Fig. 2.

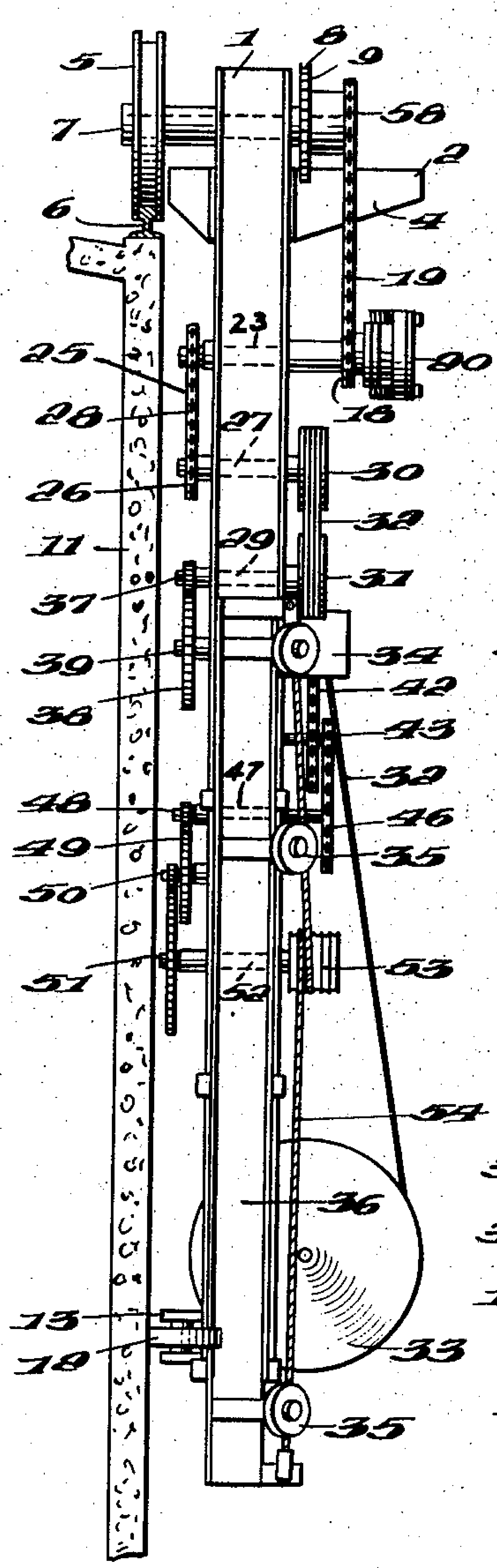
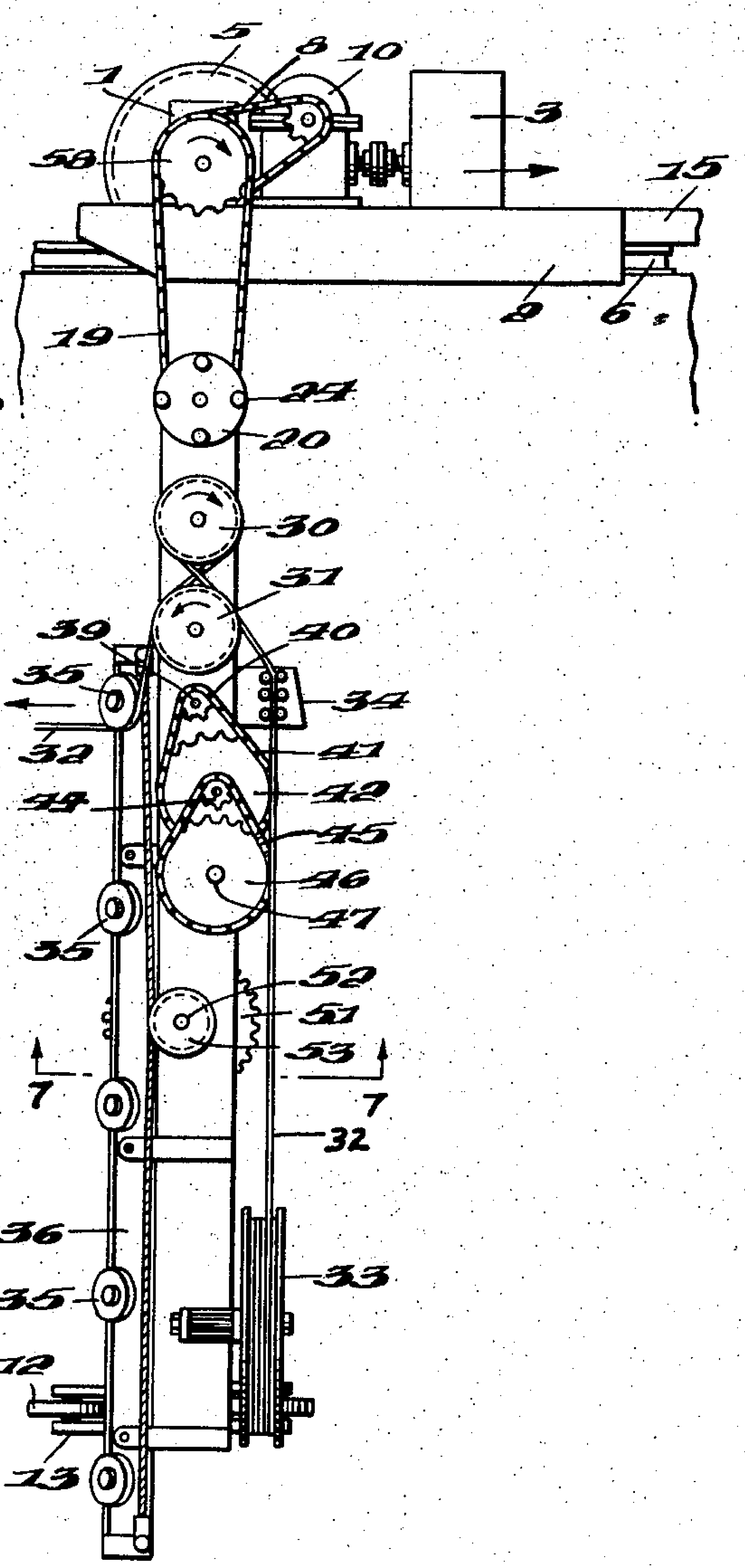


