United States Patent

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[54] **VAGINAL SPECULUM**
14 Claims, 13 Drawing Figs.

[52] **U.S. Cl.** **128/17**
[51] **Int. Cl.** **A61b 1/32**
[50] **Field of Search** 128/20, 3, 341, 354; 16/191; 81/341, 356, 364; 128/17, 18, 19, 321, 345

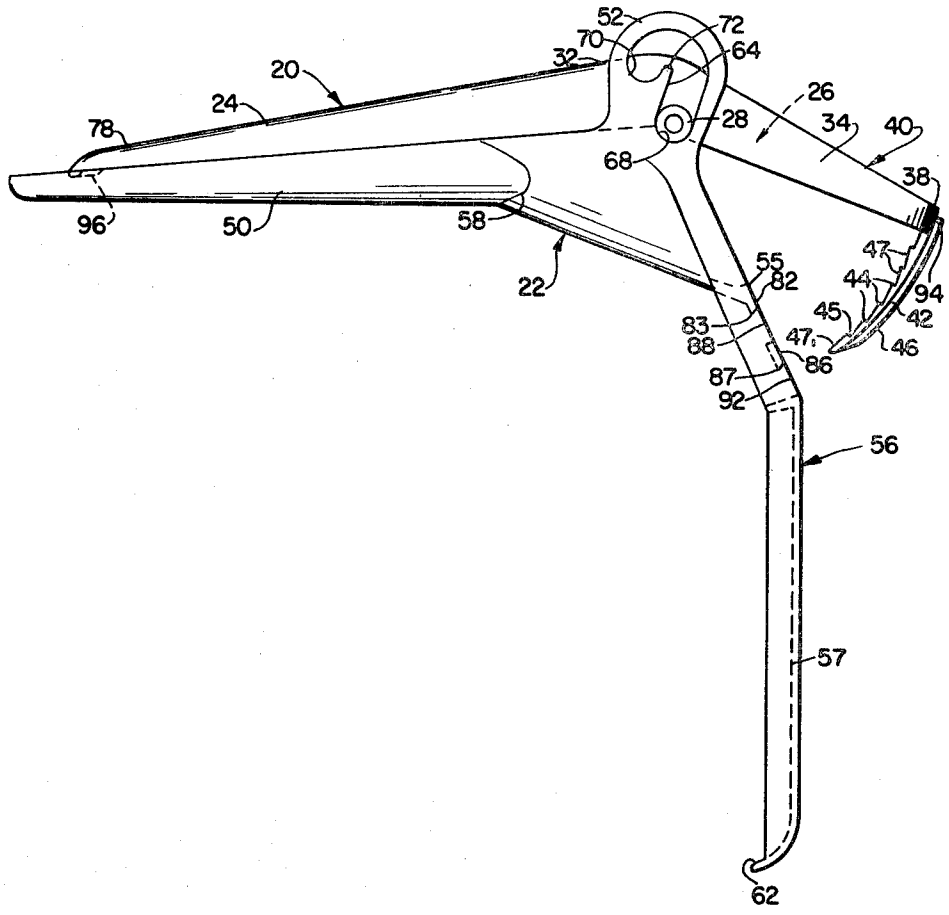
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3,332,414 7/1967 Gasper 128/17

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ABSTRACT: A disposable two-piece, plastic vaginal speculum with variable proximal end openings and multiple distal end opening adjustments. The blades are pivoted on a shiftable hinge structure at their proximal ends and the anterior bladepiece has an operating lever with a depending integral trigger latch having latching teeth on the side facing the blades. The posterior bladepiece includes a handle and slotted side ears which receive trunnions on the anterior blade and permit the hinge shift. Openings in part of the handle provide latch abutments for the teeth on the trigger latch. The trigger latch and blade lever have inherent resilience providing flexing to permit ratcheting of the latch teeth past a latch abutment when distal blade ends are pivoted to open position and the trigger latch is urged by the integral resilience to its latched condition. The trigger latch is manually flexed toward the rear by the operator to close the blades.



