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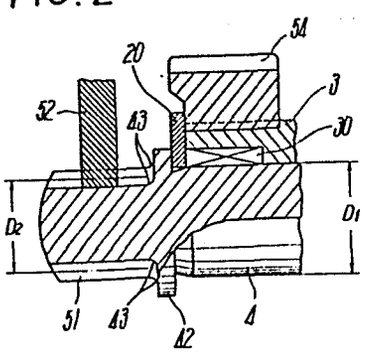
(54) **Hoist.**

(57) The present invention relates to a hoist having a drive shaft 4 rotatably mounted inside a tubular shaft 3 having a load sheave 2 and transmits a driving force from the drive shaft 4 to the load sheave 2 through a reduction gear means 5. According to the present invention the drive shaft 4 is provided at the outer periphery of one axial end with a first gear 51 formed integrally therewith, the first gear 51 having at its axially inward portion a flange 42 connected directly thereto and extended radially outwardly of the drive shaft 4.

FIG. 2



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HOIST

This invention relates to a hoist, and more particularly to a hoist provided with a frame having a pair of side plates. a tubular shaft mounted therebetween and having a load sheave, a drive shaft mounted in the tubular shaft and having projecting shafts projecting outwardly beyond each axial end of the tubular shaft, and a reduction gear mechanism which is provided with first, second, third and fourth gears for transmitting a driving force from the drive shaft to the tubular shaft.

Conventional hoists of the above type have the first gear of the reduction gear mechanism formed at the outer periphery of one of the projecting shafts on the drive shaft, second gear means engageable with the first gear, and third gear means engageable with a fourth gear coupled with the tubular shaft which are mounted on intermediate shafts supported between the one side plate of the frame and a side wall of a gear box fixed outside the side plate so that a driving force is transmitted from the drive shaft to the tubular shaft through the first, second, third and fourth gears.

In a known device, as shown in Fig. 3, a first gear $\underline{G}_1$ of the conventional hoist is formed in such a manner that a projecting shaft $\underline{P}$ of a drive shaft $\underline{D}$ is made larger in diameter than the drive shaft $\underline{D}$; a stop means or shoulder $\underline{S}$ is formed at the axially inward end of the larger diameter projecting shaft $\underline{P}$ for abutment with the axially outward end of the tubular shaft $\underline{C}$, and a plurality of cut-out grooves $\underline{a}$ is provided on the projecting shaft $\underline{P}$ and extends axially inwardly from the axially outward end thereof. A second gear $\underline{G}_2$ is engageable with the first gear $\underline{G}_1$ and a fourth gear $\underline{G}_4$ has a splined connection with the tubular shaft $\underline{C}$, a snap ring $\underline{L}$ being mounted on the tubular shaft $\underline{C}$ to retain the fourth gear $\underline{G}_4$ against axially outward movement from the tubular shaft $\underline{C}$.

It is desirable that the hoist should be lightweight and small in size. For this purpose, the driving shaft and tubular shaft need to be reduced in diameter. The first gear G_1 which is formed on the driving shaft D by cutting thereinto, is however reduced in strength when the driving shaft D is of relatively small diameter so that the possibility of breakage thereof due to overloading arises. Accordingly it has not been possible to reduce the diameter of the drive shaft D beyond a predetermined limit.

The grooves a formed in the conventional hoist by cutting or machining extend axially inwardly of the drive shaft D beyond the shoulder S so that the axially outward end of the tubular shaft C fits over the grooved portion of the drive shaft D.

Therefore, when the drive shaft D rotates relative to the tubular shaft C, the machined grooves a chip off the inner peripheral surface of the tubular shaft C to cause a backlash of the tubular shaf C, whereby the tubular shaft C is difficult to rotate smoothly.

Also, the conventional hoist locks in position the fourth gear G_4 by means of the snap ring L, whereby the aforesaid snap ring L and an annular groove b have to be provided specially therefor, thereby resulting in a high manufacturing cost.

It is an object of the present invention to avoid or minimize one or more of the above disadvantages.

The present invention is characterized in that the first gear formed on a projecting shaft of the drive shaft is formed mainly by cold forging and is provided at the axially inner end with a flange which is connected directly thereto and extends radially outwardly of the drive shaft thereby to engage the end face of the tubular shaft to restrain the drive shaft against axial movement.

