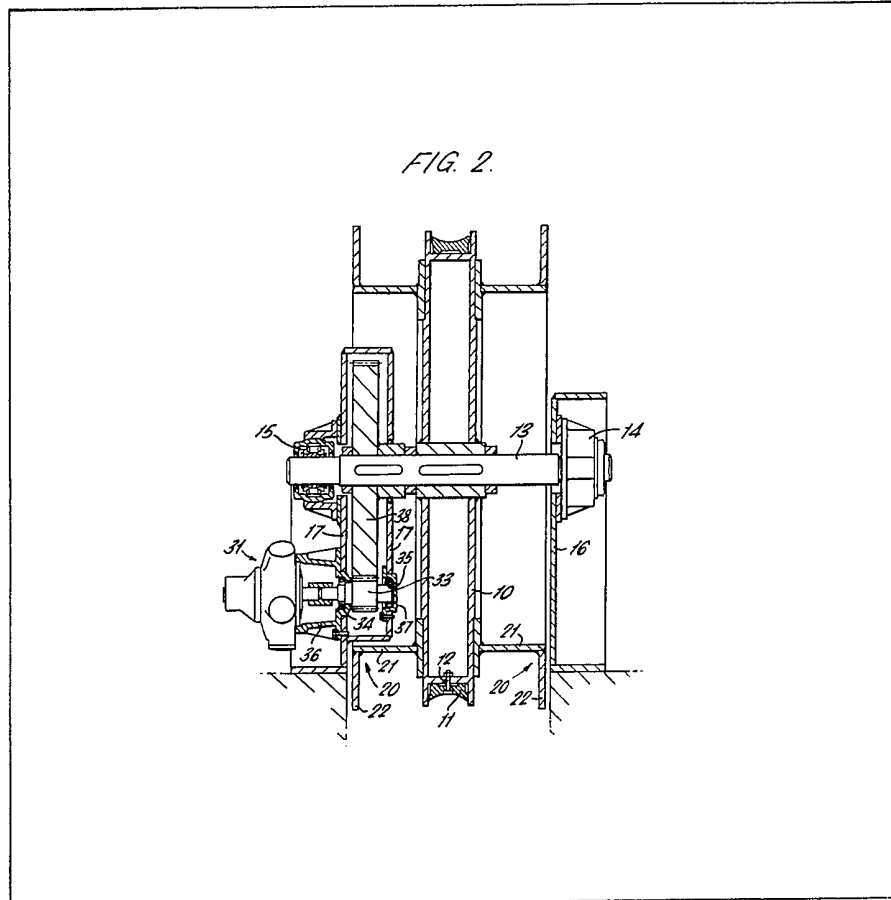


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(54) **Improvements in or relating to rope driving apparatus**

(57) Rope driving apparatus comprises a rope wheel (10) supported on support means (16,17) for rotation about a fixed axis and braking means (20), for braking the rope wheel located at or adjacent the periphery of the rope wheel on each side thereof. A gearbox is located on one or both sides of the rope wheel, and motors (31) are associated with each gearbox for driving the rope wheel through the associated gearbox, at least a part of the gearbox being received within the space of the braking means.



