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Böettcher

[11] **3,855,039**

[45] **Dec. 17, 1974**

[54] **APPARATUS FOR HEAT-SEALING SUPERIMPOSED LAYERS OF SHEET MATERIAL**

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[21] Appl. No.: **311,259**

Related U.S. Application Data

[62] Division of Ser. No. 164,307, July 20, 1971, abandoned.

[52] **U.S. Cl.** **156/521,** 112/21, 156/91

[51] **Int. Cl.** **B32b 7/04**

[58] **Field of Search** 156/91-93, 156/513, 514, 519-521, 475; 112/2, 21; 227/71, 81, 203

[56] **References Cited**

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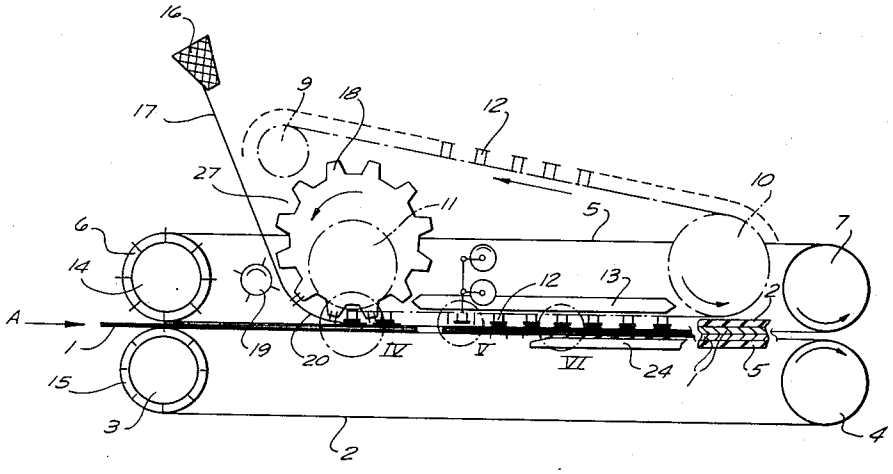
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Primary Examiner—Charles E. Van Horn
Assistant Examiner—David A. Simmons
Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

A stack of superimposed sheet material is advanced continuously in a predetermined path, and successive lengths of thread are advanced to it and pressed against one major side of the advancing stack for movement therewith. Spaced end portions of each length of thread are pushed through the stack so as to project in part from the opposite major side of the same and these parts are then deflected into engagement with this opposite major side and heat-sealed thereto, all during continuous advancement of the stack.

