Aug. 9, 1966 3,265,360

JOHANN TAX ALSO KNOWN AS HANS TAX

TOWER CRANE WITH AUXILIARY HOIST

Filed June 2, 1964 2 Sheets-Sheet 1

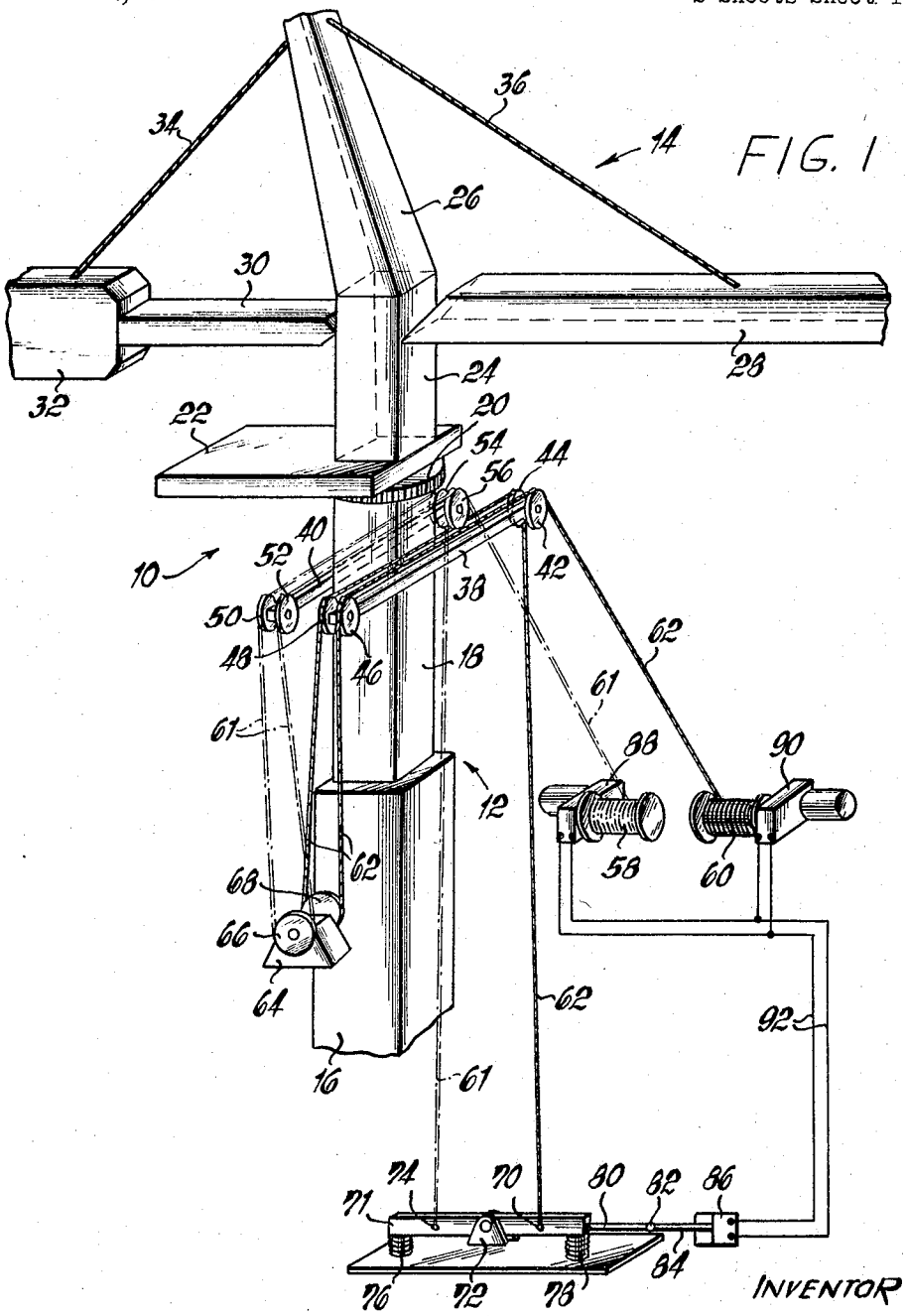


FIG. 1

INVENTOR

Hans Tax

By Richard Chunt

Agt

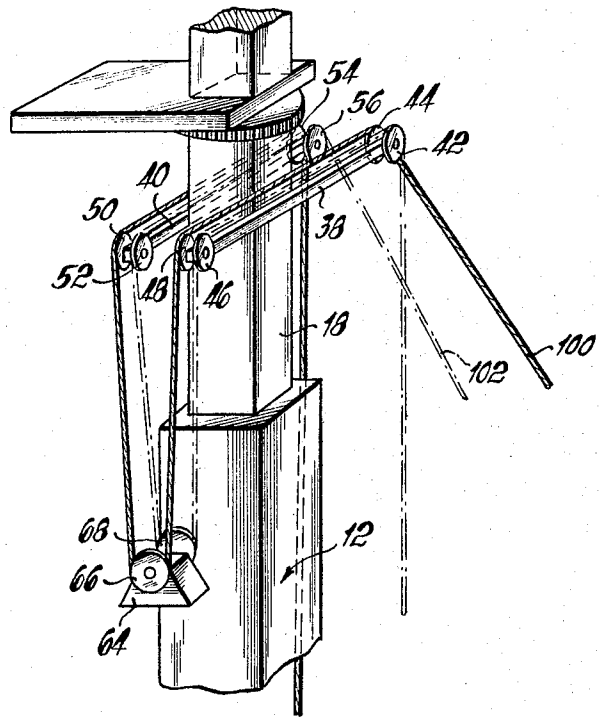
Aug. 9, 1966 3,265,360

JOHANN TAX ALSO KNOWN AS HANS TAX

TOWER CRANE WITH AUXILIARY HOIST

Filed June 8, 1964 2 Sheets-Sheet 2

FIG. 2



INVENTOR

Hans Tax

By Richard Good

Agt

United States Patent Office 3,265,360 Patented August 9, 1966

1

3,265,360

TOWER CRANE WITH AUXILIARY HOIST

Johann Tax, also known as Hans Tax, 3 Potsdamer Strasse, Munich 23, Germany

Filed June 2, 1964, Ser. No. 372,064
Claims priority, application Belgium, June 5, 1963, 507,097, Patent 633,231
10 Claims. (Cl. 254—173)

This invention relates to tower cranes of the type commonly employed in housing construction, and more particularly to a tower crane equipped with an auxiliary hoist.

It is known to increase the normal load lifting capacity of tower cranes by the provision of an auxiliary hoist equipped to raise a load closely adjacent the vertical tower axis so as to reduce the torque exerted by the load to a value substantially smaller than the torque exerted by a similar load suspended from the jib of the crane. The auxiliary hoist permits the lifting of loads which would normally exert a greater torque than is consistent with the flexural strength of the tower structure.

In view of the high tensions in the cables or ropes of the auxiliary hoists, defects in the hoist mechanism, including the cable, can have particularly serious consequences.

This invention is concerned with safety device for preventing or mitigating the consequences of such defects, and more particularly with a device which applies brakes to the hoist cables in the event of a defect.

