970,048.

N. O. HARMON.

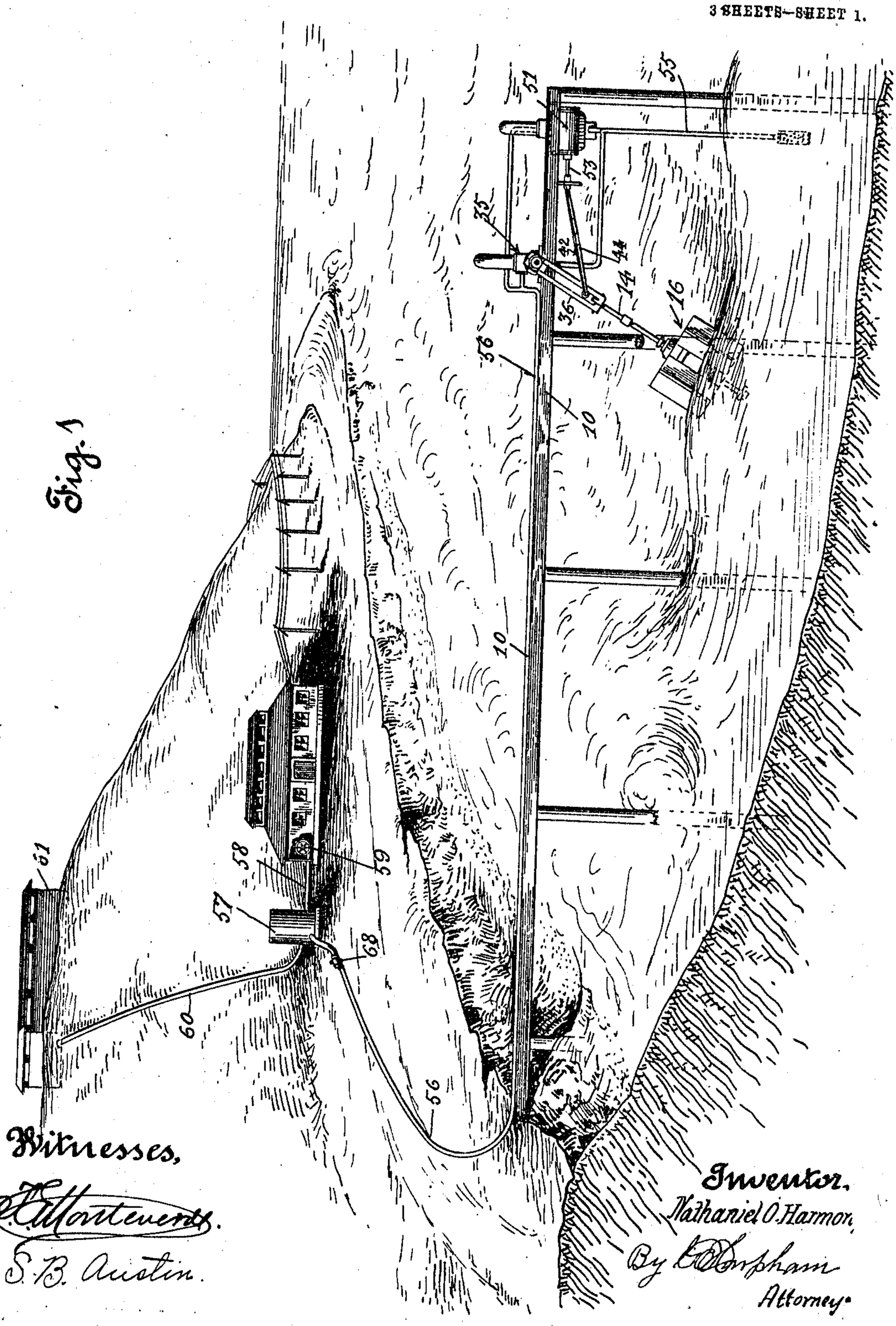
WAVE MOTOR.

APPLICATION FILED SEPT. 7, 1909.

Patented Sept. 13, 1910.

3 SHEETS—SHEET 1.

Fig. 1



Witnesses,

[illegible]

S. B. Austin.

Inventor.

Nathaniel O. Harmon,

By E. D. Orpham

Attorney.

N. O. HARMON.

WAVE MOTOR.

APPLICATION FILED SEPT. 7, 1909.

970,048.

