

[54] **APPARATUS FOR STITCHING SHEET MATERIALS**

[75] Inventor: **Winfried Böttcher**, Leipzig, Germany

[73] Assignee: **Veb Polygraph Leipzig Kombinat Fur Polygraphische Maschinen und Ausrustungen**, Leipzig, Germany

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[51] Int. Cl. **D05b 65/00, B42b 3/00**

[58] Field of Search **11/1 R; 112/21**

[56] **References Cited**

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Primary Examiner—Geo. V. Larkin

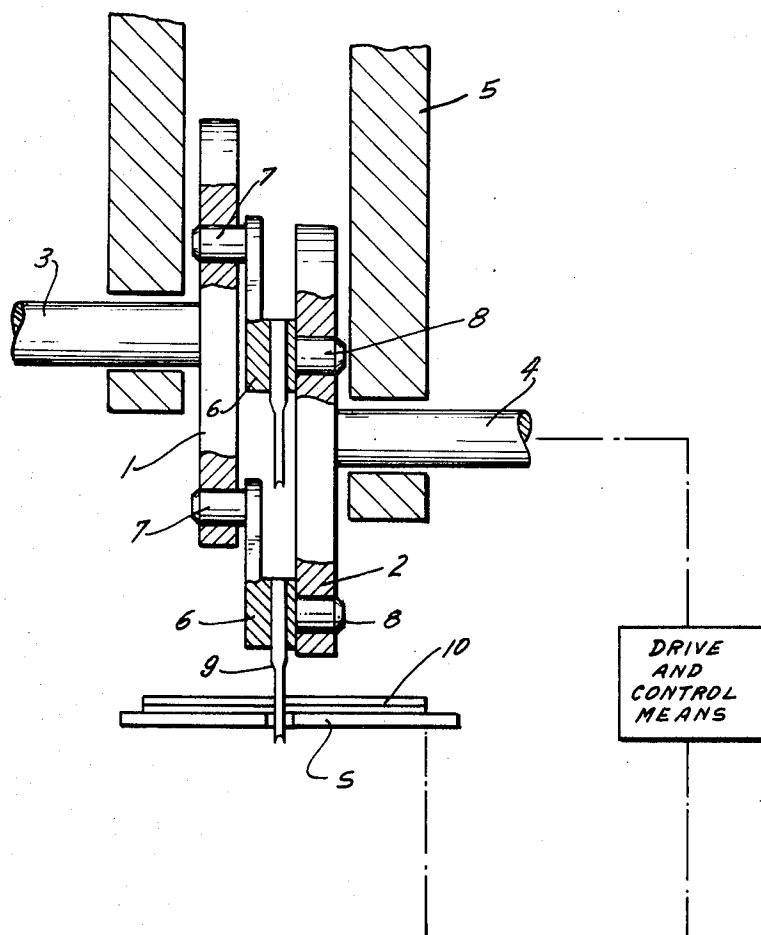
Attorney—Michael S. Striker

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ABSTRACT

A support means supports layers of sheet material which travel in a predetermined path and direction. A working station is located above the support means and comprises a pair of axially parallel rotatable shafts extending transversely of the path, a pair of flange members which are mounted on the respective shaft for rotation therewith and are located in at least substantially parallel spaced planes, and at least one needle carrier mounted between the flange members pivotable with reference to both of them about axes paralleling one another and the shafts. One or more needles are carried by the needle carrier extending radially of the flange members so as to project radially beyond the same and to successively penetrate and withdraw from sheet material beneath the working station in response to the needle carrier approaching and receding from a predetermined angular position relative to the support means. Drive and control means effects advancement of the needle carrier at a circumferential speed which at least approximates the linear speed of travel of the sheet material.

