Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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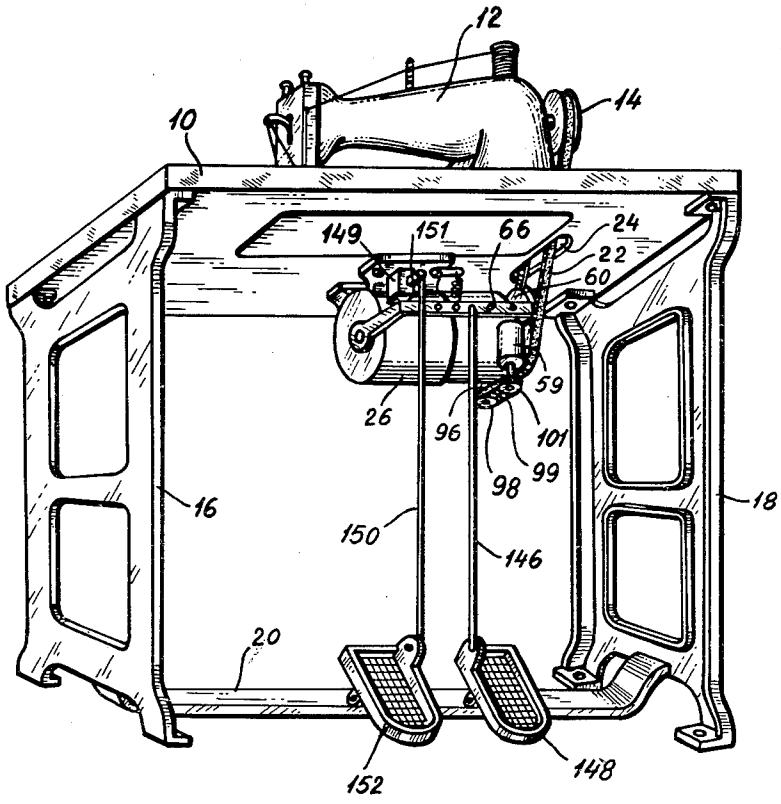


Fig. 1

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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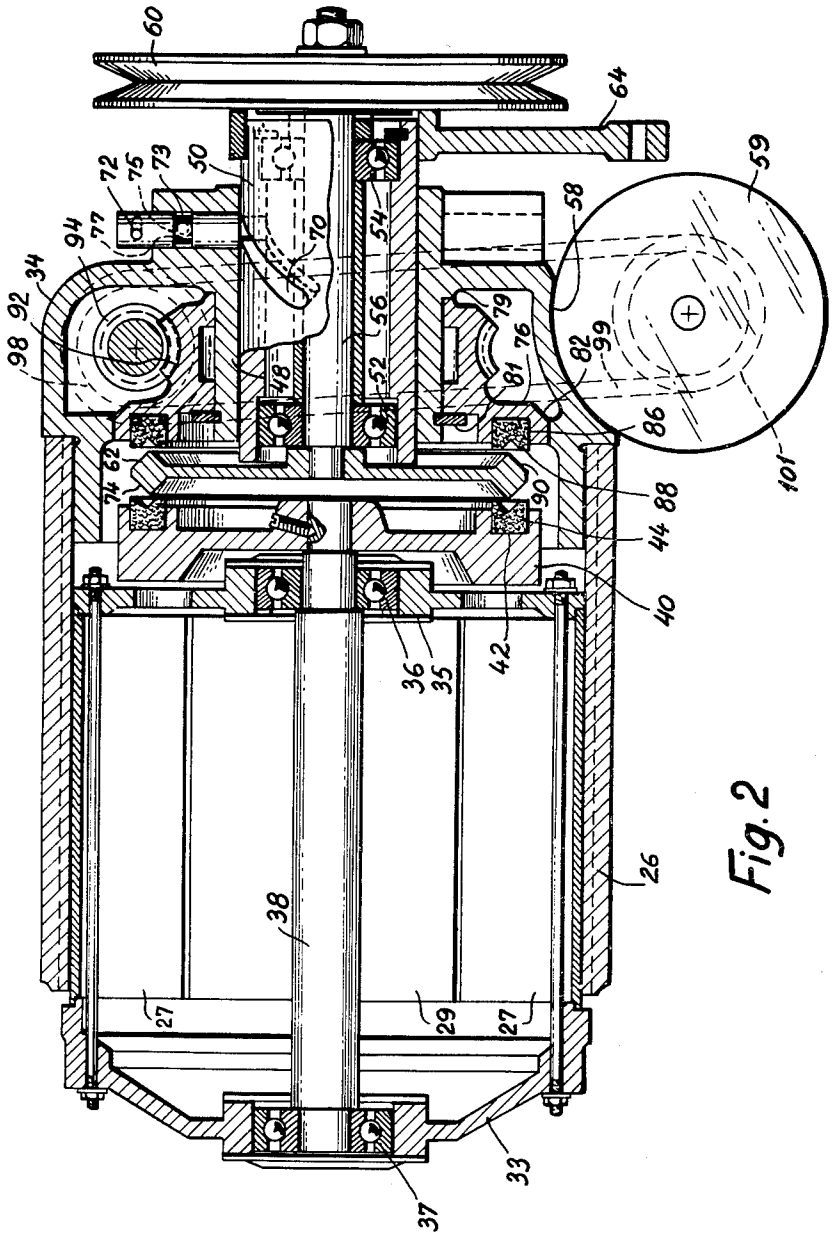


Fig. 2

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig

ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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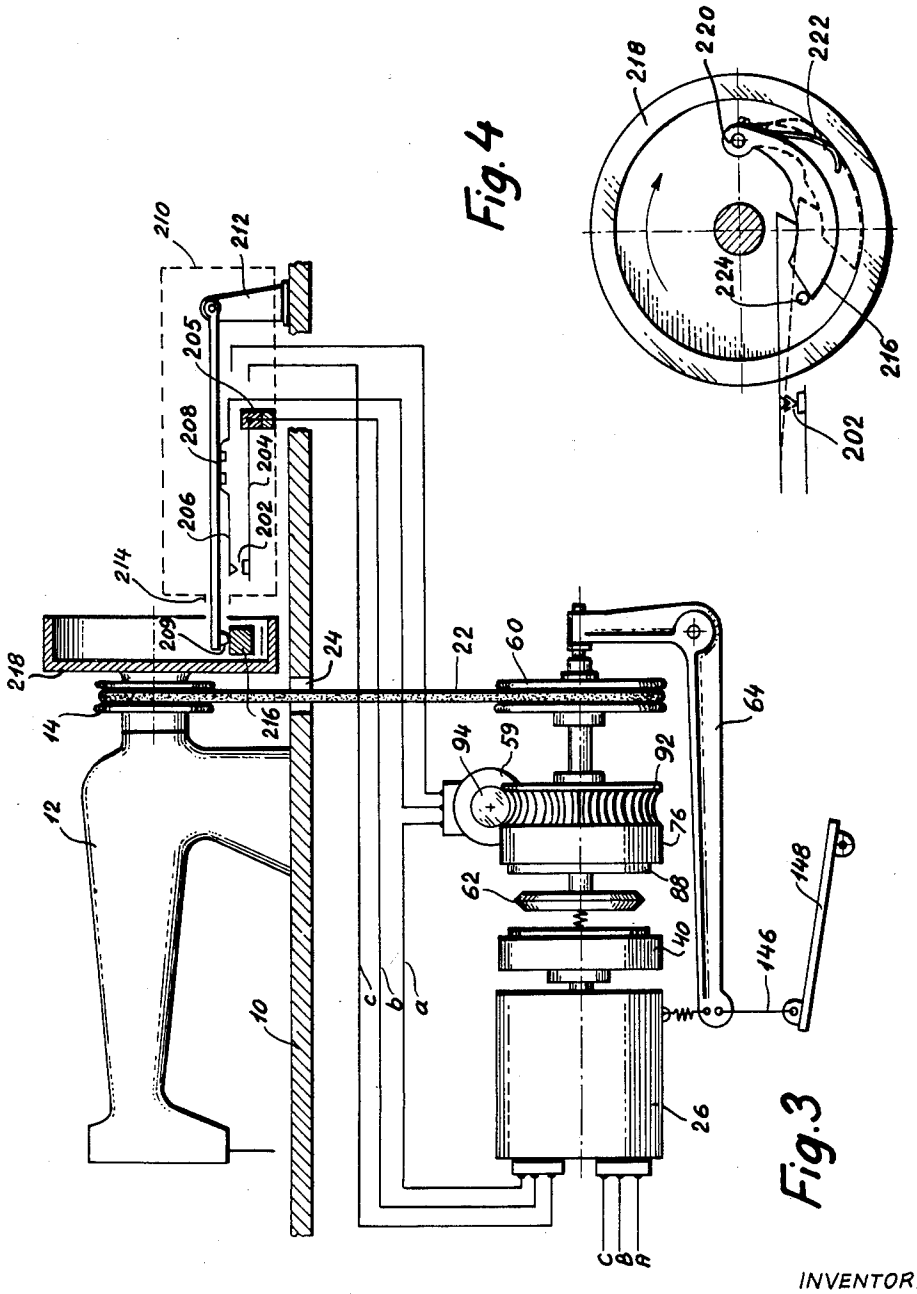


Fig. 3

Fig. 4

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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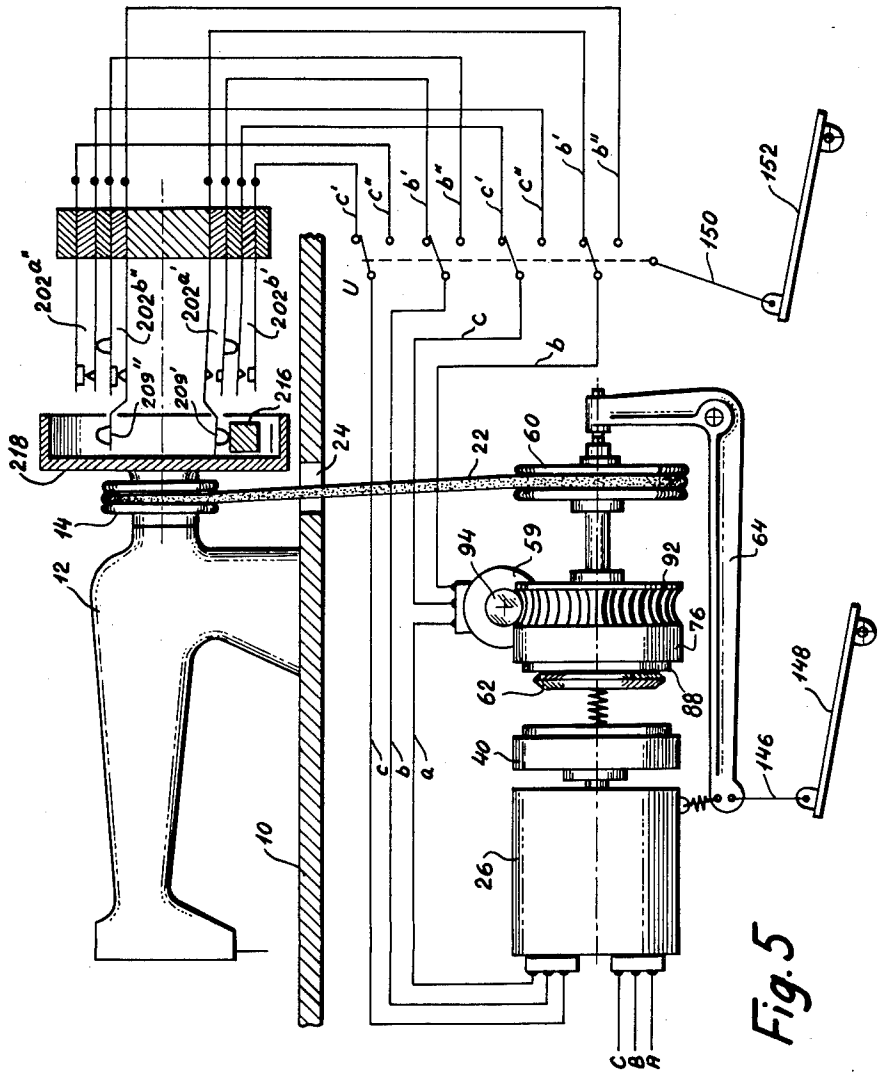


Fig. 5

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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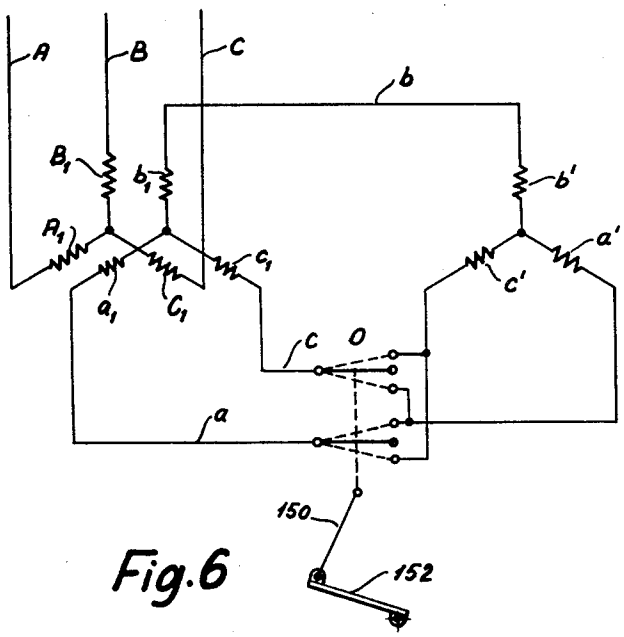


Fig.6

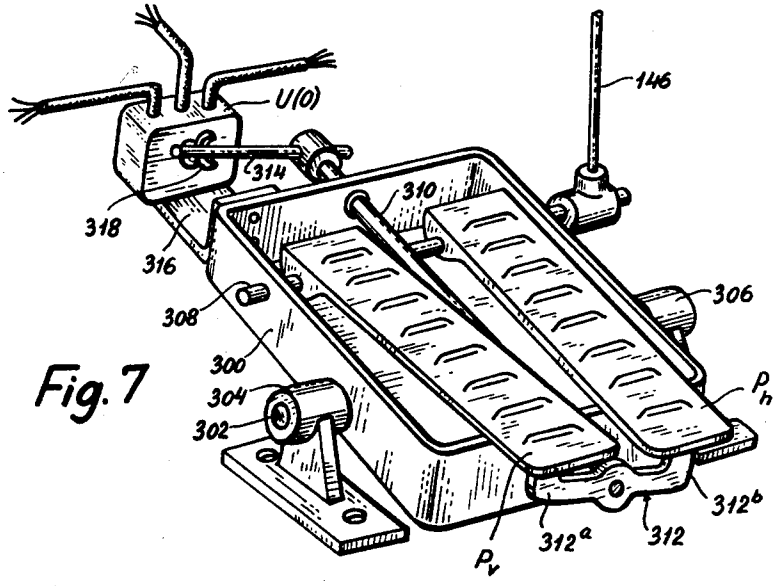


Fig. 7

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

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SEWING MACHINE DRIVING ARRANGEMENTS

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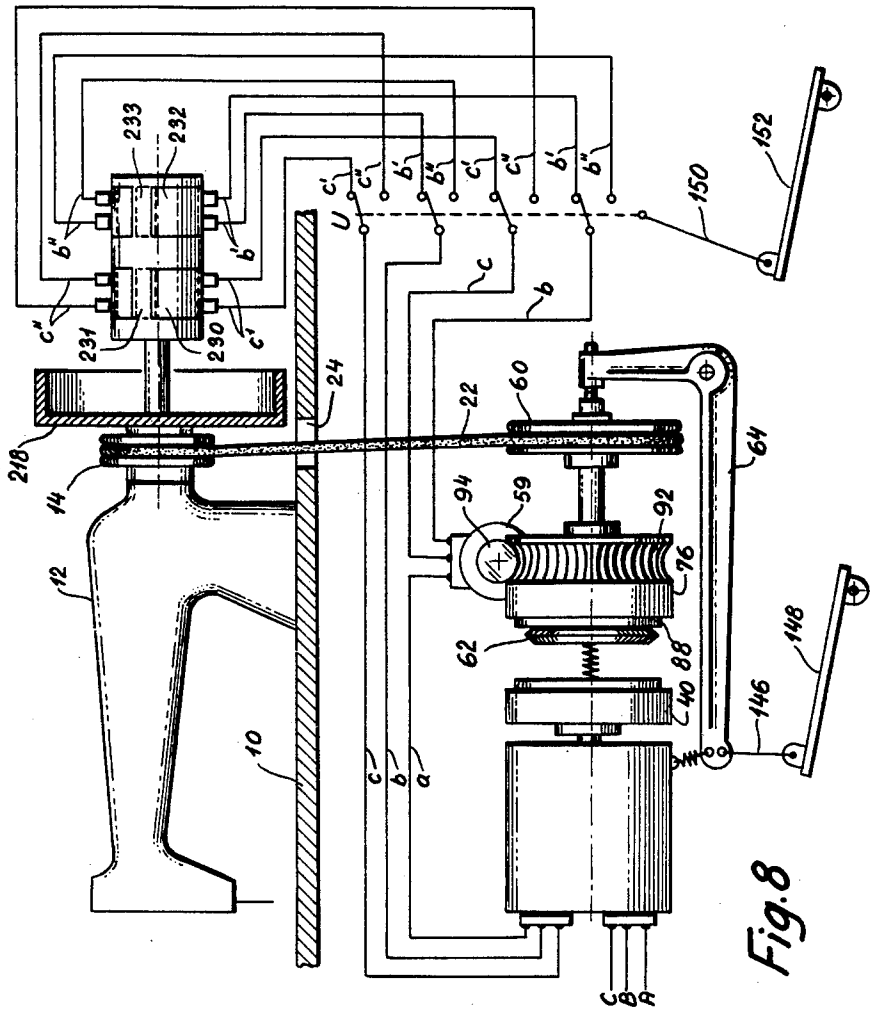


Fig. 8

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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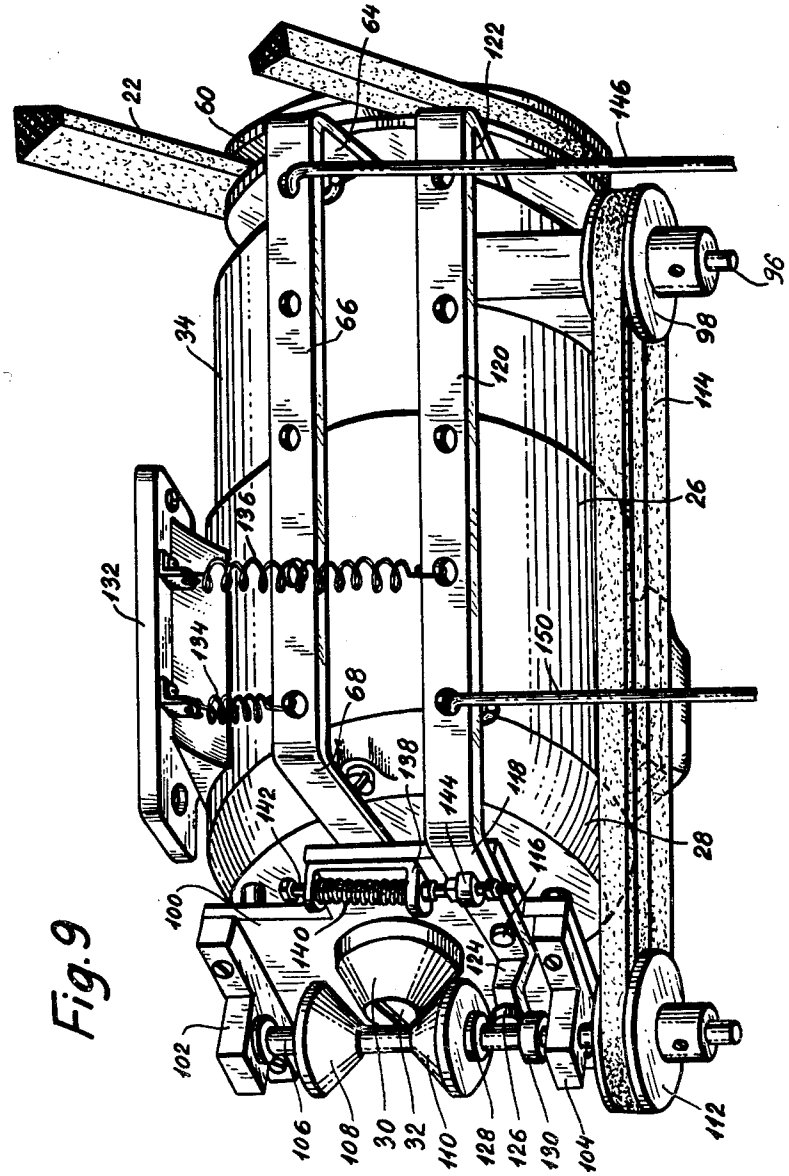


