May 20, 1947. U. M. FALTER 2,420,660

MANIFOLDING ASSEMBLY

Filed May 28, 1941 2 Sheets-Sheet 1

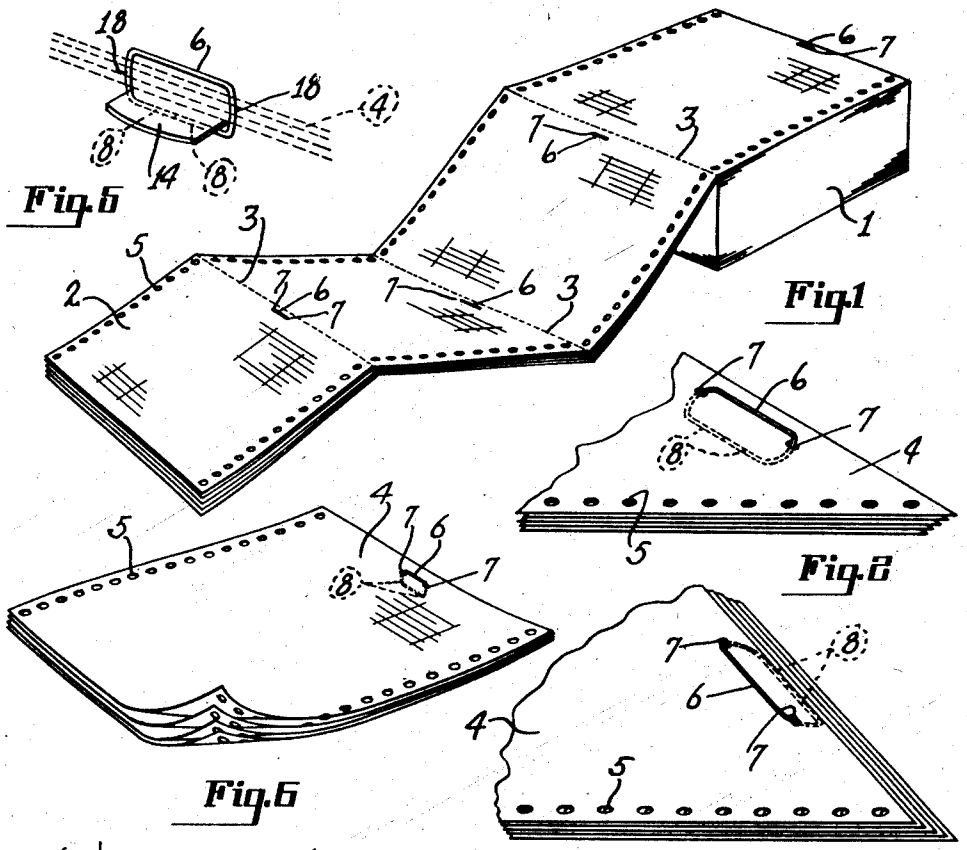


Fig. 5

Fig. 1

Fig. 2

Fig. 6

Fig. 3

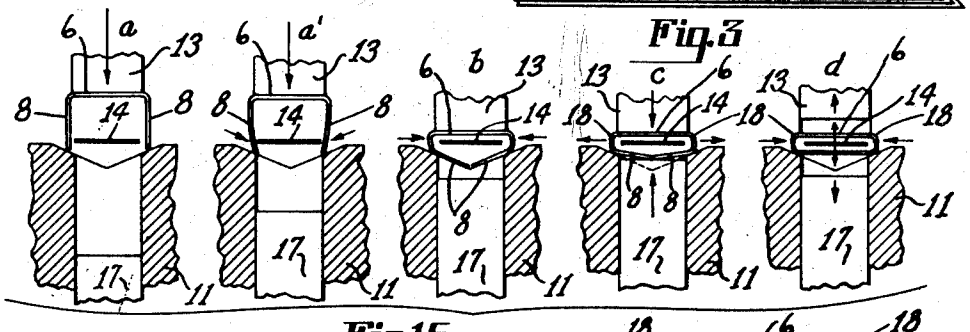


Fig. 15

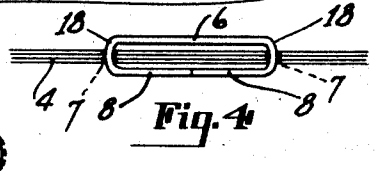


Fig. 4

