Oct. 30, 1934. E. V. CROSS 1,978,990

APPARATUS FOR POWER TRANSFORMATION

Filed July 9, 1929

Fig. 1.

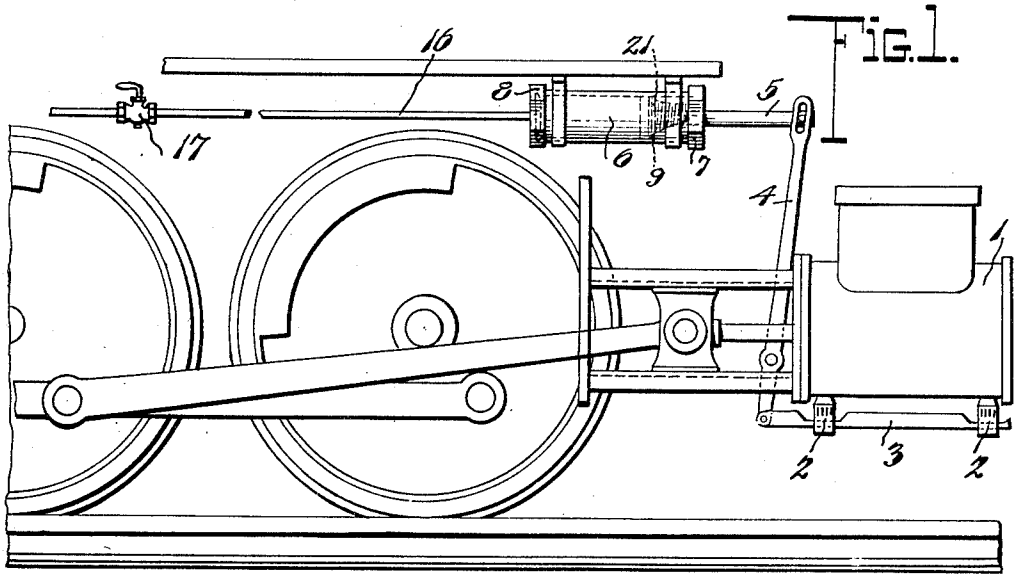



Fig. 2.

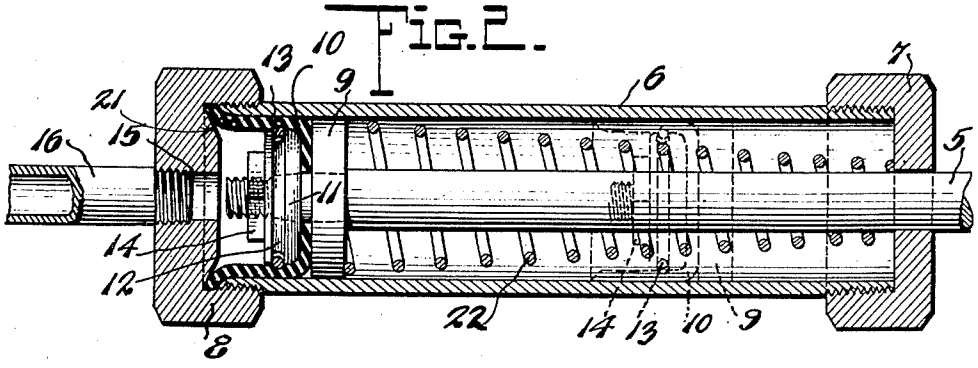



Fig. 3.

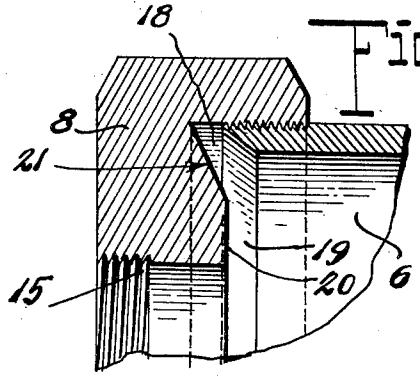
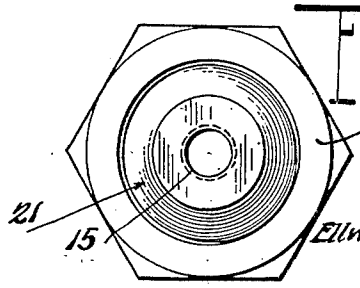



Fig. 4.




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# UNITED STATES PATENT OFFICE

1,978,990

## APPARATUS FOR POWER TRANSFORMATION

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Application July 9, 1929, Serial No. 376,991

14 Claims. (Cl. 121—38)

This invention relates to improvements in the art of transforming the pressure of fluid under pressure to work, and more particularly relates to the process of utilizing and conserving the power of low temperature pressure fluid and to the cylinder and piston construction especially adapted for the effective practicing of such art.

