July 18, 1972 J. E. FITZGERALD 3,677,904

PETRI DISH INCLUDING A CHAMBER FOR A STERILIZED SPECIMEN-SPREADING ELEMENT AND PROCESS FOR USING THE PETRI DISH

Filed Nov. 20, 1969 3 Sheets-Sheet 1

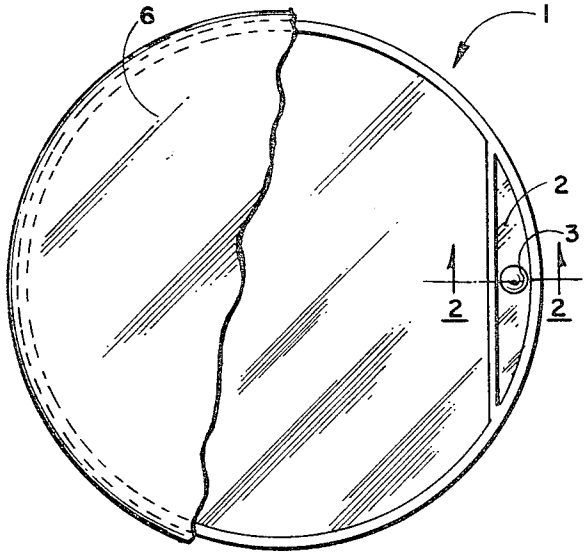


FIG. 1

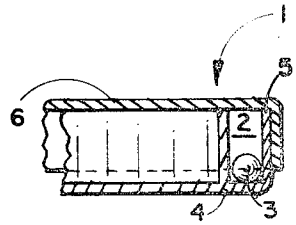


FIG. 2

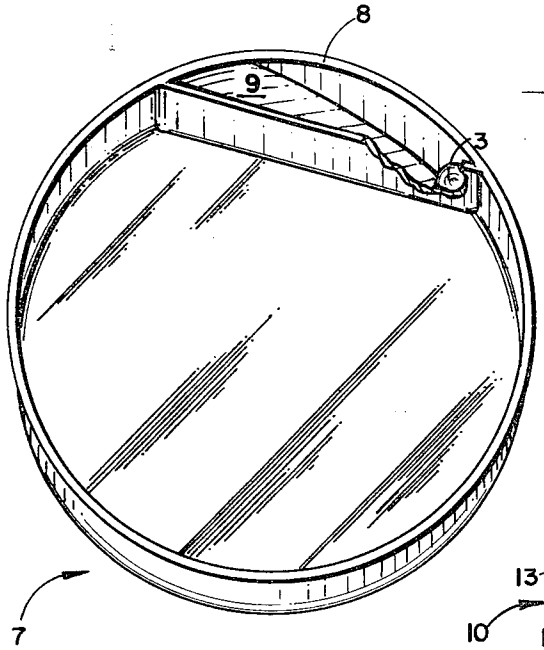


FIG. 3

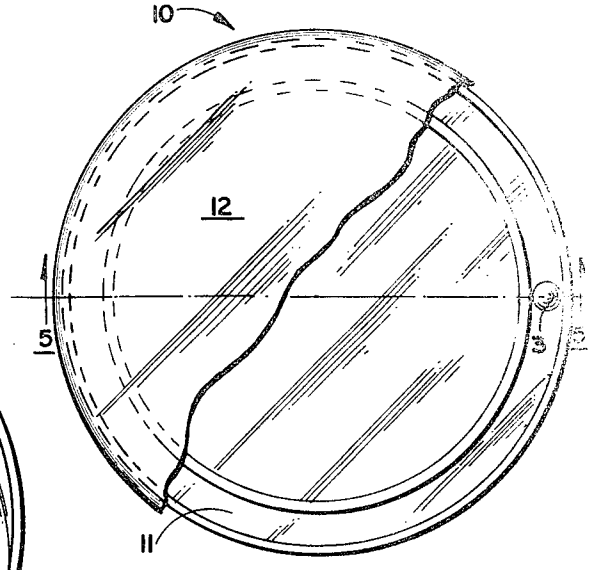


FIG. 4

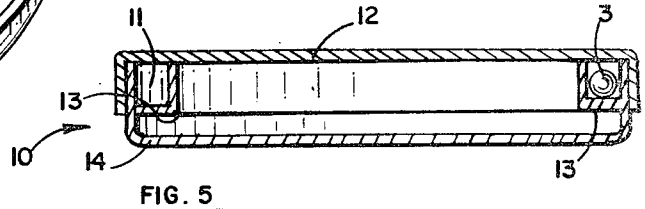


FIG. 5

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Filed Nov. 20, 1969 3 Sheets-Sheet 2