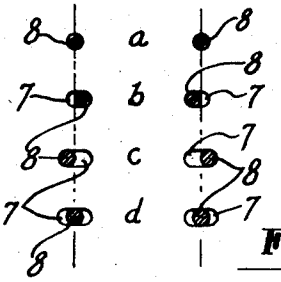


Fig. 14

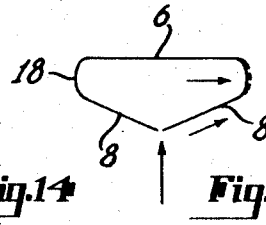


Fig. 16

INVENTOR
URBAN M. FALTER
ATTORNEY

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MANIFOLDING ASSEMBLY

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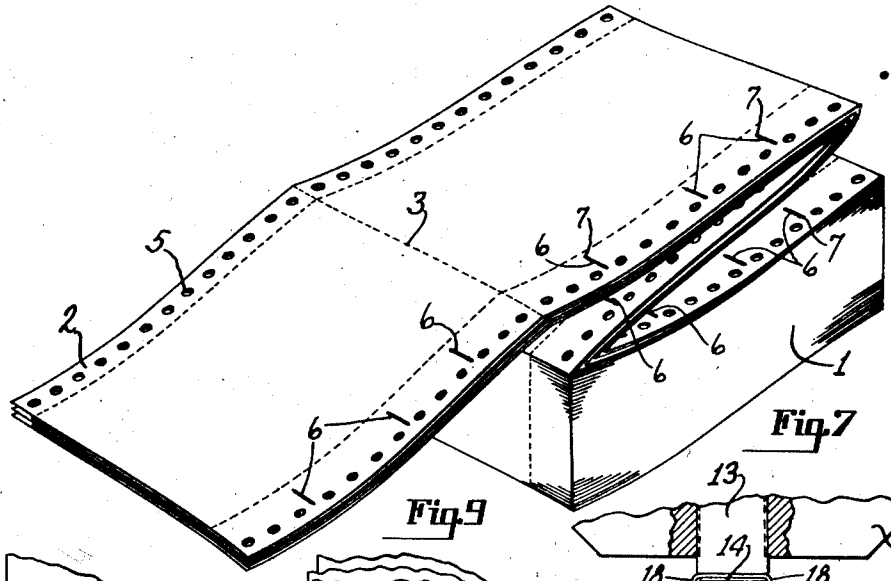


