Oct. 30, 1962 J. C. RUSH 3,060,924

APPARATUS FOR APPLICATION OF RADIO-ACTIVE SUBSTANCE TO PELVIC CANCER

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FIG. 1.

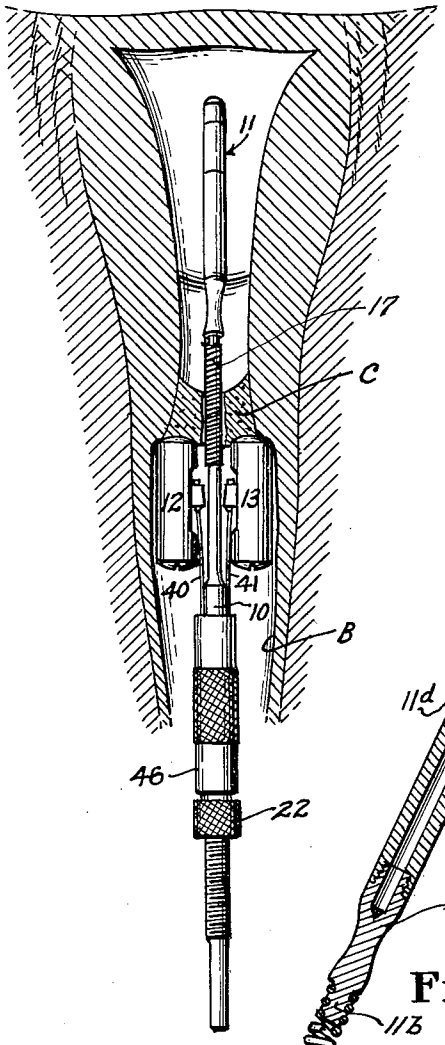
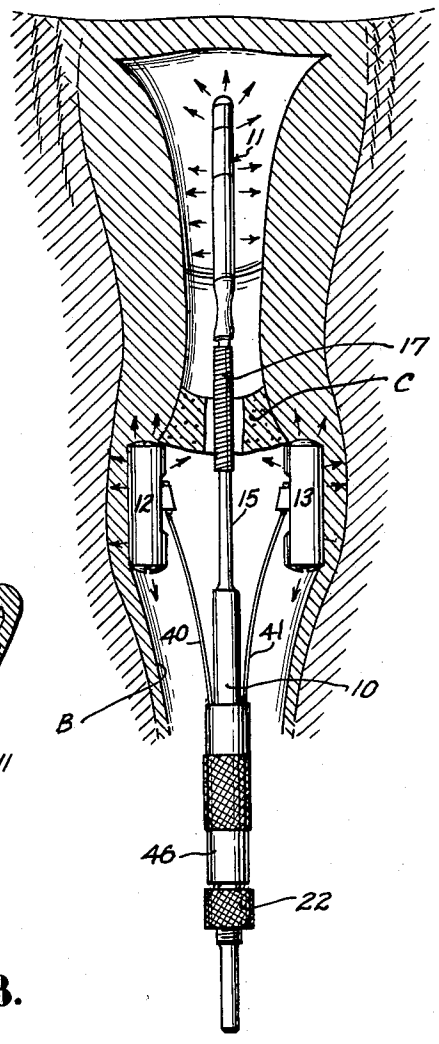


FIG. 2.



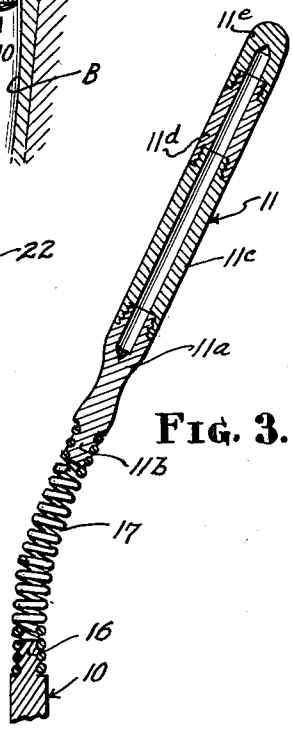


FIG. 3.

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FIG. 4.