6 Claims, 8 Drawing Figures



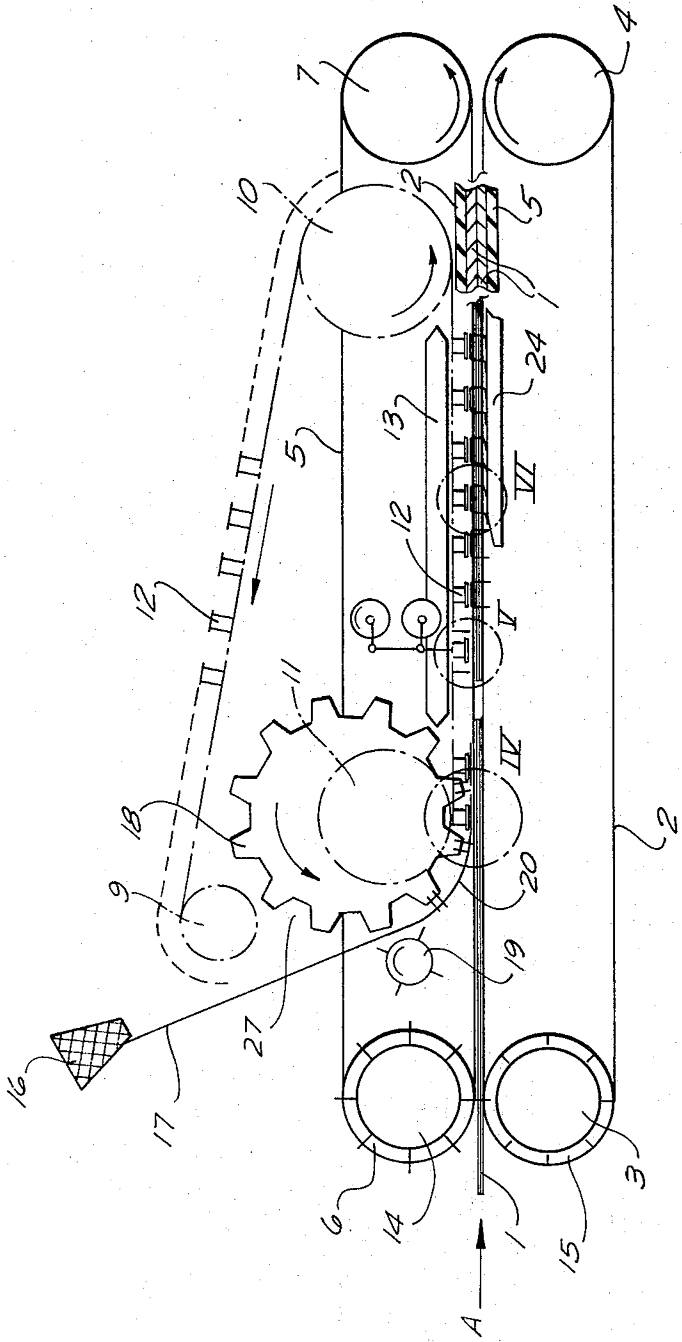


FIG. 1

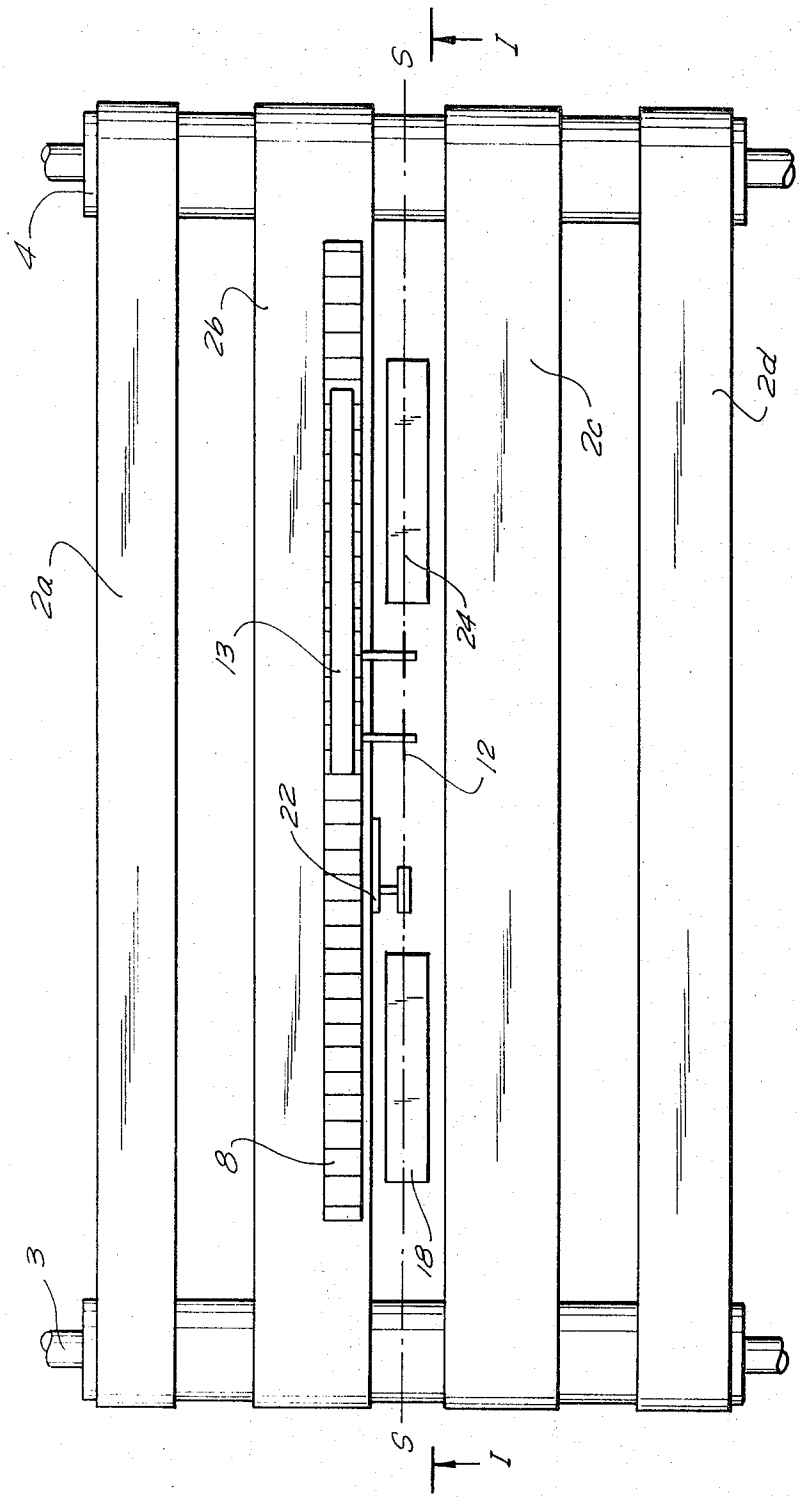


FIG. 2

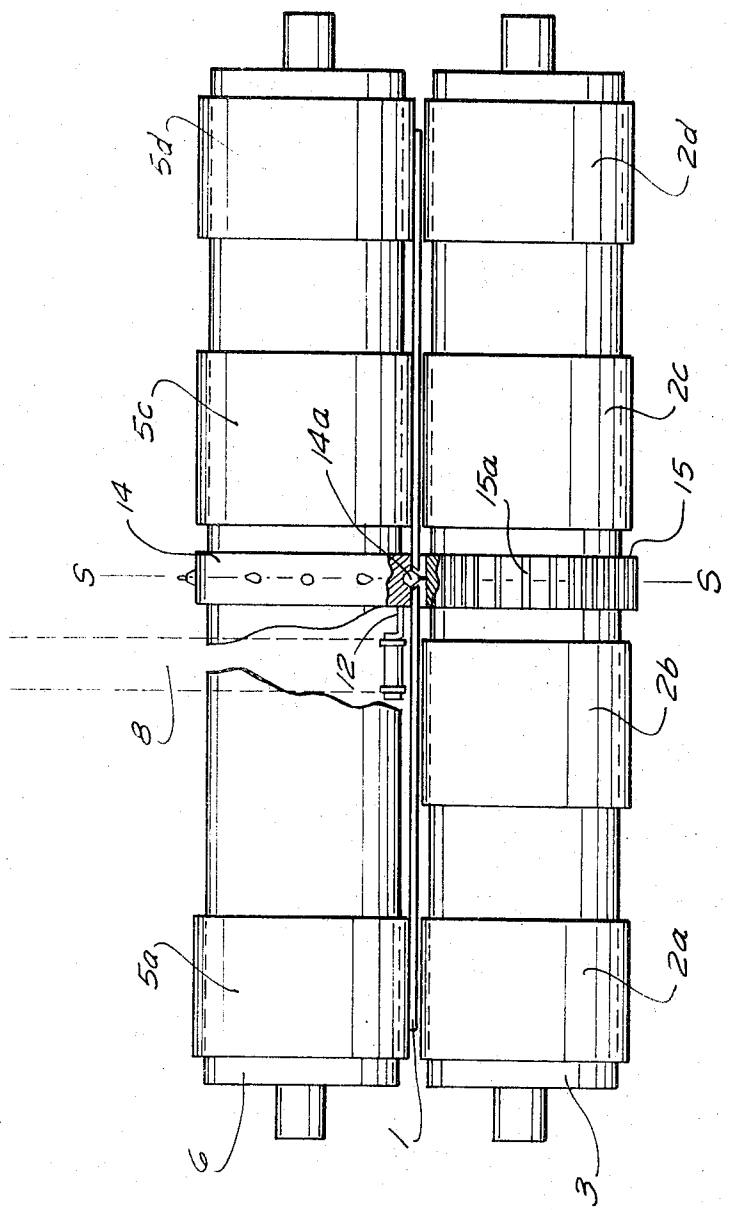


FIG. 3

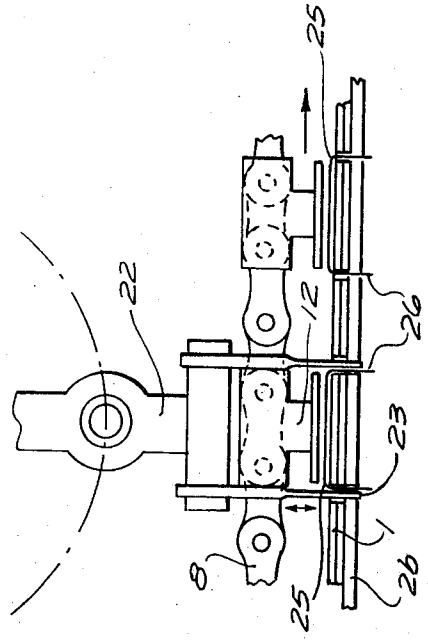


FIG. 5

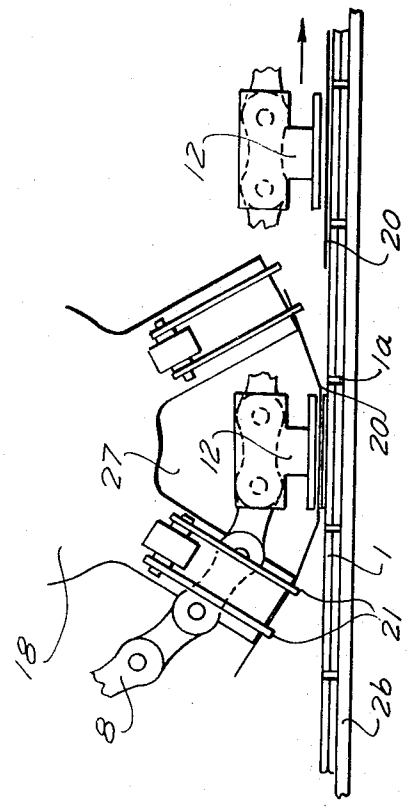


