Oct. 6, 1959 V. H. SCHRADER 2,907,291

FORWARDING DEVICE

Filed March 28, 1955 2 Sheets-Sheet 1

Fig. 1

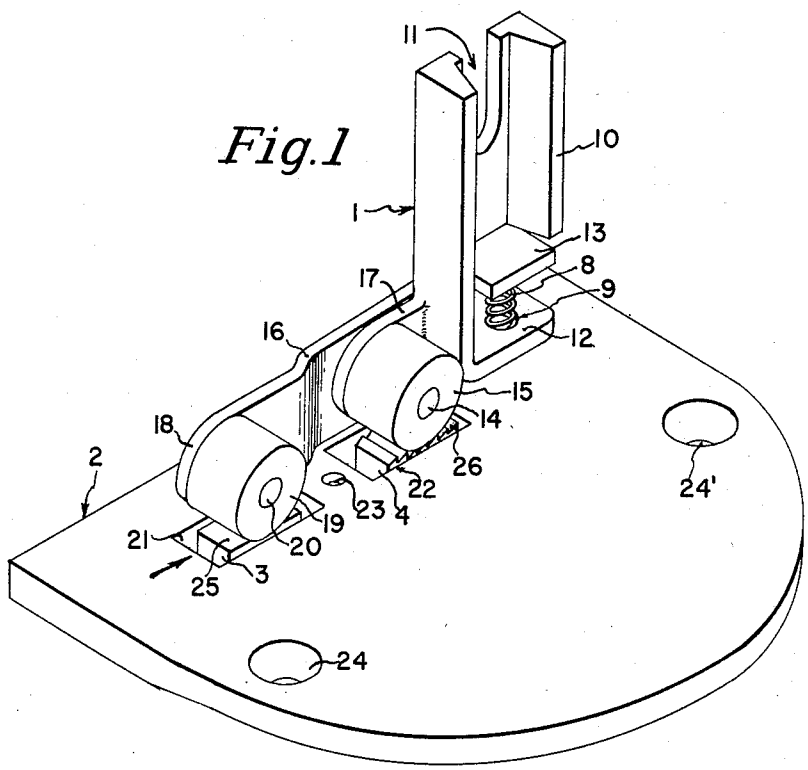
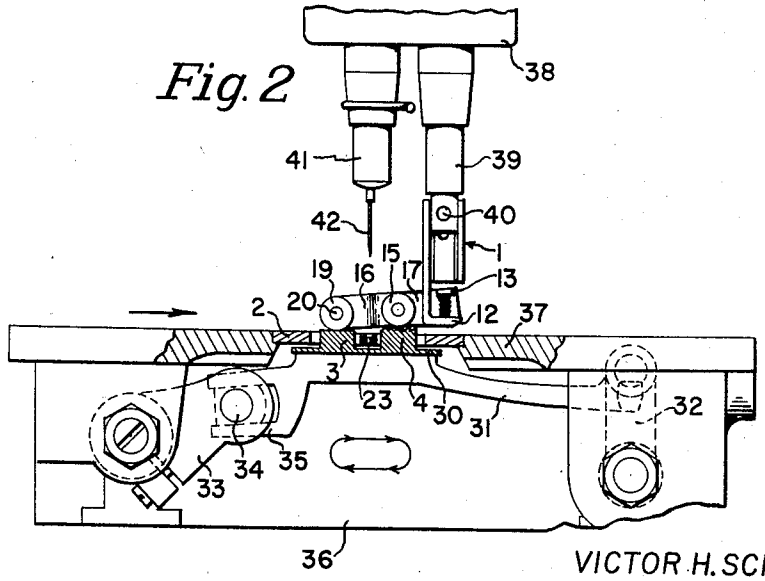