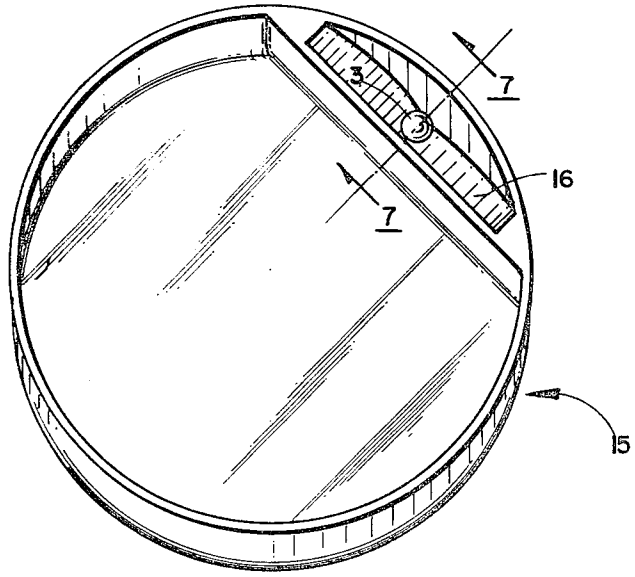


FIG. 6

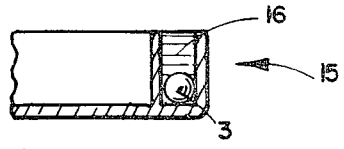


FIG. 7

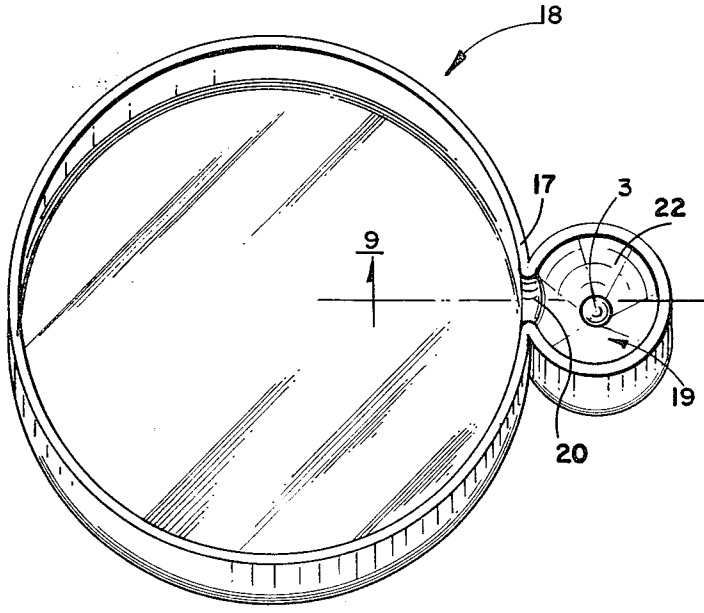


FIG. 8

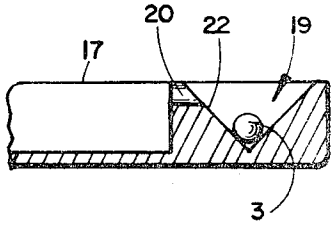


FIG. 9

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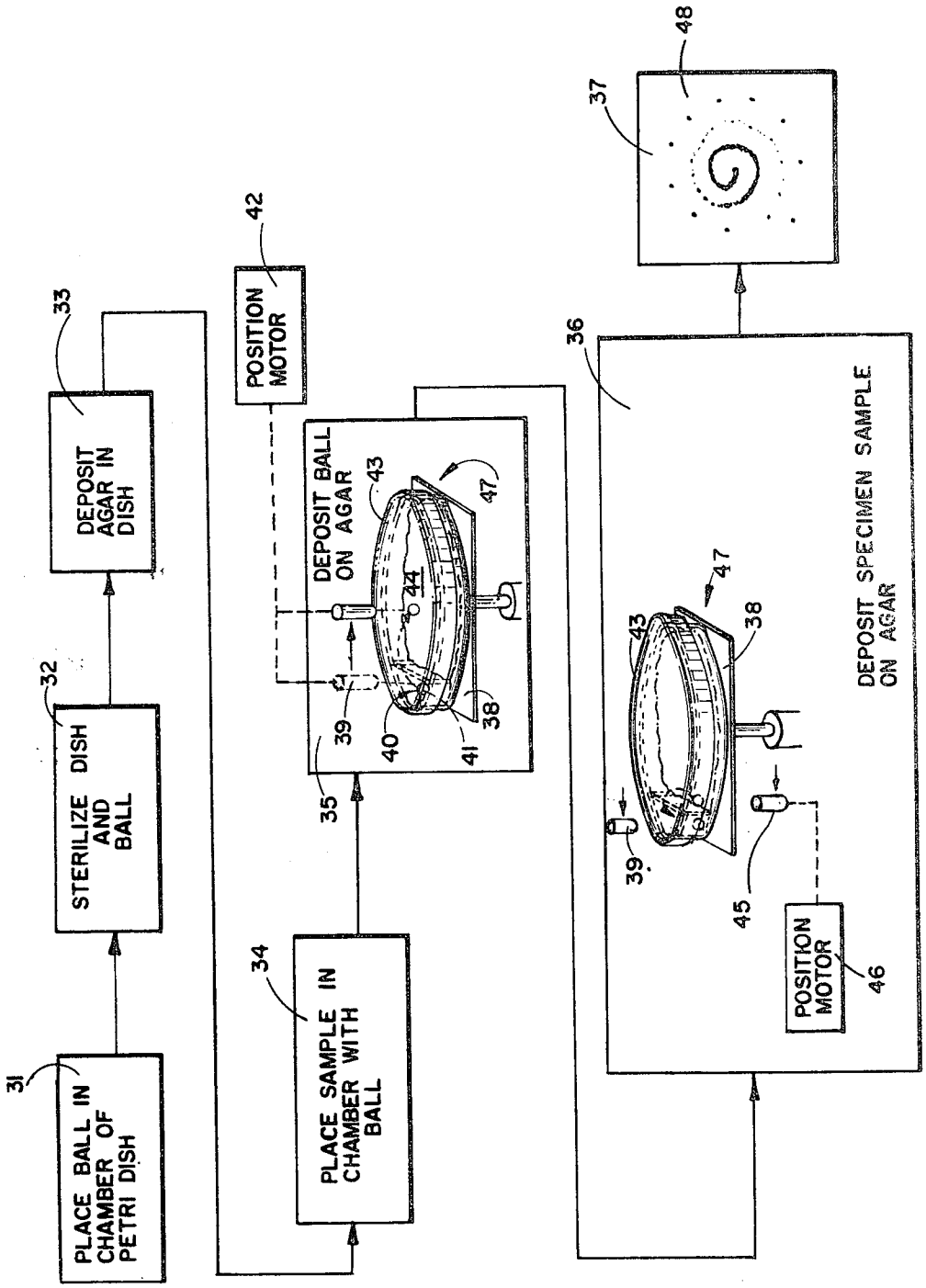
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Filed Nov. 20, 1969 3 Sheets-Sheet 3

FIG. 10



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3,677,904

PETRI DISH INCLUDING A CHAMBER FOR A STERILIZED SPECIMEN-SPREADING ELEMENT AND PROCESS FOR USING THE PETRI DISH

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Filed Nov. 20, 1969, Ser. No. 878,479
Int. Cl. C12k 1/00
U.S. Cl. 195—103.5 R 12 Claims

ABSTRACT OF THE DISCLOSURE

A petri dish is provided with a separate chamber for a sterilized ball. Prior to use, an agar layer is deposited in the dish and a specimen sample, to be spread on the layer, is placed in the chamber with the ball. A magnet is positioned over the chamber for pulling the ball covered by a film of the specimen from the chamber. The magnet places the ball and specimen at a predetermined location on the agar layer. The dish is rotated relative to the ball for spreading the specimen in a non-overlapping pattern on the agar surface. Afterwards, the ball is returned to the chamber and the agar layer is processed to incubate the micro-organisms of the specimen.

