

Oct. 8, 1957

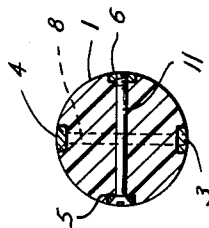
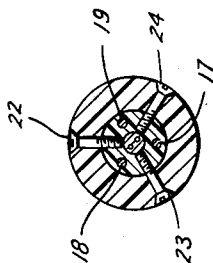
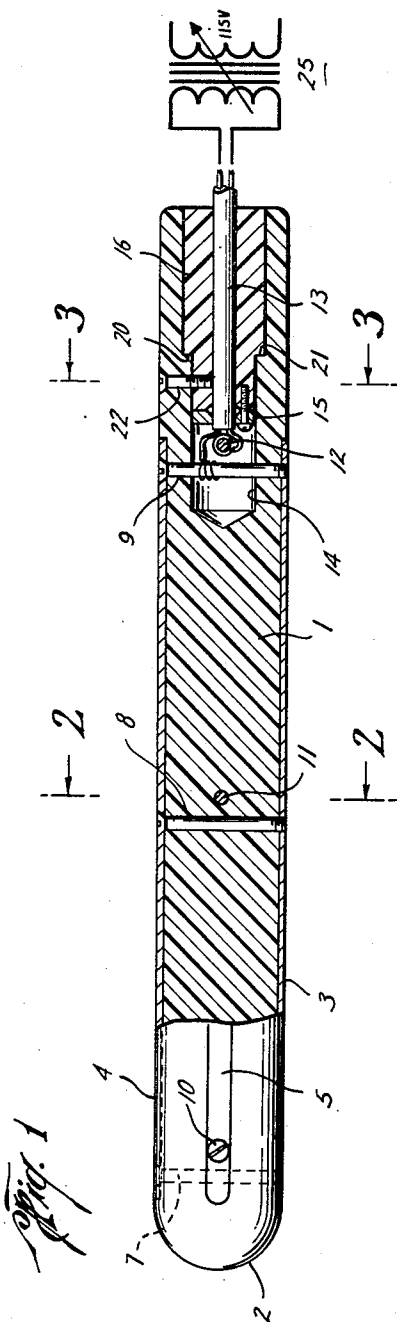
W. G. MARDEN

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APPARATUS FOR SEMEN COLLECTION

Filed June 1, 1954

2 Sheets-Sheet 1



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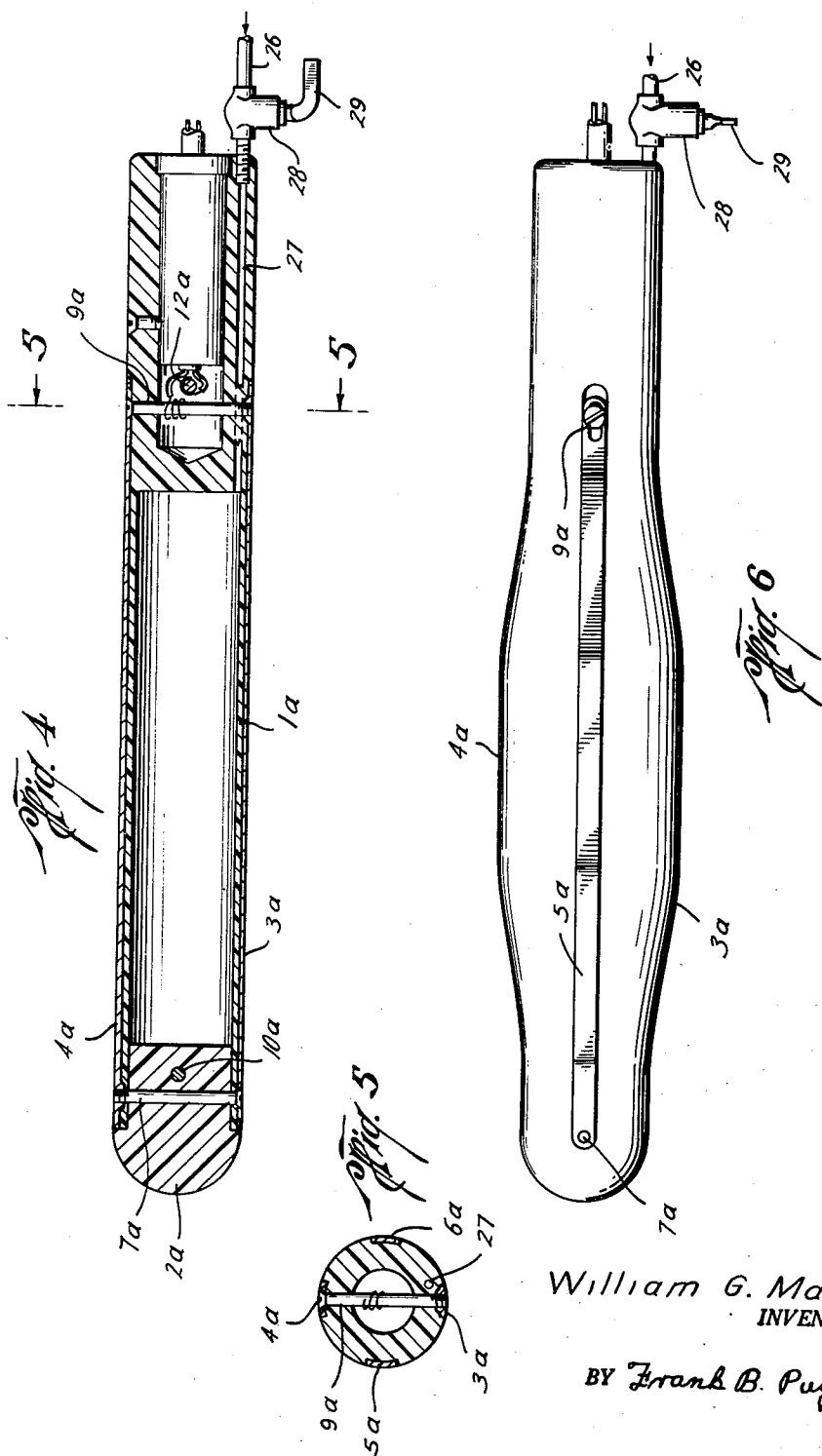
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APPARATUS FOR SEMEN COLLECTION