FIG. 4

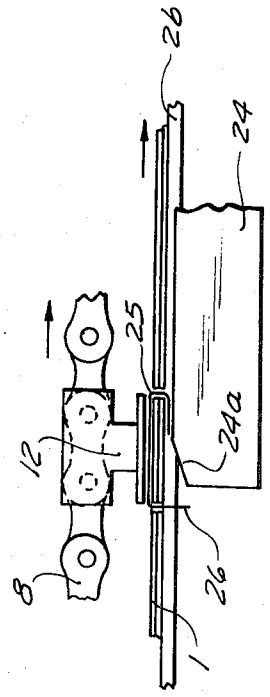


FIG. 6

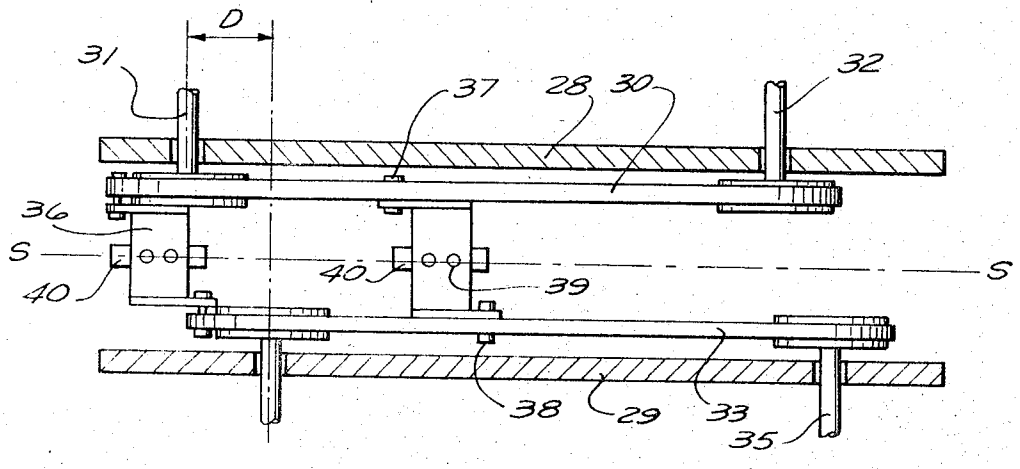

D
31
37
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S
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39
S
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FIG. 7