In one of its aspects, the invention provides the top portion of a tower in a crane of the type described with pulleys. Two cables, ropes, or similar elongated tension members, hereinafter referred to as "cable members" are trained over the pulleys. Each cable has an end portion which is attached to a cable drum and another portion which depends from a pulley and is secured to a load supporting member which is common to the two cable members. Motors and brakes are provided for rotating the pulley drums and for arresting their rotation. The cable members are under tension when supporting a load, and a sensing device is provided for sensing the quantitative relationship of the tensions. Brake actuating means are operatively connected to the sensing device and to the brakes for actuating the latter, and for thereby arresting rotation of at least one brake drum in response to a predetermined sensed relationship of the cable tensions.

Other features and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which FIGURE 1 illustrates a tower crane equipped with the safety device of the invention in a fragmentary perspective view, and FIGURE 2 illustrates the cable arrangement in a modified embodiment.

The crane **10** is illustrated only to the extent needed for an understanding of the invention, there being shown the upper portion of the tower **12** and the rotary head **14**. The tower, as far as illustrated, has two telescopically engaged sections **16**, **18** which may be moved relative to each other by means not illustrated to adapt the height of the tower to specific requirements. An annular bearing **20** on the tower section **18** supports a turntable **22** which forms the supporting platform for the rotatable crane superstructure. A pillar **24** extends axially upward from

2

the platform **22**. The jib **28** and an arm **30** carrying a counterweight **32** extend in opposite, approximately horizontal directions from the pillar **24**, and are suspended from the topmost portion **26** of the pillar by cables **34**, **36**, as is conventional. The hoisting mechanism associated with the jib has not been shown since it may be entirely conventional and is not in itself a part of this invention.