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SHEET 1 OF 3

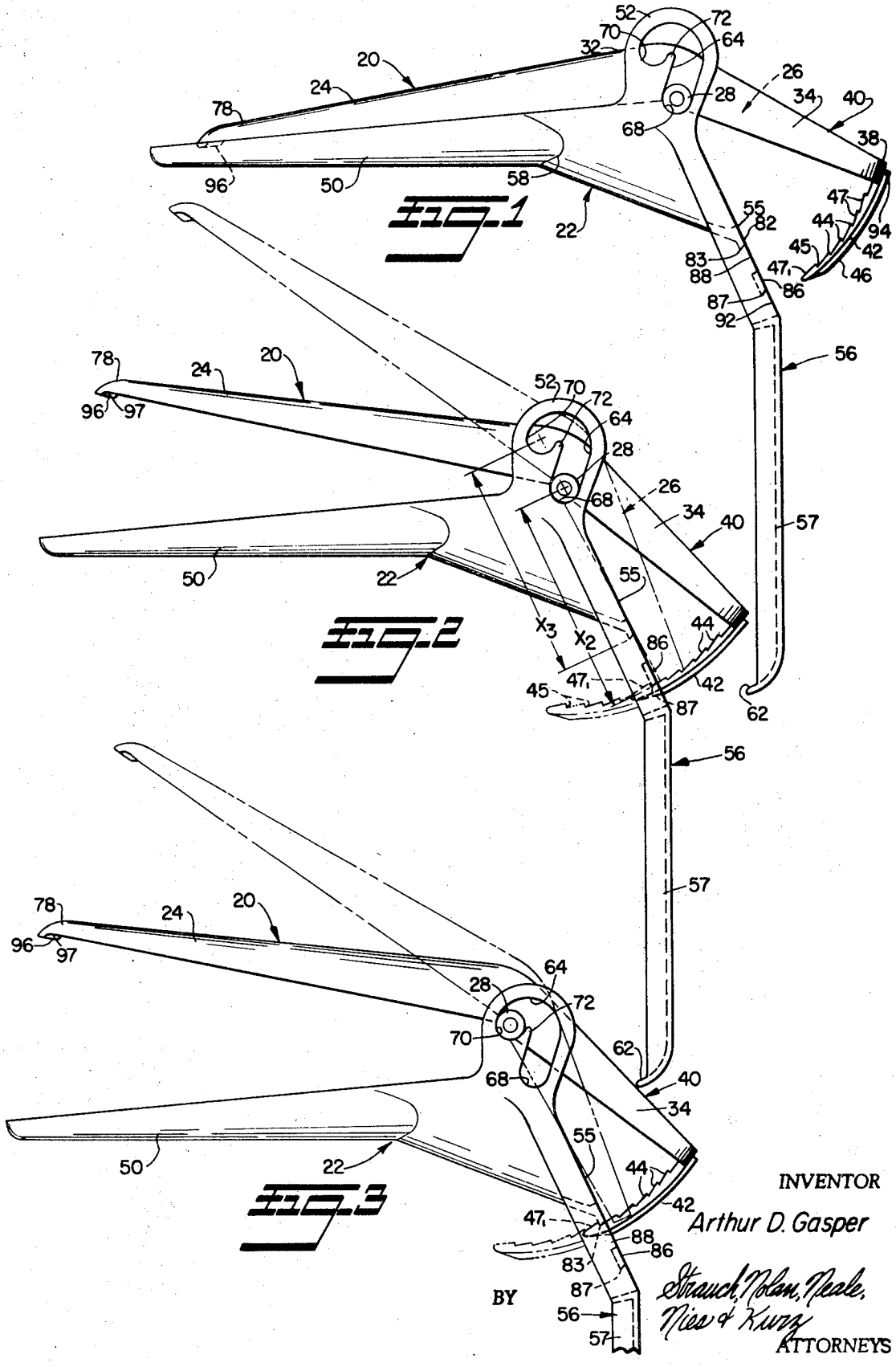


Fig. 1

Fig. 2

Fig. 3

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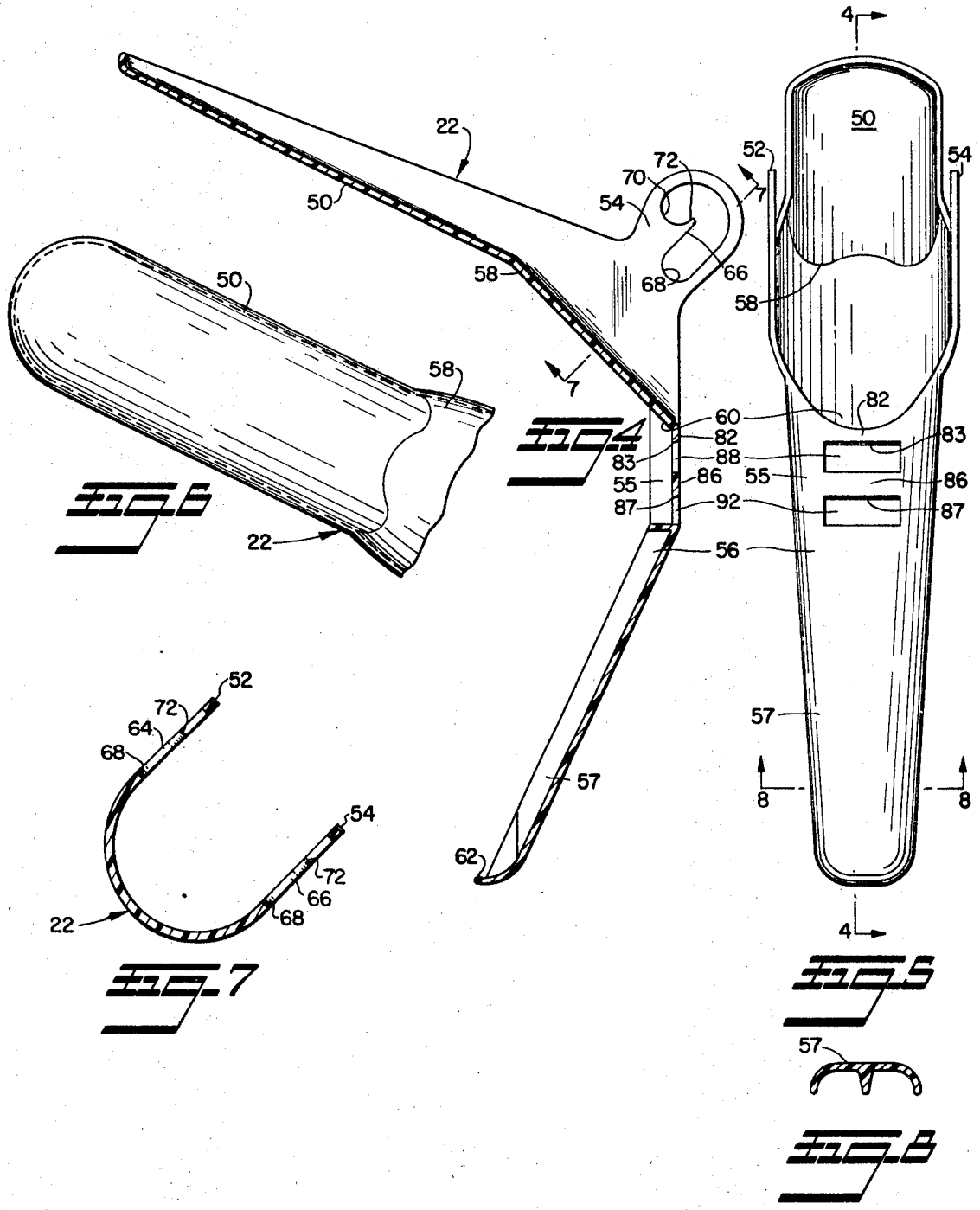


