# United States Patent

[11] **3,570,816**


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[73] Assignee **Central Research Laboratories, Inc.**
**Red Wing, Minn.**
[32] Priority **May 22, 1968**
[33] **France**
[31] **PV152,814**
**Pat. 1,578,992**


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[54] **MANIPULATOR HANDLE**
**7 Claims, 5 Drawing Figs.**


[52] **U.S. Cl.** ..... **254/173,**
200/157, 318/345, 214/1, 254/150
[51] **Int. Cl.** ..... **B66d 1/46,**
B66d 1/50, B66d 1/56
[50] **Field of Search** ..... 294/110;
254/150, 135, 173; 173/170; 318/345, 139;
200/157; 214/1 (RCM), (RC)



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*Assistant Examiner*—Merle F. Maffei
*Attorney*—Burd, Braddock & Bartz


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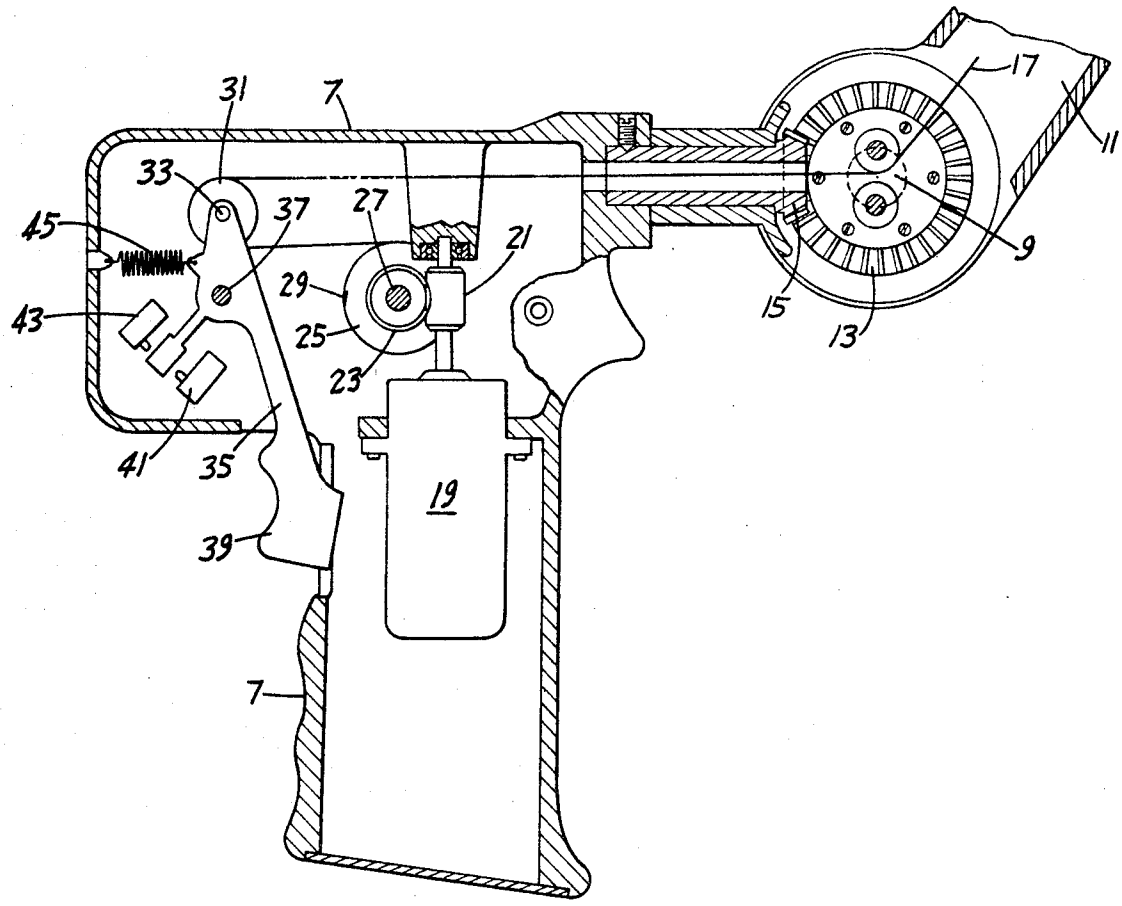
**ABSTRACT:** A motorized handle for controlling the opening and closing of the grab or tong of a master-slave remote control manipulator characterized by increased ease of operation and mechanical boost of gripping force. A motor driven winch controlled by a pair of switches actuated by a lever or trigger manipulated by the operator from his normal handle gripping position provides auxiliary force supplementing that applied by the operator. Means are provided to lock the grab in closed position with a safety feature to prevent application of excessive force which might break the force transmitting cable.