Two horizontal beams **38**, **40** are attached to opposite vertical faces of the tower section **18** in such a manner that the two ends of each beam project slightly beyond the tower section in opposite directions. The beams constitute brackets the ends of which carry pairs of pulleys, the four ends of the two beams thus supporting eight pulleys **42**, **44**, **46**, **48**, **50**, **52**, **54**, **56**. The pulleys **66**, **68** are jointly attached to a load **64**.

Two cable drums **58**, **60** are mounted on the base of the tower **12**, not itself shown in the drawing. The cable drums are respectively connected to electric brake motors **88**, **90** to constitute winches. One end of a steel cable **61** is wound on the drum **58**. The free portion of the cable is trained in sequence over a pulley **56** on one end of the beam **40**, a pulley **52** on the other end of the beam, the load supporting pulley **66**, the other two pulleys **50**, **54** on the beam **40**, and downward toward a lever **71** mounted on the tower base by means of a pivot **72**. The end of the cable **61** is attached to the arm **74** of the lever **71**.

A second steel cable **62** is attached in a corresponding manner to the drum **60**, and trained over the pulleys **42**, **46** on the beam **38**, the load supporting pulley **68**, and the pulleys **48**, **44** on the beam **38**. The end of the cable **62** is attached to the arm **70** of the lever **71**. Pivotal movement of the lever **71** is opposed by two helical compression springs **76**, **78**. An extension rod **80** on the lever arm **70** carries a cam **82** which engages the actuating pin **84** of a switch **86**. The switch is arranged in circuit with the brake motors **88** and **90** as indicated by the conductors **92**. It will be understood that the motors **88** and **90** are equipped with the usual starting and operating controls which are arranged in an operator's cab, not shown. The circuit partly represented by the conductors **92** may include non-illustrated relays and similar circuit elements conventional in themselves and commonly employed in brake motor circuits.

The motors **88**, **90** are synchronized, and the cable drums **58**, **60** are of equal diameter and of sufficient axial length to accommodate the cables **61**, **62** in a single layer when the load **64** is at the highest point to which it is intended to be raised. The cables are of equal diameter. Under all normal operating conditions, the tensions in the cables **61**, **62** are closely similar or equal. Any small or temporary differences are absorbed by the springs **76**, **78**. The lever **71** maintains a fixed angular position on the pivot **72**.

The resultant of the downward forces in the cables **61**, **62** is represented by a vector which approximately coincides with the vertical tower axis because of the symmetrical arrangement of the pulleys **42–56** about that axis. The individual bending torque components associated with the cables **61**, **62** normally balance each other.

In the event of a defect in one of the two hoist arrangements which are each constituted by a cable, pulleys, a drum, and a motor, the arms **70**, **74** of the lever **71** are unequally loaded, and the imbalance, if significant to affect

the safety of the tower, is also sufficient to overcome the resistance of the springs 76, 78. The switch 86 is thereby operated to actuate the brakes of the motors 88, 90. Because of the characteristics of a motor equipped with an internal electrically operated brake, the drums 58, 60 are not stopped abruptly. The brake arrangement has inherent damping properties.

When the imbalance of cable tension is due to increased friction in a pulley bearing which lacks lubrication or is otherwise defective, damping of the brake action is not as vitally important as in the event of a cable break. Although it is standard practice to select cables having a collective carrying capacity of at least twice the greatest load to be lifted, the sudden transfer of the supported weight to one cable when the other one breaks would impose a dynamic stress on the intact cable which may lead to failure if the brake were not applied in a gradual manner.

The illustrated very simple mechanical sensing device mainly constituted by the lever 71 is preferred because it is well suited by its ruggedness to the conditions under which it operates. Other sensing devices, however, will readily suggest themselves to those skilled in the art. A signal indicative of the tension in each cable may be derived from the pressure exerted on a bearing by a pulley over which the cable is trained. A similar signal may be derived from the current flowing through each of the winch motors 88, 90 when the motor actuates rotation of the associated cable drum. Equipment commercially available may thus be employed for generating a cable tension signal, for comparing the signals, and for actuating cable drum brakes if the cable tensions do not maintain a desired quantitative relationship. The lever 71 and the associated illustrated elements of the invention operate in an analogous manner.

Because of the close proximity of the beams 38, 40 to the vertical tower axis, the bending stresses exerted by the load 64 on the tower 12 in the event of failure of one cable are relatively small. It is essential therefore that the vector which represents the vertical forces in each individual cable be as close to the tower axis as possible, and that its spacing from the axis be no more than a small fraction of the tower height, as is evident from the drawings.