FIG. 6 FIG. 4 FIG. 7 FIG. 5 FIG. 8

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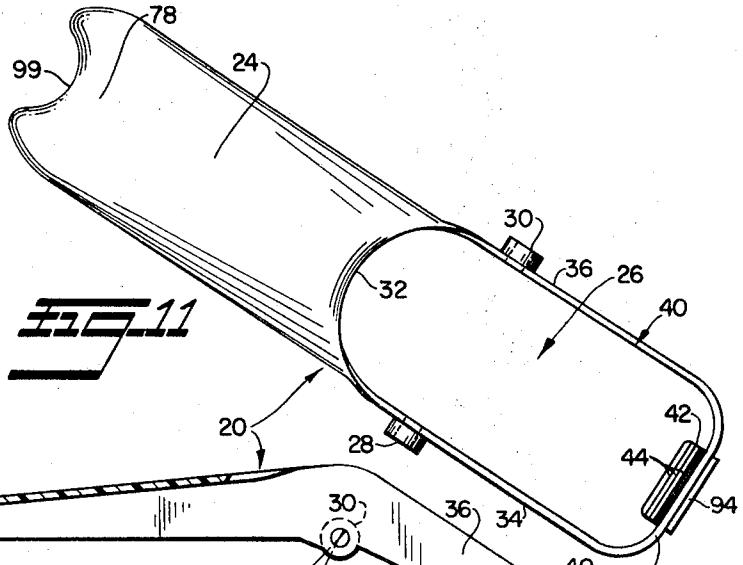