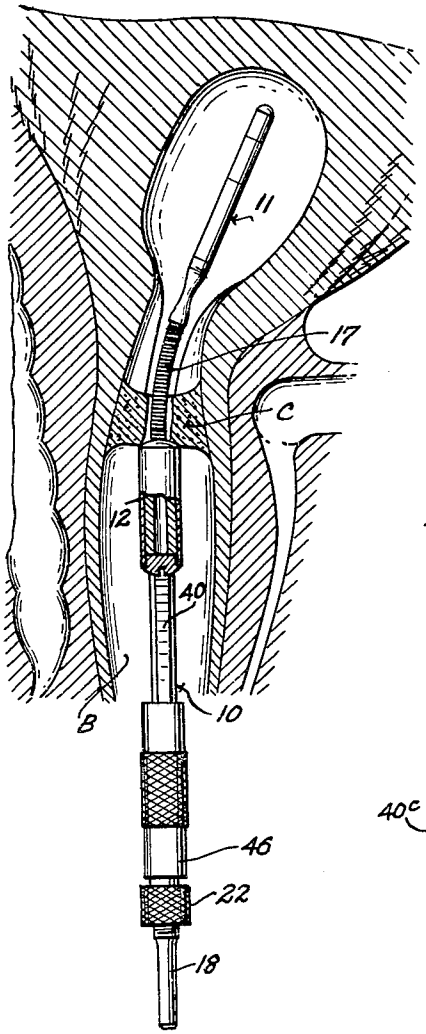

FIG. 5.

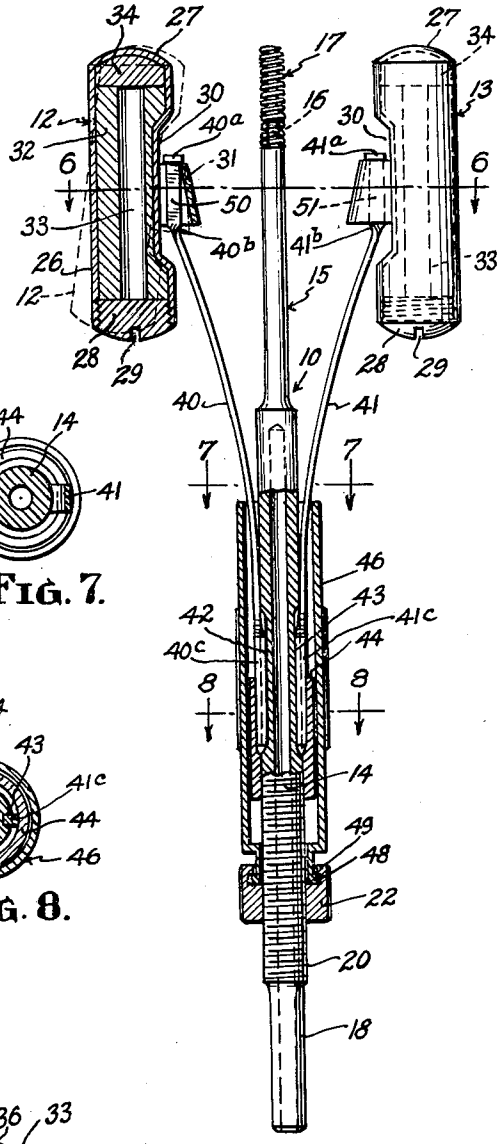

FIG. 7.

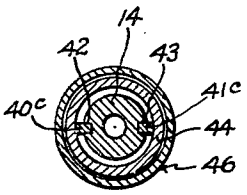

FIG. 8.

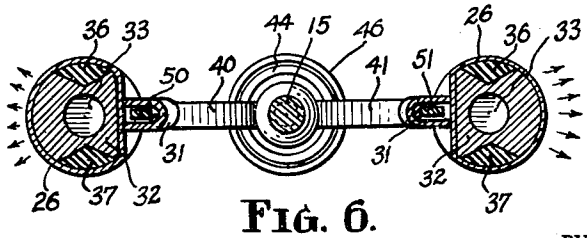

FIG. 6.

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United States Patent Office

3,060,924
Patented Oct. 30, 1962

3,060,924

APPARATUS FOR APPLICATION OF RADIO-ACTIVE SUBSTANCE TO PELVIC CANCER

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Filed June 1, 1960, Ser. No. 33,282
3 Claims. (Cl. 128—1.2)

The present invention relates to an improved apparatus for applying radio-active substances within the body, such as the cervical-vaginal cavities.

The principal object of the invention is the provision of an improved apparatus for relatively easily positioning radio-active substances within the uterus and vaginal tract so that the most effective dosages can be applied to the affected areas, such as the cervix, while shielding unaffected areas, such as the colon, bladder and urinary tract, from detrimental radiation and to maintain the radio-active substances in the required position with little or no discomfort to the patient.