FIGURE 2 shows a preferred cable arrangement. All parts besides the cable are the same as in the embodiment of FIG. 1 and are provided with the same reference numerals. A first steel cable 100 is coming from cable drum 60 and is trained in sequence over pulley 44 on beam 38, pulley 48 on beam 38, pulley 66 of load 64, pulley 50 of beam 40 and pulley 54 of beam 40. The free end of steel cable 62 is fixed to one of the arms 70, 74 of lever 71.

A second steel cable 102 is coming from cable drum 58 and is trained in sequence of a pulley 56 on beam 40, pulley 52 on beam 40, pulley 68 of load 64, pulley 46 on beam 38 and pulley 42 on beam 38 to the other of said arms 70, 74 of the lever 71.

It is to be remarked that cable 100 runs over beam 38 as well as over beam 40 and that cable 102 runs over beam 40 as well as over beam 38; this means that in the event of rupture of one of the cables the symmetry of load distribution does not get lost.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention, and that it is intended to cover all changes and modifications of the example of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

What is claimed is:

1. A crane comprising, in combination:
(a) an elongated tower having a normally vertical longitudinal axis;
(b) two cable members having respective first longitudinal portions guided on a top portion of said tower, and respective second portions depending from said first portions;
(c) joint load supporting means attached to said second portions for transmitting the weight of a supported load to said cable members;
(d) winch means operatively connected to said cable members for tensioning the same and for thereby raising a load supported on said second portions, said winch means including brake means for arresting movement of the connected cable members;
(e) sensing means for sensing the relationhip of the respective tensions in said cable members; and
(f) brake actuating means operatively connected to said sensing means and to said brake means, and responsive to a predetermined sensed relationship of said tensions for actuating said brake means.

2. A crane as set forth in claim 1, wherein the tensions in said two second cable members have a resultant vector which substantially coincides with said axis when a load is supported on said two cable members.

3. A crane as set forth in claim 1, wherein said winch means include two winches, said cable members having respective third portions attached to said winches, and said brake actuating means being operatively connected to said winches for arresting the same in response to said predetermined relationship.

4. A crane as set forth in claim 1, wherein said sensing means include a pivotally mounted two-armed lever, said cable members being respectively attached to the arms of said lever, and said brake actuating means being responsive to pivoting movement of said lever.

5. A crane as set forth in claim 4, further comprising yieldably resilient means opposing said pivoting movement.

6. A crane as set forth in claim 1, wherein said winch means include two rotatable cable drum means respectively attached to said cable members and said winch means and said brake means jointly include two brake motors respectively connected to said cable drum means for rotating the same and for arresting rotary motion of said cable drum means.

7. A crane as set forth in claim 1, wherein the tension of each of said cables defines a vertical vector closely adjacent said longitudinal axis, the horizontal spacing of said vector from said axis being not greater than a small fraction of the height of said tower.

8. A crane comprising, in combination:
(a) an elongated tower having a normally vertically extending longitudinal axis;
(b) pulley means on a top portion of said tower,
(c) two cable members;
(d) two rotatable cable drum means;
(e) load supporting means for transmitting the weight of a load to said cable members, said cable members each having
  (1) an end portion attached to a respective one of said cable drum means,
  (2) an intermediate portion trained over said pulley means, and
  (3) a dependent portion downwardly extending from said pulley means, said load supporting means including a load supporting member secured to the dependent portions of said two cable members;
(f) motor means for rotating each of said cable drum means, whereby said cable members are tensioned when supporting a load;
(g) brake means for arresting rotation of said cable drum means;
(h) sensing means for sensing the relationship of the respective tensions in said cable members; and
(i) brake actuating means operatively connected to said sensing means and to said brake means for actuating said brake means and for thereby arresting

rotation of at least one of said cable drum means in response to a predetermined sensed relationship of said tensions.

9. A crane as set forth in claim 8, wherein said sensing means include a pivotally mounted two armed lever, said cable members having respective other end portions respectively attached to the arms of said lever, and said brake actuating means being responsive to pivoting movement of said lever.

10. A crane as set forth in claim 9, wherein said brake means and said motor means jointly constitute two electric brake motors in respective engagement with said cable

drum means, and said brake actuating means include an electric switch in circuit with said brake motors.

References Cited by the Examiner

UNITED STATES PATENTS

2,241,274	5/1941	Severson	254—173
2,689,890	9/1954	Green	254—173

EVON C. BLUNK, *Primary Examiner.*

H. HORNSBY, *Assistant Examiner.*