William G. Marden, San Antonio, Tex.

Application June 1, 1954, Serial No. 433,370

6 Claims. (Cl. 128—419)

This invention relates to a method and apparatus for obtaining semen from male animals, and particularly to an improved method and apparatus for electrical stimulation, applied rectally, to cause erection and ejaculation.

In the method of semen collection now in general use an artificial vagina is employed in association with a teaser animal, usually a female. Unfortunately this technique is difficult under the most favorable conditions. Further it requires mounting of the teaser animal, which is impossible in the case of bulls which have developed certain pathological conditions in their joints, legs or feet. Moreover, not only is it difficult and time consuming to clean and sterilize the apparatus but an accidental chance service with the female animal could infect a valuable male with *Vibrio fetus* or trichomoniasis.

Because of the disadvantages of the artificial vagina technique of semen collection, researchers in this field have studied the possibility of electrostimulation of nerves and tissues to determine whether this method can be employed successfully in the stimulation of the male reproductive organs. Prior to my invention electroejaculation of a ram was obtained by the insertion of a single small metal electrode into the rectum while a second electrode in the form of a needle was embedded in the animal's back at the level of the fourth lumbar vertebra. The electromotive force applied was from 10 to 40 volts and, while it caused emission of semen, the physical stress to the animal was such that it had to be tied on its side during the stimulation. Moreover, experiments have been reported since my invention, but independently of my research, using a rectal probe to cause electroejaculation of a bull. 60 cycle current, with the voltage varied from 0 to 15 volts, was used with no apparent attention given to the excitation wave form. While ejaculation occurred, erection was not always obtained. Consequently, the semen trickled out through the puerperal sheath and pizzle hair, thus becoming contaminated with dirt and bacteria.

Accordingly, it is the object of my invention to provide a reliable electroejaculation technique and apparatus which will eliminate the need for a teaser animal and which will cause an erection prior to ejaculation.

It is a further object of my invention to provide an ejaculation technique which stimulates the ejaculatory center while minimizing stimulation of the sciatic and lumbar nerves, thus reducing stress and discomfort.

In developing my improved technique and apparatus I kept in mind that ejaculation is stimulated by the parasympathetic impulses which travel via the internal pudendal nerve and that as far as is known the ejaculatory center situated in the lumbar sacral region integrates the afferent and efferent impulses which cause the emission of semen. Attention therefore was placed on electrode design. A number of different multipolar electrodes were tried in an effort to reduce the power required to attain ejaculation, until my presently preferred design was developed.