Fig. 1.



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APPARATUS FOR WIRE WINDING OF TANKS, TUBES AND THE LIKE

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Fig. 3.

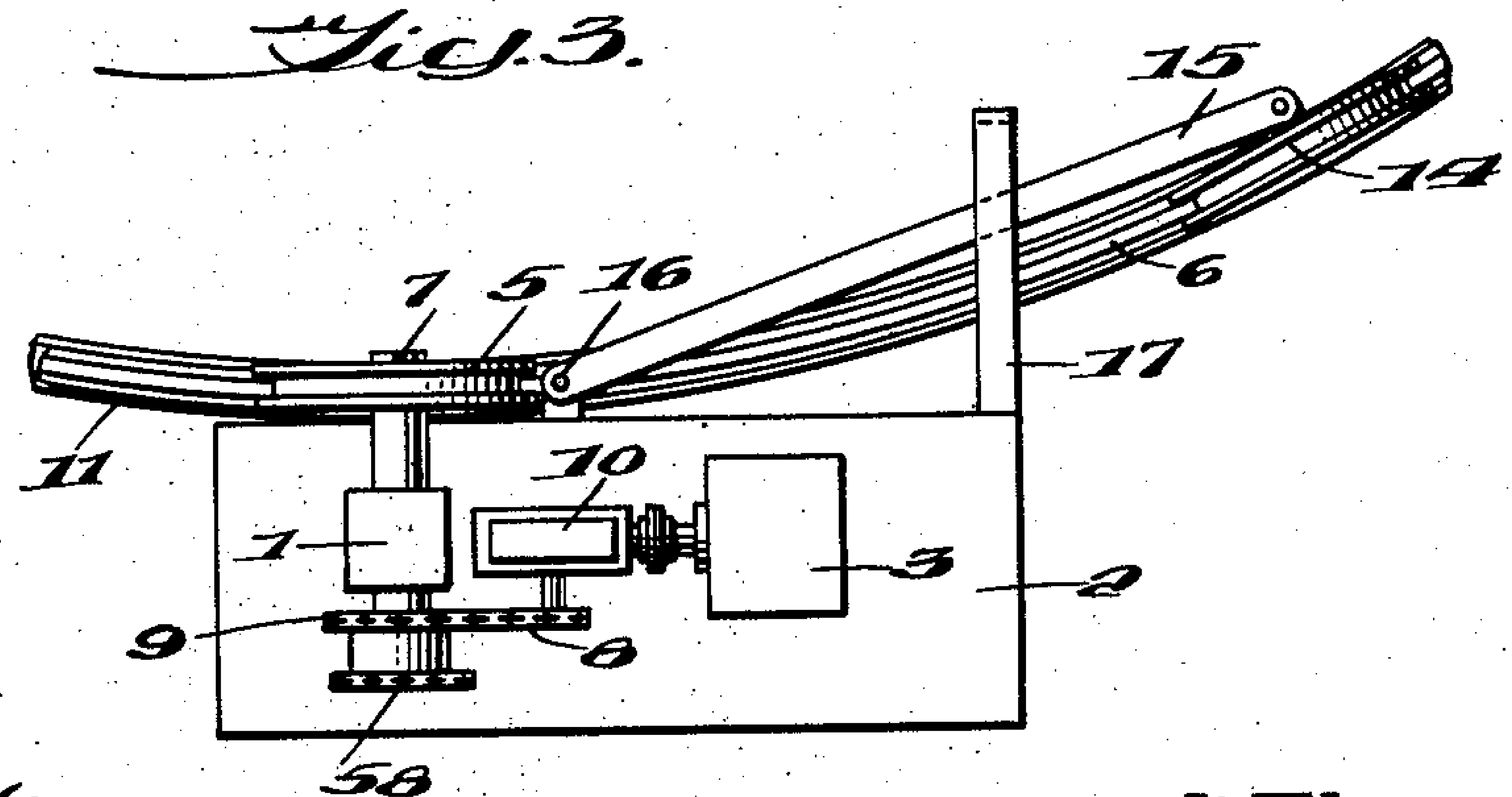

Fig. 4.

