(No Model.) 2 Sheets—Sheet 1.

E. E. EYSTER.

AIR PROPELLED BICYCLE.

No. 602,618. Patented Apr. 19, 1898.

Fig. 1

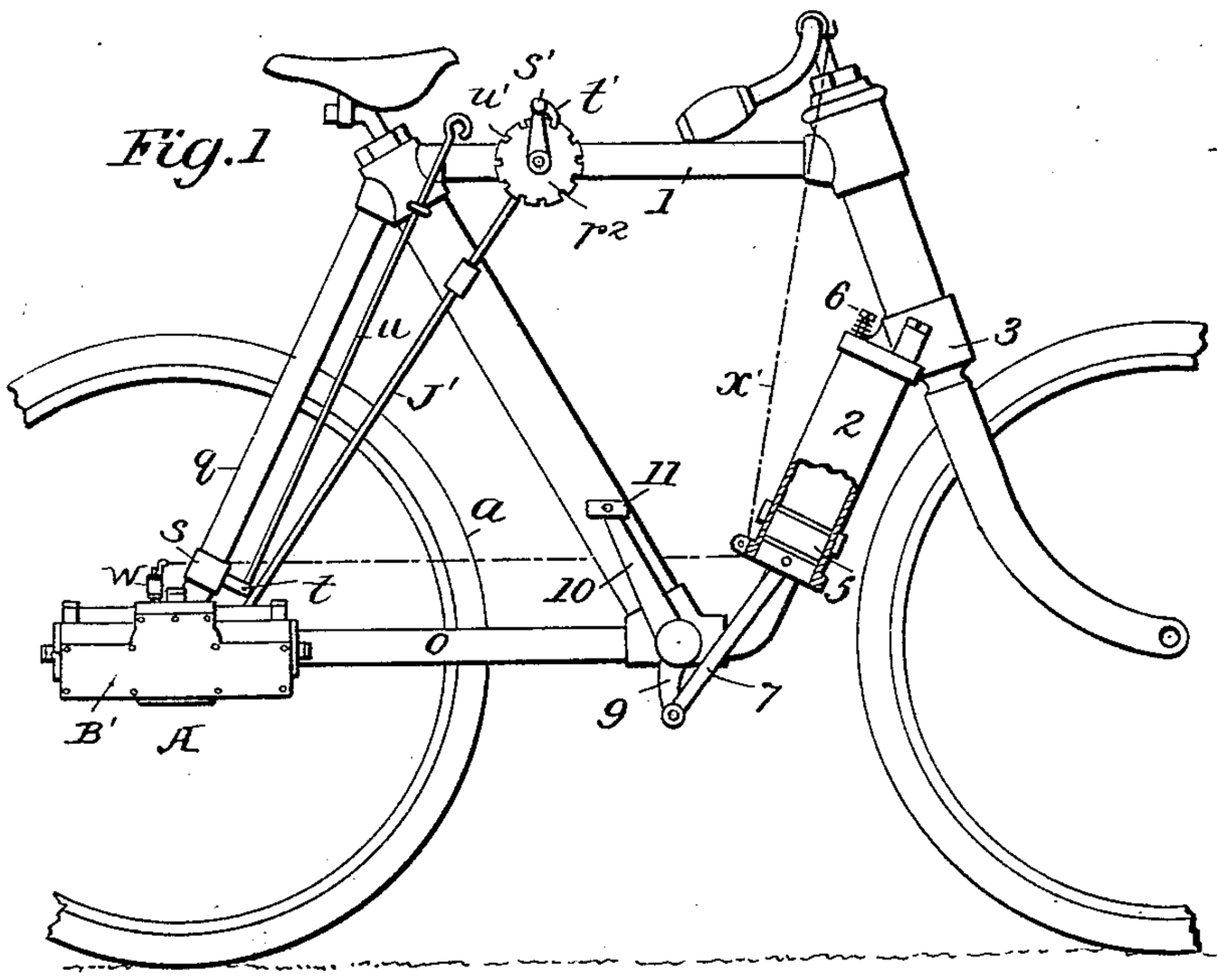


Fig. 2.