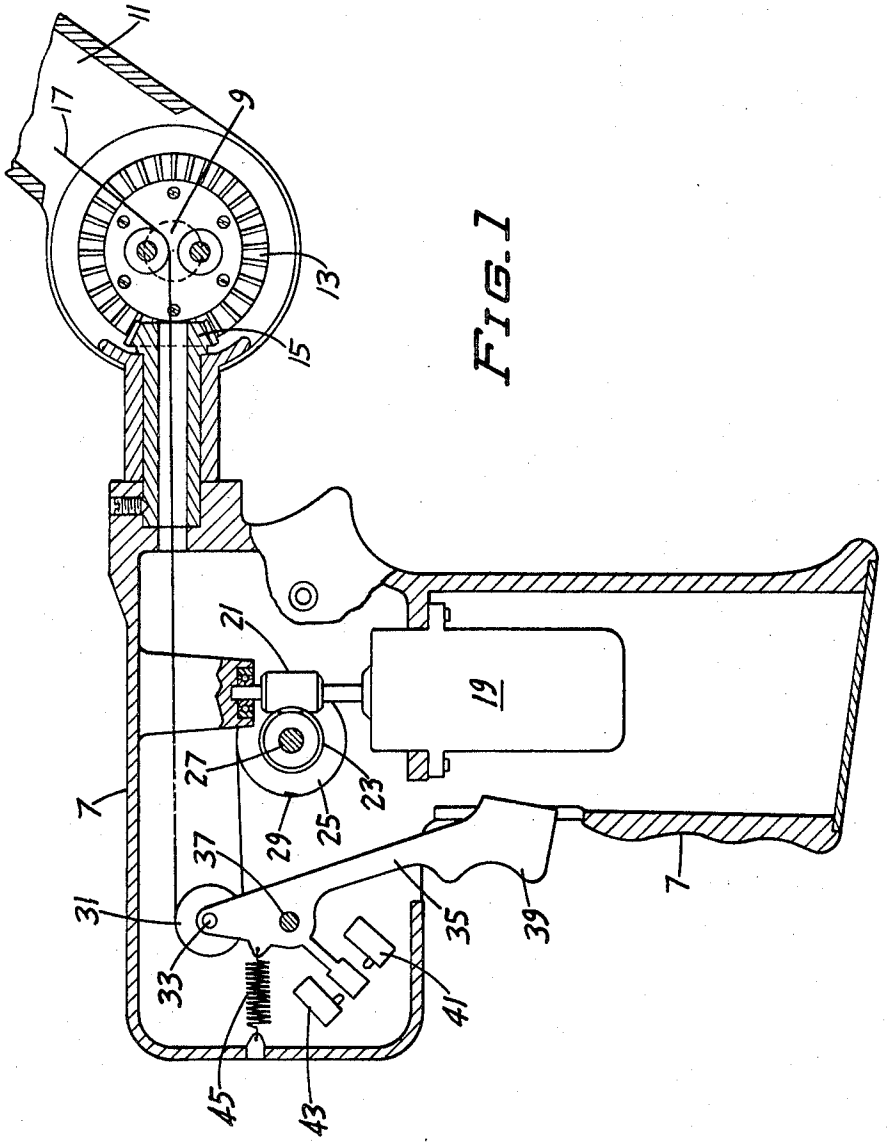



FIG. 1

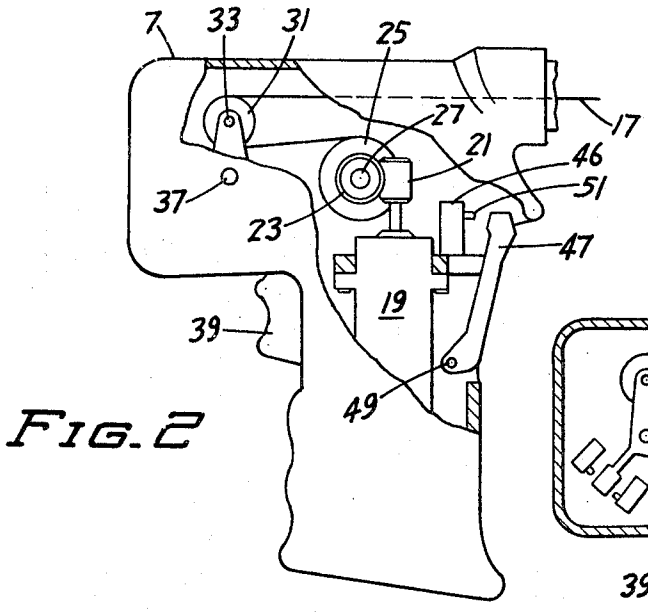



FIG. 2

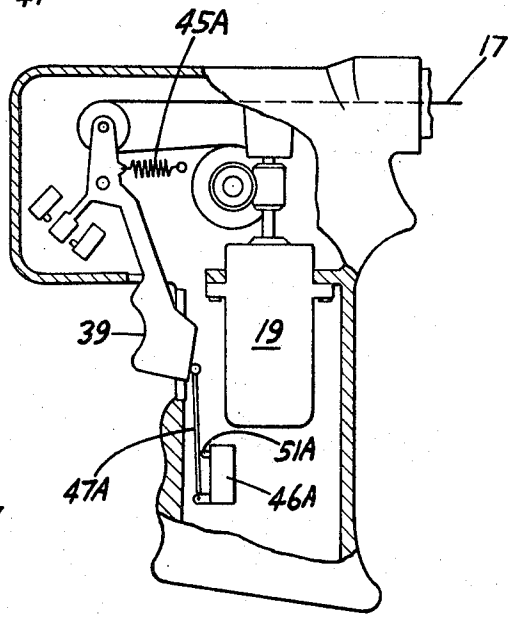



FIG. 3

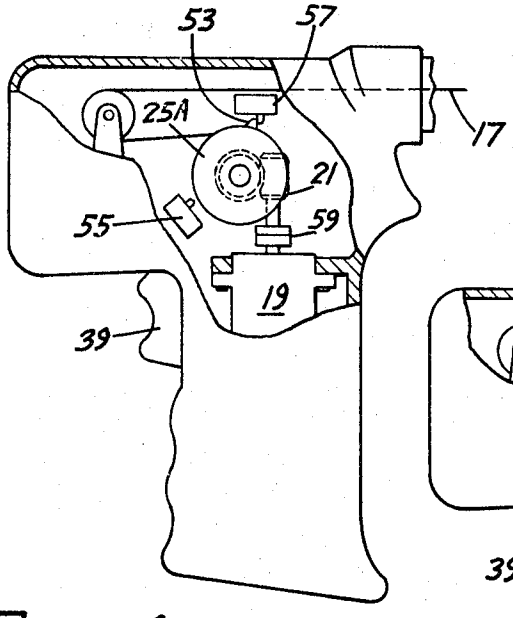



FIG. 4

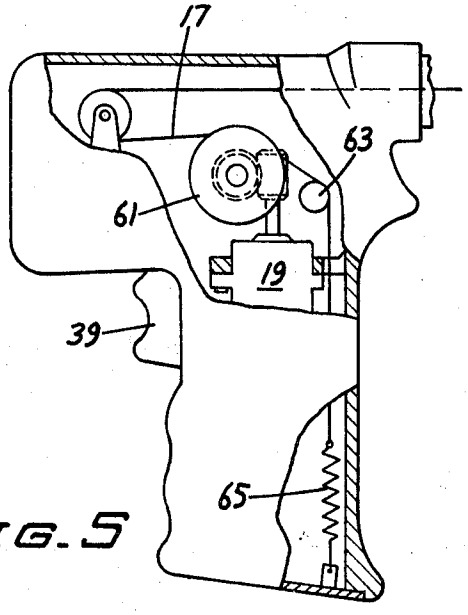



FIG. 5

# MANIPULATOR HANDLE

The invention relates to an improved "master" handle or "-master-slave" manipulators, the handle being adapted to control the opening or closing movements of a "slave" grab acting inside a biological screening enclosure.

Various kinds of handles are known for "master-slave" manipulators. All of them act in a similar mechanical manner, i.e. without contributing energy from outside, to convert the force of the operator's hand into the tensioning of a cable which controls the clamping of a grab disposed at the other end of the manipulator.

Some of these handles are held by the operator between his palm and three fingers of his hand by means of a stock, his index finger and thumb acting on levers which provide almost physiological clamping. Others resemble the stock of a weapon having a strong trigger comparable to the levers by which, for instance, cycle brakes are formed. In both cases, the travel of the levers is small, since the operator's hand must keep a good grip on the stock to which he applies the forces to be communicated to the manipulated article, to raise it and move it. Moreover, this force