Fig. 2



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FORWARDING DEVICE

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Fig. 5

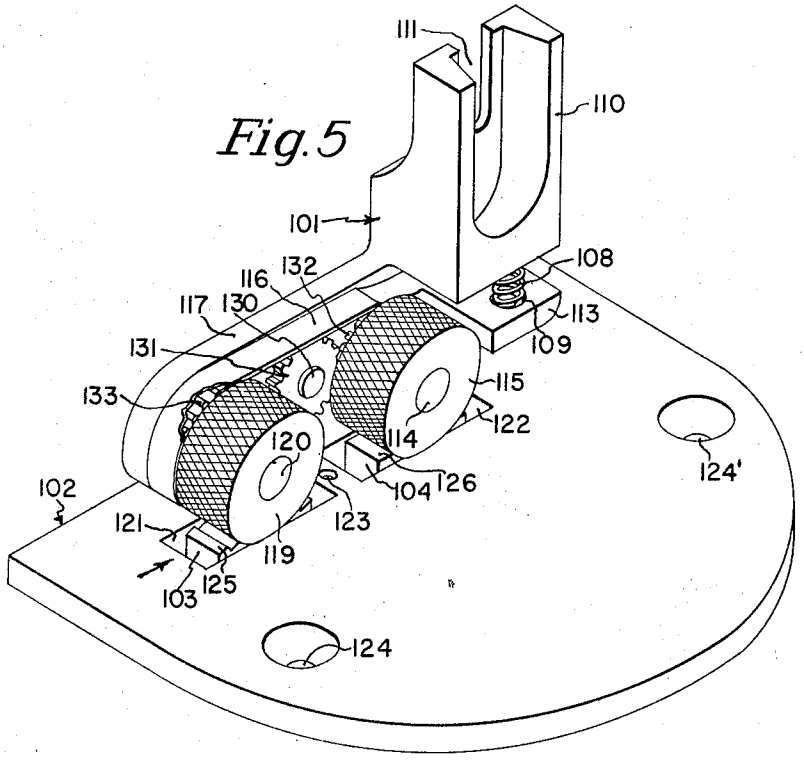


Fig. 3a

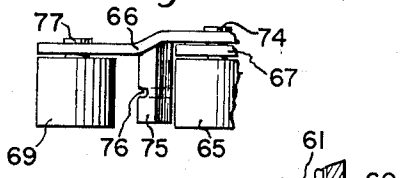


Fig. 4

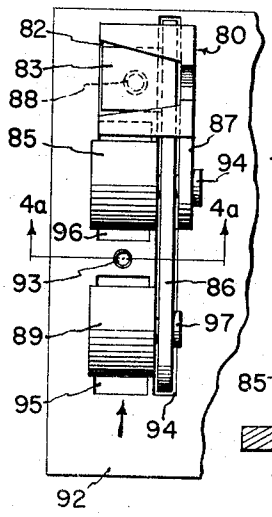
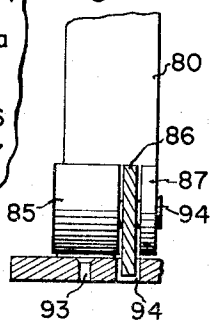


Fig. 4a



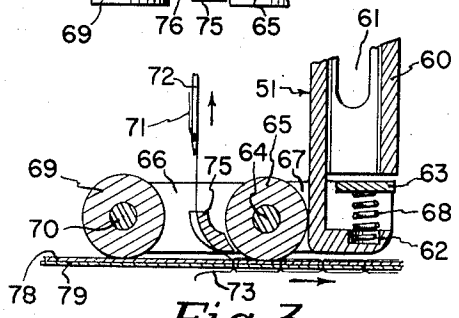


Fig. 3

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FORWARDING DEVICE

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Application March 28, 1955, Serial No. 497,018

13 Claims. (Cl. 112—211)

This invention relates to advancing or forwarding of materials past a needling location, particularly concerning improved feeding mechanism for sewing machines.

Known devices for feeding multiple layers of fabric in register past a needling location have proved somewhat less than satisfactory upon fabrics made of the newer synthetic fibers, which in many forms—including especially filamentary fabrics, as compared with staple fabrics—react unevenly to the feeding action. In the sewing of these and other materials exhibting low coefficient of friction or other unusual inter-surface characteristics, this uneven reaction often leads to a condition in the product known as "pucker," which may be attributable in part to conduct of a human operator of the machine as well as to action of the machine itself. Regardless of the exact origin of the unwanted irregularity its elimination is highly desirable in order to promote uniformity of processing and customer acceptance of the product.

A primary object of the present invention is improved feeding of multilayered materials. An object is uniform feeding of multiple layers of material past a needling location. A particular object is pucker-free sewing of superimposed materials slippery or otherwise difficult to maintain in register. Other objects of this invention, together with means and methods for accomplishing the various objects, will be apparent from the following description and the accompanying drawings.

Figure 1 is a perspective view of apparatus useful according to this invention. Figure 2 is a side elevation of the apparatus of Figure 1, partly in section, in operating conjunction with conventional sewing machine elements. Figure 3 is a side elevation, partly in section, of apparatus like part of that of Figure 1 modified by addition of other elements. Figure 3*a* is a plan view of part of the apparatus of Figure 3. Figure 4 is a plan view of a modification of the apparatus of Figures 1 and 2. Figure 4*a* is a vertical section of the apparatus of Figure 4 on 4*a*—4*a* thereof. Figure 5 is a perspective view of still another form of apparatus according to this invention.