In the preferred form of the invention, a shank-like structure is provided which may be inserted into the vaginal tract and extended into the uterus, and which carries on its leading end one or more containers or pods of radio-active material which are supported or attached to the shank by a flexible connection, preferably in the form of a tightly coiled spring having a given angular bend conforming to normal disposition of the uterus relative to the vaginal tract but sufficiently flexible so that the angular disposition of the radio-active substance container relative to the shank proper can shift according to the particular disposition of the organs involved.

Another object of the invention is the provision of an apparatus for applying radio-active substances to body cavity walls comprising a shank preferably carrying a pair of capsules or pods containing radio-active material, each supported on the outer end of an arm alongside of the shank, which arm is resiliently urged outwardly from the shank to position the radio-active material adjacent to the cervix, means being provided on the lower part of the shank for actuating the arms to move the pods toward the shank to facilitate the insertion and removal of the applicator from the patient and to regulate the outward thrust of the arms so that the lateral pressure of the pods against the walls of the body cavity can be controlled.

Still another object of the invention is the provision of an improved radio-active material applicator of the type described in which the capsules or pods carried on the arms are pivotally attached thereto whereby they can shift positions to accommodate more readily to the particular body cavity contour. Preferably, the capsules are cylindrical and are attached to the arms so that their axes extend generally parallel to that of the shank, thereby minimizing displacement of body tissue and at the same time providing ample radiation to the affected parts.

A further object of the invention is the provision of a radio-active material bearing pod having longitudinally extending shielded portions to prevent or minimize radiation to organs above or below the area to be treated. For example, in the preferred embodiment of the invention, the apparatus is utilized to treat the cervix and adjacent areas with radio-active material without adversely affecting the bladder and urinary tract or the colon, which lie immediately above and below these areas.

Other objects of the invention will be apparent from the following description of a preferred form of the

invention, reference being made to the accompanying drawings, wherein:

FIG. 1 is a view of an improved applicator embodying the invention, and being shown positioned in the vaginal tract and uterus, shown in section, to treat the uterus and cervix, including surrounding areas, the arms supporting the capsules of radio-active material being shown in retracted position to facilitate insertion or removal of the applicator from the patient;

FIG. 2 is a view similar to FIG. 1, but showing the arms carrying radio-active capsules in a laterally extended position;

FIG. 3 is a view, partly in section, of a part of the apparatus shown in FIGS. 1 and 2, but on a larger scale;

FIG. 4 is a view similar to that shown in FIG. 2 but at right angles thereto, a part of the apparatus being shown broken away;

FIG. 5 is a fragmentary view, partly in section, of the apparatus;

FIG. 6 is a sectional view taken along line 6—6 of FIG. 5, and

FIGS. 7 and 8 are sectional views taken along lines 7—7 and 8—8, respectively, of FIG. 5.

In general, the apparatus comprises a shank **10** which can be inserted in the vaginal tract and which carries a radio-active material bearing container **11**, referred to as the "uterine tandem," and a pair of radio-active material containing capsules or pods **12** and **13**, referred to as the "vaginal sources." As may be seen in FIGS. 1, 2 and 4, shank **10** may be inserted into the vaginal tract, indicated at B, and the uterine tandem **11**, which is the leading end, is inserted through the cervix C so that the vaginal sources or pods **12** and **13** will lie adjacent the cervix with the upper ends abutting the latter.

In the preferred form of the invention, shank **10** comprises a stock portion **14** having a stem **15** projecting therefrom which has a threaded neck **16** at the outer end thereof onto which one end of a coil spring **17** is threaded, and a handle **18** is provided at the lower end of the stock. Stock **14** has a threaded section **20** for receiving an adjusting nut **22** thereon, the purpose of which is explained hereinafter. Preferably, the stock **14** and handle **18** are hollow to minimize the weight of the apparatus.

Uterine tandem **11** preferably comprises several tubular sections assembled according to the desired length of the tandem and to carry an appropriate dosage of radio-active material, and as shown includes a tubular base section **11***a* having a threaded stem **11***b* projecting from the lower end, which is closed, and which is threaded into an end portion of coil spring **17**. In the form shown, the outer open end of base section **11***a* is necked and threaded externally to be threaded into the lower end of a second tubular section **11***c*, and a second tubular section **11***d* is threaded on section **11***c*. Section **11***d* is closed by a cap **11***e* threaded thereon, as seen in FIG. 3. These tubular sections thus asesmbled form a cylindrical container to receive needles of radio-active material, such as cesium, radium or cobalt, not shown. Other similar tubular sections of suitable capacities and lengths could be assembled to form a tandem of a different desired length and also to accommodate a different dosage of radio-active material. As seen by reference to FIGS. 1, 2 and 4 of the drawings, the diameter of the uterine tandem **11** is small enough to be more readily received through the cervix and into the uterus. Preferably, spring **17** has a normal curvature or bend which corresponds to the usual angle between the longitudinal medians of the vaginal

and uterine cavities, but the spring may flex universally to accommodate angles other than normal.

