

[54] **MEDICAL INSTRUMENT FOR EXAMINING A FETUS DURING DELIVERY**

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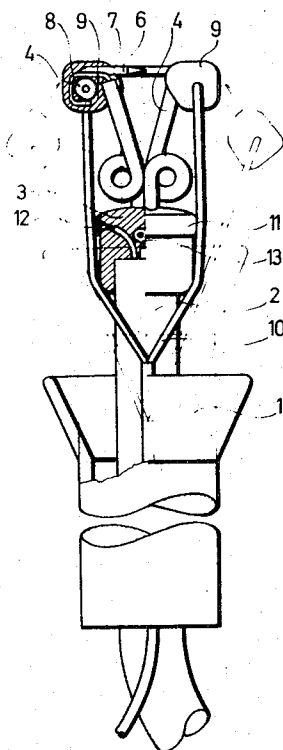
Attorney, Agent, or Firm—Young and Thompson

[57]

ABSTRACT

A medical instrument for examining a fetus during delivery, comprising an electrode carried by a normally closed clip spring for connection to the fetus, and an electrode for engaging the mother, both electrodes being connected to wires that extend through an electric cable. A tool slides on the cable and has filaments connected to it such that when the tool is pulled toward the user, the filaments spread the springs to open and release the device; and when the tool is released, then it is pulled forward on the cable by the filaments and permits the spring to close on the fetus for connection or for insertion and removal of the instrument.

6 Claims, 2 Drawing Figures



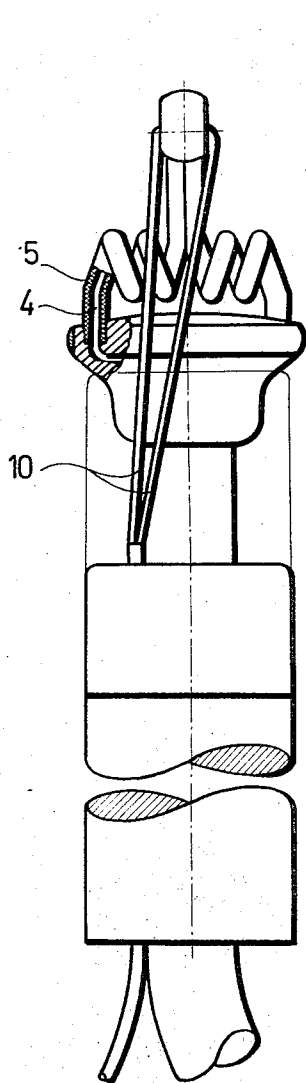


FIG. 1

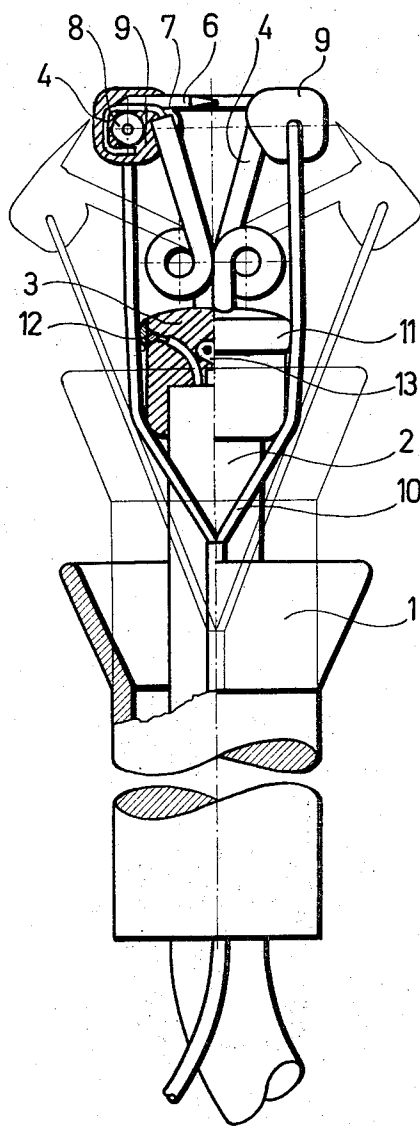


FIG. 2

MEDICAL INSTRUMENT FOR EXAMINING A FETUS DURING DELIVERY

The invention relates to a medical instrument for examining a foetus during delivery.

