United States Patent

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[54] **HOIST HAVING LOAD REGULATION**
10 Claims, 5 Drawing Figs.

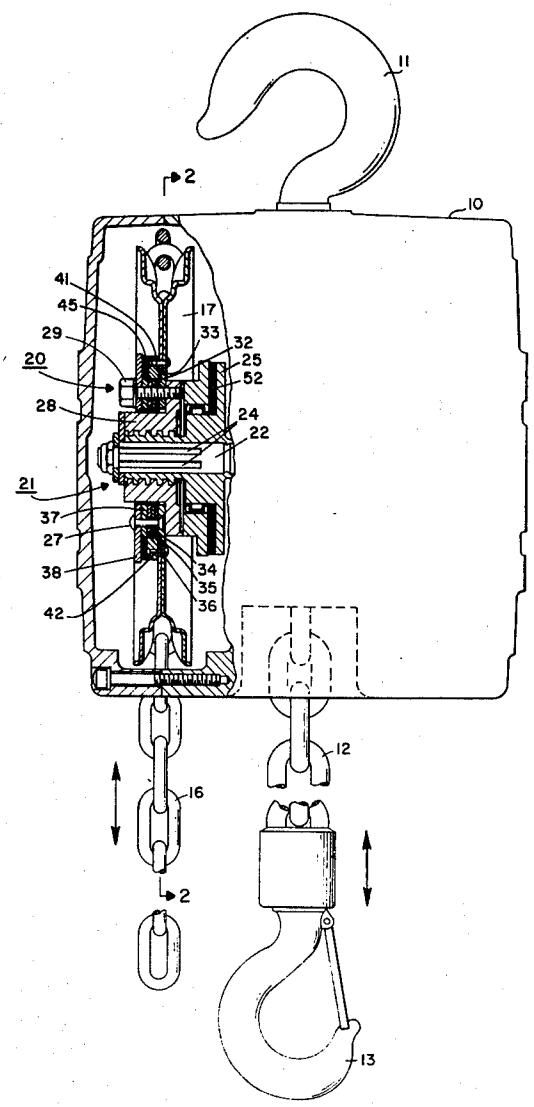
[52] **U.S. Cl.** **254/169**
[51] **Int. Cl.** **B66d 1/00**
[50] **Field of Search** ..... 254/167—171; 74/(Consulted); 188/(Consulted)

[56] **References Cited**
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ABSTRACT: A hoist having a regulator to limit load raising capacity to a predetermined maximum. The regulator is operably mounted between the hoist input by which a load is raised or lowered and the hoist output on which a load is to be contained. In the event of an applied load in excess of the predetermined limit set by the regulator, the hoist is rendered inoperable for raising the load but continues operable to lower the load. With the existence of the latter condition, an attempt to raise the load produces an audio and sensual signal transmitted to the operator instantly alerting him to the condition.