Patented Sept. 13, 1910

3 SHEETS—SHEET 2.

Fig. 2.

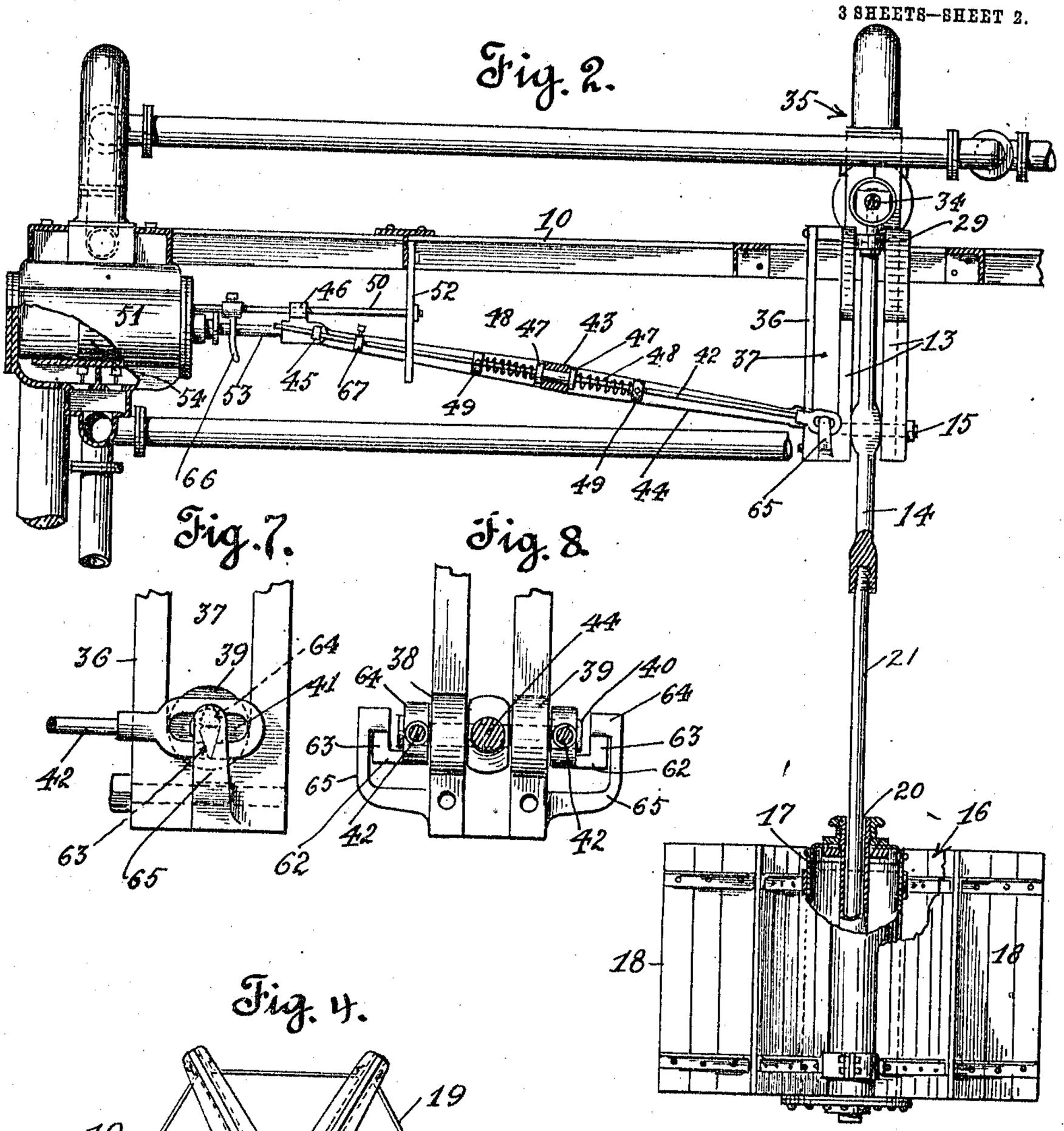
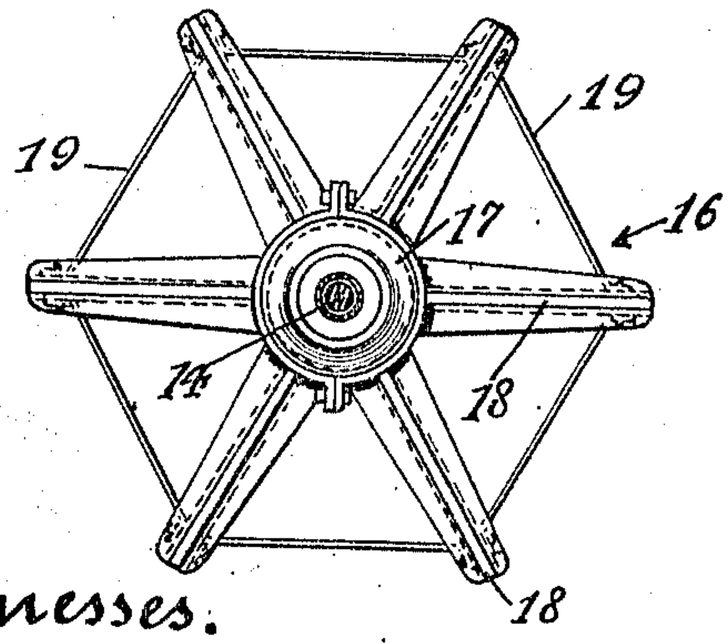