5 Claims, 7 Drawing Figures



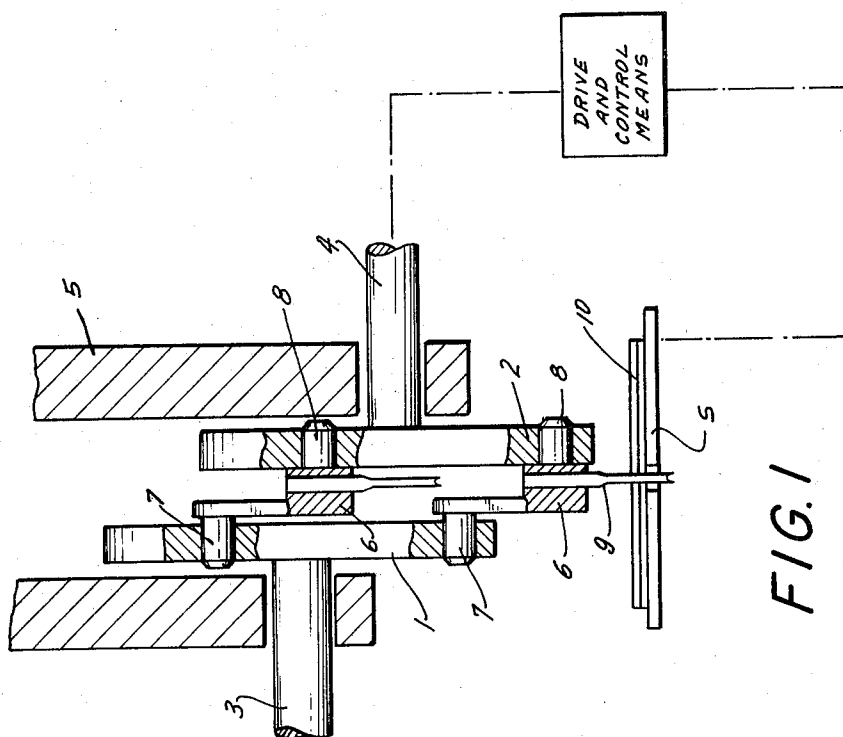


FIG. 1

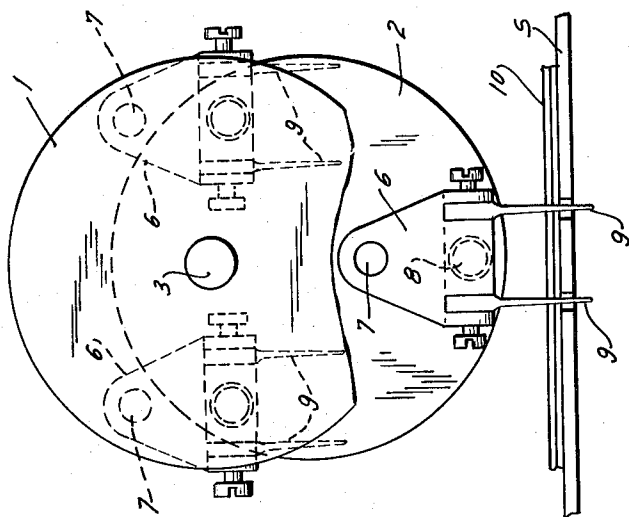
