R. A. Hardcastle,

Differential Pulley

No. 64,527. Patented May 7, 1867.

Fig. 1.

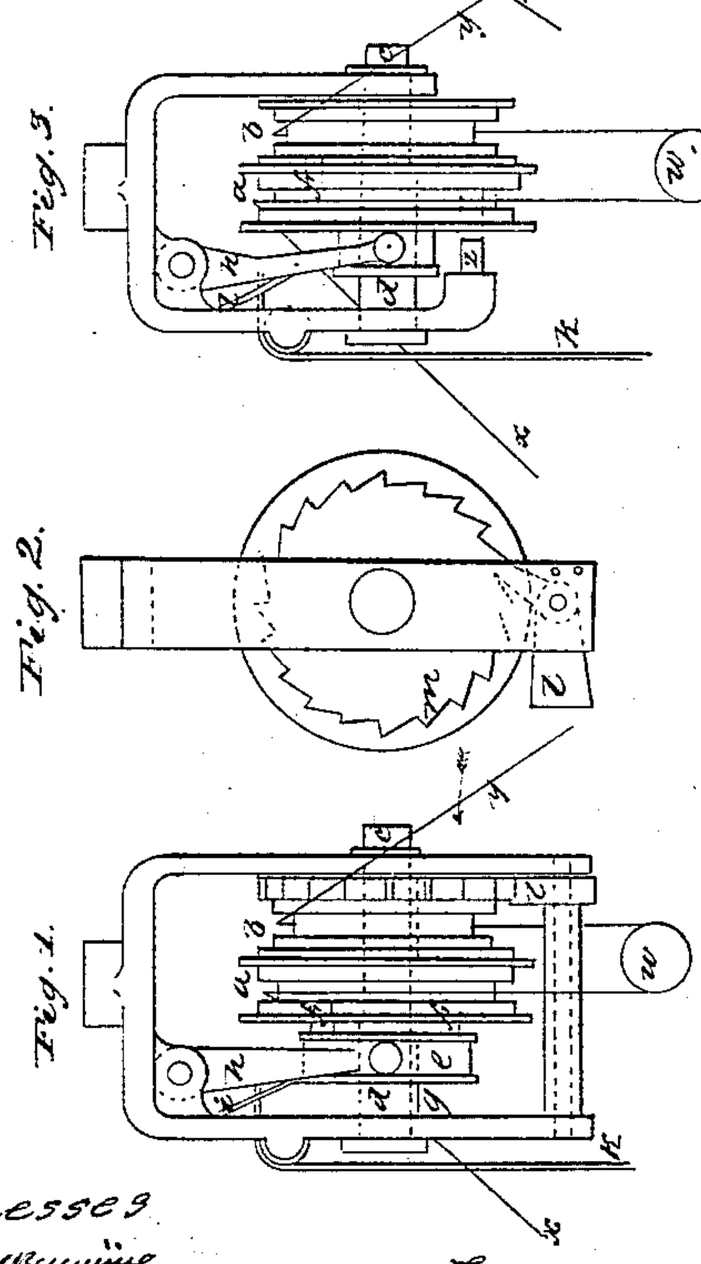

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

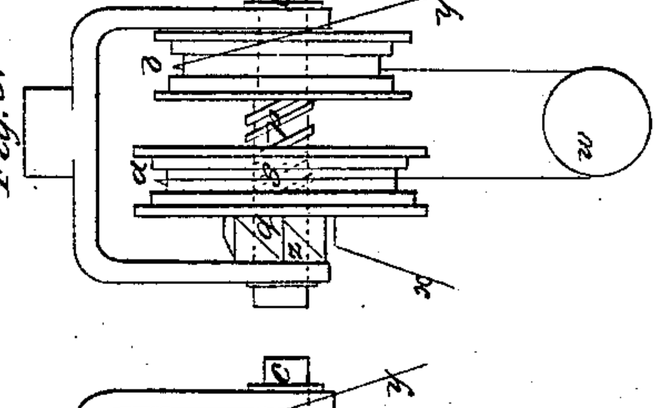

Fig. 8.