Thus the present invention provides a hoist having a frame with a pair of side plates, a tubular shaft supported between said side plats of said frame and having a load sheave, a drive shaft mounted in said tubular shaft and having projecting shafts projecting axially outwardly of each end of said tubular shaft, and a reduction gear means provided with first, second, third, and fourth gears formed and arranged for transmitting a driving force from said drive shaft to said tubular shaft characterised in that said first gear is formed integrally with the outer peripheral portion of one of said projecting shafts on said drive shaft and is provided at its axially inward end with a flange extending radially outwardly of said drive shaft for engagement with the adjacent axially outward end of said tubular shaft so as to restrain said drive shaft against axial movement.

Thus, the first gear in the hoist of the invention is not formed by cutting as is conventional but instead by means of cold forging, coupled directly with the drive shaft, and reinforced by the flange, thereby maintaining adequate strength even when the drive shaft is of reduced diameter. Also, the flange serves as a stop means for the tubular shaft, so that the projecting shaft need not be significantly larger in diameter with respect to the drive shaft, in other words it does not need to be large enough to restrain the movement of the drive shaft, thereby enabling the hoist weight to be limited to that extent.

Also, no tooth space (interdentate interval) of the first gear extends axially inwardly of the drive shaft beyond the flange serving as the stop means. Hence, the drive shaft is supportable at its rounded outer periphery on the tubular shaft and also, a bearing, such as a needle bearing can be readily interposed between the drive shaft and the tubular shaft.

Furthermore, a washer which is larger in external diameter than the tubular shaft may be fitted onto the drive shaft thereby to lock the fourth gear, which is spline-coupled with the tubular shaft, in a simple manner.

Further preferred features and advantages of the invention will appear from the following detailed description given by way of example of a preferred embodiment illustrated with reference to the accompanying drawings in which:

Fig. 1 is a longitudinal sectional elevation of a hoist of the invention;

Fig. 2 is an enlarged scale sectional elevation of the principal part thereof; and

Fig. 3 is a sectional elevation of part of a conventional hoist.

Fig. 1 shows a manually operated hoist which is constructed with a frame 1 comprising a pair of first and second opposed side plates 11 and 12 at a predetermined spacing from each other. A tubular shaft 3 having a load sheave 2 is supported rotatably between the side plates 11 and 12. A drive shaft 4 extends through a central bore 31 inside the tubular shaft 3 so as to be rotatable relative thereto, and a reduction gear mechanism 5 is interposed between the drive shaft 4 and the load sheave 2, through which the drive force from the drive shaft 4 is reduced in speed by the reduction gear mechanism 5 and transmitted to the load sheave 2.

The drive shaft 4 is axially longer than the tubular shaft 3 and at a first projecting shaft which projects axially leftwardly (as viewed in Fig. 1) of the tubular shaft 3, is formed a first gear 51 of the reduction gear mechanism 5 and at the outer periphery of a second projecting shaft which projects axially rightwardly (as viewed in Fig. 1) the tubular shaft 3 is formed a screw thread 41. A manually driven wheel 7 is screw-threadedly engaged there-

with and a mechanical brake 8 is interposed between the wheel 7 and the first side plate 11 and sleeved onto the drive shaft 4, so that the wheel 7 rotates normally to be coupled fixedly with the drive shaft 4 through the mechanical brake 8. Hence, a rotational driving force of the wheel 7 is transmitted from the drive shaft 4 to the load sheave 2 through the reduction gear mechanism 5 so that a chain (not shown) wound around the load sheave 2 will lift a load, and the wheel 7 rotates in the opposite direction intermittently to relese the mechanical brake 8 thereby to rotate the load sheave 2 in the opposite direction under the influence of the weight of the load, thereby lowering it.