In modern obstetric surgery and midwifery, great care is taken to protect the foetus and to eliminate risks in delivery. There must be immediate detection of danger to the foetus during delivery, which entails thorough observation of the vital functions of the foetus during delivery. The most important observation is continuous observation of the foetal heartbeat by means of electrocardiography of the foetus and the heartbeat. Unfortunately, this is linked with the intensity of pain and with the pressure in the womb.

In early experiments, an electrode was placed on the mother's abdomen. The electrocardiogram signals of the mother and foetus were therefore added together and the result was unsatisfactory because of delivery pains. This method was abandoned because of diagnostic errors and direct electrocardiography of the foetus was used instead, the probe being placed in contact with the foetus in the uterus. Two methods were used to insert the electrodes. In one of them, a very narrow needle-like transabdominal needle is passed through the mother's abdominal and uterine wall and inserted into the gluteal region of the foetus - i.e. into its rear parts; in the other method, an electrode (probe) is inserted transcervically through the vagina and through the uterine wall.

The first method is very dangerous for the mother and foetus because of the risk of bleeding and of injury and even of death and is therefore not used clinically. In the second method of electrodes are secured to the foetus by a suction disc or some other form of clamps or the like. A disadvantage of suction cups is that, depending on its dimensions, the vaginally inserted cup may cause bleeding from a correspondingly sized area of the foetus body for anything from eight to 10 days. At least two or three minutes are needed to make a satisfactory contact, a fairly long time. An advantage of the second method is ready removability of the electrode which is attached by the cup.

Clip or hook electrodes have provided to be most satisfactory in practice; they are attached or clipped to the skin of the foreparts — as a rule, the head — of the foetus body. Their advantages are reliable contact and less risk in use than the electrodes previously referred to.

The clips or clamps commonly used are the "HON" clamps which in shape and use resemble surgical clamps. Basically, a HON electrode has a 2–3 mm wide, 10–15 mm long U-shaped metal plate which has a needle-like end and is silvered. The signal wiring is soldered to the clamp which is, conveniently, insulated except for its needle-like end.

The other contact takes the form of a silver wire which is coiled around the end of the clamp and which is in contact with the mother's body. To insert the device, the electrodes are clipped or clamped to the skin of the foetus head by means of an appropriate tool while the U-shaped clamp is compressed, the compression permanently altering its shape. For removal the clamp must be either bent out or severed. There are a number of other probes operating on the same principle as the HON electrode but differing therefrom only in minor details.

The advantage of clamping electrodes is that they give good contact provided that they have been in-

serted properly. Unfortunately, they all have the disadvantage of needing a complicated tool for their insertion and removal, or else small forceps or tweezers, which represent a danger since the electrode is open during insertion and the needle-like end of the electrode may cause severe injuries to both the mother and the foetus. In some cases, the clamp springs back on insertion — after having been pressed together — and so removal may be risky and contact unreliable.

For removal the vagina must first be opened sufficiently for the tool to be inserted; often, what then occurs is that it proves impossible to bend the clamp without causing injury. Also, in emergencies, it is inadvisable to have to waste time on inserting and removing the electrodes.

According to the present invention, there is provided a medical instrument for examining a foetus during delivery, the instrument having a mounting member carrying an actuating spring and an opposing member, a first gripping element on the actuating spring and an opposing gripping element on the opposing member, for engaging the foetus, the spring biasing the gripping elements together, at least one of the gripping elements being in the form of a first electrode, a second electrode on the mounting member for contacting the mother, means for withdrawing the first gripping element from the opposing gripping element, and an insulated electric conductor in electrical connection with the first electrode (the electric conductor preferably being part of a screened cable containing electric conductors connected to the first and second electrodes respectively). The instrument of the invention can be simple, and can be used rapidly.