Fig.9

Fig.7

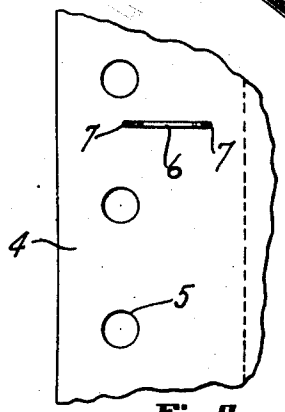


Fig.8

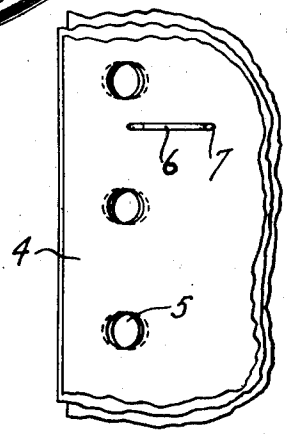


Fig.12

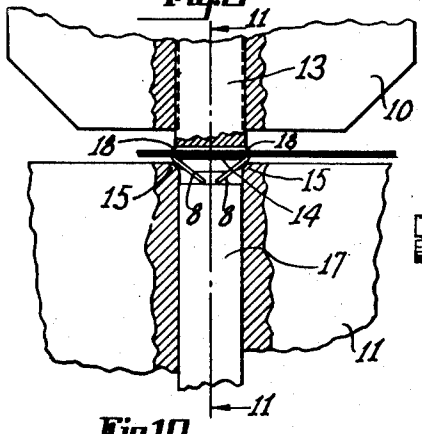


Fig.10

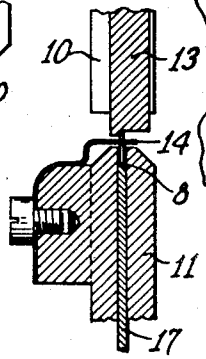


Fig.11

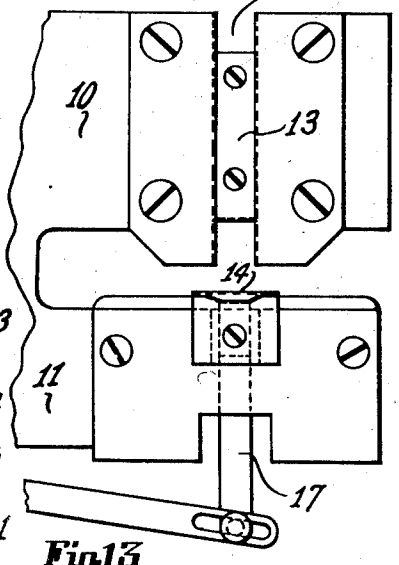


Fig.13

INVENTOR
URBAN M. FALTER
BY
ATTORNEY

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UNITED STATES PATENT OFFICE

2,420,660

MANIFOLDING ASSEMBLY

Urban M. Falter, Dayton, Ohio, assignor to The Standard Register Company, Dayton, Ohio, a corporation of Ohio

Application May 28, 1941, Serial No. 395,629

21 Claims. (Cl. 1—2)

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This invention pertains to manifolding assemblies of superposed sheets or strips, and more particularly to the method and means for loosely stapling the sheets or strips whereby they are held in grouped relation while permitting limited shifting adjustment of the sheets or strips, one relative to the other.

In modern commercial usage it has been found desirable to temporarily retain the sheets of a set or "book" of copies together after inscription, and after separation from a continuous supply of series connected detachable form stationery. It is also equally desirable that during the inscription operation the sheets or strips, as the case may be, shall be capable of limited shifting adjustment one relative to the other to enable accurate registry and alignment of imprinted forms thereon, and prescribed spaces and lines thereof to receive inscribed data, as the material is advanced into imprinting position.

Regardless of the care and skill with which the individual leaves or strips of manifolding material may be printed, it is found that they will not accurately register when superposed one on another. This is to some extent due to unequal expansion and contraction of individual sheets and strips incident to use of material of different weight, or different character and having different moisture absorptive capabilities. Even different portions of the same strip of material may expand and contract unequally due to different density thereof. Such condition may also arise from inaccuracies of manufacture or varying throw of the printing press. While such differential may be quite small in any one form length, the error is cumulative and in the course of feeding a large number of series connected detachable forms may eventually amount to as much as a full line space, causing entries made on a certain line of the original copy to appear upon a different line of the duplicate carbon copy. Even though the superposed record strips be exact duplicates throughout, further difficulty occurs in feeding such assembly about a platen roll or through an otherwise unaligned path wherein the outermost strip must traverse a greater distance than accompanying strips, and due to such differential travel the forms thereon become out of registry or alignment. To overcome the difficulty it is necessary that the superposed strips or sheets of an assembly be capable of slight relative shifting movement by which registry and alignment may be constantly maintained.

To enable automatic progressive adjustment of

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the sheets or strips, the material is punched with successions of marginal feed holes, or with holes at the ends of the succeeding forms, which holes are in definite relation with the imprinted matter upon each sheet or form. Such holes are then utilized by feeding and registering or aligning devices by which the superposed sheets are automatically shifted as the inscription receiving areas approach writing position, to bring corresponding holes of the different sheets into registry, thereby simultaneously registering the imprinted matter and the inscription receiving lines and spaces of different sheets or leaves of the set.

For subsequent inscribing operation and other commercial purposes, it is found equally desirable that the corresponding sheets or leaves containing an original and plural duplicate copies of inscribed material shall be temporarily held together after their initial inscription and after their detachment from continuous supply strips of such sheets or leaves. This has usually been effected by wire staples inserted through the leaves or strips and clenched at one or more points in each form length or set of sheets.