In more detail the reduction gear mechanism 5 comprises the first gear 51 formed circumferentially at the outer periphery of the first projecting shaft on the driving shaft 4, two second planet gears 52 mounted on two intermediate planet shafts 6 and engageable with the first gear 51 at opposite sides thereof, two third gears 53 provided on the outer peripheries of respective ones of each of the intermediate shafts 6, and a fourth sun gear 54 spline-coupled with the outer axial end portion of the tubular shaft 3 and engageable on opposite sides with respective ones of each of the third gears 53, so that the reduced driving force is transmitted from the drive shaft 4 to the load sheave 2 through said first, second, third and fourth gears 51.52, 53, and 54.

The first gear 51 in the above described embodiment is as shown in Fig. 2 formed to have a pitch diameter $\underline{D}_2$ smaller than the external diameter $\underline{D}_1$ of the drive shaft 4, and is provided at its axially inward end, that is, the end towards the tubular shaft 3. with a flange 42 formed integrally with the projection shaft and extending radially outwardly of the drive shaft 4, thereby engaging the axial end face of the tubular shaft 3 to restrain the drive shaft 4 against axial movement.

The first gear 51 and flange 42 are formed integrally on the first projecting shaft and simultaneously with each other by cold forging, the flange 42 reinforcing the first gear 51 so that the first gear 51 can be reduced in diameter without significant loss of strength thereby enabling the hoist to be reduced in size.

In this embodiment fillets 43 are provided at the junction between the flange 42 and each tooth crest and bottom of the first gear 51 to increase further the strength thereof. Also, a washer 20 which is larger in external diameter than the tubular shaft 3 is mounted on the drive shaft 4 and abuts against the flange 42 thereby to lock the fourth gear 54 against escape from the tubular shaft 3. This washer 20 is, however, not indispensable. Thus as an alternative the flange 42 could be increased in external diameter sufficiently to contact directly one side face of the fourth gear 54, thereby locking it in position.

Also, the drive shaft 4 is rounded at the outer periphery of a portion which is axially inward of the flange 4 and two needle bearings 30 and 31 are interposed between the respective axial end portions of the drive shaft 4 and the inner periphery of the tubular shaft 3 for smoothing relative rotation between the drive shaft 4 and the tubular shaft 3.

Alternatively, the flange 42 could be formed separately from the drive shaft 4 and coupled therewith instead. Also, the hoist transmission of the above-described embodiment of the invention could be equally well applied to an electrically operated hoist as to a hand operated one as illustrated. In either case, the first gear 51 is formed mainly by cold forging and reinforced by the flange 42 connected directly thereto, whereby the first gear 51 has sufficient strength even when the drive shaft 4 is of relatively small diameter. thus enabling overall size of the hoist to be reduced.

Also, there is no need to provide the conventionally cut grooves of the first gear 51, thereby preventing the tubular shaft 3 from being chipped at the inner surface by the drive shaft 4; needle bearings can be interposed between the round outer surfaces of both axial ends of the drive shaft 4 and the inner surface of the tubular shaft 3 thereby to permit smooth relative rotation between the shaft 4 and the tubular shaft 3· and the flange 42 is utilized to lock the fourth gear 54 on the tubular shaft 3 without the use of a conventional snap ring and annular groove for location thereof, thereby facilitating a low manufacturing cost of the hoist.

CLAIMS

1. A hoist having a frame (1) with a pair of side plates (11,12), a tubular shaft (3) supported between said side plates (11,12) of said frame (1) and having a load sheave (2), a drive shaft (4) mounted in said tubular shaft (3) and having projecting shafts projecting axially outwardly of each end of said tubular shaft (3), and a reduction gear means (5) provided with first, second, third and fourth gears (51-54) formed and arranged for transmitting a driving force from said drive shaft (4) to said tubular shaft (3) characterised in that said first gear (51) is formed integrally with the outer peripheral portion of one of said projecting shafts on said drive shaft (4) and is provided at its axially inward end with a flange (42) extending radially outwardly of said drive shaft (4) for engagement with the adjacent axially outward end of said tubular shaft (3) so as to restrain said drive shaft (4) against axial movement.

2. A hoist according to claim 1. wherein said first gear (51) and flange (42) are formed integrally with said drive shaft (4) by means of forging.

3. A hoist according to claim 1 or claim 2. wherein a fillet portion (43) is provided at the junction between said first gear (51) and said flange (42) for strengthening said first gear (51).

4. A hoist according to any one of claims 1 to 3 wherein said drive shaft (4) is provided with a washer (20) having an outer peripheral surface of larger diameter than the external diameter of said tubular shaft (3) for restraining axially outward movement of the fourth gear (54) which is coupled with the outer periphery of said tubular shaft.

5. A hoist according to any one of claims 1 to 4 wherein bearings (30,31) are interposed between said drive shaft

(4) and said tubular shaft (3) for facilitating relative rotation therebetween.

FIG. 1

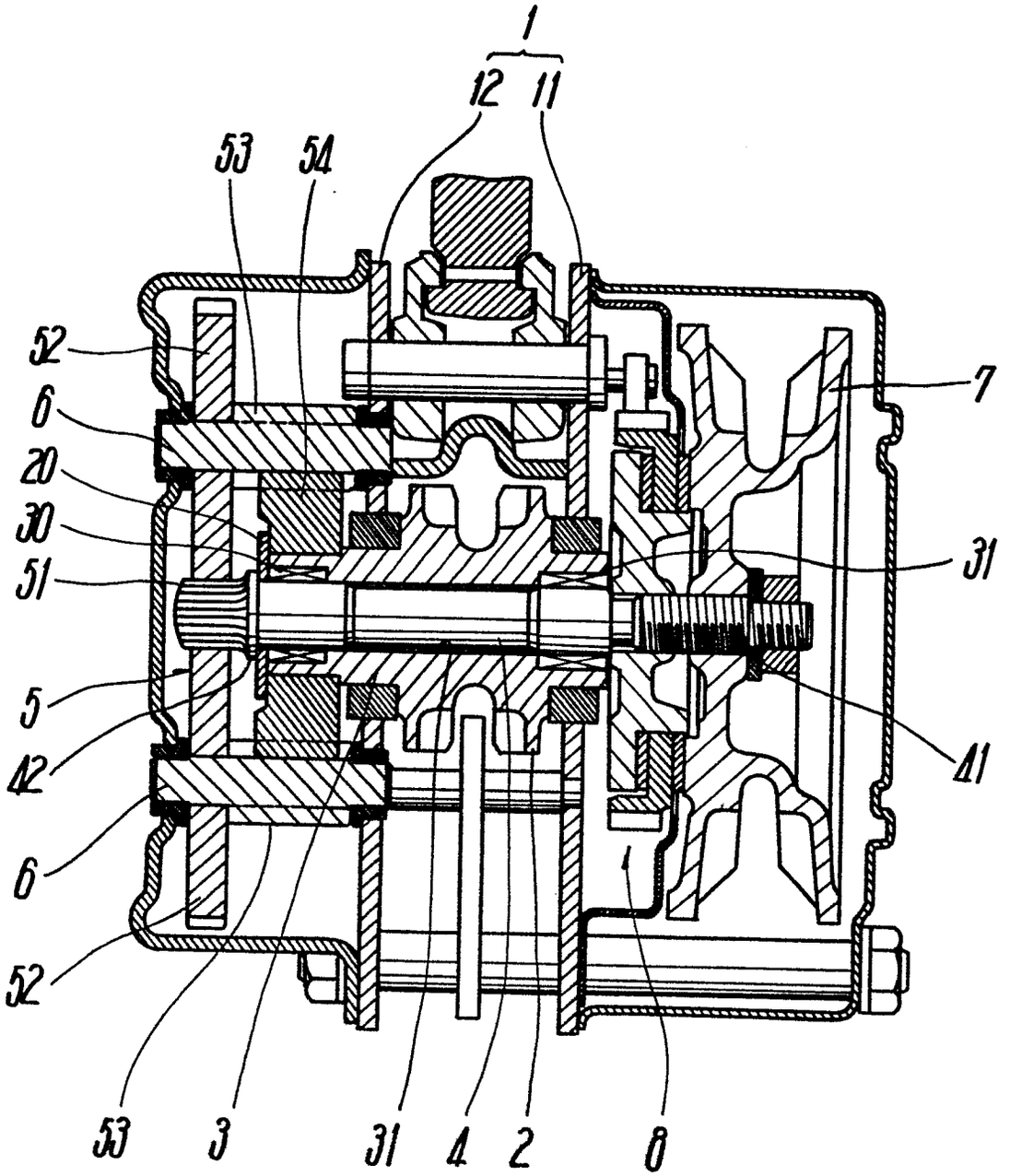


FIG. 2

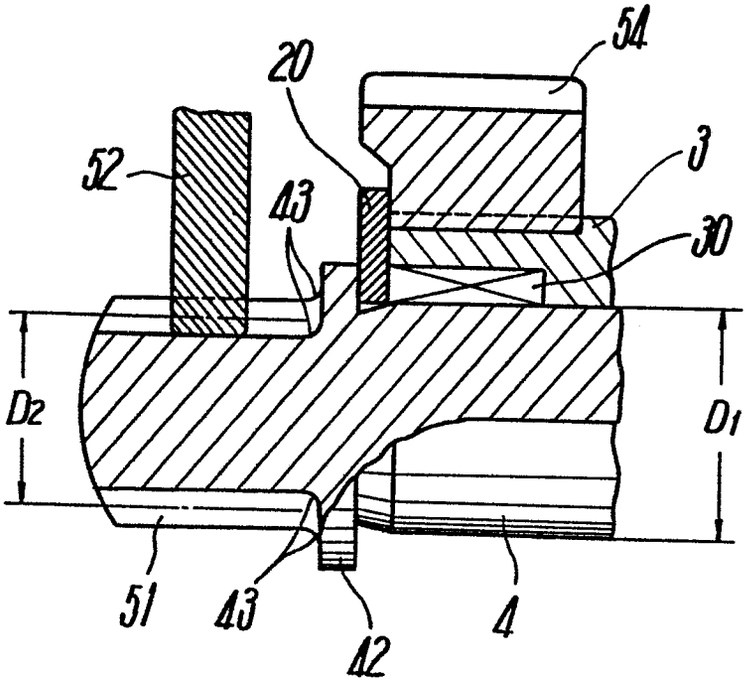
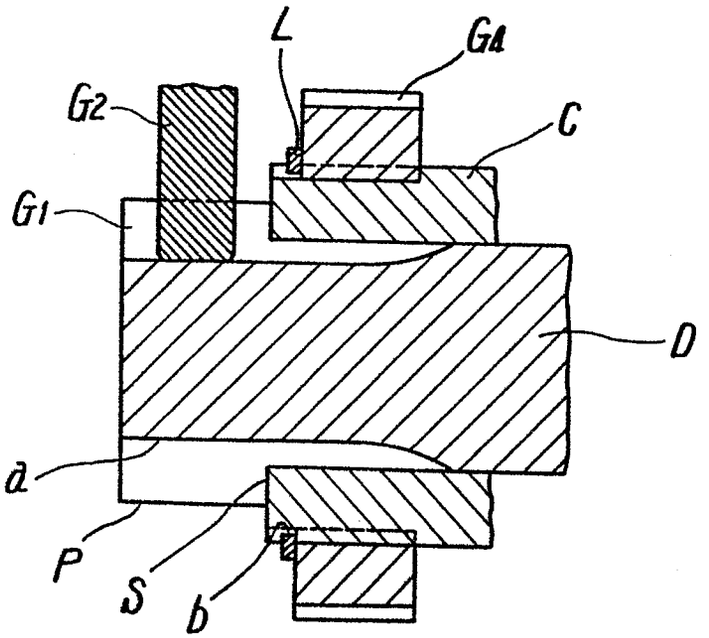


FIG. 3 (PRIOR ART)



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EUROPEAN SEARCH REPORT

0131380
Application number

EP 84 30 3847

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	US-A-1 949 920 (ROBERTSON) * Column 2, lines 76-116; figure 1 *	1,5	B 66 D 3/16 B 66 D 3/26
A	US-A-4 221 364 (NISHIMURA) * Figure 3 *	1,4	
A	DE-B-2 422 959 (K.K. TOA KIKAI SEISAKUSHO)		
A	US-A-1 492 581 (SIMPSON)		
A	US-A-2 324 000 (JOHNSTON)		

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

B 66 D 3/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	12-09-1984	KANAL P K

CATEGORY OF CITED DOCUMENTS

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