FIG. 11

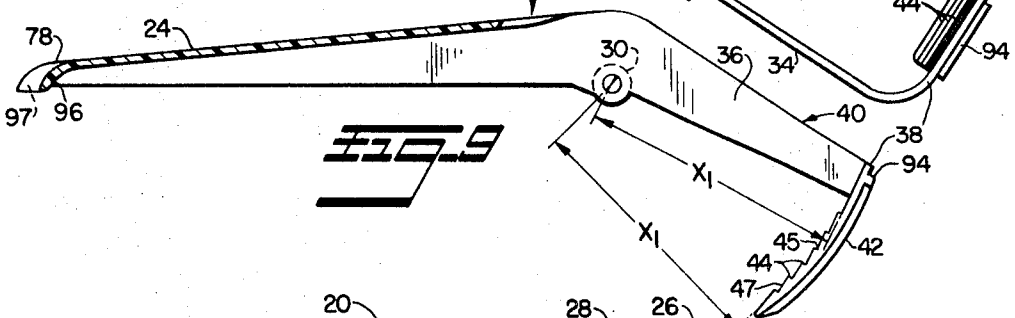


FIG. 9

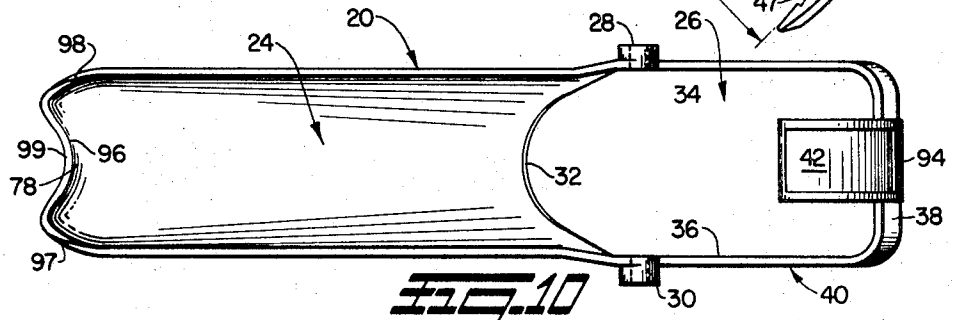


FIG. 10

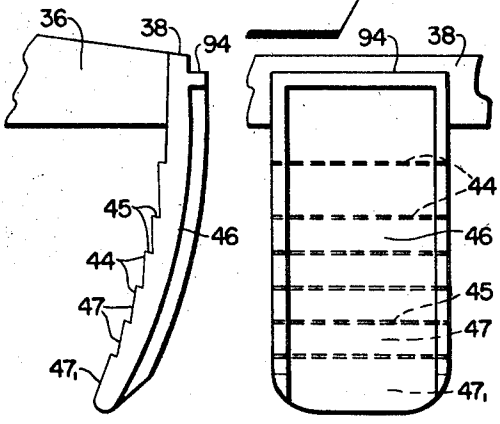


FIG. 12 FIG. 13

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VAGINAL SPECULUM

CROSS-REFERENCE TO RELATED PATENT

The invention disclosed and claimed in the present application is an improvement of applicant's Pat. No. 3,332,414 issued July 25, 1967.

BACKGROUND OF THE INVENTION

This invention relates to a surgical instrument, a speculum, for examining body orifices or cavities and more particularly to a vaginal speculum of simple construction providing a wide range of adjustability and ease of operation and manipulation. The speculum can be inexpensively made of two pieces molded from plastic and economically permits disposal of the speculum after use.

The basic principal of the prior patent, in other words, a construction which enables both proximal and distal blade end adjustments while in use and at the same time utilizing common simple latching components to lock the two different adjustments, is also utilized in the present invention. The primary improvement over applicant's previous disposable speculum is in a revision of the location and operation of the hinging and latching components. In this invention the latching coaction is made to occur positively without reliance upon pressure placed on the two blades by the vaginal sphincter muscles during use.

SUMMARY OF THE INVENTION

Accordingly a primary object of the present invention resides in the provision of an improved disposable speculum of simple two-piece construction.

An additional object resides in the provision of an improved speculum of simple construction providing reliability and ease of access through the speculum and requisite proximal and distal end adjustment during use.

Still another object resides in the provisions of an improved two-part speculum incorporating plural latching adjustments of both proximal and distal end opening dispositions of the blades, such adjustments, control and manipulation being readily made with one hand by the operator.

A still further object resides in the provision of an improved speculum in which the distal end of the anterior blade includes an operating lever incorporated with an access opening and having a trigger latch dependent therefrom with latching teeth facing the blade end, the latch teeth coacting with centrally located apertured latch abutment structure integral with a handle at the proximal end of the posterior blade. In conjunction with this object, a further object resides in providing the latch abutment apertures in an upper planar portion of the handle disposed at an obtuse angle to the posterior blade enabling minimum distal projection during use of the depending trigger latch and at the same time projecting the remaining major handle portion at approximately 90° relative to the posterior blade to enable more accurate and better manipulation by the operator.

Further novel features and other objects of this invention will become apparent from the following detailed description, discussion and appended claims taken in conjunction with the accompanying drawings showing a preferred structure and embodiment, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the assembled speculum in fully closed position;

FIG. 2 is a side view of the speculum with the proximal end disposed in a latched lowermost adjustment position, phantom lines illustrating the extent of distal end travel to its maximum latched adjustment position;

FIG. 3 is a view similar to FIG. 2 but showing the proximal end adjustment in its upper adjustment position, the full lines of the anterior blade illustrating the smallest of the latched distal end open positions and the phantom lines showing the maximum distal end opening;

FIG. 4 is a side section view taken on line 4–4 of FIG. 5, showing the posterior bladepiece, the one which includes the handle;

FIG. 5 is an elevation view of the speculum piece in FIG. 4 looking in a direction normal to the latching abutment aperture platform at the upper end of the handle;

FIG. 6 is a broken-away partial plan view looking at FIG. 4 in a direction normal and into the trough of the posterior blade;

FIG. 7 is a section taken on line 7–7 of FIG. 4, through the hinge ears of the posterior bladepiece;

FIG. 8 is a section taken on line 8–8 of FIG. 5 and illustrates the cross section shape of the handle;

FIG. 9 is a side section view of the second speculum piece, the one which includes the anterior blade, the proximal access opening, the operating lever and the depending trigger latch;

FIG. 10 is a plan view of the anterior bladepiece of FIG. 9, looking up into the trough of the blade;

FIG. 11 is a plan view of the piece shown in FIG. 9, looking in a direction normal to the plane of the proximal opening through the lever assembly of the anterior blade;

FIG. 12 is an enlarged side view showing details of the trigger latch details; and

FIG. 13 is an enlarged rear elevation view of the trigger latch shown in FIG. 12.