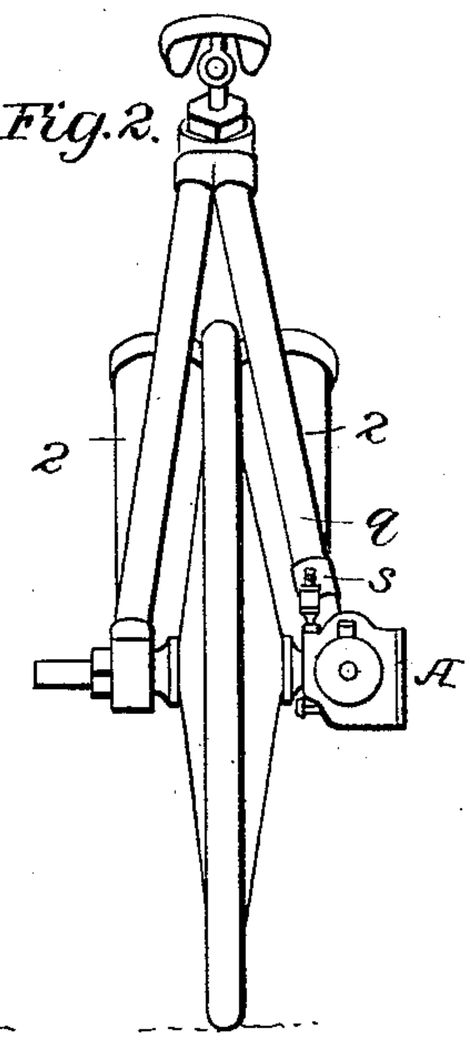


Fig. 6.