Briefly stated, the presently preferred form of my in-

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vention involves the use of a rectal probe made of a nonconductive material, such as plastic, having a plurality of metal electrodes placed longitudinally along the surface of the plastic and inlaid into it. Electrical conductors are brought out through the end of the instrument and connected to a pulse generator. Alternatively, cylindrical rings of conductive material inlaid into the plastic probe may be used, though the longitudinal electrodes presently give better results.

For best results a rising potential from zero to a peak voltage of about five and one-half volts is employed. This is accompanied by gradual increase in current up to just less than one ampere. To cause erection of the penis, and minimize other muscular reaction, sine wave excitation pulses should be used with a frequency of 20 to 30 cycles. The intensity of the excitation of the conductive electrodes on the probe is gradually increased over a period of several seconds, and then returned to zero. Short resting periods of several seconds are allowed between stimulations, the erection and ejaculation usually occurring after a minute and a half to three minutes of intermittent stimulation. Erection of the penis is obtained prior to ejaculation, the tip of it then being guided into the end of a funnel placed in a sterile test tube for the collection. If desired the initial watery secretions of the secondary sexual glands may be collected in a separate test tube from the concentrated semen which follows.

Of particular importance is my discovery that employment of the frequency range and wave form described produces erection in a majority of cases, permitting collection under more sterile conditions, and so reducing the physical discomfort to the animal that the technique can be used as a routine practice. In fact, bulls and rams subjected to regular collections with my electroejaculator soon become accustomed to the treatment and thereafter provide semen with greatly reduced electrostimulation.

My invention will be better understood from the following detailed description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing, Fig. 1 is a plan view, partly in longitudinal section, of my rectal probe and its electrical connections; Fig. 2 is a sectional view taken along the lines 2—2 of Fig. 1; Fig. 3 is a sectional view taken along the lines 3—3 of Fig. 1; Fig. 4 is a plan view, partly in longitudinal section, of a modified rectal probe adapted to be inflated after insertion into the animal; Fig. 5 is a sectional view taken along the lines 5—5 of Fig. 4; and Fig. 6 is a plan view of the probe of Fig. 4 showing it in its inflated condition.

Referring now to Fig. 1, my rectal probe consists of an elongate body 1 of non-conductive material, such as plastic, having a curved end portion 2 to facilitate insertion. A "Lucite" rod has been found to be satisfactory. The size of the probe must necessarily vary according to the animal, though its length is generally 5 or 6 times its diameter. For example, in the case of bulls a probe from 1 to 2 feet long and from 1½ to 3 inches in diameter has been found to be very satisfactory, while in the case of sheep and goats a probe about 6 inches long and slightly over an inch in diameter has given excellent results.

Inlaid or otherwise secured on the probe 1 are a plurality of electrical conductors shown, by way of illustration, as longitudinally placed conductors 3, 4, 5 and 6. It will be understood, of course, that conducting rings can be slipped over or inlaid in the probe 1, or that fewer or more than four conductors can be employed. Since it is preferred to connect conductors 3 and 4 together and likewise to connect conductors 5 and 6 together, leaving as the only open circuit that between the pairs of conductors 3 and 4 and 5 and 6 respectively, I prefer to provide attaching screws of a conductive material extend-

ing completely through the probe from one conductor to the opposite conductor. Consequently, I provide screws 7, 8 and 9 connecting conductors 3 and 4 to the probe and to each other, and screws 10, 11 and 12 connecting conductors 5 and 6 to the probe and to each other. It should be understood, however, that my method can be employed successfully without the shunting of any conductors, in which case either the screws 7, 8, 9, 10, 11 and 12 would not pass from one conductor to the other, or they would be made of a suitable non-conductive material.

The conductors 3, 4, 5 and 6 extend to a point near the curved end of the probe, but preferably begin an inch or more from its other end. For example four 11 inch conductors $\frac{5}{16}$ inch wide have given excellent results with a 13 inch probe $1\frac{1}{8}$ inch in diameter. This is because it has been found to be important that the probe be placed so that the electrodes are completely within the animal; otherwise, there is the possibility of producing extreme discomfort because of the concentration of sensitive nerve endings near the rectal opening.