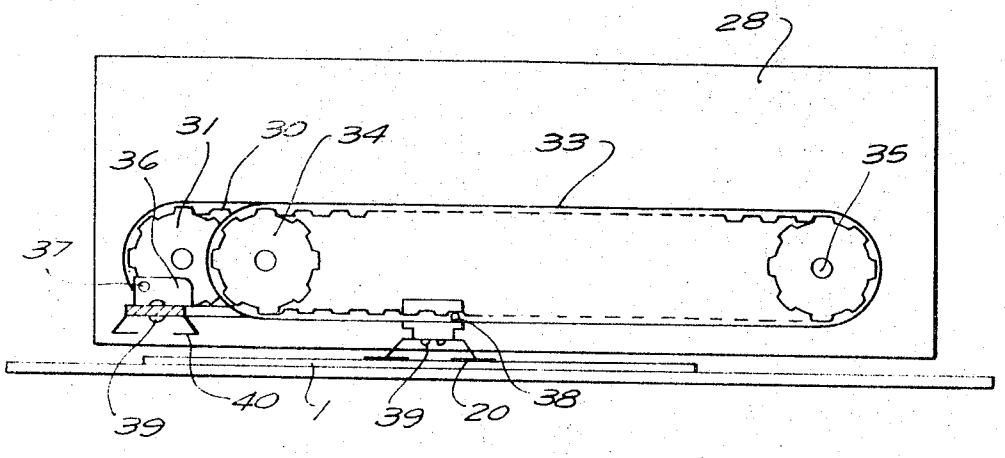

28
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20
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FIG. 8

APPARATUS FOR HEAT-SEALING SUPERIMPOSED LAYERS OF SHEET MATERIAL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a division of my copending application Ser. No. 164,307, filed July 20, 1971 and entitled "Method and Apparatus for Thread Sealing Superimposed Layers of Sheet Material, now abandoned.

Related applications have been filed in my name on Dec. 29, 1971 Ser. No. 213,255, now U.S. Pat. No. 3,763,798 and Dec. 30, 1971 Ser. No. 214,232, now U.S. Pat. No. 3,763,799 under the titles "Apparatus for Stitching Sheet Materials" and "Method for Connecting Superimposed Layers of Sheet Material and Apparatus for Carrying out the Method."

BACKGROUND OF THE INVENTION

The present invention relates generally to the connecting of superimposed layers of sheet material to one another, and particularly to a method for effecting such a connection and to an apparatus for carrying out the method.

The invention is concerned with binding of books, brochures, pamphlets and the like, with the word "binding" here being used in its broadest sense to imply only the connection of superimposed sheet material layers to one another, a process which may or may not be followed (for instance if a book is involved) by providing a separate cover, a spine or the like.

In this broad binding or connecting of superimposed sheet material layers, such as sheets of paper, which may be printed or not, with one another it is known to either staple the layers or to stitch them with thread. The stitching with thread can be carried out in different ways, which may basically be subdivided into continuous stitching, that is in sewing as with a sewing machine, or in the formation of individual stitches each of which is composed of a single length of thread spaced end portions of which are pushed through the stack of superimposed sheet materials so that the "stitch" somewhat resembles a conventional staple, with the free parts which are pushed through being sealed to the opposite side of the stack, as disclosed in GDR Pat. No. 8,801. The present invention is concerned in particular with this latter type of stitching. In the known approach to this type of stitching or thread-sealing it is known to effect such stitching of superimposed sheet materials and subsequently to fold the stack along the stitching line. The prior art disclosed in GDR Pat. No. 10,106 teaches that the stack is to be advanced in a direction at right angles to the line which is to be formed by stitching on the stack when the latter reaches a working station, and at the working station there is located a plurality of stitching arrangements corresponding in number to the number of stitches to be provided in the stack. When the stack is located beneath these stitching arrangements, which are located in a line coincident with the line of stitches to be formed in the stack, the latter is briefly arrested in its movement and the stitches are provided in it while it is stationary. Thereupon the now stitched stack is again advanced and usually moved to a folding station where it is folded along the line of stitches which have just been provided.

The self-evident disadvantage of this prior-art teaching is that the operation must be discontinuous because each stack of sheet materials must be arrested while the line of stitches is formed in it. Because of this the throughout capacity of an apparatus utilizing this prior-art teaching is considerably limited with the result that it cannot be used either with high-speed supplying apparatus (such as rotary printing presses) or with high-speed user apparatuses. On the hand the supply of stacks of material would arive too fast to be handled, and on the other hand the supply of stitched stacks to a high-speed user apparatus would be too slow. Moreover, the technical requirements which must be fulfilled in this type of apparatus are out of all proportion to the economy of operation which can be achieved with it, especially because such apparatus requires as many stitching devices as stitches must be formed in each and every stack of sheet materials.

A further disadvantage is the fact that the technical complexity as well as the physical dimensions of these stitching devices make it impossible to locate them so closely together in a row that the stitches can be provided immediately consecutively, as is often desired.

