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RETARDING DEVICE FOR MACHINERY

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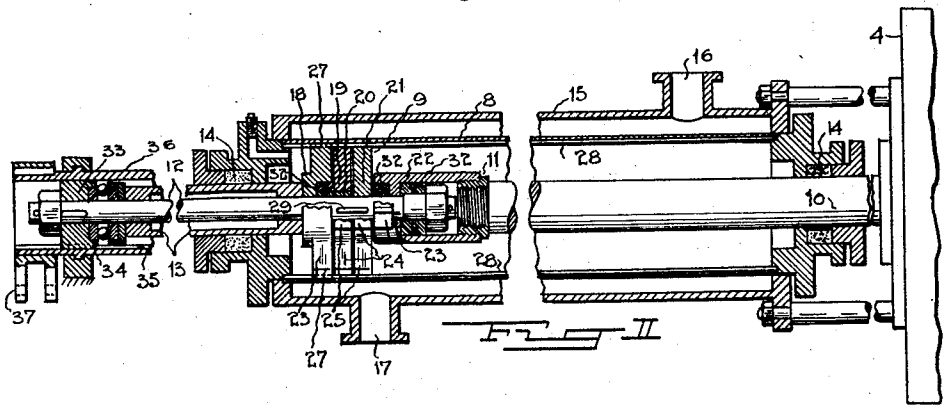