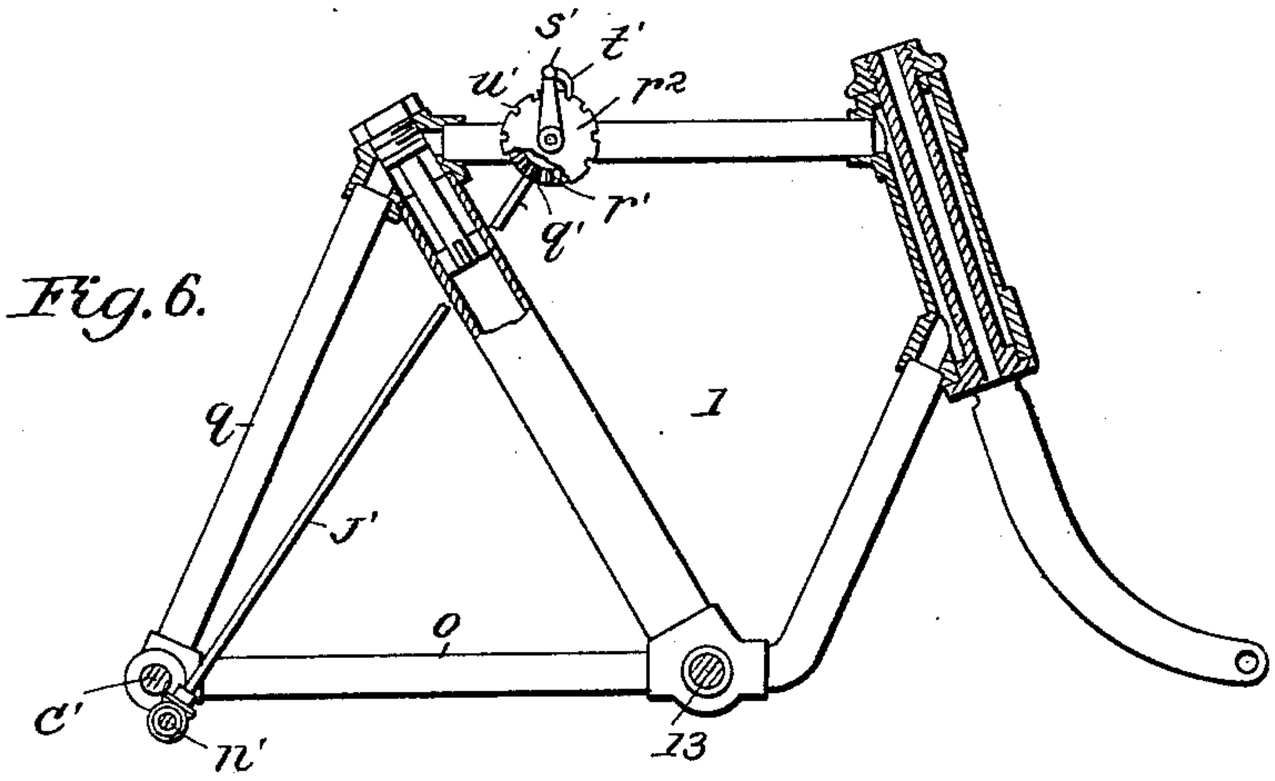
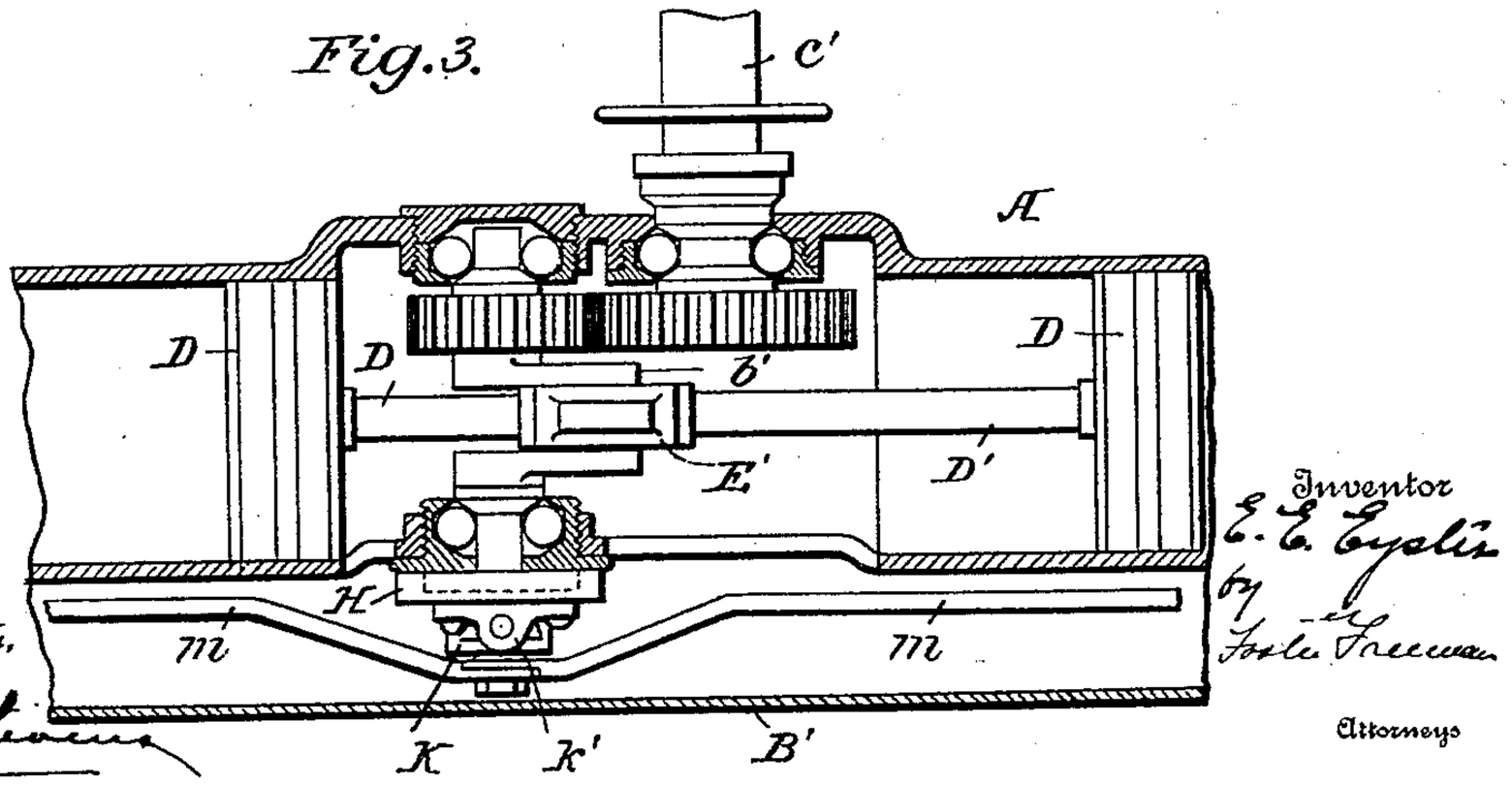


Fig. 3.



Witnesses

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(No Model.) 2 Sheets—Sheet 2.

E. E. EYSTER.

AIR PROPELLED BICYCLE.

No. 602,618. Patented Apr. 19, 1898.

Fig. 4.