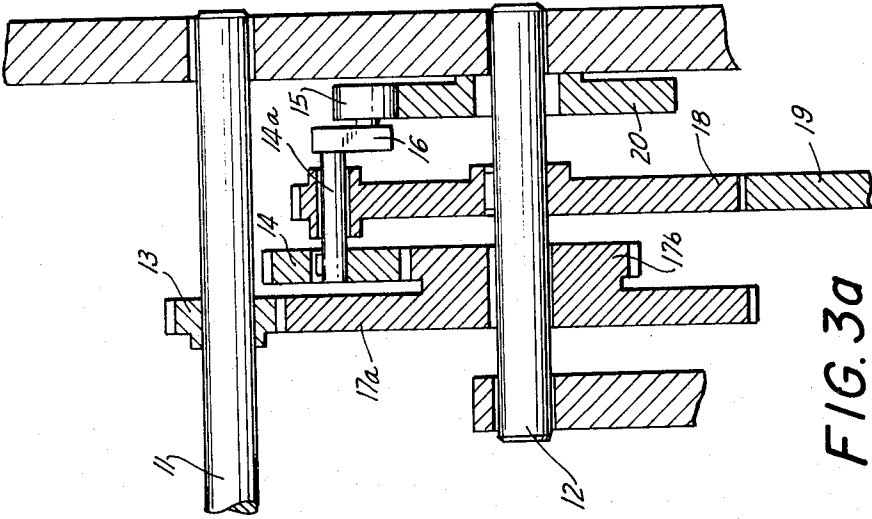
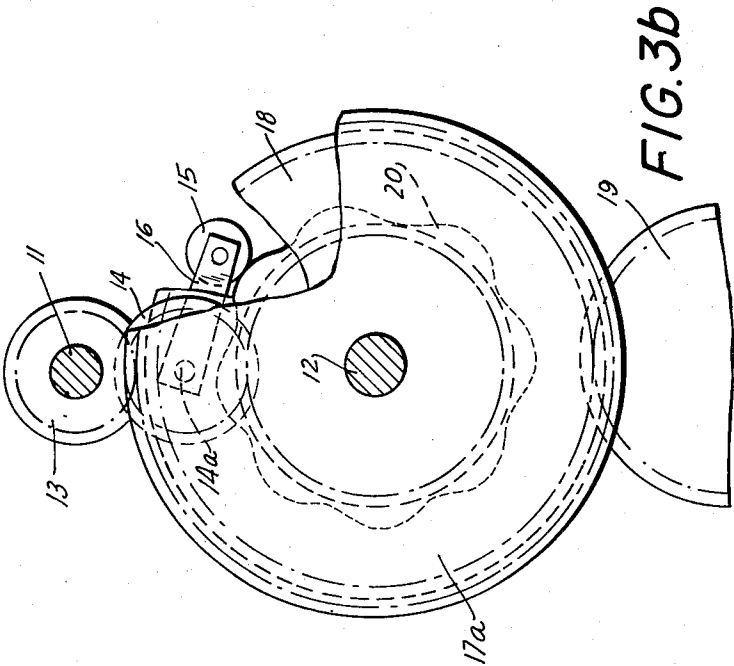


FIG. 2



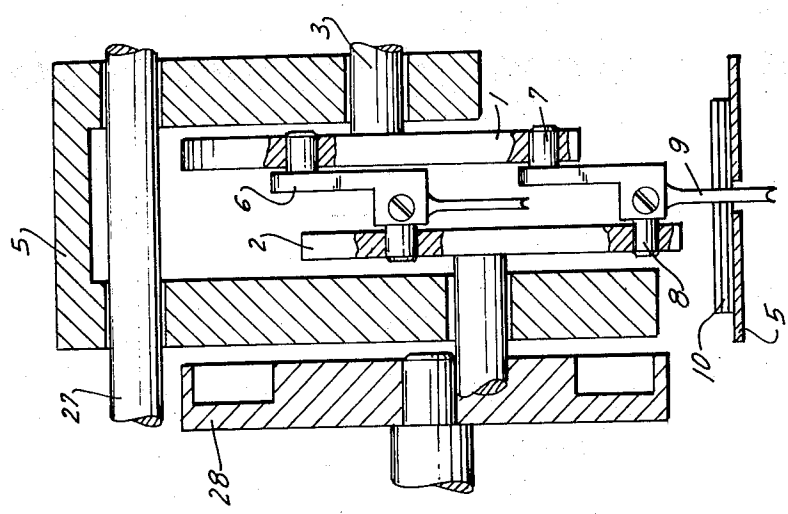


FIG. 4b

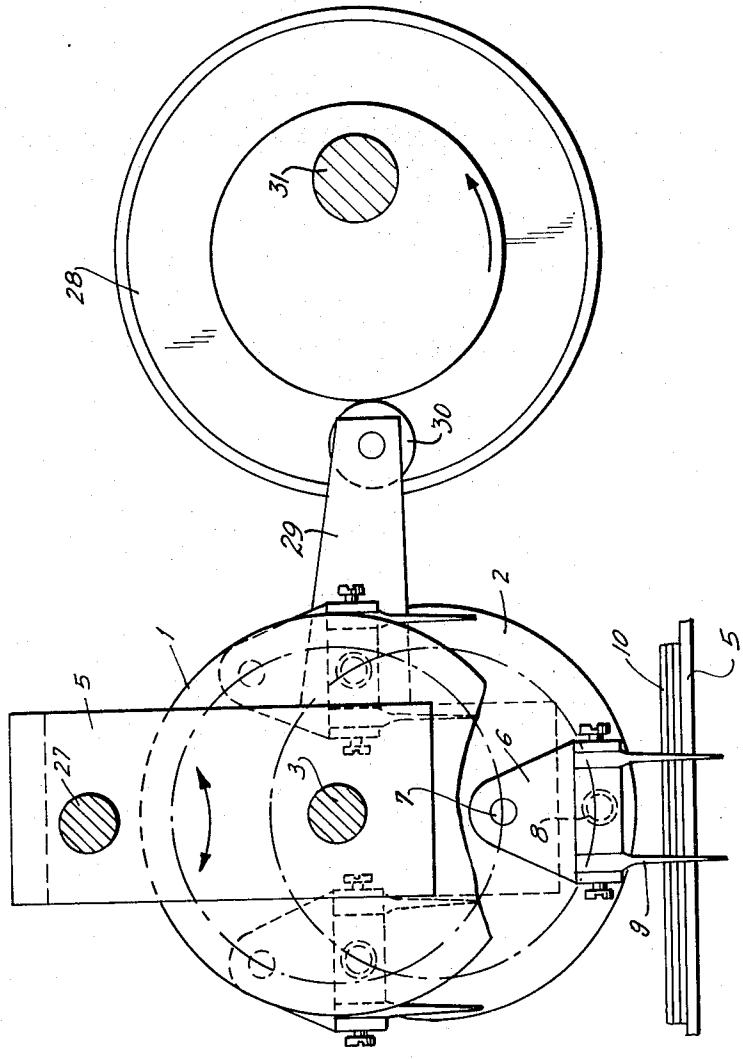


FIG. 4a

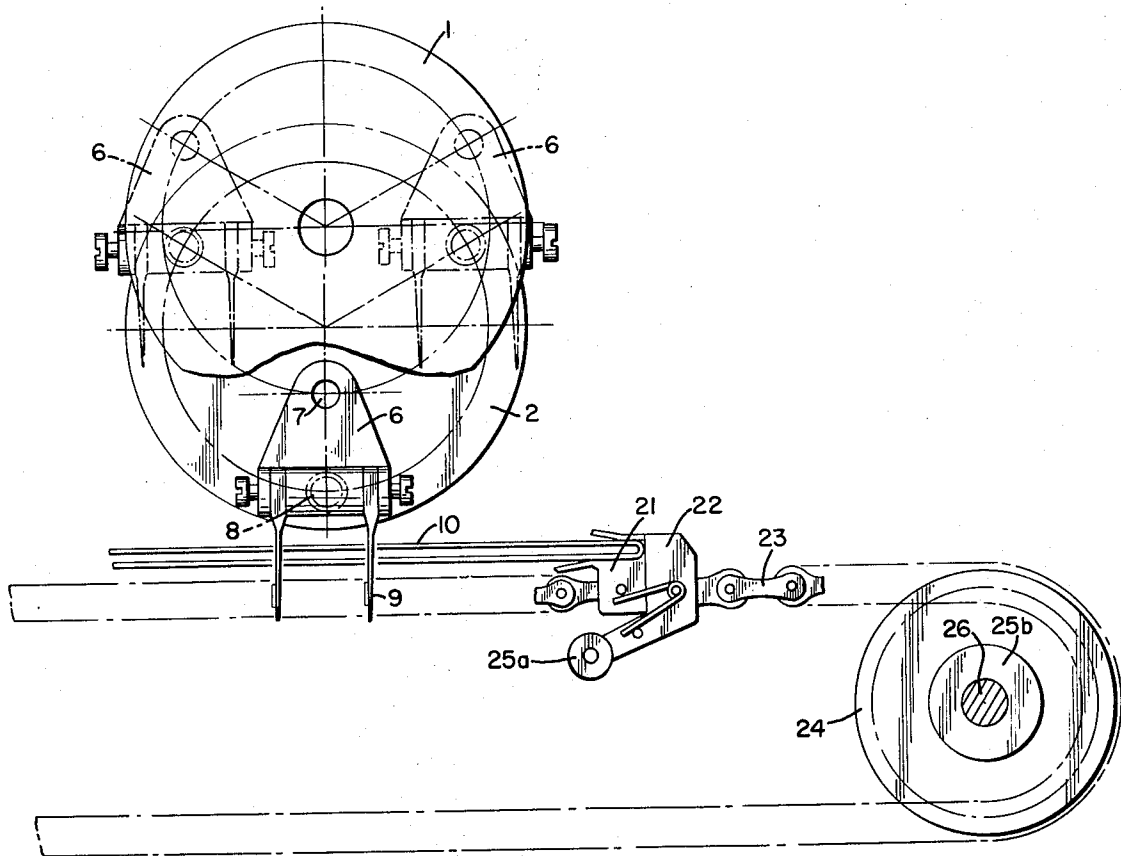


FIG. 5

APPARATUS FOR STITCHING SHEET MATERIALS

BACKGROUND OF THE INVENTION

The present invention relates generally to an apparatus for stitching of sheet materials, and more particularly to an apparatus of this type which is utilized for stitching sheet section of books, pamphlets, brochures or the like.

When sections of a book, brochure, pamphlet or the like have been printed, they must be connected together. They are therefore first folded in half because each sheet section will subsequently (when folded in half and constituting part of a book, pamphlet or the like) constitute four pages of the finished book or the like. Several of the sheet sections are placed in superimposed relationship and are then to be connected, with the resulting unit then constituting either the completed product (brochure, pamphlet or the like) or if a book is involved, being subsequently connected with additional units. Different ways of connecting the superimposed sheet section are known to form them into a unit. One such approach involves stitching them together along or in their fold line, that is where they have been folded in half. Thus there is for instance known a device from German Patent No. 843,839 in which a plurality of needles are mounted on a turnable arranged support, and the support will sequentially move the needles into a common stitching position and push them through the superimposed sheet sections. A second support is similarly provided for the plurality of needles which, contrary to those of the first support, carry the stitching thread by means of which the sheet sections are to be connected, and which enter (subsequent to withdrawal of the needles of the first support) into the holes formed by the needles of the first support, passing the stitching thread through these holes and forming loops through which in known manner a retaining thread is passed.

Experience has shown that this prior-art construction has certain disadvantages. For instance, it can utilize only an endless stitching thread, and it requires two separate supports which must be synchronously driven. In addition, the needles are not firmly guided and the danger of difficulties arises from this disadvantage. In fact, proper operation of this device is not really possible without first forming the holes for the thread with the needles of the first support, because the thread which is carried by the needles of the second support and sequentially passed through the previously formed holes, must be constantly drawn over the respective needle tip so that without the previous formation of the holes the folded sheet material sections would be torn thereby at the side. For this reason each successive one of the second needles may enter into the associated previously produced hole only after the preceding thread loop has already been completely formed, because a pulling of the thread over several needles results in strong tensile forces which may result in turn in a breaking of the thread. For this reason the individual needles must have a certain minimum spacing from one another and must not exceed a specifically determined length.

In this prior art construction it is also necessary that on entry of the needles into the sheet material section, the needles be pressed against an abutment by a spring, whereby their initial position with reference to the

sheet material section is determined. The position of the needle with reference to the sheet material section during transportation is determined exclusively by the speed of advancement of the sheet material sections and is intended always to be normal with respect to the plane of the sheet material section. This, of course, requires that the spring be tensioned to a constantly greater degree so that it will have its greatest tension on withdrawal from the respective hole and result in damaging of the latter.

A further prior-art approach is disclosed in GDR patent 75,297, wherein needles of the type in question are located in the interior of a gripper cylinder, being centrally mounted with their tips facing outwardly and with their inner ends being in abutment at the center of the cylinder on a curved cam track. In this construction the sheet material section or sections are engaged by grippers located at the exterior of the cylinder or on a gripper chain, and are passed together with the cylinder beyond a stitching plate located at the other side of the sheet material sections from the cylinder and being of curved configuration, and subsequently they are passed beyond a similarly curved sealing member. During the rotation of the cylinder the needles with the cut-off thread are pushed through the sheet material sections so that the thread ends extend into the stitching plate and during further rotation of the cylinder are folded over and are sealed at the subsequently following sealing component.

This prior-art construction has certain advantages, but it also is not without disadvantages. In particular, the location of the needles in the interior of the cylinder, and they are controlled by means of a curved cam, makes the construction rather complicated and therefore susceptible to malfunctions. Even more important is the fact that the sheet material section or sections must be conveyed via the cylinder into a circular path in order for the free thread ends to be subsequently sealed at the sealing component. This means that the respective section or sections must be deflected in its path of movement, so that the applicability of this prior-art construction is rather limited. A modification of this construction provides for positioning of the sheet material section or sections on the exterior of a cylinder, and pushes the needles from the outside into the sections via a needle-carrying wheel, the needles of which are controlled by two cams. This latter type of prior-art device can be used for straight-line sheet material section stitching if the control cam is properly configured, but it has been found that this as well as the preceding device are not suitable for operation at high speeds. The reason is that the large number of discontinuously operated components causes a relatively rapid wear of the cam tracks, coupled with a very high noise factor and inexact guidance of the needles.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present invention to overcome the disadvantages of the prior art.

More particularly it is an object of the present invention to provide an improved apparatus of the character under discussion which is not possessed of such disadvantages.

A concomitant object of the present invention is to provide such an improved apparatus which is capable at high speed operation, provides for a minimum of noise and wear, and is highly reliable in its operation.

In pursuance of the above objects, and of others which will become apparent hereafter, one feature of the invention resides in an apparatus of the type under discussion which comprises support means for supporting layers of sheet material traveling in a predetermined path and direction. A working station is located above the support means and comprises a pair of axially parallel rotatable shafts which extend transversely of the path, and a pair of flange members each of which is mounted on one of the shafts for rotation therewith and which are located in at least substantially parallel spaced planes. At least one needle carrier is mounted between the flange members pivotable with reference to both about axes paralleling one another and the shaft, and at least one needle is carried by the carrier and extends radially of the flange member so as to project radially beyond the same for successively penetrating and withdrawing from said material beneath the working station in response to the needle carrier approaching and receding from a predetermined angular position relative to the support means. The needle carrier and the sheet material are advanced with at least substantially coordinated circumferential and linear speeds, respectively, either by having the circumference of the working station be very large or by having the sheet material move in an arcuate path about the working station.

If absolute coordination of the horizontal component of movement of the needle carrier with the horizontal movement of the sheet material is desired, an auxiliary gear drive is provided at the drive for the working station. However, such absolute coordination can also be achieved by imparting periodic tilting movements to the entire working station, or by providing an auxiliary gear drive at the drive which advances the sheet material.

The device according to the present invention makes it possible to operate at high speed on sheet material sections which are flat or located in a curved path.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary end-elevational view, partly sectioned, illustrating an embodiment of the invention;

FIG. 2 is a side elevational view of FIG. 1;

FIGS. 3a and 3b illustrate, in views similar to FIGS. 1 and 2, respectively, an additional embodiment of the invention;

FIGS. 4a and 4b are views analogous to FIGS. 3a and 3b, but illustrate a further embodiment of the invention; and

FIG. 5 is a somewhat diagrammatic fragmentary view, showing still another embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail it will be seen that in the illustrated embodiment, in which all components not considered essential for an understanding of

the invention have been omitted for clarity, reference character S designates a support on which sheet material layers or sections 10 travel in a predetermined path and direction, in FIG. 1 in the direction normal to the plane of the drawing.

Located above the support S and the path of the travel of the sheet material sections 10 thereon, are two shafts 3 and 4 which extend in axial parallelism with one another and which are journaled in a frame or similar support 5. The end portion of each of the shafts 3 and 4 carries a flange or disc-shaped member 1 and 2, respectively, which members rotate with the respective shafts 3 and 4. The members 1 and 2 will be seen to be located in at least substantially parallel transversely spaced planes and located between these members is a plurality of needle carriers 6. It is emphasized that according to the present invention a single needle carrier 6 could be provided, but for the illustrated embodiment I have chosen to depict three of them (see also FIG. 2).

Each of the needle carriers 6 is mounted for pivotal movement with reference to the flange member 1 about a pivot pin 7 and for similarly pivotal movement with reference to the flange member 2 about a pivot pin 8, with the axes of the pivot pins 7 and 8 extending in parallelism with one another and with those of the shafts 3 and 4, but being radially spaced. The extent to which the flanges 1 and 2 and the shafts 3 and 4 are laterally offset corresponds to the extent to which the axes of rotation of the pivot pins 7 and 8 of the respective needle carrier 6 are similarly offset. This means that in any circumferential position of the flange members 1 and 2 relative to one another, the pivot axes of the pins 7 and 8 will always be in parallelism with one another. The needle carriers 6 each carry one or more (two illustrated) needles 9.

It will be appreciated that when the members 1 and 2 rotate with their respective shafts 3 and 4, the needle carriers pivot with reference to the members 1 and 2. Thus, as each needle carrier 6 moves from a position lowermost, that is from a position closest to the support S in circumferential and upward direction, it assumes the position shown for the upper needle carriers 6 in FIGS. 1 and 2. As it approaches the lowermost position again, the needles 9 which heretofore have been located entirely between the members 1 and 2, now project beyond the periphery of the members 1 and 2 in radial direction and during continued rotation of the members 1 and 2 they first approach the sheet material sections 10 on the support S, penetrate into them as illustrated in FIGS. 1 and 2, and thereupon are withdrawn in upward direction as a result of further rotation of the members 1 and 2. Of course, the several needle carriers 6 are connected with the members 1 and 2 at circumferentially spaced locations, as is indicated in FIG. 2 where the lowermost needle carrier 6 is illustrated in full lines and the other tubes of the three which have been shown are illustrated in broken lines being covered by the member 1.

The support means S for the sheet material sections 10, which are of course usually of paper, may be of any suitable type well known to those skilled in the art, for instance in form of a conveyor belt or the like (see FIG. 5). It is, of course, desirable in accordance with the present invention that the circumferential or peripheral speed at which the needle carriers 6 move is as closely as possible coordinated with the linear speed of travel

of the sheet material sections 10 in order to obtain accurate and high-speed operation. It goes without saying that the needles 9 which have been illustrated will carry threads which they push through the holes they have made in the sheet material sections 10.

The apparatus as thus far discussed affords an approximate coordination of the horizontal component of movement or speed of the needles 9 with that of the carrier device 21 which advances the sheet material 10 (see FIG. 5). If, however, an absolute coordination of these movements is to be obtained, in order to prevent tearing of the sheet material at the points of penetration by the needles 9, additional measures are needed.

