The invention relates to a cylinder printing machine with a uniformly rotating impression cylinder and a carriage whose return movement is faster than its forward stroke and the stationary fixed driving-wheel of which engages continuously with a spur-rack on the carriage.

Attempts have already been made to drive the carriage-driving shaft with two counter running toothed segments in alternating directions, and braking and accelerating was to be done by a spur-track that was to be controlled in a form-locked fashion by curved-disks. Experience has shown that obtaining shock-free engagement with a uniformly rotating toothed drive by means of curve-disks is very difficult, especially when great forces have to be controlled as they do occur in the case of braking the carriage of a printing press. Furthermore, any play caused by the many gear-units must create an unfavorable effect.

Another known machine employs for the varying forward and return strokes of the carriage oval toothed wheels, so-called roll-curve gears, whereby additional curve-drives become effective very shortly in front of the dead center points. For this purpose, curves are fixed onto a uniformly rotating main driving shaft, which cooperates with rolls on the carriage driving shaft.

According to the invention, the drive of the carriage of a cylinder printing machine with uniformly rotating impression cylinder and a carriage whose return movement is faster than its forward stroke is effected by means of two differing and always alternatingly acting gears that are similar to Maltese crosses. Suitable for the purpose, according to location, are true Maltese crosses, open Maltese cross flank pairs with enclosed toothed segment, and similar cross elements. Crosses with differing divisions are especially used in order to provide the main driving shaft with ample time for accelerating and retarding at the higher return speed. Obtaining approximately equally high accelerating values for forward running and return movement is thus made possible in an advantageous way. Furthermore, the entire carriage path is kept short.

With an arrangement according to Figure 1, a shaft 18 with gears thereon drives uniformly rotating single-revolution wheels respectively on shafts 2 and 11. Single-revolution shaft 2 is connected with impression cylinder 20 by an intermediate wheel which can be seen to the right and above the carriage driving wheel 1. This single-revolution shaft 2 provides for the movement of the carriage through the printing motion pushers and rollers 3 and 4 at each arcuate end and within the pitch circle of toothed segment 5 attached to the single revolution wheel on shaft 2. These pushers cooperate as pushing and braking rolls with open Maltese cross straight flanks 6 and 9 whose turn-table mounting is fixed on carriage driving shaft 7. In the shown dead center position of the carriage, one of the pushers 3 reaches tangentially its flank and driving flank 6 attached to the carriage driving shaft 7 sets the carriage moving and after a turning of 45 degrees brings the toothed segment 5 into bump-free driving engagement with the driving wheel 8 allied to shaft 7. As this occurs the forward motion of the carriage 8 is in synchronized running with the impression cylinder 20. At the end of segment 5 the other pusher 4 contacts the braking flank portion 9 of the open Maltese cross flank and brakes the carriage driving shaft 7 down to speed 0, so that the pusher 4 subsequently leaves its braking flank 9 in a tangential fashion. At this moment, a second uniformly driven single-revolution shaft 11 takes over the return movement of the carriage at the same swinging angle of the carriage driving shaft 7 as that of the forward running movement. Toothed segment 14 of the single-revolution shaft 11 also has a pusher roll and a braking roll 17 at the ends thereof. The turn-table mounting the respective straight flanks 12 and 16 in mesh on shaft 19 of a reduction gear segment or speed change drive 13. The pusher roll 16 runs into its pushing flank 12 and starts the reverse turning of the carriage driving shaft 7. Pusher 10 with shaft 11 travels an even 60 degrees before its toothed segment 14 meshes with the toothed segment 15 of the carriage driving shaft 19 and reduction gear segment 13 meshes with wheel 8 of the carriage driving shaft 7 so as to uniformly move the carriage.

Subsequently, the other flank 16 leaves with its roll 17 the quick return motion. Braking roll 17 leaves its flank 16 in a tangential fashion at the moment of dead center position of the carriage at the same time, pusher 4, as shown at the right in Figure 1 enters tangentially against its pusher flank 6. Both main driving shafts 2 and 11 rotate together with pushers in the same direction and are connected with each other by a worm drive 18 which introduces the driving force.

Figure 2 shows a driving gear developed according to Figure 1 and distinguishing itself by striking simplicity. In this instance there is only a single uniformly rotating single-revolution shaft 21. On it is fixed a toothed segment 22 which carries at one end within the pitch circle a pusher roll 23, and at the other end a braking roll 24 which work together with the straight flanks 28 and 29 respectively of a Maltese cross gear turn-table which is wedged onto the carriage driving shaft 27. The toothed segment 22 carries furthermore at a corresponding radius distance a further pusher 25. Pusher 25 causes the accelerated return motion of the carriage. Pusher 25 cooperates with a balanced 26 of toothed segment 32 on auxiliary shaft 33 which meshes continuously with the driving wheel 34 of carriage driving shaft 27 and acts as a reduction gear or speed change drive. The gear ratio to the carriage driving-shaft 27 is thereby chosen in a way so that the shaft reaches upon returning the same turning angle as with the forward motion. The position shown illustrates the return motion just completed. Pusher 25 tangentially leaves the slot (true Maltese cross) of balancer 26 and pusher 23 causes the forward movement of the carriage via the pushing flank 28 of carriage driving shaft 27. After this, toothed segment 22 in mesh with driving wheel 34 of shaft 27 takes over the uniform printing action until braking roll 24 with its braking flank 29 of carriage driving shaft 27 effects the retarding until standstill of the carriage before reversal. The toothed segment of the balancer 26 and balancer 25 remains with the driving wheel 34 of shaft 27 and is, therefore, upon the printing motion moved empty downwards in the position marked by thin dashes. At the moment of reversal to the carriage return motion, the balancer again takes up its pusher 25, whilst at the same time braking roll 24 tangentially leaves its braking flank 29. For driving the
The toothed wheel 30 is wedged on shaft 27 to cooperate with spur-rack 31 of the carriage.

In a further version of the invention, Figure 3 shows two uniformly rotating single-revolution main driving shafts 43, 44 which are countercurrently driven in a more or less known fashion by means of their meshing toothed wheels 41, 42. Each shaft carries segments 45, 46 differing in length and diameter, which cooperate with the toothed segments 47, 48 of carriage driving shaft 49 and which within the pitch circle are at both ends flanked by a pushing and braking pair of rolls 50, 51, 52, 53 respectively. Here, too, the pushing roll 51 and braking roll 52 cooperate respectively with the pusher flanks 54 and braking flanks 56 to cause smooth acceleration and retardation of the carriage to speed 0.

So also the pusher roll 51 and braking roll 52 cooperate respectively with the pusher flanks 58 and braking flanks 57 at each end of segment 47. Both turn-tables of all braking and pushing flanks are stationary wedged on carriage driving shaft 49. In contrast to Figure 1, the differing Maltese crosses are not adjusted to the same turning angle of the carriage driving shaft at forward and return motion by means of a reduction-gear, but by means of the curved shape of the driving and braking flanks 55, 57 which act as speed change driving coupling. Thus, it can be obtained that the main driving shaft allows for more time, i.e., greater rotation angles, for accelerating and retarding the high return speed than for the smaller forward motion speed. Here again it is possible to make accelerating movements at forward and return motion practically equal, which results in the smallest possible accelerating in the entire machine. The curves of the flanks 55 and 57 may be shaped more or less at will, however, exact circular cylinder pieces are especially advantageous from a manufacturing point of view. Should it be known facts that gyrocylindified shapes be chosen, the flank curves may then be shaped as locked guiding-slots by means of which auxiliary curves are no longer required. With carriage driving shaft 49 there is a toothed segment 58 connected within the machine, which continuously meshes with spurrack 59 of carriage 60. Impression cylinder 61 is driven by single-revolution shaft 43 via an intermediate wheel 62. Intermediate wheel 62 is thereby situated almost horizontally to the cylinder, so that lifting the cylinder practically does not cause any increase in teeth back-lash.

Driving cylinder can be effected by driving shaft 44 via toothed wheel 42. In addition to the open pushing and braking flanks, all gears show possess guiding which at slow running of the machine hold the pushing and braking rolls at the flanks, i.e., guide these in a form-locked manner. These guiding act as auxiliary curves which do not absorb the dynamic forces and are correspondingly less heavy in construction. For the sake of illustrating them well, they have only been indicated in Figure 2 under 34 and 35, without being limited to this arrangement.

It may be mentioned that these Maltese cross-type gears may be shaped for external switching, internal switching or as straight guiding with spur-racks. In the latter case there are by way of example fourth-revolution shafts switching with alternatingly acting pushers.

The gears according to the invention can be housed in a more or less closed-up gear-box in the known manner. Figure 4 shows a cross-section through a press, according to Figure 3. Outward to the left, in front of machine side frame II, there is running in an oil bath the reversing gear, from which the carriage driving shaft 49 leads into the machine, carrying the carriage driving wheel 59. This meshes continuously with spur-rack 59 of the carriage 60 which is led in the conventional manner. The deep level of shaft 49 has in the low level of the carriage a favorable effect. By means of a reduction gear, it is possible to increase the rotating angle of shaft 49 and to locate the carriage on a deeper level. Impression cylinder 61, for example, would receive its drive from the single-revolution main driving shaft via an intermediate wheel 62 within gear-box 63.

Main driving shafts of the multi-revolution type may be envisaged for all cases, however, these gears are unable to work on the same level. Couplings would then have to be provided or lateral shifting of the driving wheels would become necessary. Against this, the examples of gears with single-revolution main driving shafts distinguish themselves by their simple design, their small highest accelerations and their small depth in construction.

What I claim is,

1. In mechanism for transmitting alternating forward and rearward rotation to a reverse motion shaft, gear means fixedly mounted on said shaft, a first Maltese-cross type drive means meshing with said gear means and having a driving angle for rotating said shaft in one direction representing advance travel, a second Maltese-cross type drive means meshing with said gear means and having a driving angle of a larger size as compared with the driving angle of said first Maltese-cross type drive means for rotating said shaft in a reverse direction representing return travel faster than in the advance travel, said first and second Maltese-cross type drive means having pushing and braking flanks, pusher and braking rolls corresponding to the forward direction and toothed segments for meshing engagement with said gear means, and synchronizing and speed change drive means interposed between said gear means on the reverse motion shaft and one of said Maltese-cross type drive means for synchronizing corresponding rotating angles at the end of one direction of rotation of the reverse motion shaft and the gear thereon and the beginning of the reverse direction of rotation of said reverse motion shaft and the gear thereon and between such synchronizing accelerating, changing the speed of drive and decelerating the drive of said reverse motion shaft.

2. In mechanism for transmitting alternating forward and rearward rotation to a reverse motion shaft, gear means fixedly mounted on said shaft, a first constantly rotating shaft spaced from said reverse motion shaft, a first gear segment mounted on the first shaft, a pusher and a braking roll mounted respectively at the ends of said segment, an intermediate shaft mounted intermediate said reverse motion shaft and said first shaft, a first Maltese cross like gear means having a segment, a pusher flank means and a braking flank means mounted on said intermediate shaft for driving and braking engagement by said segment and rolls on the first shaft, a reduction gear segment fixed to the intermediate shaft and engaging with said gear means on the reverse motion shaft, a second constantly rotating shaft rotating at the same speed as the first shaft and in the same direction, a second Maltese-cross type drive means including a gear segment on the second shaft for meshing with said gear means on the reverse motion shaft, a pusher roll and a braking roll at each end of said last named gear segment and a pusher flank and a braking flank fixed to said reverse motion shaft and for cooperative driving action with said respectively last named pusher and braking rolls for driving the reverse motion shaft in a reverse direction of rotation and at a higher angular speed of rotation than said first shaft, said reduction gear segment and said means mounted on the intermediate shaft acting as speed change drive means and synchronizing means for synchronizing the speed of rotation of said reverse motion shaft at the end of one direction of rotation with the speed of rotation at the beginning of the reverse rotation of the reverse motion shaft and changing the speed of drive of the reverse motion shaft.

3. A mechanism according to claim 1 wherein said intermediate shaft is positioned intermediate said second shaft and said reverse motion shaft, said first Maltese cross-type gear means on the intermediate shaft having engagement with the gear segment, pusher braking rolls,
on the second shaft respectively and said gear segment, pusher and braking rolls on the first shaft having cooperative engagement with said flanks and gear means of the reverse motion shaft.

In mechanism for transmitting alternating forward and rearward rotation to a reverse motion shaft, gear means fixedly mounted on said shaft, a constantly rotating shaft, a first Maltese-cross type drive means for driving said gear means and reverse motion shaft in one direction, including pushing and braking flanks fixed to said reverse motion shaft, a gear segment fixed to said constant rotating shaft for meshing and driving engagement with the said reverse motion shaft, a pusher and a braking roll at the ends of said segment and for driving and braking action with said flanks, an auxiliary shaft, an arcuate gear segment pivoted on said auxiliary shaft and meshing with said gear means to drive said reverse motion shaft at a different rate of rotation than said first Maltese-cross type drive means and in part of its arcuate travel carrying a rotation in a synchronizing manner of the reverse motion shaft at one end of its arcuate travel in one direction with the beginning of its arcuate travel in the reverse direction, said arcuate gear segment mounted on the auxiliary shaft having a balancer drive affixed thereto of a true Maltese-cross, said constant rotating shaft having a pusher arm means fixed thereto with a pusher thereon for driving engagement with said balancer drive thereby driving said arcuate gear segment in one direction when not being driven in the reverse direction by said first Maltese-cross type drive means.

5. In mechanism for transmitting alternating forward and rearward rotation to a reverse motion shaft, said reverse motion shaft having a high speed gear segment and a low speed gear segment thereon, a first constantly rotating shaft, a second constantly rotating shaft rotating at the same speed but in a reverse direction from said first constantly rotating shaft, a Maltese-cross type drive means drivenly disposed between the first constantly rotating shaft and the low speed gear segment and including a gear segment, a pusher and a braking flank and pusher and braking rolls for respective cooperation, a Maltese-cross type drive means drivenly disposed between the second constantly rotating shaft and the high speed gear segment on the reverse motion shaft and including a gear segment, pusher and braking flanks and pusher and braking rolls respectively for cooperation with the last named flanks, said last named flank being shaped for cooperation with their respective pusher and braking rolls to drive the reverse motion shaft at a rotation rate at the beginning of its high speed reverse motion that is equal to the rotation rate at the end of its just prior direction of rotation thereby synchronizing the deceleration speed of prior direction of rotation with the acceleration speed at the beginning of said reverse rotation.

6. In a mechanism according to claim 5 wherein the flanks of the first Maltese-cross type drive means are straight flanks and the flanks of the second Maltese-cross type drive means are exact circular arcs.

7. In combination in a cylinder printing press with uniformly rotating impression cylinder, a carriage having a spur-rack thereon, a driving wheel continuously meshing with the spur-rack, a forward and rearward rotation shaft having fixedly mounted thereon said driving wheel, a reversely driven gear fixed on said shaft, a first Maltese-cross type drive means meshes with said reversely driven gear having a driving angle of a larger size as compared with the driving angle of said first Maltese-cross type drive means for driving a carriage at a higher speed in the advance travel, a second Maltese-cross type drive means meshes with said reversely driven gear having a driving angle of a larger size as compared with the driving angle of said first Maltese-cross type drive means for driving a carriage at a higher speed in the return travel faster than in the forward travel, said first and second Maltese-cross type drive means having speed change drive means interposed between the second Maltese-cross type drive means and the gear segment for driving into the reverse motion shaft; said speed change drive means having synchronizing means portion causing synchronism of angle of drive with the first Maltese-cross drive means at the beginning of the reardward motion of the reverse motion shaft, means portion accelerat- ing the rearward motion of the reverse motion shaft through a greater drive angle portion than the comparable acceleration drive for the forward drive motion of the reverse motion shaft, means portion driving said reverse motion shaft in the rearward direction at a speed greater than the comparable drive speed in the forward direction of motion of said shaft by the first Maltese-cross type drive means, means portions decelerating the rearward motion of the reverse motion shaft through a greater deceleration drive for the forward drive motion of the reverse motion shaft and synchronizing means causing synchronism of angle of drive with the first Maltese-cross drive means at the beginning of the forward drive motion of the reverse shaft.

8. In a mechanism for transmitting alternating forward and rearward rotation to a reverse motion shaft, gear means fixedly mounted on said shaft, a first Maltese-cross type drive means having a driving angle of a larger size as compared with the driving angle of said first Maltese-cross type drive means for driving a carriage at a higher speed in the forward travel, said first and second Maltese-cross type drive means having pusher and braking flanks and pusher and braking rolls corresponding to the pusher and braking flanks and associated toothed segments for driving engagement with said reversely driven gear, said bearings of one Maltese-cross type drive means being synchronized with the pusher means on the second Maltese-cross type drive means for synchronizing the swivel angles of the reverse motion shaft, gear means fixedly mounted on said shaft, a first Maltese-cross type gear means for driving said gear means and having a driving angle for rotating said shaft in one direction representing forward travel, a second Maltese-cross type drive means for driving said gear means and having a driving angle of a larger size as compared with the driving angle of said first Maltese-cross type drive means for rotating said shaft in a rearward direction representing rearward travel faster than in the forward travel; said second Maltese-cross type drive means having speed change drive means interposed between the second Maltese-cross type drive means and the gear segment for driving into the reverse motion shaft; said speed change drive means having synchronizing means portion causing synchronism of angle of drive with the first Maltese-cross drive means at the beginning of the reardward motion of the reverse motion shaft, means portion accelerat- ing the rearward motion of the reverse motion shaft through a greater drive angle portion than the comparable acceleration drive for the forward drive motion of the reverse motion shaft, means portion driving said reverse motion shaft in the rearward direction at a fixed speed greater than the comparable drive speed in the forward direction of motion of said shaft by the first Maltese-cross type drive means, means portions decelerating the rearward motion of the reverse motion shaft through a greater deceleration drive for the forward drive motion of the reverse motion shaft and synchronizing means causing synchronism of angle of drive with the first Maltese-cross drive means at the beginning of the forward drive motion of the reverse shaft.

9. In a mechanism for transmitting alternating forward and rearward rotation to a reverse motion shaft, gear means fixedly mounted on said shaft, a first constantly rotating shaft spaced from said reverse motion shaft, a first gear segment mounted on the first shaft, a pusher and a braking roll mounted respectively at the ends of said segment, and intermediate shaft mounted intermediate said reverse motion shaft and said first shaft, a first Maltese-cross like gear means having a segment, a pusher, a braking flank and a braking flank means and a braking flank means mounted on said intermediate shaft for driving and braking engagement by said segment and rolls on the first shaft, a reduction gear segment fixed to the intermediate shaft and meshing with said gear means on the reverse motion shaft, a second constantly rotating shaft rotating at the same speed as the first shaft and in the same direction, a second Maltese-cross type drive means including a gear segment on the second shaft for meshing with said gear means on the reverse motion shaft, a pusher roll and a braking roll at each end of said last named gear segment and a pusher flank and a braking flank means fixed to said means for driving rotation shaft and for cooperative driving action with said respectively last named pusher and braking rolls for driving the reverse motion shaft in a reverse direction of rotation and at a higher angular speed of rotation than said first shaft, said reduction gear segment and said means mounted on the intermediate shaft acting as speed change drive means and synchronizing means for synchronizing the speed of rotation of said reverse motion shaft at the end of one direction of rotation with the speed of rotation at the beginning of the reverse rotation.
of the reverse motion shaft and changing the speed of drive of the reverse motion shaft,

10. In a mechanism for transmitting alternating forward and rearward rotation to a reverse motion shaft, gear means fixedly mounted on said shaft, a constantly rotating shaft, a first Maltese-cross type drive means for driving said gear means and reverse motion shaft in one direction, including pusher and braking flanks fixed to said reverse motion shaft, a gear segment fixed to said constantly rotating shaft for meshing and driving engagement with said gear means on the reverse motion shaft, a pusher roll and a braking roll at the ends of said gear segment and for driving and braking action with said flanks, an auxiliary shaft, an arcuate gear segment pivoted on said auxiliary shaft and meshing with said gear means to drive said reverse motion shaft at a different rate of rotation than said first Maltese-cross type drive means and in part of its arcuate travel causing a rotation in a synchronizing manner of the reverse motion shaft at one end of its arcuate travel in one direction with the beginning of its arcuate travel in the reverse direction, said arcuate gear segment mounted on the auxiliary shaft having a balancer drive affixed thereto of a true Maltese-cross, said constantly rotating shaft having a pusher arm means fixed thereto with a pusher therewith for driving engagement with said balancer drive thereby driving said arcuate gear segment in one direction when not being driven in the reverse direction by said first Maltese-cross type drive means.

11. In a mechanism for transmitting alternating forward and rearward rotation to a reverse motion shaft, said reverse motion shaft having a high speed gear segment and a low speed gear segment thereon, a first constantly rotating shaft, a second constantly rotating shaft; rotating at the same speed but in a reverse direction from said first constantly rotating shaft, a Maltese-cross type drive means drivingly disposed between the first constantly rotating shaft and the high speed gear segment and including a gear segment, a pusher and a braking flank and pusher and braking rolls for respective cooperation with said flanks, a Maltese-cross type drive means drivingly disposed between the second constantly rotating shaft and the low speed gear segment on the reverse motion shaft and including a gear segment, pusher and braking flanks and pusher and braking rolls respectively for cooperation with the last named flanks, said last named flanks being shaped for cooperation with their respective pusher and braking rolls to drive the reverse motion shaft at a rotation rate at the beginning of its low speed reverse motion that is equal to the rotation rate at the end of its just prior direction of rotation thereby synchronizing the deceleration speed of prior direction of rotation with the acceleration speed at the beginning of said reverse rotation.

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