The invention will be further described, by way of example, with reference to the accompanying drawing, in which:

FIG. 1 is an elevation, partly in section, of an instrument in accordance with the invention; and

FIG. 2 is a side view, partly in section, of the instrument of FIG. 1.

A tubular inserting tool 1 slides on a twin-cored screened cable 2, and a mounting or inserting member 11 made of an electrically insulating material is disposed at the funnel-shaped end of tool 1. An electrode 3, for contacting the mother, is soldered to the top of the mounting member 11. Two springs 4 are secured opposite to one another in the mounting member 11 and are surrounded by insulation 5. The ends of contact (or probe) needles 6 are secured between the spring ends by soldering, are hook-shaped and emerge from glass beads 8. The needle and spring ends soldered together at joint 7, and together with the beads 8, are surrounded by an insulation 9. Plastic actuating filaments 10 extend through the apertures in the beads 8 and through the tool 1. The contact 3 for the mother, in the form of an electrically conductive metal and of annular shape, is formed on the mounting member 11 and has one core of the cable 2 connected to it by way of a soldered joint 12. The other core of cable 2 is connected to the springs by way of a soldered joint 13.

Normally the mounting member 11 rests on tool 1 and the oppositely disposed contact needles 6 are kept closed by the springs 4, as indicated by bold lines. When the filaments 10 are tightened, the needles 6 separate from one another and move into the open position, indicated in the drawing by faint lines. Slackening

3

of the filaments 10 returns the needles 6 to their normal closed position. To use the instrument, the instrument with the needles 6 in their normal position is introduced through the corresponding opened vagina, as a rule with the *os uteri* open at finger width. When the foetus is reached, the instrument is opened by operating the filaments 10, whereafter the needles 6 penetrate into the skin of the foetus, the skin is clamped and the filaments are slackened to reclose the clamp. The springs 4 apply a constant force to press the needles 6 together, thus ensuring satisfactory adhesion and therefore satisfactory contact.

In various examinations carried out during deliveries, it has been found that the derived active potential — the signal QRS — was 100 μ V except in a few cases, and in some cases was as high as 500 μ V. The potential depends upon the foetus, i.e. upon the "test specimen". Another feature of electrode sensitivity is a very good signal-to-noise ratio; we obtained good assessments of the minor elements of the ECG curve, e.g. the T-wave. The heartbeat rate is at present a vital factor in assessing risk, and so the increased sensitivity of the sprung electrodes may be of great importance for diagnosis.

To remove the instrument, the tool 1 slides back on the returning cable without any opening of the vagina. The filaments 10 are tightened to open the needles, the instrument separates, and after closure of the needles the instrument can be withdrawn.

The instrument is safe to use, since the contact needles are in the closed state during insertion and during withdrawal. Handling is so simple and rapid that the in-

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strument can be used more than once during a single delivery. The instrument can be used repeatedly and can be sterilized by conventional methods.

What we claim is:

1. A medical instrument for examining a fetus during delivery, comprising a first electrode in the form of a clip, spring means urging the clip closed for attachment to the fetus, a second electrode for contacting the mother, a cable on which said first and second electrodes are carried, separate electric wires extending through said cable from said first and second electrodes, a tool slidable on the cable, and filament means interconnecting said first electrode and said tool whereby upon sliding of the tool away from said electrodes, said filament means opens the clip of said first electrode and upon release of said tool, said spring means closes said first electrode and draws said tool toward said electrodes on said cable.

2. An instrument as claimed in claim 1, said clip having a pair of jaws, said spring means comprising a spring for each of said jaws.

3. An instrument as claimed in claim 2, both of said jaws being electrodes.

4. An instrument as claimed in claim 1, in which said second electrode is annular.

5. An instrument as claimed in claim 1, in which said filament means is flexible.

6. An instrument as claimed in claim 1, said filament means being a pair of flexible members one connected to each of said jaws.

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