In general, the objects of the present invention are accomplished by locating idling rollers fore and aft of the line of movement of sheet material being fed and opposing to each roller a cooperating intermittently actuated feeding surface. In a sewing machine equipped according to this invention the rollers are mounted on a presser foot above the topmost face of the material to be sewed, so as to be adjacent thereto, and the feeding surfaces are actuated against the lowermost face of the intervening subject material. The arrangement of far roller and feeding surface (i.e., located foremost in the feeding direction) is designed to exert greater force upon the material than does the pair of corresponding near or aftermost elements, so as to prevent intervening bunching or puckering of the material.

Figure 1 shows an apparatus embodiment that has proved quite effective, having the following major elements: presser foot **1**, throat plate **2**, and feeding platforms **3** and **4**, top portions of which are partially visible through apertures in the throat plate, shown in Fig. 1 from above and to the right of the position of an operator facing the apparatus. The presser foot includes channel member **10** slotted at the top by inlet **11** in the bed of the channel and closed at the bottom by horizontal seat **12** extended perpendicularly from the near side across the channel. Boss **17** extends outside from the channel member in line with the bed thereof and supports horizontal pin **14**, which constitutes an axle for rear roller **15** and pivot for arm **16**. This arm extends from base **13**, which is perpendicular to the central portion of the arm and parallel to the seat of the channel member, to terminate in a near end **18**. This end of the arm supports horizontal pin **20** as an axle for near roller **19** oriented parallel to the far roller. The arm is offset midway of the rollers, which are identical in the drawings, to center them on a perpendicular line through the axes of both rollers. Compression spring **8** carried in recess **9** in the seat of the presser foot between it and the base of the arm urges the near roller downward. The throat plate has front and rear apertures **21** and **22** underneath the respective rollers, needle aperture **23** between the rollers, and countersunk screwholes **24** and **24'** near the periphery of the plate. Smooth surface **25** of platform **3** is visible through the near aperture, and toothed surface **26** of platform **4** in the far aperture.

The same elements appear in side elevation in Figure 2, which shows also unitary feed dog **30** upon which both the near feeding platform and higher far feeding platform are formed. Also visible is feed bar **31** extending from rocker shaft **32**, whose oscillation imparts to the feed dog mounted on the bar advancing and returning motion (suggested by the multiple arrows). The rising and falling motion of the dog stems from oscillation of feed-lift rocker shaft **33** terminating in lift pin **34**, which engages split cam end **35** of the feed bar. Both rocker shafts are mounted in suitable bearings on frame **36**, which carries bed plate **37** onto whose top surface the throat plate is screwed. Above the throat plate is hollow head **38** from which protrude presser bar **39**, onto which screw **40** holds the presser foot, and needle bar **41** holding needle **42** directly above the needle aperture. With the exception of the presser foot, the feed dog, and the throat plate, the elements shown are completely conventional and accommodate the novel elements without necessity of any modification. The bobbin normally located below the needling aperture in the throat plate is omitted from the drawing for simplicity.

Operation of the various elements is readily apparent. Activation of the rocker shafts imparts the usual four-way motion to the feed dog: rising, advancing (toward the right or rear in the drawings), falling, and returning. In the absence of material overlying the throat plate, the feeding platforms protrude through the appropriate apertures therein into engagement with the respective rollers of the presser foot. Material placed between the rollers and the top of the platforms is gripped intermittently, receiving impulses in the direction indicated in the diagrams (by heavy arrow) as the dog advances in the raised position. The needle is timed as desired to pierce the intervening material between impulses just before entering the needle aperture in the throat plate. The more positive action provided by earlier and firmer contact of the gripping surface on the far feeding platform against the roller carried directly by the foot channel assures feeding of the material away from the needle as rapidly as pressure of the smooth near surface against its spring-loaded roller can forward the material to the needle. Movement of the lowermost layer of multilayered material is transmitted substantially undiminished through any intervening layers to the topmost layer in contact with the rollers,

which rotate sufficiently freely as not to retard the topmost layer appreciably. The operator need only supply the material to the front feeding combination of roller and platform and, in fact, thereby is substantially prevented from overfeeding the material to the needle.