Fig. II

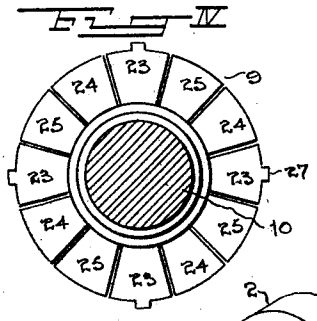


Fig. IV

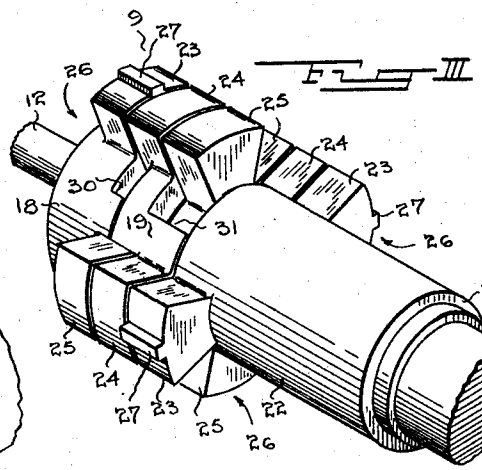


Fig. III

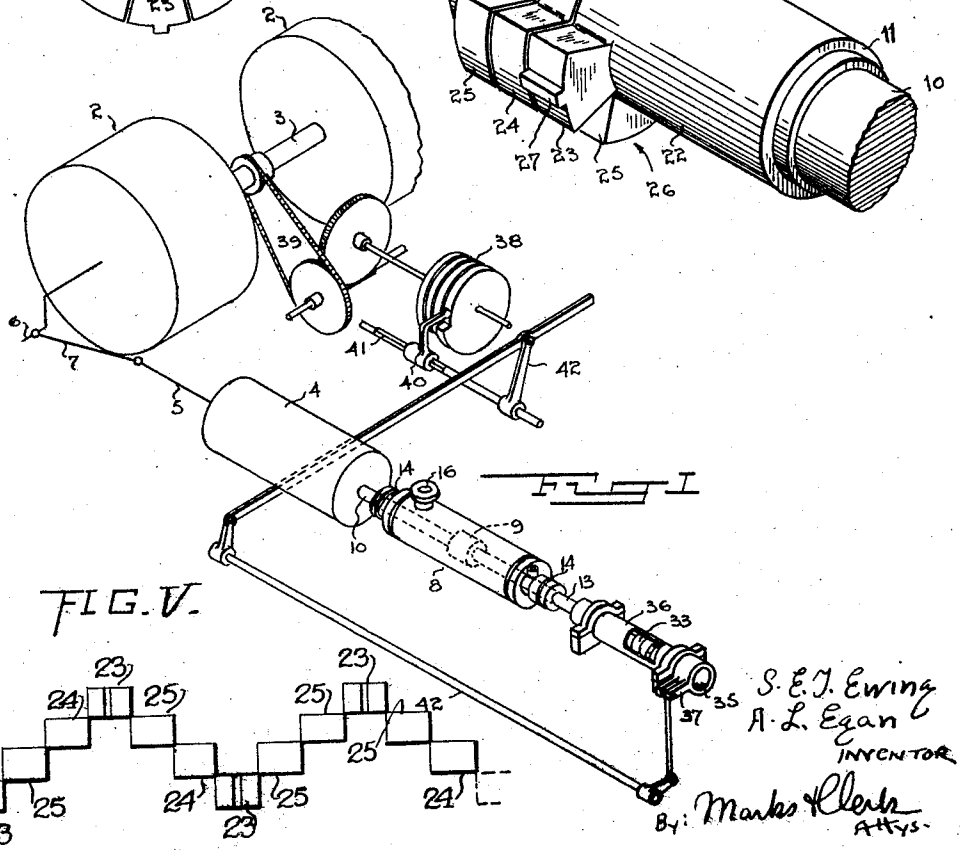


Fig. I

FIG. V.

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UNITED STATES PATENT OFFICE

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RETARDING DEVICE FOR MACHINERY

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The present invention relates to braking, retarding, or controlling devices for machinery, especially machinery comprising a rotating shaft. A particular application of the invention is to mine hoists which are steam driven or otherwise ill-adapted to regenerate the energy given up by the retardation of the load, more particularly the potential energy of a descending load.

According to this invention the braking effect is produced by relatively reciprocating a piston in a cylinder containing a liquid and having a restricted passage for the movement of liquid from side to side of the piston. Means are provided for varying the effective area of the passage, either manually, or automatically so that the resistance varies in some desired manner, for instance according to speed, or particularly in the case of a hoist, according to the conditions of hoisting.

The invention is shown in the accompanying drawing as applied to a steam winding engine,

Fig. I being a schematic perspective view showing the hoist machinery;

Fig. II a longitudinal section through one of the retarding cylinders;

Fig. III a perspective view of the retarding piston, and

Fig. IV an end view of the same piston in another state of adjustment;

Fig. V shows, to a reduced scale, a development of the periphery of the piston shown in Fig. IV.

In Fig. I, 2 indicates the winding drums carried on a shaft 3. 4 indicates one of the steam cylinders of the winding engine and 5 the piston rod thereof connected to the shaft crank 6 by the connecting rod 7.

Alined with each engine cylinder is the brake cylinder 8 containing a piston 9. The tail rod 10 of the steam piston may extend into the brake cylinder 8 and is connected to the piston 9, as at 11. The piston 9 is provided with a tail rod consisting of the shaft 12 and the filling sleeve 13 which is of the same diameter as the rod 10 in order to balance the piston 9; stuffing boxes 14 being provided for said rods.

The brake cylinder is fitted with a jacket 15 having an inlet 16 and an outlet 17 for the circulation of water by which the energy taken from the hoist is systematically disposed of.

The brake piston 9 is so constructed as to provide through itself the variable passage by which the liquid passes from one side to the other of it when it is reciprocated. For this purpose it is composed of a number of sections 18, 19, 20, 21, 22, formed with sector-shaped wings numbered 23, 24, 25, and relatively rotatable so that the wings can be opened or closed fanwise; the segmental spaces 26 left between the wings constituting the passage for liquid. The more relatively movable sets of wings there are provided, the less is the projected area they will occupy when closed up and therefore the greater is the maximum opening of the passage. The piston shown is provided with three relatively movable sets of wings, enabling the angular extent of the passage to be varied between 0 degrees and 240 degrees.

The piston accordingly comprises three relatively rotatable units all mounted on the shaft 12. One unit comprises the end piston sections 18 and 22 which are made non-rotatable as by means of tongues 27 fitting into grooves 28 in the cylinder wall. This unit provides the wings 23 each of approximately 30° angular extent and spaced 90° apart. The second unit consists of the sections 20 and 21 which are made separate to permit assembly of the piston but which when in place are both secured to the shaft 12 by a key 29 so as to be rotated thereby. This unit comprises the four wings 25 similar to the wings of the first unit and arranged to be in alinement with the latter, as shown in Fig. III in one limiting position of the piston units.

