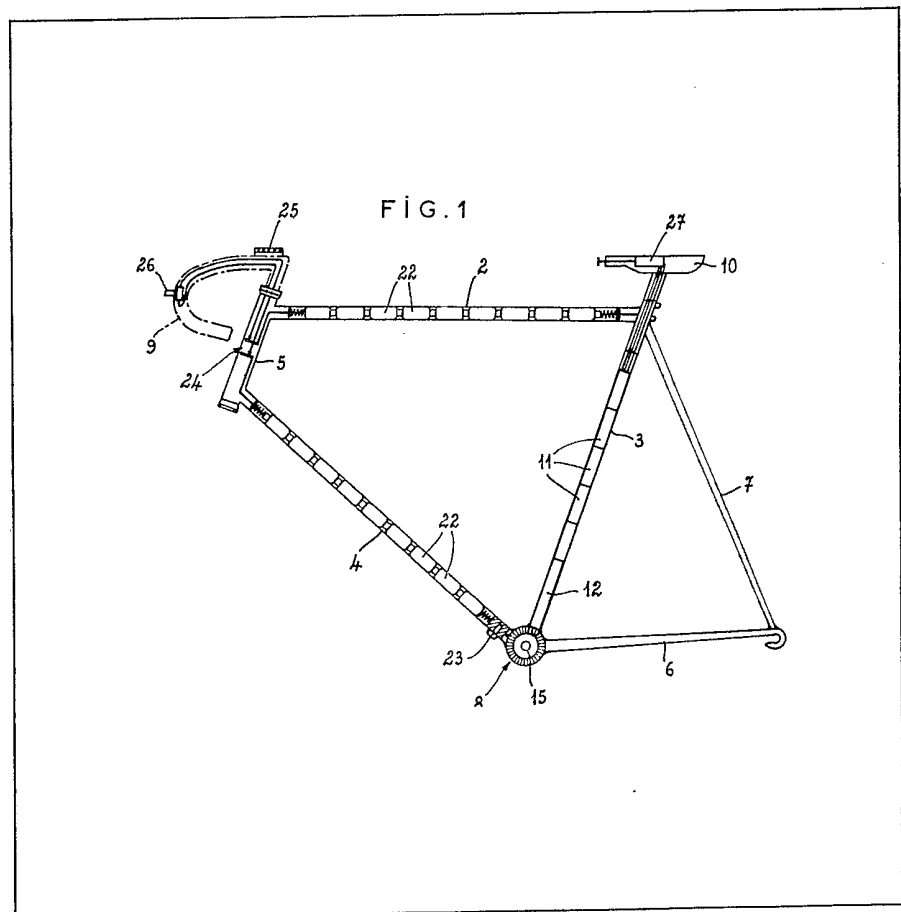


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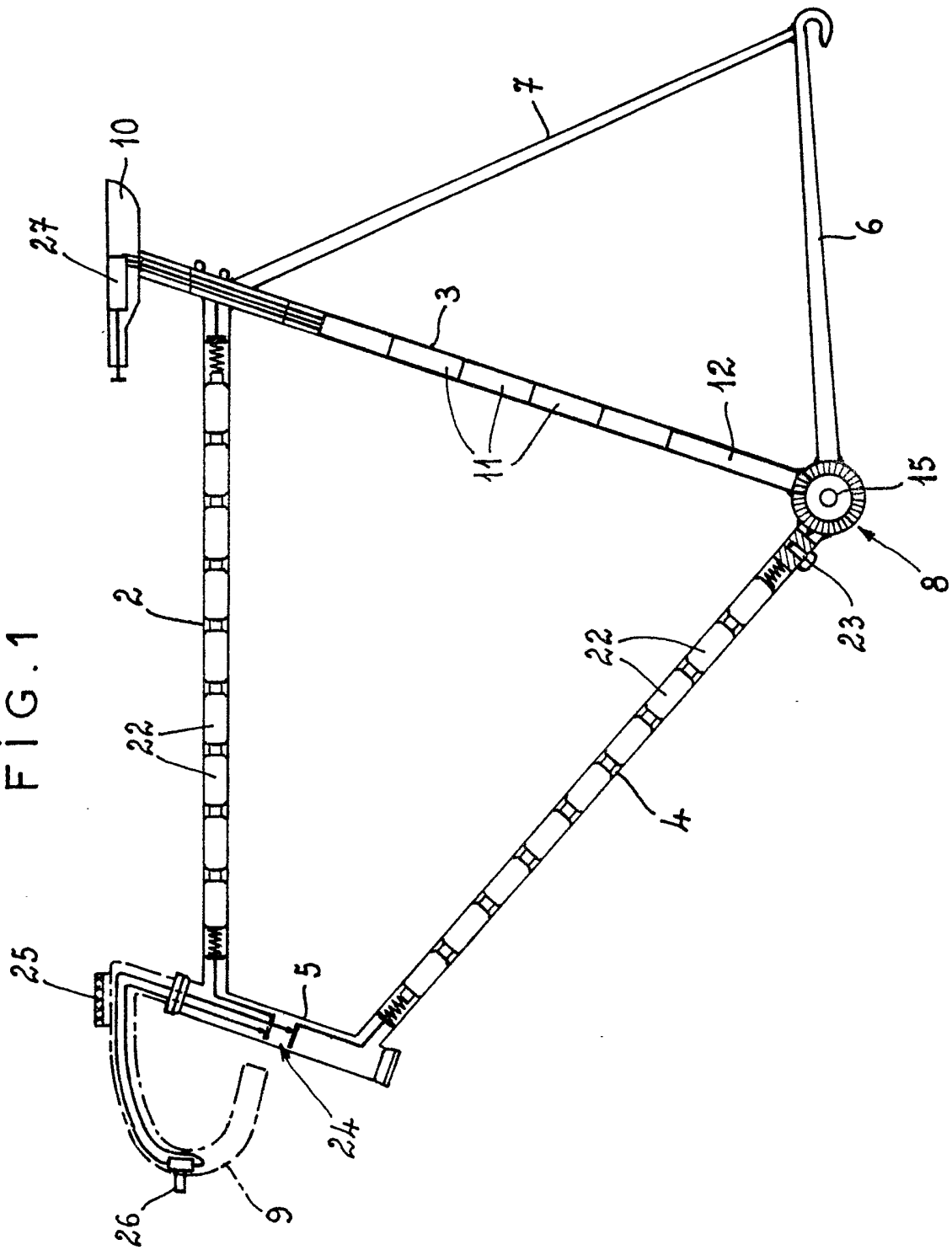
(54) An electric bicycle

(57) One of the tubes (3) of a bicycle frame opens into a crank-gear box (8) and is fitted with at least one electric motor (11). The motor (11) has a shaft coaxial to the tube (3) in which it is housed. Reduction gearing (12) driven by the motor shaft has an output connected through the intermediary of a bevel gear to a shaft keyed on a spindle driving plate of the crank-gear. Storage batteries (22) are provided which ensure a supply of current to the motor (11), the batteries being capable of connection both in series and in parallel with the motor or motors under the action of a reversing switch (27). A second switch (26) is provided for ensuring the opening or closing of the battery circuit.