Fig. 7.

Fig. 8.

Fig. 4.



Witnesses.

F. Hartenstein.

S. B. Austin.

Inventor,

Nathaniel O. Harmon,

By G. G. Sinclair

Attorney.

N. O. HARMON.

WAVE MOTOR.

APPLICATION FILED SEPT. 7, 1909.

970,048.

Patented Sept. 13, 1910.

3 SHEETS—SHEET 3.

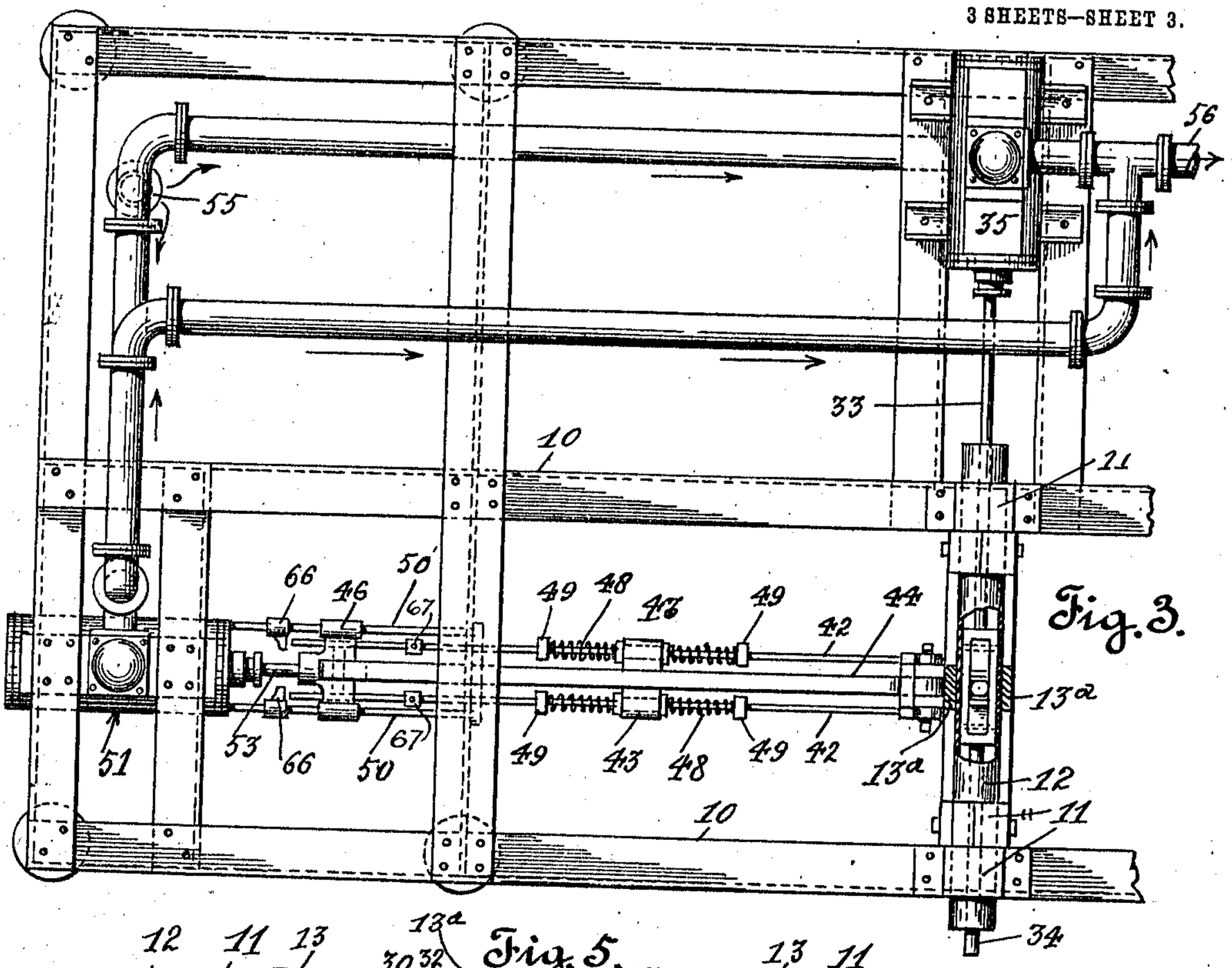


Fig. 3.