All the elements shown may be made of steel or other conventional materials. Bearings may be employed to reduce friction at points of sliding contact, as between rollers and pins or between pins and other members; of course, the pins may be fixed to the rollers and rotatable within the supporting arm or boss, instead of otherwise. The relative sizes and shapes of the feeding platforms may be varied, if desired, and their surface characteristics may be modified so long as the feeding surfaces remain essentially parallel to one another and the feeding action remains more positive at the location toward which the material moves upon leaving the needling location, conventionally the far side of the needling location from the operator. For some uses it may be desirable to tooth all the feeding surfaces to some extent, either uniformly or otherwise. The far feeding platform, whose gripping surface rises to the level of the material being fed before that of the near platform does, may be mounted on a separate dog, actuated individually and, if desired, with differential motion for greater feeding impulse at the far location. In any event the platform orientation and movement will be generally fore and aft in the line of travel of the material being sewed or being needled for another purpose. Of course, a sewing step is not essential to the practice of this invention, which is applicable similarly to movement of multilayered material such as fabrics (both woven and unwoven), sheets (including film and paper), and other laminar structures; for example, the described equipment is adapted to needling of fibers, as from a batt, through bases of these or other materials.

In the sewing of materials that stretch easily, pucker may occur because when the stitch is set the needle thread pulls upward on the material being sewed but the feeding mechanism continues to forward the material away from the needling axis; the resulting forces exerted at the surface of the material stretch it temporarily, and upon removal of the forces after completion of the stitch the material contracts irregularly, acquiring an undesirable puckered appearance. Figures 3 and 3*a* illustrate an element useful in conjunction with the apparatus just described or other sewing mechanism in eliminating or greatly reducing this secondary cause of puckering.

Figure 3 shows in vertical section, taken fore and aft on a line parallel to the direction of sewing and just to one side of the needling location, a presser foot like that of Figures 1 and 2 modified by addition of a snubbing element for the needle thread. Presser foot **51** comprises channel member **60** slotted at the top by inlet **61** and closed at the bottom by horizontal seat **62** extending perpendicular thereto away from the needling location and perpendicular to boss **67** also extending therefrom but toward the needling location and substantially in a plane parallel to the channel bed. Pin **64** extends horizontally through the boss for pivotal support of far roller **65** and of arm **66**, which is offset midway its length to support near roller **69** on pin **70** in alignment with the other roller. Extension **63** of the arm is located above the channel seat and is urged upward by spring **68** held in a recess in the seat. In Figure 3*a*, which is a plan view of that part of the presser foot of Figure 3 at and between the rollers, head **74** of the far pin and head **77** of the near pin are visible at the side of the arm away from the rollers.

Figure 3*a*, as well as Figure 3, shows snubbing element **75**, which has no counterpart in the apparatus previously illustrated. The snubbing element is a curved insert located between the rollers and supported at one side by the arm that also supports the near roller. The base of the snubbing element at the bottom edge of the arm is close to the surface of the far roller; from there the element curves smoothly upward toward the needling axis and terminates about midway of the supporting arm, being bisected from top to bottom by substantially arcuate indentation or groove **76**, which terminates tangential to the needling axis.

The relationship of the thread carried by the needle to the snubbing element just described is apparent from Figure 3, which shows needle **72** with thread **71** extending through the eye thereof down into contact with the grooved surface of the snubbing element, along the groove, thence into the material being sewed by this thread along with thread **73** supplied from an underlying bobbin (not shown). This material, which consists of top layer **78** and adjacent bottom layer **79**, is forwarded intermittently in the direction indicated by the nearby arrow through the action of the cooperating rollers and feeding platforms of the feed dog (omitted from the drawing, along with the throat plate upon which the material lies, for clarity of the showing). This movement of the material persists as the needle thread rises, as indicated by the arrow near the needle. Friction of the needle thread against the snubbing element greatly decreases the opposing forces at the surface of the sewed material, with consequent reduction in stretching and puckering that otherwise would occur. The advantage of such operation is self-evident.

A guide to facilitate even sewing of edges of sheet material is often useful, as in the manufacture of collars and cuffs; the apparatus of Figures 1 and 2 may be modified to provide such a guide without necessity for additional elements. Such a modification appears in Figures 4 and 4*a*, where the elements are so designed as to provide a guide for the edge of material at the right of the operator, as is preferred.