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FIG. 1



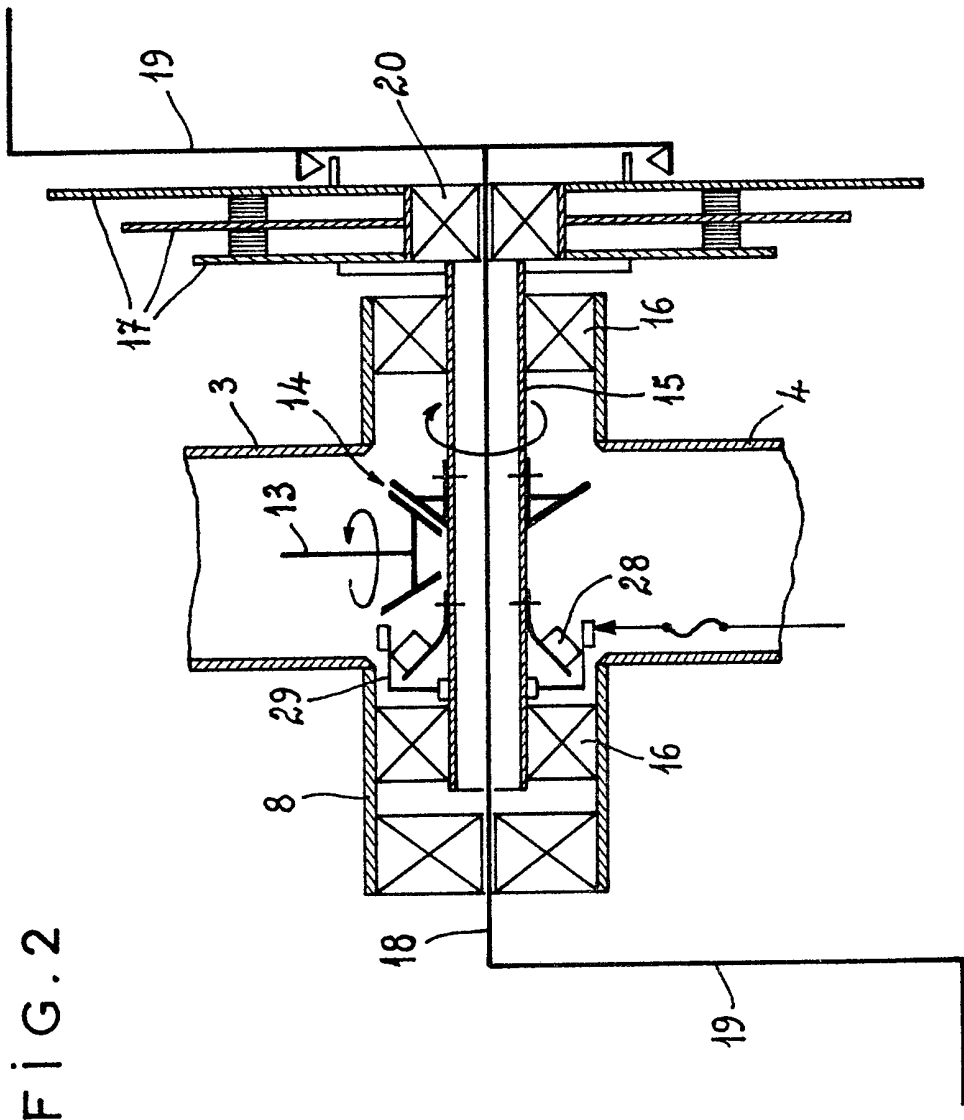


FIG. 2

## SPECIFICATION

## A bicycle

5 The present invention relates to a bicycle.

Recent years have seen a considerable increase in the use of the bicycle for the purpose of making long excursions. This sport attracts a large number of people, even those who are relatively old and have sedentary occupations. The lack of training and/or physical ability does not always enable people to make the long excursions which they would wish or occasionally allows them to make the latter solely with excessive exertion.

10 In other cases, where the bicycle is used as rehabilitation means, it is also desirable that the user is not subject to excessive physical exertions.

The object of the present invention is to provide a bicycle of a sporting type, but which is equipped so that it enables its user to overcome difficulties if the latter has a moderate physical ability or wishes to make excessively long journeys.

15 According to the present invention there is provided a bicycle comprising a tubular frame in one of the tubes of the frame opening into the crank-gear box is fitted at least one electric motor with a shaft which is coaxial with the tube in which it is housed, a crank-gear reduction gearing associated with said motor or motors whereof the output from the gearing is connected through the intermediary of a bevel gear to a shaft keyed on a spindle driving plate of the crank-gear, storage batteries which ensure a supply of electrical current to the or each motor and which are capable of being connected both in series and in parallel with the motor or motors under the action of a reversing switch, and a second switch to ensure the opening or closing of the circuit including said batteries.

20 In no case is it a question of one or two motors having sufficient power to drive the bicycle and a passenger, but solely to provide assistance to the sportsman by virtually cancelling out the effort which he would have to produce in order to move the weight of the bicycle.

25 In fact, to the extent that this bicycle is provided with five electric motors, an approximate power provided by the motors of 40 watts has to be measured at a speed of rotation of the crank gear of 80 r.p.m. This power is relatively low, as will be realised in comparison with that of 200 watts which a cyclist in training is able to produce.

30 The motors may be connected in parallel when they must produce power and may be connected in series in order to be able to operate as a dynamo, in order to recharge the batteries.

35 The assistance provided by the motors should be used advantageously solely on inclines or ascents, the cyclist benefiting from downhill stretches and even periods on the flat for recharging the batteries. So as not to constitute an excessive hindrance to the forwards movement of the bicycle, it has been found that one could produce a charging power of the order of 10 watts. It will be seen that the total duration of the charging periods should be greater than that of the periods in which the motor provides

power to facilitate riding of the bicycle.

40 It is naturally possible for the cyclist to recharge the batteries in his bicycle during periods when the latter is not in use, with the assistance of additional means.

45 The reversing switch makes it possible to place the motors either in the charging position, or in the driving position, and the second switch, provided on the handlebars of the bicycle, ensures closure of the circuit for the purposes either of supplying energy to the motors for propelling the bicycle, or recharging the batteries.

50 In one embodiment of the invention, the electric motors are housed inside the seat tube.

55 Advantageously, in this case, the batteries are housed in the tubes of the lower and upper frame.

60 It is also possible to house a certain number of batteries outside the bicycle frame in an independent container, for example in the shape of a bicycle pump, facilitating the movement of the batteries for the purpose of recharging them.

65 It should be noted that the solutions mentioned above are very advantageous since they in no way alter the aesthetic appearance of a traditional bicycle, only the sections of certain tubes being able to be slightly larger than traditionally, however without this being noticeable at a first glance.

70 In order to prevent the surges which may occur if a considerable power is required of the motor without the cyclist pedalling at a sufficient speed, the bicycle of the present invention preferably comprises a device ensuring the closure of the electrical circuit above a certain speed of rotation of the shaft driving the plates.

75 This device ensuring the closure of the electrical circuit above a certain speed of rotation of the shaft driving the plates is preferably constituted by pawls mounted on the periphery of the shaft and able to move away from the latter in order to ensure the closure of an electrical contact.

80 The bicycle also preferably comprises a free wheel in the vicinity of the crank-gear.

85 This feature is advantageous in the sense that when on a downhill stretch, it facilitates propulsion from the rear pinions of the plates of the crank-gear and from the shaft with which the bevel gear is associated for the purpose of recharging the batteries without the user having to pedal.

90 It should be noted that, when the electrical circuit is open, the bicycle may be used as a traditional bicycle apart from the difference that the crank-gear shaft ensures the drive of the reduction gearing. If this drive causes a slight hindrance at the time of starting, it does not constitute a drawback when the bicycle is moving, since its inertia facilitates the passage of the upper dead centre.

95 The bicycle according to the invention also preferably comprises a crank-gear box which contains a hollow shaft, on which a pinion is keyed belonging to the bevel gear associated with the reduction gear, which pinion is mounted to pivot in bearings at one end of which are keyed front plates for driving a bicycle chain, a spindle being provided passing through this hollow shaft, which spindle is mounted to pivot in bearings independently of the shaft and

keyed to the two ends of which are the cranks for bicycle pedals, this spindle being associated with the plate for driving the chain through the intermediary of a free wheel.

5 The invention will now be described by way of example with reference to the accompanying diagrammatic drawings in which:-

10 *Figure 1* is a longitudinal sectional view of the frame of a bicycle according to the present invention; and

*Figure 2* is a cross-sectional view to an enlarged scale of a crank-gear box of this bicycle.

In known manner, the bicycle as shown in the drawings comprises a frame comprising a top tube 15 2, a seat tube 3, a down tube 4, a steering socket 5, a base fork 6 and stays 7.

The seat tube 3, the bottom tube 4 and the base fork 6 are joined in the vicinity of the crank-gear box 8.

20 This bicycle also comprises, in a traditional manner, handle-bars 9 associated with a stem, as well as a set 10 fitted in an adjustable manner at the upper end of the seat tube.