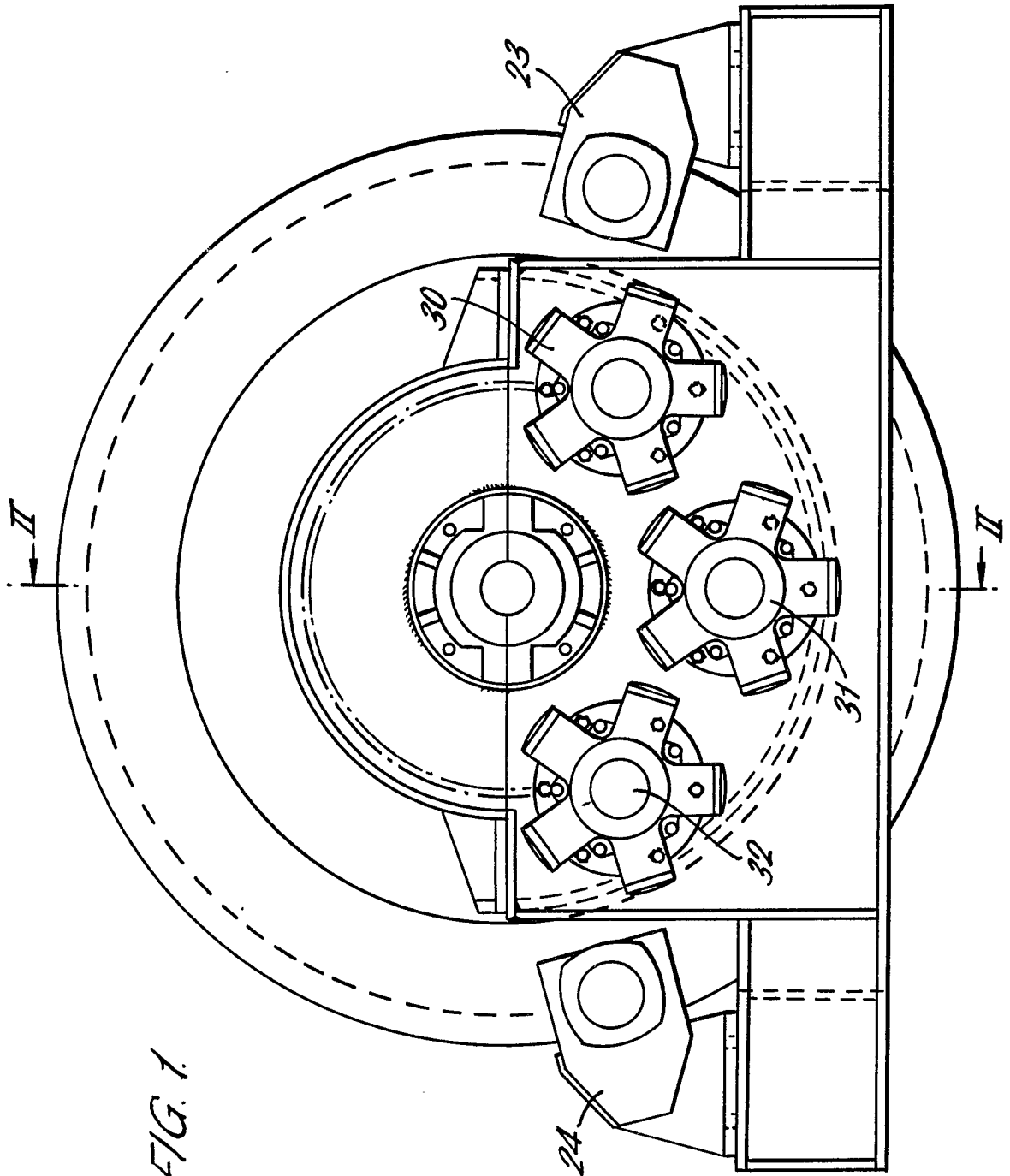


FIG. 1

FIG. 2.