is bound up with the locking force transmitted, and in practice the handle has to be gripped with at least twice the force of the weight of the article gripped, the result being that the operator becomes overtired. This tiredness increases if the grab opens widely, since the opening of the trigger is proportional thereto.

Hitherto, to avoid these disadvantages, manipulator handles have been given pawl-locking mechanisms which enable the tightening force to be maintained even if the operator ceases to press, so that his tiredness is reduced. Grabs can also be closed by auxiliary means, for instance, pneumatic means. Lastly, there are handles with a stepped-down clamping effect, the full travel of the grab being controlled by a number of successive actions performed on the trigger, but this arrangement makes the handling of the handles difficult and moreover complicates the locking systems.

It is an object of the present invention to adapt manipulator handles so that they meet various practical requirements more satisfactorily than hitherto, and more particularly so that they avoid the various aforementioned disadvantages and enable the relationship between the tightening force and the manipulating force to be correctly determined. Further objects are to improve the operator's grip on the handle, to enable the tightening of the grab to be automatically locked, and also to limit the tightening of the grab to a maximum safety force which prevents the movement-transmitting cable from being broken.

According to the invention there is provided a handle for controlling the opening or closing movements of a manipulator grab, comprising a hollow stock adapted to be held in an operator's hand, the handle also comprising, disposed inside the stock, a winch on which a movement-transmitting cable is wound, a motor, with a torque limiter, for driving the winch, a trigger for controlling the motor, the trigger, which can be actuated by the operator, being formed by one of the ends of a lever pivoting around a pivot which is fixed in relation to the stock, the other end of the lever, which is associated with a return spring, bearing a reversing pulley over which the movement-transmitting cable runs, the handle also comprising two limit members associated with the lever and controlling the operation of the motor in the required direction.

In the preferred embodiment of the invention the automatic-locking system may be formed by a switch actuated by the operator at the same time as the trigger.

The torque limiter may be of the friction type and is associated with a finger carried by the winch, the finger acting on two limit switches adjusted to prevent the movement-transmitting cable from being broken by being wound on, or from being slackened as a result of unwinding.

