** which is driven by the extended main shaft **15***a* of the machine will, by feeling the punchcard **13**, produce values in the rated value emitter or desired-required value point-setting means **45** for the horizontal direction and in the rated value emitter or desired-required value point-setting means **46** for the vertical direction which values are analogous to the directional values and magnitudes introduced into the card for the adjustment of the embroidery frame.

In the embodiment illustrated in FIG. 2, the control device **44** represents a considerable reduction in size over the heretofore known mechanical control automats and produces by means of a mechanism considerably reduced in size the rotational direction and the magnitude of the rotation of the two driving directions in customary manner and conveys these factors to the electric rated value emitters or desired-required value point-setting means; **45** and **46**.

However, it is also possible to have the control card **13** directly control contacts which in their turn establish resistor combinations for the rated value formation for the frame adjustment and the direction of the adjustment. These resistor combinations represent the electric rated values for the embroidery frame adjustment.

FIG. 3 represents the diagram for the electrohydraulic control system for an embroidery frame directional movement. In this diagram, the control device **44** (SG), the rated value emitter or desired-required value point-setting means **45** (S) coupled thereto, a device for comparing the desired-required or rated values and actual values, said device being a comparator designated **47** (SI), an amplifier **48** (V) coupled thereto, the electrohydraulic control valve **27** (RV), the hydraulic conduits **30** and **31** and **28** and **29**, the hydraulic motor **23** (HM), the embroidery frame **1** (L), the actual value emitter or actual value selsyn point-setting means **26**, and a rated value return or hydraulic conduit **29** (IR) are illustrated.

There will now be described how the embroidery frame adjustment, for instance in horizontal direction, is to be effected by means of an electrohydraulic drive.

With reference to FIGS. 2 and 3, the control device **44** which is drivingly connected to the embroidery machine, feels or scans the punchcard **13** and in the rated value emitter **45** (for the horizontal direction) produces an electric value analogous to the adjustment and the direction of adjustment. By comparing these rated values in the rated-actual value comparing device **47** (SI) with the actual value conveyed through the actual value electrical feedback or return line **49**, there will be ascertained the difference between the desired-required or rated value and actual value, and this difference is conveyed to amplifier **48** (V). By means of an electric signal, the amplifier controls the electrohydraulic control valve **27** (RV) which is connected to the device for producing oil under pressure as well as to the hydraulic motor **23** (HM) by means of hydraulic conduits **30**, **31**; **28**, **29**.

The hydraulic motor **23** (HM) is by means of the electrohydraulic control valve **27** (RV) started and actuated in conformity with the direction, the magnitude and the direction of the electric signal. The hydraulic motor **23** (HM) has coupled thereto the electric actual value emitter or actual value selsyn point-setting means **26** (I) which produces an analog electric value which is analogous to its direction and magnitude of adjustment. This electric value is through actual value electrical feed-back or return line **49** (IR) returned to the rated value-actual value comparing device **47** (SI) for comparison with the electric rated value.

The hydraulic motor **23** and thus the pinion **24** on its shaft, the rack **3**, the pipe **18**, the crosshead **20**, the guiding pipe **21** and finally the embroidery frame **1** are adjusted in a certain direction until the rated or desired-required value and actual value equal each other so that no longer any electric differential value can be conveyed from the rated or desired-required value and actual value comparing device **47** (SI) to the amplifier **48** (V). Thus, also the control of the electrohydraulic control valve **27** (RV) and of the hydraulic motor **23** (HM) is held in the resulting position by means of the same oil pressure in both hydraulic conduits **28** and **29**.

The embroidery frame adjustment in vertical direction is correspondingly effected by means of the hydraulic motor **34** and the control devices therefor.

For the sake of completeness it may also be mentioned that the vertical and horizontal adjustment of the embroidery frame may be effected independently of each other or also simultaneously in both directions. When the adjustment is effected simultaneously in both directions, resultant components of movement of the embroidery frame will be formed in a direction which is at an angle to the vertical and horizontal direction of movement.