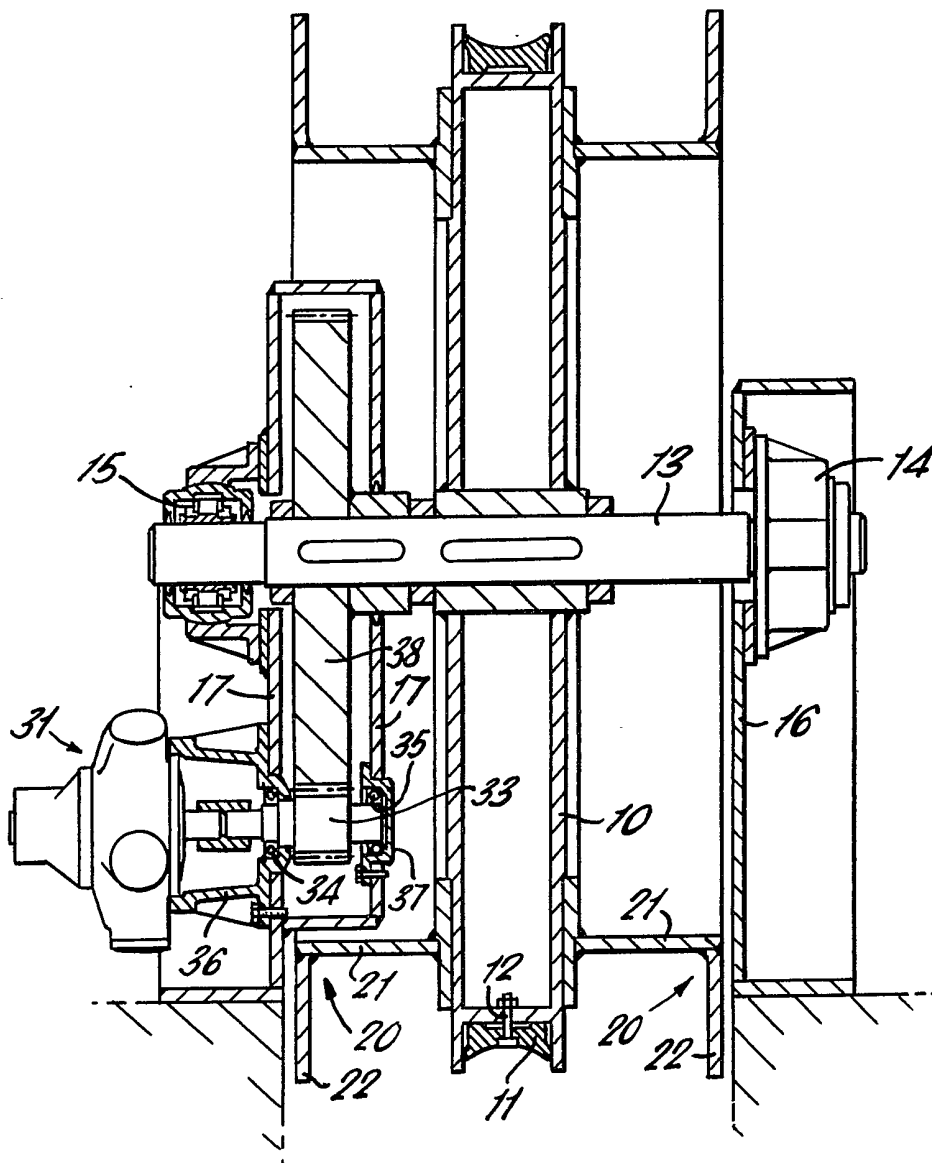
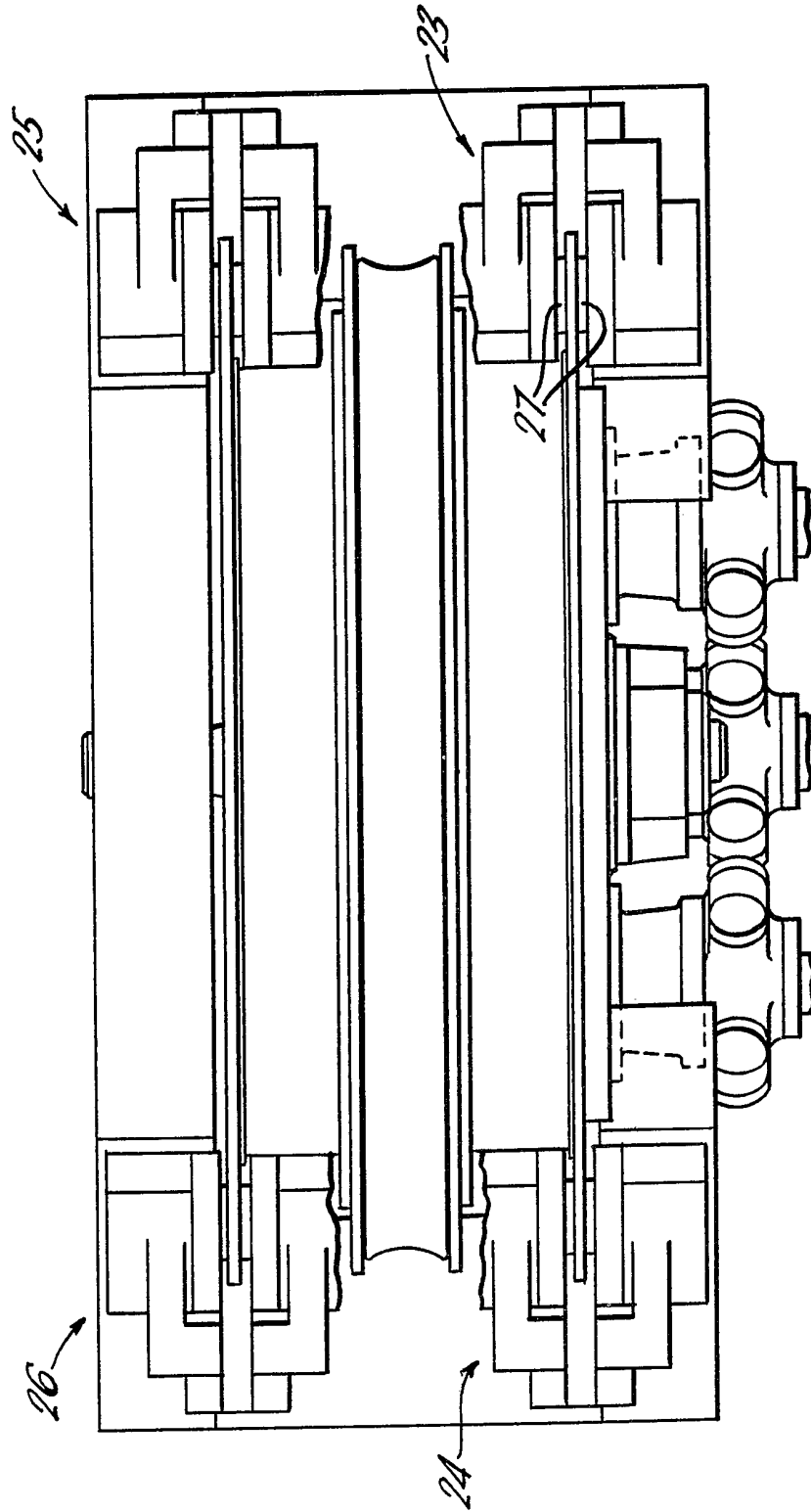