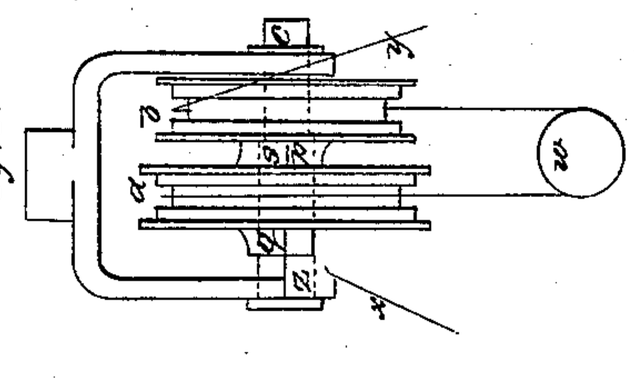

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

Witnesses

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Letters Patent No. 64,527, *dated May* 7, 1867.

IMPROVEMENT IN DIFFERENTIAL PULLEY-BLOCKS.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, ROBERT ANTHONY HARDCASTLE, of the town and county of Newcastle-on-Tyne, England, have invented or discovered certain new and useful "Improvements in Apparatus for Raising and Lowering Heavy Bodies;" and I, the said ROBERT ANTHONY HARDCASTLE, do hereby declare the nature of the said invention, and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement thereof, that is to say:

My said invention relates to certain improvements upon and modifications of the pulleys known as Weston's differential pulley-blocks, for which Letters Patent were granted to Thomas Aldridge Weston, bearing date the 25th April, 1859, No. 1033, and has for its object the affording of greater facility for coupling and uncoupling the sheaves, whereby the distance between the fixed block and the snatch block can be adjusted at any time so as to vary the range of lift at will, and weights may be moved with greater rapidity than can be effected by the differential pulley-blocks above referred to; the same apparatus possessing all the advantages of the "differential pulley-block" when used as such. According to my present invention I propose to make the two sheaves of the "differential pulley-block" separate from each other, and to couple or uncouple them by means of a sliding clutch or by using a sliding sheave, and to provide one or both the sheaves with pins, cogs, or other projections which engage with or into corresponding projections, holes, or depressions formed on or made in the contiguous face of the adjoining sheave, or the two sheaves may be coupled together by forcing the one against the other laterally by means of a wedge, inclined plane, or spiral thread or threads acting upon the sliding sheave. By the means above referred to, great facility is afforded for coupling or uncoupling the sheaves, whereby the same pulley-block is rendered capable of being used either as a "differential pulley-block," by coupling the two sheaves together, or as an ordinary block, by uncoupling or disengaging the sheaves from each other, in which latter case if one of the sheaves be locked so as to prevent it from turning round it would hold fast that portion of the chain running over it, and enable the attendant, by holding on to the opposite portion of the chain running over the loose sheave, to raise or lower weights in the same manner as with an ordinary block. This locking of one of the sheaves can either be separately effected or it may be effected by an extension of the same contrivances which serve to uncouple the sheaves.

And in order that the said invention may be fully understood, I shall now proceed more particularly to describe the same, and for that purpose I shall refer to the several figures on the annexed sheet of drawings, the same letters of reference indicating corresponding parts in all the figures.

Figure 1 of my drawings represents a front elevation of a differential pulley-block, wherein the coupling and uncoupling of the sheaves is effected by a sliding clutch; and

Figure 2 is a corresponding side elevation of the same looking in the direction of the arrow in fig. 1.