The stapling of the sheets or strips together heretofore has been tightly effected and the relative movement thereof unduly restricted. The necessity for relative shifting movement to maintain registry and alignment, and the desirability of holding the sheets together have been somewhat antagonistic to each other. Heretofore when it is required that the sheets or strips be stapled together at intervals, accuracy of registry has been sacrificed, or wrinkles and slack are permitted to form in the strips causing "treeing" or objectionable marks on the duplicate copies.

The problem has been herein solved and the antagonistic influences harmonized by making the staple sufficiently long and the holes in the forms amply large and the coupling of the superposed sheets of a set of forms sufficiently flexible as to permit the limited adjustment thereof necessary to maintain registry of the imprinted matter, and still retain the collective interconnection of the sheets or leaves in sets or groups. By the present method sufficient looseness is effected to enable lateral adjustment of the strips as well as longitudinal movement.

While especially desirable for marginally or terminally punched manifolding assemblies adapted to special registering feed mechanisms, it is to be understood that the present method of loose coupling and wobble staple attachment may be also applied to imperforate sheets for

manifolding and for other purposes, which are frictionally fed or otherwise presented at record receiving position, all within the scope of the present invention.

The object of the invention is to improve the construction as well as the means and mode of interconnecting the sheets of manifolding assemblies, whereby they will not only be held securely together, but will possess sufficient freedom for relative adjustment to enable registry and alignment of imprinted matter, and which may be economically manufactured and be efficient and convenient in use.

A further object of the invention is to provide apparatus and a mode of operation by which staples may be loosely engaged in superposed plies of material.

A further object of the invention is to provide a form of coupling staple which is capable of wobble movement to inclined relation with the plane of the sheets and which is of sufficient extent to permit adjustment of the sheets relative to the staple.

A further object of the invention is to insert a coupling staple in an assembly of forms in such manner as to afford limited lateral adjustment thereof.

A futher object of the invention is to provide a manifolding assembly and the means and mode of attaching the sheets thereof possessing the advantageous structural features and inherent meritorious characteristics herein mentioned.

With the above primary and other incidental objects in view as will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation, or their equivalents, as hereinafter described or illustrated in the accompanying drawings.

Referring to the accompanying drawings,

Fig. 1 is a perspective view of a packet of series connected detachable stationery forms embodying the present invention.

Fig. 2 is an exaggerated perspective view of a fragmentary portion of a manifolding set of leaves or sheets showing the coupling staple in a recumbent position and the sheets in echelon formation.

Fig. 3 is a similar exaggerated view showing the staple and sheets disposed in relations reverse of those illustrated in Fig. 2.

Fig. 4 is an exaggerated elevational view showing the relation of the staple and the set of leaves or sheets interconnected thereby.

Fig. 5 is a detail view illustrating the method of stapling the sheets or leaves.

Fig. 6 is a perspective view of a set or book of leaves or sheets.

Fig. 7 is a perspective view of a pack of manifolding material wherein the attachment staples are disposed along one margin of the assembly.

Figs. 8 and 9 are detail plan views showing the staple and sheets in different positions of transverse adjustment.

Figs. 10 and 11 are respectively a front view and a vertical sectional view of the stapling machine showing the staple in an intermediate stage of formation.

Fig. 12 is a detail view showing the staple at the completion of the forming operation.

Fig. 13 is a front elevation of the stapling apparatus.

Fig. 14 is a diagrammatic view of successive stages in the relation of the staple and sheet assembly.

Fig. 15 is a diagrammatic view illustrating successive stages of the staple formation.

Fig. 16 is a stress diagram of the staple during the closing operation.

Like parts are indicated by similar characters of reference throughout the several views.

In the drawings there is shown a packet 1 of zig-zag folded superposed strips 2 of series connected detachable form stationery, such as is ordinarily provided for commercial writing and imprinting machines such as typewriters, tabulators, addressing machines and analogous mechanisms. The superposed strips are divisible at longitudinally spaced intervals on transverse weakened severance lines 3, into a succession of sets or books 4 of leaves or sheets such as shown in Fig. 6. In the present instance the strips comprising the packet are shown provided with successions of marginal holes 5 for engagement of a pin type feeding device by which the strips are advanced and their imprinted matter registered and aligned.

