centre de développement pédagogique
pour la formation générale en science et technologie

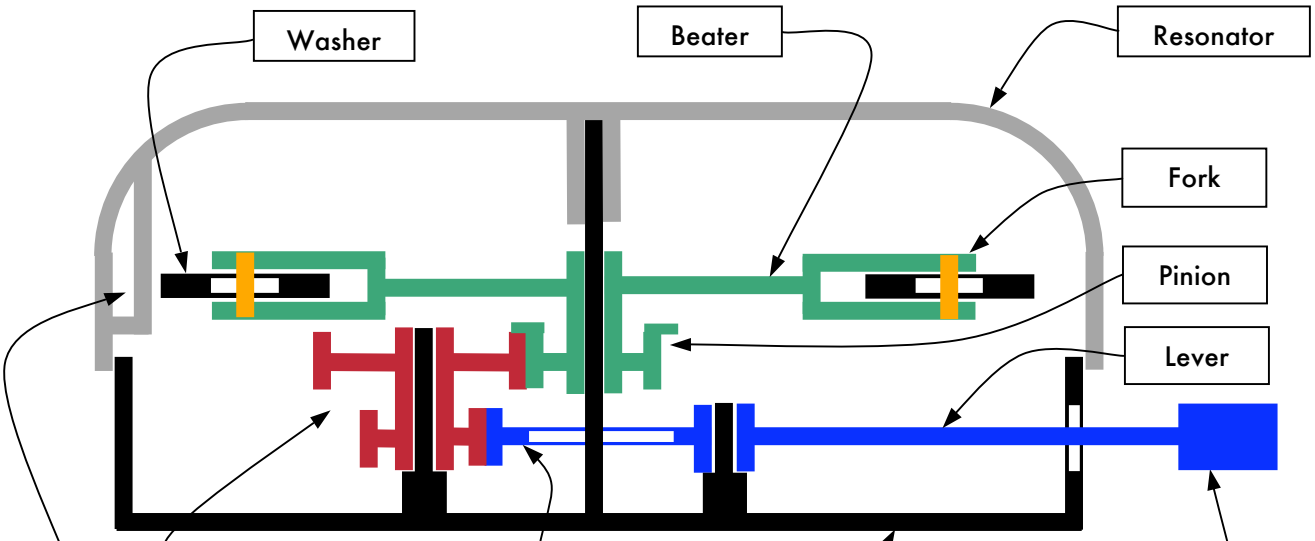
# PRINCIPLES STUDY OF THE BICYCLE BELL

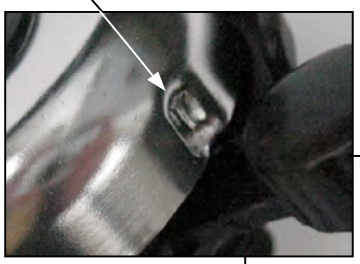
April 2011

**GLOBAL FUNCTION**

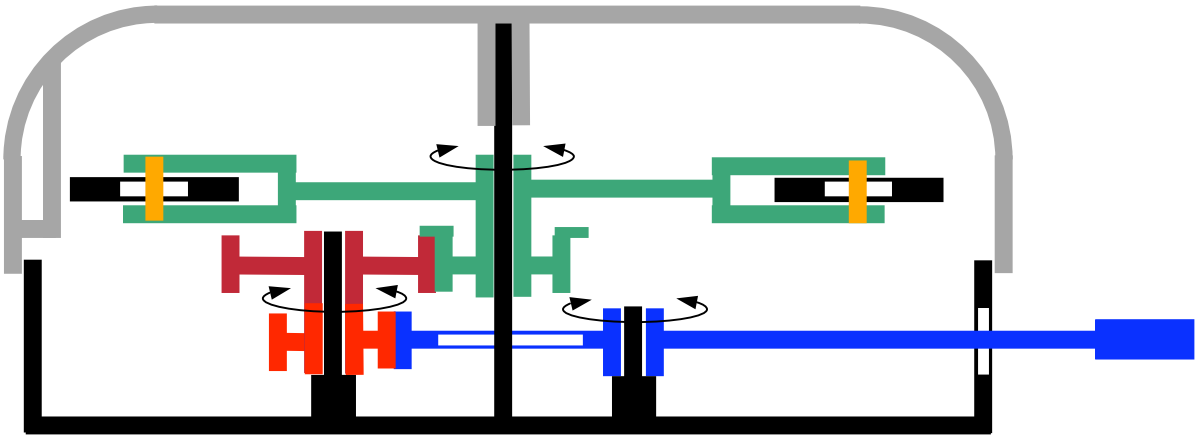
Allow the bicycle user to warn of his presence, using a single finger, by emitting a sound produced by two metal parts beaten against a resonator.