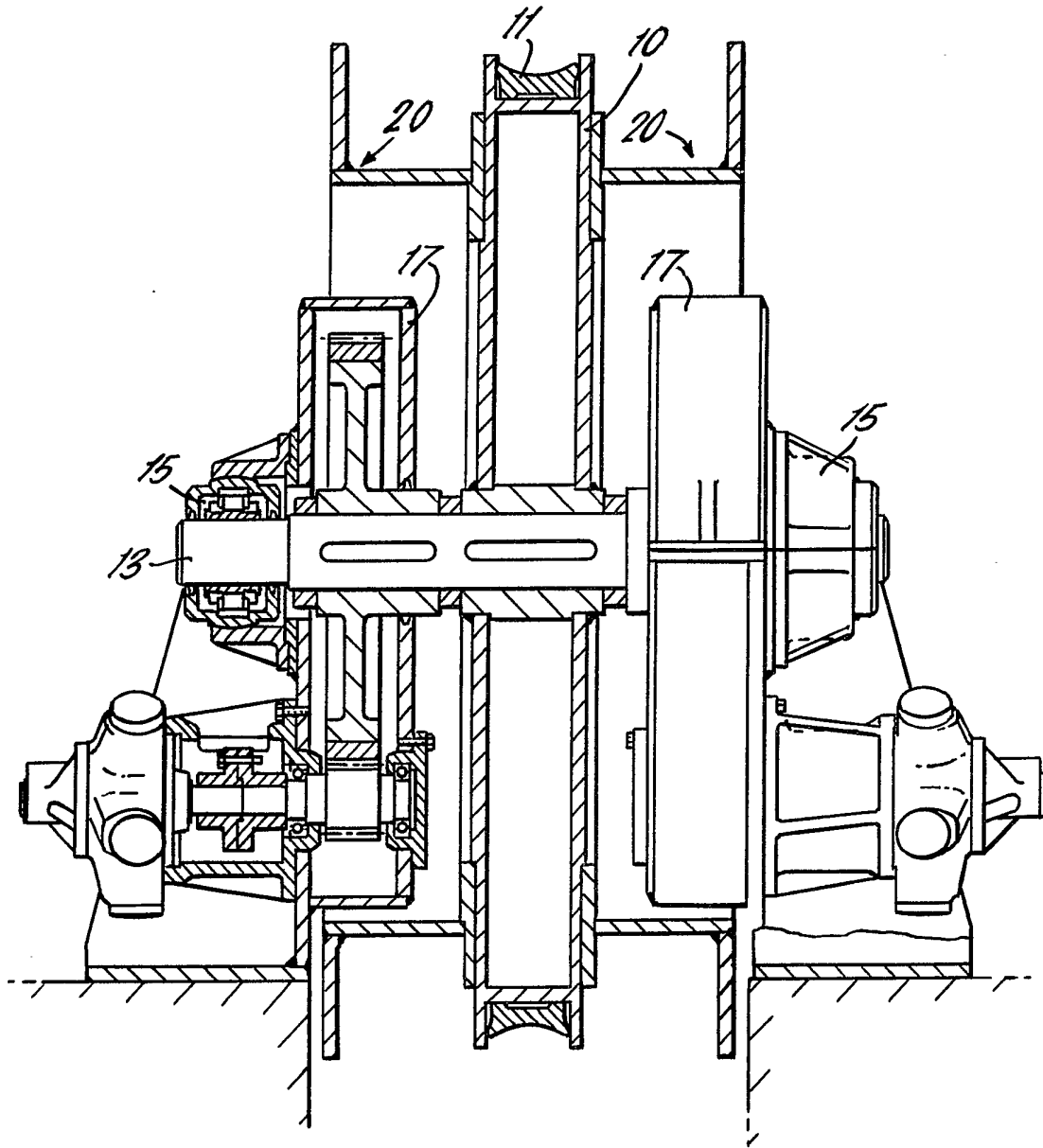


FIG. 3.



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FIG. 4.



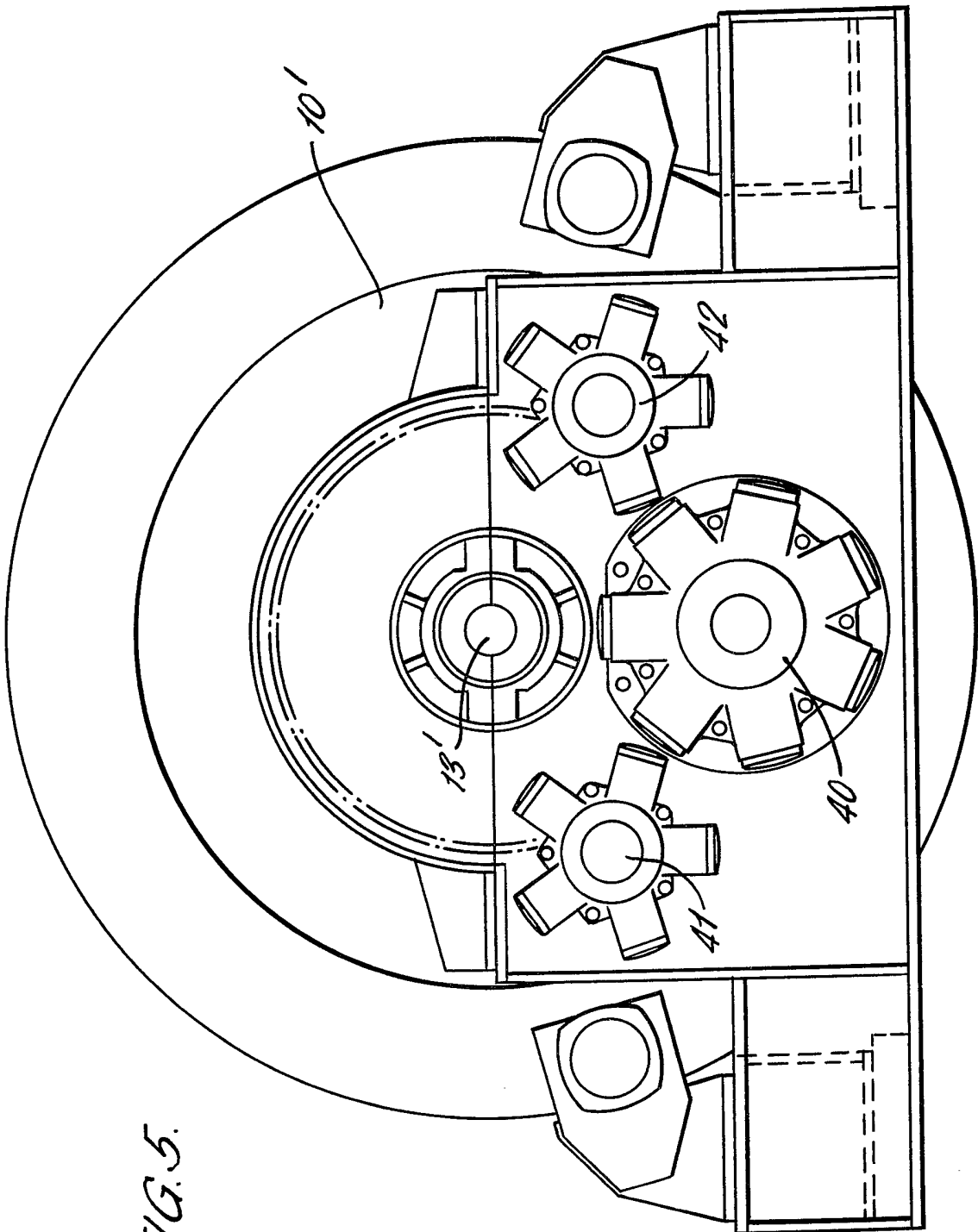


FIG. 5.