It has heretofore been proposed to actuate a piston against return stress by an overbalancing stress expressed through the introduction of pressure fluid and to maintain the piston in a predetermined position by the continued presence of the pressure fluid; and, while a degree of success has attended such attempts, when steam or other high temperature pressure fluid has been employed, heretofore unsurmounted difficulties have developed in the attempting to secure the same results by the employment of low temperature pressure fluid, such as compressed air. I have found that the heat expansion following the use of high temperature fluid has been sufficient to maintain the required non-leaking contact between the piston packing and the surrounding cylinder wall, but, when low temperature pressure fluid is employed, the expanding fluid extracting heat units from surrounding parts tends to produce such a differential contraction as to leave a leakage space between all commonly known piston packings and the surrounding cylinder wall.

It is the primary object of the present invention to overcome the resulting difficulties and to enable successful and economical utilization of low temperature pressure fluid, and it is a further object to prolong the effective life of the parts and particularly of the piston packing while overcoming the above suggested difficulties.

To this end, the invention includes the art of subjecting the piston packing to such directional approach of the pressure fluid as to cause the very pressure of such fluid to contribute an increment of additional resistance to leakage, and also includes manipulative treatment of such packing at such intervals relative to the functioning of the piston as to afford maximum efficiency in avoidance of leakage.

With the objects stated in mind, together with other objects, as will in part hereinafter become apparent and in part be pointed out, the invention comprises certain novel steps and combinations of steps of an art and certain novel constructions, combinations, and arrangements of parts as subsequently specified and claimed.

In the accompanying drawing,—

Figure 1 is a view in side elevation of an apparatus embodying the structural features of the present invention and well adapted for carrying out the art thereof, and illustrated as applied to locomotive drain cock control.

Figure 2 is a longitudinal, axial section through a cylinder embodying the features of the present invention, the piston and associated parts being shown partly in elevation and partly in section, and the retracted position of the piston being indicated in dotted lines.

Figure 3 is an enlarged, detailed, fragmentary view of the intake end portion of the cylinder detached.

Figure 4 is an end view of the cylinder head detached and shown on the same scale as Figure 2.

Referring to the drawing by numerals, 1 indicates the cylinder of an ordinary locomotive having the usual drain cocks 2, 2, controlled by the sliding wedge bar 3. Wedge bar 3 is pivotally engaged by an operating lever 4, which in turn has a pin and slot pivotal engagement with the piston rod 5. Piston rod 5 extends into a cylinder 6, illustrated as having detachable cylinder heads 7 and 8. Obviously, the heads 7 and 8 may be otherwise formed, as desired. A piston head 9 is mounted on and appropriately fixed to the inner end portion of the piston rod 5 and clamped against the head 9 is the packing leather 10 retained by the spreader disc 11 having the annular groove 12 carrying the expanding ring 13. A retaining nut 14 is preferably threaded onto the extreme end portion of piston 5 for jamming the clamping disc 11 against the piston head 9. Head 9 may be fixed to piston rod 5 in any appropriate manner, but preferably, for facility of assemblage and renewal, the head 9 is mounted against an annular shoulder or rabbet of a larger portion of piston rod 5, while the terminal portion is reduced to extend through the head, through the disc 11 and the nut 14. The packing 10, while corresponding somewhat in contour to an ordinary pump leather, and while preferably made of leather, is of sufficient depth for purposes hereinafter pointed out, and may be of any appropriate web susceptible of functioning as required. The free flange of the packing web 10 should be of sufficient depth to have its edge extend a substantial distance beyond the terminus of the piston 5 so as to have the free edge portion conditioned to be manipulated for being maintained under a constant tendency to spread or expand tightly against the surrounding walls of the cylinder 6.

The head 8 is provided with an intake port

15 into which is threaded a supply pipe 16 leading through any appropriate control valve from the compressed air tank of the locomotive, or other source of supply of low temperature fluid under pressure. A valve 17 may be employed in the pipe line 16 to cut off the pressure when desired. Port 15 discharges approximately centrally within the packing web 10, when the parts are in the position seen in full lines in Figure 2, and the entering pressure fluid expanding radially tends to maintain the free flange or cup portion of the packing web 10 in a radially expanded condition tightly against the surrounding walls of the cylinder.

As best seen in Figure 3, the wall of the cylinder 6 is formed with an inclined, annular groove, enlargement or recess 18 at the intake end of the cylinder outstanding both radially and longitudinally from the otherwise complete areas enclosed by the cylinder. As a matter of convenience of manufacture and assemblage, the cylinder 6 proper is threaded or otherwise detachably anchored in the head 8, and the groove 18 is provided by forming a bevel 19 across the edge of the end of the cylinder 6 and by forming a truncated cone 20 providing a beveled or inclined surface 21 opposing the bevel 19 and providing the limiting walls of the groove 18. Groove 18 obviously may be otherwise produced and is within the purview of the invention however formed so long as providing such occasion for treatment of the free edge portion of the packing web 10 as to contribute to the efficacy of that web in resisting leakage past the piston. This treatment includes expansion of the free web of packing 10 against the surrounding walls of the cylinder 6.

At the opposite side of piston 9 from the intake port 15, a return spring 22 surrounds piston rod 5 and rests at one end against the cylinder head 7, and at the other end against the piston head 9, so as to be compressed by any stroke of the piston away from the position seen in full lines in Figure 2, which is the position of pressure exhaustion from cylinder 6. The spring 21 is tensioned to resist movement of piston 11 under the stress of pressure fluid entering through port 15, and the spring 21 should be given the requisite pressure for the particular work to be done. The spring 21, of course, normally at all times stresses the packing 10 to its expanded condition against the walls of the cylinder 6, as seen in Figure 2, whenever the piston is not moved under the stress of incoming pressure fluid. For example, when the apparatus is set to release the drain cocks of a cylinder and the predetermined low pressure at which the release is to occur is say seventy pounds, then the spring 21 must possess expansive capacity to exert that stress required for moving the piston 9 against the pressure head of seventy pounds for seating the piston, as seen in full lines in Figure 2, when the pressure drops to seventy. This is used, obviously, only for illustrative purposes, and the pressure dealt with may be at any predetermined degree, the spring being tensioned according to the degree determined upon.

Furthermore, while the present invention is illustrated as applied to an automatic control for the drain cocks of a cylinder, applicability to a wide range of utility wherever low temperature pressure fluid is employed is within the intended use of the invention.

The structure as shown in Figure 1 is automatic and operates to insure blowing off of the cylinders as, for instance, when the locomotive is left in the roundhouse, even though the locomotive engineer neglects to give attention to his cylinder cocks. When the pressure drops in the line 16 to the predetermined minimum, spring 21 will thrust piston 9 to the return or seated position, as seen in full lines in Figure 2, and thereupon swing the operating lever 4 from the position seen in Figure 1 to a position allowing the cams of slide bar 3 to function and open the cylinder drain cocks.

As the piston 9 approaches its seated position, or position shown in full lines in Figure 2, the packing web 10 has its free edge strike the beveled surface 21, and the said free edge is flared outward thereby into a seated position in the groove 18 where the web remains expanded against the wall of cylinder 6 until the next fluid impulse overcomes the action of spring 21. The inflowing pressure fluid not only impinges against the sides of the cup or flange portion of web 10 in a manner to press the same in all outward directions against the surrounding walls of cylinder 6, but, also, forcing the piston 9 and its connected parts along the cylinder against the pressure of spring 21 causes the free edge portion or margin of the web 10 to be drawn inward against the expansive force of the impinging pressure fluid. This manipulation not only tends to maintain the terminal or free edge portion of web 10 soft, but insures a tendency to hug the cylinder wall closely, and the flange portion of web 10 is thus held firmly against the surrounding cylinder walls until the return stroke, when the free margin of said web again enters the groove 18, and by this last movement acquires a condition both increasing flexibility and further tending to accentuate tightness of contact with the cylinder walls.

Obviously, in the particular application of the invention illustrated in the accompanying drawing, after the lowered pressure in pipe line 16 has allowed piston head 9 and connected parts to move to the position seen in full lines in Figure 2, and the resulting movement of the sliding wedge bar 3 to the position for opening cylinder cocks 2, the cylinder cocks will remain open until the pressure in line 16 is again raised to that elevation predetermined for overcoming the resistance of spring 21 and thereby thrusting the piston 9 to the position seen in Figure 1 for closing the cylinder drain cocks.

As indicated above, the present invention does not relate to the cylinder cocks 2 or the bar 3, and any arrangement thereof suitable and appropriate or well known in the prior art may be utilized, and, in fact, the invention is merely illustratively shown as applied to this particular type of mechanical apparatus, whereas it is of great value and utility in many other surroundings and in connection with other devices, such as air gauges and automatic controls for pneumatic hammers and elsewhere where precision and accuracy are desired, and/or avoidance of loss of cold pressure fluid or pressure fluid at reduced temperature is a factor to be avoided. Hence, the cylinder cocks and their manipulating devices are not in fact a part of the present invention, but, for purposes of illustrative application indicating one useful connection for the present invention, when the invention is applied to a form of cylinder cock actuating or controlling linkage, the position for a closed cylinder cock is that shown in Figure 1 while the position for the open cylinder cock is that shown in full lines in Figure 2. For that reason, any appropri-

ate illustrative instance from the prior art may be resorted to, and, in fact, the cylinder cock controlling and actuating slide bar 3 has been selected from such prior art as illustrated in U. S. Letters Patent No. 1,126,900, dated February 2, 1915, and granted to one Arthur E. Stachel.

It will be observed that the skirt of the packing web 10, whenever the piston 9 is in the cylinder cock closing position, as seen in Figure 1 of the drawing, snugly hugs the walls of the cylinder and therefore will be cylindrical throughout its length and its margins will take a bell shape or flare only when the cylinder cocks are open. The movement of the cylindrical skirt of the packing from its cylindrical shape to its flared condition and back to its cylindrical shape maintains during use a highly flexible condition of the web which insures against leakage of pressure past the piston. This is an extremely important factor in the combination in which the cylinder cocks are included, since it is fatal to the commercial use of any piston which would allow the cylinder cocks to become open during the regular operation of the locomotive. Pistons heretofore proposed for this work have become undependable from leaking under such service which has rendered them incapable of commercial acceptance.

The present invention is distinctively efficacious in preventing leakage past a piston where the pressure fluid employed is cold. It is obvious that where steam is employed, or other heated pressure fluid, the expansion of the piston parts incident to the heat will largely obviate leakage, but this condition does not attain where the compressed air or like cold pressure fluid tends to produce shrinkage of the parts of the piston head. Furthermore, in apparatus of the character described, it is obvious that the pressure fluid is introduced only at intervals and therefore it is important that the spring 21 be of sufficient length and strength to insure the return stroke of the piston with the relaxing of the pressure until the parts assume the position seen in Figure 2. Thus, the spring 21 presses the piston at all times toward the position seen in Figure 2 and whenever there is no opposing stress overbalancing the spring 21 the packing of the piston will be retained expanded against the walls of the cylinder by the action of the spreader or cone frustum 21, and this spread condition is a continuous state of the piston packing whenever it is not being subjected to pressure fluid. Thus, the piston is constantly preserved in a state or condition affording maximum insurance against leakage of pressure fluid along the walls of the cylinder past the piston packing.

What is claimed is:

1. The combination of a cylinder having an expansion recess of greater diameter than the diameter of the cylinder, the said recess communicating and being coaxial with the cylinder, a piston in the cylinder adapted for actuation under the stress of pressure fluid introduced into the cylinder, said piston having a web packing located to snugly hug the walls of the cylinder and having a free marginal portion adapted to move into and out of said recess and cushioning means stressing the web toward a seated position extending into the expansion recess, the cushioning means being proportioned to so seat the web when not overcome by pressure fluid acting on the piston.

2. The combination of a cylinder having an expansion recess of greater diameter than the diameter of the cylinder, the said recess communicating and being coaxial with the cylinder, a piston in the cylinder adapted to be pressure-fluid actuated and having a web packing located with a free marginal portion adapted to move into and out of said recess, and means tensioned for directing said free marginal portion into said recess during a portion of the stroke of the piston, the packing web snugly hugging the cylinder throughout the length of the web during a piston stroke.

3. The combination of a cylinder having an expansion recess of greater diameter than the diameter of the cylinder, the said recess communicating and being coaxial with the cylinder, a piston in the cylinder having a web packing located to, during travel, conform to and hug the cylinder walls and having a free marginal portion adapted to be deformed from the cylindrical shape of the web and to move into and out of said recess, and means tensioned for directing said free marginal portion into said recess during a portion of the stroke of the piston, the recess being at one terminus of the cylinder.

4. The combination of a cylinder having an expansion recess of greater diameter than the diameter of the cylinder, the said recess communicating and being coaxial with the cylinder, a piston in the cylinder adapted to be pressure-fluid actuated and having a cylindrical web packing located to hug the walls of the cylinder and having a free marginal portion adapted to move into and out of said recess, and means tensioned for directing said free marginal portion into said recess during a portion of the stroke of the piston, the recess being at one terminus of the cylinder and the directing means being carried by the head of the cylinder.

5. The combination of a cylinder having at one end an annular enlargement beyond the extended lines of the bore of the cylinder, a piston in said cylinder having a normally cylindrical packing provided with a free marginal portion adapted at times to expand into said enlargement and to contract therefrom to cylindrical form incident to a stroke of the piston to and from that end of the cylinder having the enlargement, and means constantly stressing the piston toward a seated position with the free marginal portion of the packing extending into said annular enlargement.

6. The combination of a cylinder having at one end an annular enlargement beyond the extended lines of the bore of the cylinder, a piston in said cylinder having a normally cylindrical packing provided with a free marginal portion adapted at times to expand into said enlargement and to contract therefrom to cylindrical form incident to a stroke of the piston to and from that end of the cylinder having the enlargement, and the head of the cylinder at the end having the enlargement being formed with a conical portion extending into the cylinder in position for directing the packing into said enlargement, and means constantly stressing the piston toward a seated position with the free marginal portion of the packing in expanded engagement with said conical portion.

7. The combination of a cylinder having an intake end, of a piston head arranged in the cylinder, a cup-like piston packing connected to said head and extending from the head toward the intake end of the cylinder and proportioned to snugly engage the walls of the cylinder to prevent leakage past the piston, a spreader cone at

the intake end of the cylinder located to be engaged by the free marginal portions of the cup-like packing when the piston is seated at the intake end of the cylinder for spreading the marginal portions of said packing radially, and resilient means for thus seating the piston at all times when the piston is free from displacement under the action of pressure fluid entering through said intake end.

8. In pressure fluid actuated apparatus, the combination, with a cylinder, a piston therein, elastic means for resiliently stressing the piston toward one end of the cylinder, means for delivering low temperature fluid under pressure to the opposite side of the piston for moving the piston along the cylinder against the resilient pressure, the piston having a web packing of cylindrical form adapted for snugly hugging the walls of the piston and having free marginal portions susceptible of expansion against the cylindrical walls, and means for thus expanding said free marginal portions, the elastic means being proportioned to resiliently stress the piston to the position causing the said free marginal portions of the packing to engage and be expanded by said expanding means in the absence of pressure fluid stress moving the piston away from said expanding means.

9. In locomotive construction, the combination, with a locomotive cylinder, cylinder cocks and actuator therefor, of a piston for operatively shifting the cylinder cock actuator, a cylinder in which said piston is mounted, elastic pressure means resiliently stressing the piston toward that end of the cylinder opening the cylinder cocks, means for delivering low temperature fluid under pressure to the opposite side of the piston from the elastic pressure means for moving the piston along the cylinder against the resilient pressure, the piston having a web packing of cylindrical form adapted for snugly hugging the walls of the piston and having free marginal portions suscepticle of deformation from the cylindrical form, and means for thus deforming said marginal portions at all times in the absence of pressure fluid engaging the piston.

10. In combination, a casing, a spring loaded piston movable in said casing and provided with a packing forming a packed contact with the inner wall of the casing, and a circumferential rib within the casing spaced from the wall thereof adapted to engage and spread the packing when the latter is pressed into contact with the rib by the piston spring.

11. In cold pressure fluid devices, the combination of a piston provided with a packing, a pressure chamber within which the piston is movable, means within the pressure chamber independent of the piston for normally pressing the piston packing outwardly against the wall of the pressure chamber, and spring means acting upon said piston in opposition to the direction of movement thereof when acted upon by pressure fluid normally pressing the piston packing into contact with said first mentioned means.

12. In cold pressure fluid devices, the combination of a spring loaded piston provided with a compressible packing, a pressure chamber within which the piston is movable, and a circumferential rib within the pressure chamber and spaced from the wall thereof, adapted to bear against the piston packing when the piston is held at its normal zero position by the piston spring.

13. In cold pressure fluid devices, the combination of a spring loaded piston provided with a compressible cupped packing, a pressure chamber within which the piston is movable, and a circumferential rib having a conical outer wall within the pressure chamber and spaced from the wall thereof, adapted to engage and press outwardly upon the inner wall of the cupped packing when the piston is held at its normal zero position by the piston spring.

14. In combination, a cylinder, a piston movable within the cylinder and having packing forming a packed contact with the inner wall of the cylinder, means independent of the piston for engaging and spreading the piston packing against the walls of the cylinder, and resilient means stressing the piston toward said spreading means, the said resilient means being located, proportioned, and adapted for exerting resilient stress on the piston sufficient for seating the packing in a spread condition on said spreading means at all times when the piston is not unseated by the presence of pressure fluid acting on the piston.

ELLWOOD V. CROSS.