The third unit consists of the sections 19 providing a set of wings 24 which is similar to the sets 23 and 25 and can aline with said sets as shown in Fig. II. This unit is loose on the shaft 12 but is limited to an angular movement of 30° from the Fig. III position by a pair of stops 30 on the section 18, one of which appears in Fig. III. A similar pair of stops 31 on the unit 19 enables said unit

to be rotated from the Fig. III position by the unit 20, 21 but with a lost motion of 30°. Unit 20, 21 can therefore make a maximum movement of 60°, during which it moves unit 19 through 30°. Accordingly by suitably rotating the shaft 12, all the sets of wings may be alined as shown in Fig. III when the liquid passage 26 through the piston will be the maximum, or they may be angularly spread out as shown in Figs. IV and V from which it will be seen that the four wings 23 form fixed abutments at the ends of the piston and that the two sets of four wings 24 and 25 move into position to form a series of steps extending between each consecutive pair of wings 23 and completely closing the passage through the piston. It will be evident that the wings 24 and 25 may be arranged at any positions intermediate between the positions of Fig. III and Figs. IV and V respectively. With the wide angular opening attainable in the first position, the resistance offered by the liquid to the reciprocation of the piston 9 in the cylinder 8 can be so small as to be negligible for the purpose in view. The resistance increases with the decrease of the opening 26 and may be made as great as is desired by suitably arranging the minimum opening.

32 indicates ball bearings which are interposed between the relatively rotatable parts in order to facilitate the rotation of the shaft 12 notwithstanding the heavy axial pressures to which the piston sections may be exposed when the brake is in operation.

For effecting the angular adjustment of the shaft 12 the latter is fitted externally of the cylinder 8 with a head 33 having a feather 34 engaging a slot 35 and a sleeve 36. The latter is rotatable but otherwise fixed and is provided with a crank arm 37 for rotating it.

In the example shown the rotation of the sleeve is effected by cams 38 such that resistance is automatically applied to the hoist according to the conditions under which the hoist is operating. For example there may be two pairs of cams, one pair for use when the load on the hoist is a descending load, the other pair for use when the load is an ascending one; the individuals of the pairs being used according to the direction of rotation of the hoist. Said cams are connected to the drums 2 by gearing 39 so that they always rotate therewith and the proper cam is brought into operation by sliding an arm 40 on the shaft 41 to engage such cam. The cam moves the arm 40 and shaft 41 angularly and said shaft is connected by gearing 42 to the sleeve 36 so as to rotate the latter as determined by the profile of the cams.

In the case for example where men or stores are being lowered into the mine, the relevant cam would be such as to leave the piston wings 23, 24, 25 fully alined until the conveyance has reached the point in its travel at which it attains its regular speed, whereupon the cam would spread the wings to the extent necessary to set up resistance commensurate with the potential energy given up by the descending parts and thereby keep the speed constant; whilst at a later stage further resistance would be provided to bring the conveyance to rest at the lower terminal of its journey. On the other hand when rock is being raised from the mine, the relevant cam would be arranged to leave the piston wings fully alined until the conveyance approaches the surface, when it would cause said wings gradually to spread and so afford the resistance suitable to bring the conveyance to rest at its stopping point. In each case the fellow cam of the pair would be used on the return journey.

We claim:

1. A braking device comprising a cylinder adapted to contain liquid, a piston reciprocable therein, a piston rod and tail rod of equal diameter extending from the piston through the cylinder ends, said piston comprising relatively rotatable units providing a passage through the piston the effective area of which is varied by relative rotation of the piston units, and said tail rod being rotatable and connected to one of said piston units to rotate the latter, and means for preventing rotation of another of said piston units.

2. A braking device comprising a cylinder adapted to contain liquid, a piston reciprocable therein, a piston rod and tail rod of equal diameter extending from the piston through the cylinder ends, said piston comprising relatively rotatable units providing a passage through the piston the effective area of which is varied by relative rotation of the units, and said tail rod being rotatable and connected to one of said piston units to rotate the latter, means for preventing rotation of another of said piston units, a further piston unit being loose and rotatable with lost motion by the tail rod unit and having its angular movement limited by the non-rotatable unit.

3. A braking device comprising a cylinder adapted to contain liquid, a piston reciprocable therein, a piston rod and tail rod of equal diameter extending from the piston through the cylinder ends, said piston comprising relatively rotatable units providing a passage through the piston the effective area of which is varied by relative rotation of the piston units, a rotatable and endwise fixed member external of the cylinder, and means for preventing rotation of one of said piston units, said tail rod being rotatable and connected to another of said piston units to rotate the latter and splined to the rotatable and endwise fixed member external of the cylinder.

4. A braking device comprising a cylinder adapted to contain liquid, a piston recipro-

cable therein, a piston rod and tail rod of equal diameter extending from the piston through the cylinder ends, said piston comprising relatively rotatable units providing a passage through the piston the effective area of which is varied by relative rotation of the piston units, a rotatable and endwise fixed member external of the cylinder, means for preventing rotation of one of said piston units, said tail rod being rotatable and connected to another of said piston units to rotate the latter and splined to the rotatable and endwise fixed member external of the cylinder, and a further piston unit being loose and rotatable with lost motion by the tail rod unit.

5. A braking device comprising a cylinder containing liquid, a piston reciprocable therein, a piston rod and tail rod of equal diameter extending from the piston through the cylinder ends, said piston comprising relatively rotatable units providing a passage through the piston the effective area of which is varied by relative rotation of the piston units, a rotatable and endwise fixed member external of the cylinder, means for preventing rotation of one of said piston units, said tail rod being rotatable and connected to another of said piston units to rotate the latter and splined to the rotatable and endwise fixed member external of the cylinder, a further piston unit being loose and rotatable with lost motion by the tail rod unit and having its angular movement limited by the tail rod unit.

6. A braking device comprising a cylinder adapted to contain liquid, a piston reciprocable therein, a piston rod and a tail rod of equal diameter extending from the piston through the cylinder ends, said piston comprising at least three units each comprising sector-shaped wings comprising approximately not more than one-third of the possible piston area around the rods, the units being angularly adjustable relatively to one another to provide a liquid passage through the piston variable from zero to at least approximately two-thirds of the possible piston area around the rods.

7. A braking device comprising a cylinder adapted to contain liquid, a piston reciprocable therein, a piston rod and a tail rod of equal diameter extending from the piston through the cylinder ends, said piston consisting of one piston unit comprising two end sets of at least one sector-shaped wing, said wings being evenly spaced apart, and further piston units each with one set of at least two sector-shaped wings also evenly spaced apart, arranged with their wings between the two fixed sets, all the units being rotatable relatively to one another.

8. A braking device comprising a cylinder adapted to contain liquid, a piston reciprocable therein, a piston rod and a tail rod of equal diameter extending from the piston through the cylinder ends, said piston consisting of one piston unit comprising two end sets of at least one sector-shaped wing, said wings being evenly spaced apart, and further piston units each with one set of at least two sector-shaped wings also evenly spaced apart, arranged with their wings between the two fixed sets, means engaging one of the piston units to prevent it from rotating and means for differentially rotating the other two piston units.

9. A braking device comprising a cylinder adapted to contain liquid, a piston reciprocable therein, a piston rod and a tail rod of equal diameter extending from the piston through the cylinder ends, said piston consisting of one piston unit comprising two end sets of at least one sector-shaped wing, said wings being evenly spaced apart and further piston units each with one set of at least two sector-shaped wings also evenly spaced apart, arranged with their wings between the two fixed sets, means engaging one of the piston units to prevent it from rotating, means for positively rotating another of said piston units, a third piston unit being loosely rotatable, the second named piston unit being constructed to engage the third piston unit so as to rotate it with lost motion and the first named piston unit being constructed to engage the third unit to limit its angular movement.

10. A braking device as claimed in claim 9 in which the second named piston unit is secured to the tail rod to rotate therewith, and a rotatable and endwise fixed member external of the cylinder to which the tail rod is splined.

In testimony whereof we affix our signatures.

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