With general reference to FIGS. 1, 4 and 9, the exemplary bivalve speculum is a vaginal speculum made of two separable parts or members 20 and 22. For convenience in the description, the blade end will be designated as the front and the handle end will be the rear. Each part is capable of being molded as a single structurally integral piece, preferably made from hard, clear nontoxic high-strength plastic such as polystyrene.

All FIGS. are scale drawings with FIGS. 1—11 of the original patent drawings depicting the parts in full size with contours to accomplish satisfactory and economically feasible, injection-molded fabrication of an actual operable speculum. The two parts as depicted have actually been molded in an automatic injection-molding machine. Using FIG. 4 the full size scale of a speculum which has been made according to this invention can be determined by using 7⅛ inches as the dimension from blade tip to the end corner of the handle.

Turning to FIG. 11, member 20 includes the anterior blade 24 with the proximal access opening or throat 26 and integral pivot studs or trunnions 28 and 30, one on each side of throat 26. The throat 26 is defined by integral extensions of the proximal end 32 of the anterior blade, the sides of which extend as two sideplates 34 and 36 which project at a slight downward angle and away from the pivot studs to a curved joinder portion or bight 38, which serves as a thumb rest at the end of the operating lever structure 30 and is the bottom of the proximal throat 26.

Operating lever 40 is used to accomplish both the proximal blade end and distal blade end position adjustments, as will be described. Depending with an arcuate curvature, from the bottom of lever bight 38 is a relatively wide rigid latching lug 42 (trigger latch) with a plural number (six) of inclined teeth 44 extending forwardly toward the pivot studs from an arcuate backface 46 of the latch lug. The rear face 46 of the latch lug and the bottoms of the teeth are on arcuate surfaces about the axis of the pivot studs 28 and 30. The top, latching faces 45 (see FIG. 12) of each of the teeth 33 should fall on a plane through the axis of the studs. The lower, or camming faces 47 of the teeth are inclined at about 20° to the arcuate latch lug face, enabling ease in ratcheting of the teeth into desired adjusted positions past a selected bar on the handle of the posterior bladepiece, as will be hereinafter described.

The lateral cross section shape of the latch lug 42 is channel-shaped, the two side ribs of which provide rigidity to the lug. The relatively thinner throat (operating lever walls) permit a flexure of the entire lug to permit ratcheting to various latched positions and thereafter resiliently bias the latch lug to a latched condition under its latch bar.

Turning to FIG. 4, posterior member 22 includes the posterior blade 50, two side journal arms 52 and 54 and a handle 56. The major extent of the posterior blade 50 is troughlike with a slightly changing cross section, the upper edges of the blade sides lying in a common plane from adjacent the distal end to the journal arms. Starting a short distance ahead of and progressing to a location behind the journal arms, the posterior blade has a proximal end flare 58. At the termination 60 of the posterior blade flare, an integral platform portion 55 (upper part of handle 56) of the posterior member 22 extends, at about a 45° inclination to the top of the blade, the major handle portion 57 progressing, after another 45° of inclination, in other words at approximately a 90° angle from blade 50, to terminate in a finger stop 62 on the underside of the handle.

Journal arms 52 and 54 each have identical undulated slot-forming apertures 64 and 66, the slots being of substantially constant width and substantially parallel with each other. The two arms serve as a journal yoke, the pair of slots 64 and 66 receiving the pivot studs 28 and 30 on the anterior member and with the sides of the proximal end of the anterior blade 24 embraced between the slotted arms. The two arms 52 and 54 can be flexed apart sideways sufficiently to enable the two pieces to be assembled as a unit.

The forward edge (the edge closest to the distal end) of each undulated slot consists of a plurality (two being illustrated) of journal sockets 68 and 70 formed on essentially the same radius of curvature as the pivot studs 28 and 30 but just enough oversize to permit a close but free fit of the studs within the respective sockets, as well as along the slots. The curved abutment projection 72 which is seen between the two sockets 68 and 70 has sufficient length to ensure full substantially 180° seating of the studs in the upper sockets 68 when the widest proximal end adjustment is made, and their termini as a part of the sidewalls of the slots are curved to permit smooth shifting of the two pivot studs from one set of sockets to the other set, which can be accomplished as long as the speculum is not latched.

FIG. 4 will show that the center points of the circular bottoms of sockets 68 and 70 lie on a common plane passing along the top surface of the upper handle platformlike section 55. So constructed, the upper faces 45 of the latch lug teeth 44 have the same relationship to that common plane, regardless of which set of journal sockets receive the journal studs.