The electric rated value emitters or desired-required value point-setting means **45** and **46** as well as the electric actual value emitters or actual value selsyn point-setting means **26** and **37** may be formed by well known or standard rotary field emitters of an electric shaft, differential transformers, adjusting transformers, potentiometers (rotary resistors), or also by means of optically scanned discs with knurled angle lines for controlling resistor combinations.

As mentioned above, by circumventing the control device **44** which, controlled by the punchcard **13**, drives the electric rated value emitters or desired-required value point-setting means **45** and **46** in certain directions and by certain angles through a mechanism, it is also possible to scan the punchcard **13** directly by well known and therefore non-illustrated electric contacts which for controlling resistor combinations are employed with the purpuse of forming an electric rated or desired-required value.

It is, of course, to be understood that the present invention is, by no means, limited to the particular embodiment illustrated in the drawings but also comprises any modifications within the scope of the appended claims.

What is claimed is:

1. A drive system for an embroidery machine and comprising: in combination, an embroidery frame movable in first and second angularly related directions, an embroidery-machine base support means for said movable embroidery frame, first and second drive means for respectively moving said embroidery frame mechanically in said directions and carried by said support means, an embroidery-determining-program control means used ultimately in effecting said embroidery frame movement by said drive means respectively and operable adjacent to said support means; first and second fluid motor means carried by said support means and connected to said first and second drive means respectively, electrically operable fluid control valve means carried by said support means and connected to said first and second fluid motor means respectively, and analog electric value required point-setting emitter means operated by said embroidery-determining-program control means and electrically connected to said electrically operable fluid control valve means for controlling said fluid motor means for effecting movement and maintaining position of said embroidery frame.

2. A drive system combination for an embroidery machine according to claim 1, in which said fluid motor means comprises an independently controlled hydraulic motor for each said direction of movement of said embroidery frame, each said hydraulic motor being reversible, and said fluid control valve means comprising a respective electrohydraulic control valve connected to each said hydraulic motor and controlling the direction and magnitude of said embroidery frame movement effected thereby.

3. A drive system combination for an embroidery machine according to claim 1, which includes amplifier means connected between said analog electric value point-setting emitter means and said electrically operable fluid control valve means.

4. A drive system combination for an embroidery machine according to claim 3, in which said analog electric value point-setting emitter means comprises an emitter unit for each electrically operable control valve means and said amplifier means comprises an amplifier device between each said emitter unit and the respective said control valve means.

5. A drive system combination for an embroidery machine according to claim 1, in which an actual value point-setting emitter means is connected mechanically to each fluid motor means adjoining said embroidery frame driven thereby, and a comparator means including an output and input for receiving analog electric value signals both from said actual- and required-point-setting emitter means electrically connected to receive embroidery-frame point-setting values returned electrically by each said actual value point-setting emitter means and

delivered by the first-mentioned value emitter means for desired point-setting magnitude pertaining to the same drive means and the output of said comparator means forming derivation of electric differential values based upon comparison of desired and actual point-setting values with respect to said embroidery frame movement to be effected mechanically by said fluid motor means.

6. A drive system combination for an embroidery machine according to claim 1, in which said fluid motor means comprises a double-acting cylinder hydraulic actuator controlled as to direction of rotation, adjusting magnitude and time of adjustment by said electrically operable fluid control valve means.

7. A drive system combination for an embroidery machine according to claim 1, in which an electric comparator means is connected electrically to said analog electric value required-point-setting emitter means, an actual value point-setting emitter means is connected electrically also to said comparator means and mechanically senses result of movement of said embroidery frame by said fluid motor means, and an amplifier means for differential values from said comparator means is connected electrically between said fluid control valve means and said comparator means.

8. A drive system combination for an embroidery machine according to claim 1, in which a perforated strip portion received by said embroidery-determining-program control means provides actuation mechanically of said analog electric value required-point-setting emitter means ultimately for adjustment and direction of adjustment of said embroidery frame.

9. A drive system combination for an embroidery machine according to claim 5, in which an electrical feedback return line interconnects said actual value point-setting emitter means and said comparator means.

10. A drive system combination for an embroidery machine according to claim 8, in which said perforated strip portion is a punchcard scanned by said embroidery-determining-program control means mechanically connected to said analog electric value required-point-setting emitter means effective for said embroidery frame movement.

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