REFERENCE TO RELATED APPLICATION

"Automated Streaking Device for Isolating Micro-organisms on an Agar Surface," by James E. Fitzgerald, Ser. No. 808,914, filed Mar. 20, 1969.

BACKGROUND OF THE INVENTION

(1) Field of the invention

The invention relates to an improved petri dish and, more particularly, to a petri dish having a separate compartment for a specimen-spreading element and to a process and system using the dish.

(2) Description of the prior art

One of the many procedures which must be performed in microbiology are plate streaks for isolating microbiological colonies. Distinctly isolated colonies are produced as a result of growth starting with a single cell. The isolated colonies are absolutely necessary for the observance of colony morphology and the performance of staining and other procedures necessary for determining the genus, and in many cases the species, strain, etc. of an unknown organism.

Examples of bacterial micro-organisms which are isolated from samples include *Staphylococcus aureus, Salmonella typhosa, Escherichia coli,* and *Neisseria gonorrhoeae.* Examples of fungus type micro-organisms which are isolated from samples include *Candida albicans, Actinomyces bovis, Cryptococcus neoformans,* and *Blastomyces dermatitidis.* In an actual process, a liquid, for example isolation broths, blood, urine, etc. or solids, for example feces, scrapings, etc. might be used to identify an unknown bacteria. Fungi requires the same type of isolation as bacteria but, unlike the bacteria, the fungi are generally not subjected to additional tests since colony characteristics and microscopic appearance alone are usually adequate for their identification.

Generally, two or three plates are streaked per sample

of the test specimen. The streaking process requires approximately thirty seconds per agar plate of a technologist's time. The quality of the streak and, therefore, the degrees of isolation of the micro-organism, depends on the training received by the technologist and the care taken in performing the process.

Problems typically encountered during a streaking process include the use of an improperly cooled inoculating needle following flame sterilization. As a result, the organisms may be destroyed during the streaking process. In addition, contaminants may be introduced by the use of an improperly sterilized inoculating needle. There are also the problems caused by the lack of reproducibility of streaks from one technician to another and the difficulty a technician often encounters in streaking soft agars which are easily cut. An improperly made streak must be redone before further testing is possible. The detection of a faulty streak may require anywhere from twelve to forty-eight hours, depending on the rate of growth of the organisms present in the sample.

Several different manual methods are presently used by technicians to isolate micro-organisms from a specimen. Although any method is acceptable if it results in the isolation of the micro-organisms being streaked, it would be preferable if a device were developed for automatically streaking the micro-organisms.

The device described in the referenced patent application enables the streaking of micro-organisms on an agar surface by causing a ball to rotate relative to the agar plate in a non-overlapping pattern. Prior to the relative rotation, micro-organisms are deposited on the surface of the agar plate. As the ball rotates, the micro-organisms are deposited on the agar surface so that by the end of the rotation cycle micro-organisms are deposited in isolated quantities. Streaking by means of the device is easily reproduced and a minimum of handling by technicians is required.

However, a problem is encountered in placing the ball or an equivalent element at the proper location on the agar layer. The ball must be sterilized prior to use. Otherwise, micro-organisms other than the micro-organisms of the specimen being analyzed may be spread on the layer. When the ball is sterilized outside of the petri dish, it is likely to be exposed to foreign bacteria, etc., in being positioned on the agar layer. Although the dish and ball can be sterilized together, the later deposition on the agar ordinarily covers the ball. Therefore, a petri dish is required which can contain the ball during sterilization without permitting the ball to be covered by agar, subsequently. Some means should be provided for positioning the ball at the proper time.

The present invention provides an improved petri dish and process for using the dish. As a result, contamination of the ball prior to spreading a specimen sample is avoided.

SUMMARY OF THE INVENTION

Briefly, the invention comprises a petri dish having an isolation chamber for a sterilized specimen sample-spreading element. The element is removed from the chamber in the dish after an agar layer has been formed in the dish for spreading a specimen sample in a non-overlapping pattern on the agar layer prior to incubation.

