

July 26, 1966

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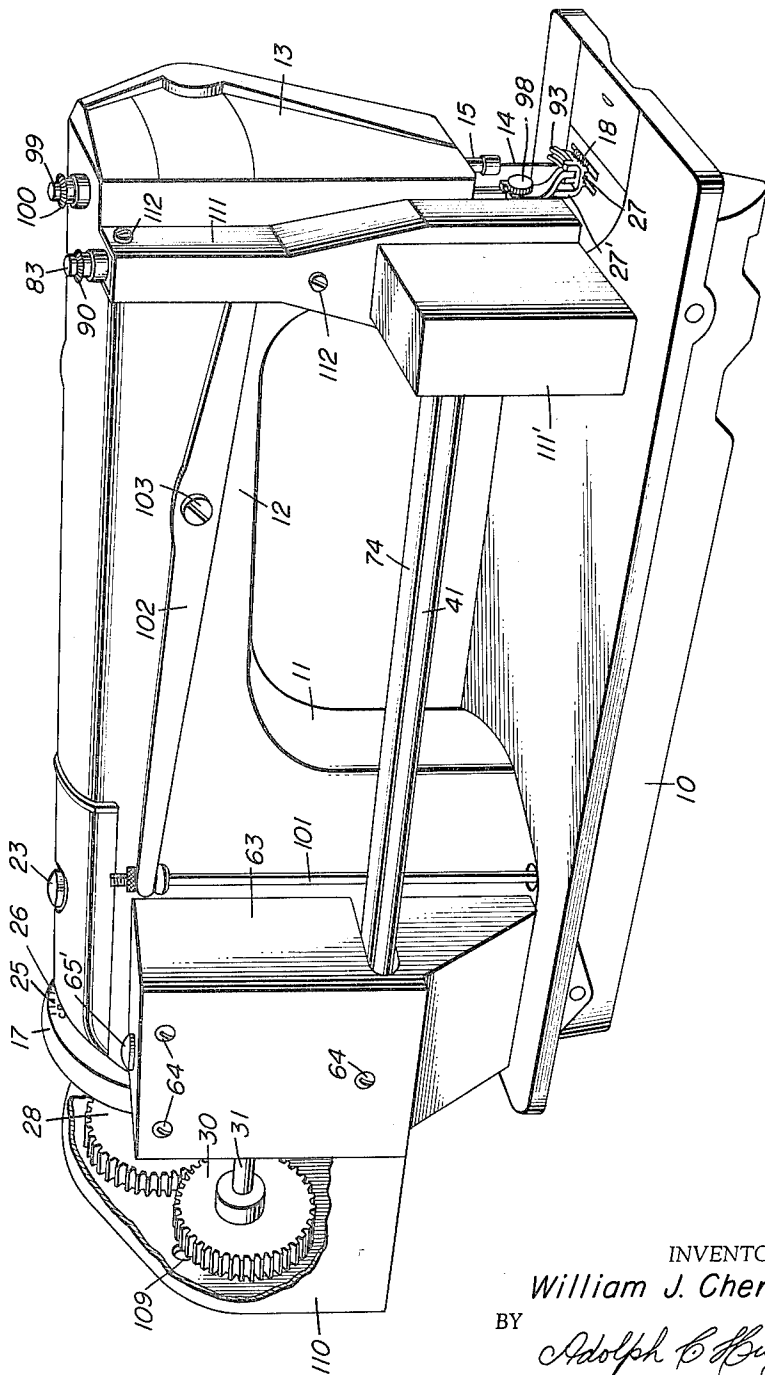
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SEWING MACHINE WORK-FEEDING MECHANISM

Filed Nov. 5, 1964

7 Sheets-Sheet 1

FIG. 1



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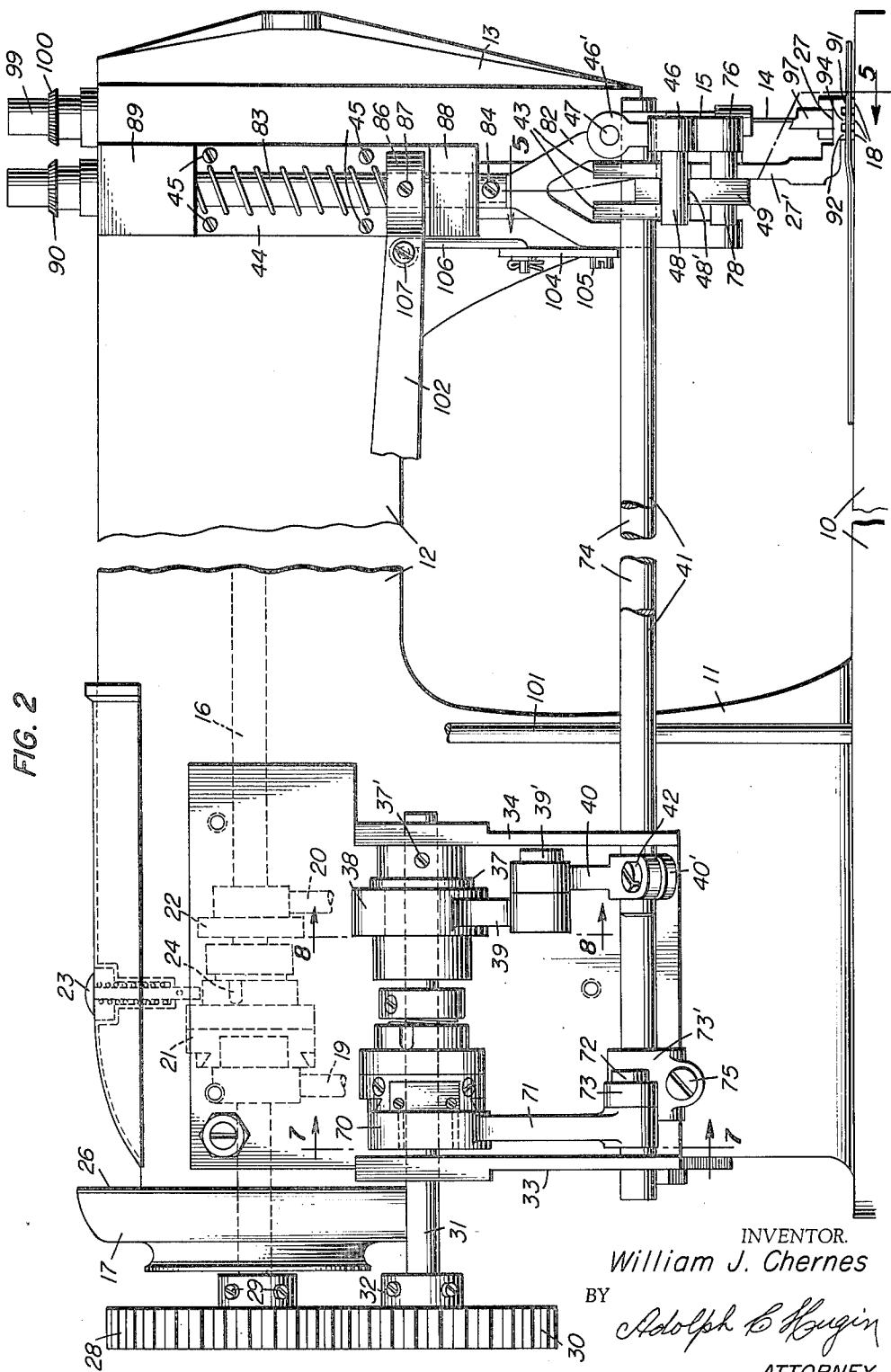
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SEWING MACHINE WORK-FEEDING MECHANISM