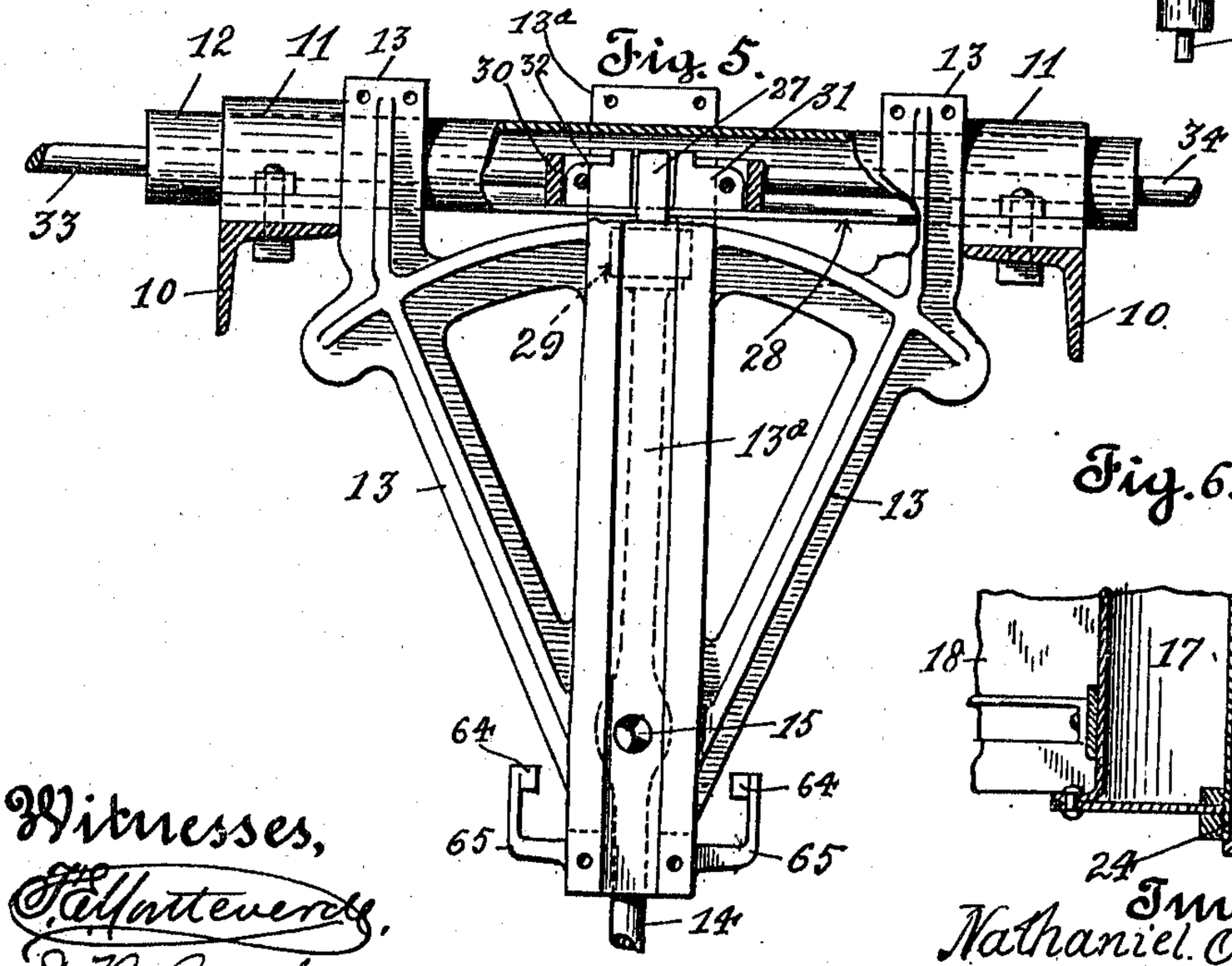


Fig. 5.

Fig. 6.

Witnesses,

F. Allattevery.

S. B. Austin.

Inventor,

Nathaniel O. Harmon,

By C. C. Dwight

Attorney.

UNITED STATES PATENT OFFICE.

NATHANIEL O. HARMON, OF LOS ANGELES, CALIFORNIA.

WAVE-MOTOR.

970,048. Specification of Letters Patent. Patented Sept. 13, 1910.

Application filed September 7, 1909. Serial No. 516,564.

To all whom it may concern:

Be it known that I, NATHANIEL O. HARMON, a citizen of the United States residing in the city of Los Angeles, county of Los Angeles, State of California, have invented new and useful Improvements in Wave-Motors, of which the following is a specification.

My invention relates to that class of wave motors in which the wave power is utilized through the operation of a pivoted lever, and the object thereof is to produce a device which will utilize the wave power no matter in what direction the waves may be rolling. I accomplish this object by the mechanism described herein and illustrated in the accompanying drawings, in which;

Figure 1 is a plan of a one unit wave motor, with parts removed for clearness of illustration, in which the power from the lever is used to operate pumps. Fig. 2 is a side elevation partly in section of the power lever and the pumps. Fig. 3 is a plan of the parts shown in Fig. 2 with parts in section. Fig. 4 is a top plan of the impact member with the power lever in section. Fig. 5 is a side elevation partly in section of the upper end of the power lever, and the adjacent parts. Fig. 6 is a fragmentary enlarged detail of the lower end of the power lever and float. Fig. 7 is an enlarged detail of the lower end of the pump operating rods and adjacent part. Fig. 8 is a view of the part shown in Fig. 7 taken on a plane at right angles to the plane of Fig. 7 with one of the guide plates removed.

In the drawings 10 is a wharf structure of any approved construction which is placed far enough from the shore to be in the active zone of the highest wave motion. This wharf structure is placed so that the wave usually will pass transversely below the upper portion of the wharf structure toward the shore.