Thus, the embodiment of FIGS. 3a and 3b—otherwise analogous to that of FIGS. 1 and 2—shows that an auxiliary gear drive is provided in cooperation with the drive for the working station. Shaft 11 is fast with the drive for the working station and fixedly carries a gear 13 which drivingly meshes with a dual gear 17a, 17b (see FIG. 3a); the latter is turnably mounted on shaft 12. Also mounted on shaft 12, but fixed therewith, is a gear 18 which is driven by gear 19; mounted in an eccentric bore of gear 18 is a shaft 14a carrying a planetary gear 14 which drives the smaller gear 17b of the dual gear 17a, 17b. Thus, gear 14 imparts to gear 17b (in addition to the normal movement) a discontinuous auxiliary movement, derived via arm 16 (which is fast with shaft 14a) and roller 15 which rides on the stationary cam 20. The teeth of the gears are illustrated in simplified manner with dot-dash circles in FIG. 3b.

The embodiment of FIGS. 4a and 4b, otherwise analogous to FIGS. 3a and 3b, achieves the same exact coordination of movement speeds in a different manner. Here, the frame 5 is periodically tilted about a pivot 27 in such a manner that the movement of needle 9 has a continuous horizontal component imparted to it. The periodicity of tilting is controlled by an appropriately configured cam 28.

FIG. 5, finally, illustrates still another embodiment affording the desired precise coordination. Here, the drive 26 advancing the carrier device 21 for the sheet material 10, is acted upon by the auxiliary gear drive. In this embodiment, a chain sprocket 24 engages and advances a chain 23. Each sheet material member 10 is engaged by a gripper device 22 of a respective carrier device 21; such gripper devices, which are urged to closure or engaging position by springs, are already well known. They are opened to release a member 10 (and prepare for engagement of another) by a roller 25a which contacts a disk 25b when device 22 reaches the location where member 10 is to be released. The auxiliary gear drive in this embodiment may be the same as that shown in FIGS. 3a and 3b and superimposed upon to the linear speed of chain 23 a periodic discontinuity in order to accommodate the linear speed of sheet material 10 to the linear speed of the needle carrier while the same travels in its horizontal component of movement.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an apparatus for stitching sheet material sections, it is not intended to be limited to the details shown, since various modifications and struc-

tural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In an apparatus for stitching books, pamphlets and the like, in combination, a support arrangement for supporting layers of sheet material travelling in a predetermined path and direction; a working station above said support arrangement and comprising a pair of axially parallel rotatable shafts extending transversely of said path, a pair of flange members each mounted on one of said shafts for rotation therewith and located in at least substantially parallel spaced planes, at least one needle carrier between said flange members pivotable with reference to both about axes paralleling one another and said shafts, and at least one needle carried by said carrier and extending radially of said flange members so as to project radially beyond the same and to successively penetrate and withdraw from sheet material beneath said working station in response to said needle carrier approaching and receding from a predetermined angular position relative to said support arrangement; and means for imparting to said needle carrier and said sheet material at least substantially coordinated circumferential and linear speeds, respectively.

2. In an apparatus as defined in claim 1, said means comprising drive means for said needle carrier, and auxiliary gear means operatively associated with said drive means for periodically imparting to said needle carrier a component of movement coincident with the travel of said sheet material and whose linear speed is exactly coordinated with the linear speed of said sheet material.

3. In an apparatus as defined in claim 1, said means comprising displacing means for periodically displacing said working station with reference to said path in a sense imparting to said needle carrier a component of movement coincident with the travel of said sheet material and whose linear speed is exactly coordinated with the linear speed of said sheet material.

4. In an apparatus as defined in claim 1, said means comprising drive means for advancing said support means in said path, and auxiliary gear means operatively associated with said drive means for imparting to said support means and thereby to said sheet material, a linear speed which is exactly coordinated with the linear speed of said needle carrier during travel of the latter in a horizontal component of movement thereof.

5. In an apparatus as defined in claim 1; further comprising at least one additional needle carrier and at least one additional needle, similar to the first-mentioned ones and mounted between said flange members at a location which is circumferentially spaced from said first-mentioned needle carrier and needle.

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