Fig. 9

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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Fig. 10

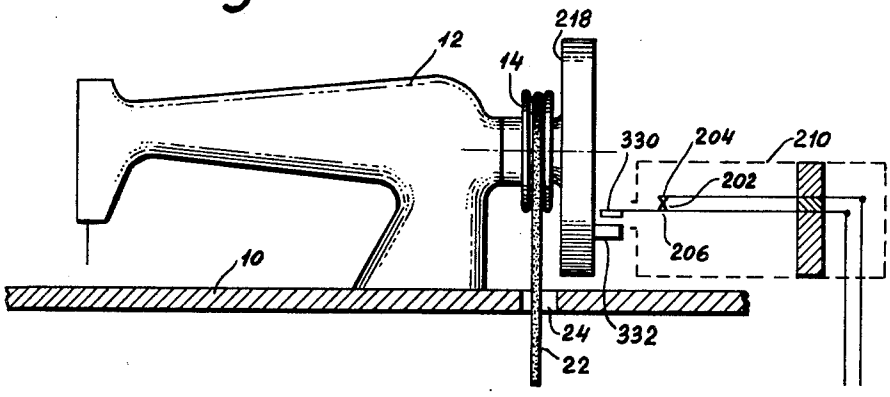
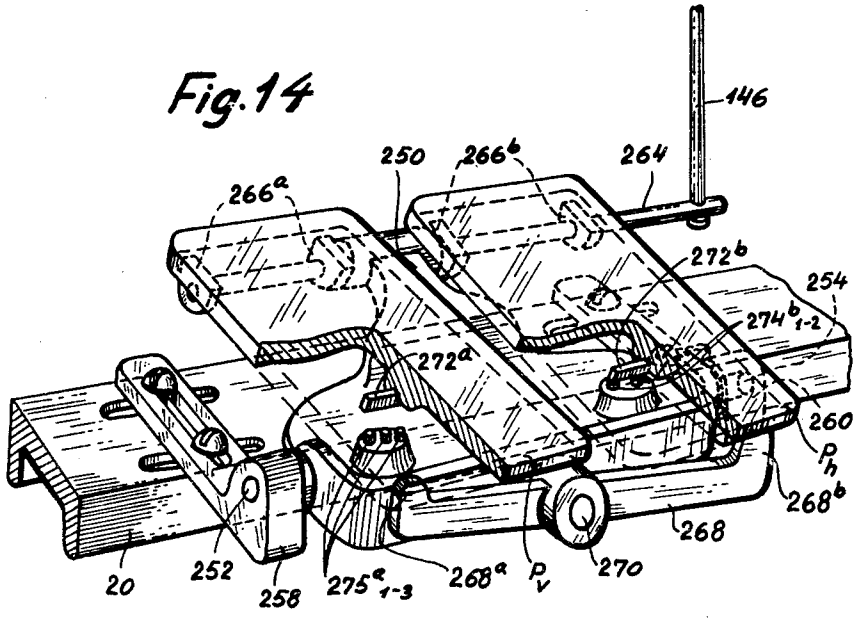


Fig. 14



INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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Fig. 11

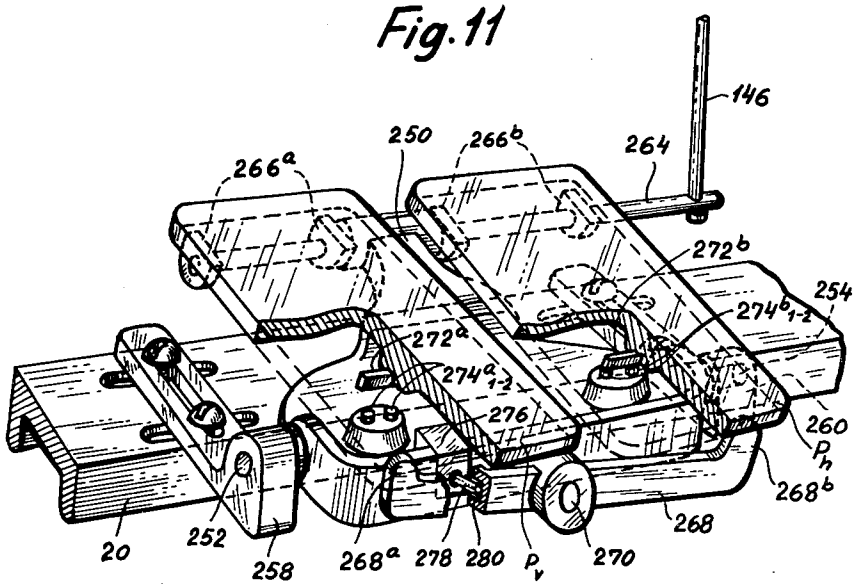


Fig. 16

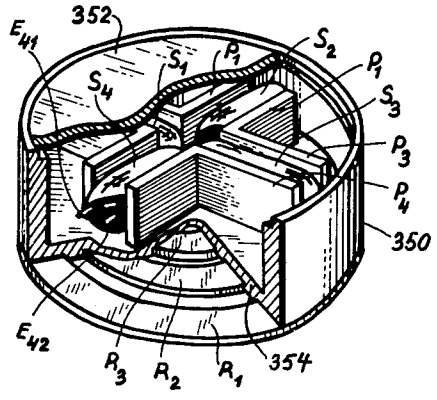
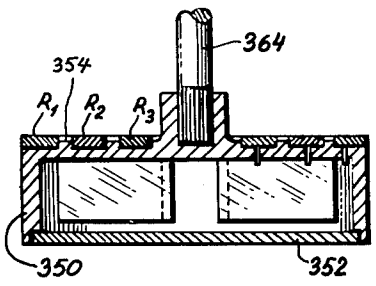


Fig. 17



INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

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SEWING MACHINE DRIVING ARRANGEMENTS

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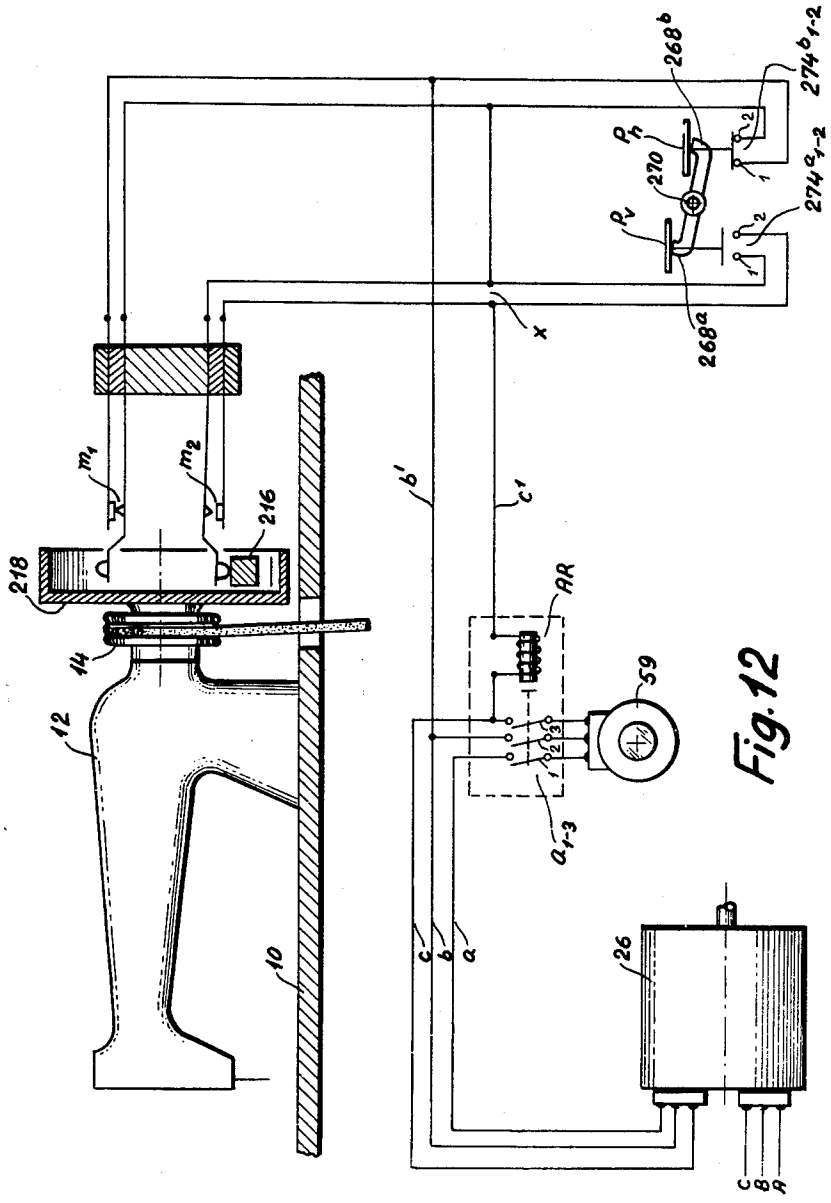


Fig. 12

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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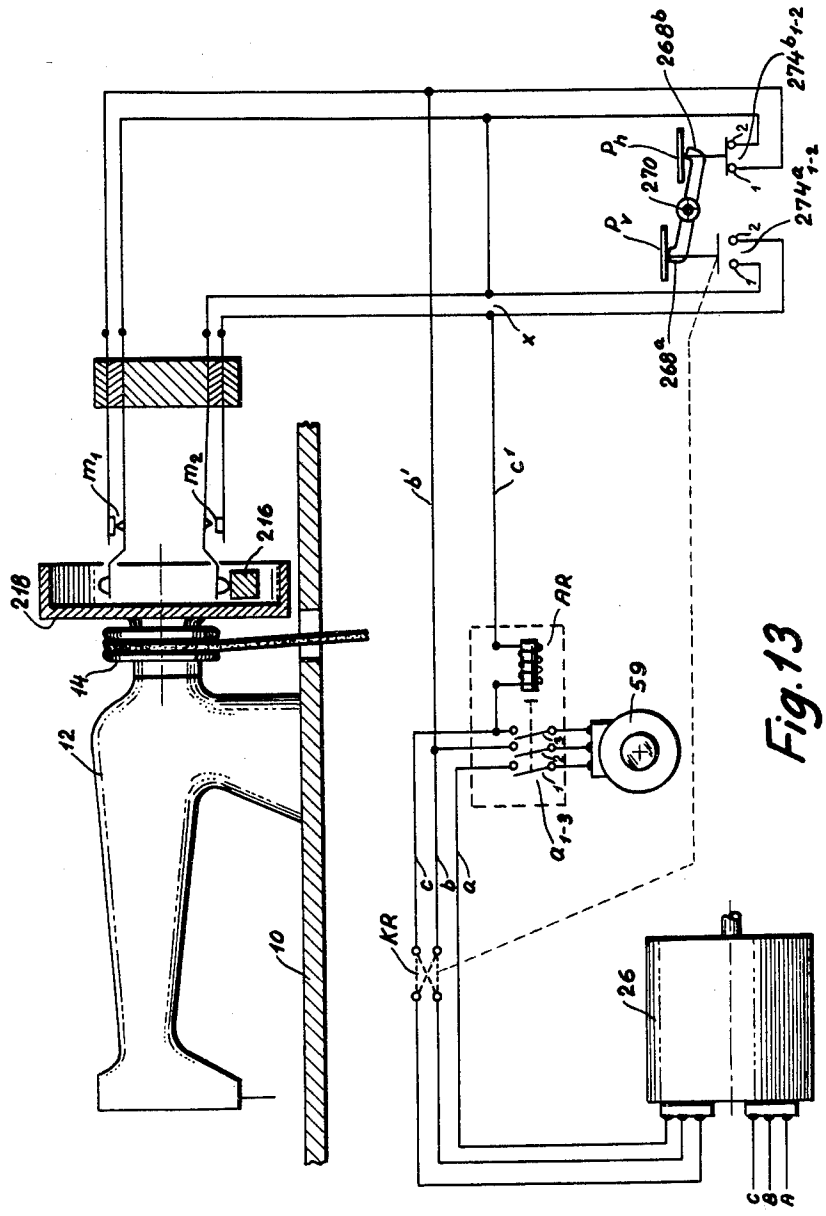


Fig. 13

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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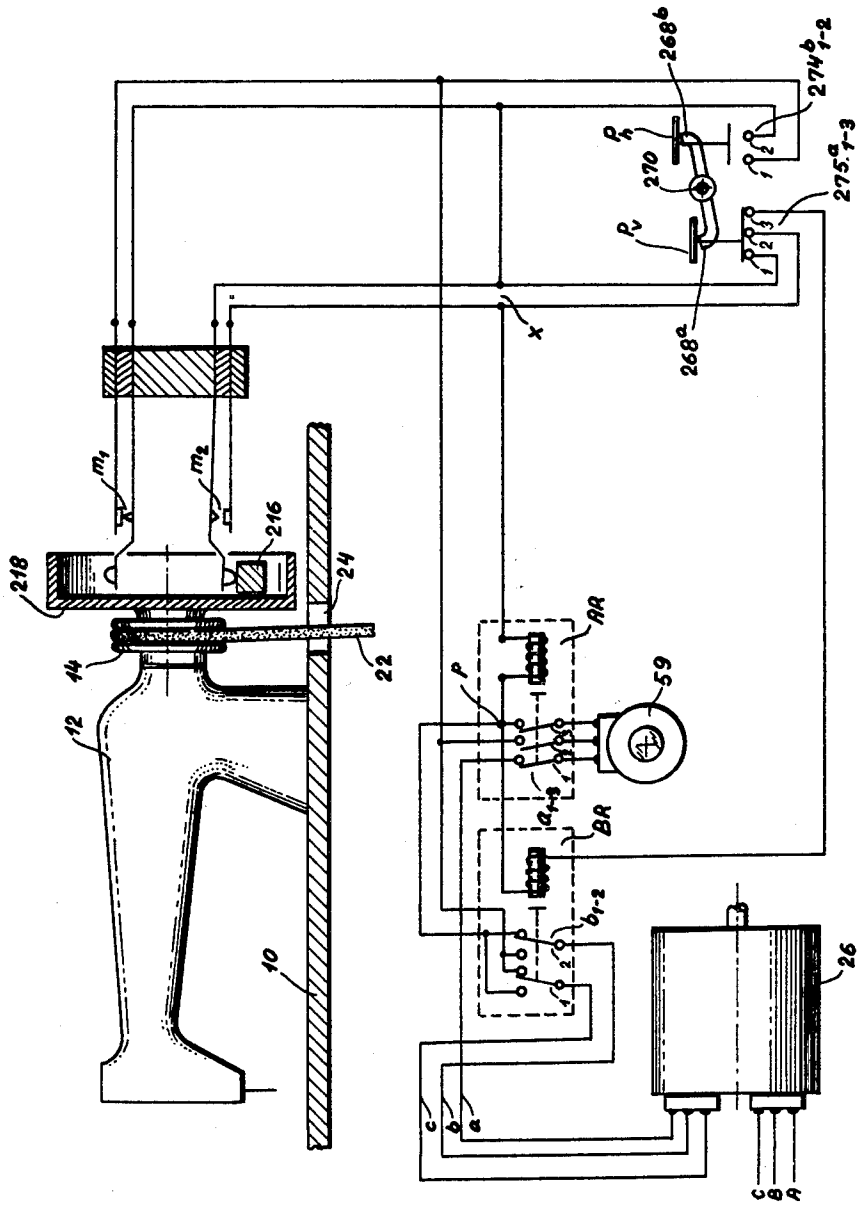


Fig. 15

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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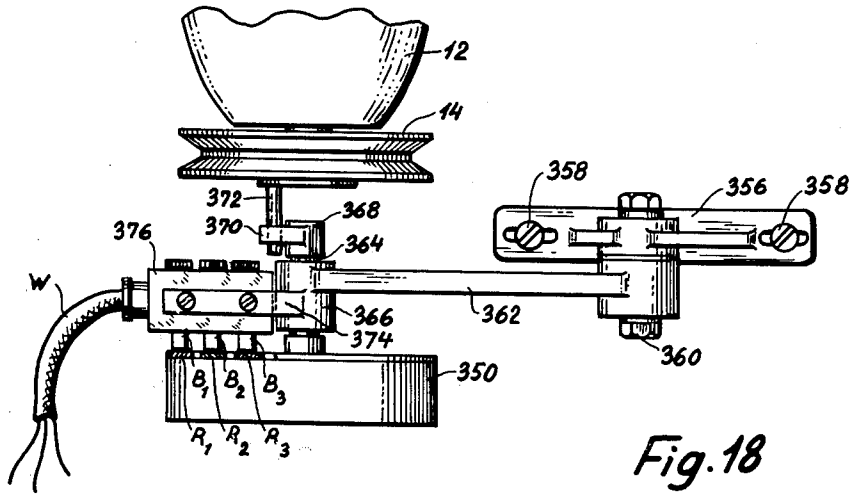