In the embodiment illustrated in the drawing, five 25 coaxial motors 11 with two shafts are mounted in the seat tube 3, the shafts being coaxial to the seat tube. These motors are associated with reduction gearing 12 whereof the output shaft 13 is itself associated, through the inter-mediary of bevel gearing 14, with a 30 hollow shaft 15.

This shaft 15 is mounted to pivot inside the crank-gear box 8 with the interposition of bearings 16. Keyed at the end of the shaft 15 are the plates 17 ensuring the drive of the bicycle chain.

35 Mounted inside the shaft 15 and passing completely through the latter is a spindle 18 on the ends of which are fixed the cranks 19 supporting the pedals, not shown in the drawing. The spindle 18 is associated through the intermediary of a free wheel 40 20 with the plates 17.

In the embodiment illustrated in the drawing, the top and bottom tubes 2 and 4 of the frame contain storage batteries 22. The storage batteries are connected to the motors through the intermediary of 45 an electrical circuit in particular comprising a fuse 23, a rotating contact 24 in the vicinity of the steering socket, a charge indicator 25, a switch 26 on the handle-bars 9, as well as a reversing switch 27 located below the bicycle seat, making it possible 50 either to connect the motors in series or in parallel.

The electric circuit passes through the inside of the crank-gear box where it comprises a switch constituted by pawls 28 cooperating with a cup 29 55 insulated electrically with respect to the shaft 15. For a low speed of rotation of the shaft, the pawls are close to the latter. When the speed of rotation increases and reaches 40 r.p.m. for example, the pawls move away from the shaft and into contact with the cup thus ensuring the closure of the electric 60 circuit.

From a practical point of view, the use of this bicycle is as follows:

When the circuit is open, the bicycle behaves like a traditional bicycle.

65 When the cyclist approached a difficult incline, it is

sufficient for him to place the reversing switch 27 in the position corresponding to a parallel connection of the motors and to depress the switch 26. If the speed of rotation of the spindle of the crank-gear is 70 sufficient, the electric circuit will be closed and the motors will provide a certain assistance for the forwards movement of the bicycle.

At the top of an incline and before beginning a descent, it is sufficient for the cyclist to operate the 75 reversing switch 27 in order to produce the series connection of the motors, causing them to act in the manner of dynamos. An action on the switch 26 in order to close the circuit will thus ensure recharging of the batteries.

## 80 CLAIMS

1. A bicycle comprising a tubular frame in one of the tubes of the frame opening into the crank-gear 85 box is fitted at least one electric motor with a shaft which is coaxial with the tube in which it is housed, a crank-gear, reduction gearing associated with said motor or motors whereof the output from the gearing is connected through the intermediary of a 90 bevel gear to a shaft keyed on a spindle driving plates of the crank-gear, storage batteries which ensure a supply of electrical current to the or each motor and which are capable of being connected both in series and in parallel with the motor or 95 motors under the action of a reversing switch, and a second switch to ensure the opening or closing of the circuit including said batteries.

2. A bicycle as claimed in Claim 1, in which the electric motor or motors are housed inside the tube 100 of a frame to which a seat is attached.

3. A bicycle as claimed in Claim 2, in which the batteries are housed in bottom and top tubes of the frame.

4. A bicycle as claimed in any one of Claim 1 to 3, 105 which further comprises a device ensuring the closure of the electric circuit only when a predetermined speed of rotation of the shaft for driving the plates is reached.

5. A bicycle as claimed in Claim 4, in which said 110 device comprises pawls mounted on the periphery of the shaft and able to move away from the latter in order to ensure the closure of an electric contact.

6. A bicycle as claimed in any one of Claims 1 to 5, which further comprises a free wheel in the 115 vicinity of the crank-gear.

7. A bicycle as claimed in Claim 6, in which the crank-gear box contains a hollow shaft on which is keyed a pinion belonging to the level gear associated with the reduction gearing, which pinion is mounted 120 to pivot in bearings at one end of which are keyed front plates for driving a bicycle chain, a spindle being provided passing through this hollow shaft, which spindle is mounted to pivot in bearings independantly of the shaft and keyed to the two ends 125 of which are the cranks for bicycle pedals, this spindle being associated with the plate for driving the chain through the intermediary of a free wheel.