Mounted in bearings 11 best shown in Fig. 5, is a hollow shaft 12, which is revoluble in said bearings. Rigidly secured upon said shaft is the power lever hanger 13, which is preferably V-shaped, and has a central stiffening rib 13ª, the upper end of which passes around shaft 12. The lower end of this hanger is bifurcated as best shown in Fig. 2, and in the furcations thereof is mounted power lever 14, by means of bolt 15 which passes through the lower end of the hanger and through the lever, thereby pivotally mounting the power lever in the hanger so that the upper end of the lever may swing transversely in the hanger. On the lower end of the power lever is mounted the impact member 16 which is preferably composed of the buoyant body 17 provided with wings 18, which are evenly spaced around the body, and is preferably slidable on the lever as thereby a shorter impact member may be used than if it is not slidable. If not slidable, the body need not be buoyant. In the drawings I have shown 6 of these wings as I have found in practice that number of wings produces satisfactory results, but there may be a greater or less number as desired. The outer ends of the wings are preferably connected by stay rods 19, as best shown in Fig. 4. The float has a longitudinal central aperture 20, through which the power lever extends, the lower end of the power lever terminates in what may be termed a shock preventer when the wave motion is so great as to leave the float in the air above the water between waves. The shock preventer is composed of a tube or pipe 21, which is screwed into a socket in the lower end of the power lever, as best illustrated in Fig. 2. In this tube is mounted a rod 22 (see Fig. 6) which is provided with a head 23. This rod passes through a stuffing box 24 in the lower end of the tube, and exteriorly the tube is provided a nut 25 which projects far enough beyond the side of the tube to engage the bottom of the float and prevent it coming off the power lever. On this rod between the head and the stuffing box is a spring 26, which will be compressed when the float slides down on the power lever sufficiently to engage nut 25. By this construction shock is prevented when the float reaches the end of the power lever.