Referring to FIGS. 4 and 5, the upper platform section 55, of handle 56 has an open center grid with two spaced-apart, laterally extended cross ledges (or bar) 82 and 86 each of which has a sharply formed lower rear edge. The openings 88 and 92 adjacent the rear edge of each cross ledge are shaped to receive and permit substantial free passage of the wide arcuate latch lug 42 on the anterior member operating lever 40 (see FIGS. 2 and 3) when the pivot studs 28 and 30 are fully seated in a pair of the journal ear sockets 68 or 70. With studs 28 and 30 located in the pair of lower sockets 68 (see FIG. 2) and the anterior member operating lever is depressed by pressure on thumb rest 38, the arcuate latch lug 42 can move down through the lower handle opening 92; and with the studs in upper sockets 70 (see FIG. 3) the lug 42 can move down through the upper handle opening 88.

The adjustment positions of the proximal ends of the blades, can be set while the distal ends are closed in which condition the latch lug 42 is not projected into a latch opening in the handle. Thereafter, depression of the lever structure 40, which varies the distal end opening of the speculum, pivots the anterior blade about the axis through the selected pair of sockets in which the studs were placed and in effect spreads the blades. At the same time, the arcuate latch lug 42 descends into an associated one of the latch bar openings in the handle. As soon as the tip of lug 42 reaches the selected handle opening 88 or 92, its lowermost inclined tooth face 47_1 engages the rear edge of a latch bar 82 or 86 and flexes rearwardly until the first tooth snaps under the latch bar. At this stage the pivot studs 28 and 30 will be effectively locked in their selected sockets, i.e., they can not shift to another set of sockets as long as the lug 42 cooperates within a handle hole.

The rear lines of the upper faces 45 of all of the lug teeth 44, i.e., the corners at the base of adjacent teeth, are equidistant (see X, in FIG. 9) from the common axis of studs 28 and 30. Also, the distance X_2 (see FIG. 2) from the center point of the lower sockets 68 to the lower latch bar's lowermost edge line 87 and the distance X_3 (see FIG. 2) from the center point of the upper sockets 70 to the upper latch bar's lowermost edge line is accurately made equal to the distance X_1 between the studs and base corners of the latch lug teeth. The aforedescribed structural relationship, as well as the close but free fit of the studs in the slots, should be carefully maintained and will enable the desired adjustments.

Now looking at FIG. 2, the journal studs are disposed in the lowermost sockets 68 and, when the operator by pressing with his thumb on the lever assembly thumb rest 38 causes the anterior blade to open by pivoting about the journal studs, the end of the latch lug 42 projects into the lower one 92 of the handle latch abutment openings. As has been described, the inclined face 47_1 the first tooth 44, engages the slightly inclined back edge of latch bar 86. Thereafter, slight downward pressure on the thumb rest causes the inclined tooth face to slide along the back edge of latch bar 86 and due to the camming action of the inclined face of the lowest tooth 44, the latch lug must shift in a direction away from the sockets. The studs, being snugly seated in the lower sockets 68, cannot shift along with the latch lug 42 but the lug must shift relative to the studs in order that its tooth 44 will ratchet past the edge of bar 86. The lug 42 is intentionally made rather rigid, to avoid undesired breakage, so it tends to undergo a pivotal or swinging shift which will be permitted by slight flexing of the sidearms 34 and 36 and the bight 38 which serve as the operating lever 40. As soon as the first tooth 44 passes beyond the rear lower edge line 87 of bar 86, the latch lug returns under bias to its normal disposition because of the resilient reflex action of the operating lever, whereupon the upper surface 45 of the tooth is disposed with a snap action under the latch bar 86. At this stage, the first distal end blade adjustment is latched and at the same time the disposition of the proximal end in the bottom sockets 68 is effectively secured or locked. This latter aspect occurs because the studs 28 and 30 cannot shift in the slots 64 and 66 because to do so they must move in direction away from the handle latch bars and since the lug is latched behind bar 86 the studs will be maintained against the bottoms of the sockets 68.

While so retained in the smallest proximal adjustment setting, i.e., the lower set of sockets 68, the operating lever can be depressed in successive steps from the first latched condition through the latched disposition of the remaining five latch teeth 44, enabling six different distal end opening adjustments, for each of which the lug and operating lever flex to permit ratcheting of the teeth from one position to the next. The depth of the teeth in the actual construction is 0.020 inch for the top tooth and 0.030 inch for the lowermost tooth.

The latch lug 42, or trigger latch as it may be designated, can be released from its latched condition in each of the six positions by the operator's hooking his forefinger in front of the lower end of the lug which projects through the handle latch abutment hole and pulling it back with a slight pressure. This action, permitted by resilient flexing of lever 40, removes any tooth 44 which is latched under the edge 87 and permits the latch lug to freely move up and out of the opening 92 as the distal ends of the blades, during actual use are urged toward their closed condition by action of the vaginal muscles.

If a larger proximal end opening is desired necessary, the operator, after insertion of the completely closed speculum (FIG. 1) into the vagina, with his thumb can exert an upward pressure on the lateral ridge 94 at the rear and top of the latch lug 42 causing the pivot studs 28 and 30 to slide upward along the rear portion of the slots. As the studs are slid along the slots they pass in a curved path over the midprojections 72 and, due to pressure of the vaginal sphincter muscles, slip

down into seated condition in the upper pair of sockets 70, as shown in FIG. 3.

With the proximal end set for the larger open position of FIG. 3, distal end opening adjustments can be made in a similar manner to that described for FIG. 2 excepting that the latch lug 42 will now pass into the uppermost opening 88 in the handle and its teeth 44 latch under the bottom edge 83 of bar 82. Six latched distal end openings are possible in the large proximal end opening condition, the sixth position being shown by phantom lines in FIG. 3. As with the smaller proximal setting, once any latch lug tooth 44 latches under the bar 82 the studs 28 and 30 are effectively locked in the selected upper sockets 70. The studs cannot move out of the sockets 70 without shifting in a direction moving away from the handle and disposition of the latch lug 42 behind latch bar 82 will effectively block movement of studs out of socket 70 and over the midportion 72. The normal action of the vaginal muscles urges the blades toward each other and will tend to seat the studs in the selected sockets 70 regardless of the distal opening adjustment. As in the smaller proximal setting, the speculum can be closed by the operator's unlatching the lug 42, i.e., pulling the lug to the rear and permitting closure of the distal ends of the blades. The proximal end opening can then be changed back to the smaller opening or the speculum can be readily withdrawn without changing the proximal adjustment.

As shown in FIG. 1, when the speculum is fully closed, the lower side edges of the anterior blade 24 rest on the side edges of the posterior blade 22, all edges being smoothly rounded and disposed essentially in a common plane. Because there is some intentional resilience in the journal yoke arms 52 and 54 and because of the desired shiftable relationship of pivot studs 28 and 30 in the undulated slots 64 and 66, when the proximal opening position is not latched, the distal end 78 of the anterior blade has a slight freedom to shift sideways. Such distal end sideplay is not desirable for proper and satisfactory insertion techniques. To eliminate such sideplay, small blunt teeth (not shown), as is taught in U.S. Pat. No. 3,332,414, could be formed integral with the lower surface and adjacent each side of the anterior blade's distal end 78, the teeth depending into the trough of the posterior blade 50 to effectively interlock the abutting distal ends of the two blades and prevent sideplay while the speculum is closed. In the present speculum the structure to accomplish the closed distal end interlock relationship has been incorporated in the terminal edge lip portion 96 of the anterior blade 24 which depends below the plane of the anterior blade side edges. The depending side ends 97 and 98 of the depending end lip 96 with the end lip itself fit into the trough of the posterior blade 50 to effectively interlock the abutting distal ends and prevent the undesirable sideplay while the speculum is fully closed and during insertion.

The depending end lip 96 of the shorter anterior blade will be slightly seated into the posterior blade trough behind and below the posterior distal end edge which, by virtue of the underlapped profile, enhances ease of insertion.

The present disclosure incorporates a concave recess 99, see FIGS. 10 and 11 in the distal end 78 of the anterior blade 24, as was taught in U.S. Pat. No. 3,332,414 to permit an opening movement of the anterior blade to be made without appreciable contact and pressure against the cervix.

The foregoing description fully discloses a speculum specifically adapted for use as a vaginal speculum with the following desirable features, it being understood that similar structure can be used in specula for other body orifices. Insertion, rear or proximal opening adjustment made after insertion, the distal blade opening, and complete positive biased latch clamping, all can be readily accomplished by using only one hand. By use of but a single hand, convenient distal blade end closure under control of thumb with continuous subsequent complete closure and removal by the same single hand is easily accomplished. Novel multiple proximal and distal end adjustment construction with positive biased latching by a single coordinating proximal and distal end lock is provided. The instrument is conceived and constructed to provide a practical vaginal speculum, capable of being molded from plastic and permitting manufacture at a price enabling the speculum to be thrown away after a single use.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

I claim:

1. A speculum having two separable parts with a dilatory blade on each part and cooperating shiftable hinge means on one adjacent set of ends of said blades; said hinge means enabling selective separate separation adjustment of both the proximal and distal ends of said blades and providing means confining hinging movement to a specific fixed axis while in each of a plural number of proximal end adjustment positions; and locking means consisting of engaging portions on said separable parts for connecting said parts and operative to prevent a shifting of the proximal blade end adjustment as long as distal blade ends are effectively separated and, in association with said hinge means, to accomplish latching of adjusted distal ends in separated disposition, the portions of said locking means which accomplish latching including interengaging members spaced from said hinge means and located on both parts, interengaging members on one of said portions constituting latching devices which ratchet past an associated interengaging member on the other of said portions while shifting about the associated selected axis of said hinge means; and said engaging portions being resiliently flexible relative to each other, relative flexing of said portions being required to permit ratcheting of said interengaging members during opening of, and to release latched engagement of said members to permit closing of the distal ends of the blades with said hinge means in each proximal end adjustment position.

2. A speculum with two dilatory blades and cooperating shiftable hinge means structurally integral with said blades on one adjacent set of ends of said blades constituting, in use, the proximal ends of the blades, which hinge means in assembly enables separate selective separation adjustment of both the proximal and distal ends of said blades and provides means confining hinging movement to a specific fixed axis while in each of a plural number of proximal end adjustment positions; a handle provided on a first one of said blades; a lever structure provided on a second of said blades enabling manipulation of said hinge means for a plurality of independent opening adjustments of both the proximal and distal ends of said blades in a selective manner; and locking means for connecting said blades and operative to prevent proximal blade end adjustment as long as the distal blade ends are effectively separated and, in association with said hinge means, to accomplish latching of the adjusted distal ends in separated disposition; said locking means comprising portions of both said handle and said lever structure constructed to provide resilient flexibility relative to each other, said two portions including cooperating latch parts; said latch parts on one of said portions ratcheting past the latch parts on the other of said portions during distal end opening movement of said blades in selected proximal end adjustment positions to enable said two portions to be placed into resiliently biased interlocked and latched engagement upon effective distal end blade opening adjustment; relative flexing of said portions being required to permit ratcheting of said latch parts during opening of, and to release latched engagement of said latch parts to permit closing of, the distal ends of the blades with said hinge means in each proximal end adjustment position.

3. A speculum as defined in claim 2, wherein said cooperating latch parts comprise latch abutments on one of

said portions and a resiliently biased trigger latch on the other of said portions always resiliently urged into a latching engagement disposition with an abutment when the distal ends of the blades are effectively opened.

4. A speculum as defined in claim 3, wherein the end of said trigger latch, in any latched condition constitutes a projection accessible to an operator and the trigger latch can be flexed relatively to, and away from, said hinge means to thereby release the latched condition and permit blade closure.

5. A speculum as claimed in claim 2, wherein said hinge means interconnecting said first and said second blades comprises: a bifurcated portion integral with the proximal end of one of said blades providing substantially parallel, elongate and spaced-apart side ears, each ear including a plurality of bearing sockets disposed at different positions along said ears, each bearing socket in one ear having an associated similarly disposed bearing socket in the other ear; said proximal end of said other blade includes trunnions on opposite sides thereof adapted to be selectively shifted between and into bearing engagement with associated pairs of similarly disposed sockets, and said locking means, when activated maintains said trunnions seated with a close free fit in the selected pair of sockets.

6. A speculum as claimed in claim 5, wherein each of said plurality of bearing sockets in each ear constitutes a closed end slot, one edge of which closest to the blade is undulated, the bottom of the undulations constituting said sockets and at least one rise of the undulation in said one edge constituting a merged curved abutment between sockets.

7. A speculum as claimed in claim 6, wherein the sidewalls of adjacent sockets merge to provide said curved abutments and said abutments project away from said locking means.

8. A speculum as defined in claim 2 wherein the end of said lever structure which is spaced from said hinge means carries a toothed latch lug projecting toward said handle; a multiplicity of latch abutment edges are provided on said handle, separate ones of which are adapted to be engaged individually by all teeth on said lug depending upon the proximal opening setting of said shiftable hinge means and upon selective distal end adjustment movement; said lug and any selected latch abutment edge on said handle being relatively resiliently urged to coact with each other and maintain said two blades in adjusted positions of proximal opening and in adjusted positions of distal opening by resiliently biased latching engagement of a tooth on said lug with an edge of the selected latch abutment edge on said handle.

9. A speculum as claimed in claim 8, wherein said teeth face toward said trunnions and are spaced along said lug in a circular arc about the axis of said trunnions; and separate apertures through said handle provides each of said latch abutment edges.

10. A speculum as claimed in claim 9, wherein said handle portion extends outwardly and rearwardly from said first blade at an obtuse angle to provide a platform area containing said latch abutment apertures and a major portion of said handle extends from said platform area at an angle of approximately 90° to said first blade.

11. A speculum as defined in claim 1 wherein each part is a structurally integral piece of injection-molded nontoxic, high-strength hard plastic material.

12. A speculum as defined in claim 5, wherein two thin flexible spaced-apart sidewalls extend rearwardly from said trunnions; said sidewalls join in a rear bight; an integral toothed latch lug projects down from said sidewall joinder; a multiplicity of latch abutment edges are provided on said handle, separate edges of which are adapted to be engaged individually by the various teeth on said lug depending upon the proximal opening setting of said shiftable hinge means and upon selective distal end adjustment movement; the teeth on said latch lug face toward said trunnions; and said thin flexible sidewalls provide the relatively resilient biasing of the cooperating latch parts.

13. A speculum as defined in claim 12, wherein said sockets have circular bottoms, separate apertures through said handle provide each of said latch abutment edges, and all of said edges and the axes of all pairs of sockets are parallel and lie in a common plane.

14. A speculum as defined in claim 13, wherein each pair of sockets is associated with a specific latch abutment edge, the distances from the axis of each pair of sockets to its associated latch abutment edge are equal, the edges of all lug teeth are parallel with the axis of the trunnions, and spaced from said trunnion axis a distance slightly less than the said distance from a pair of sockets to an associated latch abutment edge.