Alternatively, the torque limiter may be formed by a capstan acting as the winch, the movement-transmitting cable being attached upstream of the capstan to a calibrated spring adjusted to an acceptable tensioning of the cable.



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

FIG. 1 is a vertical section through a first embodiment of a manipulator handle according to the invention;

FIG. 2 is a partially sectioned view of a second embodiment of a manipulator handle according to the invention;

FIG. 3 is a partially sectioned view of a third embodiment of a manipulator handle according to the invention;

FIG. 4 is a partially sectioned view of a fourth embodiment of a manipulator handle according to the invention; and

FIG. 5 is a partially sectioned view of a fifth embodiment of a manipulator handle according to the invention.

As can be seen in FIG. 1, a handle 7 in the form of a hollow stock is articulated around the pivot 9 of a manipulator master handle 11. Articulation perpendicular to the pivot 9 is ensured by the pinions 13, 15. A movement-transmitting cable 17 extends through the whole manipulator assembly as far as its slave-grab, whose opening and closing the cable controls.

Disposed inside the hollow stock 7 is an electric motor 19 driving, after reduction, a pinion 21 which meshes with pinion 23 of a winch 25 of axis 27, to which the cable 17 is attached at a place 29. Before extending into the manipulator, the cable 17 runs over a pulley 31 whose spindle 33 is borne by a lever 35 articulated around a pivot 37 unitary with the stock 7. The other end of the lever 35 forms a trigger 39 having engagement notches. Tensioning of the cable 17 exerts on the pulley 31 a reaction which tends to move the trigger 39 away from the stock 7. The relationship between the two arms of the lever 35 enables the gripping force of the grab to be felt in a given stepped-down ratio. Having regard to the stepping down, the travel of the trigger 39 can correspond to a small travel of the grab, and when the latter seizes a hard article, the force is absorbed by the elasticity of the transmission cable 17.

Two switches 41, 43 come into operation at the end of the trigger 39 and actuate the motor 19 in the direction for winding the cable 17 on or off respectively. Moreover, a spring 45 enables the trigger 39 to be returned to the central position, even though the cable 17 is tensioned.

In these conditions the handle operates as follows: when the operator wishes to grasp an article with the manipulator, he takes the handle in his hand and actuates the trigger 39. If the travel of the trigger does not enable the jaws of the grab to be brought into contact with the article, the switch 41 comes into operation and winds on the cable 17 and therefore closes the grab. When the jaws of the grab come into contact with the article, the tensioning of the cable 17 tends to move the trigger 39 away. When the required force is felt, the operator allows the trigger 39 to move away, thus stopping the motor 19. To release the article, the operator allows the trigger to move away. If the travel of the trigger does not enable the article to be released, and this often happens, since there is a considerable stepping down, the switch 43 comes into operation and unwinds the cable 17 until the grab is completely open, if the operator does not hold back the trigger. In this case, when the cable 17 is stretched to the complete opening of the grab, the spring 45 returns the trigger 39 to the central position, thus stopping its action on the switch 43 and stopping the motor.

As can be seen in FIG. 2, which shows the main members described hereinbefore, a switch 46 may have to be provided which enables the operator to lock the assembly even when the trigger 39 is released. In these conditions the article remains gripped in the grab, the travel of the trigger causing only a slight relaxing which is absorbed by the elasticity of the cable 17. As can be seen in FIG. 2, in this embodiment the switch 46 springs is disposed at the rear portion of the stock 7 and is actuated by a lever 47 articulated around a pivot 49 and acting on a contact 51. This arrangement enables the supply circuit of the motor 19 to be closed when the operative's hand is holding the stock 7, and conversely enables the circuit to be cut out immediately when his hand releases the stock.