My electrical leads for energization of the probe conductors are preferably encased in a single sheath 13 brought in through the rear end of the probe body 1, in which a cylindrical recess 14 is formed. The electrical leads may be attached to the screws 9 and 12, respectively, in any suitable manner. To space the sheath 13 in the center of the cavity 14, and to secure it to the probe sheath 1, I provide an insulating washer 15 and an insulating bushing 16. After the sheath is in place within the bushing the washer is tightened against the face of the bushing by suitable screws 17, 18 and 19 to secure the sheath, and the assembly is then inserted within the recess 14 of the probe. As an aid in positioning the assembly the bushing 16 may be provided with a flange 20 adapted to fit into a suitable seat 21 formed in the connection end of the probe, concentric with the cylindrical cavity 14. Screws 22, 23 and 24, extending through the probe and bushing and bearing against the surface of the sheath, are inserted and tightened, holding the connection assembly securely in place.

In carrying out my method it is important to have a power supply furnishing a steady sine wave impulse, a variable frequency, provision for manual or automatic variation of the power input to the probe, and means for indication of the power output, frequency, voltage, and current. Any suitable generator circuit having these characteristics may be used, and the circuit should be tailored to fit the particular power supply available at the station at which the method is practiced. Preferably a direct current circuit resistance of from 200 to 450 ohms is provided, and an impedance, with substantial sine wave excitation, varying in the general range of 6 to 16 ohms. A typical oscillator circuit would be powered by connection to a standard 115 volts 60 cycle circuit through a variable transformer 25, as indicated diagrammatically in Fig. 1. The oscillator signal may be put into a simple push-pull amplifier, the output of which is impedance matched with the electrode when in place in the rectum of the bull. Since I prefer to control the frequency, voltage and current manually, and since the various meters for indicating the power output are standard, no detailed description or drawing of the oscillator circuit is given. Many suitable circuits for providing the variable power source needed are well known in the art, and apparatus for controlling the power input can readily be purchased.

In carrying out my method of semen collection I have found that the wave form and the frequency of the stimulating pulse are the two most critical factors. Spike or square wave pulses ranging from .01 to 30 milliseconds duration were tried without causing either erection or ejaculation, regardless of the frequency employed, though violent muscular contraction of the sciatic and lumbar regions resulted. With a sine wave pulse, however, I have induced ejaculation over the fairly wide range of fre-

quency of from 12 to 70 cycles. However, the amount of power required, and the difficulty of obtaining ejaculation, rises rapidly above 40 cycles. My best results, particularly with regard to penis erection, have been obtained between 20 and 30 cycles, depending on the animal, with a sine wave pulse. Erection of the penis can generally be obtained, however, with a substantial sine wave pulse using a frequency range of from 15 to 35 cycles.

In carrying out my method of semen collection the probe is preferably placed in a bucket of warm water, which acts as a lubricant, and then inserted into the rectum of the animal, care being taken to insure that the electrode portion of the probe is fully inserted. Stimulations are made by gradually increasing the intensity of the signal into the electrode over a period of several seconds, preferably in the general range of 3 to 8 seconds, and then returning to zero. Short resting periods of from 5 to 15 seconds are preferably allowed between stimulation. As the treatment progresses, the intensity of the stimulation may be increased, erection and ejaculation occurring after about 1 to 3 minutes of intermittent stimulation in most cases. During the stimulating process there is a gradual voltage rise from 0 to a maximum of about $5\frac{1}{2}$ volts accompanied by a gradual increase in current up to a maximum of somewhat less than 1 ampere.

The circumstance that the proper choice of frequency and of wave form, and the proper design of the probe, make it possible to produce the desired results with such a small current surprisingly minimizes the discomfort to the animal. On cattle ranches a number of beef bulls have been electrically ejaculated for the first time with no more restraint than a rope and halter tied to the nearest fence. This is in sharp contrast with the elaborate precautions and restraint needed in the use of previous techniques and apparatus.

It should be further understood, moreover, that the above values are peak readings recorded in actual tests at maximum excitation, and that under favorable conditions erection and ejaculation often can be obtained at a fraction of maximum output. This is especially true in bulls that have become accustomed to ejaculation by means of my invention and are therefore conditioned to give the desired response. In fact, such animals often have a partial erection as soon as they are brought near the stanchion.

With the electrode probe in position in the animal the direct current resistance varies within the range heretofore mentioned, from 200 to 450 ohms, depending upon the amount of feces present and possibly other factors. As electric stimulations begin, the calculated impedance varies as the current is increased in the approximate range of 16 to 7 ohms. Since the phase angle has been found to be substantially zero throughout the preferred frequency range, the reactance is also substantially zero, which is the preferred condition when the probe is in place in the rectum of the animal. Thus for practical purposes the load on the electrode can be considered as purely resistive. With the power factor substantially equal to unity, it is apparent that in the range of current and voltage heretofore set forth, the power required to be delivered at maximum excitation is about 5 watts. Moreover, in many cases a reaction can be produced with a potential of less than two volts and with a current of less than 100 milliamperes, the reaction generally being maintainable by the continued application of from one-half to 1 volt at approximately 20 milliamperes. The smaller power requirements are particularly applicable to the use of my technique on sheep and goats.

Since the apparatus occasionally may be used by persons unfamiliar with its operation, the amount of electrical excitation should be limited by the gain control to such a power rating that no injury to the animal can result.

With an occasional animal a difficulty in the use of the probe shown in Fig. 1 arises. This is a condition I call

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ballooning, wherein contact between the electrode and the tissue is broken or partially broken by controlled muscular action on the part of the animal. This may result in insufficient stimulation or discomfort, and cannot readily be corrected by using a larger probe because of the difficulty and discomfort in inserting it, and because the wall of the rectal passage after ballooning may not be in a sufficiently cylindrical form for my rigid probe to make uniform contact with the tissue. Accordingly, I have designed a modified probe with a hollow sheath adapted to be inflated after insertion in the animal, as shown in Figs. 4, 5 and 6.

My modified probe includes an elongate probe body 1a of non-conducting flexible and preferably resilient material. For example, such a probe could be made of one of the elastomeric plastics, such as butyl rubber. The sheath 1a is hollow from its rounded end portion 2a to a point near the end of the conductors 3a, 4a, 5a and 6a. These conductors should be sufficiently flexible to conform to the contour on the sheath both in its inflated shape, as shown in Fig. 6, and its normal shape, as shown in Fig. 4. Conductors 3a and 4a may be connected together and to the sheath by conducting screws 7a and 9a, while screws 10a and 12a may shunt conductors 5a and 6a and secure them to the probe body. Preferably one pair of securing screws, illustrated as 9a and 12a, pass through slotted openings near the ends of the conductors so that the latter will not be unduly stressed upon expansion of the sheath.

To inflate the sheath after its insertion into the animal, I provide means including a pipe or tube 26 for conveying under pressure a gaseous or liquid medium, preferably air, into the hollow portion. A conduit 27 communicates between the hollow portion of the sheath and the tube 26. I further provide a simple valve 28 with a manually operable handle 29 to control the flow of air into the conduit 27 and sheath 1a, whereby the sheath can be inflated as necessary after insertion into the animal.

It will be understood, of course, that the detailed construction of the modified probe shown and described for use when ballooning occurs or is expected is by way of illustration only of the principles of its design and use, many similar constructions being entirely suitable in practicing this feature of my invention.

While I have shown and described the particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto, since many modifications may be made; I therefore contemplate by the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent in the United States is:

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1. An electroejaculation stimulator device comprising a hollow sheath of flexible dielectric material, a plurality of longitudinally placed electrical conductors carried by said sheath, electrical connection means for said conductors, and fluid pressure means for inflating said sheath.

2. An electroejaculation stimulator device comprising a hollow substantially cylindrical sheath of resilient dielectric material, a plurality of elongate electrical conductors carried on the surface of said sheath, electrical connection means for said conductors, and fluid pressure expansion means for said sheath.

3. An electroejaculation stimulator device comprising a hollow elongate substantially cylindrical flexible and resilient dielectric probe, a plurality of longitudinally placed electrical conductors fixed to said probe, electrical connection means for said conductors, and means operable from one end of said probe for expanding the diameter thereof.

4. In an electro-ejaculation stimulation device of the class described for use in the rectum of an animal, in combination, a probe of non-conductive material, a plurality of metal electrodes disposed on said probe, an oscillator, an amplifier, a power supply for said oscillator and said amplifier, the output of the oscillator being fed to the amplifier, said amplifier being connected in a circuit with said electrodes whereby the frequency and intensity of the current to the electrodes may be varied at will.

5. In a device according to claim 4 wherein said oscillator supplies current to said amplifier of a frequency within the range of from 15 to 35 cycles.

6. In a device according to claim 5 wherein the output of said amplifier is impedance matched with the impedance between the electrodes when the electrodes are in place in the rectum.

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