Fig. 18

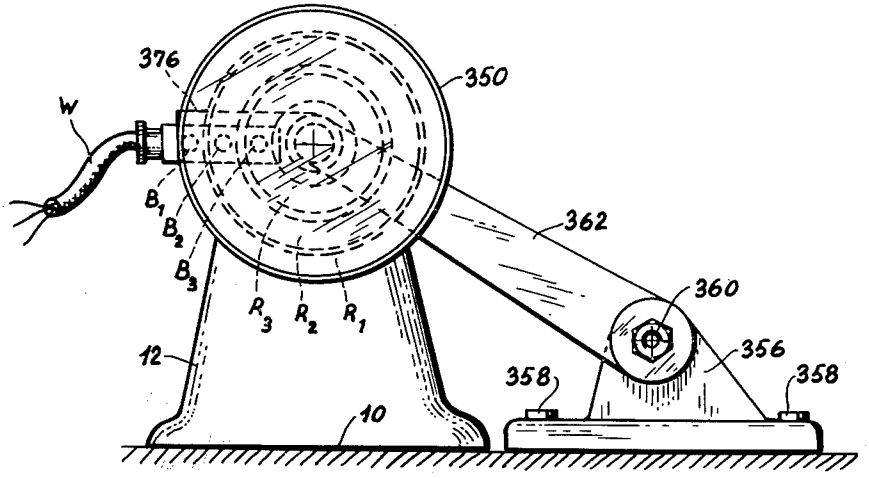


Fig. 19

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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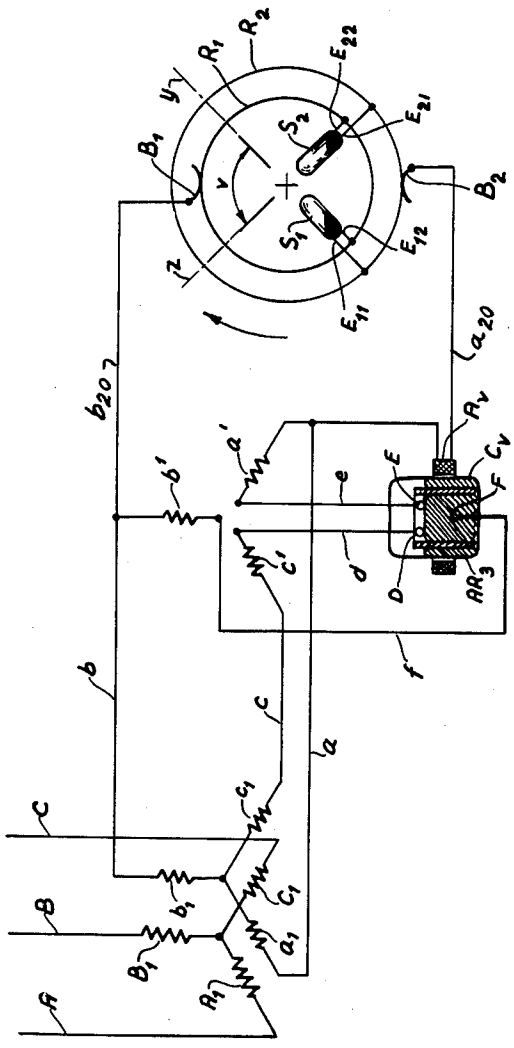


Fig. 20

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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Fig. 21

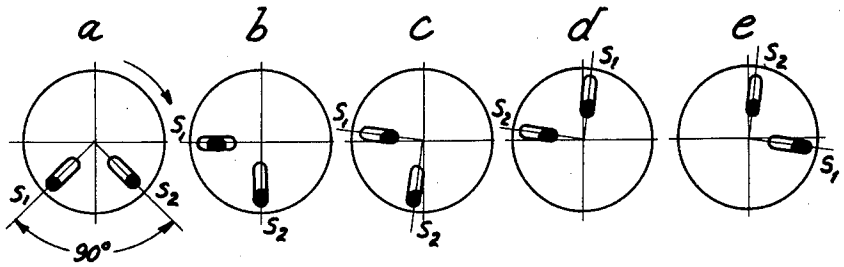


Fig. 22

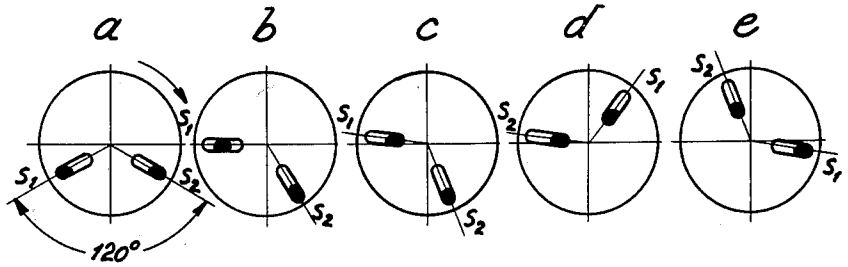
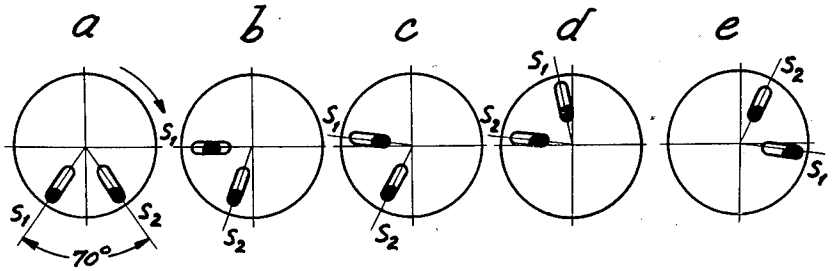


Fig. 23



INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig

ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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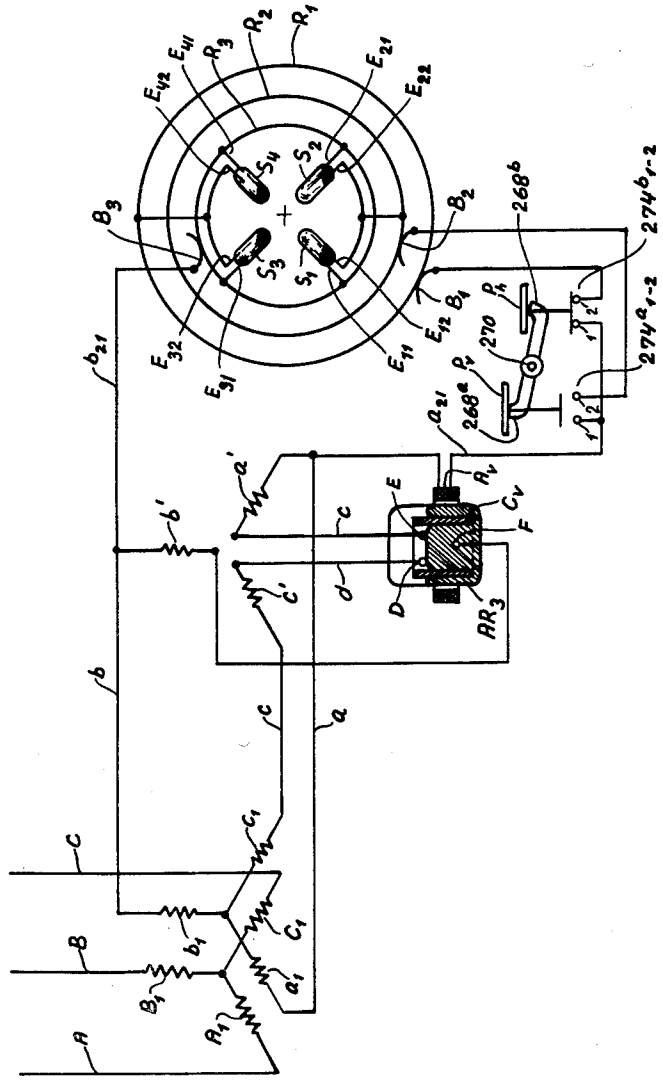


Fig. 24

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig

ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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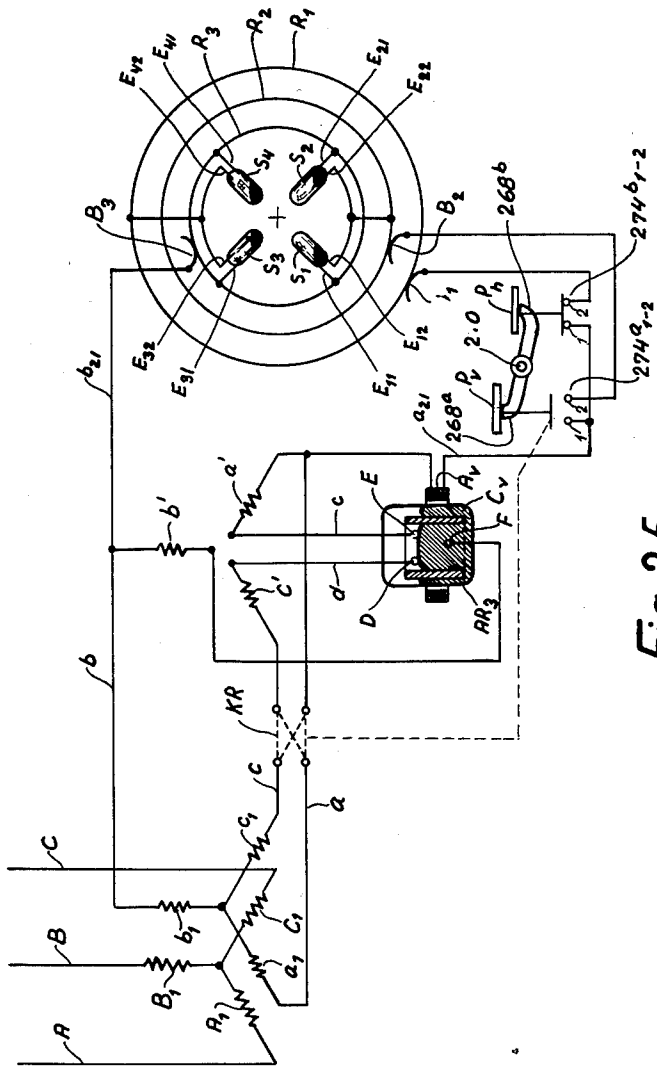


Fig. 25

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig

ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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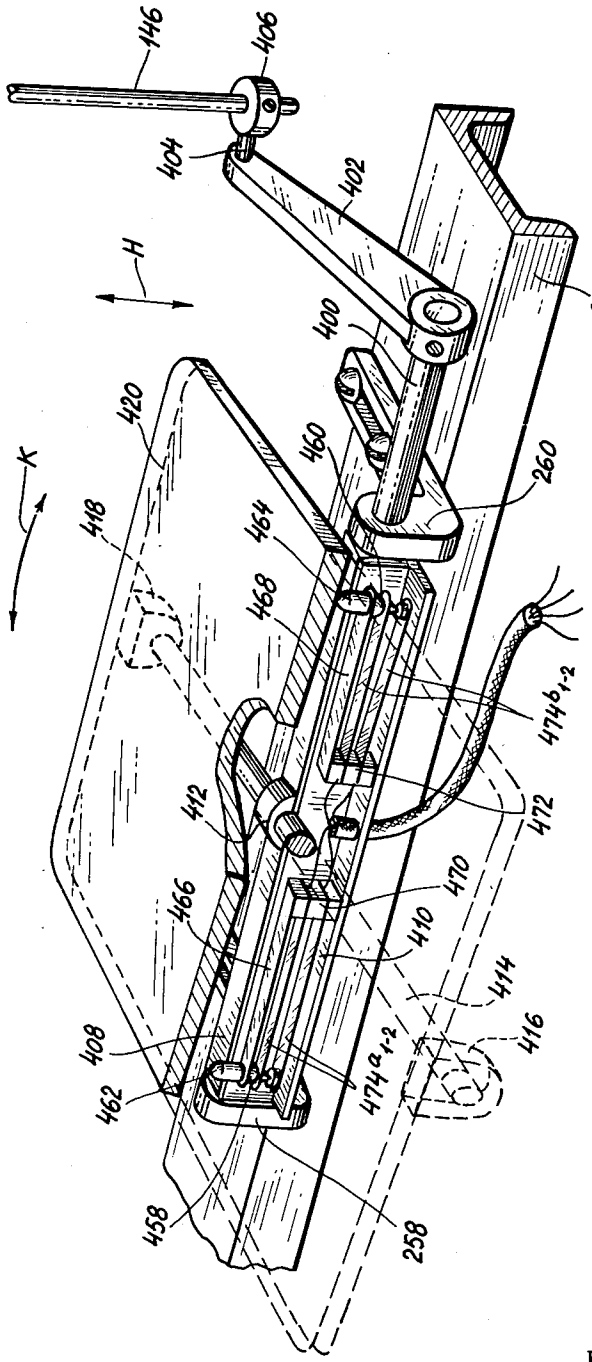


Fig. 26

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig
ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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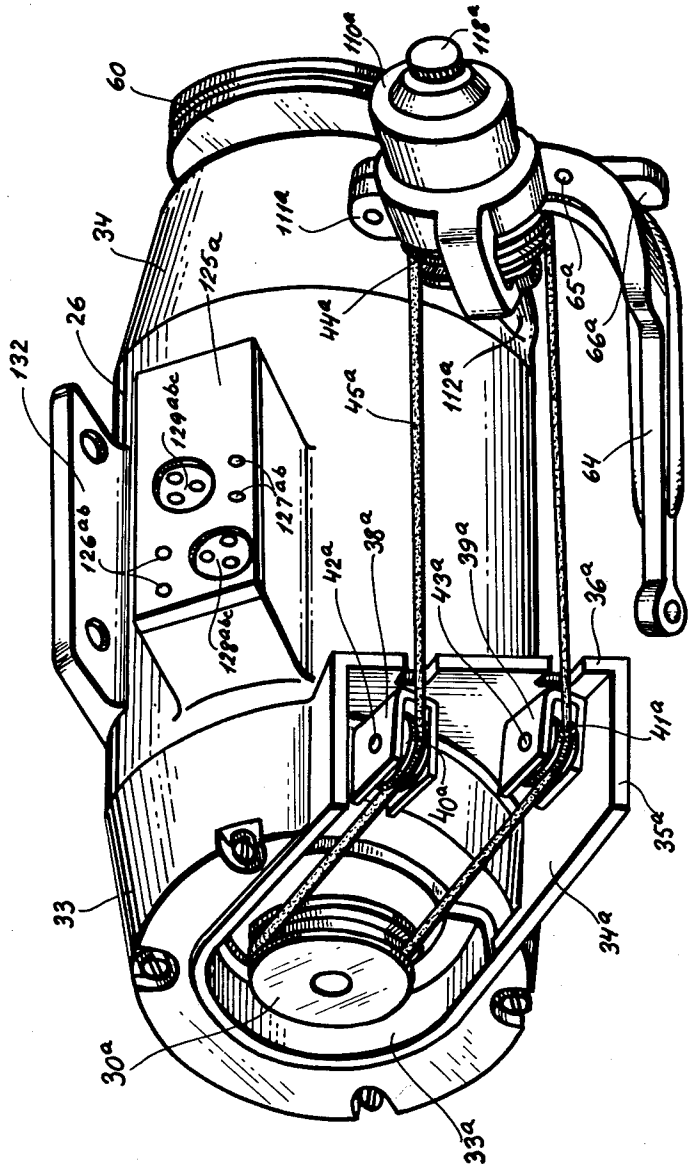


Fig. 27

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig

ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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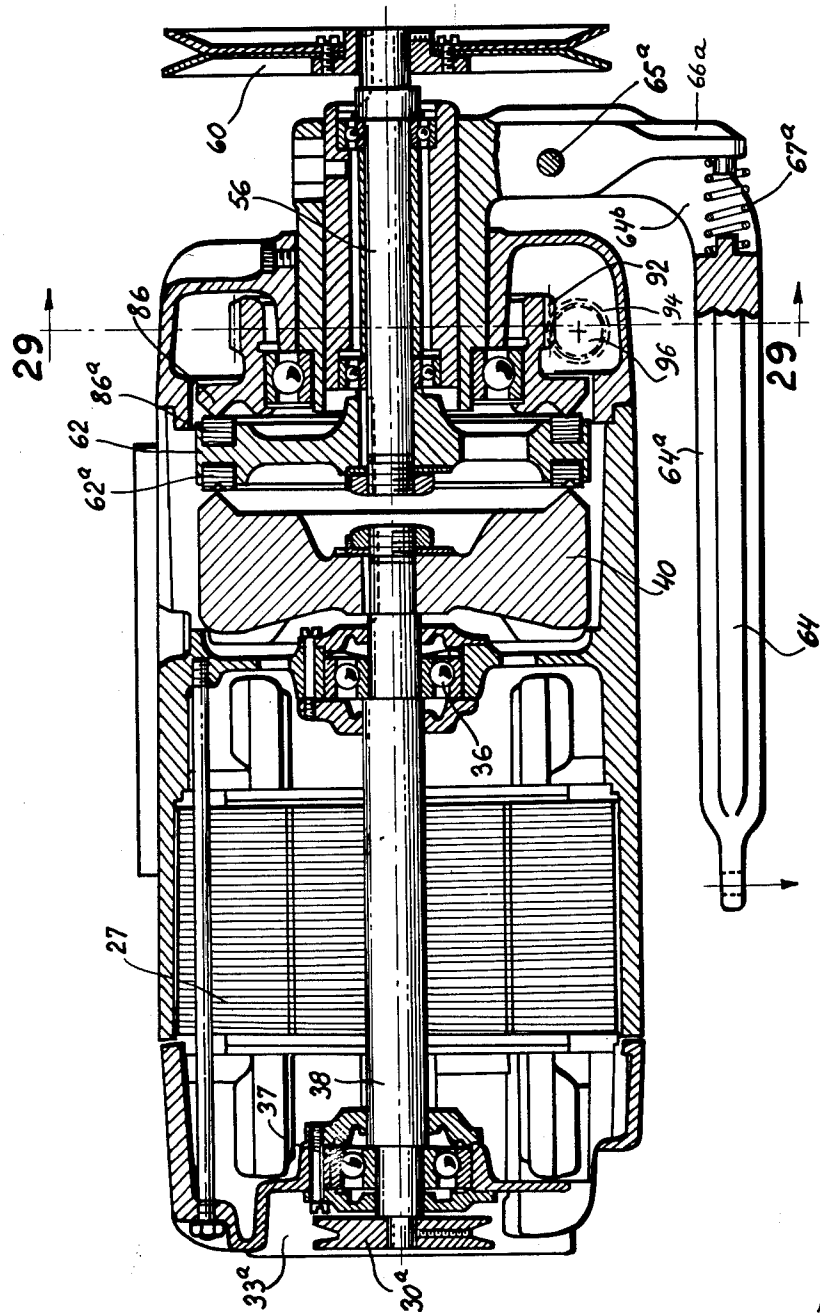


Fig. 28

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig

ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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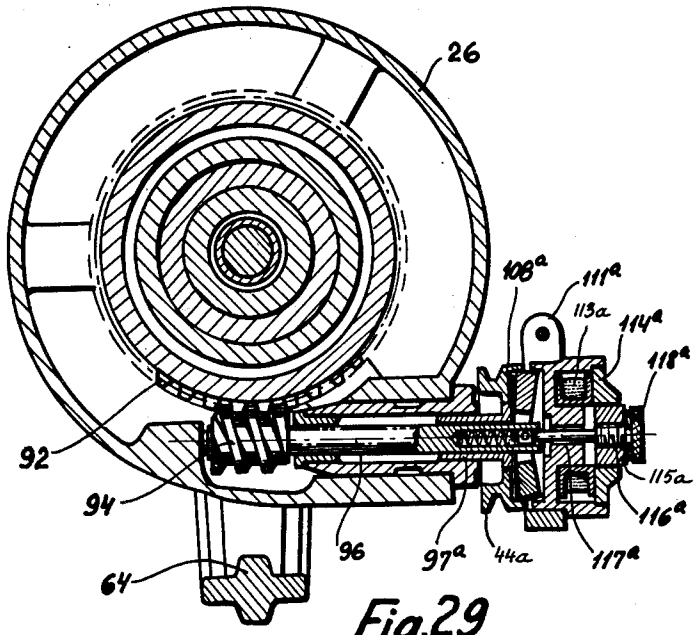