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7 Sheets--Sheet 2



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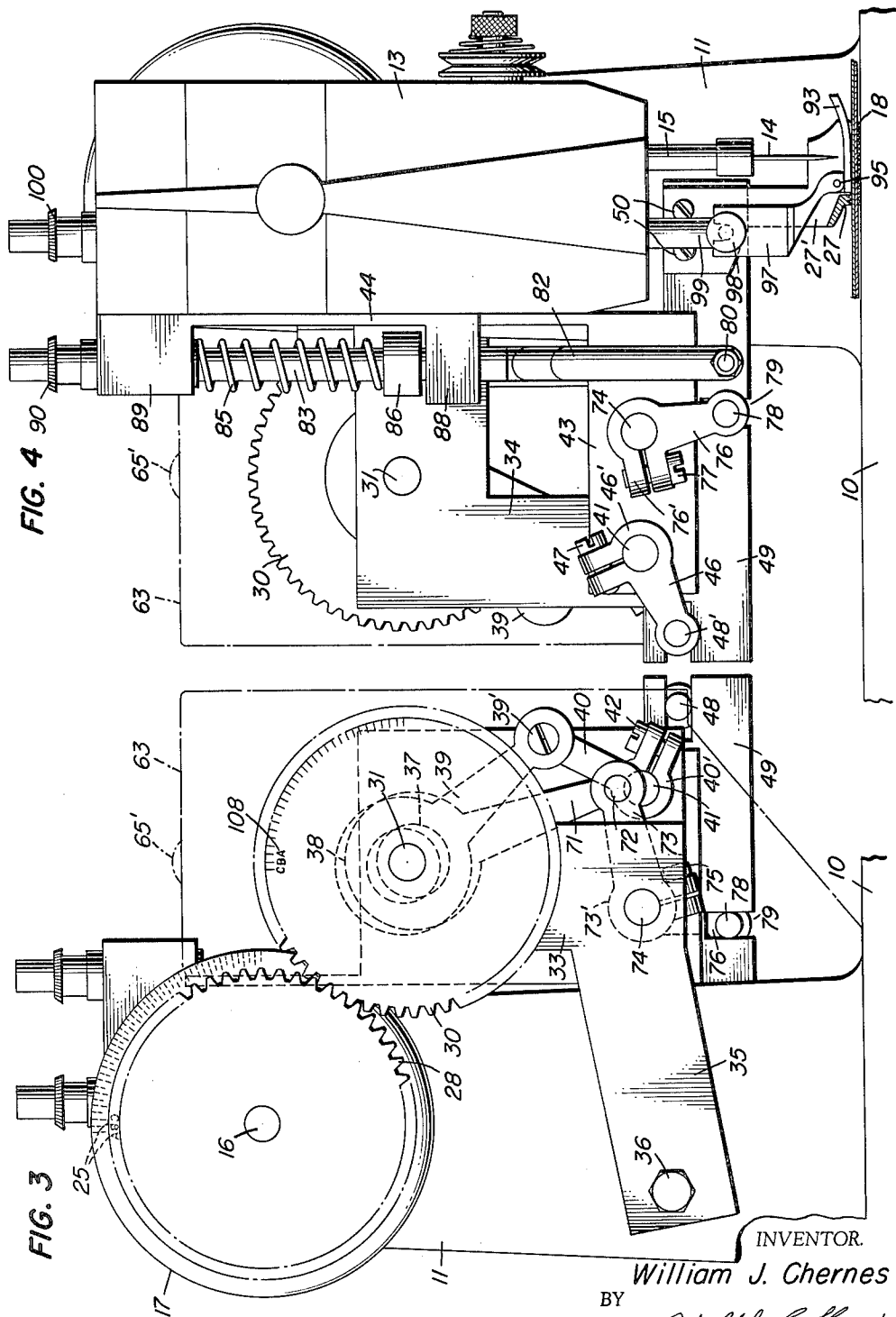
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SEWING MACHINE WORK-FEEDING MECHANISM

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7 Sheets-Sheet 3



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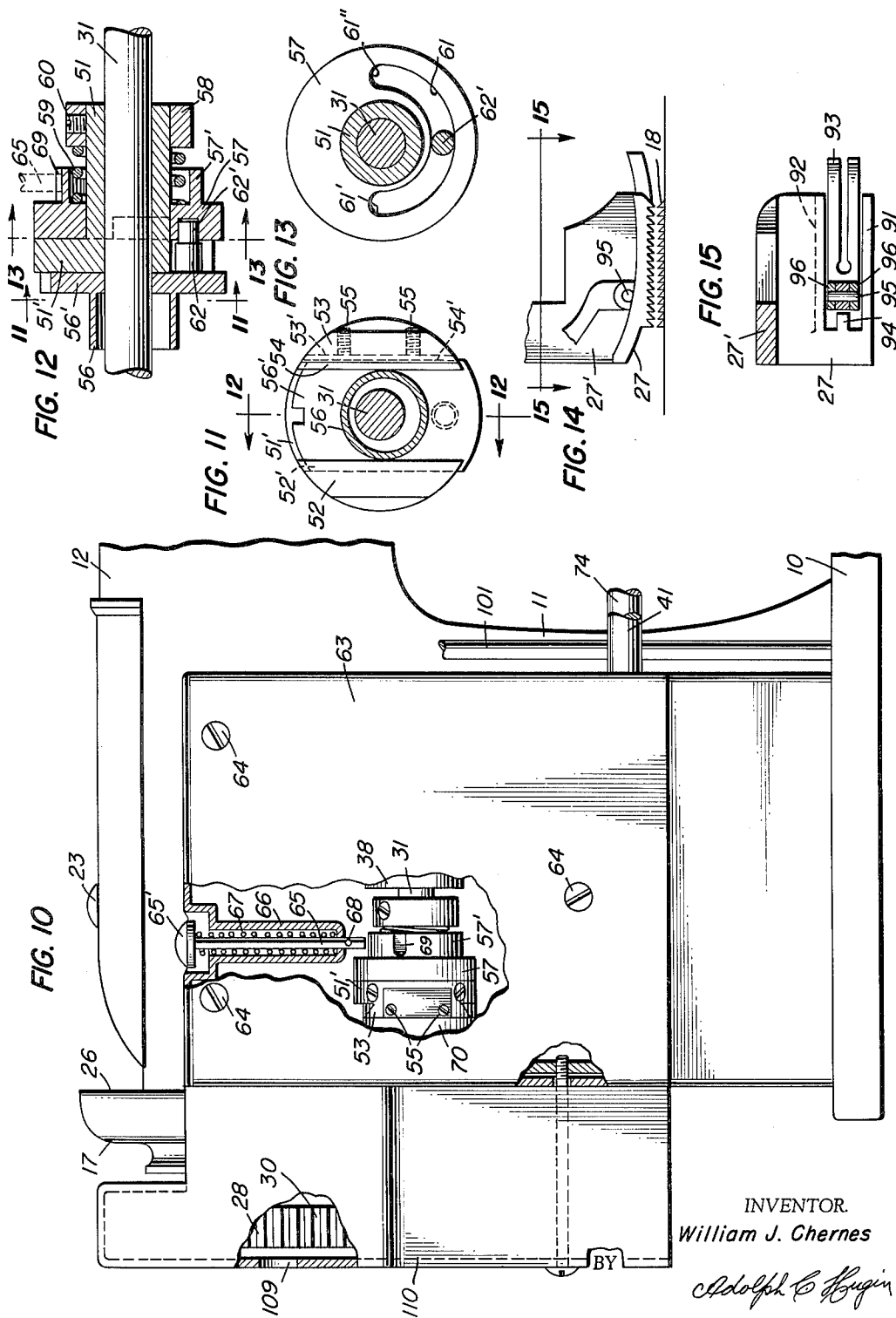
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SEWING MACHINE WORK-FEEDING MECHANISM

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3,262,410

SEWING MACHINE WORK-FEEDING MECHANISM

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4 Claims. (Cl. 112-212)

This is a continuation-in-part of application Serial No. 273,080, filed April 15, 1963, by the same applicant and now abandoned.

This invention relates to work-feeding mechanisms for sewing machines and, more particularly, to mechanisms of this type adapted to impart work-feeding or advancing movements to the top surface of material in the region of the stitch forming needle in conjunction with such feeding movements imparted to the under surface of the material by a standard bottom feed dog.

In sewing machines which are adapted to stitch heavy materials and multiple plies of work, it is desirable to impart a feeding or advancing movement to both the top and bottom faces of the work past the stitching point, so that the work will advance evenly without puckering or bunching under the presser foot and so that an even stitch will result. In some instances, the presser foot will exert a retarding action on the top ply or surface of the work being stitched, and it has been found desirable at times to impart a slightly greater feeding movement to the top feed member than to lower feed member in order to obtain the desired uniform feeding action. It is, therefore, desirable to be able to adjust the relative feeding action of the top and bottom feeding members independently of each other. In some instances, it may be desirable to obtain a predetermined greater advance or lag in the upper or lower plies of material to provide a gathering or puckering of the material, and this may also be done by regulating the relative feed advancing movement and pressure of the upper and lower feeding members.

According to the present invention, a top work-feeding mechanism is provided for cooperation with a bottom feed dog of a sewing machine with an arrangement for separately adjusting the advance feed and pressure of the top feed mechanism and the advance feed of the bottom feed dog. The top work-feeding mechanism comprises a pair of eccentric drive elements which are operatively connected to a driveshaft and are also operatively connected to a rockably mounted feed bar which carries a top feed dog arranged above the bottom feed dog and adapted to engage material between the two feed dogs for imparting material advance feeding movements thereto. More particularly, the sewing machine is provided with a positive top feed which normally is adapted to assure an even advance feeding along both top and bottom layers of material which is being sewn by the machine. The top feed dog is actuated by the top feed bar which is oscillated in the direction of feed by an eccentrically driven rod and is rockingly raised for a return stroke by a second eccentrically driven rod. Both of the rods are driven by a positive drive through rock shafts operatively connected to the eccentrics and through gearing or positive belt drive from the normal sewing machine driveshaft. Preferably, one of the gears or the positive drive belt should be made of fiber or similar material so that it can yield in case of jamming. Also, a pressure adjusting mechanism is provided which includes a substantially vertically extending rod formed with a yoke which rockably supports the drive bar. A compression spring is provided which has an adjustable seat for varying the pressure exerted by the spring on the yoke, which trans-

mits the adjusted pressure to the top feed bar and through it to the top feed dog. In addition, if desired, the lowest travel of the top feed dog can be made adjustable. Provision is made for raising and lowering the entire top feed drive by the conventional mechanism used for raising and lowering the sewing machine presser foot. This assures a complete release of the material which is being sewn by a single operation and facilitates removal or adjustment of the material relative to the stitching needle of the machine.