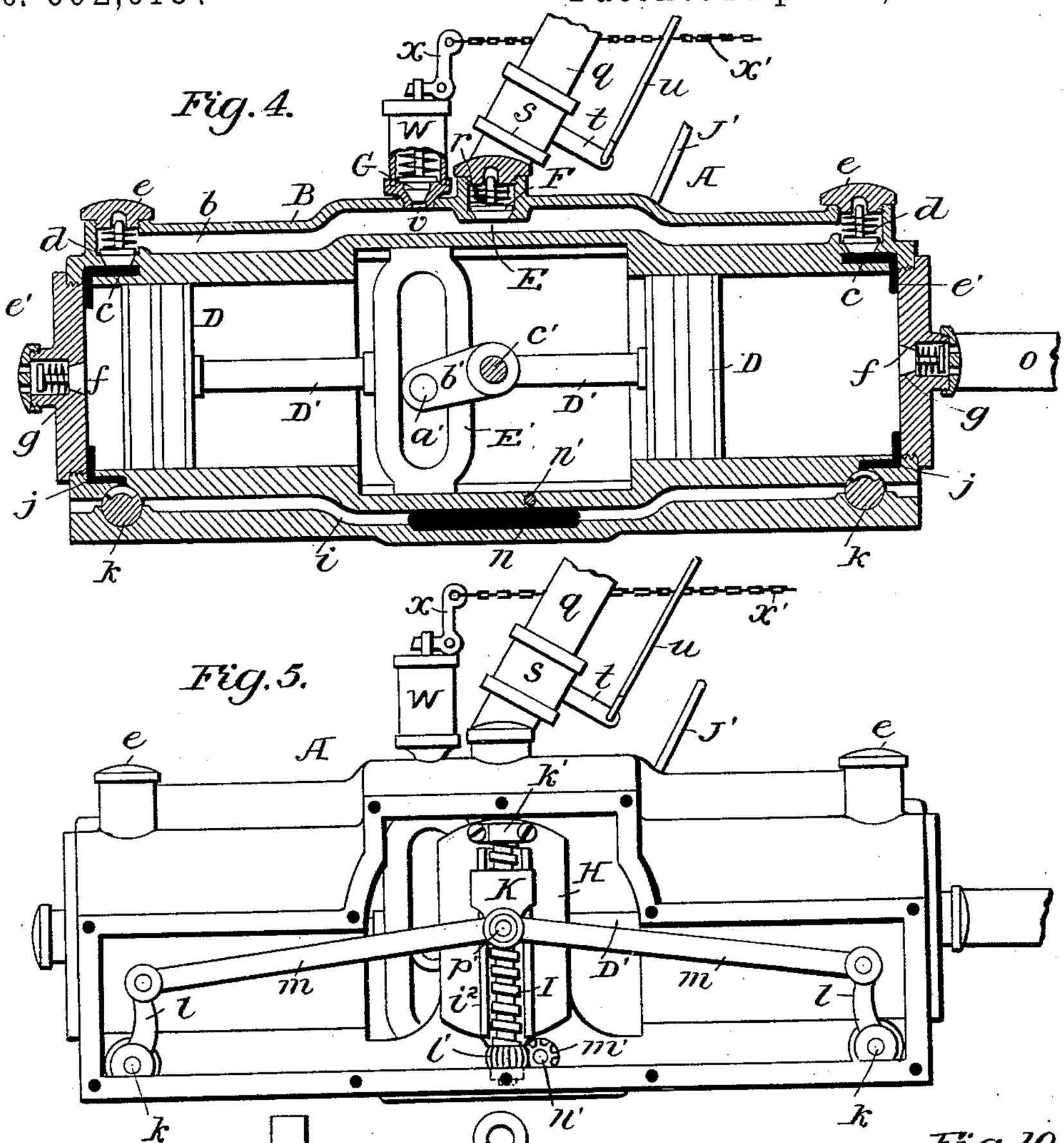


Fig. 5.

Fig. 9.

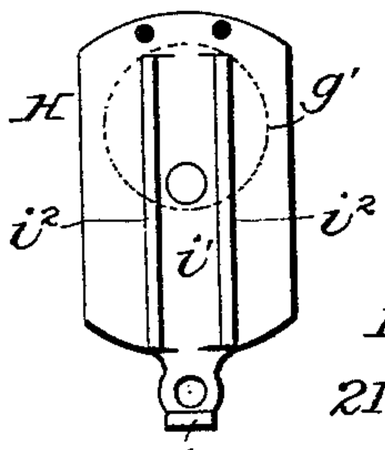


Fig. 7.