Pods 12 and 13 are formed alike, and referring to pod 12 for a description thereof, the pod comprises a cylindrical casing 26 of a suitable material which will pass rays from radio-active material and which casing is closed at its upper end 27 and open at its lower end. The lower end portion of casing 26 is threaded to receive a cap 28 which preferably has a slot 29 therein by which the cap can be turned by a tool, such as a screw driver. Preferably, the inner side 30 of casing 26, which is next to shank 10, is indented or flattened intermediate its ends, as may be seen by reference to FIGS. 5 and 6, and a stirrup 31 is attached to the flattened side to form pivotal means connecting the pod to a supporting arm, described more fully hereinafter. A plug 32, disposed inside casing 26, has a central bore 33, the upper end of which abuts a spacer 34 lying against the top of the casing, as viewed in FIG. 5, and the lower end of the bore is closed by cap 28 so that a suitable needle of radio-active material, not shown, may be carried in the bore. Referring to FIG. 6, lead shield members 36 and 37 extend lengthwise of the container 26 and their transverse cross-sectional shape is generally triangular so that radiation from the needle in bore 33 is shielded or minimized in the directions above and below the pod, as viewed in FIG. 6, and to the right and left as viewed in FIG. 4. The purpose of shields 36 and 37 is to prevent radiation from adversely affecting the colon, bladder and urinary tract, which are located on opposite sides of the vaginal and uterine cavities, as mentioned previously. On the other hand, radiation may freely pass from the needle through the upper unshielded ends of the capsules 12 and 13 and outwardly into parametrial tissue laterally of the pods, as indicated by the arrows in FIGS. 2 and 6.

Pods 12 and 13 are supported on the outer ends of two blade type spring arms 40 and 41, the lower ends of which are attached to stock 14, and for this purpose have end sections 40*c* and 41*c* respectively, rectangular and in cross section and fitting into corresponding grooves 42 and 43 formed in opposite sides of the stock, and which are retained in these grooves by a sleeve 44 having its lower end threaded on the exterially threaded portion of the stock. Arms 40 and 41 are inherently biased outwardly relative to stock 14 but are limited in outward movement by a sleeve 46 which surrounds the stock and sleeve 44, and which is arranged to be moved longitudinally along the stock by nut 22 which is attached to the lower end of sleeve 46 by a sliding, rotary connection formed by a laterally projecting flange 48, formed on the lower end of sleeve 46, retained in an annular groove in the top of nut 22 formed by a turned in lip 49 at the open end of an undercut portion. It will be seen that by rotating nut 22, sleeve 46 is moved longitudinally of stock 14, and as the sleeve is moved upwardly along the stock, the open end edges of the sleeve draw arms 40 and 41 inwardly toward stem 15, as may be seen in FIG. 1. Conversely, as sleeve 46 is lowered relative to the stock as seen in FIG. 5, arms 40 and 41 are permitted to tend to spread from the center line of shank 14.

Pods 12 and 13 are attached to the outer ends of arms 40 and 41 so that they may pivot in a plane common to the shank and pods, as is illustrated by broken lines in FIG. 5 with reference to pod 12, and for this purpose, the outer end portions 50, 51 of the arms 40 and 41 are turned or twisted at 90° to the arms proper and extend through the stirrups 31. The outer ends of the arms have enlargements 40*a* and 41*a*, respectively, which prevent removal of the stirrups from the arms, and the lower edges of the stirrup engage the shoulders 40*b* and 41*b* formed by twisting arm portions 50 and 51 to retain the pods in place on the arms. The yokes, or outer walls, of stirrups 31 are tapered to permit the pivotal movement just described.

