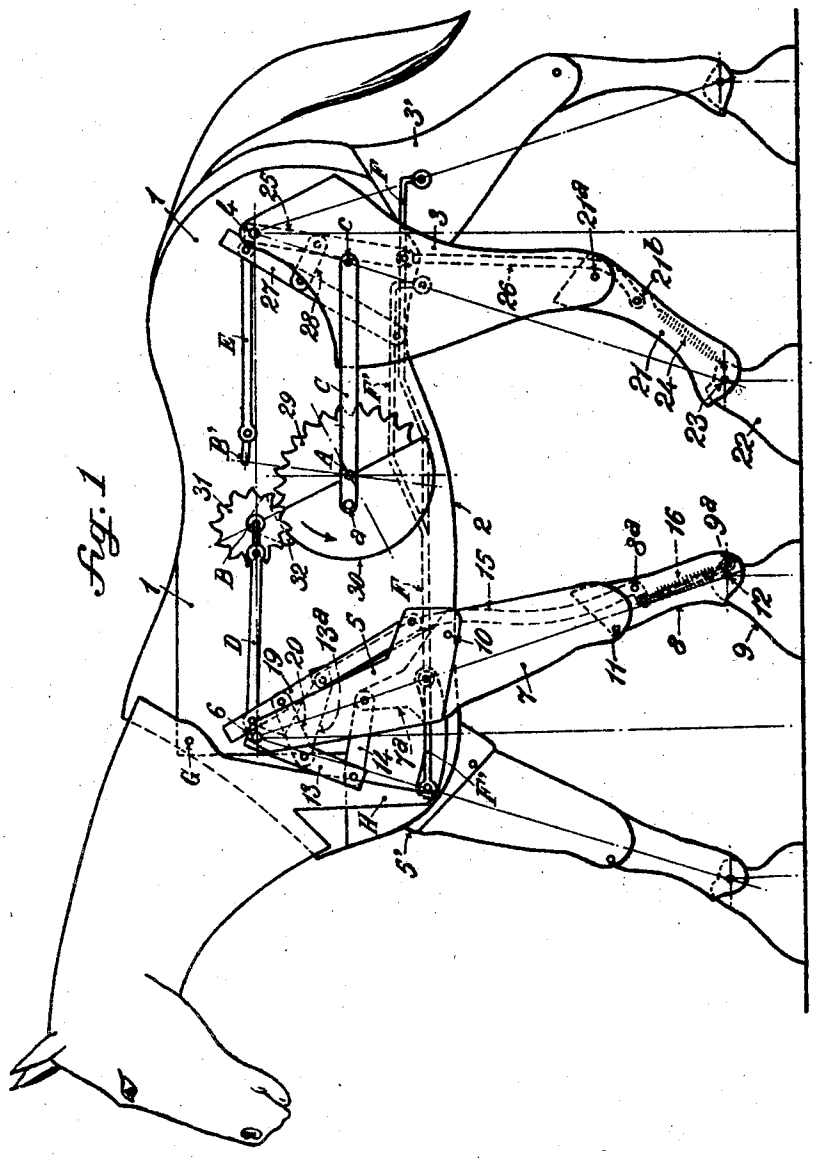
Aug. 9, 1927. 1,638,332

V. GOBBATO

MECHANISM FOR REPRODUCING ALL THE MOVEMENTS OF THE STEPS OF QUADRUPEDS

Filed March 12, 1925 2 Sheets-Sheet 1

Fig. 1



Inventor.
Vittorio Gobbato.
By Atty.