Each set of superposed detachable sheets or leaves is transfixed by a staple 6 which holds the strips together before detachment of the sets of sheets and continues to hold the sheets of each set of leaves together after detachment from the supply strips.

Staples have heretofore been employed for interconnecting manifolding strips and sheets. However, the usual practice has been to clench the staples tightly upon the engaged plies of material and increase the gripping engagement of the staple by contracting the inturned ends thereof into close relation with the material. In at least one instance an attempt has been made to enable limited shifting motion of the strips or sheets by providing preformed holes 7 therein of greater size than the diameters of the staple legs, through which the legs of the staple project.

In such case the range of relative longitudinal adjustment is quite restricted, being limited to the difference in size of the staple holes and the legs of the staple therein, which is insufficient for practical purpose.

In the present instance the legs of the staple are manipulated during the stapling operation to enlarge the holes through which they pass and thereby provide clearance for lateral adjustment of the sheets. A shim or spacer is temporarily enclosed within the staple during its formation, and the staple is subsequently disengaged therefrom, to insure an oversize staple, the ends of which are inturned in aligned relation.

Such enlarged staple of greater depth than that of the assembly being positioned in enlarged holes in the sheets, permits ample degree of freedom to permit longitudinal offset movement of the sheets necessary to maintain accurate registry of the printed matter thereon during the feeding and inscribing operations. Interconnected continuous form stationery is ordinarily superfolded into zigzag packs. The folding of succeeding strips, one inside another, causes an offsetting or misalignment of the strips while in the pack, which, if resisted by a tightly clenched staple, or one which too greatly restricts longitudinal adjustment, tends to buckle or distort and eventually tear the material. Such offsetting or displacement incident to folding is amply accommodated by the present mode of stapling. The looseness of the staple, together with its in-

creased depth, enables it to assume an acute angular relation with the sheets approaching parallelism, which facilitates feeding the strips and staples through friction rollers or other feeding devices, and catching of the staples on other sheets or with each other is minimized.

In the present instance the legs 8 of the staples are materially longer than the thickness of the collection of leaves or strips, and the ends of the staple legs are inturned in aligned relation substantially parallel with the plane of the sheets or strips.

The strips or sheets are thus loosely held together and the plies of material and the staple are slidingly adjustable relative to each other within the range of the staple legs. The legs of the staple are sufficiently long that the plies of material may be either collectively slid to and fro on the staple legs, or the individual plies or sheets may be shifted on the staple legs relative to other plies or sheets. Although retaining the strips or sheets in assembly and preventing their separation, such excess size of the staples enables the staples to wobble to and fro into recumbent positions approximately parallel with the planes of the strips or sheets, as is shown in Figs. 2 and 3. Such recumbent positions of the staples permits the strips or sheets to be individually adjusted along the staple legs whereby the respective sheets or leaves may be made to terminally extend one beyond another in echelon formation as also shown in Figs. 2 and 3. In addition to enabling relative shifting adjustment of the sheets or strips in parallel planes, the capability of the staples to assume such recumbent positions greatly facilitates their passage through a writing or imprinting machine or around a writing machine platen.

The capability of the strips for sliding movement, one relative to another upon the legs of the staples, enables the adjustment of the strips through ample range to maintain alignment and registry of the imprinted matter upon superposed strips or sheets.

In loosely attaching the strips or sheets by insertion of the staples, a spacer member 14 is temporarily inserted beneath the strips, about which the legs 8 of the staple are inturned in spaced relation with the plane of the strips, or the clenching anvil may be provided with a sheet supporting elevation intermediate the forming surfaces for the ends of the staple, whereby the ends of the staple are inturned in spaced relation with the plane of the sheets.

While it is customary to provide marginally punched manifolding material in a zig-zag folded packet as shown in Figs. 1 and 7, the present improvement is in no way dependent thereon, and such form is shown for illustrative purpose only and not with intent to in any way limit the scope or application of the invention.

While various mechanisms and other methods may be employed for inserting the staples and simultaneously enlarging the holes through which the staple legs project to afford clearance, there is shown in Figs. 10 to 13 a suitable mechanism for this purpose.

The staples may be either preformed and suitably fed to the stapling apparatus, or a continuous wire may be advanced sufficient distance at each operation and the extremity of the wire severed and formed into a staple 6. The stapling apparatus includes an overhanging head portion 10 in spaced relation with an anvil 11, between which the assembly to be stapled is advanced.

The head is provided with a guide way 12, having grooves in its inner faces through which the staple 6 descends under influence of a driver plunger 13.

Overhanging the anvil 11 in the path of the staple is a spacer shim or finger 14, the width of which substantially agrees with the space between the legs of the staple 6, and over which the sheet or strip assembly is positioned.

As initially thrust through the sheet assembly in straddle relation with the underlying spacer shim 14, the legs 8 of the staple are straight and parallel as shown at *a* in Fig. 15. The sheets are punctured thereby with holes 7 corresponding with the size and spacing of the staple legs as at *a* in Fig. 14. As the descending staple is forced through the sheets by the driver 13, its extremities engage shallow grooves in the beveled or rounded shoulders 15 of the anvil and are directed inwardly, effecting an initial inward bowing of the legs 8 of the staple, as is indicated at *a'* in Fig. 15. As the descent of the staple under pressure continues, the legs 8 finally assume convergent relation as indicated at *b* in Fig. 15. At the completion of downward movement of the driver 13, the forming shoulders 15, engaging closely to the juncture of the legs 8 with the transverse head of the staple, exert compressive influence which tends to turn or bend the legs slightly inwardly adjacent to the juncture, thus starting rounded ends of the completed staple. Such inward contraction or compression exerts lateral pressure upon the holes 7, causing them to be slightly enlarged inwardly as shown at *b* in Fig. 14. The staple legs are preferably, but not necessarily, of such length that when bent to converging relation, as at *b* in Fig. 15, they will terminally abut, one upon the other. However, it is found that such proportion is not essential, and that they may be slightly shorter whereby they will approach quite closely but will not touch each other in their final clenched relation.

Within the anvil 11 is a vertically moving clenching plunger 17, which is elevated in timed sequence against the converging ends of the inturned legs 8 of the staple. In the event that the ends of the legs are in abutting contact, they exert a toggle action under the pressure of the clenching plunger 17, whereby outward or expanding pressure is exerted upon the lateral bends of the staple, which pressure being transmitted to the outer sides of the holes 7, causes such holes to be outwardly enlarged, as is indicated at c in Fig. 14.

The completion of the ascent of the clenching plunger 17 completes the clenching of the legs of the staple under pressure beneath the spacer shim or finger 14. The latter is thus enclosed within the clenched staple, and limits the final positions of the legs to aligned relation with each other. It is found that even though the legs 8 do not exert outward toggle pressure, but in final position merely approach closely without direct contact the opposing clenching pressures of the plunger 17 and driver 13 by vertically compressing the lateral bends 18 of the staple, tend to expand the staple transversely to cause such outward enlargement of the holes 7.

It is preferable however, but not necessary, that the ends of the staple legs abut while in converging relation, since in such event they are tightly pressed together in their final position so there is no visible intervening crevice and the staple cannot catch on others or on the edges of other sheets.

Finally after the driver 13 and clenching plunger 17 are retracted and the staple withdrawn from the spacer shim 14, relieving the clenched staple from strain, the inherent resiliency of the staple material causes the staple to slightly expand vertically and coincidentally contract laterally, whereby the lateral bends 18 of the staple assumes positions in mid length of the enlarged holes or slots 7, as shown at *d* in Fig. 14. This enables any one or more of the sheets of the assembly to be relatively shifted within the limits of the enlarged holes 7, as is indicated in Fig. 9.

The spacer shim 14 having been enclosed within the loop of the closed staple during the forming and clenching operations, and subsequently withdrawn therefrom by the advancement of the sheet assembly relative thereto, the staple is materially deeper than the thickness of the sheet assembly. As the latter advances to the next staple position, and the staple is drawn off the spacer shim or finger 14, the sheets are freed for shifting adjustment relative to the staple and each other, both vertically and laterally, but are nevertheless loosely held thereby.

The staple is then free to assume a recumbent position wherein the sheets may slide on the staple into overlapping or echelon relation. Such freedom enables the superposed sheets to be shifted relative to each other, as may be necessary to maintain accurate registry of imprinted matter thereon during inscription, yet are securely held together in sets or books after inscription, and after separation from supply packs thereof.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute, the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise the preferred form of several modes of putting the invention into effect, and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described my invention, I claim:

1. In a stapling apparatus for loose sheets, a staple driving device for thrusting the legs of a staple through a sheet assembly in substantially parallel relation, a removable spacer member disposed in the path of the staple and straddled thereby simultaneously with its engagement with the sheets, a forming die engaged by the staple legs beyond the sheet assembly tending to bend the legs of the staple toward each other and enclose therein the spacer member, said forming die operating upon further advance of the staple to contract the spacing between the staple legs coincident with the sheet assembly and thereby inwardly enlarge the holes in the sheet assembly through which the legs are thrust, means for applying closing pressure to the staple in a direction perpendicular to the sheet assembly by which the staple is laterally expanded and thereby outwardly enlarge the holes through which the staple legs are thrust, the resiliency of the staple being sufficient to effect a partial lateral contraction of the staple upon release of pressure whereby the staple will assume a position medially of the enlarged holes in the sheet assembly, the subsequent withdrawal of the spacer and staple one from the other enabling relative movement of the staple and sheet assembly both perpendicular to and in the plane of the latter.

2. The herein described method of stapling a sheet assembly, including thrusting the legs of a staple fastener through the sheet assembly, inturning the legs of the staple beyond the sheet assembly inwardly, enlarging the holes in the sheet assembly through which the staple bends extend by contracting the staple in the plane of the engaged sheet assembly, outwardly enlarging the holes in the sheet assembly through which the staple bends expand by subjecting the staple to laterally expanding influence, and permitting the staple to return to untensioned condition under inherent resilience thereof to position the staple bends medially within the enlarged holes.

3. The method of stapling a sheet assembly, including thrusting the legs of a staple through a sheet assembly in substantially parallel relation with each other, closing the staple by bending the staple legs each toward the other, and successively expanding and contracting the formed staple in the plane of the sheet assembly to enlarge in opposite directions the holes in the assembly formed by thrusting the staple legs therethrough.

4. The herein described method of stapling a sheet assembly including the steps of forming spaced holes in a sheet assembly by thrusting the legs of a staple therethrough and subsequently contracting and expanding the staple substantially in the plane of the sheet assembly and thereby inwardly and outwardly enlarging the original holes formed in the sheet assembly by the staple legs.

5. In a stapling apparatus for loose sheets, a driver for thrusting the legs of a staple through a sheet assembly in substantially parallel relation, a spacer member disposed in the path of the staple and straddled by the legs thereof simultaneously with engagement of the staple with the sheet assembly, and a former for clenching the staple about the spacer and enclosed portion of the sheet assembly, the spacer and staple being subsequently disengageable, the construction and arrangement being such that the sheets will be loosely held within the staple and the latter will be capable of limited movement perpendicular thereto and to a recumbent position inclined to the plane thereof.

6. In a stapling apparatus for sheets, a driver for thrusting the legs of a staple through a sheet assembly, a former with which the legs are engageable for closing the staple and a spacer member initially enclosed within the closed staple and subsequently disengageable therefrom, the construction and arrangement being such that the closed staple is of greater depth than the thickness of the sheet assembly.

7. A sheet assembly, a staple loosely interconnecting the sheets, of greater depth than the thickness of the assembly, and holes in the sheets of larger size than the legs of the staple, the construction and arrangement being such that the staple and sheets are relatively adjustable both perpendicular to and in the plane of the sheets.

8. In a stapling apparatus for a sheet assembly, a driver for thrusting the legs of a staple through

an assembly of sheets, a forming anvil against which the staple is driven for directing the legs of the staple inwardly, a spacer interposed between the driver and anvil over which the sheet assembly is disposed in stapling position and about which the legs of the staple are inwardly directed, the spacer being subsequently disengageable therefrom by relative movement of the sheet assembly and spacer.

9. The method of stapling a sheet assembly, including thrusting the legs of the staple through the sheet assembly, bending the staple legs into terminally engaging converging relation beyond the sheet assembly and applying pressure to the apex of the converging staple legs whereby the legs will be caused to exert a toggle action in changing from converging to aligned relation while exerting expansive influence upon the staple.

10. In a stapling apparatus for a sheet assembly, a driver for thrusting the legs of a staple through an assembly of sheets, a support overlaid by the sheets and straddled by the staple, and clenching means for forming the legs of the staple against the under side of said support into aligned relation with each other.

11. In a stapling apparatus for a sheet assembly, a driver for thrusting the legs of a staple through an assembly of sheets, forming means for inturning the legs of the staple beyond the sheets, pressure means for bending the inturned legs of the staple into aligned relation, and a positive stop member against which the inturned legs are pressed, arresting the bending movement when the legs are aligned with each other.

12. In a stapling apparatus for a sheet assembly, a driver for thrusting the legs of a staple through an assembly of sheets, a fixed support for the sheets straddled by the staple, forming means for inturning the staple legs beyond the fixed support, and a pressure device for forcing the inturned legs of the staple against the under side of the support which is thereby enclosed within the loop of the staple, said support being operative to arrest the inturned legs in alignment with each other.

13. The herein method of loosely stapling superposed sheets of material including thrusting the legs of a staple through the sheets interposing a spacer within the confines of the staple, clenching the staple thereabout, and disengaging the staple and spacer one from the other.

14. The herein described method of loosely stapling superposed sheets of material, including thrusting the legs of a staple through the sheets and thereby forming holes therein and laterally expanding the staple subsequent to insertion thereby enlarging the holes.

15. The herein described method of loosely stapling superposed sheets of material including thrusting the legs of a staple through the sheets thereby forming holes therein, and changing the relative spacing of the sheet engaging portions of the staple within the holes subsequent to their insertion, thereby enlarging the holes.

16. The herein described method of loosely stapling superposed sheets, including thrusting the legs of a staple through the sheets, contracting the legs of the staple into converging relation wherein they terminally abut on each other, and

applying pressure to the legs by which they are brought into substantial alignment and by toggle action thereof laterally expanding the initial spacing of the staple legs in the holes, thereby enlarging the holes.

17. The herein described method of loosely stapling superposed sheets of material including thrusting a staple through an assembly of sheets thereby forming spaced holes therein, initially contracting the spacing of the legs under pressure, whereby the holes are enlarged inwardly each toward the other, applying pressure to the contracted staple, by which the staple is caused to laterally expand.

18. The herein described method of loosely stapling an assembly of superposed sheets whereby the individual sheets thereof will be free for limiting shifting motion one relative to another, including thrusting the legs of a staple through the sheet assembly, clenching the legs of the inserted staple in spaced relation with the engaged sheet assembly by which the loop formed by the engaged staple will be of materially greater depth than the thickness of the sheet assembly, and effecting relatively lateral shifting movement of the engaging staple and the sheet assembly in the plane of the latter to enlarge the holes in the sheet assembly through which the staple extends.

19. The herein described method of loosely stapling an assembly of superposed sheets, including thrusting the legs of a staple through the sheet assembly, inserting a spacer within the staple, clenching the legs of the staple upon the sheet assembly and spacer collectively and subsequently removing the spacer, thereby affording to the staple greater depth than the thickness of the sheet assembly.

20. The herein described method of loosely stapling an assembly of superposed sheets, including engaging a staple through holes in the sheet assembly of greater size than the thickness of the staple legs engaged therein, and clenching the legs of the staple in such relation as to form a loop of greater depth than the thickness of the sheet assembly.

21. The herein described method of loosely stapling an assembly of superposed sheets, including engaging a staple through registering holes in the sheet assembly of greater size than the staple legs, and clenching the staple to form a loop of greater depth than the thickness of the sheet assembly, and disposing the staple in inclined relation to the plane of the sheet assembly by offsetting the individual sheets of the sheet assembly.

URBAN M. FALTER.

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