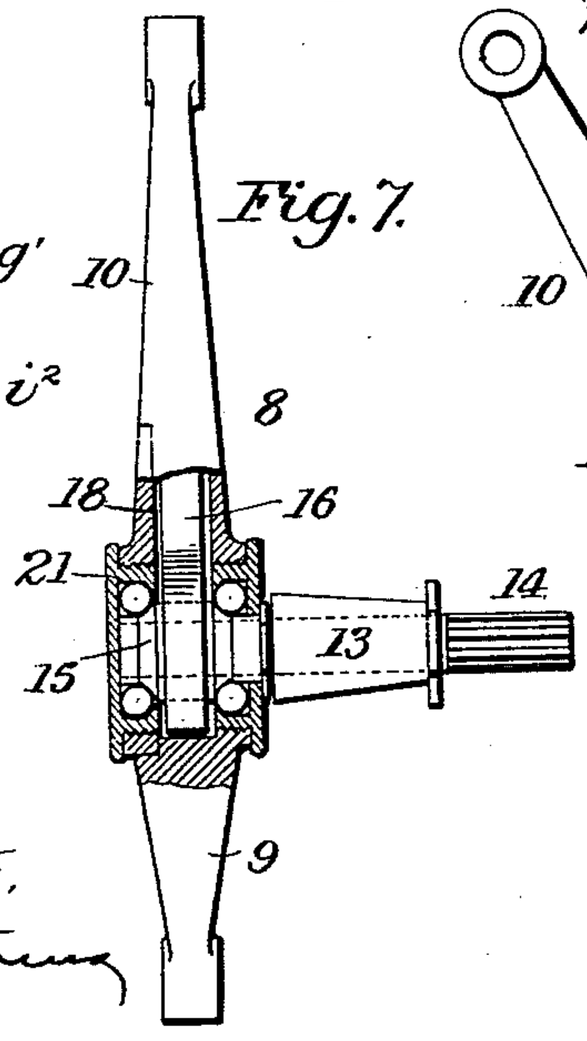


Fig. 8.

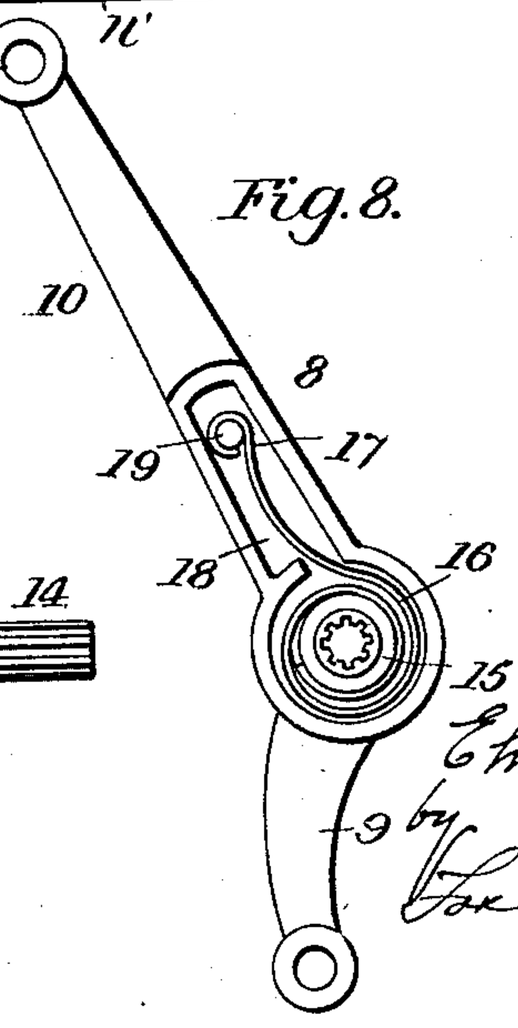
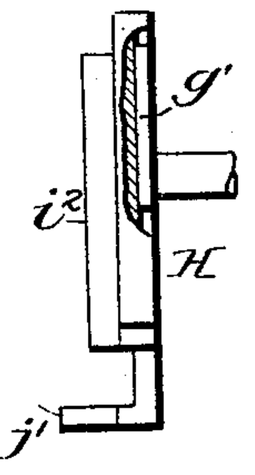


Fig. 10.



Witnesses

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UNITED STATES PATENT OFFICE.

ELMER E. EYSTER, OF INDIANAPOLIS, INDIANA, ASSIGNOR OF ONE-HALF TO FRANK F. ROGERS, OF SAME PLACE.

AIR-PROPELLED BICYCLE.

SPECIFICATION forming part of Letters Patent No. 602,618, dated April 19, 1898.

Application filed June 10, 1897. Serial No. 640,235. (No model.)

To all whom it may concern:

Be it known that I, ELMER E. EYSTER, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented certain new and useful Improvements in Air-Propelled Bicycles, of which the following is a specification.

This invention relates to certain new and useful improvements in motor-vehicles; and it consists, substantially, in such features of construction, arrangement, and combinations of parts as will hereinafter be more particularly described.