Figure 4 is a plan view of a presser foot and underlying throat plate that coact to form a novel edge guide for material to be sewed. The presser foot comprises vertical channel member **80** constructed as a mirror image (about the vertical) of channel **10** of Figures 1 and 2 having seat **82** extending horizontally therefrom at the bottom. Boss **87** extends back from the right edge of the channel member as support both for far roller **85** on a horizontal pin whose head **94** is visible at the right side of the boss and for arm **86** between the boss and the roller. The arm, which is straight (rather than offset midway, as were the arms previously described) carries the near roller **89** on a horizontal pin whose head **97** is visible to the right of the near end of the arm. The far end of the arm has extension **83** perpendicular thereto above and paralleling the channel seat; compression spring **88** (circular dashed line) mounted in the recess in the seat and terminating at the under surface of the extension urges the arm pivotally about the supporting far pin. Throat plate **92** visible underneath the presser foot, has rectangular near and far feeding apertures **95** and **96** and circular needle aperture **93** therebetween, resembling the apparatus previously described. The throat plate of this embodiment, however, cotnains in addition an elongated aperture or slot **94** extending for the length and width of the arm just described.

As is evident from Figure 4*a*, which is a vertical section of the apparatus of Figure 4 taken through the needling aperture and looking in the feeding direction, as indicated, the arm extends downward sufficiently below the roller surface to enter the slot and to remain below the top of the throat plate despite pivoting of the arm in a vertical plane about the supporting pin. The corner formed by the left edge of the arm and the top surface of the throat plate facilitates guiding of material to produce a seam of constant width at the edge of the material. The arm and surrounding slot conveniently extend from a location somewhat closer to the operator than the near roller for visibility of the edge location and

may extend, as shown, slightly beyond the far edge of the channel member for a similar reason. Of course, the feed dog of this apparatus may be as described previously; the snubbing element described above may be used also, if desired.

The objective of forwarding sheet material flat despite needling or sewing thereof can be accomplished also according to this invention by a somewhat different apparatus which is illustrated in Figure 5. In this embodiment, presser foot **101** comprises channel member **110** having inlet **111** in the top of the channel bed and carrying fixed arm **117**, which supports horizontal pin **120** upon which both near roller **119** and movable arm **116** are mounted with the movable arm located between the fixed arm and the roller. The movable arm carries horizontal pin **114** supporting far roller **115** and terminates in horizontal extension **113** below the bottom of the channel member and separated therefrom by intervening compression spring **108** seated in recess **109** in the arm extension. The peripheral surface of each roller is roughened by presence of shallow diagonal or criss-cross grooves cut therein. Each of the pins upon which the rollers are mounted also carries a gear affixed to the roller and recessed in the side of the movable arm, the larger gear **133** on the near roller and smaller gear **132** on the far roller. These two gears mesh with intermediate gear **131** recessed in the arm and carried on pin **130** extending horizontally into the arm. Visible through rectangular apertures located fore and aft of circular needle aperture **123** in throat plate **102** are feeding platforms carried on a feed dog (not shown) underneath the throat plate; near platform **103** with toothed surface **125** appears in aperture **121**, the feed direction being indicated by an arrow, and far platform **104** having somewhat higher smooth surface **126** appears in aperture **122**. Holes **124** and **124'** for mounting screws also are visible in the throat plate.

Although this apparatus also functions to move material in the indicated direction away from the needling location fully as fast as the material is fed thereby to the needling location, the operation differs somewhat from that of the previous apparatus because of the varied construction. As before, upon contact the far platform (being higher) begins to forward material supported on the throat plate beneath the rollers somewhat sooner than the nearer elements do, thus preventing puckering as the feeding begins. The forward component of motion transmitted from the near feeding platform through the material to the near roller rotates the roller at essentially the feeding speed because the opposing rough surfaces are conducive to non-slipping contact with the material. The far roller, being geared to the near roller, turns with it though more rapidly; the greater rotation of the far roller pulls the material on the smoother far feeding surface and keeps it taut between the two feeding locations. Thus, at all times this arrangement of elements prevents bunching or puckering of the material being forwarded, and the positive combination of gripping surfaces at the location nearer the operator practically eliminates manual overfeeding of the material to the needle.

It is noteworthy that, although the rollers of the last described apparatus are linked mechanically to one another (which might be accomplished as well by belts, chains, or other drive means), they undergo only driving force transmitted from the feed dog through the material being fed thereby, providing simple positive synchronization without added external means. Instead of having an unequal drive ratio, which in the apparatus described was 1.25 to 1, the diameters of the rollers may be made unequal to obtain the same effect with direct drive, the far roller then being smaller than the near roller. The optimum ratio of peripheral surface speeds of the respective rollers will depend upon the material being forwarded, but usually a ratio of at least 1.1 to 1 is desirable; ratios above 2 to 1 seldom will be advantageous, and the surface of the far roller may be made somewhat smoother than that of the near roller to permit some slippage over the adjacent material at the higher ratios. The roller surfaces may be prepared by blasting etching, coating or in other suitable manner to increase the friction thereof, instead of being grooved regularly, as shown. Other modifications of the described apparatus conforming to this invention will come readily to the mind of one skilled in the art.