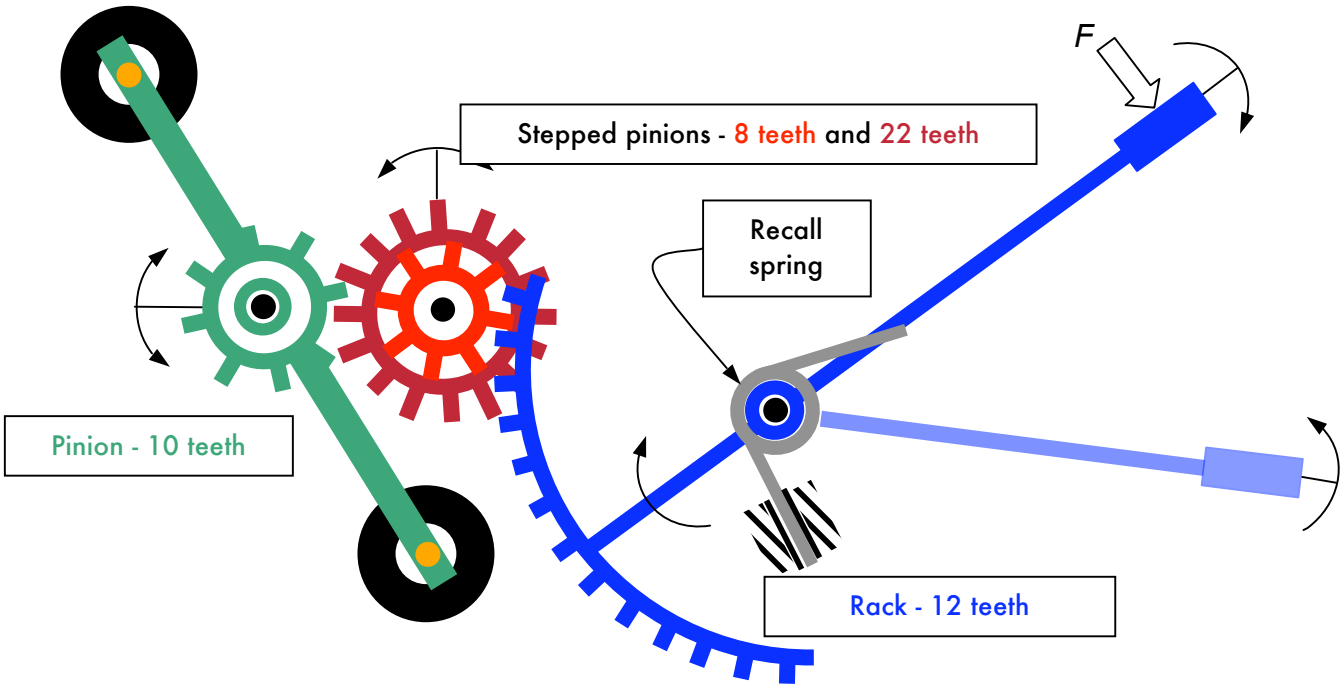
## PRINCIPLES DIAGRAM
## Side view
## (parts nomenclature)



## OPERATING PRINCIPLES

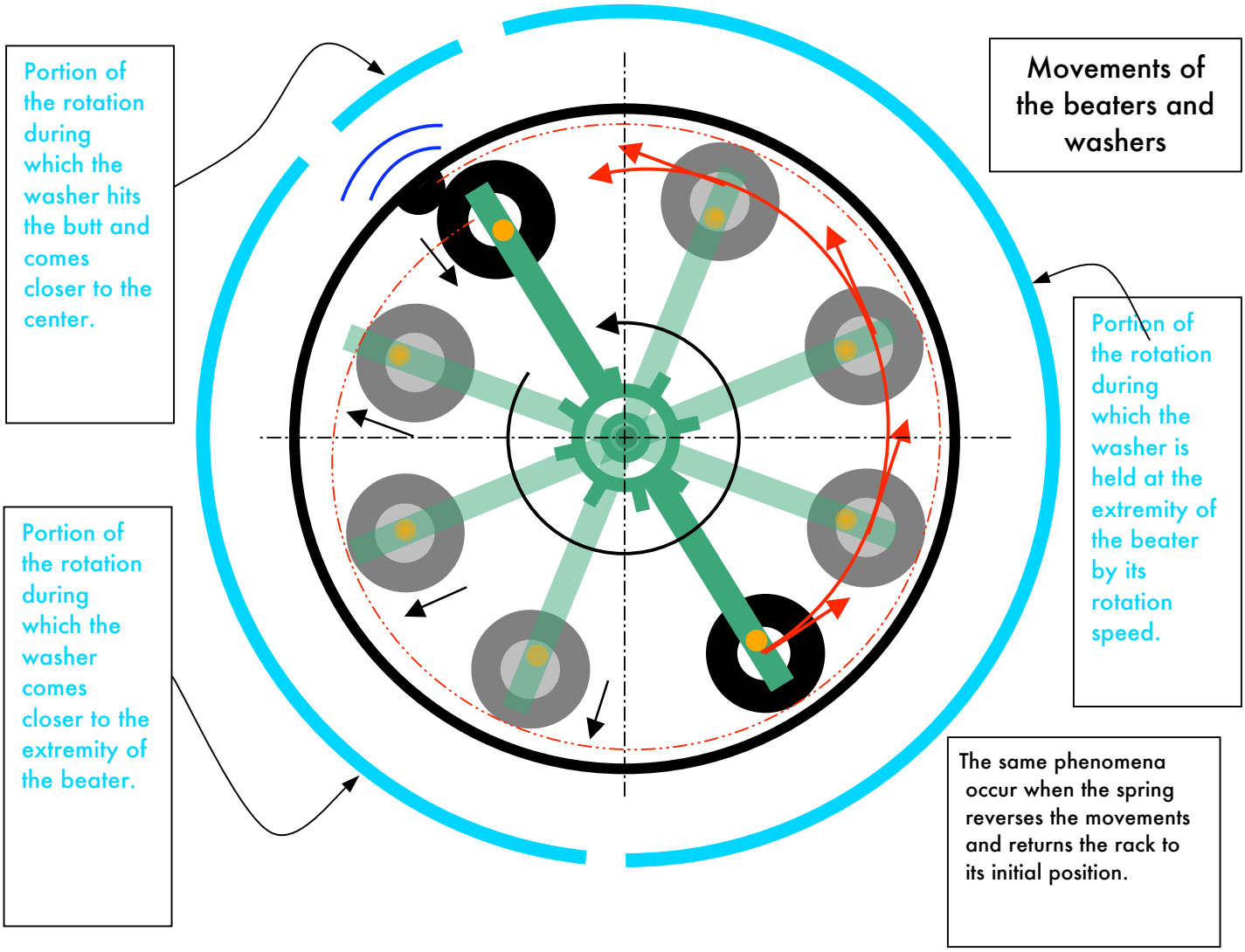





**Top view of the deployed interior mechanism**

THE NUMBER OF TEETH FOR THE GEAR COMPONENTS
12 teeth for the rack (10 operational) , 8 teeth and 22 teeth for the intermediate stepped pinions and finally, 10 teeth for the beater pinion
NUMBER OF ROTATIONS EXECUTED
For a one-way cycle of the rack, there are 1.25 rotations (10/8) of the intermediate stepped pinions and 2.2 rotations (22/10) of the beater pinions
NUMBER OF BEATS PRODUCED
Number of beats per push on the finger press:
2.2 rotations x 2 washers (one per beater): 4.4, namely 4 beats for a one way cycle of the rack. In conclusion, for each finger press, we obtain 8 beats per back and forth cycle of the rack.

The washer hits the resonator butt, which then emits a sound by vibrating. By hitting the resonator, the washer is pushed back, since the diameter of its center opening is superior to the axle's. Then, continuing to turn, the washer comes back towards the beater's extremity. Read the explanation concerning the movements of the washer in the other inset.




**(Physical) explanation concerning the movement of the washers**

The beaters create a simulated gravitational force by turning, like a centrifuge. This gravity is exerted on the washers. In fact, the washers are constrained by the beaters, which turn in a circular trajectory. Contrary to popular belief, they are not submitted to a "radial" force, often falsely called centrifugal force, which would move them away from center. The washers have an inertial and rectilinear movement which tends to make them take the trajectory illustrated in the diagram above. See the arrows. →

It is the centripetal forces that prevent them, namely the axles (●) that hold them back. According to Newton's second law, a body with a mass of *m* and an acceleration *a* is submitted to a force *F (F=ma).* Any object that describes a circle is thus submitted to a centripetal force *Fc,* directed towards the center. It is the centripetal forces holding them back, namely the axles ( ). *Fc* is a force which attracts (holds back) the body, and curves its trajectory, which would be rectilinear according to the principle of inertia. See the red arrows and also the curved trajectory in red.

**(Technological) explanation of the operation of the bicycle bell**

The device, affixed to the handlebars, is activated by a light pressure of the index finger on the finger press. This finger press is located at one extremity of a lever (class 1 lever), while a curved rack (arc of a circle) is located at the other extremity. The rotation of the lever, triggered by the force of the finger, drives the rack in rotation.

The latter is engaged with the smaller of the two stepped pinions. The larger one is engaged with a third pinion, combined with the beaters. This gearing allows a multiplication of movement (see other explanation). Thus, for a small amount of finger pressure on the lever, we obtain 2 full beater rotations.

The beaters are made up of a turning part including the washers (masses) at its extremities. Because of their speed, they tend to move away from the center of rotation of the beaters then stop on the retaining axles ( ).

When a washer hits the resonator butt, it emits a sound by vibrating, while at the same time, the washers move towards the center under the force of the impact. The beater continues its rotation and the washer comes back to the extremity under the effect of the speed of rotation (see explanation).

This phenomenon occurs for each time the washer passes by.

If we discontinue the pressure, a recall spring returns the lever to its initial position. It produces further beats on the lever's return path.

There are four beats in one direction and four in the other, producing a close succession of beats, which gives the impression of an uninterrupted ringing.