My invention has reference more particularly to that class of motor-vehicles which are driven by means of compressed air, and in the practice of the invention I construct the frame of the vehicle hollow throughout, so as to constitute a receiver or reservoir for the compressed air, and the air is supplied to said receiver or reservoir by means of air pumps or compressors, which are mounted in convenient position upon the frame of the machine. I also employ a motor for the vehicle, which is driven by means of the compressed air and which serves also as a compressor, utilizing gravitation for storing air in the receiver, and such motor may be variously constructed, but preferably is of a special form and embodies a certain arrangement of valves and operative connections, whereby the same is made to subserve the function of a brake for the vehicle either in descending grades or whenever it is desired to stop the machine.

While my improvements are applicable to vehicles generally, I shall only refer to the same hereinafter in connection with a bicycle, and it may be stated at this point that I dispense with the use of a chain or chains for driving or propelling the vehicle and connect the pedal-cranks with the plungers of the compressors.

The objects of the invention will be more fully hereinafter understood when taken in connection with the accompanying drawings, in which—

Figure 1 is a side view of an ordinary bicycle having my improvements embodied in connection therewith. Fig. 2 is a rear view. Fig. 3 is a sectional plan of the motor, showing indirect driving-gear. Fig. 4 is a sectional view of the preferred form of motor. Fig. 5 is a side view of the motor, showing the valve-link motion, the outer plate being removed. Fig. 6 is a sectional view of the hollow frame constituting the reservoir for the compressed air and devices which are operated from the seat of the rider for controlling the extent of movement of the valves admitting air to the motor from the frame or reservoir. Figs. 7 and 8 are enlarged detail views of the crank-axle and the pedal-cranks. Figs. 9 and 10 are detail views.

My invention is capable of a great many different embodiments in use, and while I have herein elected to show a certain preferred embodiment it will be understood that I am not limited thereto as to detail, but that I am at liberty to make such changes and alterations therein as may be demanded by the exigencies of any particular case. Thus the frame of the bicycle is indicated at 1, and, as shown, the same is hollow throughout, so as to constitute a receiver or reservoir for compressed air. The several joints of said frame are of course made air-tight, and if desired one or more of the members of the frame may be enlarged, so as to increase the capacity thereof for holding the air forced therein. Compressed air may be supplied to the frame in any suitable manner, but preferably I mount upon the frame at any suitable point about the axis of the crank-shaft and on each side thereof a pump or compressor 2, each of which communicates at its upper end with the frame, as shown at 3, and is provided at such end with a valve opening upwardly to admit the air to the frame and with a valve 6 to admit air to the pump in a well-known manner. The connection between the upper end of the compressors and the frame may be effected in various ways, and the valves may also be of any of the ordinary or well-known forms, as is obvious.

Each of the pumps or compressors 2 is provided with a plunger 5, having a rod or stem 7, through the medium of which the said pumps or compressors are operated directly from the pedal cranks or levers. Such operation could be effected in different ways and by various constructions; but preferably I employ a pedal-crank 8, having a short arm

9 in movable connection with the plunger-rod and having an arm 10, provided with an ordinary pedal 11 to receive the foot of the operator. This may extend rearwardly, as shown, or forwardly, if the downward stroke is in front of the axle. A spring is employed for restoring the said pedal-crank to position, and while the construction and arrangement could be varied I preferably resort to the construction which I will now describe. For instance, as shown in Figs. 7 and 8, I construct the crank-axle tapering in form, as at 13, and at each end thereof provide a straight fluted or corrugated portion 14. The tapering or conical portion of the axle fits a corresponding socket therefor in the crank-hanger, the conical or tapering surfaces providing a firm seat for the crank-axle, which is suitably secured in position, so as not to turn. A sleeve 15, corrugated or fluted on its inner side, fits upon each of the fluted portions 14 of the axle, and secured to the outer side of each of said sleeves is the inner end of a coiled spring 16, the outer end 17 of which passes up into a recess or pocket 18 in the crank and is secured upon a pin or projection 19, as shown. A cover-plate fits over the recess or pocket 18, so as to properly inclose the spring, as well as to enable ready access thereto when desired. The outer surface of each of said sleeves at each end is so constructed that any of the ordinary forms of ball-bearings may be used, and the hub of the crank from each end is arranged to receive a bearing-box 21. In order to give to the springs 16 the desired tension to act upon the cranks, the sleeves 15 are first turned or adjusted relatively to the fluted end portions of the axle before fixing them in place, and it is evident that as each crank is depressed by the foot the said springs will operate to elevate or restore the same to position. The advantages of my improved form of pedal-crank will more fully appear hereinafter.

I may employ any suitable form of motor in the practice of my invention; but I have devised a special form which I will now proceed to describe.

