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W. L. LIBBY ET AL

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INTERLOCKING CONTROL MECHANISM

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3 Sheets-Sheet 1

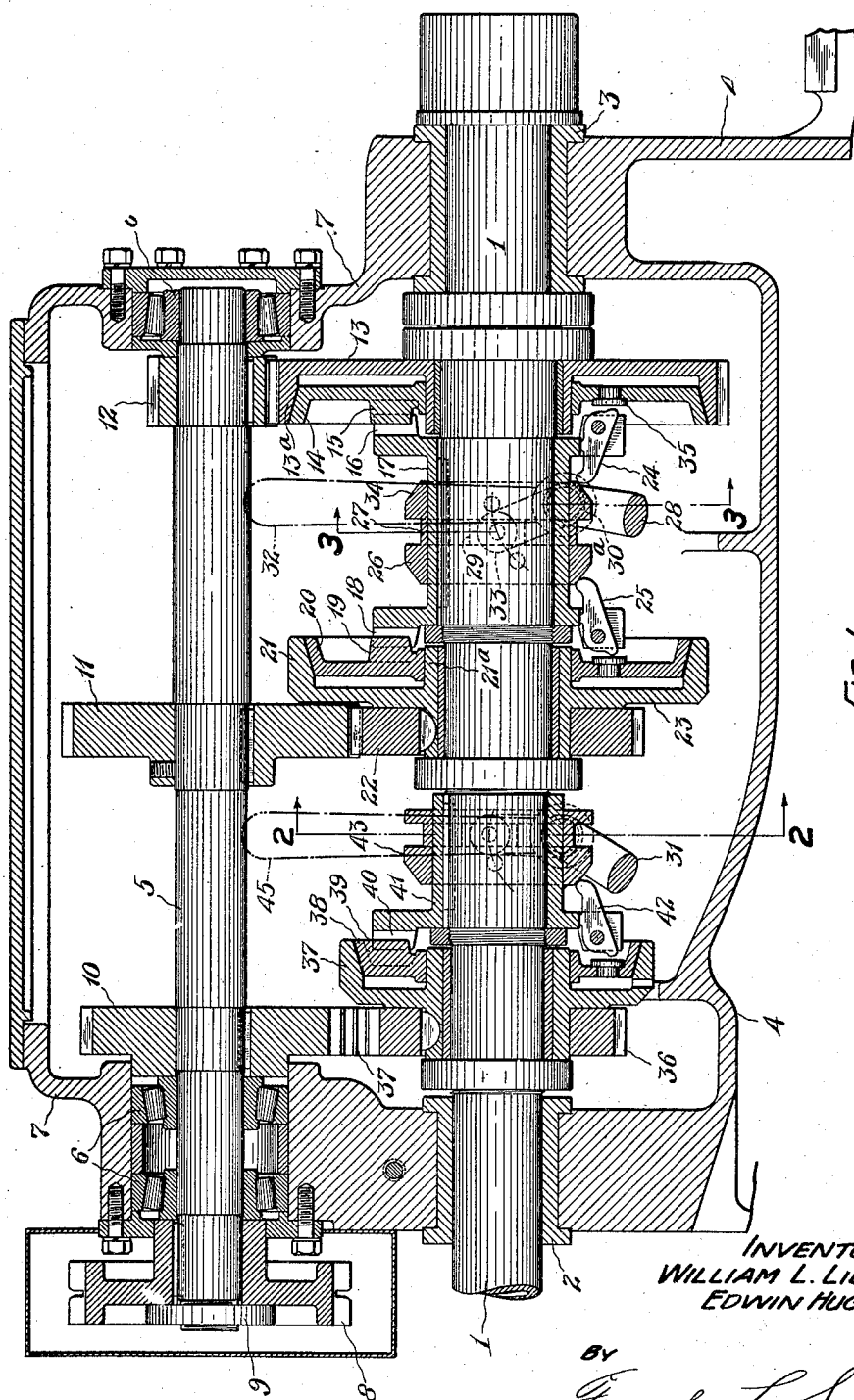


FIG. 1.

INVENTORS:
WILLIAM L. LIBBY
EDWIN HUGO

BY
Frank L. Sullivan
ATTORNEY

Sept. 23, 1930.

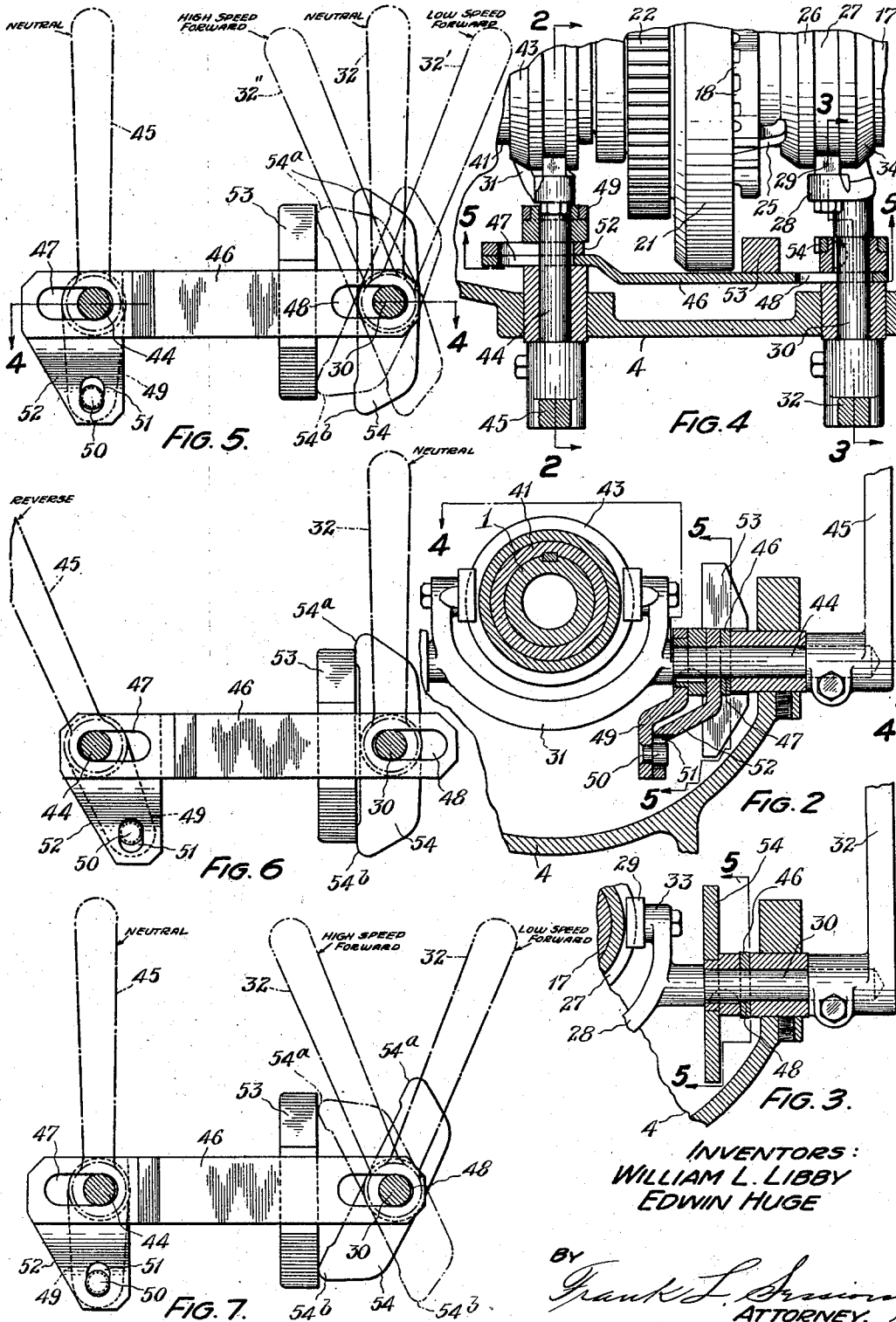
W. L. LIBBY ET AL

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INTERLOCKING CONTROL MECHANISM

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3 Sheets-Sheet 2



INVENTORS:
WILLIAM L. LIBBY
EDWIN HUGO

BY
Frank L. Sweeney
ATTORNEY.

Sept. 23, 1930.

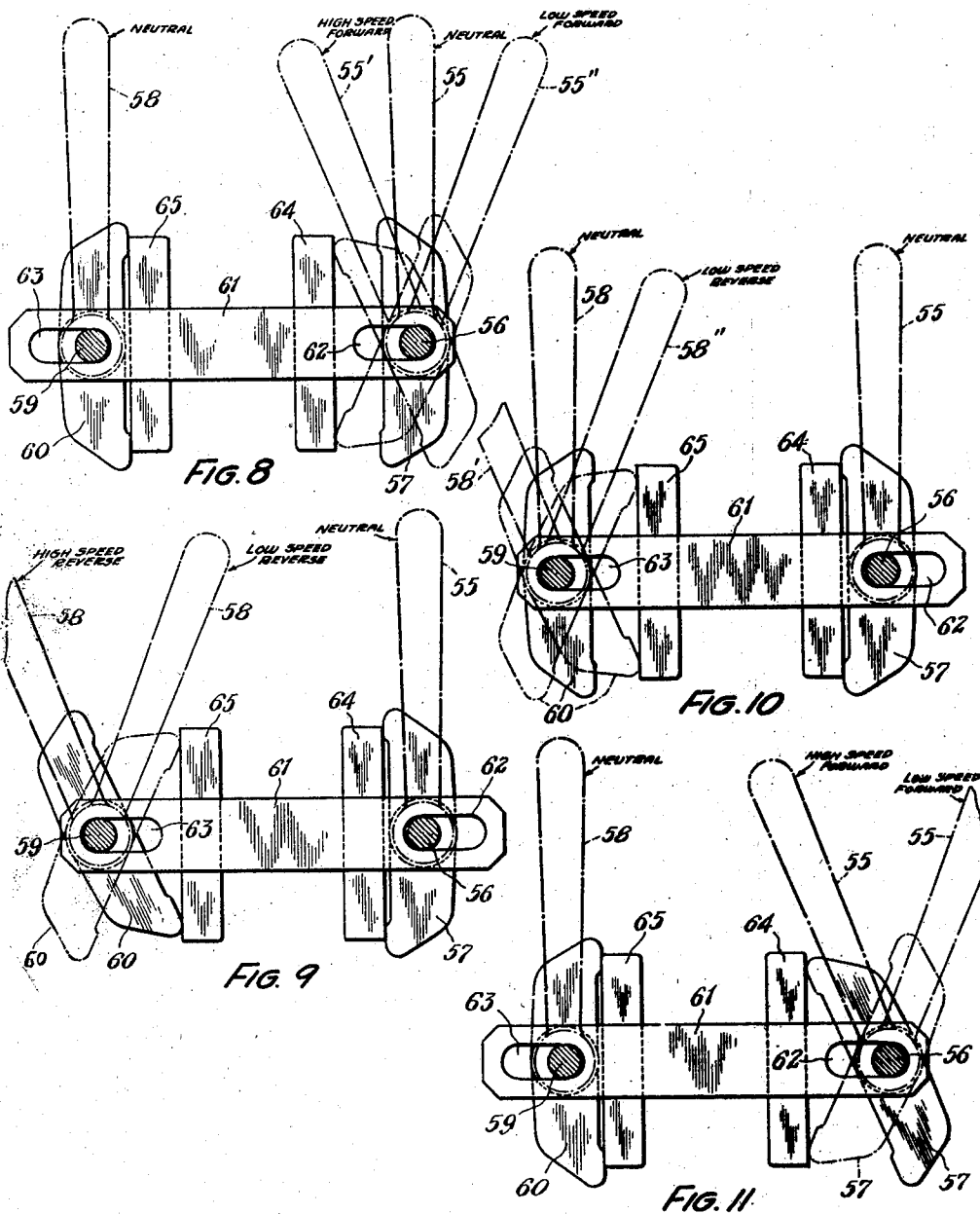
W. L. LIBBY ET AL

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INTERLOCKING CONTROL MECHANISM

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3 Sheets-Sheet 3



INVENTORS:
WILLIAM L. LIBBY
EDWIN HUGO

BY *Frank L. Sullivan*
ATTORNEY

UNITED STATES PATENT OFFICE

WILLIAM L. LIBBY AND EDWIN HUGO, OF CLEVELAND, OHIO, ASSIGNORS TO JOHN G. OLIVER, DOING BUSINESS AS BARDONS AND OLIVER, OF CLEVELAND, OHIO

INTERLOCKING CONTROL MECHANISM

Application filed May 6, 1929. Serial No. 360,828.

Our invention relates to interlocking control mechanism and is especially adapted for use on machine tools. This specification and these drawings describe and show our invention as applied to the spindle drive of a turret lathe which is controlled by a pair of hand levers, one of which controls the forward rotation of the spindle and the other the reverse. In lathes which do not have the forward and reverse control levers interlocked the operator must always make sure that one lever is in neutral position before throwing the other lever into operating position. Thus if the lathe spindle is rotating in a forward direction and it is desired to reverse its direction of rotation, the operator of a lathe not equipped with our invention must first place the forward control lever in neutral and then throw the reverse control lever into operating position. If he fails to do this and throws the reverse control lever into operating position while the spindle is rotating in a forward direction a very severe and harmful load will be placed on the driving mechanism.

Our invention provides means whereby when the operator of the machine moves either control lever into an operating position, the other control lever, if then in operating position, will automatically, positively and simultaneously be thrown into its neutral position. This results in greater speed of operation and removes all danger of damage to the machine through the operator neglecting to place one control lever in neutral before throwing the other into an operating position.

Among the objects of our invention are:

The provision of means for interconnecting and interlocking the movements of a pair of control levers which automatically and positively causes a lever, which is in an operating position, to be moved to the neutral position when the other lever is moved to an operating position.

The provision of means for interlocking the movements of a pair of control levers and the mechanisms which they control whereby it is impossible to place both levers in an operating position at the same time.

The provision of an interlocking control mechanism which may be cheaply and easily made and which occupies but little space.

The provision of means for interlocking and automatically controlling the movements of a plurality of levers and the shafts on which they are mounted which makes it possible for the operator to throw any lever into an operating position without first throwing the levers which are in operating position into neutral.

The provision of means whereby the levers which control the forward and reverse friction drive clutches on a single lathe spindle are so interlocked and interconnected that it is impossible for the operator to cause both a forward and a reverse friction drive clutch to be engaged at the same time.

The provision of apparatus for interlocking and interconnecting a plurality of control shafts with levers mounted thereon, comprising a connecting link extending between said shafts, adapted to cooperate with extensions on said levers to cause any lever, which is in an operating position, to be moved automatically into the neutral position when any other lever is moved into an operating position.

The provision of means for interlocking the movements of control levers whereby if a lever is in an operating position when another lever is thrown from neutral into an operating position, said first named lever will be automatically, positively and simultaneously returned to its neutral position, but if said first named lever is in its neutral position it will not be disturbed by the movement of any other lever into or out of any of said other lever's possible operating or neutral positions.

In the drawings:

Fig. 1 is a vertical longitudinal section through the head stock of a turret lathe equipped with our improved interlocking control levers, both forward and reverse friction driving clutches being shown in the neutral or disengaged position.

Fig. 2 is a vertical section on line 2—2 of Figs. 1 and 4.

Fig. 3 is a vertical section on line 3—3 of Figs. 1 and 4.

Fig. 4 is a plan section on line 4—4 of Fig. 2.

Fig. 5 is a vertical section on line 5—5 of Figs. 2, 3 and 4, showing the interlocking control mechanism with both forward and reverse control levers in the neutral position.

Fig. 6 is a view similar to Fig. 5 but showing the position of the parts when the reversing lever has been shifted into the reverse driving position.

Fig. 7 is a view similar to Fig. 6 but showing the position of the parts when the forward control lever has been shifted into the low speed forward operating position.

Fig. 8 is a view similar to Fig. 5 but showing a modified form of our interlocking mechanism adapted to control forward and reverse operating levers both of which have high speed and low speed operating positions. In this view, the parts are shown with both levers in neutral.

Fig. 9 is a view similar to Fig. 8 but showing the position taken by the parts when the reverse lever is shifted to high speed reverse from the position of the parts as shown in solid lines in Fig. 8.

Fig. 10 is a view similar to Fig. 8 showing both control levers in neutral position but with the connecting link in a different position.

Fig. 11 is a view similar to Fig. 10 but showing the position taken by the parts when the forward control lever is shifted to the high speed forward position from the position of the parts as shown in Fig. 10.

The explanation given above of the views shown in Figs. 5 to 11 inclusive refers to the parts as shown in the solid and heavy dot-dash lines. Each of these figures also show other positions of the parts in light dot-dash lines as will be explained later.

Referring to the drawings:

The hollow rotating spindle 1 is mounted in suitable bearings 2 and 3 which are supported in the main frame 4 of the machine. The countershaft 5 rotates in roller bearings 6 which are suitably supported by the upper casting 7. The sprocket 8 is keyed to one end of shaft 5 and held in position by nut 9. This sprocket may be connected by a silent chain to the driving motor of the machine which is not shown but which may be of any suitable type.

Gears 10, 11 and 12 are mounted on shaft 5 and keyed thereto so that they will rotate with it. Gear 12 meshes with gear 13 which is adapted to rotate freely on the spindle 1. The inside circumference of the gear 13 forms the internal cone member 13^a of a friction clutch. The external cone member 14 of this clutch is mounted on the hub of the gear 13 and can rotate freely thereon. Driving lugs 15 are formed on the web of the external cone

friction member 14 and are adapted to be engaged by the lugs 16 which are an integral part of the sleeve 17. Sleeve 17 is keyed to the hollow spindle 1 and rotates with it. On the opposite end of the sleeve 17 from lug 16 are similar lugs 18 which engage driving lugs 19 on the external cone friction member 20. This external cone friction member 20 is adapted to coact with the internal cone member 21 and is mounted to rotate freely and slide on the hub 21^a of internal cone friction member 21. A gear 22 is keyed to the hub 21^a on the opposite side of the web 23 from the internal cone friction member 21. This gear 22 meshes with and is driven by the gear 11 and as it is keyed to hub 21^a it will rotate freely on the spindle 1 with the internal friction member 21. Friction clutch actuating fingers 24 and 25 are mounted on pins which are supported in projections on the sleeve 17. A double acting wedge member 26 is rotatably and slidably mounted on the sleeve 17. The wedge member 26 has a rectangular groove 27. The yoke 28 is supported by shaft wedge operating yoke 28 has shoes 29 attached to its ends. These shoes 29 fit in groove 27. The yoke 28 is supported by shaft 30 which is mounted in a bearing on the front of the machine as shown in Fig. 3. The yoke 28 is also supported on its rear side by another shaft 30^a which is mounted in the rear of the machine and which is shown in Fig. 1 in dotted lines. Its mounting is the same as that of the yoke 31, shown in Fig. 2. A hand lever 32 (shown in dot-dash lines in Fig. 1) is clamped to the end of shaft 30 which projects out from the machine frame 4.

The above description covers the forward spindle driving mechanism of the lathe. As shown in Fig. 1, all of the spindle controls are in neutral and the spindle is stationary. If it is desired to operate the spindle at low speed forward, the lever 32 is moved to the right, as seen from the front of the machine. This rotates shaft 30 and causes the shoes 29 which are mounted on the ends 33 of yoke 28 to move to the right. As these shoes 29 project into the groove 27 in the wedge member 26 their movement will cause this member 26 to slide to the right on sleeve 17. As this member 26 slides to the right its inclined surface 34 will be pushed under one end of the finger 24. As this end of finger 24 is moved outwardly from the spindle by the inclined surface 34 of wedge member 26, its other end will be forced into contact with and will exert pressure on the button 35 which is mounted in the web of the external cone friction member 14. Thus the friction surface of the external cone member 14 will be forced into contact with the friction surface of the internal cone member 13^a which is on the inner circumference of gear 13. Assuming that at the time lever 32 is thrown to the right the countershaft

5 is being driven, then the gear 13 with its internal cone friction surface 13^a will be driven by gear 12 and will be rotating on the spindle 1. When the external cone friction member 14 engages the internal cone friction member 13^a it will rotate with it and will drive the spindle 1 through lug 15 on the web of member 14 and lug 16 which is integral with sleeve 17 which is keyed to the spindle 1. If it is desired to operate the machine at high speed forward, lever 32 is thrown to the left. This causes wedge member 26 to slide to the left and forces the external cone friction member 20 into engagement with internal cone friction member 21. The gear 22 which is driven by the large gear 11 is keyed to the hub of the internal cone friction member 21, as was above explained.

In the machine illustrated in Fig. 1 provision is made for only one reverse speed. Gear 10 drives gear 36 through an idler gear 37 which is mounted on an independent shaft (not shown). Thus gear 36 is driven in a direction opposite to that in which gears 22 and 13 are driven. Gear 36 is keyed to the hub of an internal cone friction member 37 which is rotatably mounted on the spindle 1. An external cone friction member 38 is rotatably and slidably mounted on the hub of the external cone friction member 37. Lugs 39 on the internal cone friction member 38 coact with lugs 40 on the sleeve 41 in the same manner as lugs 15 and 16, and 18 and 19, on the forward driving friction clutches. An actuating finger 42, similar to fingers 24 and 25, is mounted on sleeve 41. A single wedge member 43 is rotatably and slidably mounted on sleeve 41. The yoke 31 which actuates sleeve 43 is similar to yoke 28 which actuates sleeve 26. It is best shown in Fig. 2. A shaft 44 is attached to yoke 31 and extends out from a bearing in the front of the machine frame 4. Clamped to this shaft is the reverse control lever 45. Assuming that the parts are in the positions shown in Fig. 1 and disregarding our interlocking mechanism, when it is desired to cause the spindle to rotate in the reverse direction, the lever 45 is thrown to the left. This causes the wedge 43 to move to the left, and actuates the finger 42 causing the internal and external friction members 37 and 38 to contact. When these friction members are held together the spindle 1 will be driven in the reverse direction, the operation of the driving mechanism being the same in this case as it is for the forward speeds, with the exception that idler gear 37 is interposed between gears 10 and 36, causing gear 36 to rotate in a direction opposite to that of gears 22 and 13.

It will be evident to those skilled in the art that the spindle driving mechanism described above could be operated without any interlocking mechanism. However, in doing so

the operator would have to exercise very great care in changing from forward speed to reverse or vice versa to be sure that the forward lever was in neutral before throwing the reverse control lever into an operating position or to see that the reverse control lever was in neutral before throwing the forward control lever into an operating position. By means of our interlocking mechanism it is impossible for the operator to throw one of the control levers into an operating position while the other control lever is still in an operating position, as will be explained later.

The link 46 is provided with slots 47 and 48. This link 46 is supported on the yoke operating shafts 30 and 44, the shaft 30 passing through slot 48 and shaft 44 through slot 47. Arm 49 is keyed to shaft 44 and projects down in a direction opposite to that of operating lever 45. A pin 50 is mounted in the lower end of arm 49. This pin 50 fits into slot 51 in the extension 52 on the link 46.

A lever actuating member 53 is attached to link 46 adjacent to the slot 48. A short auxiliary lever 54 is keyed to shaft 30. This auxiliary lever 54 extends above and below the shaft 30 in line with operating lever 32.

Arm 49 may be considered as a part of lever 45 as they are both fixed on the same shaft or fulcrum 44. In like manner auxiliary lever 54 may be considered a part of lever 32 as it is keyed to the shaft or fulcrum 30 to which lever 32 is clamped.

The parts of our interlocking mechanism are best shown in Figs. 2, 3, 4 and 5 of the drawings. For practical reasons, the link 46, arm 49 and extension 52 are offset as shown in Figs. 2 and 4. In explaining the operation of the interlocking mechanism references will be made particularly to Figs. 5, 6 and 7 which show views of the operating levers in broken lines and essential parts of the interlocking mechanism in their various positions.

In Fig. 5 the solid lines and heavy dot and dash lines show the positions of the parts when both levers 32 and 45 are in their neutral positions, and the spindle 1 of the machine is not rotating. The light dot and dash lines of Fig. 5 show how the forward control lever 32 and its auxiliary lever 54 may be thrown into low forward position 32' or high forward position 32''. From this figure it will be seen that the auxiliary lever arm 54 acts as a stop limiting the movement of lever 32 in its high speed forward and low forward speed positions. When in the high speed forward position 32'' the end 54^a of auxiliary lever 54 rests against the upper end of lever actuating member 53 and when in the low forward position 32' the lower end 54^b of auxiliary lever 54 is in contact with the lower end of lever actuating member 53.

Fig. 6 is a view similar to Fig. 5 but showing the positions of the parts when the reverse

lever 45 has been shifted into an operating position. From the position of the parts as shown in Fig. 5, if the forward control lever 32 was in neutral when reverse lever 45 was thrown into operating position, the pin 50 will push against the extension 52 on link 46 and slide the link 46 to the right until lever actuating member 53 contacts with auxiliary lever 54 at both points 54^a and 54^b.

If, however, the forward control lever 32 is in the high speed forward position as shown at 32' at Fig. 5 and the reverse lever 45 is shifted into its operating position the lever actuating member 53 will push against the auxiliary member 54 at 54^a and will throw the forward lever into its neutral position. Likewise, it will be evident that if the lever 32 is in its low forward position as shown at 32' in Fig. 5, throwing lever 45 into reverse will cause the lever actuating member 53 to push against auxiliary lever 54 at 54^b and thus return the forward control lever to its neutral position and the parts will be in the position shown in Fig. 6.

If the parts are in the position shown in Fig. 6 and the lever 32 is thrown into the low forward position the end 54^b of auxiliary lever 54 will push against the end of lever actuating member 53 and slide the link 46 to the left. As link 46 moves to the left the extension 52 of link 46 will push against the pin 50 and thus throw arm 49 and reverse control lever 45 into neutral position. The parts will then be in the position shown by the solid lines and heavy dot and dash lines in Fig. 7. The same result in regard to movement of reverse lever 45 into the neutral position will be obtained if the lever 32 is thrown to the left into the high speed forward position from the position of the parts as shown in Fig. 6, and when this has been done, the parts will be in the position as shown in Fig. 7 with the exception that forward control lever 32 and auxiliary lever 54 will be in the positions shown in the light dot and dash lines.

Figs. 8, 9, 10 and 11 are views similar to Figs. 5, 6 and 7 but showing the various positions of the control levers of a modified form of our invention. These views show a pair of control levers each of which has a neutral and two operating positions. In this way it is possible to control the high and low forward speed and the high and low reverse speed of a lathe spindle. The apparatus shown in Fig. 1 is adapted to give two speeds forward but only one reverse, and in order to secure a second reverse speed it would be necessary to equip such a machine with another drive gear on shaft 5 and another friction clutch on the spindle 1. The two reverse speeds could then be controlled by a single lever in the same manner that the two forward speeds are controlled in the apparatus illustrated in Fig. 1.

In Fig. 8 the forward control lever 55 is keyed to the shaft 56 as is also the auxiliary lever 57. Reverse control lever 58 is keyed to shaft 59. Auxiliary lever 60 is also keyed to shaft 59. Thus lever 55 and auxiliary lever 57 form in effect a single lever the fulcrum of which is shaft 56, and lever 58 and auxiliary lever 60 form a single lever the fulcrum of which is shaft 59. The link 61 has a slot at each end. Shaft 56 passes through slot 62 and shaft 59 passes through slot 63. The slots 62 and 63 are so formed that they allow the link 61 to slide horizontally on the shafts 56 and 59. The lever actuating members 64 and 65 are attached to the link 61 and are adapted to cooperate respectively with auxiliary lever 57 and auxiliary lever 60.

In Fig. 8 the solid lines and heavy dot and dash lines show the position of the parts when both control levers 55 and 58 are in their neutral positions and link 61 is in its farthest left position. The light dot and dash lines in Fig. 8 show how the forward control lever 55 together with auxiliary lever 57 can be moved into either the high speed forward position 55' or the low speed forward position 55'' without changing the position of any of the other parts.

The solid lines and heavy dot and dash lines of Fig. 9 show the positions taken by the parts when the reverse lever is thrown into its high speed reverse position from the position of the parts as shown by Fig. 8. It is immaterial in which of its three positions shown in Fig. 8 the forward control lever 55 may be at the time the reverse lever is thrown into the position shown in Fig. 9. If forward control lever 55 is in neutral, the movement of reverse control lever 58 into its high speed reverse position will cause the lower end of auxiliary lever 60 to push against the lower end of lever actuating member 65, sliding link 61 to the right until lever actuating member 64 is in contact with both the upper and lower ends of auxiliary lever 57. If forward control lever 55 is in the high speed forward position 55' when reverse control lever 58 is thrown into the high speed reverse position as shown in full lines in Fig. 9 the link 61 will be moved to the right as above described and the upper end of lever actuating member 64 will push against the upper end of auxiliary lever 57 forcing it together with control lever 55 into the neutral position.

The same operations will take place if the forward control lever 55 is in its low speed forward position, as shown at 55'' in Fig. 8, when reverse control lever 58 is thrown into high speed reverse. In this case the lower end of lever actuating member 64 will be pushed against the lower end of auxiliary lever 57 to throw the auxiliary lever 57 and the forward control lever 55 into neutral.

The light dot and dash lines in Fig. 9

show the position of the reverse control lever 58 and auxiliary lever 60 when reverse control lever 58 has been thrown into the low speed reverse position from the position shown in Fig. 8. The result of throwing reverse control lever 58 into low speed reverse position is the same as when it is thrown into the high speed reverse position, and the forward control lever 55 will be thrown into the neutral position if it was in either high speed or low speed operating position and will be held in neutral if it was in neutral at the time of shifting the reverse lever 58.

Fig. 10 is distinguished from Fig. 8 in that it shows in full lines and heavy dot and dash lines another possible position of link 61 when control levers 55 and 58 are both in neutral. In this view the link 61 is in its farthest right position. The light dot and dash lines show how it is possible to throw the reverse control lever 58 together with auxiliary lever 60 into either high speed reverse position 58' or into the low speed reverse position 58'' without disturbing the position of any of the other parts.

Fig. 11 is a view showing in full lines and heavy dot and dash lines the position taken by the parts when the forward control lever 55 is shifted from the position shown in Fig. 10 to high speed forward position. When forward control lever 55 is shifted into the high speed forward position as shown in Fig. 11 the reverse lever 58 will be thrown into the neutral position if it is in an operating position or will be held in its neutral position if it is originally in neutral. This will be accomplished by the pressure of the lever actuating member 65 on the auxiliary lever 60 as the link 61 is moved to the left by the pressure of auxiliary lever 57 on lever actuating member 64.

A shift of the high speed control lever 55 together with the auxiliary lever 57 from their neutral position in Fig. 10 into the low speed forward position as shown in the light dot and dash lines in Fig. 11 will accomplish the same results in regard to movement of link 61 to the left and return of reverse control 58 from its operating position to its neutral position.

From the above description and Figs. 8, 9, 10 and 11 of the drawings it will be evident that by means of this modified form of our invention it is possible to control four different spindle speeds by means of two control levers without any danger of having more than one spindle driving means in engagement at one time.

We do not limit ourselves to the exact forms of our invention shown in these drawings and described in this specification, as it will be evident to those skilled in the art that our interlocking mechanism is adapted for interlocking the control levers of many types of machines and may be embodied in forms other

than those described and shown herein without departing from the scope of our invention.

We claim:

1. Interlocking control mechanism of the class described comprising a pair of rotatable shafts, an operating lever mounted on each of said shafts, a link having slots in its opposite ends adapted to fit over said shafts, means attached to said link adapted to co-operate with means attached to said levers to cause said link to move between said shafts when one of said levers is moved into an operating position and the other lever is in an operating position.

2. Interlocking control mechanism of the class described comprising a pair of rotatable shafts, an operating lever mounted on each of said shafts, a link having slots in its opposite ends adapted to fit over said shafts, lever actuating members on said link, each extending both above and below the center line of said shafts and each adapted to contact with one of said levers, whereby when one lever is in operating position movement of the other lever into an operating position will cause said link to be moved toward the lever which is in operating position and one of said lever actuating members to contact with said lever and move it into its neutral position.

3. In apparatus for controlling the forward and reverse rotation of a lathe spindle, a forward control lever, a reverse control lever, means for connecting said control levers to the forward and reverse spindle driving means of the lathe, an interconnecting link extending between the fulcrums of said control levers and having limited movement in a direction parallel to a line drawn through the fulcrums of said forward and reverse control levers, means for connecting said link and said reverse control lever whereby when said reverse lever is moved from its neutral position said link is moved towards said forward control lever, and a lever actuating member attached to said link extending both above and below the common center line of the fulcrums of said control levers and devices associated with the forward control lever for actuating the link in the opposite direction.

4. Mechanism for interlocking a pair of control levers each of which has a neutral position and operating positions, comprising a connecting link adapted to move in a direction parallel to a line drawn through the fulcrums of said levers, lever actuating members attached to said link between said lever fulcrums, and means on the lever co-operating with the actuating members.

5. Mechanism for interlocking a pair of control levers each of which has a neutral position and two operating positions, comprising a connecting link adapted to have limited movement in a direction parallel to

- a line drawn through the fulcrums of said levers, said link having lever actuating portions adapted to contact with auxiliary lever members, made integral with said control levers, at points both above and below the fulcrums of said control levers and having said lever actuating portions so spaced that when one of said control levers is moved into an operating position the other control lever will be held in its neutral position, or, if in an operating position, will be returned to its neutral position by pressure of said lever actuating portion of said link.
6. In apparatus for automatically moving one of a pair of control levers from an operating position into its neutral position when the other of said pair of control levers is moved from its neutral position into an operating position, said apparatus embodying a link having sliding movement on the fulcrums of said levers, a pair of lever actuating members on said link, said lever actuating members being spaced apart a distance less than the distance between said fulcrums of said levers and disposed between said fulcrums.
7. In apparatus of the class described, a pair of control shafts, a control lever attached to each of said shafts, a link extending between said shafts, said link being supported so that it may slide in a direction parallel to a line passing through the longitudinal axes of both said shafts and perpendicular thereto, means for limiting the sliding movement of said link, and lever actuating members on said link adapted to return either control lever which is in an operating position to its neutral position when the other control lever is moved into an operating position.
8. In a mechanism of the type set forth, a shaft or spindle, gearing for driving the shaft at one speed in one direction and at two speeds in the opposite direction, control mechanism for this gearing embodying two levers, one controlling the driving of the shaft at one speed in one direction and the other at two speeds in the other direction, and devices associated with said control levers whereby when either lever is moved into operative position, the other lever if in operative position will be shifted to non-operative position.
9. In a mechanism of the type set forth, a shaft or spindle, gearing for driving the shaft at one speed in one direction and at two speeds in the opposite direction, control mechanism for this gearing embodying two levers, one controlling the driving of the shaft at one speed in one direction and the other at two speeds in the other direction, and devices associated with said control levers whereby when either lever is moved into operative position, the other lever if in operative position will be shifted to non-operative position, said devices embodying a link and means for shifting it endwisely in opposite directions.
- In testimony whereof we hereunto affix our signatures.
- WM. L. LIBBY.
EDWIN HUGO.

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