According to a further proposal of the prior art described in U.S. patent application Ser. No. 851,382, now U.S. Pat. No. 3,654,004 a rotary stitching device is provided which forms a row of stitches in the stack of sheet materials which is advanced in the direction in which the row is to be formed. In this prior-art device the sheet material or sheet materials move between a pair of rollers over one of which the thread required for forming the stitches is placed, which thread is to be cut into pieces of requisite length of a stretched thread clamp, which pieces are then pushed with their opposite ends through the stack to be secured thereto in known manner.

With the type of stitching here under discussion, it is a basic requirement that a length of thread of requisite elongation be cut off, engaged and maintained taut on a major surface of the sheet material or stack of sheet materials, until it is pushed by the needles of the stitching device through the sheet material. The needles are provided with substantially wedge-shaped recesses in their leading ends which are placed over the end portions of the thread and then push the end portions through the stack of sheet materials. Because of the necessity to hold each thread piece taut on a surface of the stack until its end portions are pushed through the latter, it is necessary that the thread supply arrangement and the needles, if both are to be utilized for forming stitches in continuously advancing stacks of sheet materials so that both devices must be mounted for rotation, be capable of rotating about the same axis. The thread supply device must withdraw the thread from a supply, such as a bobbin and must sever it into pieces of requisite lengths. This, of course, requires that a cutting device must be provided in addition. The thread supply device must be constructed as a hollow drum which on its outer periphery is provided with clamping devices and cutting devices for the thread, and inwardly must have journals for the needles which must always radially with reference to a counter cylinder or roller, whereas in the interior of the hollow drum there must be provided control devices which effect the movement of the cutting device and the needles in a sense causing the latter to push the end portions of the thread increments through the stack. On the other hand it is necessary that the diameter of the hollow drum or roller be as small as possible because the number of thread holders and needles increases as the di-

ameter of the drum increases, but this in turn is a requirement which contradicts the necessity for having adequate space in the interior of the drum for the necessary control devices. The result in the prior art is a compromise according to which the thread supply as well as the control devices are made as small as possible, but on the other hand are given a reasonable life expectancy and reliability consistant with the requirement that they be as small as possible.

Once the end portions of a respective thread piece have been pushed through the stack they will project in part beyond the opposite major surface thereof. These parts must then be deflected into engagement with this opposite major surface and must be sealed thereto, and usually the sealing is effected as heat-sealing, with the thread being a heat-bondable thread of known type described, for instance, in British Pat. No. 1,048,844. The means for effecting the deflection and the bonding utilizes stationary instrumentalities over which the stack is moved.

The second-mentioned prior-art approach, utilizing a rotating thread supply arrangement and needles which are guided and controlled in it, permits, a substantial increase in throughput over the first-mentioned arrangement. However, the construction is complicated as pointed out above, and all components are located within a very small space, which facts not only faciliate breakdowns but make it exceedingly difficult to effect repairs when breakdowns do occur. All in all, the prior-art device of the second type therefore does not meet the requirements made as to speed and reliability especially in continuously operating machines. In order to avoid a complete shut-down of such a machine it would be necessary to have at least two of the second-mentioned stitching devices which can operate in parallelism and of which one can take over while the other is being repaired. In addition it would be necessary to provide means for switching over the flow of sheet material stacks from one to the other of the stitching devices, depending upon which of them is operative at any given time. All of this of course is expensive and the loss of reliability is disadvantageous. It is also found that the disadvantages mentioned above occur at the output side of printing machines utilizing such switching arrangements, and it is further pointed out that control devices for the thread severing device and for the needles are subject to rapid and considerable wear because of the movements involved, so that the advantage of being able to thread stitch a stack of sheet materials during continuous movement in accordance with the second-mentioned prior-art approach is almost or completely counteracted by these disadvantages.

SUMMARY OF THE INVENTION

It is thus a general 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 apparatus for connecting superimposed layers of sheet material which advance continuously in a predetermined path.

Still an additional object of the invention is to provide such an apparatus which is simple in its construction and 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 for sealing superimposed layers of sheet material which advance continuously in a predetermined path.

The deflecting and sealing is effected by stationary instrumentalities or a single instrumentality, and it is advantageous according to a further concept of the invention that the stack is provided with openings during this advancement but before the end portions of the pieces of thread are pushed through the stack, so that subsequently these end portions can be pushed through the thus provided openings. This is not, however, a prerequisite of the present invention and constitutes merely one advantageous aspect.

It will be appreciated that the present invention essentially differs from the aforedescribed prior art by pressing thread pieces of requisite length against a surface of the advancing sheet material stack, and moving these thread pieces with the advancing stack until they reach a device which pushes their spaced opposite end portions through the stack. Because of this, a physical and local separation of the thread supply and cutting device and the device which actually effects stitching of the thread piece ends through the stack, can be readily obtained and makes it possible to construct the various devices in such a manner that they will have optimum dimensions without influencing one another or interfering with one another. This avoids the necessity for excessive miniaturization and the concomitant disadvantage of ready susceptibility to breakdowns. Moreover, in an apparatus for carrying out the present method the various constituent components and devices can all be so mounted — because of the space availability — that any one device or component can be readily removed and replaced without interfering with or being interfered with by other devices or components, and of course also being readily accessible.

According to the present invention it is advantagous that an endless transporting device be provided which extends in parallelism at least in a portion of its path with a transporting device for the stack of superimposed sheet materials, with sections of the endless transporting device entering into recesses provided in the periphery of a continuously rotating thread supply device whose periphery contacts and rolls on one major surface of the stack of sheet material. The sections thus enter into such recesses where they contact a thread piece of requisite length which spans the respective recess, pressing this thread piece against the one major surface of the stack and pulling it loose from engagement with the thread supply device during continued advancement of the endless transport device together with the stack. The transporting device is advantageously configurated as an endless chain which is mounted for movement in parallelism with the direction of advancement of the stack of sheet material at a speed corresponding to the speed of advancement of the stack. The chain will have sections carrying pressure elements which contact the respective thread pieces pressing them against the one major surface of the stack and having a width or length in the longitudinal direction of the thread piece which is smaller than the distance between two cooperating needles of the subsequently arranged stitching device, which needles engage the opposite end portions of the thread piece and push it through the stack forming a thread clamp. The movement of the needles is so synchronized with the movement of the endless chain that the two needles always push through the sheet material at the opposite

ends of the respective pressing element, thereby contacting and pushing through the stack the spaced end portions of the thread piece which is located beneath and being held in place by the pressing element. The center portion of the clamp to be formed continues to be held during this process by the pressing element.

It is usual procedure that the stack of sheet material layers is positioned on a conveyor belt or the like by which it is advanced in its predetermined path. According to the present invention such a conveyor belt may utilize an upper and a lower conveyor which engage the stack between them in order to transport the stack without slippage. However, in place of the belts it is of course possible to use endless chains, just as only a lower belt may be provided for support of the stack whereas the function of the upper belt may be taken over by the endless chain whose pressing elements engage and hold the respective thread pieces. This is all the more readily possible because the endless chain is advanced at the same speed and in the same direction as the lower conveyor belt supporting the stack. Such use can be further facilitated by providing on the contact or pressing elements friction-promoting surfaces which should remain clean at all times and which contact the stack.

The novel features which are considered as characteristic of 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 somewhat diagrammatic side view of an apparatus according to the present invention as seen from line I—I of FIG. 2;

FIG. 2 is a top-plan view of FIG. 1;

FIG. 3 is a fragmentary end view, on an enlarged scale, of FIG. 1 as seen in the direction of the arrow A in FIG. 1;

FIG. 4 is a fragmentary enlarged detail view of the detail shown in the circle IV of FIG. 1;

FIG. 5 is a fragmentary enlarged view of the detail shown in the circle V of FIG. 1;

FIG. 6 is a fragmentary enlarged view of the detail shown in the circle VI of FIG. 1;

FIG. 7 is a fragmentary plan view of an apparatus according to a further embodiment of the invention; and

FIG. 8 is a side view of the apparatus shown in FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing firstly the embodiment illustrated in FIGS. 1–6 it will be seen that the invention is described by way of example on hand of an arrangement or apparatus for stitching stacks of superimposed sheet materials which (irrespective of the previous treatment which they have received) are subsequently intended to be folded once more along the line of stitches which is formed on them. Thus, the output for instance of printing machines can be directly supplied to the novel apparatus, or it can undergo preliminary folding except for the final folding before it reaches the novel apparatus. It is emphasized, however, that the novel apparatus can also be utilized for stitching stacks of sheet materials which have already received the final fold but which must then, of course, be unfolded again and advanced on a proper support to the apparatus for stitching purposes.

Keeping this in mind, and now referring to FIG. 1, it will be seen that reference numeral 1 identifies two stacks of superimposed sheet materials which are to be continuously advanced in the direction of the arrow A, that is from the left towards the right in FIG. 1. These stacks move between a lower conveyor belt 2 and a cooperating upper conveyor belt 5 between the juxtaposed runs of which the stacks 1 are engaged and advanced. The lower conveyor belt is composed of belt portions 2*a*, 2*b*, 2*c* and 2*d* as shown in FIG. 3, which pass around axially parallel spaced rollers 3 and 4. The upper belt 5 is similarly constituted by belt sections 5*a*, 5*c* and 5*d* which are trained about upper rollers 6 and 7 and which are respectively in contact with the corresponding belt sections 2*a*, 2*c* and 2*d* of the lower belt 2. Suitable drive means (not illustrated because conventional) are provided which drive the rollers 4 and 7 at identical circumferential speed but in mutually opposite directions (compare the arrows in FIG. 1) so that the abutting runs of the belts 2 and 5 move in one and the same direction, namely towards the right in FIG. 1. Thus, the stacks 1 are transported between the belts 2 and 5 without slippage.

Upwardly of the belt section 2*b* an endless chain 8 is provided which is trained about sprocket wheels 9, 10 and 11 and rotates in the same direction and at the same speed as the adjacent belt sections 5*a* and 5*c*. The chain 8 is provided at identical distances with pressure springs 12 of springy sheet metal or other sheet material, which are so mounted that they will press above the belt sections 2*b* and 2*c* at the middle and along the so-called sealing line S—S (see FIGS. 2 and 3) lightly against the upper surface of the stack 1. The springs 12 which contact the stacks 1 thus move with the latter without performing any relative movement with repect to the stacks 1. A pressure rail or member 13 exerts a uniform pressure upon the support rollers of the chain 8 so that the latter cannot be deflected upwardly by the pressure of the stacks 1 against the springs 12. If desired, corresponding rails or members can also be provided along or laterally adjacent to the sealing line S—S beneath the stacks 1, that is beneath the run of the conveyor 2 which supports the stacks 1, in order to prevent the stacks 1 from being downwardly deflected at least at or in the region of the sealing line S—S.

Midway intermediate the ends of the roller 6 there is mounted in this embodiment a punching disc 14, and beneath it, also midway of the opposite ends of the roller 3 which is located below the roller 6, a cooperating counter disc 15, both being shown more clearly in FIG. 3. The disc 14 is provided on its periphery with a plurality of equiangularly distributed needles 14*a* which each enter into a corresponding small recess, aperture or groove 15*a* provided in the periphery of the cooperating disc 15. Thus, a stack 1 passing between the discs 14 and 15 into the space between the belts 2 and 5, is provided with apertures or perforations 1*a* (see FIG. 4) along the line S—S of FIG. 2, and these perforations 1*a* are so spaced from one another in the direction of elongation of the line S—S that any two consecutive perforations 1*a* have from one another a distance which cor-

responds to the length of the center portion of a clamp **25** (see FIGS. **5** and **6**). Any two consecutive perforations **1***a* are also spaced from one another in the direction of the line S—S by a distance which is somewhat greater than the elongation of the springs **12** in the same direction, it being understood that these springs **12** will subsequently engage the stack **1** intermediate the consecutive ones of the perforations **1***a*. This prepunching or perforating of the stack **1** is intended to facilitate the subsequent passage of two pushing members or needles **23** (see FIG. **5**) of a stitching device **22** through the stack **1**, which needles push the spaced opposite end portions of a thread of a thread piece through these apertures or perforations **1***a*. However, it is emphasized that such prepunching and providing of the apertures **1***a* can be omitted without in any way influencing the validity of the basic inventive concept.

Reference numeral **16** in FIG. **1** identifies a bobbin or similar supply of a thread **17** which in the illustrated embodiment is assumed to be of heat-sealable type, for instance a filament or a multi-filament covered with a thermoplastic material. A thread supply disc **18** withdraws the thread **17** from the bobbin **16** and a thread cutting device **19** cuts it into successive pieces **20** the length of which corresponds to the length required for forming a single clamp **25** as shown in FIGS. **5** and **6**. The severed thread pieces **20** are maintained in taut condition (see FIG. **4**) on the periphery of the thread supply disc **18** by engagement with clamping springs **21**, being so located that each piece **20** spans a recess **27** provided in the periphery of the disc **18**. The arrangement of the recesses **27** corresponds with the arrangement of the spring members **12** on the chain **8** in such a manner that, when the chain **8** and the disc member **18** are synchronously driven, there will always be one spring member **12** entering into a recess **27** of the member **18** before the thread **17** is tautened across the associated recess **27** and held in taut condition by the clamping springs **21** upon cutting from the remainder of the thread **17**.

The periphery of the disc member **18** rolls on the upper surface of the stack **1**, and this results in the position IV shown in FIG. **1**, which is illustrated in more detail in FIG. **4**. It will be seen that when the member **18** turns, the pressure spring **12**, which is located in its respective recess **27** and presses the thread piece **20** associated therewith against the surface of the stack **1**, will move along with the stack **1** in a straight line whereby the opposite end portions of the thread piece **20** are pulled loose from the clamping springs **21**. Because the spring **12** is located precisely over the middle portion of the thread piece **20**, as to hold the back of the clamp **25** midway between two apertures **1***a* in the stack **1** (if such apertures are previously provided, which is not necessary as already pointed out), continuous advancement of the stack with the thread piece **20** held thereon by the associated spring member **12** causes the thread piece **20** to reach a thread stitching device **22** of any desired construction. This is shown in FIG. **5** and it will be seen that here the two associated needles **23** push the end portions of the thread piece **20**, which project in opposite directions beyond the associated spring member **12**, through the aperture **1***a* (or form such apertures and push the end portions through them if apertures have not been previously prepunched). Moreover, the needles **23** do not perform any relative movement with respect to the continuously advancing stack **1**, but instead advance along with the stack **1**. This means that at the position V of FIG. **1** it is possible to use continuously rotating needle-carrying discs with controlled needles, or a parallel flange needle drive utilizing pairs of needles such as disclosed in one of the aforementioned copending related applications. The drawing clearly shows the somewhat wedge-shaped recesses in the free needle ends, which straddle the thread end portions.

In FIG. **5**, in which a device such as the one just mentioned above with respect to the copending application is utilized, the deepest penetration of the needles **23**, immediately before their upward movement for retracting purposes, is illustrated. By contrast, FIG. **1** shows the beginning of their movement into and through the stack **1**. It will be seen in FIG. **5** that when the needles **23** have reached the illustrated position, the end portions of the thread pieces **20** have been pushed through the perforations **1***a* by the needles **23** of the device **22**, whereby the thread piece **20** has been transformed into a stitch **25** whose configuration essentially resembles that of a conventional metal staple (clamp). The end portions **26** of the stitch **25** pass vertically through the stack **1**. On continued movement of the stack **1** the needles **23** move along with the same and are simultaneously withdrawn in vertical direction upwardly through and out of the stack **1**, with the form and position of the stitch **25** being maintained unchanged because the spring **12** continues to press the center portion of the thread piece **20** against the upper surface of the stack **1**.