My improved motor is designated as a whole at A, and the same is mounted in position alongside of the rear wheel *a* and is inclosed by a suitable casing B, accessible through an opening in one side that is closed by a suitable cover-plate B′. The said motor comprises a longitudinal passage *b* at the top and a port *c* at each end, closed by a suitable spring-seated or other suitably-constructed valve *d*, the said ports leading to the interior of the motor and the said valves being covered by screw-caps *e*, screwing into the casing directly above the valves and ports. Said ports lead to the spaces *e′* between the ends of the motor-casing and the pistons D D, which work interiorly of the motor-casing air-tight. At each end of the motor-casing is also a port *f*, operating in connection with which is a spring-actuated valve *g*, which is arranged to open inwardly, as shown. At the bottom of the motor-casing is also a longitudinal passage *i*, which is in communication with the spaces *e′* through a port *j* at each end, and said ports being provided each with a valve *k*, provided with arms *l*, to which are connected the rods *m m*, through the medium of which the said valves are actuated. The lower passage *i* of the motor is in communication, through a passage *n*, with one of the side portions *o* of the hollow frame, and the upper passage *b* is provided at E with a port, which communicates with one of the rear portions *q* of the frame and is controlled by a valve F, opening upwardly, but which is normally held down by a spring *r* and the pressure within the frame. In said portion *q* of the frame is also a cut-off valve *s*, having an arm *t*, from which leads a rod *u* to within convenient reach of the rider of the machine. The top of the motor-casing is further provided with an additional port *v*, closed by a spring-actuated blow-off valve G, the latter being suitably supported to work in a casing *w*, and the stem thereof having attached thereto a small lever *x*, having a cord *x′* extending to within convenient reach of the rider of the machine.

Each of the pistons D D is provided with a rod D′, the inner end of which is in connection with a sliding yoke E′, suitably guided in the motor-casing, and working in said yoke is a pin *a′* of a crank *b′*, connected directly or indirectly with the axle *c′* of the rear wheel of the bicycle, and it is evident that when a longitudinally-reciprocating motion is imparted to the yoke from the pistons the machine will be driven from the yoke directly or indirectly through an intermediate gear, as in Fig. 3. In line with the center of the axle *c′* is fastened a cam *g′*, working in a groove or guide on the inner side of a swinging block or link H, said link being pivoted at its lower end to the bottom of the motor-casing in such manner as to be capable of swinging back and forth. The front of the said block or link is provided with a vertical recess *i′* to accommodate a screw I, supported at its lower end in a step or bearing *j′*, projecting from the link and being held in position at its upper end by means of a strap or clip *k′*. The said screw is provided at its lower end with a convex gear *l′*, meshing with a gear-pinion *m′*, carried on a rod *n′*, extending through the motor-casing and being in gear at its opposite end with the lower end of a rod J′, extending to within convenient reach of and designed to be operated by the rider to alter the throw of the valve-rods *m m*, as will appear. The recess *i′* for the screw I is constituted of or formed by two vertical ribs *i²* on the outer face of the link H, and moving on and guided by said ribs is a block K, constructed in the form of a half-nut and threaded on its inner surface, so as to fit upon and be operated by the said screw I. Attached to a pin *p′*, projecting from the lower end of said block K, are the

inner ends of the valve-rods *m m*, and it is evident that by raising or lowering this block the throw of the rods, as well as the movement of valves *k*, will be changed accordingly. It is desirable to move the block K by means extending to within convenient reach of the operator, so that valves *k* may be permitted to be but partially turned or else be entirely closed, and the connections already described with reference to the screw permit this to be done. Different means could be employed for effecting the desired adjustment of the block K. As shown, the upper end of said rod J′ is provided with a small gear *q′*, which meshes with a larger gear *r′*, contained in a case r^2, secured to the frame of the machine at a point between the saddle and handle-bar. The said larger gear *r′* is provided with a short shaft having a crank *s′*, which latter is provided with a suitable catch *t′*, designed to engage in notches *u′*, formed in the rim of the casing r^2, and it will be seen that by turning the crank the rod J′ will be turned, and by means of the connections described the screw will be turned and the block K lowered or raised, according to the direction in which the crank is turned.

In a general way I have set forth the construction and arrangement of the several parts constituting my improvements, and I will now proceed to set forth some of the advantages and the general operation. For instance, in connection with the pedal-cranks it will be seen that the distance the foot travels to perform each downward stroke is only about three-fourths the distance the foot would have to travel with a crank of the same length in making a revolution. Thus is avoided the movement of the foot through the space at the centers of the revolution, where but little or no power can be given, and the foot travels only through that part of the revolution wherein the rider has the advantage of developing power. Thus the foot travels through only three-fourths the space passed through on other bicycles to develop the same power or ride the same distance; or with a crank of a length that will travel the same distance as the one making a full circle I will have a much greater leverage and I am enabled to work against a proportionally greater resistance. These advantages will clearly appear from the construction and arrangement shown.