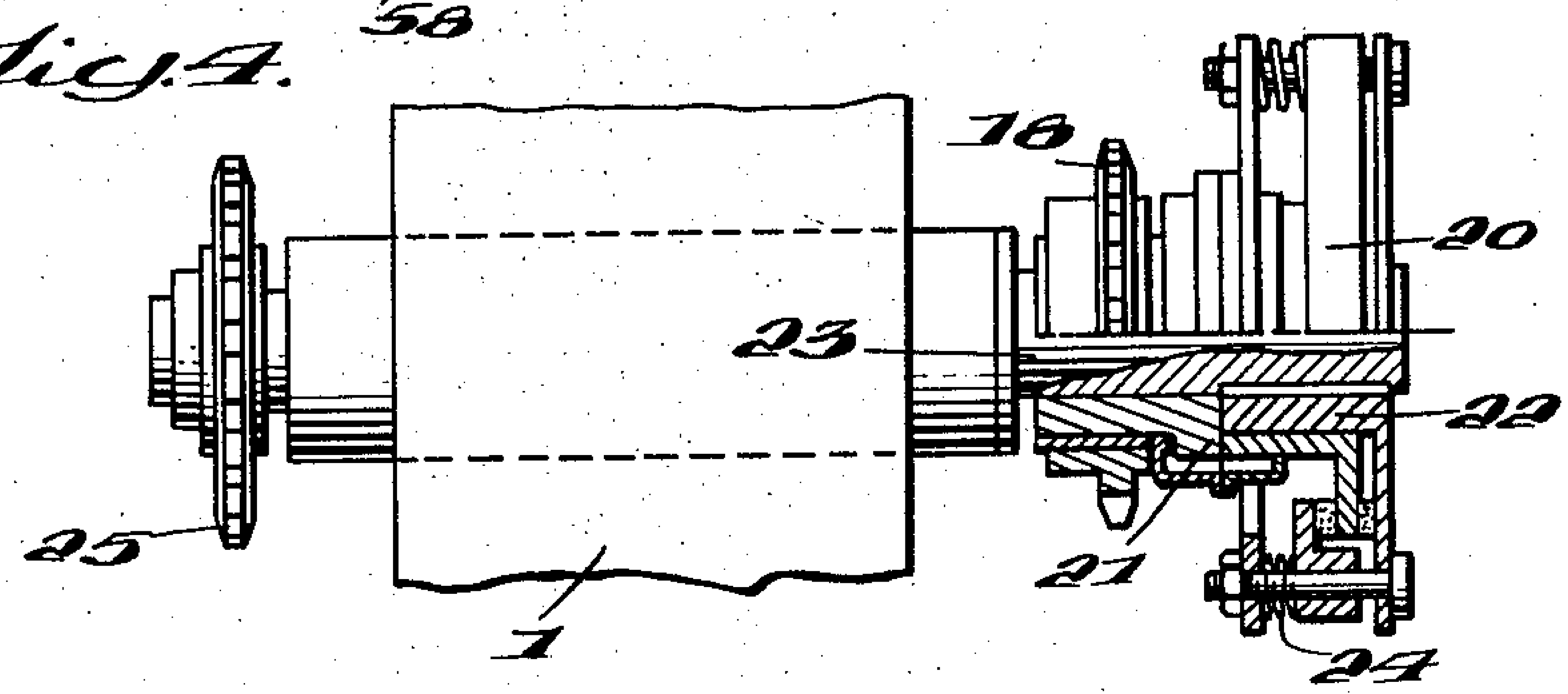

Fig. 7.