The extreme upper end of the power lever is reduced in size as shown at 27 in Fig. 5. This reduced end passes through a slot 28 in the under side of shaft 12. Just below the reduced portion the power lever is provided with a roller 29 which engages the sides of the hanger when the lever is oscillated on its pivot. When in a position of rest, which is the position illustrated in Fig. 5, the reduced end of the power lever passes through cage 30, which cage carries dogs 31 and 32 which are pivotally connected to said cage and lie on either side of the end of the power lever. Connected to and extending

from the ends of cage 30 are the piston stems 33 and 34. These piston stems are connected to pistons in pumps, one of which 35 is shown in Fig. 3, the other pump being removed for clearness of illustration. These pumps are operated by the oscillation of the power lever upon its fulcrum pin 15.

Upon one side of power lever hanger 13 when only one pump is used or on both sides if two pumps are used, and secured thereto are guide bars one of which, 36, is shown in Fig. 2. It will be understood that the power lever hanger will preferably be constructed from cast metal and that the guide bar 36 may be cast integral therewith, thereby forming guide ways 37, in which rollers 38 and 39 travel. These rollers are mounted upon shaft 40 which passes through slots 41 in the end of the locking bars 42. These locking bars pass through bearings 43, which are secured centrally upon connecting rod 44 and through bearings 45 secured upon the cross head 46. Where these rods pass through bearings 43, they are enlarged as best shown in Fig. 2. On each side of the enlarged portion are loosely mounted collars 47 and adjacent to said collars are coil springs 48 which lie between the loose collars and collars 49 which are secured to the locking bars. These fixed collars and springs retain the locking bars normally in the position shown in the drawings and the loose collars permit the bars to move longitudinally as hereafter explained. Shaft 40 also passes through the end of the connecting rod which is provided with a slot like the slot in the ends of the locking bars. The other end of the connecting rod is pivotally connected to cross head 46. This cross head is slidably connected upon guide rods 50, which are secured at one end to the casing of pump 51, and at the other end to brace bars 52. Piston stem 53 is secured to the cross head at one end and at the other end to the piston 54 of pump 51. Pumps 35 and 51 have their suction ports connected to a common suction pipe 55, and their discharge ports to a common discharge pipe 56, which discharge pipe is connected to the pressure equalizing tank 57. This tank is connected by pipe 58 to a nozzle, which delivers water upon the water wheel 59. Pipe 60 is connected to the bottom of the equalizing tank and leads to the elevated reservoir 61, in which surplus water is stored during the periods of the maximum movement of the waves.

Secured to the outer ends of the locking bars are outwardly projecting arms 62, best shown in Fig. 8. These arms carry locking lugs 63, which under normal conditions lie beneath coacting locking lugs 64, which are carried by arms 65 which last arms are secured to the lower end of the power lever hanger, as shown in Fig. 7. The locking lugs of the locking bars normally lie beneath the locking lugs carried by the power lever hanger, thereby preventing the locking bars and connecting rod from moving upwardly in the guide ways upon the oscillation of th power lever hanger.

In the operation of my device as the waves roll in toward the shore, they carry the impact member, or float along with them until the wave passes out from under the float, when the power lever will swing back, until the float is engaged by the next wave. If the movement of the waves is in a direct line toward the shore, pump 51 will be operated as the power lever swings forward and back upon the line passing through said pump longitudinally. Should the action of the waves be quartering, the power lever will not swing in a direct line toward the pump 51, but will swing on a line at an angle thereto. This movement, however, will oscillate the power lever hanger and thereby operate pump 51. At the same time the power lever will also oscillate on its pivotal bolt 15, thereby operating pump 35. Should the wave movement be on a line at right angles to the first course described, the only movement of the power lever would be on its pivot which would only operate pump 35. It will seldom happen that the waves will run on a direct line toward the shore, and for that reason I have provided two sets of pumps which will be operated as before described.