Fig.29

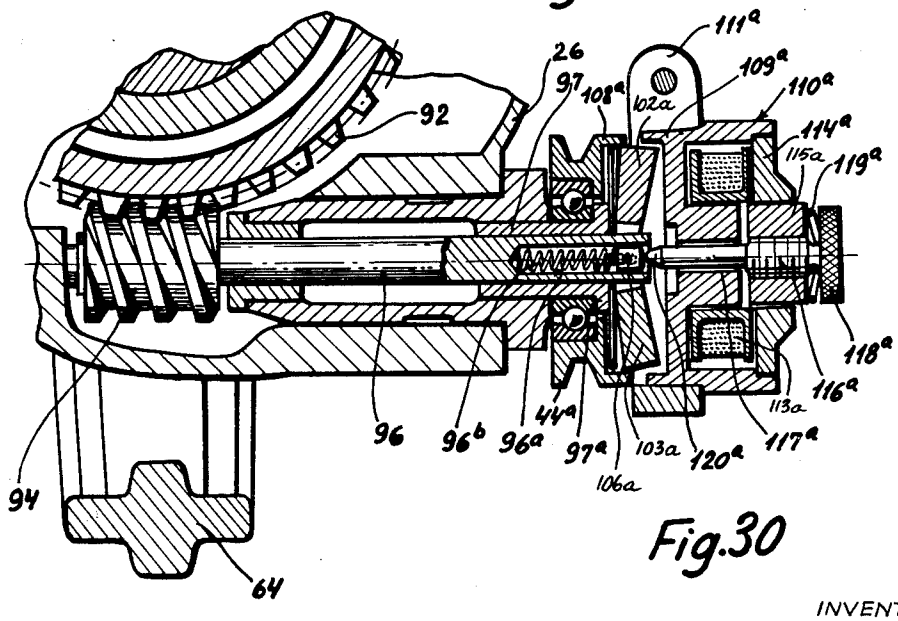


Fig.30

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig

ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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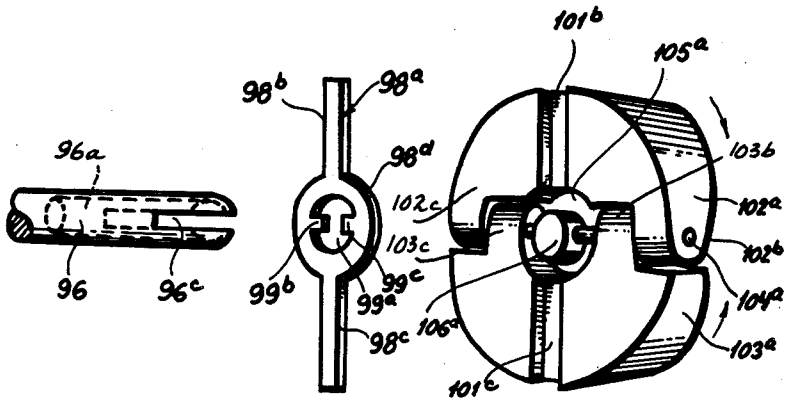


Fig.31

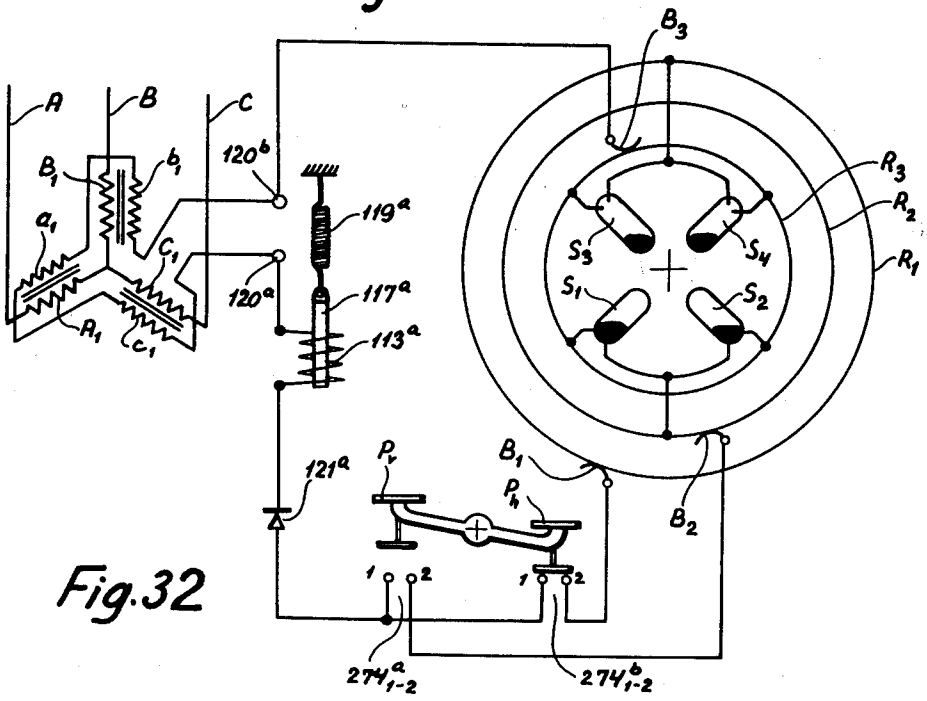


Fig.32

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig

ATTORNEYS

Dec. 17, 1963 K. HEDEGAARD 3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

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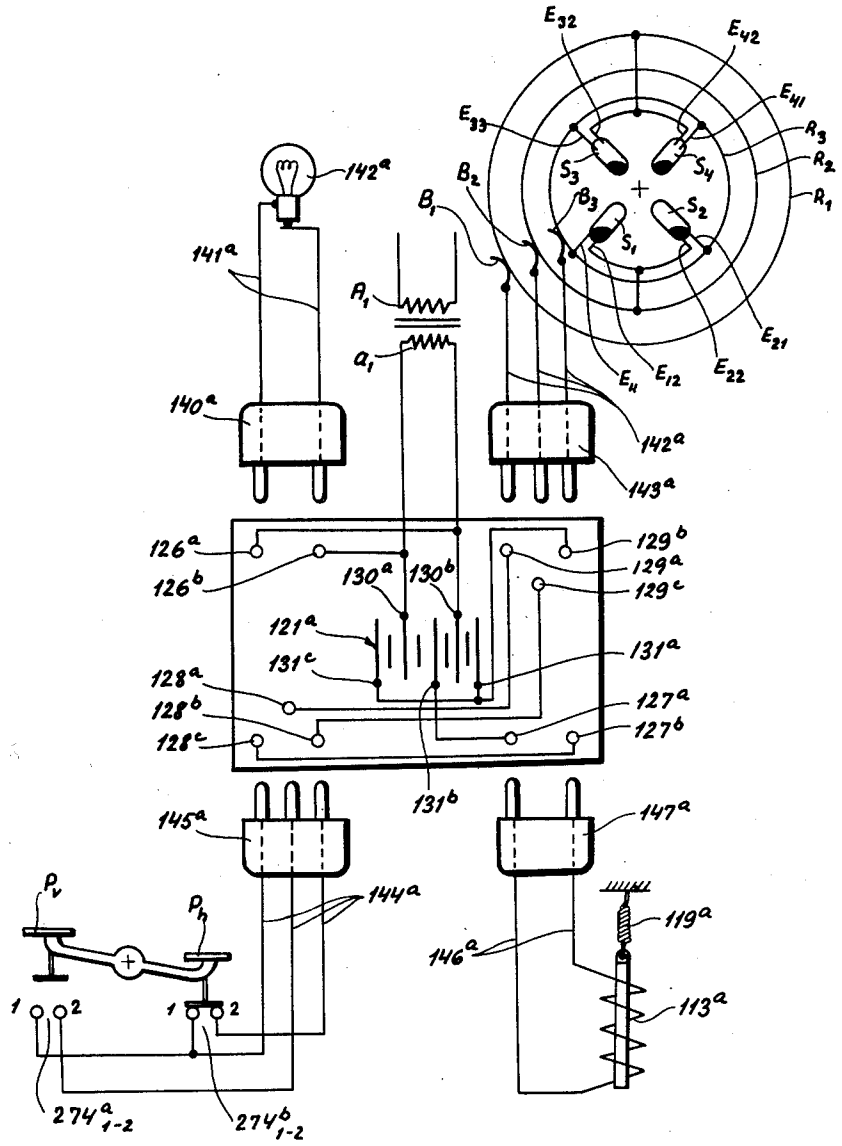


Fig. 33

INVENTOR.
KRISTEN HEDEGAARD

BY Dicke & Craig

ATTORNEYS

United States Patent Office 3,114,340 Patented Dec. 17, 1963

3,114,340

SEWING MACHINE DRIVING ARRANGEMENTS

Kristen Hedegaard, Copenhagen, Denmark, assignor to Rothenborg Specialmaskiner for Sy-Industrien A/S, Copenhagen, Denmark, a corporation of Denmark

Filed July 30, 1953, Ser. No. 371,251
Claims priority, application Denmark Aug. 1, 1952
36 Claims. (Cl. 112—219)

The present invention relates to driving arrangements.

More specifically the invention relates to driving arrangements of the clutch-and-brake type such as for instance used in sewing machines of the manufacturing type without, of course, being confined to sewing machines.

This is a continuation-in-part application of my application Serial No. 277,886, filed March 21, 1952, now abandoned, based on application in Denmark filed March 30, 1951, under Serial No. 974/51.

In sewing machines for private or domestic use the velocity of the machine does not play an important role. In the use of sewing machines for the ready made clothing industry it is necessary, however, to run the machine at a high speed and this high speed must be obtained instantaneously with the start of the machine. Therefore, in such sewing machines the driving spindle runs continuously and a clutch mechanism is used for coupling the sewing mechanism to the continuously rotating driving spindle. Thus, the sewing machine will run at full speed immediately after shifting of the clutch to the driving position.

In order to stop the sewing machine as instantaneously as it is started, the clutch is arranged to be shifted to engage a brake member. The machine will therefore also stop substantially instantaneously.

It is, however, incidental what the position of the movable parts of the sewing machine will be when it is stopped. This is a disadvantage because in some cases in order to turn the work about the needle, the latter must be in its down position, when the machine is stopped, while in other cases the needle must be in its raised position, as, for example, in order to remove the work from the machine.

The usual way of correcting for the wrong position of the needle when the machine is stopped is to rotate the balance wheel of the machine by hand. Such a manual correction is, however, irrational and time wasting. It requires the operator to remove one hand from the work to manipulate the balance wheel. A time analysis will show that the waste of time due to such manual needle adjustment may run up to approximately 25 percent or more of the total working time.

It is therefore an object of the present invention to provide a driving arrangement of the clutch-and-brake type, which will enable the operator to have full control of the driven machine, such as a sewing machine, coupled with possibility of selectively stopping the latter when the movable parts thereof are in the predetermined desired position.

It is a further object of the invention to provide a clutch-and-brake driving arrangement which enables a further movement of the driven machine after having shifted the clutch from the driving spindle to the brake member.

It is still a further object of the invention to provide a driving arrangement of the type specified which will enable the driving arrangement to be automatically stopped when the movable part of the machine such as, for instance, the stitch forming mechanism of a sewing machine is in at least one predetermined position.

A further object is to provide a driving arrangement of this kind in which the machine can be selectively stopped with the movable parts in one of a plurality of

predetermined positions selected in advance by the operator.

The invention further aims to provide simple and reliable arrangements and operating devices to fulfill the purposes specified hereinabove and other purposes which will appear from the following detailed description thereof.

The term "sewing machine" as used in the following specification is to be interpreted in its broadest sense so as to include not only ordinary sewing machines having a reciprocatory needle, for instance, upwardly and downwardly moving needle, but any kind of sewing machines designed for special purposes such as, for example, a padding machine.

In order that the invention may be more clearly understood, some preferred embodiments thereof will now be described with reference to the accompanying drawings in which:

FIG. 1 is a perspective view of a sewing machine having a motor arrangement according to one embodiment of the invention,

FIG. 2 is an axial section, on enlarged scale, through the motor and the clutch-and-brake arrangement,

FIG. 3 is a schematic diagram showing the motor arrangement in connection with an automatic control for stopping the sewing machine with the needle in a predetermined position,

FIG. 4 is a detail of the arrangement shown in FIG. 3,

FIG. 5 is an arrangement like that shown in FIG. 3 with an automatic control for stopping the sewing machine with its movable parts in two different predetermined positions,

FIG. 6 is a schematic diagram showing the circuits in an embodiment where the auxiliary drive is reversible,

FIG. 7 is an embodiment of a treadle designed for operating the machine,

FIG. 8 is a modified embodiment of an arrangement corresponding to that shown in FIG. 5,

FIG. 9 is an embodiment of the auxiliary drive having a mechanical transmission,

FIG. 10 is a modification of the arrangement shown in FIG. 3,

FIG. 11 is a modification of the treadle arrangement shown in FIG. 7,

FIG. 12 is a modification of the arrangement shown in FIG. 5,

FIG. 13 is a modification of the arrangement shown in FIG. 11,

FIG. 14 is a modification of the treadle arrangement shown in FIG. 11,

FIG. 15 is an arrangement similar to that shown in FIG. 13 with a treadle arrangement as shown in FIG. 14,

FIG. 16 is another embodiment of a switch arrangement comprising mercury switch tubes,

FIG. 17 is a cross section of the embodiment shown in FIG. 16,

FIG. 18 is a plan view of a switch arrangement comprising a switch as shown in FIG. 16.

FIG. 19 is an end view of the arrangement shown in FIG. 18,

FIG. 20 is a diagram showing an arrangement comprising a switch as shown in FIG. 16,

FIG. 21*a* through *e* are diagrammatical views of the mercury switch tubes shown in the arrangements of FIG. 20 to illustrate the operation of this arrangement with one angle between the two mercury tubes,

FIG. 22*a* through *e* are diagrammatical views of the mercury switch tubes shown in the arrangements of FIG. 20 to illustrate the operation of this arrangement with another angle between the two mercury tubes,

FIG. 23*a* through *e* are diagrammatical views of the mercury switch tubes shown in the arrangements of

FIG. 20 to illustrate the operation of this arrangement with a third angle between the two mercury tubes,

FIG. 24 is a modification of the arrangement shown in FIG. 20, in which the machine is able to stop in one or two alternative positions,

FIG. 25 is a further modification of the arrangement shown in FIG. 21 in which the machine is also able to be reversed,

FIG. 26 is a further modification of the treadle arrangement shown in FIGS. 7 and 11,

FIG. 27 is a perspective view similar to the view of FIG. 9 showing a modified embodiment of the auxiliary drive,

FIG. 28 is a longitudinal section through the embodiment shown in FIG. 27,

FIG. 29 is a cross-sectional view taken along line 29—29 in FIG. 28,

FIG. 30 is an enlarged cross-sectional view through the lower part of the cross section of FIG. 29,

FIG. 31 is a perspective view of the auxiliary clutch members used in the embodiment of FIGS. 27 through 30 with the parts drawn out to show details of the construction,

FIG. 32 is a simplified diagram of a circuit arrangement incorporating the mechanical structure of FIGS. 27 through 30, and

FIG. 33 is a schematic diagram illustrating the manner of which the different parts of the diagram in FIG. 32 are composed from various units which are plugged in to form an operating unit in accordance with the invention.

Though, in the following description, the invention will be explained specifically with reference to a sewing machine it will be understood that the invention is not limited hereto. As explained the problem of obtaining instantaneous start and stop of the machine is an important problem in connection with sewing machines for the ready made cloth industry, but it will be understood that the invention may be used also in connection with other machines in which the same problem is present.

It will further be understood that though the invention, in the following description, is explained in connection with sewing machines having a single driving unit, viz. a machine having a separate driving motor, this is not essential to the invention. The coupling arrangement may equally well be used in connection with machines which are driven from a common driving spindle feeding a plurality of machines. The term driving motor when used in the following description should therefore be interpreted in its broadest sense so as to include any sort of power drive comprising a rotatable driving spindle.

In FIG. 1, reference numeral **10** designates a table for a sewing machine **12** having a driving wheel or balance wheel **14**. The table is supported by frames or the like **16** and **18** which at their lower ends are connected by means of a cross bar **20**. The sewing machine is driven from a motor **26** suspended beneath the table **10**. The driving means is a driving cord or belt **22** driven by a pulley **60** on the motor. The coupling between the motor **26** and the pulley **60** is controlled by means of the treadle or pedal **148**, which by means of a pull-rod or the like **146** is connected with a pivotable member **66** by means of which a clutch element **62** (FIG. 2) located within the motor housing is shiftable between two positions.

By means of a further treadle or pedal **152** which is connected through a pull-rod or the like **150** with a switch arm **151** extending from the housing **149** containing a switch, the operator can, after having decoupled the motor by means of the treadle **148**, as will be more fully explained below, control the further movement of the sewing machine in such a manner that the machine can be stopped with the needle in a predetermined desired position.

The motor, which is shown in greater detail in FIG. 2, may be of any suitable construction having a stationary part **27** and a rotor **29**. The rotor **29** is arranged on a spindle **38** supported in bearings **36** and **37** respectively. The right hand bearing **36** is arranged in an interior partition **35** and the left hand bearing **37** is arranged in an end cover plate **33**. Another cover plate **34** is arranged at the opposite end of the motor **26** within which the clutch mechanism is supported. The right hand end of the driving spindle **38** carries a flywheel **40** having in its surface remote from the cover plate **33** a driving clutch element in the form of an annular groove **42** in which is arranged an annular ring or disc **44** of a suitable frictional material such as fibre.

The end cover plate **34** is provided with a centrally disposed, inwardly extending tubular member **48** which forms a guide or housing for a tubular bushing **50**. The tubular bushing **52** is provided in its interior adjacent the ends thereof provided with bearings **52** and **54** supporting a rotatable driven spindle **56**.

The cover **34** is recessed at **58** for accommodating a small auxiliary motor **59** (FIG. 1). This auxiliary motor **59** is secured in any convenient manner (not shown) to the main motor in the recess **58**.

The spindle **56** extends outwardly beyond the right hand end of the bushing **50** and is provided with a pulley **60**. The left hand end of the spindle **56** extends into the motor housing **26** and is provided thereat with a driven clutch element **62** in the form of a suitably shaped clutch disc (FIG. 2). The right hand end of the bushing **50** also extends beyond the cover plate **34** and is provided thereat with an arm or lever **64**. This arm **64** may either be an integral part of the member **66** (FIG. 1) or, alternatively, the connecting rod **146** between the treadle **148** and the motor may be connected directly to the end of the arm **64**.

In the bushing **50** there is provided a helical groove **70** cooperating with the end of a pin **72**. This pin **72** is arranged in a bore **73** provided in the end cover **34** and is secured in any convenient manner, for instance, by means of a set screw **75** extending into an annular groove **77** in the pin **72**.

An annular member **76** is rotatably mounted on the exterior cylindrical surface of the tubular member or housing **48**. This member **76** is prevented from being axially displaced at its right hand side by a shoulder **79** of the housing **48** and at its left hand side by a ring **81** received in an annular groove in the housing **48** and retained therein, for instance, by resilient action. The annular member **76** is provided with a flange **82** having in its left hand surface an annular groove **86** in which is arranged an annular ring or disc **88** of a suitable frictional material such as fibre. Preferably the ring **88** is of the same diameter as the ring **44** in the flywheel **40**. The clutch disc **62** is provided with annular ribs **74** and **90** respectively to engage either of the two rings **44** and **88**. The annular member **76** is further provided at its circumference with a worm gear **92** meshing with a worm **94** the shaft **96** of which (FIG. 1) extends outside the housing and is provided at the extension thereof with a pulley **98**, which is connected by means of a driving belt **99** with a similar pulley **101** on the spindle of the auxiliary motor **58**. It will be understood that instead of arranging the auxiliary motor **59** and the worm **94** on opposite sides of the main driving motor the auxiliary motor **59** may as an alternative, be directly connected with the worm shaft **96**.

The circuit of the auxiliary motor **59** can be closed or opened by means of the switch **149** controlled by the treadle **152** (FIG. 1).

The operation of the arrangement so far described is as follows:

The main motor **27**, **29** is maintained in continuous rotation. By operating the treadle **148** the arm **64** is swung by means of the pull-rod **146**. This will rotate the bushing **50** and due to the engagement between the pin **72** and the helical groove **70** in the bushing **50** the rotation of the bushing **50** will be translated into simul-

taneous axial displacement thereof. The spindle **56** will participate in this axial displacement and the clutch disc **62** will thereby be shifted between the two extreme positions. In its extreme left hand position the clutch disc **62** is in frictional engagement with the friction ring **44** on the flywheel **40**, which will couple the driven spindle **56** directly to the motor spindle **38**. The sewing machine will thereby be started instantaneously. In its extreme right hand position the clutch disc **62** will be in frictional engagement with the ring **88** on the brake member **76**. This will result in an instantaneous stopping of the sewing machine. If the position of the movable parts, primarily the needle of the sewing machine, when stopped instantaneously, is not in the desired position, a correction or adjustment can be made by means of the auxiliary motor **59**. This motor **59**, as shown in FIG. 1, may be started at will by operating the treadle **152** and thereby operating the switch **149** in the auxiliary motor circuit. The auxiliary motor **59** when started will, via the belt **99**, drive the worm shaft **96** which in turn will rotate the worm wheel or brake member **76** and will thereby, at a relatively slow speed, rotate the clutch element **62** which is in frictional engagement with the worm wheel or brake member **76**. Thus a relatively slow movement will be imparted to the sewing machine. The speed is so adapted that the operator is able to stop the machine by operating the treadle **152** when the needle is in the desired position by breaking the circuit of the auxiliary motor **59**.

Instead of the above described method of control of the selective closing and breaking of the circuit of the auxiliary motor **59**, the invention can be modified to provide an automatic control by means of which the sewing machine can be automatically stopped with the needle in one or more predetermined positions, for instance, in the top position or in the down position thereof.

One embodiment in which the needle is automatically stopped in a predetermined position is shown in FIGS. 3 and 4. In FIG. 3 a three-phase main motor having feed leads A, B and C is shown. The auxiliary motor **59** may, for instance, in a manner which will be more fully described with reference to FIG. 6, be inductively supplied from the stator of the main motor **26**. It will be understood that by feeding the auxiliary motor **59** inductively from the stator of the main motor **26** it is possible to feed the auxiliary motor **59** with low tension so as to use more simple switches in the circuit of the auxiliary motor and avoid any danger. The supply leads of the auxiliary motor **59** are designed by *a, b* and *c*. The breaking of the supply circuit for the auxiliary motor **59** is effected in two of the phases, for example, in phases *b* and *c* by means of switches of which, in order to simplify the drawing, only one switch **202** arranged in the phase *b*, is shown. This switch consists of a fixed contact spring **204** and a movable contact spring **206**, the latter being carried by a pivoted arm **208**. The contacts are arranged in a housing, shown schematically only, in which the contact spring **204** is firmly secured, for instance, on a support **205**. The arm **208** is pivoted in a bracket **212** in the housing **210**. The arm **208** projects through an aperture in the housing **210** and the end **209** of the arm **208** extends in the path of a cam member **216** which may be arranged within the periphery of the flywheel **218** of the sewing machine. This cam member **216** will constitute means for operating, for example, opening the switch during a certain part of its path, namely, in a certain position of the actuating mechanism of the machine.

To prevent the said cam member **216** from engaging the end **209** of the arm **208** during each revolution of the flywheel **218**, which would give rise to a noise during the operation of the machine, the cam member **216**, as shown in FIG. 4 may be pivoted on a pin **220** and be influenced by a spring **222**, which will resiliently hold the cam member **216** against a stop **224**. By including in the cam member **216** a suitable weight it will be possible by means of the centrifugal force to keep the cam member **216** in the position shown in dotted lines during the normal full-speed operation of the sewing machine. In this position the cam member **216** will no longer be in the path of the end **209** of the arm **208**.

The arrangement shown in FIG. 2 operates in the following manner:

The auxiliary motor **59** will be running continuously during the operation of the main motor **26**, the motor circuit being closed through the switch **202**. When the main motor **26** is decoupled and the clutch member **62** is brought, by means of the treadle **148**, into engagement with the brake disc **76**, the sewing machine is then driven by means of the auxiliary motor **59** but at a relatively slow speed. At this stage the spring **222** will press the cam member **216** inwardly into engagement with the stop **224**, and in this position the cam member **216** will cooperate with the end **209** of the arm **208** and thereby raise this arm to open the switch **202** to break the driving circuit for the auxiliary motor **59**. The position of the cam member **216** in the wheel **218** is such that the breaking of the circuit takes place with the needle of the sewing machine in a predetermined position, for example, in the high position.

It will also be possible to arrange the circuit in such a manner that the needle of the sewing machine can be stopped automatically at will either in the high position or in the down position. An arrangement for this purpose is shown in FIG. 5 in which a four line double pole switch generally referred to as U is inserted in the two phase leads *b* and *c*. This switch U may be operated, directly or indirectly as indicated, by the treadle arrangement of the machine or by a manually operated device. At the right hand side of this switch the phase leads are divided, each phase lead being divided from the double poles of the switch U and designated *c'*, *c''*, *b'*, *b''* etc. The leads *c'* and *b'* are connected in the same manner as the leads *c, b* in FIG. 3, to a switch **202***a'*, **202***b'* operable by a cam member **216** like the corresponding cam member in FIG. 3.

The leads *c''* and *b''* are connected in a similar manner to a similar switch **202***a''*, **202***b''*, which is also arranged to be operated by the member **216**, but located diametrically opposite the switch **202***a'*, **202***b'*. It will be understood that the switch U constitutes means for selecting **202***a'*, **202***b'* or **202***a''*, **202***b''* of the other two switches which will break the auxiliary motor circuit.

In this embodiment the switches are of the type used in telephone or like installations. One of the contact springs, in the embodiment illustrated, the top spring of switch **202***a'* and the bottom spring in the switch **202***b''*, are provided with extensions **209'** and **209''** respectively. The switches are constructed in such a manner that lifting of these extensions **209'** and **209''** of the springs will not only lead to the opening of either of the two switch portions **202***a'* and **202***b''*, but will also effect a simultaneous closing of the other switch portions **202***b'* or **202***a''*.

It will be understood from FIG. 5 that in the top or raised position of the switch U as illustrated the lower double switch **202***a'*, **202***b'* in inserted in the feed circuit of the auxiliary motor **59** so as to enable the sewing machine to be automatically stopped with the needle in one position, for example, in the lower position. By shifting or changing the switch U over, the top switch **202***a''*, **202***b''* is substituted in the auxiliary motor circuit for the previously mentioned switch **202***a'*, **202***b'* so as to enable the sewing machine to be automatically stopped with the needle in the opposite position.

In FIG. 6 is shown a diagram of an alternative arrangement, which may be either automatically or manually operated. As in FIGS. 3 and 5 the supply leads for the main motor are designed by A, B and C. The motor is a three-phase motor having stator coils A_1, B_1 and C_1. Further coils a_1, b_1 and c_1 are inductively coupled to the main motor stator coils so as inductively to feed the auxiliary motor through supply leads *a, b* and *c*. The

stator of the auxiliary motor is designed by *a'*, *b'* and *c'*. Preferably the voltage for the auxiliary motor is transformed down to a low voltage, for instance, 24 volts.

In the phase leads *a* and *c* a double pole reversing switch O is inserted having three positions. The intermediate or center position of the switch corresponds to breaking the two phase leads and thereby breaking the auxiliary motor supply circuit to stop the auxiliary motor. The two end positions of the switch O correspond to direct or reversed connection of the two phase leads *a* and *c* to enable the auxiliary motor either to run forwardly or to be reversed.

With the arrangement shown in FIG. 5 as well as with that shown schematically in FIG. 6 a treadle arrangement similar to that shown in FIG. 7 might be used.

In this treadle arrangement the main operating treadle similar to treadle **148** is combined with the corresponding switch operating treadle **152**. More specifically the switch operating treadle of FIG. 7 is split up into two parts each of which is arranged like a subsidiary treadle on the main operating treadle and each is adapted to switch on or off that part of the auxiliary motor circuit which will either stop the machine with the needle in one or the other predetermined position or reverse the motor, eventually with a subsequent stop in a predetermined position.

The main operating treadle, which by way of example is shown in the form of a rectangular frame, is designated by reference numeral **300**. This frame **300** is pivotally mounted on a spindle **302** carried by bearings in brackets **304** and **306** secured to the lower cross bar **20** (FIG. 1) of the sewing machine rack. This treadle is connected in any convenient manner with the pull-rod or chain **146** leading to the main motor operating arm **64**. It will be understood that by rocking this main treadle the main motor is stopped and started in the same manner as by means of the single treadle **148** in the various embodiments shown herein.

Individual treadle plates P_h and P_v are provided on frame **300** which are individually pivotally mounted on a common shaft **308** extending within the frame **300** and supported in the side walls thereof.

A spindle **310** is arranged between the two treadle plates P_h and P_v which extends through the end walls of the frame **300** and is rotatably arranged in bearings therein.

On one end of this spindle **310** there is arranged a two armed lever **312** having upwardly bent ends **312***a* and **312***b* adapted to be engaged by one of the two ends of the treadle plates P_h and P_v with the ends extending above that end wall of the frame **300** in which the lever **312** is carried.

At the other end of the spindle **310** there is secured a laterally extending arm **314** adapted to operate the two position switch used in the auxiliary motor circuit, viz. either the switch O in FIG. 6 or the switch U in FIG. 5.

In the arrangement shown in FIG. 7 the switch is arranged on a bracket **316** extending from the rear end of the frame **300**. The switch operating arm is provided with a bifurcated portion **318** in which the arm **314** is received.

The switch is not shown in details and may be of any convenient construction, preferably of the type comprising a tiltably arranged mercury switch tube. Switches of this kind are, however, commonly known and the proper type of switch can readily be selected by those skilled in the art.

The arrangement shown and described with reference to FIG. 7 operates in the following manner.

By way of example with reference to FIG. 5 it is assumed that the sewing machine should be automatically stopped with the needle in its top position and that the position of the switch shown in FIG. 7 corresponds to the stop-in-top position.

The operator will then operate the main treadle by means of the right foot pressing on the right treadle

plate P_h. This will keep the switch U in the proper position so that when the main treadle **300** is tilted about its spindle **302** to stop the main motor **26**, the auxiliary motor **59** will remain energized until it is stopped with the needle in the top position.

Correspondingly, if the needle has to be stopped in its lower position the operator will use the left treadle plate P_v. By operating the main treadle by means of this treadle plate P_v it will tilt the lever **312** and thereby change over the switch U so as to result in stopping the sewing machine with the needle in the lower position.

Correspondingly if in some cases reverse motion of the sewing machine is wanted after decoupling or disconnection of the main motor **26**, the treadle arrangement may be included in the arrangement shown in FIG. 6 so that by operating either of the two extra treadles the auxiliary motor will drive the sewing machine in the normal direction or in the reverse direction.

Also a slow continuous motion of the sewing machine can be obtained by the treadle arrangement shown in FIG. 7.

When the treadle is used, for instance, in the arrangement of FIG. 5 it will be understood that after having decoupled or disconnected the main motor **26**, an alternative operation of the two treadle plates P_h and P_v in the way like cycling will result in a slow movement of the sewing machine with stoppage thereof in either top or bottom position of the needle depending on which of the two extra treadles has been last depressed, because each of the two treadle plates will constitute means for selecting that portion of the auxiliary motor circuit which will effect driving the machine half a revolution.

Instead of using a centrifugally operated cam, as shown in FIGS. 3 and 5, to control the breaking of the electric circuit for the auxiliary motor **59**, the arrangement may be that shown schematically in FIG. 8 in which the same parts as in FIGS. 3 and 5 are referred to by the same reference numerals. In FIG. 8 there is provided on the spindle of the sewing machine flywheel **218** a member, which in FIG. 8 is shown as a cylinder, but which within the scope of the invention might be a plane disc. On this member **218** there are provided two contact strips **230** and **232** respectively. These strips are interrupted at **231** and **233** respectively along part of the cylinder surface so as to provide insulating portions between the ends of the contact strips. The leads *c'* and *b'* are connected by means of contact brushes to the contact strips at one point of the drum surface and the leads *c''* and *b''* are in a similar manner connected to the strips at a point diametrically opposite.

In operation it will be understood that in one position of the switch U the two phases will be broken in the position of the parts of the sewing machine in which the insulated segments **231** and **233** will be in alignment with the contact brushes connected to the leads *c'* and *b'*, corresponding to stopping the sewing machine, for instance, with the needle in high position, while the sewing machine will be stopped with the needle in the lowest position by changing over the switch U.

While in the foregoing embodiments an auxiliary motor in the form of an electric motor has been described, it will be understood that mechanical driving means may be substituted such as will now be described with reference to FIG. 9.

In FIG. 9 there is a plate **100** situated adjacent the end cover **28** of the motor **26**. The end of the motor spindle extending through this cover is provided with a conical head **30**. At each end of the plate **100** there are provided brackets **102** and **104** respectively in which is supported a spindle **106**, which is both axially displaceable and rotatable in bearings in the two brackets. On this spindle there are provided at each side of the conical head **30** cones **108** and **110** respectively. The spindle **106** is extended beyond the bracket **104** and carries thereat a pulley **112** which by means of a belt

114 is connected with a pulley 98 mounted on the lower end of the spindle 96. Pivoted on pin 116 on the plate 100 is one arm 118 of a bow 120 the other right arm 122 of which is pivotally supported on the other end cover of the motor in any appropriate manner (not shown). The left hand arm 118 of the bow 120 has a projection 124 carrying at its end a roller or the like 126 engaged between a shoulder 128 and a ring 130 on the spindle 106. The motor is carried by a base plate 132 by means of which it is secured under the sewing machine table. Springs 134 and 136 are provided between this base plate and the bows 66 and 120 respectively. These springs will tend resiliently to draw both bows 66 and 120 in an upward direction. Furthermore, in a bracket 138 on the plate 100 is a spring 140 acting on a longitudinally displaceable rod 142 and lower end of which is connected with arm 118 by means of a bracket 144 secured to the latter.

The bow 120 is intended to be connected with the treadle 152 of FIG. 1. In this embodiment of FIG. 9 only a selective operation of the auxiliary driving mechanism at the operator's will is possible. The operation is as follows:

If the sewing machine has been stopped with the needle in an unwanted position the operator will use the treadle 152. By operating this treadle, which is connected to lower the bow 120, the roller 126 is raised with the result that the spindle 106 is displaced axially upwardly. Thus the cone 110 is brought into operative driving connection with the cone 30. The latter being secured to the shaft 38 which is in continuous rotation will impart rotation to the spindle 106, which rotation is transmitted through belt 114 and spindle 96 to the worm such as 94 (FIGS. 2 and 3), and, in the manner already described in connection with the previous embodiments, will drive the sewing machine. The transmission ratio is so adapted that the speed of the sewing machine when driven by the auxiliary drive is so slow that the machine can be stopped with the needle in the desired position.

By operating the treadle 152 to raise the bow 120 the cone 108, in a corresponding manner, will be brought into driving connection with the cone 30, which will produce a slow motion of the sewing machine in the other direction.

It will be understood that the spring 140 in connection with a stop on the rod 142 serves the purpose in the position of rest to keep the bow 120 in such a position that neither of the two cones 108 or 110 will be in operative connection with the cone 30.

Instead of the automatic control for the switches in the auxiliary motor circuit as shown in FIGURES 3, 5 and 8 a modification may be used as indicated in FIG. 10. Only the sewing machine is shown in FIG. 10, the circuit being omitted. It will be understood, however, that the arrangement of FIG. 10 can be used as well in connection with the circuit of FIG. 3 as in connection with that of FIG. 5, and also in connection with any of the circuits to be described hereinafter in connection with FIGS. 12, 13 and 15.

In FIG. 10 only one contact 202 is shown having contact springs 204 and 206 as in FIG. 3. One end of the contact 204 is extended outside the housing 210 and is provided thereat with a magnetic armature 330. On the sewing machine flywheel 218 there is provided a small permanent magnet 332 in such a manner that it will move in a path adjacent the position of the armature 330. As long as the flywheel 218 rotates at full speed the magnet 332 will not be able to attract the armature 330, but when the speed of the sewing machine is decreased subject to driving the sewing machine by the auxiliary motor the magnet 332 will be able to attract the armature 330 and thereby open the switch 202 to break the auxiliary motor circuit.

Another embodiment of the specific treadle arrangement shown of FIG. 7 is shown in FIG. 11 in which the main treadle is denoted by numeral 250.

The main operating treadle is in the form of a substantially T-shaped plate 250. This plate is pivotally mounted on pins of which only the left hand pin 252 is shown in full lines. These pins 252 and 254 are supported in bearings 258 and 260 respectively carried in brackets which, as shown, may be secured by means of screws to the lower cross bar 20 of the sewing machine. At the rear end of the plate 250 there is arranged a spindle 264 the right hand end of which is connected to the operating rod or chain 146 leading to the main motor operating arm 64. It will be understood that by rocking the main plate 250 the sewing machine can be stopped and started in a manner similar to operation of the single treadle 148 in the different embodiments described hereinbefore.

The switch operating treadle 250 is combined with switch control treadle plates by providing on the spindle 264 two individual treadle plates P_h and P_v each carried by pairs of brackets 266*a* and 266*b* respectively. On the front end of the plate 250 there is arranged a pin 270 carrying a two armed rocking lever 268 having ends 268*a* and 268*b* respectively extending upwardly and so dimensioned that only one or the other of the two plates 262*a* and 262*b* can be pressed down at the same time.

The two treadle plates P_h and P_v may either be of insulating material or they may have insulating portions carrying contact pins 272*a* and 272*b* respectively adapted to cooperate, by pressing down either of the treadle plates, with pairs of contact pins $274a_{1-2}$ and $274b_{1-2}$. This will bridge one pair or the other pair of the contact pins and close a circuit in a manner similar to that described in connection with the two treadle plates in FIG. 7 for actuating the switch U or O.

A circuit in which the treadle arrangement according to FIG. 11 is used is more specifically shown in FIG. 12. This circuit substantially corresponds to the circuit shown in FIG. 5 with the exception that only single switches m_1 and m_2 are arranged on diametrically opposite sides of the sewing machine flywheel 218. Furthermore in FIG. 12 the mechanical arrangement between the main motor 26 and the auxiliary motor 59 has been omitted to simplify the survey of the diagram.

In general the circuit arrangement of FIG. 12 comprises in combination with the driving and driven clutch elements (not shown) a circuit arrangement having electromagnetic means for controlling the disconnection of the auxiliary drive by means of which the sewing machine is driven at low speed with the driven clutch element shifted between the high speed driving clutch element and the slowly rotating brake element.

As in FIG. 5 the auxiliary motor 59 is inductively fed from the main motor through three phase leads *a*, *b* and *c*. In these phase leads there is inserted a three-pole switch a_{1-3} controlled by a relay AR, which is inserted in a circuit comprising an extension *b'* of the phase lead *b* and an extension *c'* of the phase lead *c*. The ends of these two phase extensions *b'* and *c'* and the contacts $274b_{1-2}$ belonging to the right hand treadle plate P_h are also shunted by the switch m_1. In the phase lead c_1 there is further inserted at X the switch m_2 shunted by the left hand treadle plate contacts $274a_{1-2}$. The arrangement shown in FIG. 12 operates as follows:

The treadle is pivoted to decouple the main motor as described with reference to FIG. 7. By changing over the clutch the sewing machine is slowed down while being driven by the auxiliary motor 59. The operation of the treadle is effected by either of the two treadle plates P_v or P_h.

By operating the treadle with the right hand plate P_h the relay AR is coupled in a circuit comprising the phase leads *b'*, *c'*, the switch m_2 and the switch m_1 shunted by the contacts $274b_{1-2}$. When the switch operating member 216, which is shown as a centrifugal member, but which

within the scope of the invention may be magnetic as shown in FIG. 10 or communicator-type contacts as shown in FIG. 8, opens the switch m_1 this will not stop the auxiliary motor **59**, because the switch m_1 is short circuited by the contacts **274**b_{1-2}. When, however, after predetermined rotation of flywheel **218** the switch operating member **216** opens the switch m_2 this will break the relay circuit with the result that the relay contacts a_{1-3} will open the motor circuit for the auxiliary motor **59**, stopping the latter with the needle in the selected position, for example, the bottom position.

Conversely, when the left hand treadle plate P_v is depressed, the contacts **274**a_{1-2} will short circuit the switch m_2 leaving the contacts **274**b_{1-2} open. This means that opening of the switch m_2 by the switch operating member **216** will have no influence on opening of the auxiliary motor circuit. The relay AR will, however, drop out when the switch m_1 is opened by the switch operating member **216** corresponding to a stop of the sewing machine with the needle in the other position, for instance, the top position.

As further shown in FIG. 11 there may be a switch **276** incorporated in the treadle and having an operating pin **278** extending into a bifurcated portion of the left hand lever arm **268** so as to throw over the switch **276** by pressing the left hand treadle plate P_v.

A treadle arrangement as shown in FIG. 11 and including this switch may be incorporated in the circuit arrangement shown in FIG. 13.

This arrangement corresponds to that shown in FIG. 12 with the exception that the switch **276** is inserted in the two phase leads *b* and *c* at KR and is operable in such a manner that these two phase leads are directly connected with the right hand treadle plate P_h in the bottom position, while the two phase leads are cross-connected when the left hand treadle plate P_v is in the bottom position.

If it is assumed that operation of the treadle by means of the right hand plate P_h corresponds to stoppage of the sewing machine with the needle in bottom position, while operation of the treadle with the left hand plate P_v corresponds to stopping the sewing machine with the needle in the top position, it will be understood that the sewing machine by the arrangement shown in FIG. 13 can be operated in the following manner.

The treadle is operated by the right hand treadle plate P_h. This will as in the case of FIG. 12 stop the machine when the switch m_2 is opened corresponding to the needle in bottom position. Hereafter the left hand treadle plate P_v is operated. This will close the auxiliary motor circuit through the relay AR, because now the contacts **274***a* are interconnected, thereby short-circuiting the open switch m_2. Simultaneously therewith, however, the switch **276** will be operated crossing the phase leads. This means that the auxiliary motor **59** will be started again but in reverse direction, will thereafter make half a revolution until the switch m_1 is opened, and be stopped with the needle in the top position. This arrangement is useful, for instance, when locking a certain stitch chain in the work.

Instead of incorporating in the treadle arrangement a special switch **276** the arrangement may be as shown in FIG. 14, which only differs from the arrangement in FIG. 11 in that instead of the switch **276** the left hand contact set **274***a* is provided with three contact pins and in FIG. 14 designated by **275**a_{1-3}.

This arrangement may, for instance, be used as shown in the wiring diagram of FIG. 15. This differs from the diagram shown in FIG. 12 only in that between the point *x* and the third of the three pins **275**a_{1-3} there is inserted a further relay BR having contacts b_{1-2} inserted in the phase leads *b* and *c* operable either to connect the two phase leads directly or to cross-connect those phase leads.

The arrangement as shown in FIG. 15 operates in the following manner:

By operating the treadle in the right hand treadle plate P_h the circuit is closed through the relay AR. The relay BR is unenergized and assumes a position corresponding to a "straight" connection of the two phase leads *b* and *c*. As in the case of FIGS. 12 or 13 the auxiliary motor **59** is stopped with the sewing machine needle in the bottom position upon opening of the switch m_2.

By thereafter depressing the left hand treadle plate P_v the auxiliary motor **59** is again started, because the open switch m_2 is short-circuited by the two left hand contact pins **275**a_{1-2}. Simultaneously a circuit through the relay BR is formed by means of the third contact pin **275**a_3. When this occurs the relay BR throws over the switch b_{1-2} cross-connecting the phase leads *b* and *c*, whereupon the sewing machine motor, as in the case of the operation of the switch **276** in FIGS. 11 and 13, is reversed and then again stopped when the needle is in top position.

While in the foregoing description the means for synchronizing the breaking of the auxiliary motor circuit with the position of the sewing machine needle has been described with reference either to the centrifugal member shown in FIGS. 3 and 4 or the magnetic means shown in FIG. 10, it will be understood that the invention is not restricted to the use of these specific means, but that other means can be used within the scope of the invention.

As an example of other means there is shown in FIGS. 16 and 17 an embodiment comprising a plurality of switch tubes. A substantially cylindrical housing **350** has a rear wall **352** and a front wall **354**. In the front wall there are arranged three circular concentric contact rings designated R_1, R_2 and R_3. A plurality of switch tubes are further accommodated within the interior of the housing. In the embodiment shown there are four switch tubes designated S_1, S_2, S_3 and S_4 and kept in a position extending radially, with a suitable angle such as an angle of 90° between each pair of tubes by means of partitions P_1, P_2, P_3 and P_4. The tubes may be small glass bulbs containing a liquid body such as mercury. From the exterior end of each tube there extends into the interior thereof two electrodes marked E_{41} and E_{42} as illustrated in connection with the end of the tube S_4.

The mechanical arrangement may be as more specifically shown in FIGS. 18 and 19. A bracket **356** is secured by screws or the like **358** on the surface of the sewing machine table **10**. The sewing machine as in the other figures is denoted by the reference numeral **12**. The bracket arm **362** is pivotally mounted on a shaft **360**, where it can be adjusted and secured in position. The outer end of this arm **362** carries the housing shown in FIGS. 16 and 17. As shown in FIG. 17 the housing **350** is arranged on a spindle **364**. This spindle **364** is rotatably journalled in a bearing **366** (FIG. 18) supported at the end of the arm **362**. At the other end of the spindle **364** there is secured a bushing **368** having a radial arm **370**. A hole in the latter receives a pin **372** which is secured eccentrically to the sewing machine flywheel **14**. From the bearing **366** there also extends an arm or the like **374** carrying a brush holder **376** having three carbon or other brushes B_1, B_2 and B_3 cooperating respectively with the three contact rings R_1, R_2 and R_3. An electric lead with three conducting wires connects the arrangement with the electric circuit to be more fully described hereinafter.

By mounting the arrangement described herein care should preferably be exercised to ensure that the axis of the rotating housing **350** is exactly in axial alignment with the axis of the main sewing machine spindle carrying the flywheel **14**.

It will be understood that during the rotation of the sewing machine the housing **350** will be rotated, the movement being transmitted through the pin **372** to the arm **370**.

A diagram of the motor drive, in which the arrangement shown in FIGS. 16 to 19 is utilized, is schematically shown in FIG. 20 in which A_1, B_1 and C_1 constitute the

main motor stator, and a_1, b_1, c_1 are the feeding coils for the auxiliary motor, which is inductively fed from the main motor as in FIG. 6.

Instead of connecting the three auxiliary motor stator windings directly in Y-connection as shown in FIG. 6, the interior ends of the stators a' and c' are connected through leads d and e with top electrodes D and E in a mercury relay AR_3, the bottom electrode F of which is connected through a lead f with the interior end of the auxiliary motor stator b'.

The relay is of the kind comprising an exterior relay winding A_v containing a cylindrical core C_v normally floating on the mercury but which, upon energization of the relay, is drawn downwardly to raise the mercury and thereby to bridge the three electrodes. Relays of this kind are so well known that a further detailed description of the relay is not believed necessary herein.

In the circuit shown in FIG. 20 there is assumed the use of an arrangement along the lines described with reference to FIGS. 16 to 19 but comprising only two mercury switch tubes S_1 and S_2 with two contact rings R_1 and R_2 connected respectively with a brush B_1 and B_2. The brush B_1 is connected with the phase lead by an extension thereof b_{20} while the brush B_2 is connected through the relay winding A_v with the phase lead a through an extension a_{20} thereof. The two electrodes of the switch tube S_1, viz. E_{11} and E_{12} are connected with the two contact rings R_1 and R_2 and in a similar manner the electrodes E_{21} and E_{22} of the switch tube S_2 are connected with the two contact rings.

The operation of the arrangement shown in FIG. 20 is as follows: Under normal speed, i.e., with full velocity of the main motor, the centrifugal force will keep the mercury in the two switch tubes at the outer ends of the tubes bridging the electrodes in the two tubes and thereby short-circuiting the connection between the two contact rings R_1 and R_2. The direction of rotation of the switch described will be that indicated by the arrow in FIG. 20. The relay winding A_v is therefore connected into the circuit comprising the leads a_{20} and b_{20} and accordingly the core C_v will be in the down position with the mercury interconnecting the three electrodes D, E, F and thereby connecting the three auxiliary motor windings a', b', c' so that the auxiliary motor will also be running.

When the main operating treadle is operated and the main motor decoupled as described hereinbefore, the sewing machine will be further driven by the auxiliary motor but at reduced speed insufficient to produce a large enough centrifugal force to hold the mercury at the outer ends of the mercury tubes. This means that when the mercury tube S_1 arrives slightly above the horizontal position, the mercury in this tube will flow back to the inner end of the tube. The same applies to the switch tube S_2 in which upon inward flow of the mercury in this tube will then break the connection between the two contact rings R_1 and R_2, which again means that the circuit through the relay winding A_v will be broken with the result that the Y-connection of the motor M_2 is broken.

In FIGS. 21*a* through 21*e* the influence of the angle between the two mercury tubes S_1 and S_2 is illustrated as per the following explanation:

In general the needle of a sewing machine will be in either the top position or the down position within a certain angle of the main spindle of the sewing machine. As previously mentioned the synchronization device is arranged on the hand wheel of the sewing machine so as to follow the angular movements of the main spindle of the sewing machine. Generally speaking there is no sharply defined angular position of the main spindle which corresponds to needle top or needle down position so that it is understood that within a certain range of angular positions of the main spindle the needle will be in top position and within a certain range of angular positions diametrically opposite thereto the needle will be in down position. These angular positions have to be considered in the design of the synchronization device. In the ideal case, of course, the main spindle is stopped, when the sewing machine needle is either in top or down position but in practice this will not be necessary, because the purpose of the synchronisator is either to keep the tip of the sewing machine needle free of the work piece or embedded therein. Another purpose of the synchronisator is to stop the sewing machine spindle in either of those two positions with the minimum number of rotations after the operator's heel has stepped on the treadle and switched over the driven clutch element to engage the rotating brake member. In other words, a purpose of the synchronisator is to avoid any superfluous number of rotations of the main sewing machine spindle.

Assuming that only one single mercury switch tube is used in series with this circuit of the auxiliary drive circuit, it will be appreciated that if this mercury switch tube incidentally was in a position above the horizontal level, when the operator's heel steps on the treadle, the machine would stop. In contrast thereto, a position of a mercury switch tube below the horizontal level at the moment of starting the slow motion brake action will result in at least half a revolution of the main spindle.

It is therefore a fundamental principle of the synchronisator to use a two-pole mercury switch incorporating two switch tubes shunted in the auxiliary drive circuit and forming a suitable angle.

In practice a single tube would give an angle of 70° within which there is a possibility for incorrect stop position. By means of two parallel shunted mercury switch tubes it is possible to secure the correct stop position within an angle of 0°–180° as will now be more fully explained.

In FIG. 21*a* through 21*e* the two mercury switch tubes S_1 and S_2 form therebetween an angle of 90°. The rotation is in the direction of the arrow shown in FIG. 21*a*. When the tube S_1 arrives at the horizontal position as shown at FIG. 21*b*, the mercury will start to leave the electrodes which for the sake of clarity are not shown in these schematic views. The tube S_2 will, however, still maintain the circuit for the auxiliary drive circuit through the position shown at FIG. 21*c*, until the mercury switch tube S_2 is slightly above the horizontal position as shown in FIG. 21*d*. The circuit will then remain interrupted, until the tube S_1 arrives at the position shown in FIG. 21*e*. As evident from these views there exists between FIG. 21*d* and FIG. 21*e* a free angle of 90° corresponding to the angle of 90° between the tubes. In practice this means that there will be a small angle of approximately 20° within which the sewing machine spindle will have to make an extra revolution if incidentally the auxiliary drive is applied with the mercury switch tubes in very specific position. In all other positions, the spindle will be stopped after not more than half a revolution.

In FIGURES 22*a* through 22*e* the angle between two mercury switch tubes S_1 and S_2 is 120°.

It will be appreciated that the angle of interruption in accordance with this description will be

$$\beta = 180° \div \alpha = 120°$$

which in accordance with the above explanation will correspond to an angle of interruption of $\beta = 60°$. When applying the rotational brake member within an angle of 60°, it will, however, be necessary to allow the spindle to make one whole revolution.

In FIGS. 23*a* through *d*, $\alpha = 70$, which in many cases will be the optimum condition, because many sewing machines have a rotational angle of 110° of the main spindle between the extreme top and the extreme down position of the needle.

From the formula $\beta = 180° \div \alpha$ it will be understood that if in a sewing machine β is 110°, $\alpha = 70°$ will be the correct angle between the tubes to assure that in any position of the main spindle, the spindle will make only maximum half a revolution, until the spindle is stopped.

In some of the following figures, separate pairs of shunted switch tubes are used for selectively stopping the sewing machine with the needle either in top or down position. The theoretical explanation given hereinabove will not be repeated in connection with the following example, but it will be understood that the angle between the shunted pairs of mercury are designed for stopping the machine with the needle in top or in down position.

In practice and in view of the fact that the synchronisator is universally applicable when allowing the machine to be stopped with the needle in either of the two positions, an angle of 90° between the two tubes in either of the pairs of tubes will in general be allowable and sufficient for all general purposes.

The arrangement shown in FIG. 20 enables the needle to be stopped in a single position, for instance, in top position.

FIG. 24 shows an embodiment similar to that shown in FIG. 20, but further incorporating a double plate treadle as shown in FIG. 11 and four switch tubes as shown in FIGS. 16 to 19. The extension a_{21} of the phase lead contains the relay winding A_v and is connected to the brushes B_1 and B_2 respectively. The other phase lead extension b_{21} is connected to the third brush B_3

The four contact tubes are interconnected and connected with the three contact rings in the following manner:

Electrodes E_{31}, E_{41}, E_{21} and E_{11} are all connected to the interior contact ring R_3. The electrodes E_{32} and E_{42} are interconnected and also connected with the exterior contact ring R_1, while the electrodes E_{12} and E_{22} are interconnected and also connected to the intermediate contact ring R_2.

It will be understood that by pressing the right hand treadle plate P_h the circuit will be completed through the relay winding A_v, the right treadle contact pins $274b_{1-2}$, exterior contact ring R_1, switch tubes S_3 and S_4 and interior contact ring R_3.

This will, in the manner describe with reference to FIG. 20, keep the auxiliary motor running until the mercury in these two tubes S_3 and S_4, under the reduced driving speed, is no longer held in the outer position in the tubes. The auxiliary motor circuit will therefore be interrupted with the sewing machine needle in one position, for instance, in the bottom position.

By pressing the left hand treadle plate P_v the circuit is completed through the phase lead a_{21}, left hand treadle plate contacts $274a_{1-2}$ to intermediate contact ring R_2 through the mercury switch tubes S_1 and S_2 to the interior contact ring R_3 and further through contact brush B_3 and the phase lead b_{21}.

This means that the switch tubes S_1 and S_2 will now take over the control of the position in which the auxiliary motor circuit is broken, and since these tubes are arranged diametrically opposite to the tubes S_3 and S_4 it will be the opposite position, viz. the top position of the needle.

It will further be understood that the arrangement shown in FIG. 24 can be modified so as to include also the possibility of reversing the auxiliary motor, for instance, by including a reverse switch in the circuit as schematically shown in FIG. 25. Here the reverse switch KR is only shown schematically inserted in the phase leads *a* and *c* operable for example by the treadle in the form of a separate switch as shown in FIG. 11.

It will be understood, however, that the arrangement according to FIG. 25 may also be modified to include a further relay to operate the reverse switch in the manner already shown and described with reference to FIG. 15.

It will be understood that in the foregoing specification many different embodiments have been shown and described.

Although in order to simplify the description, several of the embodiments are shown as incorporating the centrifugally operated cam member, viz. that type of switch in which the switch itself is stationary and is operable by a member, which, when the machine is driven at reduced speed, will lie in a path abutting the switch operating member, it is to be understood that in these embodiments the centrifugal switch can be replaced by a rotating switch according to FIGS. 16 to 19, if desired.

While in the foregoing embodiments of the treadle arrangement species have been shown and described in which the pivotable treadle operatively connected with the driven clutch element is provided with treadle plate portions, which are individually pivotable to operate the switch selecting means in order to effect stopping of the auxiliary motor in either of two different predetermined positions, it will be understood that the same can be effected by means of the treadle arrangement shown in FIG. 26.

Here only one treadle plate is used, the two half parts of which are equivalent with each of the two treadle plate portions of the foregoing species. To facilitate the survey of FIG. 26 the front half part of the treadle plate is cut away and only shown in dotted lines. As also shown in FIG. 11 the treadle is supported in brackets **258** and **260** secured to the lower transverse bar **20** of the sewing machine. In these brackets there is rotatably arranged a shaft **400** extending at one end beyond the bracket **260** and provided thereat with a radially extending arm **402** to the end of which at **404** there is linked a ring or bushing **406** connected to the pull rod **146** shifting the driven clutch element between the driving clutch element and the rotatable brake member. Between the two brackets **258** and **260** there is secured on the spindle **400** a bar **408**, which is preferably provided with a shelf-like portion **410**. This bar **408** may be of any convenient cross section, but is preferably of rectangular cross section. The bar **408** is provided between its ends with a suitable bearing or the like **412**, in which is secured a rod or spindle **414** perpendicular to the spindle **400**. The ends of the spindle **414** extends into bearings in brackets **416** and **418** respectively, on which is secured a treadle plate **420**.

The bar **408** is secured to the spindle **400** in such a manner that it is not allowed to rotate relatively to the spindle **400**. As will be understood the treadle plate **420** is thus allowed to pivot in two perpendicular directions H and K in a similar way as that in which a compass is suspended. The one movement as represented by the double-arrow H will cause a rotation of the spindle **400** thus shifting the driven clutch element, while a pivoting of the treadle plate in direction of the double-arrow K will effect control of breaking of the auxiliary motor circuit in the manner to be described hereinafter.

On the projection or shelf-like portion **410** there are provided below the treadle plate **420** the contact springs $474a_{1-2}$ and $474b_{1-2}$ corresponding to the contacts $274a_{1-2}$ and $274b_{1-2}$ in FIG. 11. These contact springs $474a_{1-2}$ and $474b_{1-2}$ are clamped in insulating supports **470** and **472** respectively. Above each of the contact springs $474a_{1-2}$ and $474b_{1-2}$ resilient arms or springs **466** and **468** provided with abutments **462** and **464** at the ends thereof are secured to the top of the insulating supports **470** and **472** respectively. Below these arms or springs **466** and **468** there are furthermore secured thereto insulating knobs or the like **458** and **460** to engage the upper of the two contact springs in each of the pairs $474a_{1-2}$ and $474b_{1-2}$ thereof.

It will readily be understood that by operating the treadle arrangement of FIG. 26 with the right foot the treadle plate will be tilted to the position shown in FIG. 26, in which the right hand half part of the treadle plate operates to close the switch $474b_{1-2}$. Accordingly, by using this treadle arrangement in any of the circuits described hereinbefore having two switches to be selected to effect stopping of the auxiliary motor with the sewing machine actuating mechanism in one of two predetermined positions this position of the treadle plate will enable control of the sewing machine auxiliary drive to be

stopped, for instance, in the top position. In a similar manner operation of the treadle plate in FIG. 23 with the left foot tilting the plate in the opposite direction of that shown will enable the sewing machine auxiliary drive to be operated to stop the machine with the stitch forming mechanism in the opposite direction.

While in the foregoing the majority of the species has been illustrated with reference to an auxiliary electric motor as auxiliary drive with exception of the embodiment of FIG. 9, the invention will now be explained in connection with an example using a mechanical auxiliary drive for the rotating brake member and with an electromagnetic control of the mechanical auxiliary drive.

In the embodiment shown in FIGS. 27 through 32, those parts, which are common to the species already described, will in order to facilitate the explanation be referred to by the same reference numerals and only a general survey of the common features will be given here.

The motor **26** has a right hand end cover **34**, in which the rotatable brake **86** and the shiftable clutch member **62** together with the intermediate spindle **56** are arranged as a unit to be secured to the clutch motor with the shiftable clutch member **62** disposed opposite the clutch motor flywheel **40**.

In the actual construction of the embodiment of FIG. 28, the only difference is that the friction members, which in FIG. 28 are referred to as **62***a* and **86***a*, instead of being arranged in grooves of the surface of the flywheel and brake member respectively, as shown in FIG. 2, are incorporated in grooves in the shiftable clutch member **62** itself.

Another difference between the embodiment of FIG. 2 and that of FIG. 28 resides in the actual design of the clutch shifting arm **64** which in FIG. 28 comprises an arm having two perpendicular parts **64***a* and **64***b* carried on the spindle **65***a*. This spindle is secured in a bracket or the like **66***a* firmly secured to the end cover. A spring **67***a* is interposed between this bracket **66***a* and the arm **64**. Such embodiment of the clutch shifting arm is rather traditional in clutch motors and will be known to those skilled in the art in various designs so that a further description will not be necessary.

In the left hand end cover **33** of the motor **26** there is provided a cavity **33***a*. A pulley **30***a* is mounted on the end of the motor spindle **38** extending beyond the ball bearing **37**. The cavity **33***a* of the end cover extends as shown at **34***a* (FIG. 27) inside extension walls **35***a* and **36***a* and **37***a*. On the wall **36***a* there are secured bifurcated bearings **38***a* and **39***a* in which pulleys **40***a* and **41***a* are arranged by means of short bearing spindles **42***a* and **43***a*. In connection with the auxiliary drive main spindle **96**, viz. the spindle driving the worm **94**, there is arranged in a manner to be more fully disclosed hereinafter a further pulley **44***a* (FIGS. 27, 29 and 30). A belt **45***a* is arranged between the pulleys **30***a* and **44***a* guided over the pulleys **40***a* and **41***a* so as to drive the worm spindle **96** from the continuously rotating main motor spindle.

The purpose of arranging the cavity **33***a* and the extension walls **35***a* and **37***a* is to be able to apply a suitable cover plate (not shown) so as to enclose the belt drive.

As will be understood from this description the general idea of the embodiment of FIGS. 27 through 30 is to drive the rotational brake member mechanically from main motor spindle **38** in a similar manner as already described with reference to FIG. 9.

A specific clutch arrangement is, however included in the embodiment of FIGS. 27 through 30. In contrast to FIG. 9 where the clutch is arranged at the left hand end of the main motor spindle a more compact design of the clutch is used in the embodiment of FIGS. 27 through 30.

It has already been indicated in the above specification that magnetic control means may be used for operating and disconnecting of the auxiliary drive. In the embodiment of FIGS. 27 through 30 this magnetic control means is designed more specifically as electromagnetic control means being equivalent, for instance, to the electromagnetic winding A_v as shown in FIG. 20.

More specifically there is provided between the pulley **44***a* and the worm spindle **96** an electromagnetically operated clutch member capable of connecting or disconnecting the drive from the belt **45***a* to the spindle **96**. Furthermore this electromagnetically operated clutch is of the clutch-and-brake type by which is understood that simultaneously with the disconnection of the drive the clutch acts as a brake serving instantaneously to stop the worm spindle and prevent the rotatable brake member **62** from making any superfluous revolutions or part thereof which again means that the brake action caused by the clutch-and-brake member interposed between the auxiliary drive and the worm spindle will prevent any superfluous rotations of the sewing machine spindle and thereby any superfluous stitches of the needle.

As most clearly shown in the cross section of FIG. 30 and supported by the perspective view of the parts in FIG. 31 there is provided in the end of the spindle **96** a bore **96***a*. The spindle **96** is surrounded by a sleeve **97** forming a bearing for the spindle **96**. At the end of the sleeve **97** there is provided a radially extending flange **97***a* against which rests a bearing for the pulley **44***a*. In the bore **96***a* of the spindle **96** there is arranged a spring **96***b*. The end of the spindle **96** is as most clearly shown in FIG. 31 slotted at **96***c*. On the end of the spindle there is provided a dog **98***a* having two oppositely extending arms **98***b* and **98***c* and a circular portion **98***d*, in which there is a hole **99***a* substantially corresponding to the diameter of the spindle and having two inwardly extending flaps **99***b* and **99***c* gripping into the slot **96***c*.

The dog arms **98***b* and **98***c* are received in slots **101***b* and **101***c* provided in two substantially semi-circular discs **102***a* and **103***a*.

The disc **102***a* has an exterior bifurcated portion **102***b*, **102***c* and the disc **103***a* has an interior bifurcated portion **103***b*, **103***c*. These bifurcated portions **102***b*, **102***c* and **103***b*, **103***c* overlap each other so as to allow connection of the two discs by means of a pin **104***a*. Adjacent their centers the discs define an aperture **105***a* substantially corresponding to the exterior diameter of the spindle **96**. Within this aperture a circular portion **106***a* is arranged on the pin **104***a* having an exterior diameter substantially corresponding to the bore **96***a*. Both of the semi-circular discs **102***a* and **103***a* are slightly wedge-formed. The discs **102***a* and **103***a* together with the dog **98***a* are secured on the slotted end of the spindle **96** with the spring **96***b* abutting against the portion **106***a*.

It will be understood that with the semi-circular discs **102***a* and **103***a* in alignment in a position in which their surfaces form a part of a cylinder coaxial with spindle **96**, the outer surfaces thereof exhibit the smallest diameter. By tilting the discs **102***a* and **103***a* in the direction of the arrow shown in FIG. 31, their left hand edges rotating about pin **104***a* will expand to a larger diameter and by tilting the discs in the opposite direction their right hand edges will expand similarly to a larger diameter.

The discs **102***a* and **103***a* are arranged in a cavity defined by a collar **108***a* of the pulley **44***a* and another collar **109***a* extending from a member generally referred to as **110***a*. This member **110***a* has a projection **111***a*, which by a convenient support **112**a (FIG. 27) such as an extending bracket on the motor casing, is prevented from rotation. In the member **110***a* there is a cavity, in which is enclosed a coil winding **113***a*. This cavity is closed by an end cover **114***a* in an end bore of which there is slidably arranged a closure member **115***a*, which is allowed to effect an axial movement but is prevented from rotating, for instance, by a key way connection between the cover **114***a* and the closure member **115***a*. Further the closure member **115***a* is prevented from being

withdrawn by any convenient means such as a set screw extending into the key way.

In the closure member **115***a* there is a center bore provided with screw treads for receiving the screw threaded portion **116***a* of a magnetizable core member **117***a*. At the exterior end thereof there is provided a finger screw **118***a* and between the interior surface thereof and the end of the closure member **115***a* there is arranged a spring **119***a*.

The left end of the core member **117***a* abuts against the end of the member **106***a* remote from the spring **96***b* and in order to decrease the friction there is preferably interposed at that end a ball **120***a*, which may be wholly or partly embedded or in any other way rotatably supported in the end of the member **117***a*.

The interior diameters of the sleeves **108***a* and **109***a* are so adapted to the exterior diameter of the semi-circular wedge-formed discs **102***a* and **103***a* that with the discs in alignment they are allowed to rotate freely in the cavity defined between the pulley **44***a* and the member **110***a* and the flanges **108***a* and **109***a*, while by tilting the discs in one direction of the arrow shown in FIG. 31, they will at their left hand edges abut against the interior surface of the sleeve **108***a* so as to transmit the rotation of the pulley **44***a* to the spindle **96** by means of the dog **98***a*. By tilting the discs in the opposite direction they will at their right hand edges engage the interior surface of the sleeve **109***a*, which will cause an instantaneous stoppage due to the fact that the member **110***a* is prevented from rotating.

In other words there is provided by the mechanism described herein a clutch-and-brake type drive also in the auxiliary drive. It will be appreciated that the actual embodiment of this clutch-and-brake type connection is not limited to the specific embodiment including tiltable discs. This embodiment, however, is advantageous insofar as it enables a very compact structure, which only occupies a small space. The construction is also advantageous insofar as the movement necessary in order to switch over the tiltable discs **102***a* and **103***a* from the driving position to the brake position is very small, and very little energy is necessary in order to effect the tilting.

As shown in FIG. 32 the coil winding **113***a* may be enclosed in a circuit equivalent, for instance, to the circuit of FIG. 20 similarly in the same manner as the electromagnetic coil winding A_V is enclosed in that circuit.

The difference between the circuit of FIG. 32 and that of FIG. 20 is that since no auxiliary electric motor is used in the embodiment of FIGS. 27 through 31, the auxiliary motor winding which in FIG. 20 is connected in series with the electromagnetic coil winding A_V is eliminated in FIG. 32.

It will be understood that instead of the arrangement of FIG. 32 also that of FIG. 20 may be used in connection with the embodiment of FIGS. 27 through 31 as it is possible also to use either of the treadle arrangements of FIGS. 11, 14 or 23 in connection with the circuit of FIG. 32.

Considering that the circuit of FIG. 20 has been described in great detail, only a short survey of the circuit of FIG. 32 will be given herein. A_1, B_1 and C_1 designate the stator winding of the main motor. Supplementary windings a_1, b_1 and c_1 are inductively coupled to the winding A_1, B_1 and C_1. These auxiliary windings are interconnected in series so as to supply a voltage over the terminals **120***a* and **120***b*. From these terminals the voltage is applied over the synchronisator comprising the four mercury switch tubes S_1, S_2, S_3, S_4, the treadle switches $274a_{1-2}$, $274b_{1-2}$ and the clutch operating coil **113***a* in series with a rectifier **121***a*.

The operation of the arrangement of FIGS. 27 through 32 is as follows:

As long as the main clutch treadle is operated by the toe and the arm **64** swung downwardly in the direction of the arrow shown at the end of this arm in FIG. 28, the clutch member **62** is connected to the flywheel **40** and the machine is driven at full speed.

Due to the action of the centrifugal force, the mercury bodies in all the four mercury switch tubes S_1, S_2, S_3, S_4 close the circuits through the switch tubes and current flows through either of the pairs of switch tubes S_1, S_2 or S_3, S_4 depending on which part of the treadle the operator's foot rests, the respective treadle switch contacts, the rectifier **121***a* and the coil **113***a*. As a result thereof, the core member **117***a* is drawn inwardly against the action of the spring **119***a* to displace the center portion **106***a* of the tiltable discs **102***a* and **103***a* thereby tilting the same in such a manner to engage with their left hand edges the interior of the clutch collar **108***a*, whereby the rotation of the pulley **44***a* is transmitted to the worm spindle **96**, which, in turn, drives the brake member **86** at low speed.

When the operator steps with the heel on the main treadle to stop the machine, the clutch operating arm **64** is swung back to the position shown in FIG. 28 and the clutch member **62** is moved to engage the rotating brake member. If as shown in FIG. 32 it is the right hand side of the treadle which is used in operation, then the circuit is completed through the switch tubes S_3 and S_4. This circuit will remain closed during the slow motion of the machine until these switch tubes assume the circuit breaking position as explained in detail in connection with FIG. 20. In the circuit breaking position the circuit through the rectifier **121***a* and the coil **113***a* is interrupted with the result that the core member **117***a* is retracted under the influence of the spring **119***a*. The spring **96***a* thereby tilts the discs **102***a* and **103***a* into the opposite direction to engage with their right hand edges the interior of the stationary flange **109***a* which instantaneously not only disconnects the driving connection between the pulley **44***a* and the worm spindle **96**, but also stops the worm spindle.

In the actual design of the arrangement the synchronisator and the treadle are constructed as separate subassemblies or are performed as specific units adapted to be connected with the motor unit by means of electric plugs as shown schematically in FIG. 33. Preferably also the electromagnetic auxiliary drive control coil is adapted to be connected with the motor by means of a plug type connection.

As shown in FIG. 27 there is provided on the motor housing a box **125***a* having two double pole outlets **126***a*, **126***b* and **127***a*, **127***b* and two three-pole outlets **128***abc* and **129***abc*. The circuit within this box is as shown schematically in FIG. 33. In order to simplify the showing in FIG. 33, only one of the auxiliary windings *a*, is shown, leading to two terminals **130***a* and **130***b* of the rectifier **121***a* arranged within the box **125***a*. From the terminals **130***a*, **130***b* there is a direct connection to the outlets **126***a*, **126***b* which is adapted for plugging in a plug **140***a*, from which an electric cable **141***a* leads to the lamp **142***a* normally used for the sewing machine.

The rectifier **121***a* is provided with three output terminals **131***a*, **131***b* and **131***c*, of which the terminals **131***a* and *c* are interconnected and connected with the outlet terminal **129***b*. The rectifier output terminal **131***b* is connected with the output terminal **127***a*. Furthermore, the output terminal **127***b* is connected with that designated by **128***c*, while the output terminal **128***b* is connected with that designated by **129***c*. Finally the terminal **129***a* is connected with that designated by **128***a*. From the synchronisator a three-wire cable **142***a* leads to a three-pole plug **143***a* adapted to be plugged in the outlet **129***a*, *b*, *c*. In a similar manner a three-wire cable **144***a* leading from the treadle arrangement to a three-pole plug **145***a* is adapted to be plugged in the outlet **128***abc*. Finally a two-wire cable **146***a* leads from the electromagnetic coil **113***a* to a two-pole plug **147***a* adapted to be plugged in the outlet **127***a*, *b*.

As will be apparent from the circuit of FIG. 33, the actual circuit established when the three-plugs **143***a*, **145***a*

and 147*a* are plugged into the respective outlets will be that shown more schematically in FIG. 32. The specific plug arrangement has as mentioned the advantage that the synchronisator and the treadle arrangement can be made as independent units fully pre-wired and adapted to be connected with the motor only by plugging in the plugs 145*a* and 143*a*. Similarly also that part of the electromagnetic clutch control, which comprises the parts enclosed in the stationary housing 110*a* can be made as an independent unit which is attached to the motor after pre-assembly thereof and connected to the electric circuits by plugging in the plug 147*a*.

Another important feature of the arrangement shown in FIGS. 27 through 31 is the manual control of the auxiliary clutch-and-brake connection interposed in the auxiliary drive between the power source thereof and the rotatable brake member. As explained the closure member 115*a* is axially movable in the end cover 114*a* but prevented from rotating relatively thereto.

When the parts are assembled the correct location of the core member 117*a* relative to the clutch-and-brake member 102*a*, 103*a* is simply obtained by adjusting the control screw 118*a* by turning it clockwise so as to approach the end of the armature member 117*a* which is provided with the small rotatable ball 120*a* to the clutch member and during the rotation pushing the set screw inwardly. At a certain point during this repeated screw and push operation it will be seen that the main pulley of the motor is driven, which means that the auxiliary clutch is coupled to the auxiliary drive pulley 44*a*. Hereafter the adjustment is completed.

Another way of adjusting the electromagnetic clutch when the main motor is coupled to a sewing machine is to turn the hand wheel of the machine to a needle position, which does not correspond to either the top- or the down-position, in which the needle is supposed to be automatically adjusted by means of the mercury switch synchronisator and then effect the same turn and push adjustment as hereinbefore described, until the end of the core member is capable of operating the auxiliary clutch to turn the sewing machine to a position in which it is stopped with the needle in the correct position corresponding to that part P_v or P_h of the treadle which is depressed during the adjustment operation.

While in the foregoing embodiment of FIGS. 27 through 33 are described in connection with the circuit in which the electromagnetic winding of the auxiliary clutch is supplied constantly with current and operates the auxiliary clutch when the circuit is interrupted only, it will be understood that it is also possible to design the auxiliary clutch to be operated in such a manner that no current normally flows in the electromagnetic coil winding of the auxiliary clutch so that in such instance the clutch will be operated when the circuit is closed through the electromagnetic winding. Such arrangement may be achieved, for instance, in form of a modification in either of the embodiments according to FIGS. 2, 10, 12, 13 or 15, which involves such change of the arrangements of these embodiments that he switch operated by the synchronisator instead of being opened in the correct position of the needle is closed in that position.

Having now by way of example described different embodiments of my invention it will be understood that the invention is not limited to the specific examples and may be varied in different respects without departing from the scope of my invention.

Basically my invention provides, in combination with a sewing machine or another machine, means for driving the machine at high speed and auxiliary driving means for driving the machine at a reduced speed which is so slow that the stoppage of the machine when driven by the auxiliary drive is completely under control and can be stopped either at will in a predetermined position, for instance, of the reciprocatory needle of the sewing machine or automatically in such predetermined position.

An important feature of my invention therefore resides in the provision of an auxiliary drive in the driving connection with the sewing machine spindle for rotating the latter at reduced speed in the position in which the driven clutch element disengaged from the driving clutch element.

Another important feature of my invention resides in the provision of a small electric motor as auxiliary drive. In combination with such small electric motor a further feature of my invention resides in the circuit arrangements including circuit branches and switch means to be controlled automatically in the different manners described to provide automatic stoppage of the machine in a predetermined position of the movable parts thereof.

It will readily be understood that my invention is by no means confined to the specific embodiments illustrated.

Though in combination with a sewing machine the driven spindle and the machine have to be stopped instantaneously and then after stoppage rotated, it will be understood that my invention is not confined to an operative connection of the auxiliary drive with the stoppage or brake member. Considering, however, that it will not be practical to allow the machine to decelerate by itself, because the stitch forming mechanism will then make 3, 4 or 5 further stitches before it stops the provision of a stoppage or brake member is variable and therefore it is practical to allow the driven clutch element to remain in engagement with the brake member which is rotatable and driven by the auxiliary drive.

The basic point is, however, to provide the auxiliary drive, but whether this provides a driving connection between the driven clutch element and the sewing machine as illustrated and described by means of a rotatable brake member when the latter is in engagement with the driven clutch member or by means connecting the auxiliary drive with the clutch member in some other way or elsewhere in the driving connection between the driven clutch member and the sewing machine is of less importance.

It will also be understood that my electric circuits for the auxiliary driving motor and the different embodiments of the automatic control, for instance, by means of the two way pivotable treadle can be used in combination with any kind of auxiliary driving motor irrespective of the fact where it interconnected into the driving connection.

I claim:

1. In a driving arrangement comprising a motor of the clutch-and-brake type having a continuously rotating driving clutch member, an auxiliary drive, a rotatable brake member driven by said auxiliary drive at reduced speed, a driven clutch member, means for alternately shifting said driven clutch member to engage said driving clutch member and said brake member, a driving connection between the driven clutch member of said clutch motor and a working machine provided with a spindle, auxiliary clutch-and-brake means between said auxiliary drive and said brake member driven thereby, and means for activating said auxiliary clutch-and-brake means responsive to a predetermined angular position of said working machine spindle for disconnecting said auxiliary drive and stopping the movement of said brake member.

2. In a driving arrangement comprising an electric motor of the clutch-and-brake type having a continuously rotating driving clutch member, an auxiliary drive, a rotatable brake member driven by said auxiliary drive at reduced speed, a driven clutch member, means for alternately shifting said driven clutch member to engage said driving clutch member and said brake member, a driving connection between said driven clutch member of said clutch motor and a working machine provided with a spindle, switch means rotating synchronously with

said spindle of said working machine, an auxiliary clutch-and-brake type arrangement operatively connected between said auxiliary drive and said brake member, an electric circuit including said rotating switch means, and electromagnetic means included in said circuit for enabling to shift said auxiliary clutch-and-brake arrangement to the brake position responsive to a predetermined angular position of said working machine spindle for disconnecting said auxiliary drive and stopping the movement of said brake member.