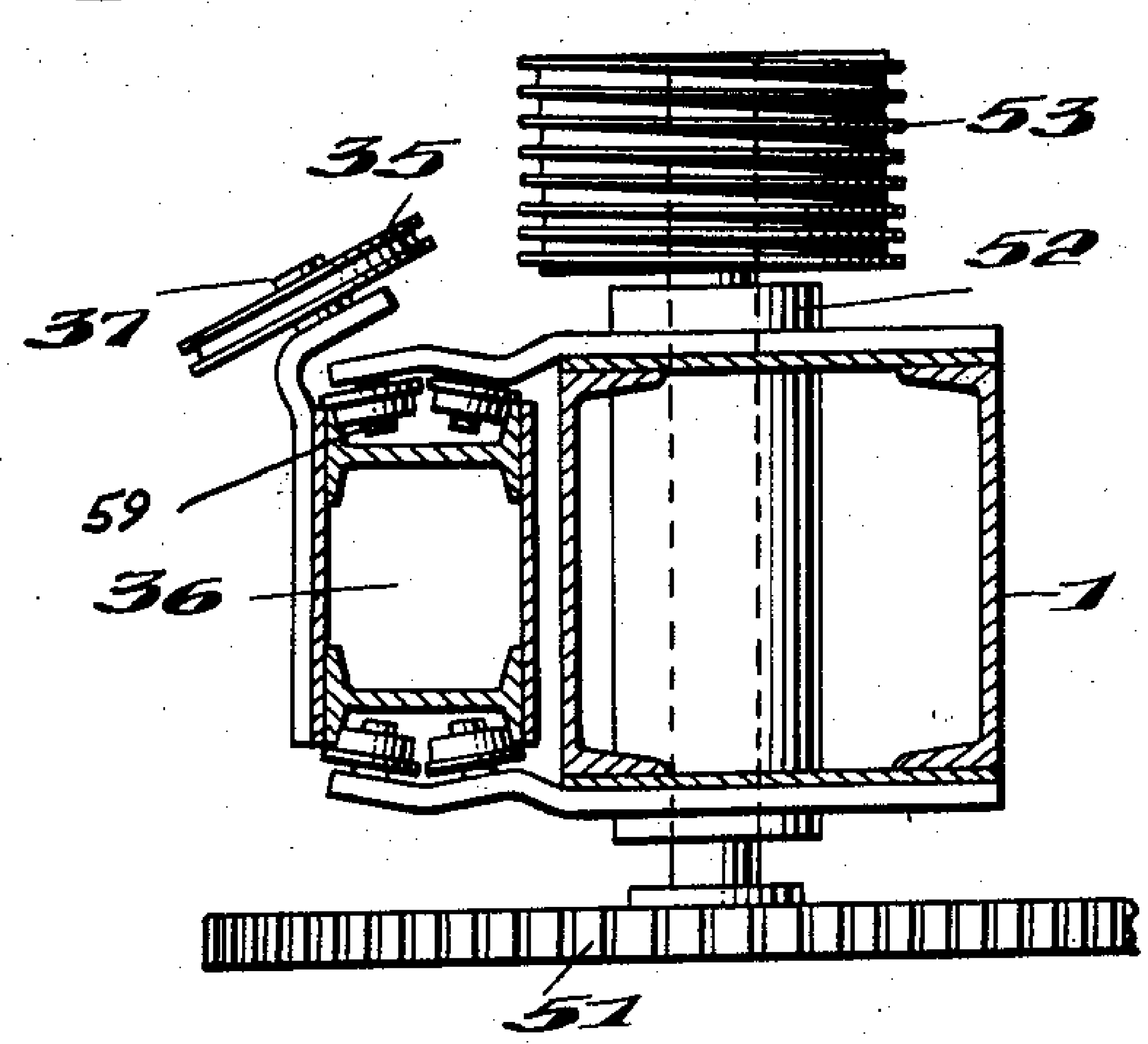

Fig. 6.

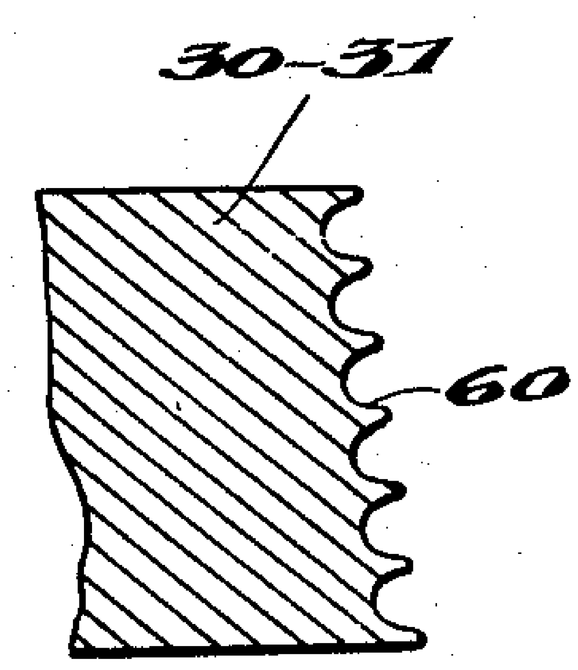

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Fig. 5.

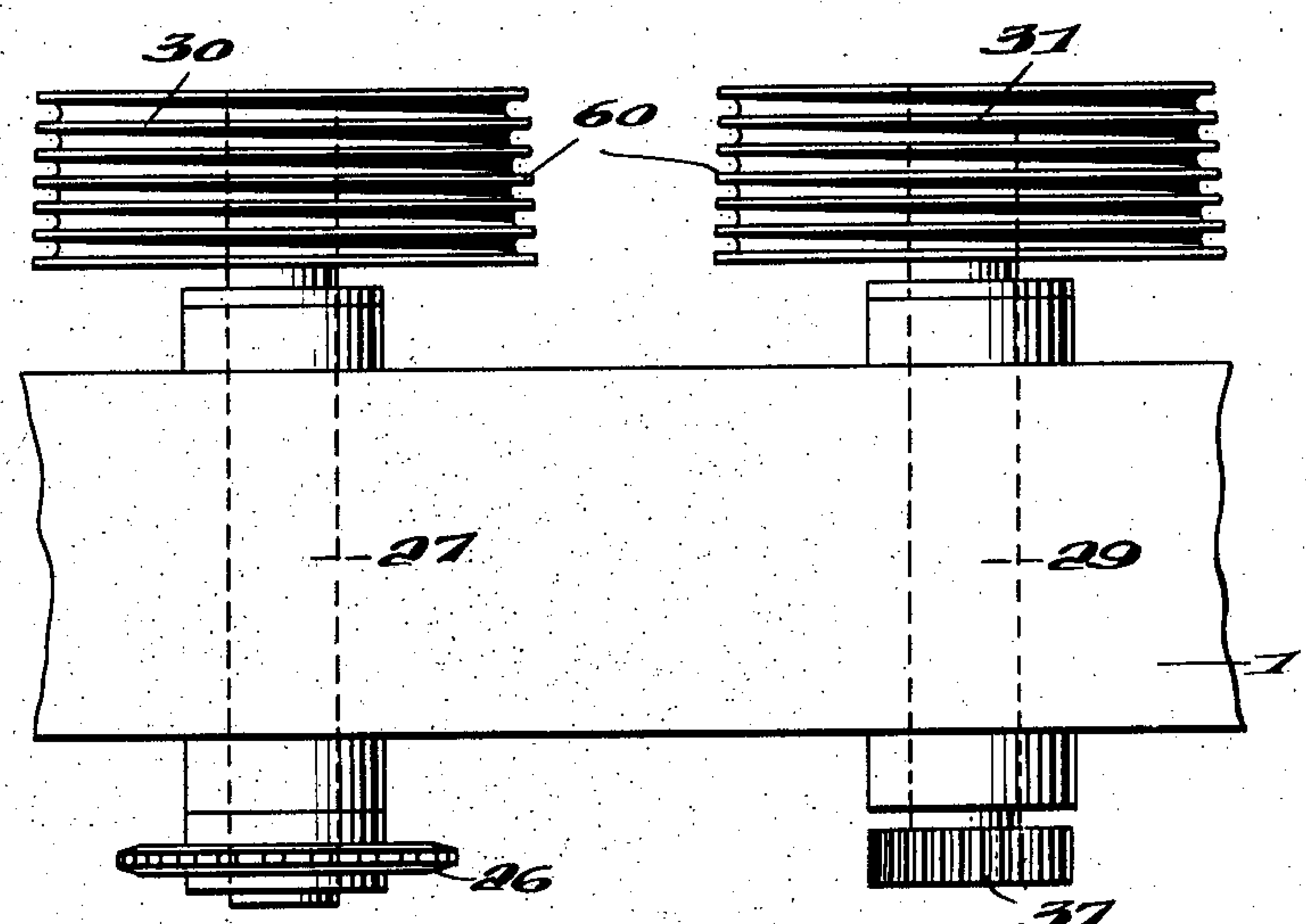
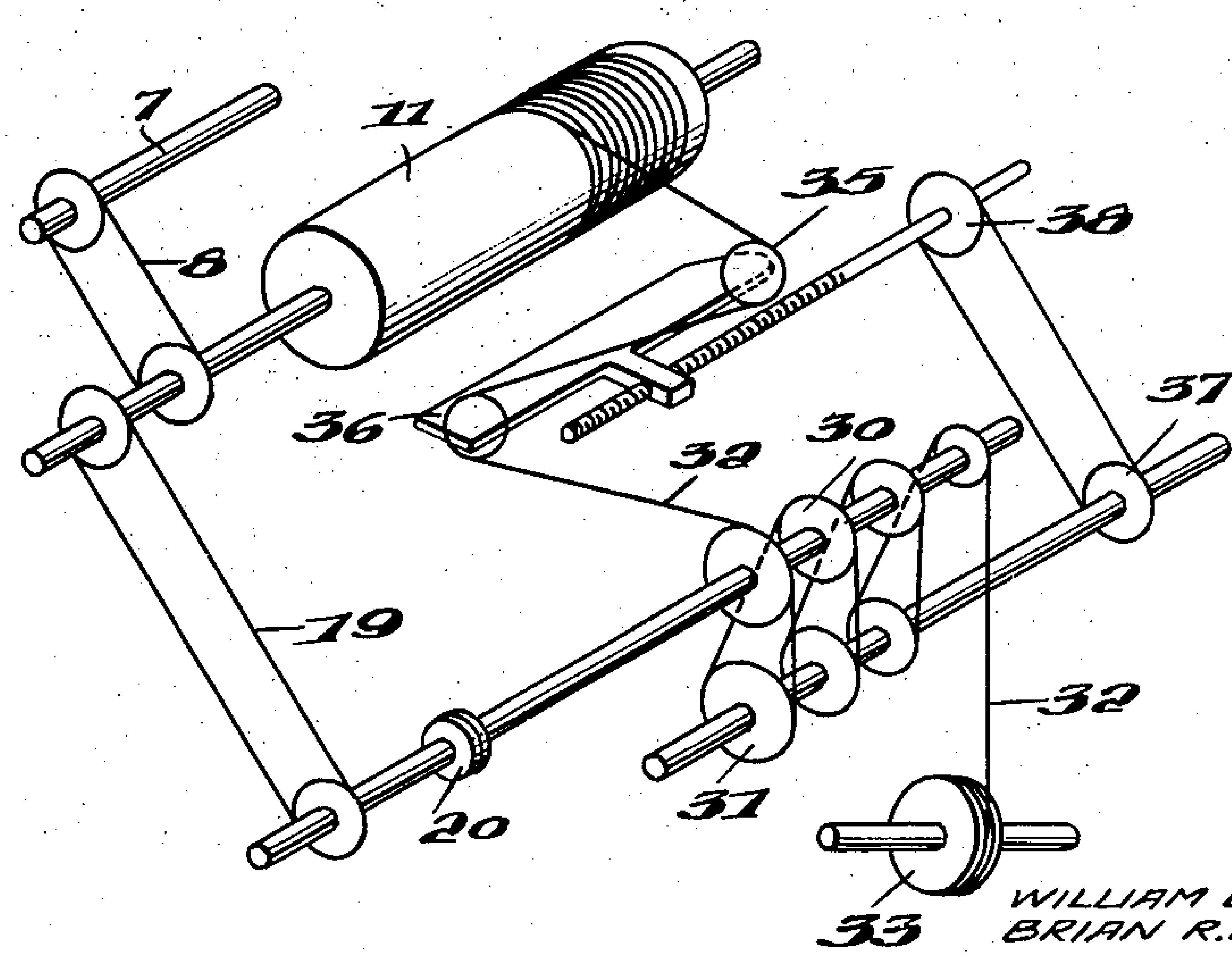


Fig. 8.



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APPARATUS FOR WIRE WINDING OF TANKS, TUBES AND THE LIKE

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2 Claims. (Cl. 242—7)

This invention relates to apparatus for wire winding of tanks, tubes and the like for the purpose of reinforcing and compressing the walls thereof.

The distinction between tanks and tubes for the purpose of this application is that normally tanks are too large to be rotated, they must rest on their own foundation and the winding apparatus must travel around it. A tube on the other hand is of such a size that it is more conveniently wound by rotating it on its axis as in a lathe or by revolving it on rollers as in certain types of circular dryers. The winding apparatus paying out the wire will then be fixed. The relative motion is the same in each case and the improvements hereinafter described could be applied to either with slight modifications in detail.

The invention consists essentially in the provision of a self-contained apparatus which when properly adjusted for speed of travel and for tension of wire will operate to wind a wire spirally or in any other regular pattern on the wall of a tank or tube at a predetermined spacing or pitch of spiral: at the tension required, and in which, so long as the drive is applied and the wire payed out, the operation of winding will continue automatically.

The tension and stretching of the wire is obtained by means of a novel stretching device wherein the wire is gradually stretcher over a considerable length rather than locally as in a die or direct friction brake. The longitudinal stretching resulting in a more uniform quality of wire which, in conjunction with the tension control, can be wound on a tank at considerable higher speeds than is at present permissible and with less chance of breakage of the wire.

One form of the apparatus hereinafter described in greater detail, consists of a winding unit completely self-contained, which can be mounted on or at the side of tanks of varying character. It comprises a main column supporting or carrying a prime mover of any desired or suitable type. The prime mover drives the winding unit around the wall of the tank and the tensioning is effected by the drag of the wire payed out as the apparatus is rotated about the tank.

The apparatus includes a drive engine which is directly coupled to a wheel which rides on the upper surface of the tank to drive the winding unit around the tank. The drive engine is also coupled with a sheave upon which the wire is wound so that the wire is payed out from the coil over the sheave to the tank. As the engine drives the wheel to move the apparatus around the periphery of the tank, the sheave will also be rotated to pay out a given amount of wire. By suitably selecting the diameters of the drive wheel and the sheave and the drive ratio between these two rotatable members, it can be seen that the apparatus can be adjusted so that for a given movement of the apparatus around the tank, less wire will be payed out and consequently the wire must be stretched and tensioned in order to compensate for the difference in peripheral distance travelled by the drive wheel and the sheave. There is provided a friction clutch or coupling between the drive engine and sheave which can be adjusted so as to slip in the event that excessive tension is created in the wire.

The apparatus for wire winding of tanks disclosed herein possesses a number of advantages over prior art devices designed for a similar purpose. The primary advantage in this apparatus is that a uniform tensioning throughout the length of the wire is assured. The desired tension may be predetermined by preselecting the diameters of the driving wheel and the sheave and presetting the drive ratio between these two elements and by adjustment of the slip coupling. Once these adjustments are made, assurance is given that the correct tensioning will be uniformly applied throughout the spiral winding. Furthermore, the presently disclosed apparatus requires less power for operation than similar prior art devices.

A primary object of the invention is to provide an apparatus for tensioning wire to strengthen and compress the walls of tanks or tubes wherein the wire is uniformly tensioned throughout the length thereof.

A further object of the present invention is to provide an apparatus in which a minimum power is used to tension wire on a tank with a minimum degree of friction losses.

Still another object of the present invention is to provide a wire winding device which is adaptable to any diameter of tank and which can be made readily adjustable to suit any variation in wire size and degree of tension required.

These and other objects will be more readily understood from the following detailed specification of which the following drawings are a part.

Fig. 1 is a vertical elevation looking in the front face of the apparatus;

Fig. 2 is a vertical elevation looking on the side of the apparatus and showing it mounted on the wall of a tank;

Fig. 3 is a plan view of the apparatus showing the main drive and the self-aligning guide wheel;

Fig. 4 is a partial sectional detail of the slip coupling assembly and showing the two drive sprockets;

Fig. 5 is a side view of the tensioning and stretching device;

Fig. 6 is a fragmentary enlarged sectional detail of a tensioning and stretching sheave showing the step-by-step enlargement of the diameters of the grooves;

Fig. 7 is a sectional detail of the apparatus on the line 7—7 of Fig. 1 showing the mounting of the sliding carriage in the apparatus; and

Fig. 8 is a diagrammatic illustration of the apparatus showing the essential elements only and the drive connections to and from these elements.

Referring to the drawings, the main framework of the device consists of a vertical column **1** of suitable section and strength to support the working equipment to be mounted on it and to take care of the stresses imposed upon it under maximum working conditions. Secured to the column **1** at a position near its top is the horizontal working platform **2** (Fig. 3) which is sufficient in area to have mounted on it the prime mover **3**, which can be of any suitable type and is hereinafter referred to as the drive engine. The platform is suitably braced to the main column **1** by the brace **4**.

As shown in Fig. 2 of the drawings, the vertical column **1** is supported on the top of the side wall of a tank **11** through the flanged drive wheel **5** running on the rail **6** concentric with the wall of the tank **11**. The drive wheel **5** is keyed to the shaft **7** supported in the head of the column **1** and is driven by the chain **8** and sprocket **9** from the reduction gear unit **10** which in turn is directly connected to the drive engine **3**. While the top end of the column **1** is supported on the top of the tank, the bottom end of the column **1** is held parallel with the wall of the tank **11** and in spaced relation thereto by means of the guide wheels **12** supported on the horizontal transverse bracket **13**. The above described structure forms the complete working base for the self-contained wire winding apparatus. The flanged drive wheel **5** insures that once the unit is placed on the rail track it will remain thereon and will be constrained to run on the rail at all times. However, in order to insure that the wheel **5** and the column structure **1** will not twist about the axis of the column when the drive is applied, a guide wheel **14** (Fig. 3) is pivotally fitted in the end of the boom **15** which in turn is pivoted on the horizontal platform **2** at a point **16**. A guide bar **17** limits the horizontal travel of the boom **15** and supports it vertically, but within this limit the guide wheel can be aligned on the rail **6** over a wide range of diameters of rail track and diameter of tank. While the above description concerns a unit suspended from the top of a tank, the complete unit could as before mentioned be reversed and the rail be on the ground and requiring only a simple guide wheel at the top of the tank; also another such guide wheel could run on the inside of the tank wall **11**, or a pivoted structure mounted in the center of the tank could guide the column **1** around the tank.

Having now described the base unit and the manner of its mounting on a tank, the details of the drive to the wire and the means to stretch and tension the wire, together with the means for setting the pitch of payout of the wire on the tank will be described in detail. As above described, the drive from the engine **3** is through the reduction gear unit **10** to the chain **8**, sprocket **9** and to the shaft **7**. The shaft **7** is provided with a second sprocket wheel **58** which drives the sprocket wheel **18** through the drive chain **19**. This sprocket wheel **18** is keyed to the inner half **21** of the friction coupling **20**. Sprocket wheel **18** and the inner half of the friction coupling **20** are rotatably journaled on a shaft **23** which is mounted in bearings on the column **1**. The shaft **23** is rigidly connected with the outer half **22** of the friction coupling **20**. The coupling **20** can be of any suitable type and is here shown as being of the friction plate type wherein the amount of friction between the plates may be adjusted by adjustment of the screws **24**. Thus, under light load conditions sprocket **18** will drive the inner half of the coupling which will in turn drive the outer half of the coupling and shaft **23**. Under excessive load conditions on shaft **23** the inner and outer portions of the coupling will slip.

As shown in Fig. 2 the shaft **23** has a sprocket **25** keyed to the outer end thereof. This sprocket drives a sprocket **26** through chain **28**. Journaled on column **1** is a shaft **27** having sprocket **26** keyed on one end thereof and sheave **30** on the other end. A second shaft **29** is journaled in column **1** below shaft **27** and is provided with a sheave **31** rigidly mounted on one end thereof and gear **37** keyed to the other end.

The sheaves **30** and **31** are provided with grooves **60** as clearly shown in Fig. 5. These grooves are of constantly increasing diameter for a purpose which will become more fully apparent hereinafter.

The gear **37** engages a gear **38** journaled on shaft **39** which has a sprocket **40** mounted on the other end thereof as shown in Fig. 1. This sprocket drives shaft **47** through chain **41**, sprockets **42** and **44** mounted on shaft **43**, chain **45** and sprocket **46**. Shaft **47** has gear **48** fixed to the opposite end thereof as shown in Fig. 2 and this gear drives shaft **52** through drives **49**, **50** and **51**. Mounted on shaft **52** is a spirally grooved pulley **53**.

As shown in Fig. 7, column **1** is provided with a plurality of rollers **59** which are disposed along the length thereof to support frame **36** for vertical sliding movement therein. The frame **36** has a plurality of arms fixedly mounted thereon on which are rotatably mounted pulleys **35**. It can be seen in Fig. 2 that there are provided three such rollers **35**. Rigidly secured to each end of the vertically movable frame **36** is a rope **54** and this rope **54** is wound around the spirally grooved pulley **53** as shown. It can be seen that rotation of the pulley **53** will cause vertical movement of the frame **36** with its pulleys **35**.

Mounted on the column **1** adjacent the sheaves **30** and **31** is a braking device **34** which comprises a plurality of friction blocks through which the wire passes. The coil of wire **33** is rotatably mounted on the supporting column and the wire passes from this coil through the braking device **34** and is wrapped around the sheaves **30** and **31** in such a manner that the wire passes from the coil first over the smaller diameters on the sheaves onto the larger diameters on the sheaves. The wire is then fed over the guide pulleys **35** as shown in Figs. 1 and 8 and is payed out from these pulleys onto the tank which is to be wound by the wire.

The wire winding apparatus disclosed herein is operated in the following manner. The wire on the coil is fed through the braking device, over the sheaves and through the outlet pulleys **35** in the manner previously described. The end of the wire is then anchored on the tank. The drive engine **3** is then energized to cause the drive wheel **5** to traverse the upper periphery of the tank. Simultaneously, the drive motor will rotate sheaves **30** and **31** to pay out the wire **32**. The diameters of drive wheel **5** and sheave **30** and the drive connection between the motor **3** and sheave **30** are such that the length of wire payed out is not as great as the distance traversed by the wheel **5**. Consequently, the wire is stretched and tensioned automatically as the apparatus moves forwardly. The brake **34** provides a snubbing action on the sheaves **30** and **31** in order to prevent the wire from simply slipping around the sheaves. Theoretically, it would be possible to use a single sheave but it has been found in practice that a more uniform action is assured through the use of the pair of sheaves having increasing diameters.

It is apparent from Fig. 1 that the tension in the wire **32** will tend to rotate the sheaves in the same direction as the motor **3** tends to turn these sheaves. This component of the tension in the wire brings about a reduction in the amount of power required to operate the apparatus. That is to say, less power is required to wind a tank with wire at a given tension with the presently disclosed apparatus than with similar devices in which friction blocks or the like are used to produce the tension.

Theoretically, it would be possible to provide an apparatus in which the drive ratio between the sheave and drive wheel and the diameter of these elements could be so related as to predetermine the exact tension produced in a line for a given tank. Assuming a perfectly shaped structure, this tension would be uniformly applied throughout the length of the wire. However, as a practical matter, tanks are not perfectly shaped and certain areas will have diameters which may vary considerably. Consequently, the diameters of the drive wheel and the sheave and the drive connections between these elements are so related as to produce a tension greater than that desired. The friction coupling **20** is then set to slip at the desired final tension and thus, assurance is given that the wire will be uniformly tensioned even though the diameter of the tank varies within rather large limits. As the wire traverses the tank over an area of normal tank diameter or over an area of greater than normal tank diameter, the friction coupling **20** will slip to prevent greater tension than that desired whereas in areas of less than normal tank diameter the coupling will slip to a lesser degree or perhaps will not slip at all.

As the wire is payed out over the pulleys **35** these pulleys are being moved upwardly by vertical movement of the column 36 through the drive connection between pulley 53 and rope 54. When the lowest pulley 35 moves upwardly to the point where the second lowest pulley was originally located, the apparatus is stopped and the wire 35 is anchored to the drum and removed from the lower pulley 35. The column 36 is then lowered to its original position and the wire is passed over the second pulley 35 and the operation is resumed. Thus, the wire may be spirally wound around the tank without the need for a lead screw of a length equivalent to the height of the tank. It can be appreciated that the drive connection to the pulley 53 may be varied so as to produce any desired rate of vertical ascent of column 36 in relation to the forward movement of the apparatus around the periphery of the tank. If the diameter of the tank be large, then the drive to the sliding carriage 36 will be slower than if the diameter of the tank is small. The larger the diameter of the tank, the longer it will take for the sliding carriage to travel the single pitch step required for the proper laying of the wire on the tank wall.

Obviously, there are other factors which are considered in making the various adjustments in order to produce the desired tensioning in the wire. Such factors include the modulus of elasticity of the wire and the size of the wire utilized. Such factors are obvious to those skilled in the art and it is not believed necessary to set forth such details herein. It will be evident, however, that the presently disclosed apparatus may be readily altered to suit various operational requirements without in any way affecting the basic principles involved in providing a structure for creating uniform tension.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. What is claimed as new and desired to be secured by Letters Patent is:

1. An apparatus for winding, stretching and tensioning a reinforcing wire around the outer circumferential surface of a cylindrical object comprising a frame vertically disposed adjacent the outer circumferential surface of the object, a driving wheel mounted on said frame and engaging the upper surface of said cylindrical object, a guide

wheel mounted adjacent the lower edge of said frame and engaging the outer circumferential surface of the object, said driving wheel and said guide wheel constituting the sole supporting means for said frame on the object, drive means connected with said driving wheel for driving said frame around the outer surface of the object, a wire stretching device including a wire reel mounted on said frame and at least a pair of sheaves, the wire from the reel being passed around the sheaves and onto the cylindrical object, said sheaves having a plurality of grooves therein of diameters increasing from the groove over which the wire from the reel is threaded to the groove from which the wire passes to the cylindrical object whereby the wire is uniformly tensioned by said pair of sheaves, a driving connection including an adjustable slip clutch between said drive means and one of said sheaves, said driving connection including means for rotating said one sheave to pay out lengths of wire less than the distance that the rotation of the driving wheel moves the frame around the cylindrical object to further tension the wire, and means for spacing the turns of the wire uniformly over the surface of the object, said last-named means being driven by rotation of the other of the sheaves by movement of the wire as it is payed out onto the cylindrical object.

2. An apparatus according to claim 1 wherein said last-named means includes a carriage slidably mounted on said frame and a plurality of guide pulleys spaced on said carriage, the wire being selectively laid over each of said guide pulleys as the sliding carriage is advanced along the frame.

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