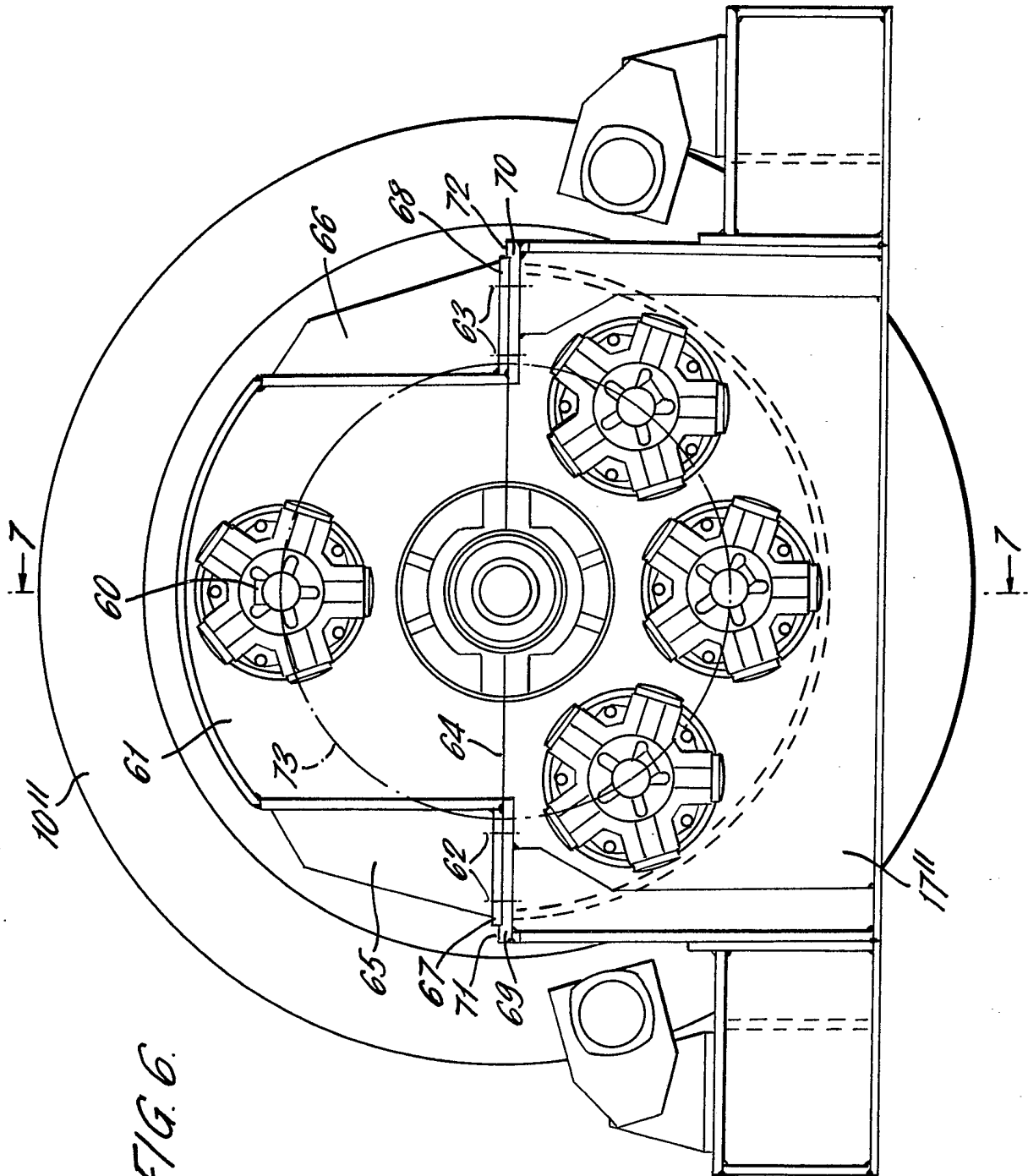
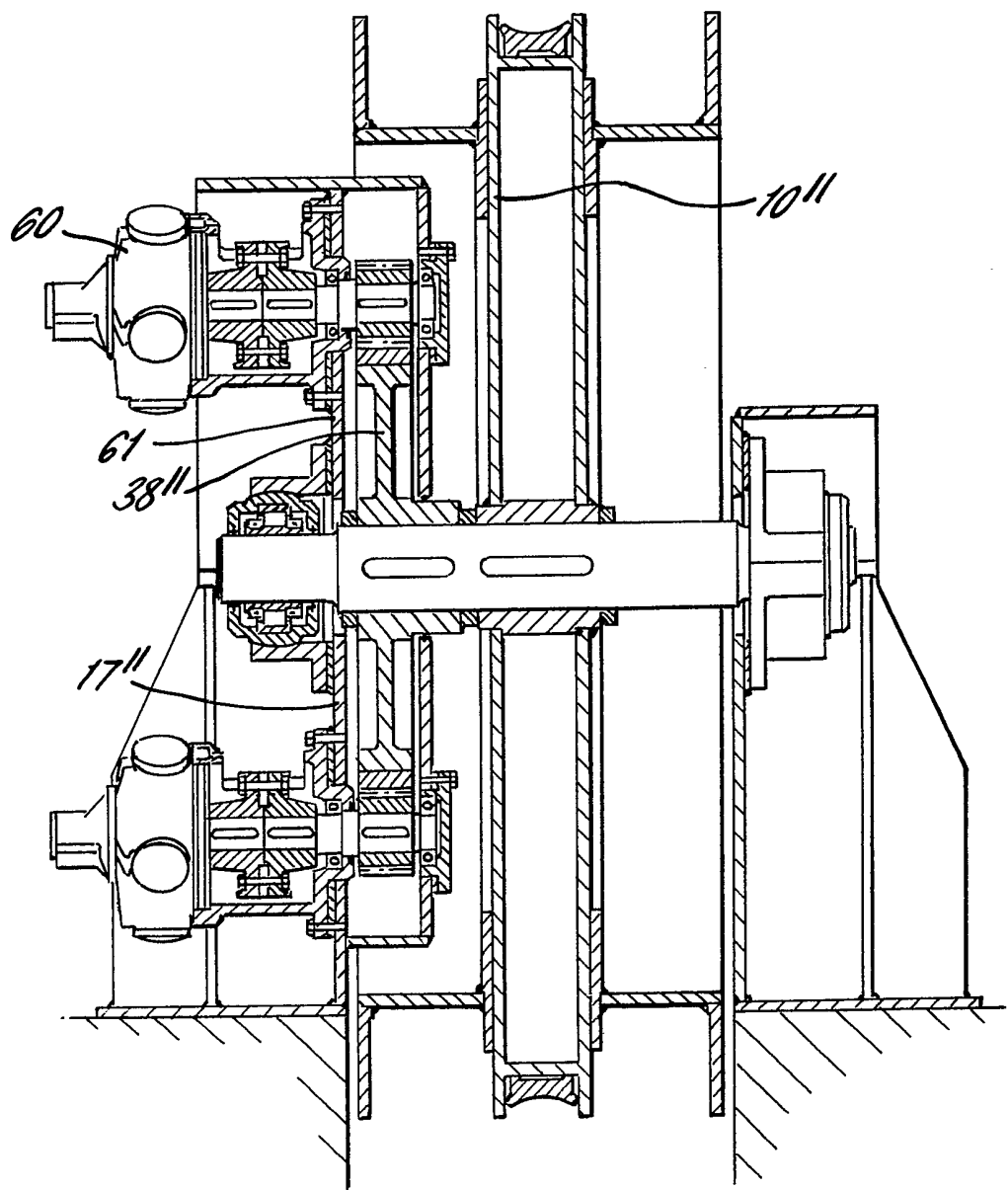


FIG. 6.

FIG. 7.





## SPECIFICATION

**Improvements in or relating to rope driving apparatus**

5 The invention relates to rope driving apparatus, for example haulages, winches or hoists in which rope is driven by a rope wheel, surge wheel, drum or the like around which the rope is at least partly wound.

10 The term "rope wheel" used herein will include within its scope surge wheels, drums or the like.

According to the invention there is provided rope driving apparatus comprising a rope wheel, two side frames one on either side of the wheel for supporting the rope wheel for rotation about a fixed axis, driving means for the wheel, and braking means for the wheel associated with a cylindrical structure attached to one side of the wheel and coaxial therewith, in which the driving means comprises a circumferentially toothed gear wheel positioned between the rope wheel and one side frame and fixed for rotation coaxially with the rope wheel, at least one hydraulic motor attached to the said one side frame and driving a pinion in peripheral driving engagement with the gear wheel to rotate the rope wheel, the gear wheel and pinion and the structure being on the same side of the wheel and the gear wheel and pinion being received at least partly within the structure.

30 The or each motor is preferably a hydraulic motor, although other types of motors, such as electric motors, may be used. One or more hydraulic motors may be of variable displacement to provide different speed ranges for the rope wheel.

35 The cylindrical structure preferably comprises a cylindrical element attached to one side of the rope wheel, an annular element extending radially outwardly from the cylindrical element, and means fixed relative to the support means and movable into and out of frictional engagement with one of said elements. There are preferably friction lined plungers of a caliper unit movable into and out of frictional engagement with the annular element. Alternatively, braking may be effected by friction linings or the like acting on the cylindrical element.

45 The rope wheel is preferably mounted on and rotatable with a shaft supported on two bearings, one on each of the side frames. The gears preferably have a casing formed at least partly by the said side frame.

50 Preferably a sub-frame carrying at least one hydraulic motor is attached to the said side frame and means are provided to ensure alignment of the sub-frame and hence the hydraulic motor on the sub-frame with the axis of rotation of the gear wheel.

By way of example, four embodiments of apparatus according to the invention will now be described with reference to the accompanying drawings, in which:-

60 *Figure 1* is a side view of a haulage rope driving apparatus;

*Figure 2* is a view along the line II-II of *Figure 1* but with only one hydraulic motor being shown;

65 *Figure 3* is a plan view of the apparatus of *Figures 1* and *2*;

*Figure 4* is a sectional view of a second embodiment of a haulage rope drive apparatus;

*Figure 5* is a side view of a third embodiment of a haulage rope drive apparatus;

70 *Figure 6* is a side view of a further embodiment; and

*Figure 7* is a sectional view on the line 7-7 of *Figure 6*.

75 *Figures 1* to *3* show a rope drive apparatus for a rope haulage. Such rope haulages are used, for example, for transporting personnel or materials in mining operations.

A rope wheel 10 is provided with concavely surfaced outer segments 11 around which the haulage rope is to be wound. The segments 11 are secured to the rope wheel 10 by bolts 12. It will be appreciated that the segments may be replaced by frictional inserts for less than one turn of rope, and also that the concave surface of the outer segments 85 may or may not be symmetrical.

The rope wheel 10 is mounted coaxially on and fixed for rotation with a shaft 13. The shaft 13 is rotatably supported at each end by bearings 14, 15 and the bearings 14 and 15 are supported on side frames 16 and 17 respectively, the frame 17 also providing a gearbox casing.

90 Braking members 20 are secured to each side of the rope wheel 10. The braking members 20 comprise a cylindrical element 21 attached to the periphery of and coaxial with the rope wheel 10 and an annular element 22 extending radially outwardly of the cylindrical element 21. Hydraulically, or alternatively pneumatically or electrically operated calipers 23, 24, 25, 26 are movable into frictional engagement with associated annular elements 22 to brake the rope wheel. The calipers each have friction pads 27 as shown in *Figure 3*. Alternatively, the cylindrical elements 21 may be used to provide a braking surface against which part cylindrical friction linings 105 may be applied in order to achieve braking of the rope wheel. In such an arrangement, further support of the cylindrical portion 21 would be required, for example by struts or other angled elements extending from the rope wheel, in order to withstand the radial forces required in braking.

110 Drive of the rope wheel is provided by three hydraulic motors 30, 31 and 32 of conventional design. It will be appreciated that a different number of motors may be used and that the motors may be other than hydraulic. Each hydraulic motor drives a pinion 33 which is mounted for rotation in bearings 34, 35. The bearing 34 is supported in an element 36 secured to the combined framework and gearbox casing 17 and the bearing 35 is supported by an element 37 secured to the combined framework and gearbox casing 17.

115 Each pinion 33 is in toothed engagement with an externally toothed gear wheel 38 mounted coaxially on and fixed for rotation with the shaft 13. Accordingly, drive from one or more of the motors 30, 31, 32 causes rotation of one or more pinions 33, which in turn causes rotation of the externally toothed gear wheel 38, the shaft 13 and the rope wheel 10.

120 As can be seen clearly from *Figure 2*, the gearbox casing 37 is dimensioned so that its external dimen-

sions in a radially outward direction are less than the internal diameter of the cylindrical element 21 of the braking members 20. This enables the side frame and gearbox casing 17 to be positioned so that the majority of the side frame and gearbox casing 17 lies inside the cylindrical element 21 of the associated braking member 20 on the drive side of the gear wheel 10. This arrangement has significant advantages over previously known haulage drive apparatus of similar type in which a free standing gearbox was used, the dimensions of which were such that the gearbox had to be spaced further from the rope wheel than the braking elements.

Figure 4 shows a second embodiment of rope driving apparatus for a haulage. The embodiment of Figure 4 is designed to deal with greater rope loads than the embodiment of Figures 1 to 3 by the provision of six hydraulic motors instead of three. Further motors may be used to deal with even greater loads. As can be seen from Figure 4, the apparatus is symmetrical about the drive wheel 10, and the construction of each side is the same as the apparatus of Figures 1 to 3 on the gearbox side of the rope wheel 10.