Aug. 9, 1927. 1,638,332

V. GOBBATO

MECHANISM FOR REPRODUCING ALL THE MOVEMENTS OF THE STEPS OF QUADRUPEDS

Filed March 12, 1925 2 Sheets-Sheet 2

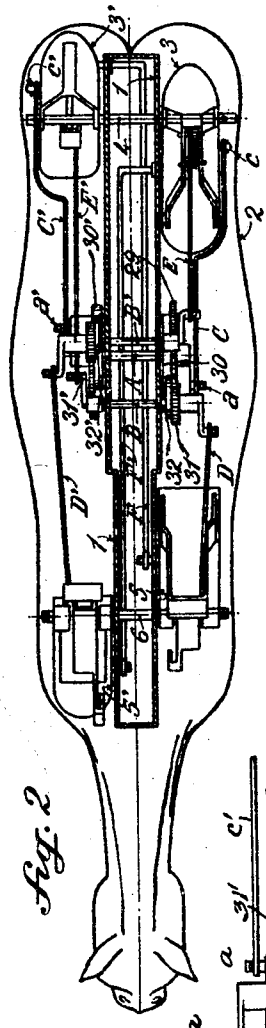


Fig. 2

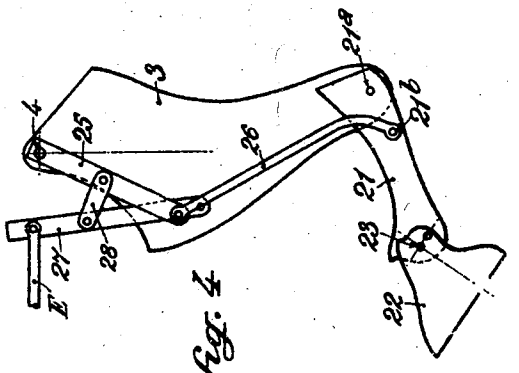


Fig. 4

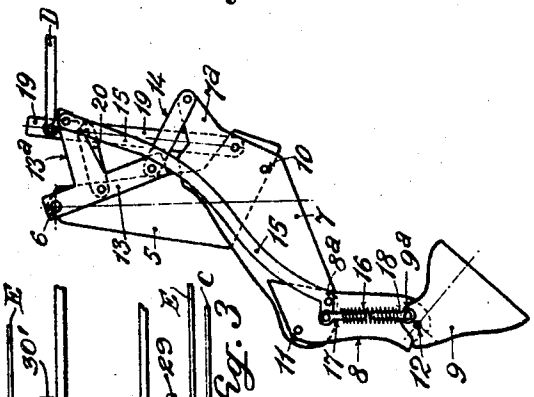


Fig. 3

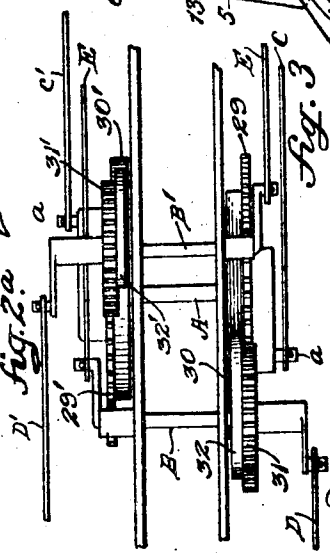


Fig. 2a

Inventor,
Vittorio Gobbato
By
Atty.

Patented Aug. 9, 1927. 1,638,332

UNITED STATES PATENT OFFICE.

VITTORIO GOBBATO, OF MILAN, ITALY.

MECHANISM FOR REPRODUCING ALL THE MOVEMENTS OF THE STEPS OF QUADRUPEDS.

Application filed March 12, 1925, Serial No. 15,014, and in Italy March 22, 1924.

The present invention has for its object to provide a mechanism for reproducing all the movements of the steps of quadrupeds, this mechanism comprising essentially a main shaft having two oppositely arranged cranks and continuously rotated from a suitable source of power. This shaft serves to impart through connecting rods a to-and-fro pendulum movement to one pair of the legs of the mechanism which are each composed of several parts articulated to one another and are attached to the body of the mechanism so as to be capable of oscillating movement relative thereto, coupling rods being provided for transmitting the movement of each leg of the hind pair to a leg of the front pair on the opposite side of the body.

The arrangement further comprises two secondary shafts, each provided with two oppositely arranged cranks driven intermittently in succession from the same source of power, and actuating in an intermittent manner by means of connecting rods, the mechanisms for operating the articulations of two legs located on opposite sides, one in front and the other at the back, whilst the articulations of the other two legs are locked against movement owing to the locking of their driving crank shaft, so that the latter legs being held rigid engage with the ground, and perform the step.

One constructional form of the invention is shown, merely by way of example, in the accompanying drawing in which: Figures 1 and 2 show the mechanism as a whole in vertical and horizontal section respectively; Fig. 2ª is an enlarged detail view of a portion of the mechanism shown in Fig. 2; Figures 3 and 4 show the mechanisms controlling the articulations of a front and back leg respectively.

The mechanism comprises the main shaft A having two oppositely arranged cranks—*a*—, —*a'*— and rotatably mounted in a suitable frame 1, which is arranged inside the body 2 of the quadruped, this shaft being continuously rotated, in any suitable manner, as for example by means of a spring motor arranged in the interior of the frame 1. Connecting rods C, C', are provided connected at one end to the cranks —*a*—, —*a'*—, and at the other end at —*c*—, —*c'*— to the upper parts 3, 3' of the hind legs of the quadruped, which are mounted so as to be capable of oscillating on the transverse shaft 4 secured to the frame 1, these rods serving to impart opposite pendulum movements to the legs. The upper parts 5, 5' of the front legs of the quadruped, are mounted so as to be capable of oscillation on the transverse shaft 6, which is also secured to the frame 1, and are actuated with a pendulum movement by the parts 3', 3 respectively of the hind legs by means of crossed rods F, F' which effect the coupling of the upper part of a hind leg with that of the front leg located on the opposite side of the body.