In operation the machine is started by depressing the pedal-cranks alternately in the usual way, and as the plungers of the compressors are worked the receiver or reservoir (the hollow frame) is charged with quantities of compressed air. The valve-rods *m m* being capable of movement to operate the valves *k k*, air will pass through the port of one of said valves, say at the left, and by expansion behind the piston at that end of the motor will move said piston, and consequently the yoke E′ will be moved, as well as the opposite piston, the valve *k* at the right-hand end of the motor being at that time in a position to permit the adjacent cylinder to exhaust through the extreme outer end of the passage *i*. On the limit of the stroke of the pistons, the position of the valves *k k* is reversed and air will be admitted by the valve at the right in like manner, while the valve at the left will be open to the exhaust through the opposite end of the passage *i* and the pistons and yoke will return or move in the opposite or reverse direction, and it is evident that the machine will be driven through the medium of the connections between the said yoke and the rear-wheel axle. Should it be desired to alter or stop the movement of the valves, the rider simply shifts the position of the block K upon its screw by the means already described, and a corresponding effect will be had on the travel of the machine. In going downgrade said valves can be closed altogether and the motion of the rear wheel may be relied on altogether to operate the pistons of the motor, in which instance said motor becomes practically a double compressor in that the pistons alternately draw in air through the valves *g* at the ends of the motor-casing and force the air to the frame through the ports and passages at the upper part of said casing. By operating the cut-off valve *s* the air cannot enter the frame, but will be compressed in the spaces and passages below, and in this way an effectual braking effect can be had on downgrades, and when the resistance offered is too great the blow-off valve G may be opened to allow escape of some of the air.

I do not limit myself to the particular kind of valve in either of the instances described, and as regards the cut-off valve in the frame above the motor I lay stress on its location and use in connection with the double-piston compressor and the reservoir by which to perform the duty of an air-brake in the manner described. The blow-off valve G may also be of any suitable construction; but the location and function thereof when operated from the seat of the driver by the means described possesses features which are deemed novel herein. Another feature of my improvement is that the frame which constitutes the reservoir is in direct attachment with the motor-frame without intermediate contrivances.

As regards the improved form of motor it will be seen that the same is constructed of a double cylinder fitted with valves and pistons to enable the same to be employed either as a motor or a compressor, and this also is considered an important feature of the present invention.

I claim—

1. In a motor-vehicle, the combination of the combined motor and compressor having the positively-operated valves and the pistons, the hollow frame supplying air under pressure through said valves to actuate the pistons, a connection between the combined motor and compressor and frame through which air is forced into the frame, and a cut-

off valve located on the frame, substantially as described.

2. In a motor-vehicle, the combination with the motor, its controlling-valves, the link pivoted to the motor midway between the valves, the screw carried by the link, and the adjustable connections extending in opposite directions from the screw to said valves, of an upright rod connected to turn the screw and having a small gear at its upper end, an enlarged gear-wheel engaging said small gear, a casing therefor having stops or notches, and a crank or handle carried by said large gear and provided with a catch for engaging said notches, substantially as described.

3. In a motor-vehicle, the combination of the hollow frame, the motor having the pistons and constructed with the upper and lower passages, ports leading from the lower passage to the spaces behind the pistons and provided with controlling-valves, similar ports leading from the upper passage and having valves, a check-valve between the upper passage and the frame, and a cut-off valve and a relief-valve, substantially as described.

4. In a motor-vehicle, the combination of air-compressors, the hollow frame constituting a reservoir for the compressed air, a separate motor receiving air from the reservoir, means for shutting off the air, connections whereby the motion of the machine may be made to operate said motor to force air into the reservoir, and means for controlling the admission of the air from the motor to the reservoir and thus make the motor act as a brake, substantially as described.

5. In a motor-vehicle, the combination with the compressors, of the pedal-cranks having a short arm connecting with the plunger-rods of said compressors, and an upper longer arm carrying the pedal, and means on each crank for independently restoring said cranks after depression, substantially as shown and described.

6. The combination with the pedal-cranks, and the crank-axle having the fluted end portions, of the sleeves fluted to fit said portions, and the springs having one end secured to the sleeves and their other ends secured to the cranks, substantially as shown and described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ELMER E. EYSTER.

Witnesses:
F. M. HELMS,
PHILIP WILKINSON.