To prevent injury to the pumping mechanism in case the waves run very high, I have mounted upon the guide rods 50 adjustable stop lugs 66, which are engaged by the ends of the locking bars when the power lever swings toward the pumps, which causes lugs 63 to pass from beneath lugs 64 and to permit the outer end of the connecting rod and the locking bars to rise in the guide way. When the power lever swings in the reverse direction beyond its normal movement, adjustable stop lugs 67 engage brace bar 52 and withdraw lugs 63 from beneath lugs 64 so that the outer ends of the connecting rod and locking bars may rise in the guide ways. Lugs 63 and 64 are preferably triangular in shape in cross section so that they will slip past each other easily when the power lever swings back toward the normal position. Dogs 31 and 32 permit the upper end of the power lever to disengage from the cage as soon as the maximum travel of the cage and connected pistons has been reached. It will be observed that by this construction the water is forced by the pumps into the pressure equalizing tank. During periods of the maximum movement of the waves a greater amount of water is pumped than can be utilized upon the water wheel. The surplus water is forced through pipe 60 into the elevated reservoir, and during periods of minimum wave movement or

in case of a calm, the water can flow back from the elevated reservoir into the pressure equalizing tank and be delivered to the water wheel. To prevent the water passing back to the pumps, a check valve 68 is placed upon the discharge pipe between the pumps and the equalizing tank. As all of the pipes lead into or from the pressure equalizing tank at the bottom thereof, there is always a regular pressure upon the water delivered to the water wheel by reason of the compressed air pressure in the equalizing tank, thereby producing a steady and uniform flow of water to the water wheel.

While I have shown an apparatus designed for utilizing the wave power by means of pumps for pumping water, instead of using water the pumps may be air compressors and the air may be delivered into suitable storage tanks for future use. In the drawings I have illustrated in full only one side of a one power unit, but it will be understood that there may be another set of pumps connected up like those shown and that there may be as many units as may be required to produce the desired power.

Having described my invention what I claim is:

1. A wave motor comprising a wharf structure; a dependent power lever hanger mounted on said wharf structure and adapted to oscillate; a power lever pivotally mounted in said hanger and adapted to oscillate in said hanger transversely to the plane of oscillation of said hanger; an impact member mounted on said power lever; and means to utilize the motion of said power lever.

2. A wave motor comprising a wharf structure; a depending power lever secured thereto by a universal joint; a wave impact member slidably mounted upon said lever; power transmitting means mounted upon said wharf structure; a connection from said power transmitting means to said lever; means to lock said connecting means to said lever during a predetermined portion of the stroke thereof, and to unlock the same from said lever after the predetermined portion of the stroke has been reached.

3. A wave motor comprising a wharf structure; a dependent power lever hanger revolubly mounted on said wharf structure and adapted to oscillate; a power lever pivotally mounted in said hanger and adapted to oscillate therein transversely to the plane of oscillation of said hanger; an impact member mounted upon the bottom of said power lever; power transmitting means connected to said power lever hanger; and other power transmitting means connected to the top of said power lever.

4. A wave motor comprising a wharf structure; a depending power lever secured thereto by a universal joint; an impact member mounted upon said power lever; pumps mounted upon said wharf structure; an equalizing tank; means operable by wave action connected to said pumps and adapted to operate the same; a connection from said pumps to said equalizing tank; an elevated reservoir; a connection from said reservoir to the bottom of said equalizing tank; a water wheel; and means leading from the bottom of said equalizing tank to deliver the said water from said tank to said water wheel.

5. A wave motor comprising a wharf structure; a depending power lever mounted on said wharf structure by a universal joint; a buoyant impact member having a plurality of vertical wings slidably mounted upon said lever; and means to utilize the oscillation of said lever.

6. A wave motor comprising a wharf structure; a depending power lever mounted on said wharf by a universal joint; a buoyant impact member having a plurality of vertical wings slidably and revolubly mounted upon said lever; and means to utilize the oscillation of said lever.

7. A wave motor comprising a wharf structure; a dependent power lever hanger mounted on said wharf structure and adapted to oscillate; a power lever pivotally mounted in said hanger and adapted to oscillate therein transversely to the plane of said hanger; an impact member having a plurality of wings revolubly and slidably mounted upon said member; power transmitting means upon said wharf structure; a connection from some of said power transmitting means to said power lever hanger; and a connection from the upper end of said power lever to other of said power transmitting means.

8. A spring operated shock preventer secured to the bottom of the power lever and adapted to prevent the float from coming off the power lever.

In witness that I claim the foregoing I have hereunto subscribed my name this 30th day of August, 1909.

NATHANIEL O. HARMON.

Witnesses:

G. E. HARPHAM,

S. B. AUSTIN.