The head and neck of the quadruped is as a whole pivotally mounted so as to be capable of oscillation on a shaft G secured to the frame 1 and is provided with two lugs H which project downwards and are arranged to abut sometimes against one and sometimes against the other of the two parts 5, 5' of the front legs with the object of imparting to the whole an oscillating movement synchronous with that of these parts.

Each front leg comprises in addition to the upper part 5 or 5', the three parts 7, 8, 9, each articulated to the preceding part respectively at 10, 11, 12. The actuation of the articulated limb is effected by the lever 13, which is pivotally mounted on the shaft 6, and is connected by means of a link 14 to the end 7ª of the part 7 and by means of a link 20 to the lever 19 connected to a point in the part 5. To a projection 13ª on the lever 13 is also connected the upper end of a bent lever 15 descending the length of the leg and pivotally connected to a point 8ª in the part 8, whilst between the end of the short arm of the lever 15 and a point 9ª in the last part 9 of the limb, constituting the shoe, there is connected a tie rod constituted by the two distinct parts 17, 18 connected together by the tension spring 16 formed as a helix surrounding these parts. As a result of the arrangement of the group of levers described above, when the lever 19 is thrust forward towards the shaft 6, as shown in Figure 1, the different articulated parts constituting the leg straighten out to the elongated form taken by the leg when it is thrust against the ground; on the other hand when the lever 19 is caused to rock towards the rear, as

shown in Figure 3, the parts, including the shoe 9, mutually move to the completely flexed position assumed by the raised leg which is about to take a step forward.

Each hind leg, in addition to the upper part 3, or 3′ comprises the two parts 21, 22, each articulated to the preceding one respectively at 21^a and 23. In the case of the hind leg the positive actuation of the articulated whole is limited to the single part 21, the shoe 22 being merely supported resiliently by the preceding part by means of the spring 24 (Figure 1). This actuation is effected by means of the lever 25 pivotally mounted on the shaft 4 and articulated to the lever 26 which, descending the length of the leg, is articulated at 21^b to the part 21. A lever 27 having the same function as the lever 19, is pivotally mounted at a point on the part 3 and connected by means of a link 28 to the lever 25, serves, when it is thrust backwards towards the shaft 4, as shown in Figure 1, to straighten the leg in its extended position touching the ground, whilst when it is caused to rock forwards as shown in Figure 4, it serves to effect the flexing of the leg itself.

The actuation of the articulating mechanisms of the legs is effected by the two counter shafts B, B′, each having two oppositely arranged cranks and rotatably mounted in the frame 1. The cranks of the shaft B, by means of the connecting rods D and E′, operate respectively the lever 19 for the articulating mechanism of the left front leg and the lever 27 for that of the right hind leg; similarly the cranks of the shaft B′, by means of the connecting rods D′ and E control in an analogous manner the articulating mechanisms of the right front leg and of the left hind leg.

The counter shafts B, B′ are intermittently rotated in succession, in such a manner that each performs a complete revolution whilst the other is at rest, whereas one revolution of each of the counter-shafts corresponds to a half revolution of the main shaft A from which they are driven through any suitable form of intermittent transmission device, for example that adopted in the construction illustrated in the drawing and constituted as follows: For driving the counter shaft B, a disc formed in two halves 29, 30, arranged in two different planes is mounted on the shaft A. The first half disc 29, preferably of variable radius, is toothed on its circumference and engages with the toothed wheel 31, which is of variable radius, and is mounted on the shaft B. The other half disc 30, which has a concentric and smooth circumference is adapted to engage with an eccentric shoe 32 also mounted on the shaft B. During one half revolution of the shaft A the toothed edge of the disc 29 intermeshes with the wheel 31 and causes the shaft B to perform one revolution, the shoe 32 being out of engagement with the circumference of the disc 30. During the other half revolution of the shaft A the toothed edge of the disc 29 does not intermesh with the wheel 31 whilst the shoe 32 engages with the disc 30 and the shaft B remains stationary. The shaft B′ is driven in a similar manner by means of the other disc 29′, 30′, which is also mounted on the shaft A and cooperates with the wheel 31′ and the shoe 32′ mounted on the shaft B′. The toothed half discs 29 and 29′ are angularly displaced relative to each other so that the period of rest of one of the counter shafts B or B′ corresponds to that of movement of the other.

The operation of the mechanism is as follows:—

During the rotation of the shaft A the legs of the front and hind pairs tend to be oscillated about the axes 4 and 6, so that the front right leg and the left hind leg, coupled together, oscillate in opposite directions to the other two, which are also coupled together. Now of the two legs of each pair, that leg which is in the most forward position has its articulating mechanism locked by reason of the fact that the shaft B or B′ controlling it is immovable, in such a manner that these stiffened legs are applied to the ground. On the other hand the two remaining legs have the articulating mechanism operative and are consequently raised by bending as shown in Figures 3 and 4, whilst at the same time, owing to the oscillating movement given to them by the shaft A, they are carried forward. Furthermore the legs applied to the ground tend at the same time to swing towards the rear, and since they are absolutely stiff, since their articulating mechanism is locked. these legs thrust against the ground, and there is thus effected a relative forward movement of the body 2. In this manner the exact reproduction of the movement of the steps of quadrupeds is obtained, whilst the head and neck as a whole oscillate rythmically at each step.

It is evident that the invention is in no way restricted to its application to a horse, as shown in the drawing, nor to the precise arrangements described and illustrated, since it would be possible, acording to the nature of its application or with the object of simplifying the construction, to decrease the number of articulations of each leg or the number of positively driven elements of each of these legs, or to adopt any other device for intermittently driving the counter crank shafts, and so on; all these variations and modifications of a constructional nature being within the scope of the invention.

I claim:

1. Mechanism for reproducing the step movements of quadrupeds, the combination

with a body portion and articulated front and hind legs jointed thereto, of a rod connecting each hind leg to a front leg, a main rotary shaft having oppositely arranged cranks, rods connecting the cranks to the hind legs for imparting opposite oscillating movement thereto, two secondary rotary shafts, means on the main and secondary shafts for successively and intermittently rotating the secondary shafts, controlling mechanisms for the articulated members of the legs, and means operated by the secondary shafts for actuating the controlling mechanisms.

2. Mechanism for reproducing step movements of quadrupeds, the combination with a body portion, and articulated front and hind legs jointed to the body, of a main rotary shaft having oppositely arranged cranks, rods connecting the cranks to the hind legs for imparting oppositely oscillating movement thereto, a cross rod connecting each hind leg with a front leg on the opposite side of the body, two secondary rotary shafts each having oppositely arranged cranks, means operated by the rotation of the main shaft for successively and intermittently rotating the secondary shafts means for intermittently and successively locking said secondary shafts, mechanism for controlling the articulated members of the legs, and transmission members operated by the cranks of the secondary shafts for successively and intermittently actuating said controlling mechanisms, whereby the articulations of the two legs located on opposite sides, one in front and the other behind are actuated intermittently.

3. Mechanism for reproducing step movements of quadrupeds, the combination with a body portion, a front leg comprising four elements articulated successively together, a shaft in said body on which the upper most or first element is pivotally mounted, a control lever pivoted on said shaft, a tie-rod connecting the lever to the second element of the leg, an actuating lever adapted to oscillate on the first element and connected to the control lever, a bent lever articulated to the third element, and a resilient connecting device connected to the short arm of the bent lever for actuating the fourth element of the leg.

4. Mechanism for reproducing step movements of quadrupeds, the combination with a body portion, a hind leg comprising three elements articulated successively together, a shaft in said body on which the uppermost or first element is pivotally mounted, a control lever pivotally mounted on said shaft, an actuating lever pivoted on the first element, a tie-rod connecting the control lever to the actuating lever, a lever pivoted on the second element operatively connected to the control lever, and a resilient member connecting the second and third elements.

5. Mechanism for reproducing step movements of quadrupeds, the combination with a body portion, and articulated front and hind legs jointed to the body, of a main rotary shaft having oppositely arranged cranks, two secondary crank shafts, each having two oppositely arranged cranks, means for intermittently driving the secondary shafts comprising two discs carried by the main shaft, each consisting of two half-discs arranged in different planes, one half-disc having a smooth circumference and the other a toothed circumference, a toothed wheel carried by the corresponding secondary shaft meshing with said toothed circumference whereby the secondary shaft will make a complete rotation for each half rotation of the main shaft, eccentric shoes carried by the secondary shafts adapted to engage the smooth circumference, the two discs being angularly displaced from one another whereby the period of movement of one secondary shaft corresponds to the period of rest of the other secondary shaft.

6. Mechanism for reproducing the movements of quadrupeds, the combination with a body portion, articulated front and hind legs jointed to the body and means for oscillating said legs, of a head and neck portion pivoted on the body, and lugs on said neck portion adapted to be engaged by the front legs during their oscillating movements.

In testimony that I claim the foregoing as my invention, I have signed my name.

VITTORIO GOBBATO.