A and *b* represent respectively the larger and smaller sheaves of the block, which in all cases should have their peripheries so formed as to prevent the surging or slipping of the endless chain X Y over them. The sheave A runs loose on the spindle C, and the sheave *b* is keyed or otherwise made fast thereon, an enlargement or shoulder, *d*, being formed on the spindle in order to keep the sheaves in their places. *e* is a clutch-box, sliding along the part *d* of the spindle and prevented from turning thereon by the key *q*. This clutch is provided with one or more pins or other projections *ff*, which enter corresponding holes or depressions in the face of the sheave A when the coupling is effected. *h* is a lever, carried by the frame of the block for throwing the sliding clutch *e* in or out of gear with the sheave A, and *i* is a spring, which may be used, if found desirable, for maintaining the clutch in gear. A cord, *k*, attached to the lever *h*, and passing over a guide-pulley in the frame, descends to within easy reach of the hand of the operator, who, on pulling the cord, can at any moment throw the clutch out of gear with the sheave A, whereupon the sheave A will be left free to revolve on the spindle *c* independently of the sheave *b*. By locking the sheave *b*, by means of the pawl *l* carried by the frame, and engaging into the ratchet-wheel *m* fast on the spindle, or into teeth formed on the sheave itself, the portion *y* of the chain will be held fast, whilst the other portion *x*, passing over the loose sheave *a*, may be hauled upon or let go, as the case may be, for the purpose of raising or lowering light weights with rapidity. On releasing the cord *k* the spring *i* will throw the clutch *c* in gear with the sheave *a*, when, as the two sheaves will then rotate together with the spindle *c*, the arrangement may be used in the same manner as a "differential pulley-block." As the pawl *l* will only allow the sheaves to revolve in the direction for lowering a weight by the differential

action, it will be necessary to throw it out of gear with a ratchet-wheel, *m*, should it be required to hoist differentially. If the pulleys be reversed, and *b* locked, it will be seen that the pawl will have to be thrown out of gear to lower differentially. In the arrangement last described, it will be seen that neither of the sheaves slides laterally, and that the coupling and uncoupling is effected solely by a sliding-clutch box. In the modification illustrated by Figures 3 and 4 the sheave *a* is caused to slide to and from the sheave *b*, along the spindle *c*, by the same means as those described for sliding the clutch in the first arrangement, the lever *h* being caused to engage in a groove in the boss of the sliding sheave *a*. Both the sheaves *a* and *b* may be loose on the spindle *c*, or one of them may be fast or caused to revolve therewith whilst the other is loose thereon. The coupling of the two sheaves is in this modification effected by the pin or projection *f* in one sheave entering a corresponding hole in the other sheave when the two are brought together.

Figure 3 represents the two sheaves coupled together and operating as a differential pulley-block; and

Figure 4 shows them uncoupled or disengaged from each other.

The locking of the sheave *a* is effected by the mere act of uncoupling, a stud or pin, *z*, in the frame, being caused to enter an aperture in the sliding sheave as it is being withdrawn from the other one, and so locks it, and holds fast the part *x* of the endless chain, whilst the part *y* is free to be hauled or let go over the pulley *b* for raising or lowering a weight with rapidity.

Figures 5 and 6 illustrate a third modification, wherein the sheaves *a* and *b* are coupled or geared together by the mutual interlocking of a series of inclined or wedge-shaped projections or ratchet-teeth, *s* and *p*, formed on the contiguous faces of the two sheaves respectively, the locking of one of the sheaves being also effected by inclined projections *q*, on the outer face of the sheave, engaging with a corresponding inclined projection, *z*, formed on or fitted to a convenient part of the frame of the block. In this modification, as in the one last described, the same movement which serves to uncouple the sheaves locks one of them, but the coupling and uncoupling of the two sheaves and the locking and releasing of one of them is effected by the ordinary endless chain attached to the block, the separate cord *k*, lever *h*, and spring *i* being dispensed with.

Figure 5 shows the sheaves *a b* uncoupled and the sheave *a* locked; and

Figure 6 shows the same sheaves coupled or engaged together and acting as differential pulleys.

The inclined projections *s* and *p*, which are formed on the inner faces of the sheaves *a* and *b* respectively, are made to lock into each other in such a way that the weight suspended from the snatch block *w* tends to keep them so locked or coupled together, as shown in fig. 6. The sheaves *a* and *b* being thus coupled, by hauling on the part *x* of the chain the weight will be lifted, and by hauling on the part *y* of the chain the weight will be lowered differentially, but by hauling on both parts *x* and *y* of the endless chain simultaneously with sufficient force to overcome the gravity of the weight, the inclined projections *s* and *p* would slide or pass over each other, and thereby force or wedge the sheave *a* partly into the fixed stop *z*, with which one of the series of inclined projections *q* becomes engaged, whereupon the said sheave will be locked or prevented from turning in one direction and will consequently hold fast the part *x* of the chain where it passes over the said sheave. By continuing to haul on the part *y* of the chain, the sheave *a* will be completely engaged or locked with the stop *z*, and wholly uncoupled or disengaged from the sheave *b*. In this condition of the pulley the weight can be readily raised or lowered with a power of two to one by the portion *y* of the chain and the sheave *b*. In lieu of hauling on both parts *x* and *y* of the chain simultaneously for the purpose of uncoupling the sheaves, this may be accomplished by making fast one part of the chain and hauling on the other. It will be seen on referring to the drawing that the sheave *a* cannot be uncoupled from the sheave *b* without being at the same time locked or engaged with the fixed stop *z;* also that it is impossible for the operator to uncouple the sheaves when acting differentially unless he has power of lifting the weight; hence no risk is incurred of the operator being overpowered on uncoupling the sheaves when acting differentially, as more power will be required to effect such uncoupling than to sustain the weight when the sheaves are uncoupled. The two sheaves, when separated or uncoupled, can again be brought together and coupled by hauling on the parts *x* and *y* of the chain.

Figures 7 and 8 illustrate another modification, wherein the sheaves *a* and *b* are coupled and uncoupled by moving one of them laterally by hand along the spindle *c*, each sheave being provided with one or more projections *s p*, the projections *s* on one sheave locking against the projection *p* on the other sheave. The projections *q* and *z* serve to lock the sheave *a* when uncoupled.

Figures 9 and 10 illustrate another modification for coupling and uncoupling the sheaves *a* and *b*, fig. 9 showing the sheaves uncoupled, and fig. 10 coupled. In this arrangement an inclined plane in the form of a spiral thread or threads is employed as the medium for coupling and uncoupling the sheaves, the requisite motion of the parts for effecting such operations being as in the arrangement shown at figs. 5 and 6, derived solely from the ordinary endless chain passing over the sheaves of the block. The spindle *c* is provided with spiral threads or projections *p*, which engage into corresponding spiral grooves made inside the centre of the sheave *a*, whilst the sheave *b* is fast on the spindle *c*. On hauling both parts *x* and *y* of the slack portions of the chain simultaneously, the sheaves will be separated by the action of the spiral thread, (see fig. 9,) until the sheave *a* is moved entirely sufficiently far to be locked by the inclined projections *q* and *z*, as in figs. 5 and 6, and to be released from the spiral threads or projections *p*. In this condition the sheave *b* with its spindle is free to rotate independently of the sheave *a*, and the block may then be employed for expeditiously raising or lowering light weights with a purchase of two to one. The sheaves when separated may again be coupled by hauling on the parts *x* and *y* of the chain, when the inclined projections *q* and *z* will, by sliding over each other, force the sheave *a* in contact with the spiral threads *p*. By now releasing the part *y* of the chain, the weight at *w* will rotate the spindle *c* and cause the spiral thread to enter the sheave *a*, and so tighten the two together, as in fig. 10, when the differential action will be resumed.

Figure 11 represents a sectional elevation of another modification, wherein the results hereinbefore referred to are obtained by the use of a sliding clutch in lieu of a sliding or laterally adjustable sheave, such clutch being thrown in and out of gear with one of the two sheaves so as to couple and uncouple the same, and simultaneously locking the larger pulley *a* and releasing it again by the sole action of the ordinary endless chain, in the manner hereinbefore described in reference to figs. 5 and 6 of my drawings. *a* is the larger sheave; *b* the smaller one; and *c* the spindle or axis of the same. Upon this spindle *c* revolves freely the sliding clutch *e*, a detail elevation of which is shown at Figure 13. This clutch is made square, or of such other form at the part *g*, where it enters the sheave *a*, as will prevent the said sheave from turning on the clutch. *s* are inclined projections or ratchet-teeth formed on one end of the clutch, which engage with corresponding ratchet-teeth on the inner face of the smaller sheave *b*. On the opposite end of the clutch *e* there is formed a series of inclined projections or ratchet-teeth, *q*, which, when the clutch is disengaged from the sheave *b*, become locked or engaged with a correspondingly shaped or inclined catch or stop, *z*, formed on the interior of the frame of the block. The direction of inclination of the several teeth or projections *s*, *p*, *q*, and *z*, is the same as illustrated by figs. 5 and 6, and hence the coupling and uncoupling of the sheaves and the locking of one of them may be effected by the chain itself, in the manner already described, the only difference being that in lieu of the sheave *a* moving laterally under the operation of the inclined projections, it is the clutch *e* which receives that motion and slides freely inside the sheave *a*. It will be readily seen that although in figs. 3 to 12 the large sheave slides and locks, the same operations can be performed if the small sheave is made to slide and lock.

Having now described and particularly ascertained the nature of my said invention, and the manner in which the same is or may be used or carried into effect, I would observe in conclusion that I am aware that it has already been proposed to employ separate or divided sheaves capable of independent action in what are known as "Weston's differential pulley-blocks" with a view to lowering weights, and also that it has been proposed, where three or more sheaves are employed in a differential pulley-block, to make one of them capable of being disconnected from the rest with a view solely to enable more or less chain to be taken in or let out from such loop in order to vary the range of lift, and therefore I do not claim as of my invention the use in differential pulley-blocks of a sheave capable of being disconnected from the adjoining sheave or sheaves, nor do I claim every mode of coupling and uncoupling such sheaves; but what I consider as novel and original, and therefore claim as the invention secured to me by the hereinbefore in part recited Letters Patent, is—

1. The application and use of a sliding clutch for the purpose of coupling and uncoupling the sheaves in differential pulley-blocks, substantially in the manner hereinbefore described and illustrated by fig. 1 of my drawings.

2. The application and use of a sliding clutch for the purpose both of coupling and uncoupling the sheaves in differential pulley-blocks, and of locking one of such sheaves, as hereinbefore described and illustrated by figs. 11, 12, and 13 of my drawings.

3. The application and use of lateral cogs, pins, projections, or teeth on one sheave, in combination with a fixed stop or catch on the frame of the pulley-block, both for the purpose of coupling and uncoupling the sheaves in differential pulley-blocks, and simultaneously locking one of such sheaves, substantially as and for the purpose hereinbefore described and illustrated by figs. 3, 4, 5, 6, 7, and 8 of my drawings.

4. The application and use to and in differential pulley-blocks of a sliding clutch or a sliding sheave, in combination with a lever, cord, wedge, or spring, for producing the necessary motion for coupling and uncoupling, or for coupling, uncoupling, and locking the sheaves, substantially as hereinbefore described and illustrated by figs. 1, 2, 3, and 4 of my drawings.

5. The application and use in differential pulley-blocks of one or more spiral projections or threads formed on the spindle or axis of the sheaves, and being in combination with inclined teeth or projections on one of the sheaves and on the frame on the pulley-block, for the purpose both of coupling and uncoupling the sheaves, and of locking one of such sheaves, as hereinbefore described and illustrated by figs. 9 and 10 of my drawings.

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Witnesses:

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