Figure 5 shows a third embodiment of rope driving apparatus for haulage. Essentially, the apparatus of Figure 5 is the same as that shown in Figures 1 to 3 with a rope wheel 10' fixed for rotation on a shaft 13', the shaft being rotatably mounted at each end in special bearings. Braking is carried out in the same way as was described in relation to Figures 1 to 3.

However, in order to increase the flexibility of the rope drive, the lower hydraulic motor 31 of Figures 1 to 3 has been replaced by a hydraulic motor 40 which can be operated with either one of two different displacements, hydraulic motors 41 and 42 being of fixed displacement. The hydraulic motors are driven by a hydraulic power pack which provides a variable flow of hydraulic fluid to the motors to provide an infinitely variable rotational speed for the motors, and therefore of the rope wheel, up to a maximum speed limited by the maximum output of the power pack. It will be appreciated that if the hydraulic motor 40 is operating on the higher of its two displacements, that is if a larger flow of fluid is required to rotate the motor at a given speed, the maximum speed of the motor or indeed of the three motors in combination if all are driven, will be less than if the motor 40 is operating on the lower of its two displacements. Thus two speed ranges are provided for the hydraulic motor set and therefore the rope wheel, both ranges starting at zero and being infinitely variable up to a different maximum. Clearly, the torque/speed characteristic in each case will be different, more torque per unit speed being available for the speed range which has the lower maximum. Further speed ranges and alternative torque/speed characteristics can be arranged by using more than one dual displacement hydraulic motor.

Figures 6 and 7 show a third embodiment of rope driving apparatus for haulage.

Once again the apparatus is essentially that of Figures 1 to 3. However a further hydraulic motor 60 has been added, and if desired further motors could

be added on each side of the motor 60. In this way the power transmitted to the rope wheel can be increased.

The motor 60 is mounted in a sub-frame 61 which is bolted to the side frame 17" at 62 and 63. The sub-frame 61 and the side frame 17" are split along a plane 64.

A very important feature is that the sub-frame incorporates two end frames 65, 66 having bottom plates 67, 68 respectively. These bottom plates are superimposed on top plates 69, 70 forming part of the side frame 17". The top plates are machined out along the plane 64 leaving guide rails 71, 72 upstanding. Thus when the sub-frame is attached to the side frame the ends of the end frames are received in a guideway formed by the rails 71, 72. This ensures accurate alignment of the motor 60 to the axis of rotation of the wheel 10" and the centre bore diameter 73 on which the hydraulic motors are arranged and therewith the attached geared pinions on the hydraulic motor can correctly gear into the gear wheel 38" as shown in Figures 6 and 7.

It will be seen that the sub-frame and the side frame form between them a gear box for the gear wheel 38" and the pinions of the motors.

#### CLAIMS

1. Rope driving apparatus comprising a rope wheel, two side frames one on either side of the wheel for supporting the rope wheel for rotation about a fixed axis, driving means for the wheel, and braking means for the wheel associated with a cylindrical structure attached to one side of the wheel and coaxial therewith, in which the driving means comprises a circumferentially toothed gear wheel positioned between the rope wheel and one side frame and fixed for rotation coaxially with the rope wheel, at least one hydraulic motor attached to the said one side frame and driving a pinion in peripheral driving engagement with the gear wheel to rotate the rope wheel, the gear wheel and pinion and the structure being on the same side of the wheel and the gear wheel and pinion being received at least partly within the structure.

2. Rope driving apparatus as claimed in claim 1 wherein the rope wheel is mounted on and rotatable with a shaft supported on two bearings, one on each of the side frames.

3. Rope driving apparatus as claimed in claim 1 or claim 2 wherein the gears are in a casing formed at least partly by the said side frame.

4. Rope driving apparatus as claimed in any preceding claim wherein the cylindrical structure comprises a cylindrical element attached to one side of the rope wheel, an annular element extending radially outwardly from the cylindrical element, and means fixed relative to the support means and movable into and out of frictional engagement with one of said elements.

5. Rope driving apparatus as claimed in claim 4 wherein said movable means comprise caliper means movable into and out of frictional engagement with the annular element.

6. Rope driving apparatus as claimed in any

preceding claim wherein one or more hydraulic motors are of variable displacement to provide different speed ranges for the rope wheel.

5 7. Rope driving apparatus as claimed in any preceding claim comprising driving means and braking means on each side of the rope wheel.

8. Rope driving apparatus as claimed in any preceding claim in which a sub-frame carrying at least one hydraulic motor is attached to the said side  
10 frame and means are provided to ensure alignment of the sub-frame and hence the hydraulic motor on the sub-frame with the axis of rotation of the gear wheel.

9. Rope driving apparatus as claimed in claim 8  
15 in which the sub-frame is split from the side frame along a plane which includes the axis of rotation of the rope wheel.

10. Rope driving apparatus substantially as  
hereinbefore described with reference to and as  
20 shown in Figures 1 to 3 or in Figure 4 or in Figure 5, or in Figures 6 and 7 of the accompanying drawings.