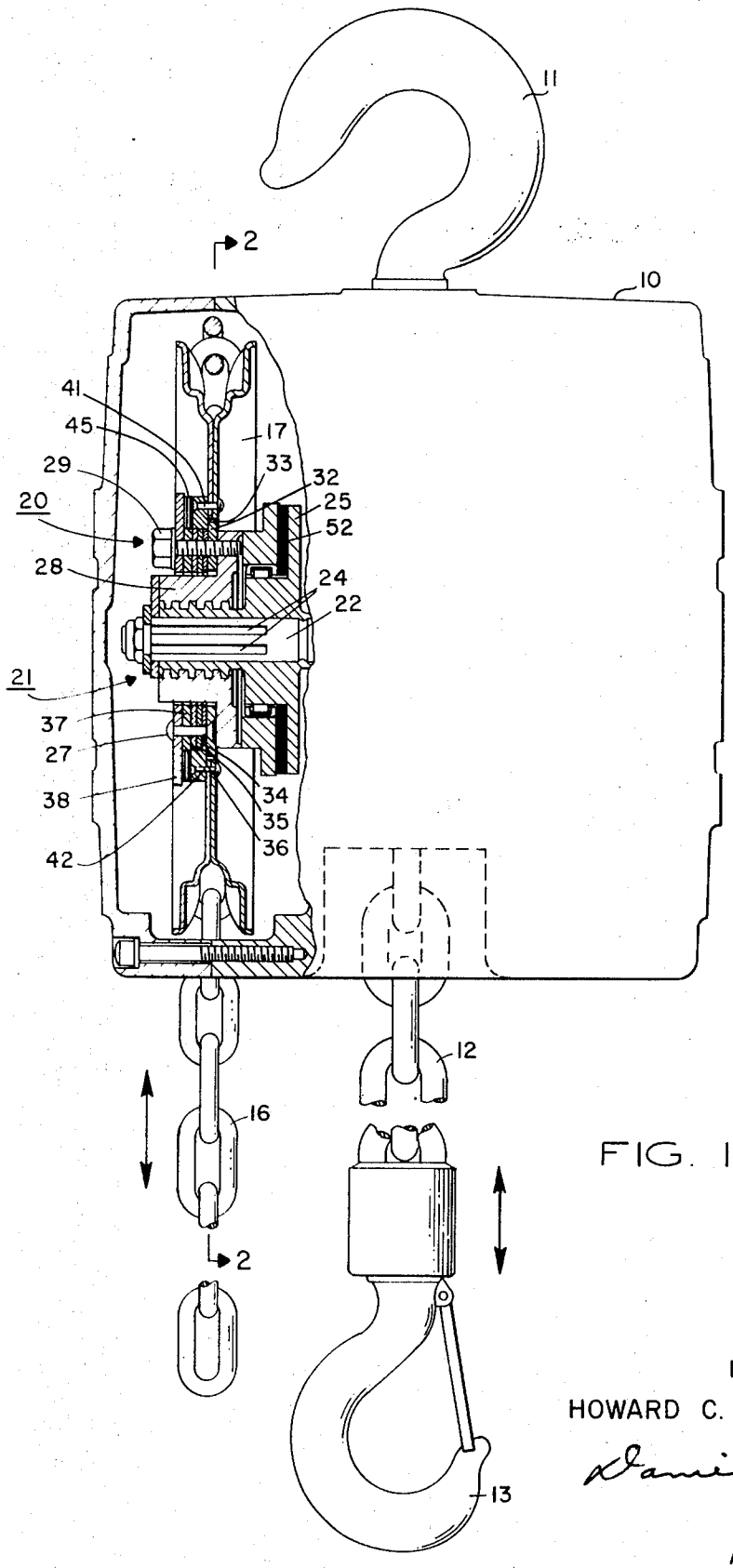


FIG. 1

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FIG. 2

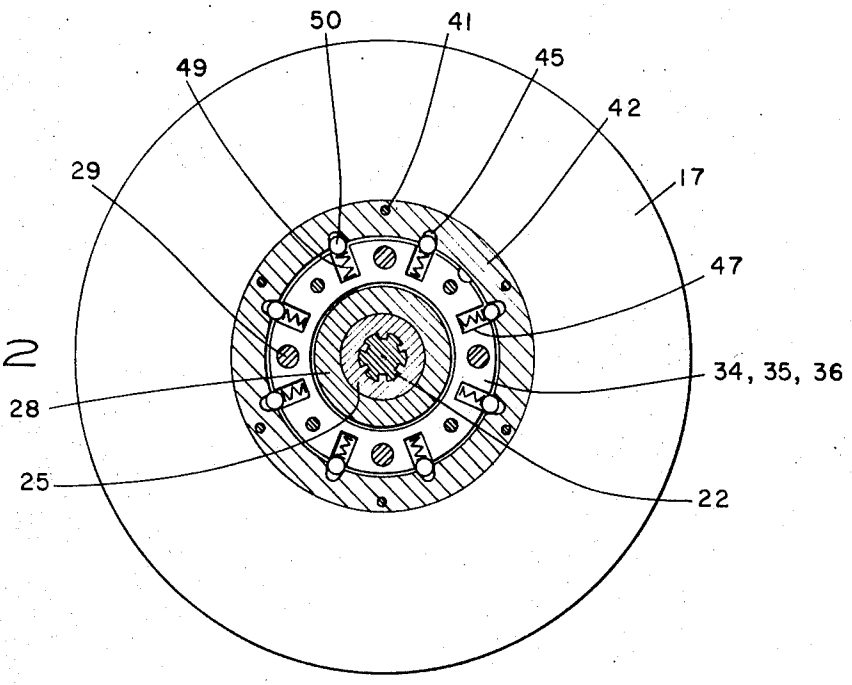
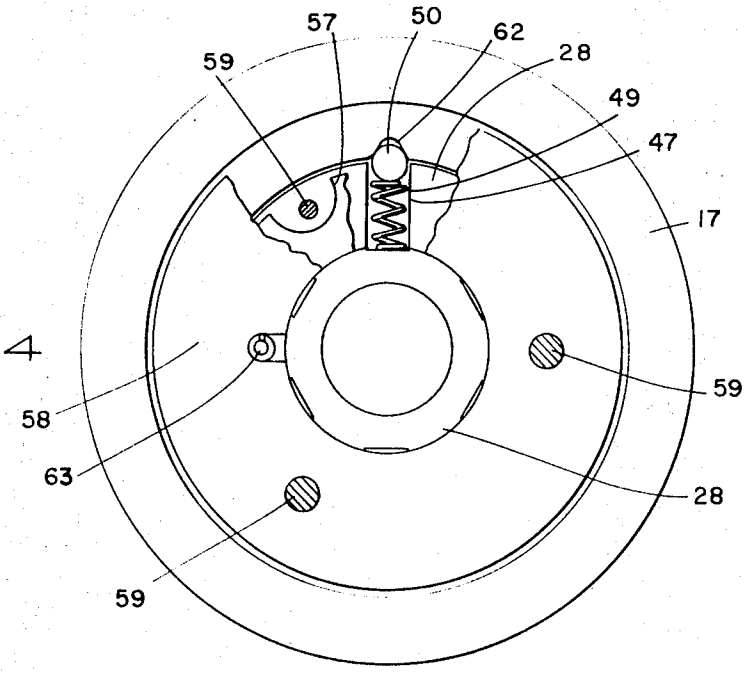


FIG. 4



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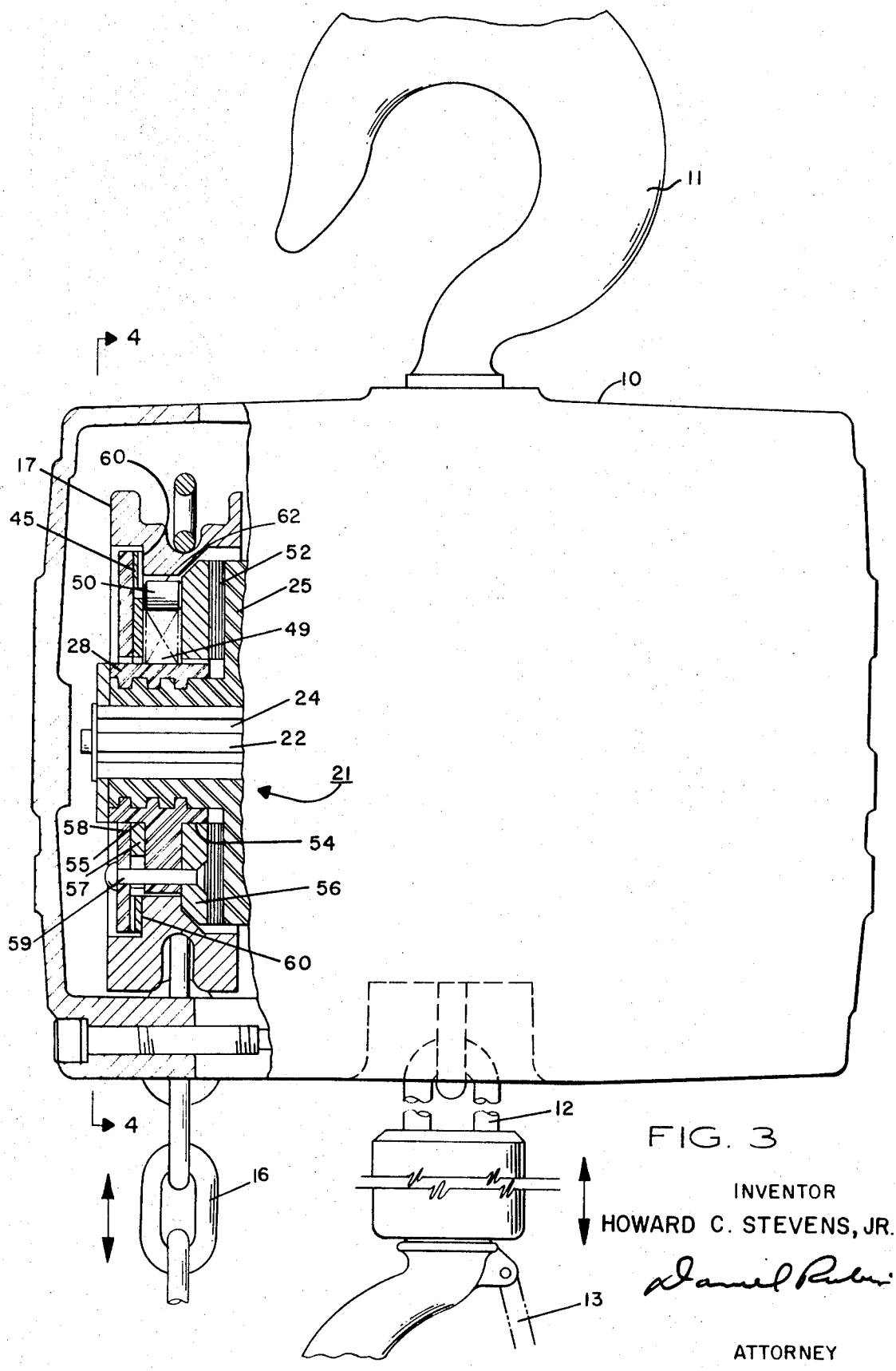


FIG. 3

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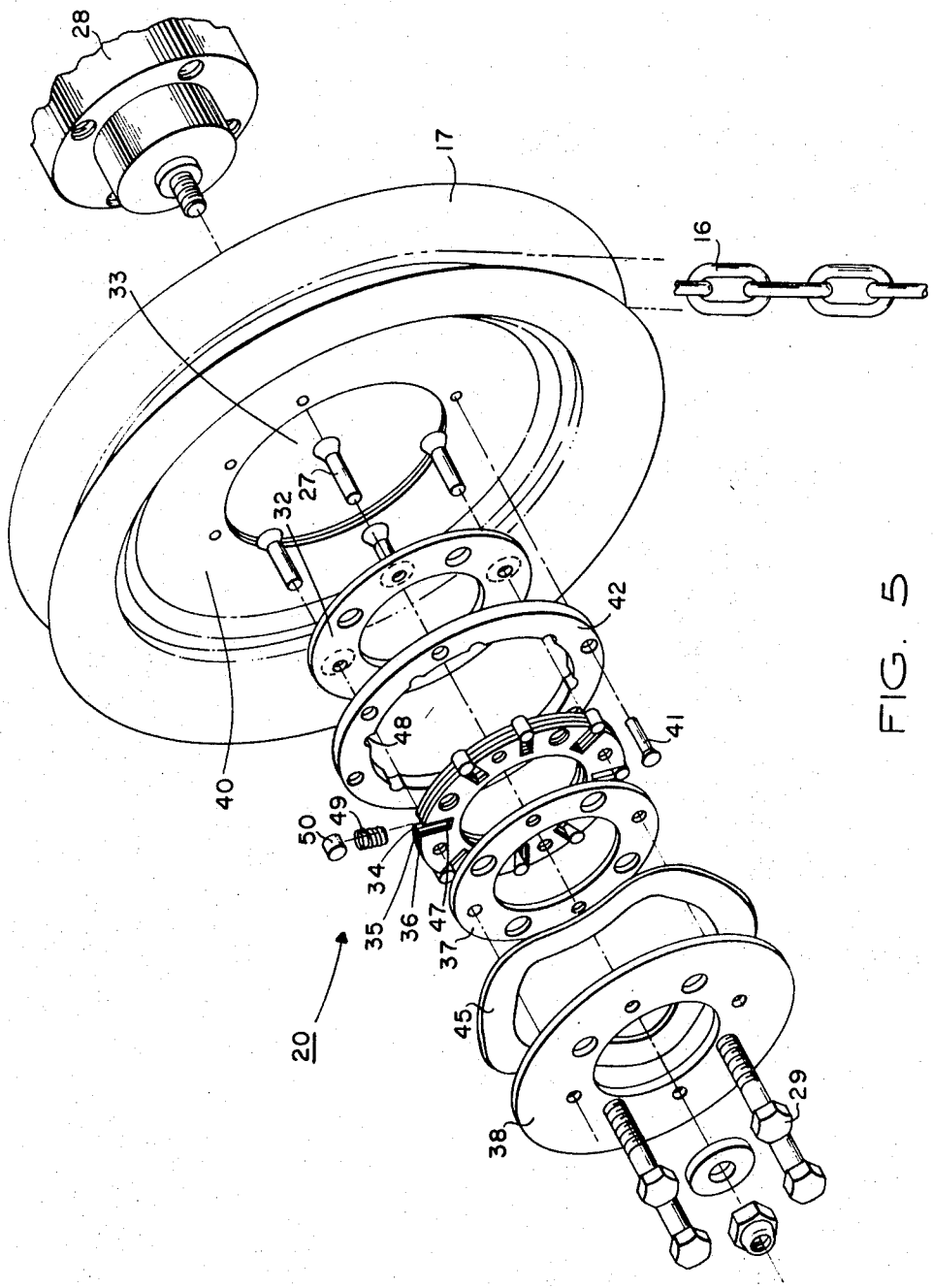


FIG. 5

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HOIST HAVING LOAD REGULATION

BACKGROUND OF THE INVENTION

1. The field of art to which the invention pertains generally includes the art of article handling as specifically directed to hoisting equipment having a torque-limiting clutch mechanism for overload prevention.

2. Hoists, and in particular hand operated chain hoists, for elevating articles or other similar type loads are extensively employed in many applications of industrial life. Noteworthy users are the chemical companies, the automotive companies, shipyards and others having operations requiring frequent hoisting of parts, cargo or the like. Each hoist when sold is built to a manufacturer's specification for a rated load capacity within which the hoist is capable of being safely used. When the rated capacity is observed and the hoists are otherwise maintained they can be expected to provide many years of trouble free life. However, despite the usual conspicuous display of rated capacity it is common practice among hoist operators to generally ignore the rating and determine hoist input capacity solely by the hoist ability to operate with a particular load. Because it is frequently difficult to prejudge an actual load to be encountered, safe operating capacity is judged by the operator purely on the basis of whether the hoist can tolerate the load without failure. In the case of hand-operated hoists, the input power is limited only by the operator's physical strength which via the mechanical leverage provided by the hoist permits misjudgment substantially greater than intended by the manufacturer. While most marketed hoists have built-in safety factors permitting occasional and moderate exceeding of rated capacities without equipment damage, it is both economically impractical and impossible for the manufacturer to design a hoist in anticipation of every field condition to which the hoist will likely be subjected.

Hoist failure can of course result in load dropping and consequent damage not least of which is personal injury or loss of life. Hoist failure from the inability to elevate a load from the ground produces the minimal injury in that the failure is immediately apparent to the operator and no dropping of load occurs. What frequently happens however is a form of progressive failure from frequent overloading permitting an actual failure from a load even within the rated hoist capacity. It can be well appreciated that this latter situation presents a real legal dilemma for the hoist manufacturer in the determination of product liability.

Therefore despite long recognition of the overload problem, hoist manufacturers have not heretofore been practically able to protect their equipment and consequently themselves from the after sale abuse inflicted by their customers. Various techniques toward resolving this difficulty have been tried including the obvious of providing a weigh scale on the load or output side of the hoist permitting preload determination by the operator. It has been found however that such scales are either ignored or not serviceably maintained, so that overloading continues unchecked and notwithstanding. Moreover, while overload slip clutches of various types are well known for may many other industrial applications, it has not been known heretofore how to utilize such a clutch with a hoist for positive control which within reasonable limits also prevents dropping yet enables lowering of a suspended overload.

SUMMARY

This invention relates to hoists and particularly hand-operated chain hoists for the raising and lowering of loads frequently on the order of **10** tons and above. More specifically, the invention relates to hoists having a load regulator whereby negligent operation of the hoist by input overloading in excess of predetermined limits over rated hoist capacity is prevented. Consequently, a greater degree of legal protection after sale of the equipment is afforded a manufacturer by preventing this form of equipment abuse under field conditions otherwise beyond the manufacturer's control. Not only does a hoist in accordance with invention hereof minimize the possibility of overload within prescribed limits, but moderate overload condition incurred during load suspension will not result in a load fall with consequent damage or personal injury. In addition when overload is incurred, the regulator device hereof emits an audio and sensual signal to the operator clearly indicating that a state of overload is being experienced. Moreover, despite moderate overload condition, the hoist hereof continues operable for lowering the load to ground or other safe level whereat the excess load can be removed.

It is therefore an object of the invention to provide a novel load lifting hoist inherently capable of operably controlling applied overload.

It is a further object of the invention to provide a novel loading lifting hoist having a contained load regulator for preventing input overload abuse thereof.

It is a further object of the invention to provide a hoist in accordance with the aforesaid objects capable of emitting a signal indicating the existence of an input overload condition.

It is still further object of the invention to provide a hoist in accordance with the aforesaid objects adapted for hand chain operation and in which an audio and sensual signal is emitted to the operator at the time an input overload is incurred.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevation view partly in section of a first hoist embodiment constructed in accordance herewith;

FIG. **2** is sectional elevation taken substantially along the lines **2–2** of FIG. **1**;

FIG. **3** is an elevation view partly in a section of a second hoist embodiment constructed in accordance herewith;

FIG. **4** is an elevation view taken substantially along the lines **4–4** of FIG. **3**; and

FIG. **5** is an isometric exploded view of the regulator device of FIGS. **1** and **2** to facilitate a better understanding thereof.

Referring now to the drawings and in particular to FIGS. **1**, **2**, and **5** there is illustrated a hand chain hoist which may be an adaptation of a type disclosed in U.S. Pat. No. 2,739,789 commercially suitable for 2 to 10 **load on rated load capacity. The hoist includes a generally enclosed housing** 10 **having an upwardly extending hook** 11 **for attaching the device to a beam or other suitable stationary overhead support. Extending outward beneath the frame from a chain block wrap therein is an extended length of output load suspension chain** 12 **containing produce hook** 13 **on which to receive a load to be lifted in a conventional manner. Leftward of chain** 12 **as viewed in FIG.** 1, **is an endless input drive chain** 16 **which depends downward to within ready grasp of an operator for operating the hoist whereby hook** 13 **is caused to raise or lower as a function of the direction in which chain** 16 **is caused to move.**

Supported within the housing is a chain wheel **17** receiving chain **16** to be rotated thereby and on which is mounted for coaxial rotation therewith a load regulating device hereof generally designated **20** as will be described. The regulator device is in turn coaxially mounted on a braking mechanism **21** of the conventional Weston type as for example disclosed in the aforementioned U.S. Pat. No. 2,739,789 . *Coaxially coupled to the brake via splines 24 is the central operating shaft 22 by which operator imposed force applied to chain 16 is translated into vertical movement of chain 12 and hook 13. Consequently, a pull applied by the operator to chain 16 in the appropriate direction for raising hook 13 is transmitted to handwheel 17 and regulator 20 wherefrom it is conducted through brake 21 to shaft 22 on which is operably secured chain 12 for responsive vertical movement thereto. Hence, when raising a load supported on hook 13 within the normal rated capacity of the equipment the operator's input raising force applied via chain 16 will be transmitted through the regulator 20 in a direct coupled relation as will be explained. However, where the load on hook 13 either initially or subsequently exceeds the preset control limit of the regulator, further imposed operator lifting force on hand chain 16 will not produce further elevating of the hook 13. Instead at such time as the latter condition arises,*

further pull on the hand chain for elevating the load will produce loud audible clicking with a predetermined drag torque on the chain both of which signal to the operator that an overload condition has been reached.

The load regulator **20** hereof as seen in the FIGS. **1**, **2** and **5** comprises a plurality of axially contiguous components including a preassembled tandem or laminated construction maintained assembled via angularly displaced rivets **27**. Aperture **33** within the radial wheel flange **40**, concentrically receives the end portion of the assembly which is secured to outer brake hub **28** on the control side of the brake by means of a plurality of angularly displaced bolts **29**. Comprising the latter assembly is a holddown plate **32** mounted facing against the brake hub but rotatably free of the chain wheel, a series of retaining plates **34**, **35**, and **36**, a spacer **37** and a second holddown plate **38** of generally larger diameter than the other preassembled components thereof. Secured by means of angularly displaced rivets **41** to the chain wheel rotatably free of the brake and radially outward of the retaining plates is an annular detent plate **42**. Disposed in a compressed drag relation affording, for reasons as will be explained, a predetermined torque friction between the opposing faces of the detent plate and the radially outwardmost portion of holddown plate **38** is a wave washer **45** of a type commercially marketed.

To operate the hoist within rated capacity the relatively movable regulator assembly secured to brake hub **28** is directly coupled with the detent plate **42** secured to chain wheel **17**. This is achieved by means of retainer rings **34**, **35**, and **36** having a plurality of coextensive radial slots **47** communicating in radial alinement with corresponding notches **48** in the detent plate. The axial alinement of the latter elements maintained by means of adjacent holddown plate **32** and spacer **37** respectively. Supported within each of the slots is a compressed coil spring **49** constantly urging an axially parallel roller **50** into the corresponding notch of the detent plate. As can be seen in FIG. **2**, the rollers **50** are of a diameter less than the width of slot **47** permitting free radial movement of the roller therein in opposition to the spring bias while notch **48** is of a depth and configuration permitting only partial roller penetration insufficient to separate the rollers from the retainer plates. In this relation the roller diameter is effectively overlapped radially by the relatively movable edges of the retaining and detent plates essentially providing an interlock therebetween. By this means, the coupled relation between these latter components for driving shaft **22** is maintained from chain wheel **17** as a limiting function of the imposed load on hook **13**.

Where the applied hook load either initially is in excess of the regulator setting or is increased under load beyond the regulator setting, a further attempt to operate the hoist in an upward direction overcomes the coupling bias imposed by springs **50** and forces or ejects the rollers radially inward of the retainer rings until clear of the detent plate. When this latter condition occurs a relative slipping action develops between the uncoupled components representing operation during an overload condition at which time further operation of the hoist to raise the load is positively prevented. While such overload is being experienced by the operator, a loud audible ratchetlike clicking noise is generated between the relative moving notches **48** and the biased rollers **50** signalling existence of the condition. At the same time, the relative movement encounters the torque resistance imposed by wave washer **45** and which is fed back via the input hand chain to be felt by the operator in form of a hand pull. The washer imposed resistance prevents releasing the chain to a zero torque which could be potentially dangerous to the operator caught off balance in exerting a raising force on the chain. By maintaining a minimum wave washer torque approximately 20 percent of the torque required to lift rated load, the operator is given an opportunity to regain his stance without losing balance and falling when the overload condition has suddenly and unexpectedly been reached.

The precise load condition at which the regulator will respond with overload operation can be accurately preset. By an appropriate combination of selecting the machined angle of notch **48** against which roller **50** will be ejected in attempting to raise the hoist against an overload, the number of rollers **50**, and the spring rate of springs **49**, the hook loading condition for overload can be preset or varied. While any desired load condition relative to rated hoist capacity can be preset as desired, it is usual to set this operating point at approximately 125 percent of rated capacity. With a symmetrical configuration of notches **48**, there is provided a similar rolling action in either direction for raising or lowering. Since approximately 20 to 25 percent as much torque is normally required to lower as compared to raising a particular load, the notch angles can be relatively changed to provide any desired operating characteristics. That is, by increasing the contained approach angle in notch **48** relative to a line of tangency on the retaining plate peripheries, it is possible to alter the operating characteristics to reduce the overload limit or otherwise be suitably adapted to various conditions of use.

Should an overload condition reasonably within the physical capacity of the components be first incurred during suspension of a load, as by adding load in flight or while elevated, the hook position is instantly maintained against falling independent of the regulator. At that instant brake **21** is operable by means of load side radial brake flange **25** and control side brake flange **28** engaging against friction shoe **52**. Therefore, while further lifting of the load is prevented by regulator **20**, lowering the entire load to the ground or other supporting position continues possible via the hand chain in the normal operating mode. It should be recognized of course that the regulator is ineffective to prevent overloading on descent except to the extent the operator was previously alerted on ascent. Where, for example, the hoist is principally employed for lowering loads, overloading abuse of the equipment cannot be minimized by means of the regulator.

Referring now to FIGS. **3** and **4** there is illustrated a modification of the above as herein intended for lower rated capacity loads on the order of approximately ¼ to ½ ton of lift and similar components as before have been given

the identical character reference numbers for clarity of understanding herein. Specifically, the upper brake hub section **28** includes axial shoulders **54** and **55** on which is respectively supported a back plate **56**, a washer spacer **57**, and a holddown plate **58** all secured together in laminated tandem relation via rivets **59**. Secured compressed between the radially outward portion of the holddown plate and the inside face **60** of the chain wheel is wave washer **45** providing a bias torque resistance as before. In order to maintain a coupling relation between the laminated section and the chain wheel the outer diameter of hub **28** includes coextensive slots **47** each of which contain a spring **49** biasing a roller **50** outwardly into a notch **62** formed in the internal diameter of the chain wheel.

In operation, the unit of FIGS. **3** and **4** is substantially similar as described previously in connection with embodiment of FIGS. **1**, **2**, and **5** being modified to accommodate relatively smaller operating parts for a reduced load capacity equipment. When the operator attempts to raise an overload, the rollers **50** are forced radially inward of slots **47** to become disengaged from the hand wheel notches **62**. This as before produces a loud audible signal with a similar wave washer torque imposed to prevent the operator from losing his balance as the overload condition is suddenly encountered.

By the above description there is disclosed a novel hoist construction containing an integral load regulator by which input overloading of the hoist beyond permissible limits is positively prevented. When such overload condition is reached both an audible and felt sensation is transmitted to the operator as a signal of existence of the overload thereby to instantly alert him of the condition. At the same time, even during existence of the condition, the unit hereof continues operable for the purpose of lowering a suspended load while securing the load against falling is maintained independent of

the regulator device. The hoist hereof is highly effective in achieving a greater degree of protection long sought by manufacturers of hoisting equipment yet retaining the desirably braking feature commonly contained in hoists previously available commercially. Thus by the simple relatively uncostly addition to the equipment of a regulator essentially in the form of a roller detent type clutch, applicant has solved a long standing need which has plagued the industry for many years.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the drawings and specifications shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A hoist for the raising and lowering of loads comprising in combination:

a. an output suspension on which to receive a load;

b. input drive means responsive to a correlated directional input thereto for operably controlling the raising and lowering of said output suspension; and

c. load regulator means operably interposed between said output suspension and said input drive means to limit the maximum load raising capacity, said regulator means comprising:

1. a first section connected to said input drive means for movement therewith;

2. a second section connected to said output suspension for movement therewith; and

3. detent coupling means operable to maintain said first and second sections connected for conjoint movement when an input is imposed on said drive means to raise a load on said output suspension less than a predetermined maximum and is operable to disconnect said first and second sections from said last-recited relation when the imposed drive input is to raise a load on said output suspension greater than said predetermined maximum.

2. A hoist according to claim 1 including signal generating means operative in response to a raise input to said drive means for transmitting a discernible signal to an operator indicating a disconnect condition of said coupling means.

3. A hoist according to claim 1 in which said sections are coaxially mounted for rotation, and said detent coupling means comprises radially extending angularly displaced slots in one of said sections, notches in the other of said sections cooperating with said slots, a member in each of said slots radially movable therein, and biasing means urging said member into the cooperating notch thereat to effect a coupling interlock between said sections.

4. A hoist according to claim 3 in which said slot member comprises a roller and said biasing means comprises a spring, and said rollers are forced from said notches in opposition to the spring to disconnect said first and second sections in response to an overload imposed on said input drive means permitting relative movement between said sections.

5. A hoist according to claim 4 in which relative movement between said sections produces a discrete audible signal indicative of an overload condition.

6. A hoist according to claim 5 in which relative movement between said sections also encounters a torque resistence of predetermined proportion relative to said maximum load at which disconnect occurs between said sections.

7. A hoist according to claim 1 including means maintaining a minimum predetermined torque resistance on said input means when said first section becomes disconnected from said second section.

8. A hoist according to claim 7 in which said input means is chain operated from human input and said minimum torque maintained during the disconnect of said first and second sections provides a sensual signal to the operator indicative of an existing overload condition.

9. A hoist according to claim 8 in which said predetermined torque resistance is provided by resistance means interposed between the relatively movable disconnected regulator sections.

10. A hoist according to claim 8 including brake means operative to maintain a suspended load against falling, said brake means having two interengaging sections operatively interposed between said second regulator section and said output suspension.