An object of the present invention is to provide an improved top work-feeding mechanism for a sewing machine.

Another object of the present invention is to provide a top work-feeding mechanism for a sewing machine which is adapted to cooperate with a bottom feed dog and which is separately adjustable to provide for regulating the advance feeding movement imparted to material in the region of the stitch-forming needle of the machine.

Yet another object of the present invention is to provide an improved sewing machine top work-feeding mechanism which is adjustable as to the lowest travel it can have.

A further object of the invention is to provide a sewing machine with top and bottom work-feeding dogs which are separately adjustable and capable of providing the same or different work-advancing movements to materials engaged by the two dogs.

A yet further object of the present invention is to provide an improved sewing machine top work-feeding mechanism separately adjustable for regulating the advance and the pressure of the top feed dog.

Further objects and advantages of this invention will become apparent from the following description referring to the accompanying drawings, and the features of novelty which characterize this invention will be pointed out with particularity in the claims appended to and forming a part of this specification.

In the drawings:

FIG. 1 is a perspective view, partly broken away, illustrating a sewing machine provided with an embodiment of the present work-feeding mechanism;

FIG. 2 is a side elevational view, partly broken away, with the top work-feeding mechanism covers removed so as to illustrate the general arrangement of the present invention applied to a sewing machine such as that shown in FIG. 1;

FIG. 3 is an end elevational view of the sewing machine shown in FIGS. 1 and 2 with the covers removed as viewed from the lefthand end of the machine as shown in FIGS. 1 and 2;

FIG. 4 is an end elevational view of the machine shown in FIGS. 1, 2, and 3 as viewed from the right end of the machine as shown in FIGS. 1 and 2;

FIG. 5 is a sectional fragmentary end elevational view, taken along line 5-5 in FIG. 2, illustrating the top work-feeding mechanism shown in FIGS. 2 and 4, partly broken away, so as to illustrate the relative arrangement of the drive rods and rock shafts which provide for rockably driving the feed bar about its mounting to provide a desired advance step driving movement to the top feed dog;

FIG. 6 illustrates the feed bar and top dog in two working positions, in addition to the position shown in FIG. 5;

FIG. 7 is a fragmentary sectional view, taken along line 7-7 of FIG. 2, illustrating the adjustable eccentric drive which forms a driving connection between the main drive shaft and one of the rocker arms connected to a drive rod for providing the desired adjustment of the advance feeding step of the top dog;

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FIG. 8 is a sectional view, taken along line 8—8 of FIG. 2, illustrating the other eccentric drive between the main drive shaft and the other drive rod which is formed through a rocker arm similar to the one shown in FIG. 7;

FIG. 9 is a schematic perspective view illustrating the relative driving connections between the main drive shaft and the top feed dog which form the top work-feeding mechanism of the sewing machine illustrated in FIGS. 1—8;

FIG. 10 is a fragmentary side elevational view of the driving end of the sewing machine shown in FIGS. 1 and 2, partly broken away to show in greater detail the arrangement of the stitch top adjusting feature for the top work-feeding mechanism and the manner in which an operator can view the indicia on a driving gear for indicating the material advancing movement to be provided by the stitch top adjusting device;

FIG. 11 is a sectional view, taken along line 11—11 of FIG. 12, illustrating details of the adjustable eccentric drive which is provided for adjusting the material advance feeding movement of the top feed dog;

FIG. 12 is a longitudinal sectional view of the adjustable eccentric drive shown in FIGS. 2, 7, 10, and 11, illustrating the adjustable feature of this drive for adjusting the material advance feeding movement of the top feed dog;

FIG. 13 is a sectional view, taken along line 13—13 of FIG. 12, showing further details of the adjustable eccentric drive;

FIG. 14 is a fragmentary enlarged side elevational detail view of the top feed dog and presser foot in relation to the bottom feed dog of the sewing machine illustrated in the other figures of the drawings;

FIG. 15 is a sectional view, taken along line 15—15 of FIG. 14, illustrating the relative plan arrangement of the top feed dog and the presser foot;

FIG. 16 is an end elevational view, similar to FIG. 4, of another embodiment of the present invention, partly broken away better to show the pressure adjusting feature of the top feed dog, and showing its attachment to a conventional sewing machine head;

FIG. 17 is a side elevational view, similar to FIG. 2, of the end of the embodiment shown in FIG. 16;

FIG. 18 is a sectional view, taken along line 18—18 of FIG. 16, with the conventional parts of the machine removed better to illustrate the top feed dog and its feed bar;

FIG. 19 is a fragmentary sectional view taken along line 19—19 of FIG. 17, illustrating the mounting of the mechanism on the machine head;

FIG. 20 is a perspective view of the feed bar shown in FIGS. 16 and 17; and

FIG. 21 is a schematic perspective view, similar to FIG. 9 illustrating the relative driving connections for the top work-feeding mechanism shown in FIGS. 16 through 20.

Referring to the drawings, an embodiment of the present invention is disclosed applied to a sewing machine having a main frame comprising a pan-like bed or base 10 with an upwardly extending housing standard 11 formed with an overhanging housing bracket arm 12 which terminates in a head 13. The sewing machine may be of any suitable conventional construction and may comprise any desired driving mechanism for operating a sewing needle 14 mounted on an operating post 15, which is adapted to be actuated through a suitable mechanism by a main drive shaft 16 supported in any suitable manner in the housing bracket arm 12. A combined belt and handwheel 17 is operably connected to the main drive shaft 16 and is adapted to transmit power thereto from any suitable source.

As in most conventional sewing machines, a material advance feeding mechanism is provided for advancing the material after each stitching operation of the needle 14. This is illustrated as comprising a lower feeding member including a bottom feed dog 18 which may be actuated

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in timed relationship to the stitching operation through suitable rocker arms 19 and 20 and associated drive shafts extending through the housing standard 11 and the sewing machine bed 10. The rocker arms 19 and 20 may conveniently be driven by conventional eccentric drives 21 and 22 respectively, such as those illustrated and described in the booklet, "Instructions for Using and Adjusting Singer Machines of Class 241," copyright 1941, published by the Singer Manufacturing Co.

This type of drive is provided with a simple adjustment for varying the advance feed movement of the bottom feed dog 18 by changing the eccentricity of the eccentric drive 21. This adjustment can be made by simply pressing-in a plunger 23 and turning the handwheel 17 slowly by hand until the plunger drops into a notch 24 in the eccentric drive 21. The handwheel 17 then is turned forward or backward to increase or decrease the length of the movement of the bottom feed dog 18 and thus correspondingly change the length of the stitch. The length of the stitch or movement of the bottom feed dog is indicated by letters 25 on an indicator plate 26 mounted on the housing standard 11 adjacent to the handwheel 17. On conventional machines the letter A indicates the longest stitch and the highest letter on the plate the shortest stitch. It must be noted that such an adjustment of the bottom feed dog should never be made by pressing-in the plunger 23 while the sewing machine is running, as this might permanently damage the eccentric drive 21 and the adjusting plunger mechanism. Details of this bottom feed dog drive and adjusting mechanism are not part of the present invention and are disclosed in order to facilitate a proper understanding of the present invention and its cooperative operation with a conventional adjustable stitch bottom feed drive.

In accordance with the present invention, a step advance feeding movement is adapted to be applied to the upper surface of material which is being stitched by a sewing machine, which advance movement may be the same, greater, or less than the advance movement applied to the undersurface of the material by the conventional bottom feed dog of the sewing machine. Such advance feed movement of the upper surface of material which is being stitched may be in the nature of movement which will assure an even advance of all of the material which is being stitched or may be used to provide for a predetermined unequal advance between the upper and lower portions of the material to provide for a desired gathering or puckering by the stitching. Also, when multiple plies of material are stitched, it has been found desirable in many instances to apply a slightly greater advance feed to the upper ply of the material than to the lower ply because of the drag produced by the presser foot of the sewing machine on the top of the several plies of material. Any of these advance feeding movements applied to the upper surface of the material which is being stitched may conveniently be provided through a top feed dog 27, preferably having gripping teeth along the lower surface thereof adapted to be arranged substantially in alignment with and vertically above the bottom feed dog 18 so as to provide a direct cooperative relationship between the teeth on the top feed dog 27 and the teeth on the bottom feed dog 18.

The actuation of the top feed dog 27 should be substantially synchronized with the actuation of the bottom feed dog so that the advance movement imparted by the two dogs on the top and bottom surfaces of the material occurs substantially simultaneously and starts and stops also substantially simultaneously. Such a synchronized cooperative operation of the two feeding dogs may be conveniently provided by driving both of the dogs from the same drive shaft and providing for an adjustable related actuation of the dogs through respective driving mechanisms.

In the illustrated embodiment, the correlated operation of the top feed dog 27 to the bottom feed dog 18,

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is obtained by a driving mechanism which is adapted to be actuated by the main drive shaft 16 of the sewing machine. This drive includes a gear 28 secured in any suitable manner to the drive shaft 16, as by set screws 29, and arranged in driving engagement with a second gear 30 operatively mounted on a countershaft 31 and secured thereto in any suitable manner, as by set screws 32. The countershaft 31 is rotatably mounted in bearings in bracket arms 33 and 34 which form part of a supporting frame 35 secured to the sewing machine housing standard 11 in any suitable manner, as by a bolt 36. The rotary driving motion of the countershaft 31 is adapted to be converted into a desired cyclic movement of the top feed dog 27 by a pair of eccentric drives coupled respectively to a pair of rock shafts which are adapted to have their major rocking movement respectively in the direction of movement of the stitching needle and substantially at right angles thereto.

The eccentrics of these top feed drives may be basically similar to those of the eccentric drives 21 and 22 for actuating the bottom feed dog 18. One of these top feed dog eccentric drives is illustrated as comprising an eccentric 37 operatively secured to the countershaft 31 in any suitable manner, as by a set screw 37', and rotatably mounted within an eccentric strap 38 forming the base of an eccentric drive element arm 39. This drive arm 39 is operably connected in any suitable manner, as by a crank pin 39', to a crank or rocker arm 40, which drivingly engages an oscillatable drive rod 41 in any suitable manner, as by being clamped thereto by a split ring base 40' and a clamping screw 42. The drive rod 41 is rotatably supported in journals in the frame bracket arm 34 and in a pair of mounting frame bracket arms 43, which form part of a main mounting frame 44 which is conveniently secured to the sewing machine head 13 by mounting screws 45 or other suitable means. The end of the oscillatable drive rod 41 away from the rocker arm 40 is operably secured to a second rocker arm 46 in any suitable manner, as by a split end ring 46' on the rocker arm and a clamping screw 47. This second rocker arm is operatively connected to a rock shaft 48, in any suitable manner, and the rock shaft 48 has a lost-motion operative connection to a feed bar 49 by engagement with the sides of a guide slot 48' extending longitudinally in an end of the feed bar 49. This feed bar is adapted to provide the actuation of the top feed dog 27, which is rigidly secured thereto through a mounting stem 27' fastened in any suitable manner, as by screws 50, to the feed bar.

The eccentric 37 is secured to the countershaft 31, and, therefore, with reference to the main drive shaft 16, with its axis of major and minor eccentricity angularly arranged with regard to the axis of the rocker arm 40 and the axis of the rocker arm 46 such that the major rocking movement of the rock shaft 48 is alternately up and down respectively in the direction of movement of the stitching needle 14 during the time that the needle is raised out of material engaging position. The remainder of the rocking movement of the rock shaft 48 between its alternate up and down movements results in substantially lost motion of the rock shaft 48 in the guide slot 48'. This produces a raising and lowering of the top feed dog 27 during the time that the stitching needle 14 is out of engagement with the material being stitched. The part of the operating cycle of the drive rod 41 which produces the lost-motion movement of the rock shaft 48 in the guide slot 48' allows the maintaining of the top feed dog 27 in engagement with the upper surface of the material between the feed dogs 18 and 27 without imparting any advance feed to the material during the time that the stitching needle 14 is performing a stitching function and also permits other members of the top feed dog drive mechanism to impart predetermined driving movements to the top feed dog for actuation thereof in a predetermined relationship to the operation of the bottom feed

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dog 18 to provide a desired advance feeding of the material being stitched. This advance feed must occur while the needle 14 is out of engagement with the material and after the time the top feed dog has been moved down and before it has again been moved up.

The material advancing drive of the top feed dog 27 is produced by another eccentric driving mechanism which may comprise a compound adjustable eccentric, details of an embodiment of which are illustrated in FIGS. 2, 7, 8, 10, 11, 12, and 13. Basically, this compound adjustable eccentric may be of the conventional type, such as is used in the eccentric drive 21 for operating the drive rod 19 connected to the bottom feed dog 18. This compound eccentric may include a mounting sleeve member 51 drivingly secured to the countershaft 31 in any suitable manner and provided with an outwardly extending eccentric supporting base 51' formed with a pair of parallel guide flanges 52 and 53. These guide flanges form an adjustable support for the eccentric. This support comprises an internal guideway 52' in the guide flange 52 and an internal guideway 53' in the guide flange 53. A guide member 54 is adjustably secured in the guideway 53' on the guide flange 53 in any suitable manner, as by a pair of screws 55, which are threaded into complementary tapped holes in the guide flange 53 and are adapted to bear against the surface of the guide member 54 in the base of the guideway 53'. The adjustable eccentric, mounted on the eccentric supporting base 51', is constructed so that its eccentricity can be increased or decreased within predetermined desired limits.

The structure of this eccentric includes an eccentric cylindrical sleeve 56 which extends axially around the countershaft 31 in radially spaced relation thereto and is preferably integrally formed with an eccentric mounting base 56' slidably mounted in the guideway 52' and in a similar guideway 54' formed in the adjustable guide member 54. This mounting of the sleeve mounting base 56' in the guideways 52' and 54' provides for adjustment of the base 56' transversely of the countershaft 31 so as to change the eccentricity of the cylindrical sleeve 56 relative to the countershaft 31. The adjusting screws 55 are adapted to be screwed inwardly towards the axis of the countershaft 31 so as to clamp the mounting base 56' relatively tightly in the guideways 52' and 54' so as to form a snug sliding fit therewith whereby accidental displacement of the mounting base 56' is prevented and consequently the eccentricity of the sleeve 56 is maintained against accidental displacement.

An eccentric adjusting plate 57 is slidably and rotatably mounted around the mounting sleeve member 51 and is normally frictionally clutched in any desired adjusted position. The frictional clutching is provided by a cylindrical collar 57' which extends axially from the plate 57 radially spaced outwardly from the sleeve 51 by having an internal diameter greater than that of the sleeve 51 so as to provide a spring seat on the plate 57 within the collar 57'. A collar 58 is mounted on the sleeve member 51 spaced axially from the collar 57' and a spring 59 is spaced between the collar 58 and the plate 57. This spring 59 is placed under compression by adjusting the position of the collar 58 axially relative to the plate 57 so as to exert a predetermined axial pressure on the plate 57. This desired compression is maintained by securing the collar 58 rigidly on the mounting sleeve member 51 in any suitable manner, as by a set screw 60, and serves to hold the face of the plate 57 adjacent to the eccentric supporting base 51' in frictional clutching engagement therewith, so that the plate 57 normally rotates with the eccentric supporting base 51'.

As is better shown in FIG. 14, the eccentric adjusting plate 57 is formed with an arcuate groove 61 in the face thereof engaging the base 51', and, in the illustrated embodiment, this groove extends around approximately 180° of arc and is formed about a center which is eccentric

with reference to the axial center of the plate 57. Thus, the arcuate groove 61 is eccentric with reference to the axis of both mounting sleeve member 51 and the countershaft 31, so that an end 61' of the groove 61 is nearer the axis of the countershaft 31 than is the other end 61'' of the groove 61. A positioning pin 62 is secured to the eccentric mounting base 56' and extends parallel to the axis of the mounting base and its eccentric cylindrical sleeve 56, with an end 62', of reduced cross section, arranged in operative sliding engagement with the sides of the eccentric arcuate groove 61 in the adjusting plate 57. The position of the end 62' of the pin 62 in the groove 61 determines the transverse position of the eccentric mounting base 56' and of the eccentric sleeve 56 in the guideways 52' and 54' and, therefore, the eccentricity of the eccentric supporting base and sleeve relative to the mounting sleeve member 51 and countershaft 31. The eccentricity of the sleeve member 51 can, therefore, be varied with reference to the countershaft 31 by rotating the eccentric adjusting plate 57 relative to the eccentric supporting base 51' and the eccentric sleeve member 51.

In order to provide for such an adjustment of the eccentricity of the adjustable eccentric member of this drive, any suitable arrangement may be used for obtaining the relative rotation between the eccentric adjusting plate 57 and the eccentric mounting base 56'. In the illustrated embodiment, an enclosing housing 63 is arranged around the eccentric drives for actuating the top feed dog 27. This housing may be secured in any suitable manner, as by screws 64, to the sewing machine housing standard 11, and adjustment of the eccentricity of the adjustable eccentric is adapted to be provided without removal of this enclosing housing. Such a simple adjustment structure is illustrated as comprising a plunger 65 which is mounted in a tubular housing 66 formed in the upper side of the housing 63 and extending inwardly toward the eccentric adjusting plate collar 57'. Under normal conditions, the adjustable eccentric provides the desired drive of the top feed dog 27 in accordance with the eccentric setting or placement of the eccentric mounting base 56', and the plunger 65 normally is biased out of engagement with the collar 57' by a compression spring 67 arranged around the plunger 65 and seated between the lower end of the tubular housing 66 and a pushbutton 65' on the upper end of the plunger 65. A suitable retaining pin 68 extends through the plunger 65 so as to hold the plunger in the housing 66 with the spring 67 under compression and to position the inner end of the plunger 65 normally spaced radially out of engagement with the eccentric adjusting plate collar 57'.

Relative adjustment of the eccentricity of the eccentric cylindrical sleeve 56 may readily be obtained by simply depressing the pushbutton 65' of the plunger 65 and turning the handwheel 17 slowly by hand until the inner end of plunger 65 drops into a notch 69 in the eccentric adjusting plate collar 57'. Further turning of the handwheel 17 forward or backward will turn the countershaft 31 forward or backward and consequently similarly turn the eccentric supporting base 51'. Since the depressed plunger 65 in engagement with the notch 69 in the eccentric adjusting plate collar 57' prevents a corresponding turning of the eccentric adjusting plate 57, the turning of the eccentric supporting base 51', which carries the eccentric mounting base 56', causes the positioning pin end 62' to travel in the arcuate groove 61. Such travel of the positioning pin end 62' will move the positioning pin nearer to or farther from the axis of the countershaft 31 according to the direction in which the handwheel 17 is turned. This may be clearly seen from a consideration of details of this construction in FIG. 13. Movement of the positioning pin 62 nearer to or farther from the axis of the countershaft 31 results in a corresponding translation of the eccentric mounting base 56' in the guideways 52' and 54', with corresponding resultant change in the eccentricity of the eccentric cylindrical sleeve 56 relative

to the axis of the countershaft 31. This simple type of adjustment of the eccentricity of the adjustable eccentric provides an arrangement for readily varying the advance feed movement of the top feed dog 27 and, therefore, for varying or adjusting the length of the stitch of the sewing machine.

The material advance feed actuation of the top feed dog 27 is provided to the feed bar 49 by the countershaft 31 through the adjustable eccentric feed drive and an associated driving linkage. This associated linkage includes an eccentric strap 70 within which the adjustable eccentric cylindrical sleeve 56 is rotatably mounted so as to provide an oscillatory movement to an eccentric drive element arm 71. The drive arm 71 is, in turn, operatively connected in any suitable manner, as by a crank pin 72, to a rocker arm 73 which drivingly engages an oscillatable drive rod 74 in any suitable manner, as being clamped thereto by a split ring base 73' and a clamping screw 75. The drive rod 74 is rotatably supported in the bracket arms 33 and 34 at one end thereof and in the mounting frame bracket arms 43 at the other end thereof. The oscillatory drive is transmitted from the drive rod 74 to the top feed dog 27 through the feed bar 49 by a second rocker arm 76 which is secured in any suitable manner to the drive rod 74, as by split end ring 76' on the rocker arm 76 and a clamping screw 77. This second rocker arm is operatively connected to a rock shaft 78 in any suitable manner and the rock shaft 78 has a lost-motion operative connection to the feed bar 49 by engagement with the sides of a guide slot 79 extending transversely of the feed bar 49.

The eccentricity of the adjustable eccentric cylindrical sleeve 56 and its position with respect to the main drive shaft 16 and the eccentric drive including the eccentric 37 is such that the axis of major and minor eccentricity of the eccentric cylindrical sleeve 56 extends angularly with reference to the axis of the rocker arm 71 and the axis of the second rocker arm 76, such that the major rocking movement of the rock shaft 78 is alternately substantially transversely toward and away from the stitching needle 14. Movement away from the needle is the material advancing movement and occurs during the time that the needle is raised out of material-engaging position with the top dog down or in its lowered position. The remainder of the rocking movement of the rock shaft 78 between its alternate transverse movements toward and away from the needle results in substantially lost motion of the rock shaft 78 in the guide slot 79. This produces a transverse movement or drawing of the feed bar 49 away from the stitching needle 14 during the time that the stitching needle is out of engagement with the material being stitched, and the lost-motion movement of the rock shaft 78 in the guide slot 79 provides for allowing the top feed dog 27 to be raised away from the upper surface of the material at the end of an advance feed movement and while the stitching needle 14 is out of engagement with the material, and also permits a lowering of the top feed dog 27 after it has been returned to an initial position for a stitching operation.

In order to obtain the desired complete cycle of operation of the top feed dog, the feed bar 49 is rockably and longitudinally movably supported by a pivot pin 80 which extends through a mounting slot 81 extending longitudinally of the feed bar 49 and having a width equal to the diameter of the pivot pin 80 so as to form a snug sliding fit therewith. The slot 81 has a length sufficient to provide a predetermined maximum longitudinal movement of the feed bar 49 relative to the pivot pin 80, which longitudinal movement corresponds to the maximum feed advancing movement of the top feed dog 27 for a maximum length stitch. The pivot pin 80 is carried by a yoke 82 which is adjustably mounted in a socket in the end of a pressure post 83 and secured in position therein in any suitable manner, as by a set screw 84. The pressure post 83 and yoke 82 are adapted to support the feed

bar 49 while applying a downward pressure thereto through the pivot pin 80 so as to transmit the pressure through the feed bar 49 to the top feed dog 27 whereby suitable material gripping pressure is exerted by the teeth of the top feed dog 27 on the material which is being stitched so as to advance the material between each engagement of the needle 14 with the material and thereby assure a proper length of stitch for each stitching operation of the needle. Downward pressure is exerted on the pressure post 83 by a spring 85 which is held in compression between a spring seat 86 secured in any suitable manner to the pressure post 83, as by a set screw 87.

The entire mounting of the feed bar 49 is supported in journals formed by mounting bosses 88 and 89 which extend from the main mounting frame 44 and position the pressure post 83 with reference to the needle operating post 15. When different kind and thicknesses of materials are being stitched by the sewing machine, it may be desirable to adjust the pressure of the top feed dog 27 on the material. This may conveniently be obtained by adjusting the compression of the spring 85 so as to vary its pressure on the spring seat 86 of the pressure post 83. An adjustable upper spring seat for the spring 85 is provided by a thumb screw 90 which may be screwed in and out of the mounting boss 89 and thereby respectively increase or decrease the pressure of the spring 85 on the pressure post spring seat 86.

In order to obtain the most effective correlation between the advance feed by the top feed dog 27 and the advance feed action of the bottom feed dog 18, the top feed dog preferably is formed as is more clearly seen in detail in FIGS. 14 and 15. As shown in these figures, the top feed dog has two relatively long material engaging claw surface portions 91 and 92 which are arranged spaced slightly laterally on each side of a conventional presser foot 93. A third claw surface portion 94 also preferably is formed intermediate the two claw surface portions 91 and 92, and is relatively much shorter and extends from the rear portion of the top feed dog 27 toward the presser foot 93, without mechanically engaging the presser foot. The particular structure of the presser foot 93 does not form a part of the present invention and may comprise any suitable type of foot. A suitable conventional structure of this type is disclosed in detail in a manual entitled "Instructions for Using and Adjusting Singer Sewing Machines of Class 241," copyright 1941 supra, pages 12, 13, 16, and 24. In the illustrated construction, it is shown as a pivotally mounted element which is supported by a suitable pivot pin 95 extending through upwardly extending presser foot bosses 96 on the lower end of a presser foot mounting leg 97. This mounting leg is suitably secured, as by a retaining screw 98, to a presser foot pressure post 99 which is adjustably mounted in the sewing machine head 13. Regulation of the pressure exerted by the presser foot 93 on the material which is being stitched by the machine may readily be obtained by adjusting the position of a thumb screw 100, as on any conventional machine.

When material is to be placed in stitching position or when it is to be removed from the sewing machine, the presser foot 93 and the top feed dog 27 must be raised away from the top surface of the material. In a conventional sewing machine, various mechanisms are provided for raising the presser foot either by hand or by a simple movement of the operator's knee against a knee lever. In the illustrated construction, a conventional knee lever mechanism is shown which includes an operating rod 101 secured to an end of a lever 102 rockably mounted in any suitable manner, as by a pivot pin 103 formed as a screw, secured to the housing bracket arm 12 of the sewing machine. The end of the lever 102, opposite the end which is connected to the operating rod 101, is adapted to be operably connected to the pressure post 99 so as to raise this post when it is desired to raise the presser foot 93. In order to obtain a simultaneous

raising of the top feed dog 27, a linkage is provided for connecting the feed bar 49 to the linkage which raises the presser foot 93. This linkage may conveniently comprise a link 104 pivotally secured in any suitable manner, as by a screw 105, to an arm of the yoke 82 and also pivotally connected to the lever 102 by a second link 106 which may be pivotally secured to the lever 102 in any suitable manner, as by a screw 107. Thus, whenever the operating rod 101 is actuated in the conventional manner so as to lower the end of the lever 102 to which the rod 101 is secured, the opposite end of this lever will be raised so as to raise the presser foot 93 and simultaneously raise the yoke 82 and, therefore, the pivot pin 80 which supports the feed bar 49. This movement of the pivot pin 80 will raise the feed bar 49 and thereby raise the top feed dog 27 simultaneously with the raising of the presser foot 93. Release of the knee pressure in the conventional manner so as to release the operating rod 101 will permit the conventional spring in the sewing machine head 13 to press the presser foot 93 downwardly and similarly will allow the compression spring 85 to bias the pressure post 83 downwardly so as correspondingly to exert a pressure on the pivot pin 80 which will transmit this pressure to the top feed dog 27 through the feed bar 49.

Adjustment of the advance feed of the top feed dog 27 may be provided by adjusting the eccentricity of the eccentric cylindrical sleeve 56 with reference to the eccentric supporting base 51' by simply depressing the pushbutton 65' and turning the handwheel forward or backwards until the plunger 65 engages the notch 69 in the eccentric adjusting plate collar 57 and thereafter further turning the handwheel 26 so as to provide the desired eccentricity to the eccentric cylindrical sleeve 56, as has been previously explained. In order to correlate the advance feed of the top feed dog 27 to the advance feed of the bottom feed dog 18, suitable indicia, such as letters 108, may be placed on the gear 30 and a viewing aperture 109 formed in a gear housing 110 in a position so as to facilitate sighting of these letters. An arrowhead or other suitable aligning point may be placed on the housing adjacent to the aperture 109 with which the letters 108 may be aligned to indicate the extent of the advance feed provided by the top feed dog 27. By suitably correlating the spacing of the letters 108, these letters may be made to correspond to the letter indicia 25 which indicate the advance feed of the bottom feed dog 18 on the indicator plate 26. In this manner, separate adjustment of the advance feed of the top and bottom feed dogs may be obtained and also these advance feeds may be correlated to make them the same or different, as desired.

The operating cycle of the top feed dog 27 may best be understood by a consideration of FIGS. 5 and 6 which illustrate different positions during the actuation of the top feed dog 27 in providing the desired advance feed of material between the top feed dog 27 and the bottom feed dog 18. The dotted position of the feed bar 49 and its associated rock shaft 48 and 78 indicate the position taken by the feed bar 49 when these two rock shafts are actuated by their eccentric drive mechanisms to place the top feed dog 27 in initial material engaging position. As the eccentric drive mechanisms are operated by the main drive shaft 16, the top feed dog 27 will provide an advance feed movement to the material simultaneously with a similar feed by the bottom feed dog 18 to a position as shown in FIG. 5. This material advance feed actuation occurs after the stitching needle 14 has completed a stitching operation and has been raised out of engagement with the material which is being stitched. While the needle is still in this raised position, the rock shaft 48 will rock the feed bar 49 to the position shown in solid lines in FIG. 6, and further actuation of the two eccentric drives will cause the rock shaft 78 to move from the solid line position to the dotted line position in FIG. 6, thereby returning the top feed dog 27 to a

forward position above that shown in dotted lines in this figure. The final actuation of the eccentric drives will cause the rock shaft 48 to move from its solid line position in FIG. 6 to the position shown in dotted lines in this figure, which will again rock the feed bar 49 about its mounting on the pivot pin 80 to the dotted line position in FIG. 6, thereby lowering the top feed dog 27 to material engaging position as shown in dotted lines in this figure. Further actuation of the eccentric drive mechanisms for the top feed dog 27 by the main drive shaft 16 will repeat this cycle of operation.

In some types of machine, the handwheel may be driven in the opposite direction from that explained with reference to FIG. 9, so that gear 28 turns in the opposite direction from that indicated by the arrow 28'. This results in the rotation of the gear 30 and, therefore, the countershaft 31, in a direction opposite to that shown by the arrows 30' and 31', respectively. In such machines, the desired advance-motion drive provided by the top feed dog 27 is obtained by shifting the eccentricity of the two eccentrics 180° from the positions shown in FIG. 9. This will provide the same relative drives to the two drive rods 41 and 74, as has been explained, and thus maintain the synchronized operation of the top feed dog 27 and the bottom feed dog 18.

In order to minimize possible damage to the mechanism and possible injury to operators of the sewing machine, additional suitable casings may be arranged around the operating mechanisms. These may include a housing 111 extending around the pressure post 83 and its associated mechanism and include a portion 111' which encloses the feed bar 49 with its connections to the top feed dog 27, to the pressure post 83, and to the drive rods 41 and 74. This housing may be secured in any suitable manner to the sewing machine, as by screws 112 which fasten the housing to the sewing machine head 13.

Another embodiment of the present invention which, like the first described embodiment, is particularly adaptable as an accessory to a standard sewing machine, is illustrated in FIGS. 16-20. In general, the associated sewing machine parts described with reference to the first embodiment are the same with reference to this second embodiment, and like parts will be indicated by the same reference numeral as previously used. In addition, the driving source and structural details of the driving mechanism including the cams and their adjustable features may be the same as those illustrated and described with reference to the first embodiment, so that these details will not be repeated with regard to the present structure.

The major difference between the source of drive power between the two embodiments is simply that a positive drive type pulley 120 of the type generally associated with a conventional timing belt having transverse bars thereon to provide a positive drive is used to connect the countershaft 31, FIG. 21, to the main driveshaft of the sewing machine. This drive replaces the illustrated drive of the first embodiment comprising gears 28 and 30. Any suitable drive can be used to provide correlated rotation between the countershaft 31 and the main sewing machine drive shaft, and the two alternatives illustrated are readily interchangeable with each other or with any other similar drive. The timing belt and pulley drive provide a safety factor similar to the use of a fiber gear, as previously mentioned, so that any tendency to jam the operation of the mechanism will not result in a breakage of important elements but will simply result in a slippage between the drive members connecting the countershaft 31 and the main shaft.

In this embodiment a top feed dog 121 is adapted to be operated in synchronism with a bottom feed dog 18 to provide for engagement of material being sewn both on the top and bottom thereof for the advance of the material between stitching operations of the sewing machine needle 14 while the sewing machine needle 14 is raised out of working engagement with the material. In addition, the

top feed dog 121 must be returned from the end of its material advancing movement to its initial material engaging position raised out of engagement with the material. These two essential movements are correlated as in the first embodiment to provide the top feed dog 121 with an advance movement in a lowered position at the end of which it is raised a predetermined amount, returned to a position above its initial material engaging position, and then again lowered into engagement with the material, after which the cycle is repeated. The sewing needle 14 performs its stitching function in engagement with the material during the time that the top feed dog 121 is not in the material advancing position. This is essential, in order to avoid puckering of the material.

The desired correlated operation of the top feed dog 121 and the bottom feed dog 18 is obtained in this embodiment by an improved driving mechanism which is actuated through the countershaft 31. In this construction, the drive of the top feed dog 121 is transmitted from the countershaft 31 through and generated by a pair of eccentric feed-drive elements comprising a pair of eccentrics 37 and 56 which are drivingly engaged by eccentric drive element arms 39 and 71 respectively. Details of construction of these elements may be essentially the same as those illustrated and described with reference to the first embodiment of this invention. The major difference between the arrangement of these two embodiments is the relative positions of the eccentric drive elements so that the connections between the eccentric drive element arms 39 and 71 are transposed from those for the first embodiment, that is, the drive rod 41 connected to the eccentric drive element arm 39 through the rocker arm 40 is positioned nearer the sewing machine housing standard 11 than the drive rod 74 which is driven by the eccentric drive element arm 71 through the rocker arm 73. This relative arrangement of driving part is illustrated schematically in FIG. 21.

A suitable mounting for the entire mechanism is provided by a frame 122, which is adapted to be rigidly secured to the sewing machine housing and is preferably mounted directly on the housing standard 11 and the housing head 13. This frame 122 may comprise any suitable rigid supporting member and, in the illustrated embodiment, comprises a unitary casting having journal bearing portions 123 at each end thereof for supporting the ends of the drive rods 41 and 74. These two journal bearing portions 123 preferably are integrally secured together by a longitudinal brace portion 124 extending therebetween, which may conveniently enclose, at least in part, the drive rods 41 and 74.

A correct positioning of the top feed dog with reference to the bottom feed dog 18, the needle 14, and a suitable sewing machine presser foot 93 is obtained by a special adjustable mounting for the frame 122. Details of this mounting are illustrated in FIG. 19. As shown in this figure, the mounting frame 122 is formed with a mounting boss 125 which is internally threaded to receive a locking sleeve 126 which is threadedly engaged with the threaded portion of the boss 125. This sleeve 126 is formed hollow to receive a mounting bolt 127 having a central unthreaded shank portion and a threaded outer end portion 128. The end 128 is adapted to extend slightly beyond the outer end of the locking sleeve 126, and the inner end of bolt 127 preferably is of a larger diameter than the shank of the bolt and is threaded for screwed engagement with a threaded socket 129 formed in a mounting boss 130 on the housing head 13 of the sewing machine. In mounting the bracket 122 in position, the locking sleeve 126 is screwed through the threaded portion of the frame boss 125 until it extends a distance beyond this boss and mounting bolt 127 is passed through the hollow portion of the sleeve 126 and preferably through a washer 131, after which it is screwed tightly into the threaded socket 129. This may conveniently be done by a screw driver engaging a suitable slot 132 in the outer end of the mounting

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bolt. A suitable lock washer 133 is arranged over the outer end of the mounting bolt 127 and is drawn tightly against the end of the locking sleeve 126 by a suitable nut 134 which threadedly engages the outer threaded portion 128 of the mounting bolt.

This tightens the inner end of the locking sleeve 126 against the washer 134 and definitely positions the frame 122 with reference to the sewing machine head 13. If it is found that the top feed dog 121 is not in its desired operative position with reference to the presser foot 93, the lower feed dog 18, and the needle 14, the bracket 122 can be readily adjusted simply by loosening the nut 134 and adjusting locking sleeve 126 by screwing it in or out of the boss 125, and again securely locking the assembly in position by drawing up the nut 134. This will adjust the position of the frame towards and away from the sewing machine head 13. The vertical position of the top feed dog 121 is adjustable by other parts of the mechanism, and it may be necessary to mount the mechanism in a temporary position and make several adjustments both vertically and transversely before the desired operative position of the top feed dog is obtained. This, however, need only be done once for one particular installation in order to obtain the desired transverse position for the top feed dog. Various vertical adjustments of the top feed dog may be desirable depending on the material which is being sewn and the thickness of the material which is being sewn. These adjustments will be explained later.

For any given material which is to be sewn, the top feed dog 121 is operated in the desired manner previously explained by the two drive rods 41 and 74 through an improved drive mechanism. This mechanism comprises a pair of rocker arms 134 and 135 mounted respectively on the ends of the drive rods 41 and 74 adjacent to the sewing machine housing head 13. These rocker arms may conveniently be secured to the ends of the drive rods by having slits 136 extending from an outer edge thereof to the openings in the rocker arms which are adapted to receive the ends of the drive rods, thus bifurcating these ends of the rods. The rocker arms are respectively arranged so that the arm 134 will have a major rocking movement in an up and down direction, as indicated by the arrow 134', similar to the up and down movement of the sewing machine needle 14, while the rocker arm 135 extends substantially perpendicular to the rocker arm 134 and is secured to its drive rod so that its major rocking movement is transversely towards and away from the sewing machine needle 14, as indicated by the arrow 135'. These two rocker arms are clamped in these respective positions in any suitable manner, as by positioning screws 137 which engage and clampingly draw together the parts of the rocker arms which are bifurcated by the slits 136. The two major rocking movements of these rocker arms which provide for the desired travel of the top feed dog result from the oscillatory movements of the drive rods 41 and 74 which are alternatively transmitted to these rods by the eccentric drives which connect these rods to the countershaft 31.

In order to transmit the major rocking movements of the rocker arms 134 and 135 in the desired alternatively timed relationship thereof to the top feed dog 121, the rocker arm 134 is connected by a rock shaft 138' to a link 138, FIG. 16. This link 138 is pivotally connected to a rock shaft 139 which pivotally transmits the up and down major rocking movement of the rocker arm 134 and rock shaft 138' to an end of a feed bar 140 with which the rock shaft is pivotally and drivingly engaged. Similarly, the rocker arm 135 transmits its transverse major rocking movement toward and away from the needle 14 through a link 141 to which it is connected by a rock shaft 141'. This link 141 also is drivingly connected to feed bar 140 by a pivotal connection thereto through the rock shaft 139. The opposite end of the feed bar 140 is rigidly secured in any suitable manner, as by screws 142, to a mounting arm 143 which is integrally formed with the top

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feed dog 121, so that movements of the end of the feed bar 140 are transmitted directly to the top feed dog. The desired movement of the end of the feed bar 140 to which the top feed dog mounting arm 143 is secured is obtained by an improved mounting mechanism which provides for the desired transmission of the driving movement and concurrently also provides for an adjustable predetermined pressure on the top feed dog 121.

This improved mounting mechanism includes an arrangement for supporting the driving mechanism on the frame 122 through a pair of upwardly extending flanges 144, which rotatably support a balance arm 145 through a supporting pin 146, which is rotatably journaled in bearings in the frame flanges 144. The end of the balance arm 145 adjacent to the sewing machine head 13 forms the main support for the feed bar 140 to which it is connected by a pair of suspension links 147. The upper ends of the links 147 are pivotally secured to the inner end of the balance arm 145 through a pin 148 which is pivotally journaled in the end of the balance arm and to which the upper ends of the suspension links 147 are rigidly secured in any suitable manner, as by set screws 149. The lower ends of the suspension links 147 support the feed bar 140 through a suspension pin 150 which extends through the ends of the suspension links and the feed bar 140 and is rotatably journaled in the feed bar. The pin 150 is rigidly secured to the lower ends of the suspension links 147 in any suitable manner, as by being clamped in a complementary opening therein by a clamping screw which is adapted to draw together bifurcated lower ends of the suspension links 147. The suspension pin 150 is also adapted to provide an additional adjustment for properly positioning the top feed dog 121 relative to the bottom feed dog 18, the needle 14, and the top presser foot 93, by the arrangement of a pair of collars 151 around the pin 150 on each side of the feed bar 140. These collars 151 are secured to the pin 150 in any suitable manner, as by set screws 152, and can be moved axially of the pin 150 so as to provide a limited amount of relative axial adjustment of the pin 150 within the feed bar 140. Such an adjustment can thereby provide a limited amount of adjustment of the top feed dog transversely of the presser foot 93 if this should be found necessary.

The vertical position of the top feed dog 121 is determined by two elements which are adapted to adjust the normal position of the balance arm 145. These two elements include an arrangement for exerting a yieldable pressure on the top feed dog through its supporting mechanism and also to limit the lowest positions of travel of the top feed dog. The yieldable pressure is obtained by providing an adjustable pressure mechanism for exerting pressure on the end of the balance arm 145 opposite its connection to the suspension links 147. This pressure mechanism includes an adjustably mounted spring seat member 154 in the form of a socket 155 in which a suitable compression coil spring 156 is arranged. A follower plunger 157 is slidably fitted in the outer end of the socket 155 and is adapted to hold the spring 156 in compression within the socket 155 as the spring resiliently biases the plunger into engagement with an anvil 158 formed as a boss on the adjacent upper surface of the frame 122. In order conveniently to provide for the adjustment of the pressure which this biasing device exerts on the balance arms 145, the spring seat member is threadedly mounted in a complementary threaded passageway in the end of the balance arm 145, and the outer end of the spring seat member preferably is formed with a suitable multiple-sided socket 159' in which a complementary multiple-sided socket wrench can be fitted for screwing the spring seat member in and out of the end of the balance arm 145. This functions to increase and decrease, respectively, the pressure of the coil spring 156 transmitted through the balance arm 145 to the top feed dog 121.

As can more readily be understood by a consideration of FIG. 16, major rocking movement of the rocker arm 134 in an up and down direction produces an opposite down and up movement of the top feed dog 121, and a major rocking movement of the rocker arm 135 towards and away from the needle 14 and produces a corresponding major movement of the top feed dog 121 towards and away from the needle 14. The first of these movements results from the teetering support of the feed bar 140 by the suspension links 147 through the suspension pin 150, while the second of these movements is obtained as a result of the swingable support of the feed bar 140 through the relatively long suspension links 147 pivotally mounted on the end of the balance arm 145 through the pin 148. The actual movements of the feed bar 140 through the suspension links 147 are slightly arcuate; however, due to the relatively long length of the links 147 and the relatively small back and forth movement of the feed bar 140 by the actuating rocker arm 135, the actual movement transmitted to the top feed dog 121 is substantially a straight line movement.

It is desirable that the lowermost position of the top feed dog 121 be such that it will not, at any time, come into actual mechanical engagement with the teeth of the bottom feed dog 18. It is also desirable that the lowermost position of the top feed dog 121 should be adjustable. Both of these features are conveniently provided in the present improved structure by an adjustable stop in the form of a finger screw 159 which is threadedly engaged in an opening 160 through the balance arm 145 and extends into engagement with a seat formed by a boss 161 on the frame 122. As can be more readily seen from FIG. 16, if the screw 159 is screwed into the balance arm 145, it will press against the seat on top of the boss 161 and will limit the downward movement of the adjacent end of the balance arm 145, thus limiting the downward movement of the top feed dog 121. The opposite turning of the finger screw 159 will permit the adjacent end of the balance arm 145 to move downwardly under the resilient pressure of the spring 156 and will correspondingly permit the top feed dog 121 to move further downwardly towards the bottom feed dog 18. A lock nut 162 preferably threadedly engages the finger screw 159 to prevent accidental movement of the screw after it has been adjusted to its desired position. In this manner, the top feed dog 121 is mounted so that it is readily adjustable vertically for use in sewing various thicknesses of material simply by manipulation of the finger screw 159, and the pressure of the top feed dog 121 on the material being sewn also is readily adjustable for different types of material and different numbers of plies of materials simply by adjustment of the position of the spring seat member 154.

During the normal operation of the sewing machine there are various times, such as when material is being inserted or being removed from stitching position, when it is necessary to relieve the pressure exerted on the material by the presser foot 93 and the top feed dog 121. In the present embodiment, this may be conveniently achieved simply by adding a pressure relief mechanism which includes a slotted link 163, rigidly secured to the conventional presser foot lifting lever 102 in any suitable manner, as by bolt 164, and rigidly mounting a finger 165 in any suitable manner on the nonrotatable end of the supporting pin 146 with the end of the finger 165 slidably mounted for lost motion in the slot 166 in the link 163. The slot 166 in the link 163 extends downwardly to a distance sufficient to allow for the downward movement of the suspension links 147 which would bring the top feed dog 121 substantially into engagement with the ends of the teeth of the bottom feed dog 18. With this arrangement, whenever it is desired to raise the presser foot 93 and the top feed dog 121, the usual actuation of the presser foot lifting lever 102 will cause the end of this lever to which the link 163 is secured to be raised. This

will cause the lower end of the slot 166 to engage the finger 165 so as to raise the finger and this will correspondingly raise the suspension links 147, which will in turn lift the top feed dog 121 simultaneously with the raising of the presser foot 93.

While particular embodiments of this invention have been illustrated and described, modifications thereof will occur to those skilled in the art. It is to be understood, therefore, that this invention is not to be limited to the particular details disclosed, and it is intended in the appended claims to cover all modifications within the spirit and scope of this invention.

What is claimed is:

1. In a sewing machine having a main frame with a work supporting base and a drive shaft and stitching needle driven by said shaft providing an up and down working movement thereto into and out of material engaging positions with a bottom feed dog actuated in timed relation to stitching by said needle for exerting an advancing force on material being sewn for a predetermined adjustable advance step movement, a top work-feeding mechanism for cooperation with said bottom feed dog comprising a pair of eccentric feed-drive elements, means for mechanically driving said eccentric feed-drive elements by said drive shaft in predetermined angular relationships, a pair of rocker arms each operably connected respectively to one of said eccentric drive elements, a pair of oscillatable drive rods each operably connected respectively to a separate one of said rocker arms and rotatably supported on said main frame, a second pair of rocker arms each operably connected respectively to one of said drive rods, a pair of rock shafts each operably connected respectively to one of said second pair of rocker arms, said operable connections of said eccentric drive elements to said drive shaft and to said rock shafts being angularly and oscillatably related respectively to provide for a major rocking movement of one of said rock shafts transversely toward and away from said needle and for a major rocking movement of the other of said rock shafts up and down in the direction of movement of said needle, a feed bar drivingly engaged by said rock shafts slidable respectively in directions perpendicular to the direction of major rocking movement of each rock shaft and drivingly engaged thereby in said respective major rocking movement directions, means for rockably and slidably supporting said feed bar, and a top feed dog operably carried by said feed bar alternately to engage and be disengaged from material above said bottom feed dog and for exerting an advancing force while the needle is out of material engaging position synchronously with said bottom feed dog.

2. In a sewing machine having a main frame with a work supporting base and a drive shaft and stitching needle driven by said shaft providing an up and down working movement thereto into and out of material engaging positions with a bottom feed dog actuated in timed relation to stitching by said needle for exerting an advancing force on material being sewn for a predetermined adjustable advance step movement, a top work-feeding mechanism for cooperation with said bottom feed dog comprising a pair of eccentric feed-drive elements, means for mechanically driving said eccentric feed-drive elements by said drive shaft in predetermined angular relationships, a pair of rocker arms each operably connected respectively to one of said eccentric drive elements, a pair of oscillatable drive rods each operably connected respectively to a separate one of said rocker arms and rotatably supported on said main frame, a second pair of rocker arms each operably connected respectively to one of said drive rods, a pair of rock shafts each operably connected respectively to one of said second pair of rocker arms, said operable connections of said eccentric drive elements to said drive shaft and to said rock shafts being angularly and oscillatably related respectively to provide for a major rocking movement of

one of said rock shafts transversely toward and away from said needle and for a major rocking movement of the other of said rock shafts up and down in the direction of movement of said needle, a feed bar, means including a pair of links each pivotally connected respectively to one of said rock shafts and both pivotally drivingly connected to said feed bar for transmitting thereto a drive corresponding to said two major movements of said rock shafts, means for rockably and swingably supporting said feed bar, and a top feed dog operably carried by said feed bar alternately to engage and be disengaged from material above said bottom feed dog and for exerting an advancing force while the needle is out of material engaging position synchronously with said bottom feed dog.

3. In a sewing machine having a main frame with a work supporting base and a drive shaft and stitching needle driven by said shaft in an up and down working movement into and out of material engaging positions with a bottom feed dog actuated in timed relation to stitching by said needle for exerting an advancing force on material being sewn for a predeterminable adjustable advance step movement, a top work-feeding mechanism for cooperation with said bottom feed dog comprising a pair of eccentric feed-drive elements, means for mechanically driving said eccentric feed-drive elements by said drive shaft in predetermined angular relationships, a pair of rocker arms each operably connected respectively to one of said eccentric drive elements, a pair of oscillatable drive rods each operably connected respectively to a separate one of said rocker arms and rotatably supported on said main frame, a second pair of rocker arms each operably connected respectively to one of said drive rods, a pair of rock shafts each operably connected respectively to one of said second pair of rocker arms, said operable connections of said eccentric drive elements to said drive shaft and to said rock shafts being angularly and oscillatably related respectively to provide for a major rocking movement of one of said rock shafts transversely toward and away from said needle and for a major rocking movement of the other of said rock shafts up and down in the direction of movement of said needle, a feed bar having means providing a driving engagement with said rock shafts and respectively having a lost motion connection in directions perpendicular to the direction of major rocking movement of each rock shaft and drivingly engaged thereby in said respective major rocking movement directions, means for rockably and longitudinally movably supporting said feed bar, a top feed dog operably carried by said feed bar alternatively to engage and be raised out of engagement with material above said bottom feed dog and for exerting an advancing force synchronously with said bottom feed

dog on material being sewn, and means for adjusting the length of a stitch by adjusting the eccentricity of said eccentric feed-drive element connected to the rock shaft having a major rocking movement transversely toward and away from said needle.

4. In a sewing machine having a main frame with a work supporting base and a drive shaft and stitching needle driven by said shaft in an up and down working movement into and out of material engaging positions with a bottom feed dog actuated in timed relation to stitching by said needle for exerting an advancing force on material being sewn for a predeterminable adjustable advance step movement, a top work-feeding mechanism for cooperation with said bottom feed dog comprising a pair of eccentric feed-drive elements, means for mechanically driving said eccentric feed-drive elements by said drive shaft in predetermined angular relationships, a pair of rocker arms each operably connected respectively to one of said eccentric drive elements, a pair of oscillatable drive rods each operably connected respectively to a separate one of said rocker arms and rotatably supported on said main frame, a second pair of rocker arms each operably connected respectively to one of said drive rods, a pair of rock shafts each operably connected respectively to one of said second pair of rocker arms, said operable connections of said eccentric drive elements to said drive shaft and to said rock shafts being angularly and oscillatably related respectively to provide for a major rocking movement of one of said rock shafts transversely toward and away from said needle and for a major rocking movement of the other of said rock shafts up and down in the direction of movement of said needle, a feed bar, means for rockably and longitudinally movably supporting said feed bar means including a pair of links each pivotally connected respectively to one of said rock shafts and both pivotally drivingly connected to said feed bar for transmitting thereto a drive corresponding to said two major movements of said rock shafts, a top feed dog operably carried by said feed bar alternatively to engage and be raised out of engagement with material above said bottom feed dog and for exerting an advancing force synchronously with said bottom feed dog on material being sewn, and means for adjusting the lowest travel of said top feed dog toward said bottom feed dog.

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