3. In a clutch motor, a main electric motor, a main driving clutch element driven by said electric motor, a rotatable brake element, a driven clutch member, means for shifting said driven clutch element to alternately engage said main driving clutch element and said brake member, means connected with said driven clutch element for transmitting the movement thereof to a working machine, an auxiliary driving element, a driving clutch element driven by said auxiliary driving element, an auxiliary brake element, an auxiliary driven clutch element, means for shifting said auxiliary driven clutch element to alternately engage said auxiliary driving clutch element and said auxiliary brake member, and means for transmitting the movement of said auxiliary driven clutch element to forcibly drive said main brake element.

4. In a clutch motor, a main electric motor comprising an electric wiring system, a main driving clutch element driven by said electric motor, a rotatable brake element, a driven clutch member, means for shifting said driven clutch element to alternately engage said main driving clutch element and said brake member, means connected with said driven clutch element for transmitting the movement thereof to a working machine, an auxiliary driving element, a driving clutch element driven by said auxiliary driving element, an auxiliary brake element, an auxiliary driven clutch element, a means including electromagnetic means to enable shifting of said auxiliary clutch element to alternately engage said auxiliary driving clutch element and said auxiliary brake member, means for transmitting the movement of said auxiliary driven clutch element to forcibly drive said main brake element, an electric voltage source derived from said main motor wiring system, an electric circuit system extending from said voltage source and including said electromagnetic means in series with an outlet for connection to an outside circuit including a switch operated synchronously with the movement of said working machine.

5. In a clutch motor, a main electric motor, a main driving clutch element driven by said electric motor, a rotatable brake element, a driven clutch member, means for shifting said driven clutch element to alternately engage said main driving clutch element and said brake member, means associated with said driven clutch element for transmitting the movement thereof to a working machine, an auxiliary driving element, a driving clutch element driven by said auxiliary driving element, an auxiliary brake element, an auxiliary driven clutch element, means including electromagnetic means to enable shifting of said auxiliary clutch element to alternately engage said auxiliary driving clutch element and said auxiliary brake member, and means for transmitting the movement of said auxiliary driven clutch element to forcibly drive said main brake element, an electric voltage source derived from said main motor wiring system, an electric circuit system extending from said voltage source and including said electromagnetic means in series with an outlet for connection to an outside circuit including two switches operated synchronously with the movement of said working machine and operable in opposite positions of a part thereof, and an outlet for connection to a switch arrangement operable at will to select either of said switches.

6. In and for a clutch motor to drive a working machine, a main driving arrangement of the clutch-and-brake type including a main driving clutch element, a rotatable brake member, a driven clutch element, means for shifting said driven clutch element to alternately engage said main clutch element and said brake member, an auxiliary drive to forcibly rotate said brake member, in combination with a circuit arrangement comprising a voltage source, a unitary switch structure, means for rotating said unitary switch structure synchronously with a part of said working machine, means for operating said unitary switch structure at a predetermined angle of said part of said working machine, a unitary treadle arrangement, switch means selectively operated by said unitary treadle arrangement, electromagnetic means for operating said auxiliary drive means, said voltage source being combined with said clutch motor, parts of said circuit arrangement extending from said voltage source to outlets arranged on said clutch motor, and said switch means rotating synchronously with said working machine being plugged into said one of said outlets.

7. In combination with a clutch motor having a main driving arrangement of the clutch-and-brake type including a main driving clutch element, a brake member, a driven clutch element, means for shifting said driven clutch element to alternately engage said main clutch element and said brake member, an auxiliary drive to forcibly rotate said brake member, electromagnetic means for operating said auxiliary drive and a circuit arrangement comprising a voltage source, a working machine in driving connection with said driven clutch element, a unitary switch structure, a unitary treadle arrangement, means for disengagingly connecting said unitary switch structure and said unitary treadle arrangement to said voltage source in series with said electromagnetic means, means for rotating said unitary switch structure synchronously with a part of said working machine, means for operating said unitary switch structure in at least one predetermined angular position of said part of said working machine, switch means selectively operated by means of said unitary treadle arrangement, outlets from said voltage source arranged on said clutch motor.

8. A clutch motor comprising an electric motor, a flywheel driven by said electric motor, a driving clutch element on said flywheel, a brake member arranged in juxtaposition with said clutch element, a driven clutch element disposed between said driving clutch element and said brake member, means for alternately shifting said driven clutch element to engage either said driving clutch element or said brake member, an auxiliary drive, means for driving said brake member by said auxiliary drive including a clutch-and-brake type connection between said auxiliary drive and said brake member, and means for operating said auxiliary clutch-and-brake type connection to assume the brake position when cutting off said auxiliary drive.

9. A clutch motor comprising an electric motor, a flywheel driven by said electric motor, said flywheel forming a driving clutch element, a rotatable brake member, a driven clutch element, means for alternately shifting said driven clutch element to engage either said driving clutch element or said brake member, a worm member for driving said brake member, means for driving said worm member by said electric motor including an auxiliary clutch-and-brake type connection between said electric motor and said worm, and electromagnetic means for operating said auxiliary clutch-and-brake connection to assume the brake position when cutting off said electric motor from said worm.

10. A clutch motor comprising an electric motor, a flywheel driven by said electric motor, a power transmission member driven by said motor, said flywheel forming a first driving clutch element, a first rotatable brake member, a first driven clutch element, means for alternately shifting said first-driven clutch element to engage either said driving clutch element or said brake member, an auxiliary driving spindle, a reduction gear between said driving spindle and said brake member, a second driving clutch element driven by said power transmission member, a second brake element, a second driven clutch element

in driving connection with said auxiliary driving spindle and adopted to be alternately shifted to engage either said second driving clutch element or said second brake element, and means for shifting said second clutch element.

11. A clutch motor comprising an electric motor, a flywheel driven by said electric motor, said flywheel forming a driving clutch element, a brake member, a driven clutch element, means for alternately shifting said driven clutch element to engage either said driving clutch element or said brake member, an auxiliary drive, means for driving said brake member by said auxiliary drive including an auxiliary clutch-and-brake connection between said auxiliary drive and said brake member and effectively and selectively providing two operating conditions for said brake member consisting of a driving condition by said auxiliary drive and of an effective braking condition by the auxiliary brake, resilient means for normally keeping said auxiliary clutch-and-brake connection in one of said two conditions, and means for operating said auxiliary clutch-and-brake connection to assume the brake position when cutting off said auxiliary drive.

12. A clutch motor comprising an electric motor, a flywheel driven by said electric motor, a power transmission member driven by said motor, said flywheel forming a first driving clutch element, a first rotatable brake member, a first driven clutch element, means for alternately shifting said first-driven clutch element to engage either said driving clutch element or said brake member, an auxiliary driving spindle, a reduction gear between said driving spindle and said brake member, a second driven clutch element of the expansion type in driving connection with said auxiliary driving spindle, a second driving clutch element driven by said power transmission member and at least partly surrounding the periphery of said second driven clutch element, a second stationary brake element surrounding at least partly the periphery of said second driven clutch element, means for alternately expanding said second driven clutch element to engage either said second driving clutch element or said second brake element, and means for shifting said second clutch element.

13. A clutch motor comprising an electric motor, a flywheel driven by said electric motor, said flywheel forming a first driving clutch element, a first rotatable brake member, a first driven clutch element, means for alternate-shifting said first-driven clutch element to engage either said driving clutch element or said brake member, an auxiliary driving spindle, a reduction gear between said driving spindle and said brake member, at least one substantially semi-circular disc having wedge-formed cross section and a substantially cylindrical exterior surface towards which the thickness of the wedge increases, and supported on said auxiliary driving spindle for rotation therewith, said disc being allowed to tilt on said spindle in opposite directions from a neutral position in which said disc surface is concentric with said spindle, an auxiliary drive, a second driving element driven by said auxiliary drive, said second driving element having a substantial cylindrical portion of an interior radius larger than the smallest radius of said wedge-formed disc but smaller than the largest radius thereof, said cylindrical portion extending substantially over half of said cylindrical surface of said wedge-formed member in the neutral position thereof, a second brake element, said second brake element having a stationary substantial cylindrical portion of substantially the same radius as said cylindrical portion of said second driving element and extending substantially over the other half wedge-formed member, and means for tilting said semi-circular disc to alternately engage either said cylindrical portion of said second driving element or said cylindrical portion of said second brake element.

14. In a clutch-and-brake driving arrangement in combination: a first driving clutch element, a first rotatable brake member, a first driven clutch element, means for alternately shifting said first-driven clutch element to engage either said driving clutch element or said brake member, an auxiliary driving spindle, a transmission between said auxiliary driving spindle and said brake member, a second driving clutch element, auxiliary driving means for driving said second driving clutch element, a second stationary brake element, a second driven clutch element in driving connection with said auxiliary driving spindle and adapted to be alternately shifted to engage either said second driving clutch element driven by said auxiliary driving means or said second stationary brake element, and electromagnetic means for shifting said second clutch element.

15. A clutch motor comprising an electric motor, a first driving clutch element driven by said motor, a first rotatable brake member, a first driven clutch element, means for alternately shifting said first driven clutch element to engage either said driving clutch element or said brake member, an auxiliary driving spindle, a reduction gear between said auxiliary driving spindle and said brake member, auxiliary driving means including a power transmission member, a second driving clutch element concentric with said auxiliary spindle and driven by said power transmission member, a second brake element concentric with said auxiliary spindle and axially spaced from said second driving clutch element, a second driven clutch element supported on said auxiliary driving spindle and having a portion axially displaceable relatively thereto between a first position in which said second driven clutch element is engaging said second driving clutch element and a second position in which said second driven clutch element is engaging said second brake element, resilient means for keeping said second driven clutch element in one of said positions, a member in axial alignment with said auxiliary spindle, and means for axially displacing said member to thereby axially displace said portion of said auxiliary driven clutch member to the other of said positions.

16. A clutch motor comprising an electric motor, a first driving clutch element driven by said motor, a first rotatable brake member, a first driven clutch element adapted to be alternately shifted to engage either said driving clutch element or said brake member, means for shifting said driven clutch element, auxiliary drive means including a power transmission member, an auxiliary driving spindle, a reduction gear between said auxiliary driving spindle and said brake member, a second driving clutch element concentric with said auxiliary spindle and driven by said power transmission member, a second brake element concentric with said auxiliary spindle and axially spaced from said second driving clutch element, a second driven clutch element supported on said auxiliary driving spindle and having a portion axially displaceable relatively thereto between a first position in which said second driven clutch element is engaging said second driving clutch element and a second position in which said second driven clutch element is engaging said second brake element, resilient means for keeping said second driven clutch element in one of said positions, a member in axial alignment with said auxiliary spindle, electromagnetic means for axially displacing said member to axially displace said portion of said auxiliary driven clutch member to the opposite of said positions, switch means included in an accessory to be mounted on a spindle of a machine driven by said clutch motor to rotate synchronously with said last-mentioned spindle, and means for selectively varying the electric current through said electromagnetic means under control of said accessory switch.

17. In a driving arrangement, a main driving clutch element, a rotatable brake element, a driven clutch element, means for shifting said driven clutch element to alternately engage said main driving clutch element and said brake element, a driving spindle for said rotatable brake element, a driving member for said brake spindle arranged substantially concentric therewith and surrounding said spindle in spaced relationship to the end thereof,

auxiliary driving means for driving said driving member, a longitudinal bore provided in the end of said spindle, a spring in said bore, a member arranged for longitudinal displacement in said spindle bore adjacent the end of said spindle abutting against one end of said spring, an elongated member arranged in substantially axial alignment with said spindle, means operable at will for adjusting one end of said elongated member to abut said member slidably arranged in said spindle bore at the end remote from said spring in said spindle bore, an electromagnetic coil winding for longitudinally displacing said elongated member in the direction against said spindle to displace said member slidably arranged in the bore thereof against the action of said spring, diametrically opposite slots provided in said bored spindle end, supporting pins extending through said slots and connected with said member slidably arranged in said spindle bore, clutch members supported on said supporting pins outside the periphery of said spindle, an auxiliary stationary brake member arranged opposite said auxiliary driving member rotatably supported on said spindle, said auxiliary brake member and said auxiliary driving member being located to be alternately engaged by said auxiliary clutch members in the extreme positions of said member slidably arranged in the bore of said spindle.

18. In a clutch and brake driving mechanism for driving a machine having a rotating spindle in combination: a high speed driving member, means for driving said member at a high speed, a brake member spaced from but adjacent to said driving member, a clutch element positioned between said driving member and said brake member, means operable at will to shift said clutch element to alternately engage said driving member and said brake member, auxiliary driving means for slowly driving said brake member, means operable to disconnect said auxiliary driving means, and auxiliary brake means operable to halt said brake member in response to the disconnection of said auxiliary driving means.

19. A driving mechanism as claimed in claim 18, wherein said disconnecting means includes clutch means operatively connected to said auxiliary driving means, electromagnetic means for operating said clutch means, means for energizing said electromagnetic means to thereby operatively connect said auxiliary driving means to drive said brake member, and means for applying said auxiliary brake means in response to de-energization of said electromagnetic means.

20. A driving mechanism as claimed in claim 19, further comprising switch means operable by said rotating spindle of said machine to be opened in at least one predetermined angular position thereof, switch means operable to be closed at will, and a power source included in series with both said electromagnetic means and said switch means.

21. A driving mechanism as claimed in claim 20, in which switch means operable to be closed at will is provided with actuating means operable in response to shifting by said shifting means of said shiftable clutch element to the position thereof engaging said brake member.

22. A driving mechanism as claimed in claim 20, in which said first-mentioned switch means operable to open said circuit includes two switch means operable in two predetermined different angular positions of said rotatable spindle, and further comprising selector means for selecting each of said switch means.

23. A driving mechanism as claimed in claim 22, in which said circuit includes two circuit branches, each of said last-mentioned two switch means being included in a respective one of said branches, and in which said switch means operable to be closed at will includes two switch means operable at will for selectively connecting each of said circuit branches in said circuit with said electromagnetic means and said power source.

24. A driving mechanism as claimed in claim 19, in which said means for applying said auxiliary brake includes resilient means.

25. A driving mechanism as claimed in claim 24, in which said resilient means is operative to urge said clutch means to assume a braking position, and in which said electromagnetic means is operative to overcome the tension of said resilient means to connect said auxiliary driving means to drive said brake.

26. In a clutch and brake driving mechanism for driving a machine having a rotating spindle in combination: a high speed driving member, means for driving said member at a high speed, a brake member spaced from but adjacent to said driving member, a clutch element positioned between said driving member and said brake member, a driving transmission between said clutch element and said machine, means operable at will to shift said clutch element to alternately engage said driving member and said brake member, means for slowly driving said brake member including an auxiliary drive provided with a power source, a driving member connected with said power source of said auxiliary drive, a brake driving member operatively connected with said brake member, a driven clutch member connected with said brake driving member, an auxiliary stationary brake member, and means for shifting said driven clutch member from a position engaging said driving member to a position engaging said auxiliary stationary brake member.

27. A driving arrangement as claimed in claim 26, in which said means including said auxiliary drive forms an auxiliary clutch-and-brake assembly.

28. A driving arrangement as claimed in claim 27, further comprising means operable to energize said auxiliary clutch-and-brake assembly to drive said brake member, and means operable to normally retain said auxiliary clutch-and-brake assembly in its brake position.

29. A driving arrangement as claimed in claim 28, in which said auxiliary clutch-and-brake assembly comprises at least one clutch member of the expansion type.

30. A driving arrangement as claimed in claim 29, in which said expansion type clutch member comprises two hingedly connected wedgeformed semicircular discs, a driving sleeve member, and a stationary sleeve member mounted in alignment outside the periphery of said semicircular discs, both sleeve-members having an interior radius larger than the centre radius of said disc and less than the dimension thereof across either surface thereof, and further comprising means for tilting said discs in the opposite direction.

31. A driving arrangement as claimed in claim 30, in which said driving sleeve forms a part of a pulley driven by said auxiliary drive for said brake member.

32. A driving arrangement as claimed in claim 30, including a driving spindle for said brake, said driving spindle having an extending end, means connecting said driving spindle with said semicircular discs to rotate together, a resilient member operable to tilt said semicircular discs to the position engaging said stationary sleeve, and electromagnetic means operable to tilt said discs against the action of said resilient means to engage said driving sleeve member.

33. An electric power source for a sewing machine which enables the operator to stop the machine with the needle bar in a pre-elected dead position, the said power source comprising an electric motor having an extended motor shaft, a first coupling element fastened to one end of said motor shaft, a second coupling element adapted to move in and out of operative contact with said first coupling element mounted at the coupling shaft end adjacent to said first coupling element, spring tension means adapted to keep the said second coupling element out of contact with the said first coupling element, a braking element adapted to operatively contact said second coupling element, a sheave for driving the sewing machine attached to the free end of the said coupling shaft, a lever adapted to be connected at one end to the foot control of

the sewing machine and linked at the other end to means counteracting the spring tension and moving the said second coupling element into operative contact with the said first coupling element when the said lever is moved into one position and moving the said second coupling element into operative contact with said braking element when the said lever is moved into the opposite position, means rotatably connecting the said braking element to a first element of a magnetic clutch consisting of the said first element and another element rotated by the said motor shaft, and circuit means including an interrupter adapted to act in synchronism with the rotation of the sewing machine for supplying power to the said magnetic clutch and keeping the said magnetic clutch closed when the said lever is maintained in the said one position and for cutting the power supply to the said magnetic clutch when the said lever is moved into the opposite position and the sewing machine attains a pre-elected point of rotation.

34. A sewing machine driving arrangement comprising a unitary self-contained electric clutch brake power transmitter having frame means, comprising an electric motor with a rotor, means rotatably supporting said rotor within the said frame means, a clutch including a driving clutch member operatively connected with said rotor, a single brake member, and a driven clutch member, means for selectively shifting said driven clutch member into engagement with said single driving clutch member and with said single brake member, output means operatively connected with said driven clutch member, means rotatably supporting said driven clutch member, said output means and said brake member within said frame means, slow speed drive transmission means for said single brake member supported on said frame means and operative to constitute said single brake member a directly acting slow speed drive member, said slow speed drive transmission means including electromagnetically operated clutch means.

35. A sewing machine driving arrangement comprising a unitary self-contained electric clutch brake power transmitter having frame means, comprising an electric motor with a rotor, means rotatably supporting said rotor within the said frame means, a clutch including a driving clutch member operatively connected with said rotor, a single brake member, and a driven clutch member, means for selectively shifting said driven clutch member into engagement with said single driving clutch member and with said single brake member, output means operatively connected with said driven clutch member, means rotatably supporting said driven clutch member, said output means and said brake member within said frame means, slow speed drive transmission means for said single brake member supported on said frame means and operative to constitute said single brake member a directly acting slow speed drive member, said slow speed drive transmission means including electromagnetically operated clutch means, and means operable in response to a predetermined position of said sewing machine for operating said electromagnetically operated clutch means to thereby render said slow speed drive transmission means ineffective to drive said single brake member so as to thereby constitute said single brake member a directly acting brake member for stopping said sewing machine in a predetermined position of its parts by halting said driven clutch member during engagement thereof with said brake member.

36. A sewing machine driving arrangement according to claim 35, wherein said means operable in response to a predetermined position of said sewing machine includes electric circuit means and switch means for de-energizing said electromagnetic clutch means upon opening of said switch means.

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