Oct. 31, 1933. H. K. TEGARDEN 1,932,993

GRINDING MACHINE

Filed Nov. 19, 1931 2 Sheets-Sheet 1

Fig. 1

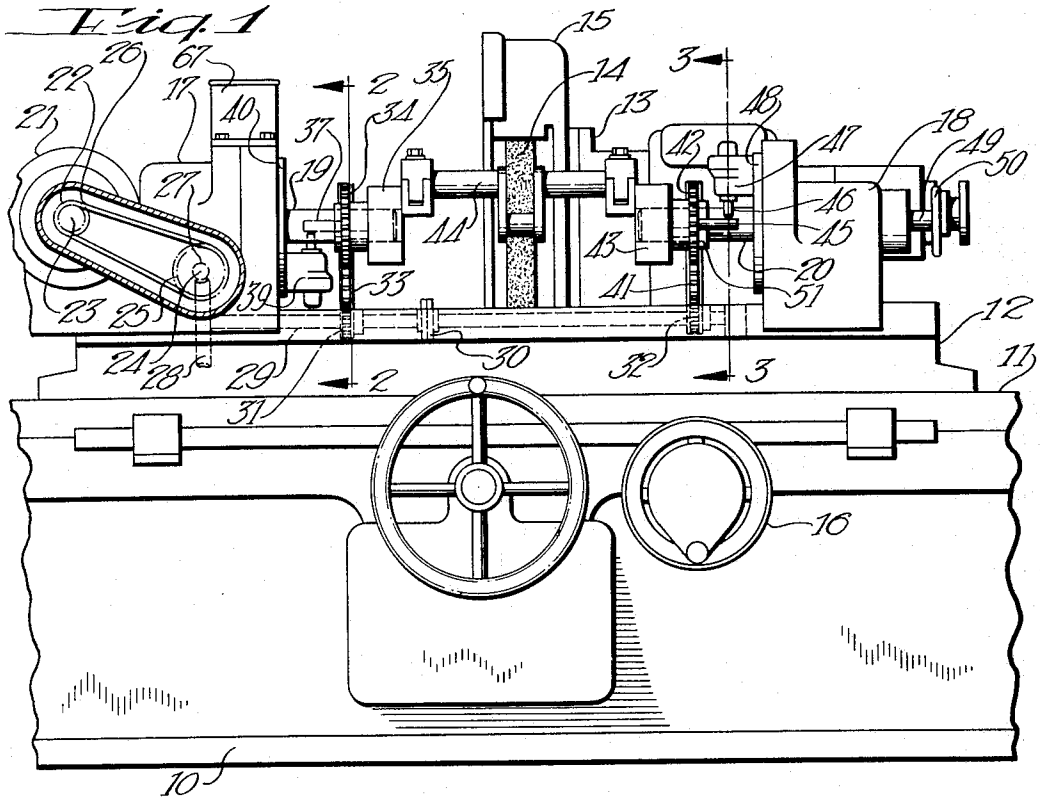
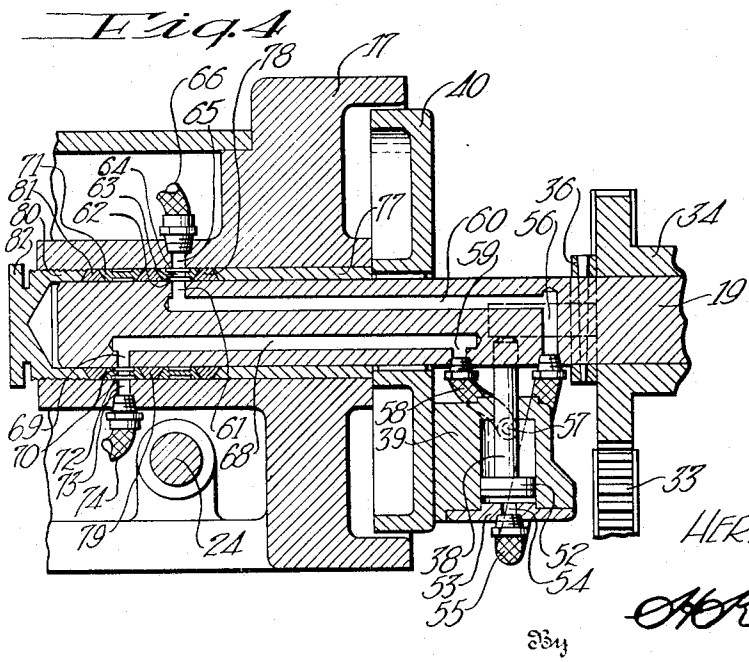


Fig. 4



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Fig. 2

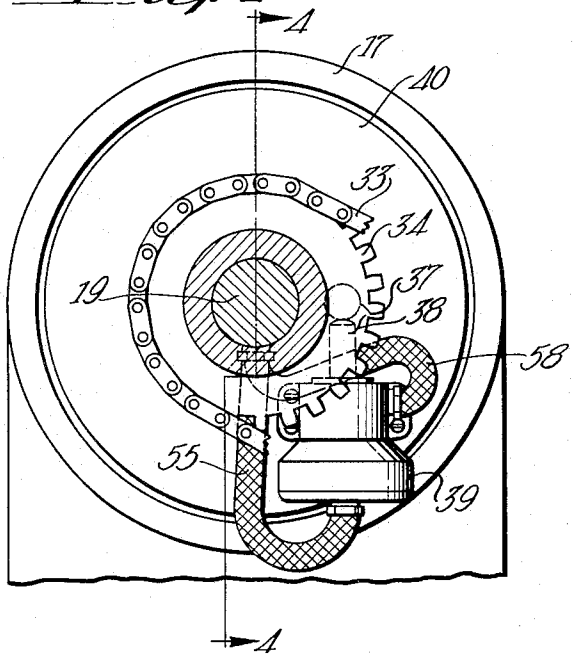
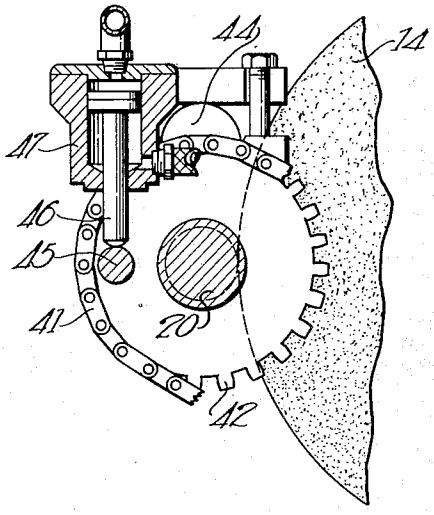


Fig. 3



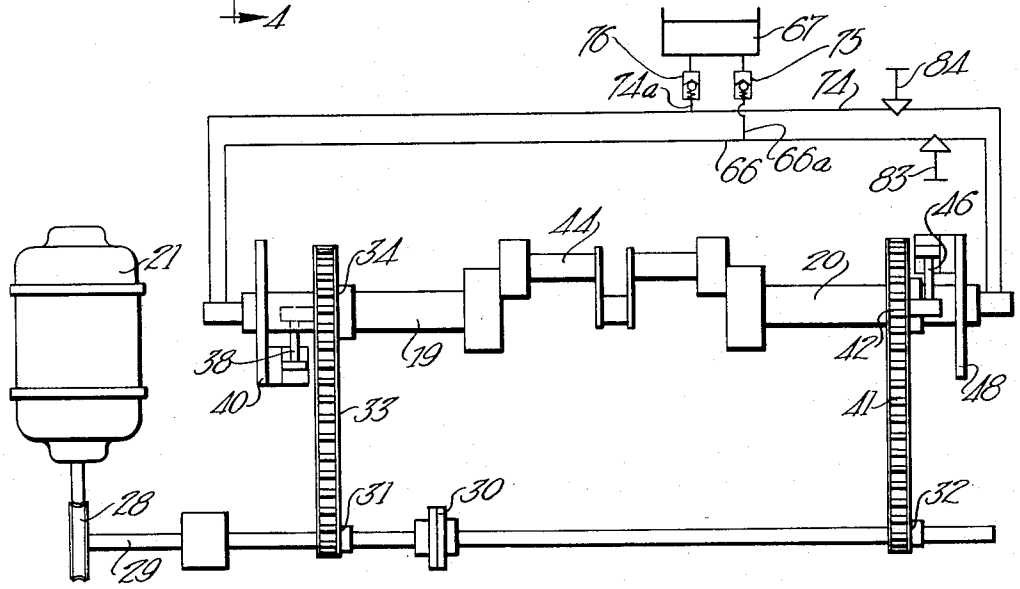


Fig. 5

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UNITED STATES PATENT OFFICE

1,932,993

GRINDING MACHINE

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Application November 19, 1931
Serial No. 576,108

13 Claims. (Cl. 51—237)

This invention relates to improvements in machine tools and especially to improvements in grinding machines.

One of the principal objects of this invention is the provision of a grinding machine for grinding work pieces normally difficult to rotate due to their mass or their tendency to twist when a driving force is applied to one end thereof.

A further object of the invention is the provision of a grinding machine for rotating work from opposite ends thereof and in which the driving torque between two ends is equalized.

Another object of the invention is the provision of an improved double end drive in which the driving torque is transferred from one end to the other for equalizing the driving torque on the work.

These and other objects are obtained by the means illustrated in the accompanying drawings and described in the following specification and it is to be understood that any modifications may be made in the exact structural details there shown and described within the scope of the appended claims without departing from or exceeding the spirit of the invention.

In the drawings:

Figure 1 is a front elevation of a grinding machine embodying the improvements of this invention.

Figure 2 is a sectional view taken on line 2—2 of Figure 1.

Figure 3 is a sectional view taken on line 3—3 of Figure 1.

Figure 4 is a sectional view taken on line 4—4 of Figure 2.

Figure 5 is a diagrammatic illustration of the several component parts of the invention.

Throughout the several views of the drawings similar reference characters are employed to denote the same or similar parts.

While the invention is capable of general use for grinding comparatively long slender cylindrical work pieces as well as heavy rolls, it has been illustrated in connection with a machine for grinding crank shafts. In each of these work pieces it is necessary and essential that the work be rotated about a definite axis and that the twist therein be held to an absolute minimum. Attempts have been made to drive the work from both ends, but considerable difficulty has been experienced in trying to balance or equalize the driving torque at the said ends. This invention obviates these difficulties and equalizes the driving torque so that a constant rotation of the work is had about a definite unvarying axis.

A machine embodying this invention may comprise a bed 10 having formed on the upper end thereof guideways 11 for the work supporting table 12 for guiding said table longitudinally of the bed 10. The bed is further provided with ways for the grinding wheel carriage 13 which supports a spindle for the grinding wheel 14 enclosed within a suitable guard or the like 15 carried by the carriage 13. The carriage 13 and grinding wheel are adapted to be fed laterally of the bed 10 toward and from the work table 12, for which purpose a feeding mechanism indicated in the drawings by the numeral 16 is provided. The table 12 supports at opposite ends thereof a head stock 17 and a tail stock 18 from which project the spindles 19 and 20. The head stock 17 supports a prime mover or motor 21, which rotates a pinion 22 secured to its shaft 23. A shaft 24 mounted in the head stock 17 has secured to its inner end a sprocket 25. A gear chain 26 is trained about the sprockets 22 and 25 for rotating the shaft 24 at the desired speed, which is or may be varied by changing the ratio between the sprockets 22 and 25. The other end of the shaft 24 has formed thereon or secured thereto a worm 27 meshing with a worm wheel 28 on one end of a jack shaft 29. The shaft 29 is journaled in suitable bearings extending from the table 12 so that said shaft moves with the table. The shaft 29 is in two parts, being connected together by a separable coupling 30 for a purpose that will later appear.

The jack shaft 29 has secured to opposite ends thereof sprocket chain gears 31 and 32, the former being adjacent the head stock 17, while the latter is near the tail stock 18. A sprocket chain 33 extends about the gear 31 as well as about a gear 34 loosely journaled on the spindle 19. A chuck head or crank shaft fixture 35 is secured to one end of the spindle 19 and forms one abutment for the loose gear 34 and limits the movement of the gear longitudinally of the spindle 19 in one direction. A collar 36 is secured to the spindle 19 on the other side of the gear 34 and limits its movement in the other direction. Projecting from one face of the gear 34 is a driving pin 37, adapted to engage a piston rod or pin 38 projecting outwardly from a cylinder 39 secured to face plate 40, which is in turn fastened to the head stock spindle 19.

The chain gear 32 at the other end of the shaft 29 has also extending about it a sprocket

chain 41 which is trained about a gear 42 loose on the tail stock spindle 20. A chuck or crank shaft fixture 43 is secured to the outer end of the tail stock spindle 20, to which the other end of the work piece 44 is secured. The gear 42, similar to the gear 34, has projecting from it a driving pin 45 adapted to contact with a piston rod or pin 46 projecting outwardly from a cylinder 47 secured to a face plate 48 in turn fastened to the tail stock spindle 20. The tail stock spindle is also connected with an adjusting screw 49 operated by a hand wheel 50 whereby the axial position of the tail stock spindle 20 may be effected. The chuck or crank shaft fixture 43 and a collar 51 co-operate to limit the axial movement of the driving gear 42 relative to the tail stock spindle 20.

From the foregoing it will be noted that the rotation of the jack shaft 29 will through the gear chains 33 and 41 effect simultaneous rotation of the gears 34 and 42, which through their inter-engagement with piston rods or pins 38 and 46 rotate the spindles 19 and 20.

Each of the cylinders 39 and 47 enclose a piston 52 movable therein for actuating the piston rods or pins 38 and 46. The construction about to be described is the same at each end and it is, therefore, deemed sufficient if but one of the driving mechanisms or dogs be described in detail. Accordingly, the cylinder 39 has its one end closed by a head or cap 53 through which a port 54 is formed. A conduit or pipe 55 extends from the port 54 and terminates at a port 56 formed radially in the spindle 19. The cylinder 39 is provided on its other end with a port 57 from which a pipe 58 extends, likewise terminating at a port 59 formed in the spindle 19. A channel 60 extends from the port 56 longitudinally of the spindle 19 from which a radial port 61 projects. The port 61 is aligned with a circumferential groove 62 formed on the inner surface of a ring 63 which surrounds the spindle 19. The ring 63 is provided on its exterior surface with a second groove 64 which aligns with a port 65 formed through the bearing portion of the head stock 17. A conduit 66 extends from the port 65 to a conduit 66A which terminates in the base of a tank or sump 67 mounted on the head stock 17 containing an hydraulic medium, preferably oil. The port 59 also connects with a channel 68 extending longitudinally of the spindle 19 having a radial port 69 at one end thereof projecting outwardly of the spindle 19. The port 69 is also aligned with a recess 70 formed on the inside of a ring 71 surrounding the spindle 19. A second recess 72 on the outer surface of the ring 70 affords communication with a port 73 formed in the head stock 17. A conduit 74 extends from this port and is connected to the base of the tank 67 by a branch conduit 74A.

From the foregoing it will be noted that any oil or other hydraulic medium within the tank 67 flows by gravity from the conduits 66 and 74 filling the channels 60 and 68 and the cylinder 39 on opposite sides of the piston 52. The conduits 66 and 74 continue to the tail stock end of the table 12, where they are similarly connected with the spindle 20 for filling the cylinder 47 on opposite sides of the piston contained therein.

As will be noted from the diagrammatic view in Figure 5 the branch conduits 66A and 74A are each provided with a check valve 75 and 76 which prevent hydraulic medium within the cylinders being forced back into the tank 67 from the lines 66 and 74.

The figures 2 and 3 illustrate the driving pins of the head and tail stocks as contacting with the pistons on opposite sides of the axial center of the work so that a movement of the gears 34 and 42 in the driving direction will rotate the work in the same direction. The operation of the mechanism is as follows. A work piece is mounted between the head and tail stock spindles and clamped to the chucks or fixtures 35 and 43. The motor 21 is then rotated for effecting rotation of the jack shaft 29. This shaft 29 immediately initiates movement of the gears 34 and 42 causing the driving pins thereof to engage the piston pins 38 and 46. Should one of the piston pins be projecting slightly beyond the other pin, the following operation will result. Assuming the head stock piston pin 38 to contact with the driving pin 37, it will be forced inwardly of its cylinder, forcing the hydraulic medium behind its piston 52 from the cylinder through the conduit 55, ports and channels, 56, 60 and 61, through the conduit 66 to the tail stock spindle where it will connect behind its associated piston for forcing it outwardly to meet the driving pin 45 of the tail stock gear. This movement will continue until an equal pressure is had on the rear face of each of the pistons whereupon the unitary rotation of the dogs will result. Should, for any reason, one of the dogs attempt to out-drive the other or assume a greater load, the torque thereof will be immediately transferred through the hydraulic lines to the other driving mechanism. From this it will be seen that the driving connections will immediately balance themselves as far as the torque is concerned for rotating the work at a constant rotation and eliminating all possible twist within the work.

By reference to Figure 4 it will be noted that the head stock bearing has secured therein a sleeve 77 which forms a bearing for the spindle 19. The end of the sleeve 77 nearest the ring 63 is inclined oppositely the inclination of the adjacent face of said ring. In the space between these opposed inclined faces is mounted a packing member 78 which prevents leakage of the hydraulic medium along the spindle toward the chuck or fixture secured thereto. The opposed faces of rings 63 and 71 are inclined in opposite directions to one another and have mounted between them a packing member 79 which prevents leakage of the hydraulic medium from the rings into the said space between said rings. The remaining face of the ring 71 is also inclined which is in a direction opposite to the direction of inclination of the adjacent face of a packing gland 80 which is threaded into the end of the spindle bearing. In the space between the opposed faces of ring 71 and gland 80 a packing member 81 is positioned to prevent leakage of the hydraulic medium along the spindle toward the rear end thereof. The end 82 of the gland 80 is of an angular cross section for the reception of a wrench whereby the gland may be screwed into the spindle bearing. It will be noted that the inclined faces of the gland 80, rings 63 and 71 and sleeve 77 co-operate with one another to force the packing members 78, 79 and 81 into close contact with the outer surface of the spindle.

In the event it is desired to drive only from the front end of the machine, it is only necessary to loosen the coupling 30 thereby effectively disconnecting the tail stock drive and the other end. To insure no interference from the tail

stock end of the machine when driving solely from the head stock end thereof, choke valves 83 and 84 may be respectively provided for the lines 66 and 74.

What is claimed is:

1. In a grinding machine of the class described the combination of a bed, a work supporting table mounted thereon, means supporting the work on the table, driving means at each end of the table each comprising a freely rotatable member, a fixed member connected to the driving means, a yieldable coupling between each pair of loose and fixed members of the drive, and means checking the yieldable coupling of one pair and transferring the driving torque to the other pair for balancing the driving torque of each member.

2. In a grinding machine of the class described the combination of a bed, a table mounted thereon for supporting a work piece, means at each end for simultaneously rotating the work, and means for balancing the driving torque of said rotating means comprising a piston and cylinder associated with each driving means at each end of the work, a closed hydraulic circuit between the pistons and cylinders, and means in the hydraulic circuit for balancing the driving torque between each piston and cylinder.

3. In a grinding machine of the class described the combination of a bed, a table mounted thereon for supporting a work piece, means at each end for simultaneously rotating the work, and means for balancing the driving torque of said members comprising a piston and cylinder at each end, a closed hydraulic circuit between the pistons and cylinders, means for balancing the driving torque between each piston and cylinder, and a common activating means for the driving members.

4. In a grinding machine the combination of a bed, a grinding wheel rotatably mounted thereon, means supported by the bed for supporting a work piece for rotation adjacent the active face of the grinding wheel, means for rotating the work at each end thereof comprising a member secured to the supporting means at each end thereof, a freely rotating member adjacent each fixed member, a coupling between the loose and fixed members, and means equalizing the driving torque between the loose and fixed members.

5. In a grinding machine the combination of a bed, means supporting the work at each end comprising a spindle, means rotatably supporting each spindle, a member loosely journaled on each spindle, a second member secured to each spindle, a driving dog on each loose member, a companion dog secured to the fixed member of each spindle, means for simultaneously rotating the loose members relative to the spindles, and means for equalizing the driving torque between the dogs and their companion members.

6. In a grinding machine the combination of a bed, means supporting the work at each end comprising a spindle, means rotatably supporting each spindle, a member loosely journaled on each spindle, a second member secured to each spindle, a driving dog on each loose member, a companion dog secured to the fixed member of each spindle, means for simultaneously rotating the loose members relative to the spindles, means for equalizing the driving torque between the dogs and their companion members, said means comprising a closed hydraulic circuit between the companion members, and a piston associated with each of the companion members for transferring the torque of one through the hydraulic circuit to the other.

7. In a grinding machine the combination of a bed, means supporting the work at each end comprising a spindle, means rotatably supporting each spindle, a member loosely journaled on each spindle, a second member secured to each spindle, a driving dog on each loose member, a companion dog secured to the fixed member of each spindle, means for simultaneously rotating the loose members relative to the spindles, means for equalizing the driving torque between the dogs and their companion members, said means comprising a closed hydraulic circuit between the companion members, a piston associated with each of the companion members for transferring the torque of one through the hydraulic circuit to the other, and means for maintaining the closed circuit primed.

8. In a double end drive for grinding machines and the like the combination of a spindle at each end of a work piece and operatively connected therewith for rotation thereby, a driving member associated with each spindle but normally disconnected therefrom, a common power source for rotating said members, a driven member associated with each spindle and connected thereto, a driving dog between each driven member and driving member, and means equalizing the driving torque between the driving dogs.

9. In a double end drive for grinding machines and the like the combination of a spindle at each end of a work piece and operatively connected therewith for rotation thereby, a driving member associated with each spindle but normally disconnected therefrom, a common power source for rotating said members, a driven member associated with each spindle and connected thereto, a driving dog between each driven member and driving member, means equalizing the driving torque between the driving dogs, said means including a closed hydraulic circuit between the dogs, and a piston associated with each dog for transferring the driving torque to the other dog through the hydraulic medium.

10. In a double end drive for grinding machines and the like the combination of a spindle at each end of a work piece and operatively connected therewith for rotation thereby, a driving member associated with each spindle but normally disconnected therefrom, a common power source for rotating said members, a driven member associated with each spindle and connected thereto, a driving dog between each driven member and driving member, means equalizing the driving torque between the driving dogs, said means including a closed hydraulic circuit between the dogs, a piston associated with each dog for transferring the driving torque to the other dog through the hydraulic medium, and means for maintaining the hydraulic circuit filled at all times.

11. In a double end drive for grinding machines and the like the combination of a spindle at each end of a work piece and operatively connected therewith for rotation thereby, a driving member associated with each spindle but normally disconnected therefrom, a common power source for rotating said members, a driven member associated with each spindle and connected thereto, a driving dog between each driven member and driving member, means equalizing the driving torque between the driving dogs, said means including a closed hydraulic circuit be-

tween the dogs, a piston associated with each dog for transferring the driving torque to the other dog through the hydraulic medium, means for maintaining the hydraulic circuit filled at all times, said means comprising a tank, an hydraulic medium within the tank, and means permitting a flow of the hydraulic medium from the tank to the closed hydraulic circuit but preventing a reverse flow of the medium.

12. In a double end drive for grinding machines or the like the combination of a bed, a head stock supported by the bed, a tail stock supported by the bed, a spindle associated with each stock, a gear loosely journaled on each spindle, a driven shaft, means connecting the shaft and gears for simultaneous rotation of the gears, a face plate secured to each spindle, a driving pin projecting from each gear, a driven dog projecting from each face plate, each dog comprising a cylinder and piston, a piston pin projecting from each piston for engagement with its associated driving pin of the gear, conduits between the cylinders, and an hydraulic medium in the cylinders and conduits whereby the driving torque on one of the dogs is transferred to the other dog equalizing the driving torque thereon.

13. In a double end drive for grinding machines or the like the combination of a bed, a head stock supported by the bed, a tail stock supported by the bed, a spindle associated with each stock, a gear loosely journaled on each spindle, a driven shaft, means connecting the shaft and gears for simultaneous rotation of the gears, a face plate secured to each spindle, a driving pin projecting from each gear, a driven dog projecting from each face plate, each dog comprising a cylinder and piston, a piston pin projecting from each piston for engagement with its associated driving pin of the gear, conduits between the cylinders, an hydraulic medium in the cylinders and conduits whereby the driving torque on one of the dogs is transferred to the other dog equalizing the driving torque thereon, a tank for the hydraulic medium, connections between the tank and conduits for supplying the hydraulic medium to the conduits, and means associated with the connections for preventing the flow of the medium from the conduits into the tank.

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