In a preferred embodiment, a magnetic spreading element is coated with the specimen while in the chamber.

The element with the specimen coating is magnetically lifted from the chamber and placed on the agar layer at a predetermined location. Thereafter, a second magnet means is actuated for enabling relative movement of the petri dish and element in a non-overlapping pattern. Afterwards, the element is removed and the plate is processed according to known techniques for incubating the micro-organisms spread on the agar surface.

Therefore, it is an object of this invention to provide a petri dish including a chamber for a sterilized specimen sample-spreading element.

It is another object of this invention to provide a process for using a petri dish having a chamber for isolating a specimen-spreading element.

It is a further object of this invention to provide a petri dish having a chamber for holding a specimen-spreading element during sterilization of the element and for permitting the element to be coated with a specimen sample prior to spreading the sample on an agar layer in the dish.

A still further object of this invention is to provide a magnetic element which can be removed by a magnet from its isolated chamber in an improved petri dish for spreading a specimen sample.

Still another object of this invention is to reduce contamination for a specimen-spreading element by isolating the element in a separate compartment of a petri dish until ready for use.

A still further object of this invention is to provide a process for coating a specimen-spreading element and placing the coated element at a predetermined position on an agar layer in a petri dish without exposing the element to unwanted contamination.

A still further object of this invention is to provide an improved petri dish having an isolation chamber where the dish is rotated for spreading a specimen sample by a sterilized element stored in the chamber prior to use.

These and other objects of this invention should become more apparent from the description of the invention, a brief description of the drawings of which follows:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view of a petri dish having a chamber along a portion of its circumference for enclosing a magnetic specimen sample-spreading element.

FIG. 2 is a cross-sectional view of the FIG. 1 embodiment.

FIG. 3 is a perspective view of a different embodiment of a FIG. 1 petri dish in which the chamber is slanted.

FIG. 4 is a top view of a third embodiment of a petri dish in which an isolation chamber comprises a circular channel inside the circumference of the dish.

FIG. 5 is a cross-sectional view of the FIG. 4 embodiment.

FIG. 6 is a perspective view of the fourth embodiment of a petri dish having an isolation chamber with slanted sides.

FIG. 7 is a cross-sectional view of the FIG. 6 embodiment.

FIG. 8 is a fifth embodiment of a petri dish including an isolation chamber located outside the circumference of the dish.

FIG. 9 is a cross-sectional view of the FIG. 8 embodiment.

FIG. 10 is a block diagram of the process for using the petri dishes shown and described herein.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 is a top view of the first embodiment of a petri dish **1** including chamber **2** formed at one side of the petri dish. Cover **6** is also shown. The dish, cover and the chamber may be formed simultaneously by moulding a plastic material into the configuration shown. A typical petri dish may be 3½ inches in diameter and be approximately ½ inch deep.

The chamber **2** must have an area sufficient for accommodating a specimen sample-spreading element. For purposes of this description, the element is represented by magnetic metal ball **3**. In less preferred embodiments, elements having other configurations could be used. For example, an oval or oblong member would be satisfactory to spread a specimen member sample on an agar layer (not shown).

Although petri dishes are ordinarily comprised of transparent, plastic material, other materials may be used as equivalents. For example, glass, wood, rubber or aluminum materials could be used. In one embodiment, the selected material must be capable of withstanding relatively high temperatures to which the dishes are subjected during sterilization. In other embodiments, the dish is sterilized by a gas, such as ethylene oxide, at relatively lower temperatures.

FIG. 2 is a cross-sectional view of the FIG. 1 embodiment showing the configuration of chamber **2**. The ball **3** rests on the bottom **4** of the chamber **2**. The top **5** of the chamber is open to permit the ball to be placed inside the chamber and to be removed at the appropriate time.

Cover or lid **6** seals the top of the chamber to prevent the ball from being displaced from the chamber prematurely. It also seals the petri dish and chamber from contamination prior to use.