The claimed invention:

1. Apparatus for advancing laminar material uniformly, comprising a plurality of rotatable cylindrical material-engaging surfaces spaced from one another in the direction of advancing and a corresponding plurality of movable gripping surfaces each spaced from one another in the direction of advancing and each mounted for oscillating movement upward into juxtaposition to a cylindrical surface and forward while maintaining the juxtaposition, the gripping surface farthest in the direction of advancing movement being elevated above the other gripping surfaces during the advancing movement, one of said cylindrical surfaces being mounted for vertical movement relative to the other of said cylindrical surfaces, there being spring means provided for biasing said one cylindrical surface vertically into engagement with its juxtaposed gripping surface.

2. Apparatus for advancing flexible laminar material in flat configuration by gripping the material from opposite sides at locations in line with a direction of advancing, comprising a pair of rollers spaced from one another at the gripping locations adjacent one face of the material with their axes parallel to one another and perpendicular to the direction of advancing and a corresponding pair of gripping surfaces spaced from one another and mounted for oscillating movement upward to a position in contact with the opposite face of the material at the gripping locations, in the direction of advancing while maintaining the gripping contact, and thence to their original location, the gripping surface farthest in the direction of advancing movement being elevated above the other gripping surface during the advancing movement, one of said rollers being mounted for vertical movement relative to the other roller, there being spring means provided for biasing said one roller vertically in the direction of the gripping surfaces.

3. The apparatus of claim 2, wherein the gripping surface at the gripping location of said other roller is a friction surface providing a positive grip on said material.

4. The apparatus of claim 6, wherein is provided a drive means coupling said one roller to said other roller to synchronize rotation of the rollers.

5. The apparatus of claim 7, wherein said drive means is a gear train providing synchronized rotation of said one roller at a speed greater than the speed of said other roller.

6. In a sewing machine having a presser foot and a throat plate: a first roller rotatably mounted on said foot; an arm pivoted on said foot; a second roller rotatably mounted on said arm in spaced alignment with said first roller; a feed dog having spaced gripping surfaces thereon; means mounting the feed dog on the machine beneath the throat plate for oscillatory advancing and retarding motion of the respective gripping surfaces into and out of engagement with said rollers, said throat plate being apertured to receive said surfaces; and spring means extending between the foot and said arm for urging said second roller downwardly.

7. A sewing machine as recited in claim 6, wherein the gripping surface farthest in the direction of advancing motion is elevated above the other gripping surface.

8. A sewing machine as recited in claim 6, wherein

the gripping surface associated with said first roller is a friction surface.

9. A sewing machine as recited in claim 6, wherein the pivot axis of the arm is located between the second roller and said spring means.

10. A sewing machine as recited in claim 9, wherein an elongated slot is provided in said throat plate and said arm extends into said slot to present a guide edge for material being advanced.

11. In a sewing machine having a presser foot and a throat plate: a first arm extending laterally from said foot and provided with a horizontally projecting pin; a first roller rotatable on said pin; a second arm pivotally mounted at one end thereof on said pin; a second roller rotatably mounted on said second arm intermediate the ends thereof; a feed dog having spaced gripping surfaces thereon; means mounting the feed dog on the machine beneath the throat plate for oscillatory advancing and retarding motion of the respective gripping surfaces into and out of engagement with said rollers, said throat plate being apertured to receive said surfaces; spring means extending between said foot and said arm

for urging said second roller downwardly; and means coupling the rollers for synchronized rotation thereof responsive to the advancing motion of said surfaces.

12. A sewing machine as recited in claim 11, wherein the gripping surface associated with said second roller is elevated above the other gripping surface.

13. A sewing machine as recited in claim 12, wherein said other gripping surface is a friction surface.

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CERTIFICATE OF CORRECTION

Patent No. 2,907,291

October 6, 1959

Victor H. Schrader

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 60, for "cotnains" read -- contains --; column 6, line 52, for the claim reference numeral "6" read -- 3 --; line 55, for the claim reference numeral "7" read -- 4 --.

Signed and sealed this 3rd day of May 1960.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents