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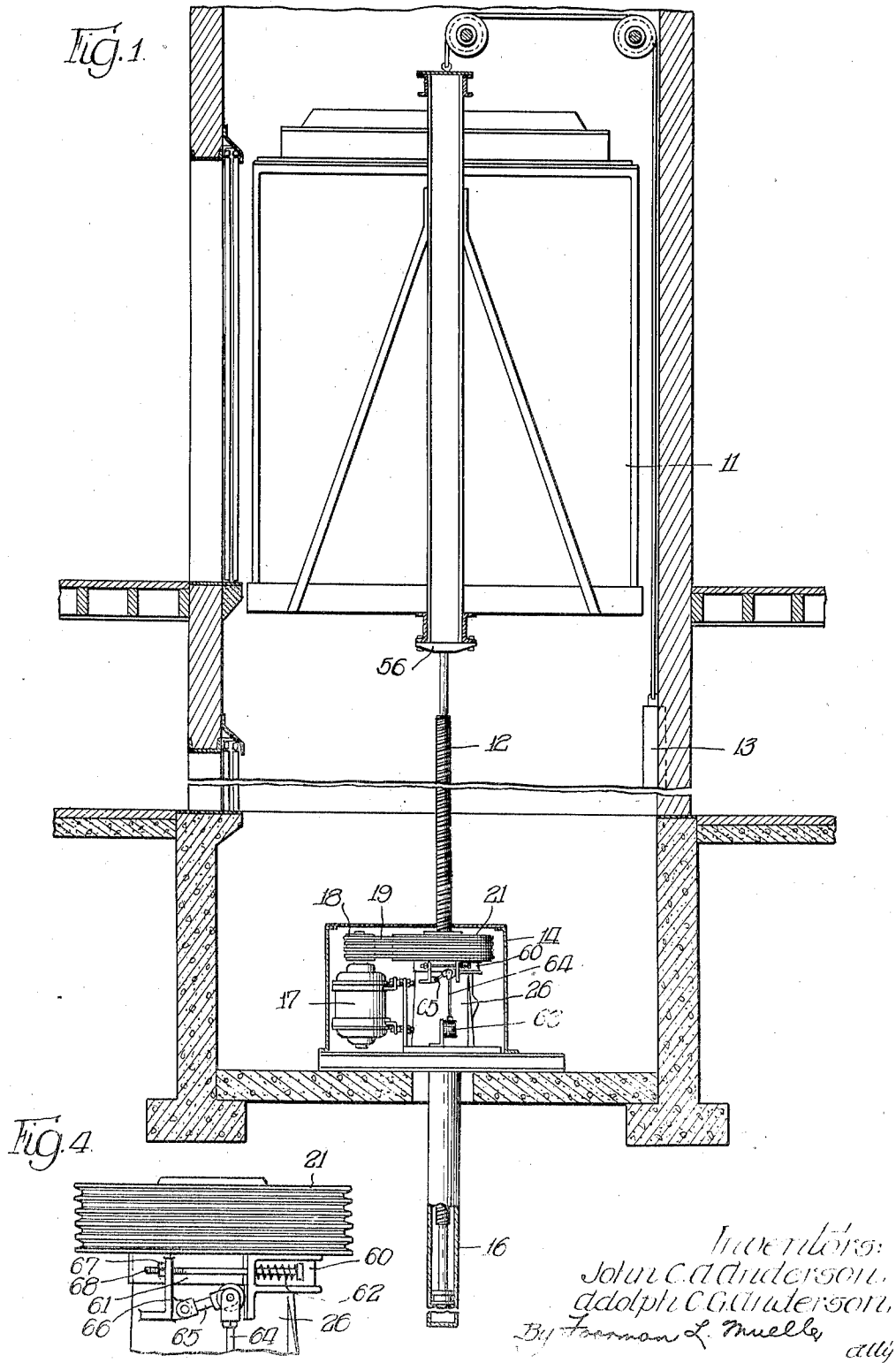
J. C. A. ANDERSON ET AL

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SAFETY AND INDICATING MECHANISM FOR ELEVATORS

Filed March 30, 1938

2 Sheets-Sheet 1



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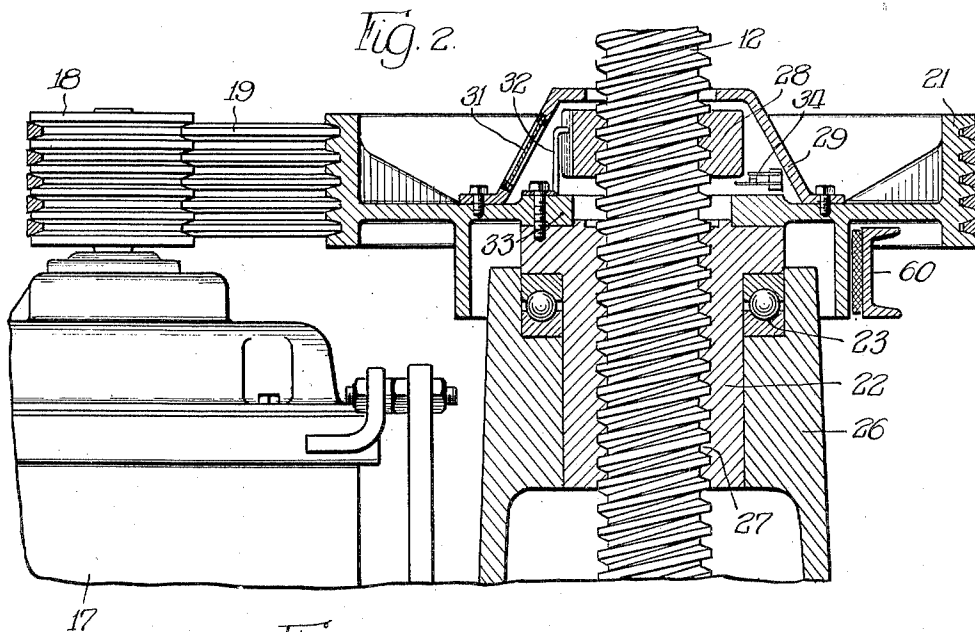
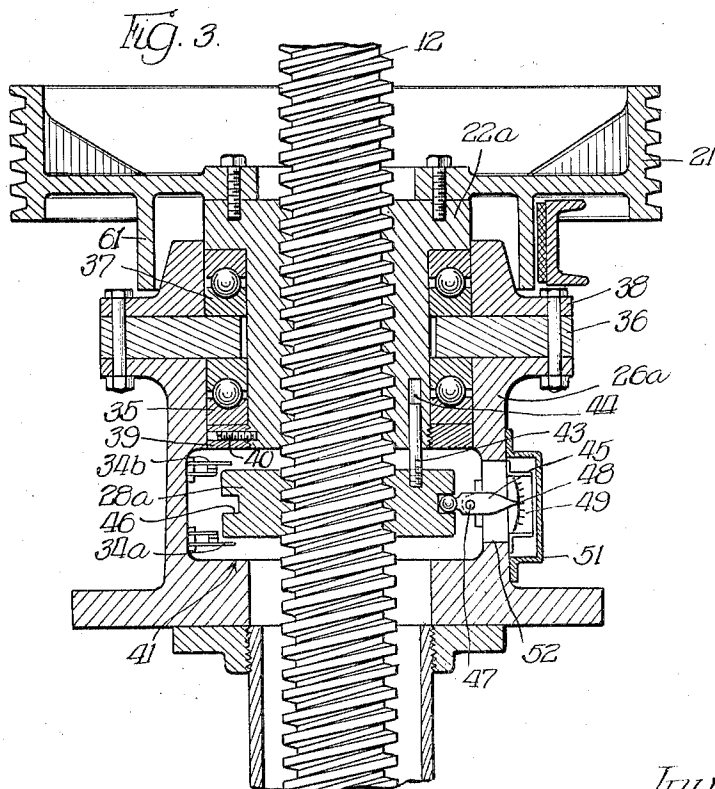
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SAFETY AND INDICATING MECHANISM FOR ELEVATORS

Filed March 30, 1938

2 Sheets-Sheet 2



Inventors:
John C. Anderson
Adolph C. G. Anderson,
By *Frederick L. Mueller* atty.

UNITED STATES PATENT OFFICE

2,187,390

SAFETY AND INDICATING MECHANISM
FOR ELEVATORS

John C. A. Anderson and Adolph C. G. Anderson,
Chicago, Ill., assignors to Reliance Elevator
Manufacturing Company, Chicago, Ill., a cor-
poration of Illinois

Application March 30, 1938, Serial No. 198,835

17 Claims. (Cl. 187—24)

This invention relates to elevator drives and particularly to that type of elevator in which the elevator is supported by a threaded shaft, commonly called a lifting screw.

A very simple form of elevator mechanism which eliminates the necessity of expensive cable and pulley structure is the type in which the elevator car is supported by a threaded shaft or lifting screw which is restrained from rotation and which is raised up and down by the rotation of a nut having a threaded engagement with the lifting screw, the nut being connected with a pulley which is driven with belts by a suitable motor mounted on the frame and housing for the nut and screw. Such a lifting mechanism is extremely simple and because of the self-locking nature of screws and nuts may be perfectly safe as long as the threads on the shaft and on the nut remain in good condition, and this is normally for a period of many years. However, in the commercial structure employed prior to the present invention, there was no way to examine the driving nut to ascertain the condition of the threads, and as a result the threads on such nut can give way suddenly before the worn condition is discovered, and let the elevator drop because the lifting screw will pass freely through the nut. The present invention is concerned with the positive prevention of any such catastrophe, and with providing means to indicate the extent to which the threads of the nut may be worn.

Furthermore, in this type of elevator mechanism prior to the present invention, the lifting screw was normally driven by a worm or gear which in turn was driven by a motor spaced therefrom and connected to the worm by a shaft. In order to stop the movement of the screw as quickly as possible after the power was shut off and thus stop the elevator at the desired floor, a friction brake was applied to the drive shaft. This entire mechanism included a number of expensive elements, which likewise were expensive when they had to be replaced or repaired, and required a relatively large amount of space in the elevator pit. The present invention greatly simplifies the construction and in addition places the brake at the safest place, directly on the lifting nut assembly.

According to the present invention both the safety feature and the indication are provided through the use of a safety nut which ordinarily bears no load and hence is not appreciably worn, which would support the shaft in the event that the lifting nut should give way, and which is mounted to permit a small amount of vertical movement so that the amount of its movement in the course of years will indicate the amount of wear on the threads of the main nut.

The present invention also provides a simpler,

less expensive and more compact driving mechanism with a suitably supported driving nut on the lifting screw with such nut connected directly with a driving pulley driven by V-type belts from a motor mounted adjacent the pulley in the elevator pit. The pulley is provided with a flanged portion, having a friction brake thereon which acts automatically to stop the rotation of the pulley upon switching off the motor. The brake will be effective even though the driving belt or belts may break.

The objects of the invention are for the most part apparent from the foregoing introductory discussion. Further objects and advantages will be apparent from the following description and from the drawings, in which:

Fig. 1 is a fragmentary and partially diagrammatic view of an elevator system embodying the present invention.

Fig. 2 is a fragmentary sectional view on a larger scale showing one form of the invention.

Fig. 3 is a similar fragmentary sectional view showing a modified form of the invention.

Fig. 4 is a fragmentary view showing the brake mechanism on a larger scale.

Although this invention may take numerous forms, only two have been chosen for illustration. Both of the illustrated forms are intended for use in an elevator system in which the car 11 is raised by a lifting screw 12. The car may be counterbalanced by a weight 13 in the usual manner. The lifting screw generally extends downwardly from the car, through a casing 14 which houses the raising mechanism, and into a tube 16 below the casing 14.

The mechanism within the casing 14 includes a motor 17 provided with a compound pulley 18 which through a set of V-belts 19 drives a second pulley 21 which is mounted concentrically with the screw 12 as seen best in Fig. 2. The pulley 21 is bolted to a nut 22 which rotates on anti-friction bearings 23 and which is in threaded engagement with the screw 12 so that rotation of the nut 22 in one direction raises the screw 12 and in the other direction lowers the screw 12. The screw 12 is secured to the elevator car 11 in such a manner that rotation of the screw 12 is prevented. The car 11 of course runs in suitable guides which prevent its rotation.

From the foregoing it is seen that driving the motor in one direction drives the pulley 21 and the nut 22 to raise the elevator car, while driving the motor in the other direction in like manner lowers the car.

Because the nut 22 is very adequately supported by a pedestal 26 and because it extends for a considerable length along the screw 12, it is obvious that the factor of safety is very high. However, the threads on the nut 22 will wear so thin in time that the weight of the elevator

thereon, transmitted through the screw 12, will break the threads and cause the elevator to drop.

According to the present invention a safety nut 28 is provided, which in the first place will give warning of the wear on the threads 27 long before they reach their danger point, and in the second place would support the elevator to prevent its dropping an appreciable distance if the threads did fail. It should be understood that the thread of the screw 12 will not be worn dangerously thin, since the wear corresponding to the wear on the thread 27 is distributed throughout the length of the screw 12. Furthermore, even if the thread on the screw 12 did become unduly worn, such wear would be immediately apparent from even a casual inspection. The thread 27, on the other hand, is completely hidden so that even a careful inspection will not disclose the condition of the same.

In Fig. 2 the nut 28 is shown as enclosed within a housing 29 on pulley 21, the housing 29 preferably having a window 31, which may simply be a removable plate, to permit inspection of the safety nut 28. The safety nut 28 is caused to rotate with the pulley 21 by a bracket 32 which is preferably so arranged as to permit the safety nut 28 to move in a vertical direction. The safety nut 28 is shaped so that it could come to rest on the hub 33 of the pulley 21, but it is initially positioned as shown in Fig. 2 a substantial distance above the pulley 21. If the threads should become worn, they would permit the screw 12 to be positioned relatively lower in the nut 22, and the safety nut 28 would likewise be lowered with the screw 12. A pair of contacts 34 are preferably provided in a position to be opened by the safety nut 28 so as to break the motor circuit for the motor 17 before the wear on the threads 27 becomes dangerous. Of course, the contacts 34 could be connected to operate a danger signal instead of cutting off the motor, or a preliminary set of contacts could operate the danger signal and a final set of contacts could cut off the motor in case the wear was long continued after the danger signal.

Even if the contacts 34 were not provided or if in the course of years some careless engineer should shunt them out of the circuit, there would still be no danger when the safety nut 28 was provided since even the complete failure of the threads 27 would merely let the safety nut 28 drop onto the seat or hub 33 of the pulley 21, at which point the safety nut 28 would support the screw 12 and prevent its dropping farther. Inasmuch as the safety nut 28 carries no load but its own weight during the many years in which the thread 27 is becoming worn, it is obvious that the threads of the safety nut 28 will not be appreciably worn. Of course, the contacts 34 could be positioned to extend between the threads of screw 12 and be actuated by them, but the provision of safety nut 12 is preferred because it absolutely eliminates danger.

Some elevators are very decidedly overbalanced by their counterweights 13. With such overbalancing the threads 27 might conceivably give way at a time when the elevator was nearly empty and consequently would ascend in the housing or compartment rather than descend. The housing 29 could be made strong enough to restrain the safety nut 28 in such an event, but Fig. 3 shows a form of the invention which is preferred in installations where the counterweight will ever overbalance the weight of the car and associated parts. In this form both up-

per and lower thrust bearings are provided and the safety nut 28a is so positioned that in case the threads 27 should give way, the safety nut 28a would be adequately restrained as to both upward or downward movement.

In this form of the invention the lift screw 12 may be lowered into the pedestal 26a, with the safety nut 28a, the lower thrust bearings 35, a plate 36, the upper thrust bearings 37, nut 22a and ring 39 all assembled thereon in the relationship shown. The sturdy plate 36 may be bolted to the pedestal 26a preferably together with a flange ring 38 which acts as a housing for the upper thrust bearing 37. It is thus seen that the weight of the elevator is sustained by the upper thrust bearing 37 which rests on plate 36, and the weight of the counterweight when it exceeds that of the elevator is supported by ring 39 and lower bearing 35 which rests on the underside of plate 36. The ring 39 may be threaded onto the lower end of nut 22a and is locked against unscrewing therefrom by any suitable key such as a screw 40 screwing into screw 22a through a notch or hole in ring 39.

The form of the invention shown in Fig. 3 is substantially the same in principle as that shown in Fig. 2. In this instance the nut may be positioned at a mid-point in the pedestal 26a so that it may seat downwardly on the pedestal at 41 or upwardly on the ring 39. It may be caused to rotate with the nut 22 by means of a pin 43 which may be screwed into the safety nut 28a and may be slidably disposed in a hole 44 in nut 22a. The contacts 34a may serve the same function as the contacts 34 in Fig. 2, to give a warning indication or to shut off the motor, and the contacts 34b may serve the corresponding function in case the car and its associated parts should be overbalanced. In assembling the parts the nut 22a may first have assembled thereon the bearings 37 and 35, plate 36 and ring 39. The ring 39 is preferably then adjusted to provide the proper bearing action in the frictionless bearings 35 and 37, after which the screw 40 may be inserted. This screw may be an ordinary set screw, screwing through the ring 39 if preferred in order to permit adjustment of ring 39 exactly to any position. Next, the pin 43 is inserted in the hole 44 and then the nuts 22a and 28a are screwed onto the lift screw 12, and when they are properly spaced apart thereon the pin 43 is screwed into the safety nut 28a to retain the nuts 22a and 28a in the proper relative position. This entire assembly may then be lowered into the pedestal 26a, after which the ring 38 is bolted in place, and then the drum 21 is bolted to the nut 22a. After the bolts have been applied, the elevator car may be secured to the lift screw 12.

The elevator car is secured to the lift screw 12 by means of a plate 56 which may be permanently secured onto the lift screw 12 as by being threaded and keyed thereto. The plate 56 is removably secured to the elevator car as by bolts so that it may be removed from the elevator car when desired. To this end the elevator car is of course separately secured in place as by being blocked up. When the plate 56 has thus been removed from the elevator car, the lift screw 12 may be lowered into the tube 16 and the belts 19 may then be removed and replaced by new belts.

If it should be desired to have some direct reading device for indicating at a glance the amount of wear on the threads 27, this can be

provided by means of a pointer 45 preferably having its butt end running in a groove 46 in safety nut 28a and pivoted as at point 47 near the safety nut 28a so as to give amplified movement to the needle 48 of the pointer. In this structure a scale 49 is provided adjacent the needle 48, and a cover 51 preferably having a glass window is provided for permitting reading the scale 49 and permitting access to the safety nut 28a. It may be noted, incidentally, that the pointer 46 can extend through an opening 52 in the pedestal 26a, which opening can also be used for the insertion of the safety nut 28a within the pedestal.

One feature of the invention is the simplified brake system. According to this feature the brake shoe 60 (including a suitable lining, of course) acts directly on the lifting nut assembly, that is, on flange 61 of pulley 21 which is secured directly to the nut. This brake shoe may be pivoted to a suitable anchor pin, not shown, carried by the pedestal 26 or 26a and may be actuated in any desirable manner. A very simple manner of actuation, which is preferred, is that illustrated in Figs. 1 and 4. A spring 62 normally urges the brake shoe into engagement with the flange or brake drum 61. When movement of the elevator is desired, i. e., whenever the motor 17 is energized, current is supplied to a solenoid 63. This solenoid may be connected in parallel with the motor 17 or it may be energized by a separate switch simultaneously therewith or slightly in advance thereof. The solenoid 63, when energized, draws down a rod 64 which in turn draws down a pivoted link 65 carrying a roller at the movable end and pivoted at its other end to a bracket 66 carried by the pedestal 26 or 26a. When the rod 64 is drawn down, the link 65 approaches the horizontal position and therefore spreads the brake shoe 60 away from the bracket 66 and hence away from the brake drum 61. When the motor 17 is turned off under the control of the elevator operator, the current also ceases flowing through solenoid 63 with the result that rod 64 is released and spring 62 presses the brake shoe 60 into engagement with the brake drum 61. The tension of this engagement and hence the rapidity with which the motor 17 and the elevator are brought to a stop is controlled by tightening nut 67 on tension bolt 68. It will be observed that this arrangement provides the maximum safety since not only is the brake shoe applied directly to the lifting nut assembly without any intervening gears or drive rods which could break, but also the brake is biased in the direction of application rather than being biased to the off position. Applying the brake by the spring instead of by the solenoid therefore makes the application of the brake independent of the continuation of power. Hence, if the electricity fails, the brake will automatically be applied. Likewise, the elevator may rest indefinitely in a given position without the consumption of power to hold the brake applied. Of course, if preferred, the brake shoe could extend around the drum in the opposite direction from the point of application of force and the solenoid connected to be actuated when the motor is turned off. With this construction the solenoid would apply the brake and the spring would release it.

From the foregoing it is seen that means are provided for positively preventing accidents due to failure of the threads in the lift screw type of elevators and for giving some indications and, if

necessary, shutting off the motor before the threads have been worn to such an extent that their failure is likely to occur. Furthermore, a calibrated scale is provided for indicating the exact amount of wear which has occurred on the threads.

Although we have disclosed our invention in its preferred embodiments, it is understood that we do not limit the same thereby, but the invention is limited only by the scope of the appended claims.

We claim:

1. An elevator mechanism including a lift screw, a lift nut rotatably mounted but non-vertically movable engaging the lift screw, means for rotating the lift nut to raise and lower the screw, and a safety nut normally bearing substantially no load but adapted to restrain vertical movement of the screw in the event of failure of the lift nut.

2. An elevator mechanism including a lift screw, a lift nut threadably engaging the lift screw, means for rotating the lift nut to raise and lower the screw, a safety nut threadably engaging the screw, rotating in a normally fixed relation to said lift nut, and in a normally constant horizontal path, but mounted to permit vertical movement, and means for causing the rotation of the safety nut with the lift nut whereby any wear on the threads of the lift nut causing the lift screw to change its relative threaded position in the lift nut will cause a correspondingly vertical movement of the safety nut from its original rotary horizontal path, with said movement of said safety nut indicating the amount of wear on the threads of the lift nut.

3. An elevator mechanism including a lift screw, a lift nut rotatably mounted but non-vertically movable threadably engaging the lift screw, means for rotating the lift nut to raise and lower the screw, a safety nut threadably engaging the screw and normally rotatable in a single horizontal path but mounted to permit vertical movement, means for causing the rotation of the safety nut with the lift nut whereby any vertical movement of the safety nut will indicate wear on the threads of the lift nut, and means for indicating the vertical movement of the safety nut.

4. An elevator mechanism including a lift screw, a lift nut threadably engaging the lift screw, means for rotating the lift nut in a substantially constant horizontal position to raise and lower the screw, a safety nut threadably engaging the screw but mounted to permit vertical movement with said screw, means for causing the rotation of the safety nut with the lift nut whereby any vertical movement of the safety nut will indicate wear on the threads of the lift nut, and electrical contacts operated by the vertical movement of the safety nut with said screw to indicate a predetermined amount of wear on the threads of the lift nut.

5. An elevator mechanism including a lift screw, a lift nut threadably engaging the lift screw, means for rotating the lift nut to raise and lower the screw, a safety nut threadably engaging the screw but mounted to permit vertical movement, means for causing the rotation of the safety nut with the lift nut whereby any vertical movement of the safety nut will indicate wear on the threads of the lift nut, and an indicator carried at one end in the safety nut and movable at the other end over an indicating scale, with said indicator operated by the vertical move-

ment of the safety nut for indicating on the scale the extent of wear of the threads of the lift nut.

6. An elevator mechanism including a frame, a lift nut threadably supported by the frame, a pulley secured to the lift nut, means for driving the pulley to rotate the lift nut, a screw threadably carried by the lift nut and raised or lowered by its rotation, and a safety nut threadably carried by the screw, rotated with the lift nut, and normally supported by the screw but adapted, in the event of failure of the lift nut, to support the screw at the frame.

7. The combination of an elevator car and an elevator mechanism including a lift screw for raising and lowering the car, a lift nut threadably engaging said screw and rotatable to raise and lower the same, a safety nut threadably carried by the screw and rotated with the lift nut, and means to limit the movement of the safety nut in either vertical direction whereby it will limit the elevator car in descending or ascending movement in the event of failure of the lift nut.

8. An elevator system including an elevator car, a lift screw for raising and lowering the car, a lift nut threadably engaging the screw, a frame for rotatably supporting the lift nut, means for rotating the lift nut to raise or lower the screw and the car, a safety nut threadably engaging the screw within the frame, and means for causing the safety nut to rotate with the lift nut, said safety nut being vertically movable with the screw a limited distance and said frame including seat portions adapted to limit the vertical movement of the safety nut in either direction.

9. An elevator system including an elevator car, a lift screw for raising and lowering the car, a lift nut threadably engaging the screw, a frame for rotatably supporting the lift nut, means for rotating the lift nut to raise or lower the screw and the car, a safety nut threadably engaging the screw within the frame, means for causing the safety nut to rotate with the lift nut, said safety nut being vertically movable with the screw a limited distance and said frame including seat portions adapted to limit the vertical movement of the safety nut in either direction, and contact means adapted to be actuated by the safety nut upon movement in either direction prior to seating on said seat portions for indicating a movement of the safety nut beyond a predetermined amount.

10. An elevator having a platform and an operating mechanism therefor including a vertically movable left screw, a pair of nuts engaging the screw with both nuts being entirely independent of the platform but acting one at a time for supporting the left screw, and means for supporting the nuts differentially and rotating them simultaneously whereby the failure of one nut to support the screw will be evident by differential vertical movement of the nuts with the other nut functioning as a screw support.

11. An elevator mechanism including a vertically movable lift screw, a first support means for said screw and a second support means therefor, each capable of supporting the elevator and lift screw independently of the other, and means for differentially supporting said support means whereby if one of them fails its failure will be

evident from the differential movement of the two support means while the other one continues to function.

12. An elevator mechanism including a lift member, a fixed support therefor, means supported by the support for causing the lift member to lift, and a safety member engaging the lift member, having a normally idle movement with respect thereto, but adapted to rest on the support and limit the movement of the lift member if said means fails.

13. A drive mechanism including a drive member, a base, means resting against the base to cause the drive member to drive, and a safety unit engaging the drive member, with a relatively moving relationship which is normally relatively idle, but adapted to rest against the base and limit the movement of the drive member if said means fails.

14. An elevator mechanism including a lift screw, a lift nut engaging the lift screw, means for rotating the lift nut in a fixed horizontal path to raise and lower the screw vertically, and indicating means independently engaging the threads of the lift screw to indicate a departure of said threads from their original helical course.

15. An elevator mechanism including in combination a vertically movable lift screw, a pair of nuts threadably engaging said lift screw with each of said nuts rotatable normally in a horizontal path, frame means for supporting said nuts, with one of said nuts being driven to drive the lift screw and non-displaceable vertically, with the other of said nuts being displaceable vertically with reference to the one nut and each of said nuts one at a time acting to support the vertically movable lift screw.

16. Lifting mechanism including in combination a vertically movable lift screw, a driven lift nut threadably engaging said lift screw for vertically moving the latter, means for driving said lift nut to rotate the same, a safety nut threadably engaging said lift screw and rotatable normally in a horizontal path in a substantially fixed vertical relation with said lift nut, with said safety nut movable in a vertical direction toward said lift nut upon failure of the latter for supporting said lift screw against undesirable downward movement, and frame means for rotatably supporting said lift nut and operatively supporting said safety nut when said safety nut is supporting said lift screw.

17. Lifting mechanism including in combination a vertically movable lift screw, a driven lift nut threadably engaging said lift screw for vertically moving the latter, means for driving said lift nut to rotate the same, a safety nut threadably engaging said lift screw at a position vertically displaced from said lift nut and with said safety nut movable in a vertical direction with reference to said lift nut for supporting said lift screw against undesirable vertical movement, and frame means for rotatably supporting said lift nut having a pair of rigid supporting shoulders on each side of a cavity in said frame means, with said safety nut positioned in said cavity and adapted to engage one supporting shoulder or the other to limit the undesirable vertical movement of said lift screw.

JOHN C. A. ANDERSON.
ADOLPH C. G. ANDERSON.