In using the apparatus, suitable needles of radio-active material, such as cesium 137, radium 226 or cobalt 60, are loaded into the vaginal sources and uterine tandem in the manner described, and sleeve 46 is then moved to its uppermost position by rotating nut 22 so as to cause the pods 12 and 13 to be drawn inwardly adjacent to stem 15 to facilitate insertion of the apparatus into the vaginal or uterine cavity. The insertion is made so that uterine tandem 11 enters through the cervix and into the uterus, as seen in FIGS. 1, 2 and 4. The upper ends of pods 12 and 13 engage the tissue adjacent to the cervix, and sleeve 46 is then moved to a lower position which permits arms 40 and 41 to spread, under their inherent bias, outwardly from stem 15, as may be seen by reference to FIG. 2, and the degree of force exerted outwardly by the arms can be regulated by longitudinal positioning of sleeve 46 in the manner described. Furthermore, the pivotal connection between arms 40, 41 and pods 12 and 13 permits the pods to accommodate themselves somewhat to the contour of the tissue adjacent the cervix, thereby minimizing or avoiding areas of high pressure bearing on the tissues. The flexible connection 17 between shank 10 and uterine tandem 11 permits the latter to flex, if necessary to accommodate the tandem to any angular disposition on the uterus relative to the vaginal cavity, in the event it is off from norm. The fact that the axes of pods 12 and 13 lie generally parallel to the axis of shank 10 permits relatively easy insertion and removal of the apparatus from the vaginal cavity, and the form of the pods and their shielding elements 36 and 37 permit controlled and accurate radiation of the affected areas while shielding other tissue or organs from adverse effects of the radiation.

The apparatus is readily removed from the body by moving sleeve 46 to the upper position, as shown in FIG. 1, which draws pods 12 and 13 inwardly toward stem 15, thereby reducing the over all diameter of the apparatus to a minimum for easy withdrawal thereof.

If circumstances indicate, the uterine tandem can be omitted by unscrewing spring 17 from neck 16, in which case the leading end of the shank 10 would not enter the cervix; however, the pods 12 and 13 would be disposed adjacent to the cervix in the manner shown and described.

It will be seen that the apparatus can be readily disassembled for cleaning by unthreading spring 17 from neck 16 and removing arms 40 and 41 by running nut 22, including sleeve 46, and sleeve 44 down the threaded stock for releasing the arms from the retaining grooves.

While but one form of the invention has been disclosed, it is to be understood that other forms, modifications and adaptations could be employed, all falling within the scope of the claims which follow.

I claim:

1. Apparatus for applying radioactive materials to a body cavity having anterior and posterior portions with a restricted passage therebetween, said apparatus comprising a shank including a handle and a stock portion, a plurality of resiliently flexible arms each having one end attached to said stock portion and each tending to spread away from said shank, a plurality of pods for containing radioactive material each attached to the other end of one of said arms, said arms resiliently biasing said pods laterally away from said shank for engagement of said pods with the walls of said anterior cavity portion adjacent said restricted passage, adjusting means acting on said arms adjacent their attachment to said stock portion for adjustably increasing and decreasing the lateral biasing effect of said arms on said pods, a resiliently flexible member mounted on said stock portion and extending beyond said pods from between the outer ends thereof so as to be adapted to project through said restricted passage, and a tubular casing mounted by one end on said resiliently flexible member for support thereby in said posterior cavity portion, whereby said resiliently flexible member when in said restricted passage is adapted to flex to permit deflection of said tubular casing when in said posterior

cavity portion with respect to said shank but resiliently tends always to align said tubular casing with said shank.

2. Apparatus as defined in claim 1 wherein said arms are two in number and lie in a plane common with said shank on opposite sides thereof, said pods being of cylindrical shape, and said attachment of said pods to said arms being by pivot means to permit movement of said pods with respect to said arms and in said plane.

3. Apparatus for applying radioactive materials to a body cavity having anterior and posterior portions with a restricted passage therebetween, said apparatus comprising a shank including a handle and a stock portion, a plurality of resiliently flexible arms each having one end attached to said stock portion and each tending to spread away from said shank, a plurality of pods for containing radioactive material each attached to the other end of one of said arms, said arms resiliently biasing said pods laterally away from said shank for engagement of said pods with the walls of said anterior cavity portion adjacent said restricted passage, adjusting means acting on said arms adjacent their attachment to said stock portion for adjustably increasing and decreasing the lateral biasing effect of said arms on said pods, a resiliently flexible member mounted on said stock portion and extending beyond said pods from between the outer ends thereof so as to be adapted to project through said restricted passage, and a tubular casing mounted by one end on said resiliently flexible member for support thereby in said posterior cavity portion, whereby said resiliently flexible member when in said restricted passage is adapted to flex to permit deflection of said tubular casing when in said posterior cavity portion with respect to said shank but resiliently tends always to return said tubular casing to a predetermined angular position with respect to said shank.

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