In FIG. **6**, which illustrates the encircled portion VI of FIG. **1**, I have illustrated the beginning of the operating step at which the parts of the end portions **26** which project beyond the lower side of the stack **1**, are deflected into engagement with this lower side and sealed thereto. For this purpose there is provided beneath the stack **1**, coincident with the sealing line S—S, a heated sealing or bonding element **24** which is spring mounted or mounted for floating movement with very little spacing from the underside of the stack **1**. The edge portion **24***a* of the member **24** which faces oppositely the direction of advancement of the stack **1** is slightly inclined as illustrated, and as the projecting parts of the end portions **26** move against it, they are deflected in upward direction, and by contact with the heated material of the member **24** they are sealed against the underside of the stack **1**. Such sealing by heat is of course already well known and it is emphasized that sealing could also be effected in other manner, for instance by separately applying an adhesive. Once any one stitch moves in downstream direction beyond the member **24**, the material of the stitch can cool and finally the associated spring member **12** is lifted off the stitch due to the change in the direction of movement of the chain **8** as the latter passes around the sprocket **10**. Ultimately, the now stitched stack **1** is released by the belts **2** and **5** and can be received in a receptacle or can be passed on to other processing stations or user stations.

In FIGS. **7** and **8** I have illustrated one additional embodiment among the many which can be realized without departing from the scope and concept of the present invention. Here there are provided at opposite sides of the sealing line S—S, extending in parallelism with the same, two walls or plates **28** and **29**. Located intermediate these are the non-illustrated thread supply ar-

rangements, thread stitching arrangements and thread sealing arrangements which may operate in the same manner as previously described.

A toothed belt **30** which is endless is trained about two wheels **31** and **32** of which the latter is driven and journalled on the plate **28.** An equally long endless toothed belt **33** is trained about the wheels **34** and **35** of which the latter is driven and both of which are journalled in the plate **29.** The belts **30** and **33** are located at opposite sides of the sealing line S—S and in accordance with the present invention the journal bores for the wheels **31** and **32** on the one hand, and the wheels **34** and **35** on the other hand, are each spaced from one another by identical distances and located at the same level, but are offset longitudinally by a distance D (see FIG. 7) which corresponds to the length of the desired thread pieces, and therefore also to the spacing of the successive pressure-exerting elements which engage consecutive ones of the thread pieces.

A plurality of carrier bolts **37** extend through the gap defined between the upper and lower runs of the belt **30,** being spaced from one another at the aforementioned distance D, and similar bolts **38** extend through the gap defined between the upper and lower runs of the belt **33.** Spring carriers **36** are pivotably mounted on the bolts **37** and **38** and to these carriers **36** there is mounted by means of two rivets **39** a spring plate **40** which, as shown in FIG. **8,** presses each thread piece against the respective stack **1.**

In FIG. **8,** which is a side-elevational view of FIG. **7,** the plate **29** has been omitted for the sake of clarity. It will be appreciated that due to the coupling of the belts **30** and **33** via evenly distributed pivotable spring carriers **36** a drive of the belt **30** by means of the wheel **32** is sufficient to take along the belt **33.** During such movement the carriers **36** will always maintain (due to their pivotal mounting) the identical relative position in space. In FIG. **8** it is shown that each spring plate **40** will move vertically onto a thread piece **20** which is held spanning a recess **27** of a disc member **18** (as described with respect to FIG. **4**) and will press the thread piece against the upper surface of the stack **1** which in turn is advanced in the manner already described, for instance by means of the belt **26** shown in FIG. **8.**

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 of the type discussed, it is not intended to be limited to the details shown, since various modifications and structural 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 spirit 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 connecting superimposed layers of sheet material, in combination, advancing means for continuously advancing a stack of superimposed sheet material layers at a predetermined speed and in a predetermined path; supply means for engaging a thread and for moving the same at least intermittently at said speed; cutting means for severing at least one predetermined length of said thread per stack from the remainder of said thread, said length having spaced end portions engaged by said supply means and sharing said movement of the latter to a position along said path adjacent one major surface of said advancing stack; pressing means for pressing said length, when in said position, intermediate said end portions thereof against said major surface with a force sufficient to disengage said end portions from said supply means, said pressing means mounted mouned for movement at said speed in a different path having a path portion extending along said predetermined path in close proximity thereof so as to press said length against said major surface during said movement of said pressing means in said path portion; stitching means spaced from said supply means and adjacent said path portion and operative for engaging said end portions of said length and for pushing the same through said stack beyond the opposite major surface thereof; and sealing means located proximal to said predetermined path in the region of said path portion at said opposite major surface and operative for deflecting said end portions into contact with said opposite major surface and for sealing the former to the latter during the advancement of said stack in said predetermined path.

2. In an apparatus as defined in claim **1,** said advancing means comprising an advancing device having a surface supporting said stack and travelling in an endless path.

3. In an apparatus as defined in claim **2,** said pressing means comprising a pressing device comprising a plurality of sections which successively move towards said surface, travel with said stack thereon, and recede from said surface.

4. In an apparatus as defined in claim **3,** said supply means comprising a continuously rotating disc member having a periphery rolling on said one major surface of said stack and being provided in said periphery with a plurality of circumferentially successive recesses at least one of which is spanned by said length of thead, successive sections of said pressing device each entering into the respective recesses, and the section which enters into said one recess engaging and pressing said length of thread against said one major surface of said stack.

5. In an apparatus as defined in claim **1,** said stitching means comprising at least two pusher members each engaging one of said end portions and pushing the same through said stack.

6. In an apparatus as defined in claim **1,** said thread being heat-sealable; and wherein said sealing means comprises a stationary heated bonding element positioned for contact with said end portions during advancement of said stack, to thereby deflect said end portions into contact with said stack and heat-seal them thereto.

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