An agar layer (see FIG. 10) fills the perti dish prior to being used and after sterilization. Since the ball is secured within the chamber, the forming of the agar layer is relatively easy. If the ball had been loose inside the dish, it would have been necessary to remove the ball prior to filling the dish with agar. As a consequence, the ball could have been contaminated. To prevent contamination, extraordinary precaution would have had to have been taken. The FIG. 1 embodiment overcomes that problem by the use of a chamber **2**. Chamber **2** isolates the ball from the rest of the dish when the agar layer is being deposited.

FIG. 3 is a perspective view of a petri dish **7** having a different embodiment of a chamber **8**. The chamber is formed by an incline **9** towards the bottom of the chamber. Otherwise, the FIG. 3 embodimetn is the same as the FIG. 2 embodiment. Ball **3** is shown in the chamber.

FIG. 4 is a top view of a petri dish **10** including cover **12**. The chamber for the ball **3** is a channel **11** extending around the inner circumference of the dish. The channel **11** has a width for accommodating ball **3**.

FIG. 5 is a cross-sectional view of the FIG. 4 embodiment. As indicated in FIG. 2, the cover seals the channel to prevent contamination and to prevent the ball **3** from escaping.

The bottom **13** of the channel is sufficiently removed from the bottom **14** of the dish so that the agar layer can be easily formed. However, it is pointed out that the bottom of the channel could be the bottom of the dish. It is generally not as deep as the bottom of the dish so that a less powerful magnet is required to lift the ball from the chamber and place it at a predetermined location on the agar layer (not shown) in the dish. However, it could be as deep as the bottom **14** of the dish **10** as indicated in FIG. 2.

FIG. 6 is a perspective view of a petri dish **15** having a chamber **16** with slanted sides. The ball rests at the bottom of the chamber where the slanted sides meet.

FIG. 7 is a cross-sectional view of the FIG. 6 embodiment. The ball **3** is shown in the bottom of the chamber. The cover is omitted in FIGS. 6 and 7.

FIG. 8 is a perspective view of a petri dish **18** including an external chamber **19** for a ball **3**. The chamber **19** is formed as shown in FIG. 9 so that the ball is held within the inverted cone formed by sides **22**. A cover seals both the chamber and the dish. The FIG. 8 embodiment is particularly useful when a magnet is not used to

position the ball. The inside rim **20** of the chamber is recessed from the top **17** of the dish. As a result, the dish can be tilted to permit the ball to race onto the agar layer (not shown) in the dish.

FIG. 10 is a block diagram of a process using the petri dish shown in FIGS. 1–9 in conjunction with the system described and shown in the referenced patent application. In the first step, numeral **31**, a ball is placed in a chamber of a petri dish. If the ball is sterilized prior to being placed in the chamber, care is taken to avoid handling the ball with anything but sterilized members. For example, a sterilized mechanical clamp could be used to move the ball from a sterilization cabinet into the chamber.

If the ball has not been previously sterilized, as is the usual case, it is sterilized in the chamber during the second step, numeral **32**. In that case, the dish and the ball are sterilized simultaneously. During the sterilization, the cover remains in place.

In the third step, numeral **33**, the dish is filled with an agar layer to the bottom of a chamber (see bottom **4** of FIG. 2). The cover is replaced afterwards. Processes for filling a petri dish with agar are known to persons skilled in the art.

In step four, numeral **34**, the cover is removed and a specimen sample is placed in the chamber with the ball. In a less than preferred embodiment, the specimen may be placed directly on the agar layer. A wooden stick or other known devices can be used to place the specimen sample at the selected place. As a result of putting the sample in the chamber with the ball, a film or coating is formed over the ball.

By reducing the quantity of specimen at the beginning of the spreading step, the specimen can be spread in smaller quantities on the agar. As a result, it is easier to isolate the micro-organism colonies produced during the incubation step.

In step five, numeral **35**, the petri dish **47** is placed on a rotatable table **38** such as the table shown and described in the referenced patent application. A magnet **39** is positioned over the chamber **40** for attracting the ball **41**. The magnet **39** may be automatically positioned by positioning motor **42** or it can be done manually. In other embodiments, the dish **47** can be tilted to permit the ball to roll out of the chamber onto the agar surface.

When the magnet **37** is positioned over the ball **41**, the ball is attracted toward the magnet. The force of the magnet pulling the ball forces the cover **43** upwards so that the ball is freed from the chamber. The magnet is moved by the positioning motor **42** and appropriate gears across the top of the cover until the ball is positioned at a predetermined location relative to the agar layer **44** in the dish.