As can be seen in FIG. 3, the switch 46A, its contact 51A and the lever 47A are disposed beneath those fingers of the operator which actuate the trigger 39. In this arrangement the

complete release of the trigger 39 does not abruptly open the grab. The return force produced by the spring 45A, which in this embodiment is disposed towards the rear, and the return force of the tensioning of the cable 17, is always greater than the force required for closing the switch 46A. Clearly, the switch can readily be released without releasing the trigger 39, so that precise manipulation can be performed without any risk that the motor 19 will suddenly come into operation.

As can be seen in FIG. 4, a safety system can also be provided to prevent the cable 17 from being excessively tensioned or relaxed. In a first possible method, the winch 25A has a finger 53 which acts for required limit travel on switches 55, 57.

A friction-type torque limiter 59 can also be disposed between the output of the reducer of the motor 19 and the pinion 21. The torque limiter is adjusted to the maximum nominal force of the grab and the cable 17.

FIG. 5 shows a modification of the preceding system which avoids the use of two switches and regulates the cable automatically if it is slightly elongated. A capstan 61 takes the places of the winch 25A and the cable 17, after running over a reversing pulley 63, is attached at its end to a calibrated spring 65 which ensures, for a constant wound-on length, a sliding tension adjusted to the maximum nominal value of the force of the grab and the cable 17. During the opening of the grab, when the tensioning of the cable 17 falls to zero, the cable then slides freely over the capstan 61.

We claim:

1. A handle for controlling the opening and closing of a grab of a master-slave manipulator, said handle comprising:
   - A. a hollow stock adapted to be held in an operator's hand;
   - B. a winch disposed within the stock on which an elongated flexible movement-transmitting member is wound;
   - C. a motor for driving the winch;
   - D. a lever resiliently mounted for rotational movement about a pivot which is fixed in relation to the stock;
   - E. one end of said lever being a trigger which can be actuated by the operator for controlling the motor;
   - F. a reversing pulley, over which said movement-transmitting member runs, mounted at the opposite end of said lever;
   - G. a pair of switches for controlling operation of the motor in opposite directions; and
   - H. an arm on said lever disposed between said switches for actuation thereof in response to movement of the lever.

2. A manipulator handle according to claim 1 further characterized in that said motor is provided with an automatic-locking system comprising:
   - A. a further switch for controlling the power supply to the motor; and
   - B. a further lever mounted for actuation by the operator for rotational movement about a pivot which is fixed in relation to the stock;
   - C. said switch being in the rotational path of said lever for actuation of the switch by the operator.

3. A manipulator handle according to claim 1 further characterized in that said motor is provided with a torque limiter.

4. A manipulator handle according to claim 3 further characterized in that:
   - A. said torque limiter is of the friction type;
   - B. a pair of limit switches for controlling said torque limiter are mounted adjacent the periphery of said winch; and
   - C. said winch has a switch-actuating finger on its periphery whereby upon rotation of said winch said switches are actuated to prevent the movement-transmitting member from breaking by being wound or from being slacked by being unwound.

5. A manipulator handle according to claim 3 further characterized in that:
   - A. said winch is a capstan;
   - B. one end of a spring is secured within said handle stock;
   - C. the upstream end of the movement-transmitting member is attached to the opposite end of said spring; and
   - D. said spring is calibrated to an acceptable tensioning of the movement-transmitting member to prevent said member from breaking or being slackened.

6. A manipulator handle according to claim 1 further characterized in that said movement-transmitting member is a cable.

7. A manipulator handle according to claim 5 further characterized in that said lever is spring loaded for resilient rotational movement relative to said stock.

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(5/69)

# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,570,816 Dated March 16, 1971

Inventor(s) Jean Germond et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 3, "or" should be --for--.

Column 2, line 35, after "the" (second occurrence) --travel of the-- is omitted.

Column 2, line 67, "springs" should be omitted.

Column 2, line 69, "5!" should be --51--.

Column 2, line 73, after "Fig. 3", --in a modification-- is omitted.

Column 4, line 39, "claim 5" should be --claim 1--.

Signed and sealed this 20th day of July 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents