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HYDRAULIC BRAKE DYNAMOMETER

Filed Jan. 28, 1925

Fig. 1.

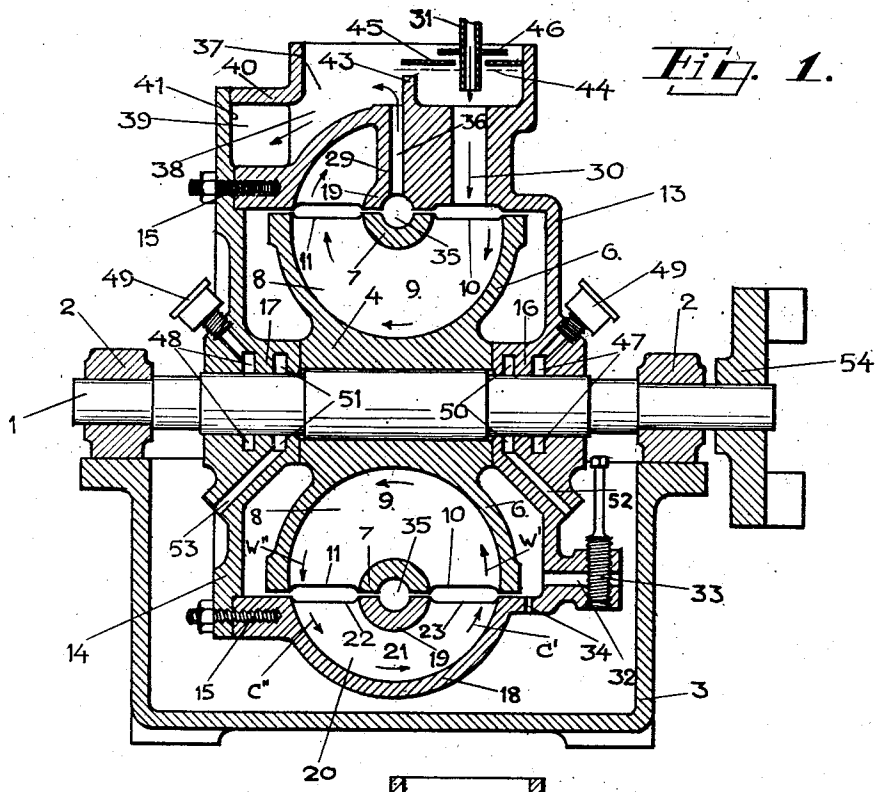
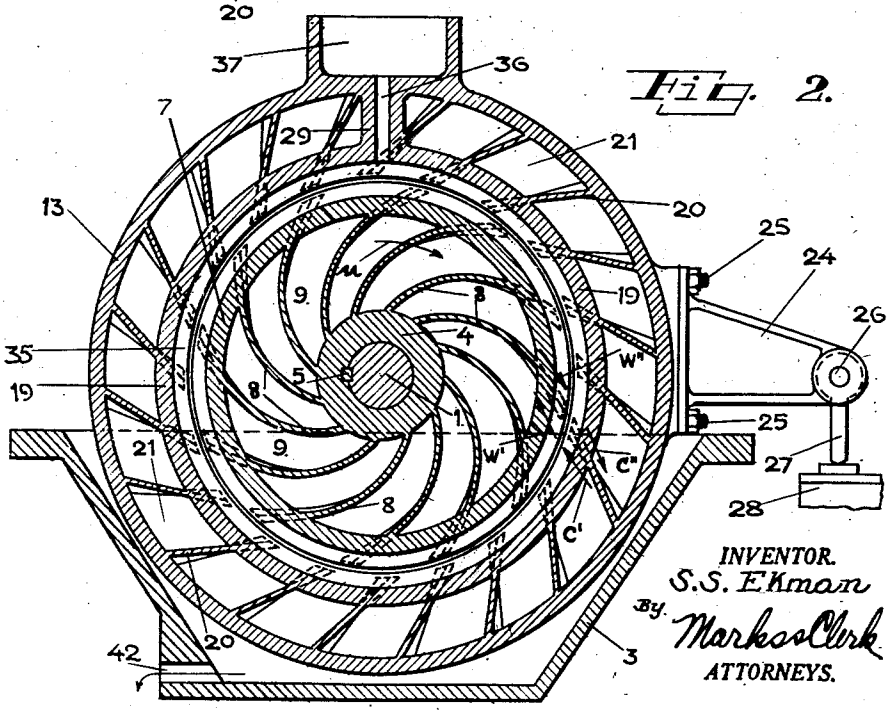


Fig. 2.



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HYDRAULIC BRAKE DYNAMOMETER.

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This invention relates to dynamometers of the type wherein a liquid—usually water—is caused to establish a resistance between a rotatory wheel mounted upon or otherwise connected with the shaft of the engine to be tested, and a substantially stationary casing adapted to oscillate about an axis like a balance and acting upon a scale to counterweigh and indicate the torque exerted by the engine to be tested. Such hydraulic brake dynamometers usually are known as "Froude hydraulic dynamometers."

This invention has for its principal object to provide a hydraulic brake dynamometer of the class mentioned, which is adapted to produce a more powerful and correct circulation of the liquid within the dynamometer and a more effective motion of the jet therein, than is possible with such dynamometers as hitherto known.

Another object of this invention is to provide a hydraulic brake dynamometer of the type mentioned, wherein the movements of the liquid within the dynamometer can be more accurately calculated and controlled, so that the results obtained in practice correspond more exactly to the results which were theoretically expected. A further object of this invention is to provide a hydraulic brake dynamometer, which can be built for a comparative low cost and nevertheless serviceable for a considerable extensive range of engine sizes, so that the same machine can be used for testing rather large engines as well as for testing engines which develop only small horsepower.

In the accompanying drawing

Fig. 1 shows in axial section an elevation of an embodiment of the improved hydraulic brake dynamometer and

Fig. 2 the same apparatus in a vertical transverse section.

The same reference letters refer to similar parts in the both figures.

In the drawing the shaft of the dynamometer is designated by 1 and is supported by two bearings 2, which are mounted on a frame 3 designed as a trough for waste liquid. The shaft 1 carries a dynamometer wheel 4 fixed thereto by a key 5. The dynamometer wheel 4 comprises a central body 6 with a channel shaped rim and a hub as well as with an annular rim 7 encircling the channel shaped central body 6. Between the body 6 and the rim 7 a series of vanes 8 is arranged all round the wheel like the vanes of a turbine or centrifugal pump. Said vanes together with the central body 6 and the rim 7 constitute a series of closed channels 9, which are open only at their intake end 10 as well as at their discharge end 11. This closed character of the channels 9 is clearly shown by Fig. 2. In Fig. 1 said channels 9 are illustrated as bent substantially along a semicircle with the inlet end 10 and outlet end 11 disposed in the same height.

The vanes 8 according to Fig. 2 are bent substantially as the vanes of a centrifugal pump and provided to make the wheel 4 revolve in the direction indicated by the arrow *u*. The outer ends of the vanes 8 in Fig. 2 are designed by diverging lines, illustrating an inclined position of said ends according to the plane of the drawing, whereby of said lines, the one line is parallel to the arrow *w'* indicating the relative inlet direction of movement of the liquid, and the other line is parallel to the arrow *w''* indicating the relative outlet direction of movement. The first mentioned line represents the intake end 10 of the channels 9, and makes clear that said end is directed parallel to the direction of the relative intake direction of movement of the liquid, while the other line represents the discharge end 11 of the channel 9 and indicates, that the said end is directed parallel to the direction of the relative outlet direction of movement of the liquid.

The casing within which the wheel 4 rotates is designated with 13, which casing constitutes the substantially stationary but oscillatory suspended brake. The casing 13 is closed at the one side by a cover 14, secured to the casing 13 by studs 15, and its oscillatory movements occur about the shaft 1 by means of bearings 16 and 17, which support the casing 13. The casing 13 is in its interior designed substantially analogous to the wheel 4, namely with one outer portion or body 18 forming a channel shaped inwardly directed rim and an annular rim 19 encircling the body portion 18, and vanes 20 provided between the body portion 18 and the rim 19, thus producing a series of closed channels 21 open only at their inlet ends 22 as well as at their discharge ends 23. In Fig. 1 the channels 21 are substan-

tially semicircular with the inlet ends and outlet ends in the same height, and in Fig. 2 the vanes 20, which constitute guide blades for the dynamometer wheel 4, are designed by several lines, indicating, that the vanes 20 are inclined to the plane of the drawing. Just as the inclination of the vanes 8 is indicated by the arrows w' and w'' respectively, the inclination of the vanes 20 is indicated by the arrows c' and c'' respectively, whereby the arrow c' represents the absolute inlet direction of movement of the liquid, showing that the discharge end 23 of the guide blades is parallel to the direction of said direction of movement, and the arrow c'' represents the absolute outlet direction of movement, showing that the inlet end 22 of the guide blades is parallel to the direction of said absolute outlet direction of movement.

From the casing 13 a dynamometer arm 24 projects, fastened by studs 25 and carrying a bolt 26 about which a support 27 is pivotally hinged down. The support 27 bears against a balance 28 by means of which the oscillating amplitudes of the dynamometer can be read off.

In the top portion of the casing 13 the upper most vane or guide blade 20 is substituted by a thicker wall 29 provided with an inlet 30 for the fluid into the dynamometer. The fluid is supplied to the inlet 30 through a pipe 31. As the fluid within the dynamometer gets hot during the operation of the dynamometer on account of the friction against the wheel and the casing, fresh fluid must be supplied at some intervals, and a corresponding quantity hot fluid drained off. For this purpose there is a drain opening 32 provided with a regulating screw plug 33. When the dynamometer is left in rest, the liquid therein will be automatically discharged by a hole 34 in the lowermost portion of the casing 13, and further the waste liquid can take its way through the interspaces between the parts 7 and 19 into an annular enlargement 35 of said interspace, and from this enlargement depart upwards through a hole 36. The liquid departing through the hole 36 as well as the waste liquid from the supply pipe 31 is collected into vessel 37 formed in one with the casing 13 and provided with a discharge opening 38, from which the waste liquid is carried to the trough 3 through a channel 39, formed within a wall 40 in the casing 13 and an annular recess 41 in the cover 14. The channel 39, however, does not reach further down than necessary for guiding the fluid down into the trough 3, wherein the waste liquid from other parts becomes collected and can be discharged through a drain hole 42 (Fig. 2).

For the purpose of preventing air from the pipe 31 entering the interior of the dynamometer together with the liquid the vessel 37 is provided with a partition wall 43 of such a height, that the discharge end of the pipe 31 becomes immerged below the level 44 of the fluid within said vessel 37, forming a liquid seal. Sprays from the liquid from the inlet 30 are prevented by means of a cover 45, which is provided with a hole for the supply pipe 31, which pipe for the same purpose is provided with a splashing plate 46.

Annular recesses 47, 48 in the bearings 16, 17 respectively, communicating with oil cups 49, can be filled up with some lubricants for reducing the friction as usual, and intermediate annular recesses 50, 51 in same bearings, provided with drain holes 52, 53, respectively, prevent liquid from the dynamometer from destroying the lubricating effect.

The dynamometer shaft 1 is connected to the shaft of the engine, which shall be tested, by means of a shaft coupling 54.

The channels 9 in the wheel 4 and the channels 21 in the casing 13 form two closed systems of bent channels, which through their cooperation constitute such a circulating course of the liquid within the dynamometer, that the liquid, when following the direction of the arrows in Fig. 1, passes alternately through the channels in the wheel 4 and the channels in the casing 13. As shown by the arrows c', c'', w', w'' in Fig. 2, which represent the directions of movement of the liquid, the liquid when departing from the guide channels 21 becomes thrown into the wheel channels 9 in a direction opposite to the moving direction of the wheel 4, as indicated by the arrow u, and when departing from the wheel channels 9 it becomes thrown into the guide channels 21 in the same direction, as the wheel 4 moves. Hereby the liquid consumes the motive power exerted by the engine to be tested, which motive power in a similar manner becomes transmitted to the guide blades 20, so that said guide blades tend to turn the casing 13 in a direction opposite to the motion of the shaft 1. The turning moment or the torque upon the casing 13 is taken up and read off on the balance 28.

It must be remembered, that I do not wish to limit myself to the special embodiment of this my invention, which is illustrated in the drawing, but I want to express my opinion, that the structural parts can be designed in other ways within the scope of the invention, such as same has been defined by the following claims.

What I claim is:

1. In hydraulic brake dynamometers, a rotatory wheel, means to temporarily connect said rotary wheel with the engine to be tested, an oscillatory suspended substantially stationary casing enclosing said rotary

wheel, means to take up and counteract upon a balance the oscillating amplitudes of said casing, a series of closed channels in said rotary wheel, said channels open only at their inlet end and outlet end, a series of closed channels in said stationary casing, said channels open only at their inlet end and outlet end, said closed channels in the rotary wheel as well as in the stationary casing being curved in such a manner, that a continuous passageway is formed by the channels in the rotary wheel in cooperation with the channels in the stationary casing.

2. In hydraulic brake dynamometers a rotatory wheel, an oscillatory suspended substantially stationary casing enclosing said rotatory wheel, closed channels in the rotatory wheel as well as in the stationary casing, said channels in the wheel and in the casing formed each of a body portion of the wheel respectively of the casing, and of an annular rim encircling the outer periphery of the wheel, and an annular rim encircling the inner periphery of the casing respectively, vanes between said body portion of the wheel and the annular rim therein, as well as vanes between said body portion of the casing and the annular rim therein, whereby said body portions of the wheel and of the casing as well as said annular rims in the wheel and in the casing are curved in such a way, that the channels in the wheel in cooperation with the channels in the casing form a continuous passageway for the liquid within the dynamometer.

3. In hydraulic brake dynamometers a rotatory wheel and an oscillatory suspended, substantially stationary casing, and closed channels in the rotatory wheel as well as in the stationary casing, said channels open only at their inlet ends and outlet ends and curved so, that in cooperation between the wheel and the casing, continuous passageways are formed thereof, said channels in the wheel as well as in the casing formed by vanes disposed between inner walls and outer walls in the wheel and in the casing respectively, said vanes positioned in such a way, that the outlet end of the channels have another angle of inclination than the inlet end of the same channels.

4. In hydraulic brake dynamometers of the class described, a rotary member provided with vanes, and an oscillatory suspended casing provided with guide members, the angles of the inlet ends of said vanes and guide members diverging from the angles of the discharge ends thereof.

5. In hydraulic brake dynamometers a rotatory wheel and an oscillatory suspended, substantially stationary casing, and closed channels in the rotatory wheel as well as in the stationary casing, said channels open only at their inlet ends and outlet ends and curved so, that in cooperation between the wheel and the casing, continuous passageways are formed thereof, said channels in the wheel as well as in the casing formed by vanes disposed between inner walls and outer walls in the wheel and in the casing respectively, said vanes inclined in such a way, that the outlet end of the channels in the casing is parallel to the direction of the absolute inlet direction of movement of the liquid into the wheel-channels, and the inlet end of the channels in the casing parallel to the direction of the absolute outlet direction of movement of said liquid from the wheel channels, and the inlet end of the wheel-channels parallel to the direction of the relative inlet direction of movement of the liquid therein, and the outlet end of the wheel channels parallel to the direction of the relative outlet direction of movement from said wheel.

6. In hydraulic brake dynamometers a rotary dynamometer wheel, an oscillatory substantially stationary casing encircling said wheel, closed channels in said wheel as well as in said casing, said channels constituting a continuous passageway for the liquid within the dynamometer, an inlet for said liquid into the casing, said inlet being open to the surrounding air and provided with means to prevent splashing liquid to escape from said inlet.

7. In hydraulic brake dynamometers a rotary dynamometer wheel, an oscillatory substantially stationary casing encircling said wheel, closed channels in said wheel as well as in said casing, said channels constituting a continuous passageway for the liquid within the dynamometer, an inlet for said liquid into the casing, said inlet being open to the surrounding air and provided with means to prevent air to enter the interior of the dynamometer together with the fresh liquid.

8. In hydraulic brake dynamometers a rotary dynamometer wheel, an oscillatory substantially stationary casing encircling said wheel, closed channels in said wheel as well as in said casing, said channels constituting a continuous passageway for the liquid within the dynamometer, an inlet for said liquid into the casing, said inlet being open to the surrounding air, and a liquid seal formed in the inlet by means of a partition wall, and the free end of a supply pipe disposed at a lower level than the upper edge of said partition wall.

9. In hydraulic brake dynamometers, a rotatory wheel, and an oscillatory suspended, substantially stationary casing, said rotary wheel and said stationary casing each being provided with channels, said channels being curved so that in cooperation the channels in the wheel and the channels in the casing form continuous passageways for the operative liquid in the brake, the channels in said

wheel and said casing being formed by vanes in the wheel and vanes in the casing, said vanes being inclined in such a way, that the inlet end of each channel in the casing is parallel to the direction of the absolute outlet direction of movement of said liquid from the wheel-channels, and the inlet end of each wheel-channel parallel to the direction of the relative inlet direction of movement of said liquid from the channels in the casing.

In testimony whereof I have hereunto affixed my signature.

SVEN SIGURD EKMAN.