In the preferred embodiment, the ball is deposited on the layer near the center as shown. When the ball is in the proper position, the magnet is either moved upwards so that its force is reduced or, if an electrical magnet is used, the electricity is turned off.

In step six, numeral **36**, magnet **45** is activated by positioning motor **46** to move in a straight line under the dish. Simultaneously, the table **38** is caused to rotate. As a result, the ball rolls along the agar surface in a non-overlapping pattern. More specifically, the ball and dish rotate relative to each other so that the specimen sample is deposited on the agar in a spiral pattern.

As previously described in the referenced patent application, the specimen is deposited on the agar layer in decreasing amounts. By the time the ball is rotated near the circumference of the dish, isolated quantities are deposited. When the ball reaches the outer circumferences, the magnet **45** is deactuated and magnet **39** is reactuated to place the ball back into the chamber.

In step 7, numeral **37**, the dish is placed in an incubator according to known techniques. After a required period of time, the micro-organisms grow on the agar layer as shown in the figure. The spiral pattern **48** is evident in the figure. The micro-organisms are taken from the dish for further study.

I claim:

1. A specimen-spreading combination comprising,
- a petri dish having a portion for holding an agar layer and a separate chamber isolated from said portion containing a magnetic ball for spreading a specimen sample on said agar layer,
- a removable cover common to said portion and said chamber,
- magnetic means for removing said magnetic ball from said chamber and depositing said magnetic ball on said agar layer,
- means for rotating said dish, and
- second magnetic means controlling said magnetic ball for spreading said specimen on said agar layer in a non-overlapping pattern.

2. The combination recited in claim **1** wherein said compartment has a depth less than the depth of said dish.

3. The combination recited in claim **2** wherein said compartment comprises slanted walls for confining said element at the bottom of the compartment until ready for use.

4. The combination recited in claim **1** wherein said compartment comprises a channel adjacent to the outer circumference of said dish.

5. The combination recited in claim **1** wherein said compartment is external to the circumference of said dish.

6. The combination recited in claim **1** wherein said compartment has an inclined surface adjacent to the circumference of said dish for guiding said element in and out of said compartment.

7. A process for automatically streaking a specimen sample over an agar layer in a petri dish having a separate chamber for a specimen-spreading element and a removable dish cover common to said dish and chamber, said process comprising the steps of,
- placing a magnetic ball spreading element in said chamber until ready for use,
- depositing an agar layer in said dish but not in said chamber,
- placing said dish on a rotatable plate,
- suspending a magnet over said chamber for attracting said magnetic element,
- moving said magnet for removing said element from said chamber without removing the cover and for positioning said element at a predetermined location over the agar layer,
- releasing said element from said magnet,
- placing a second magnet under said dish for attracting and guiding said magnetic element,
- rotating said dish and moving said second magnet means for spreading a specimen sample on the agar layer in a non-overlapping pattern.

8. The process recited in claim **7** wherein a specimen sample is placed in said dish, said specimen being placed in said dish for contacting the element prior to the relative rotation of the element and the dish.

9. The process recited in claim **7** wherein a specimen sample is placed in said chamber with said element prior to the removal of said element from said chamber whereby a relatively thin layer of the specimen is formed on the surface of said element.

10. A system for automatically streaking a specimen sample on an agar layer, said system comprising,
- a magnetic ball specimen-spreading element,
- a petri dish including a chamber for isolating said element from the portion of the dish provided for the agar layer until ready for use, said dish having a removable cover common to said dish and compartment for preventing contamination,
- a first movable magnet means for sufficiently lifting said cover and said element to remove said element from

said chamber and for placing said element at a predetermined location on said agar layer,

means for rotating said dish, and

a second movable magnet means for guiding said ball while said dish is being rotated.

11. The combination recited in claim **10** further including means for rotating said element and said dish relative to each other for spreading a specimen sample in a non-overlapping pattern.

12. The combination recited in claim **10** further including means for placing a specimen sample in said chamber with said ball, whereby a film of the specimen

sample is formed over the ball prior to being placed on said agar layer.

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U.S. Cl. X.R.

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