

March 18, 1941.

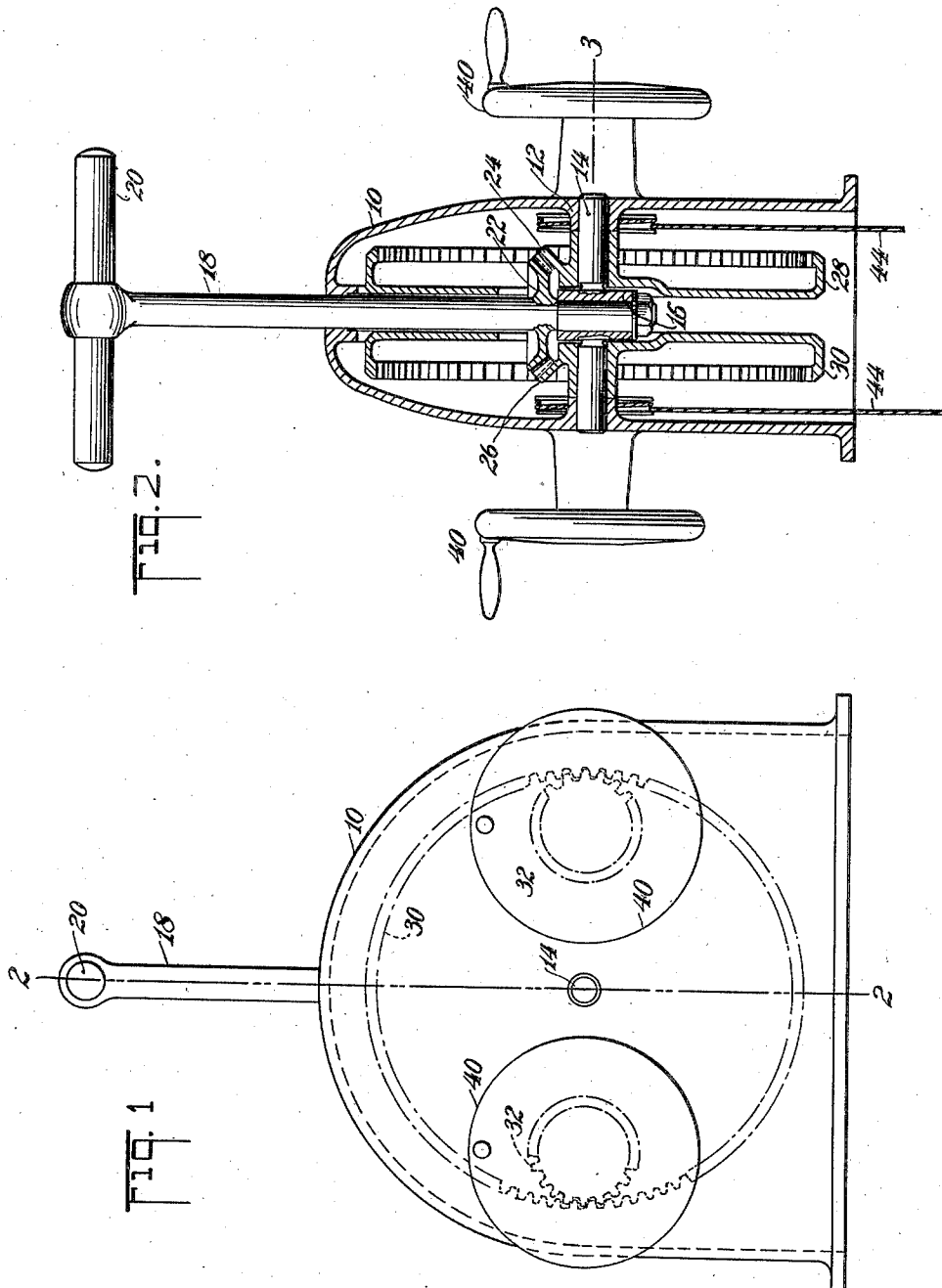
C. C. DE PEW

2,235,013

MULTIPLE CONTROL

Filed Nov. 3, 1936

4 Sheets-Sheet 1



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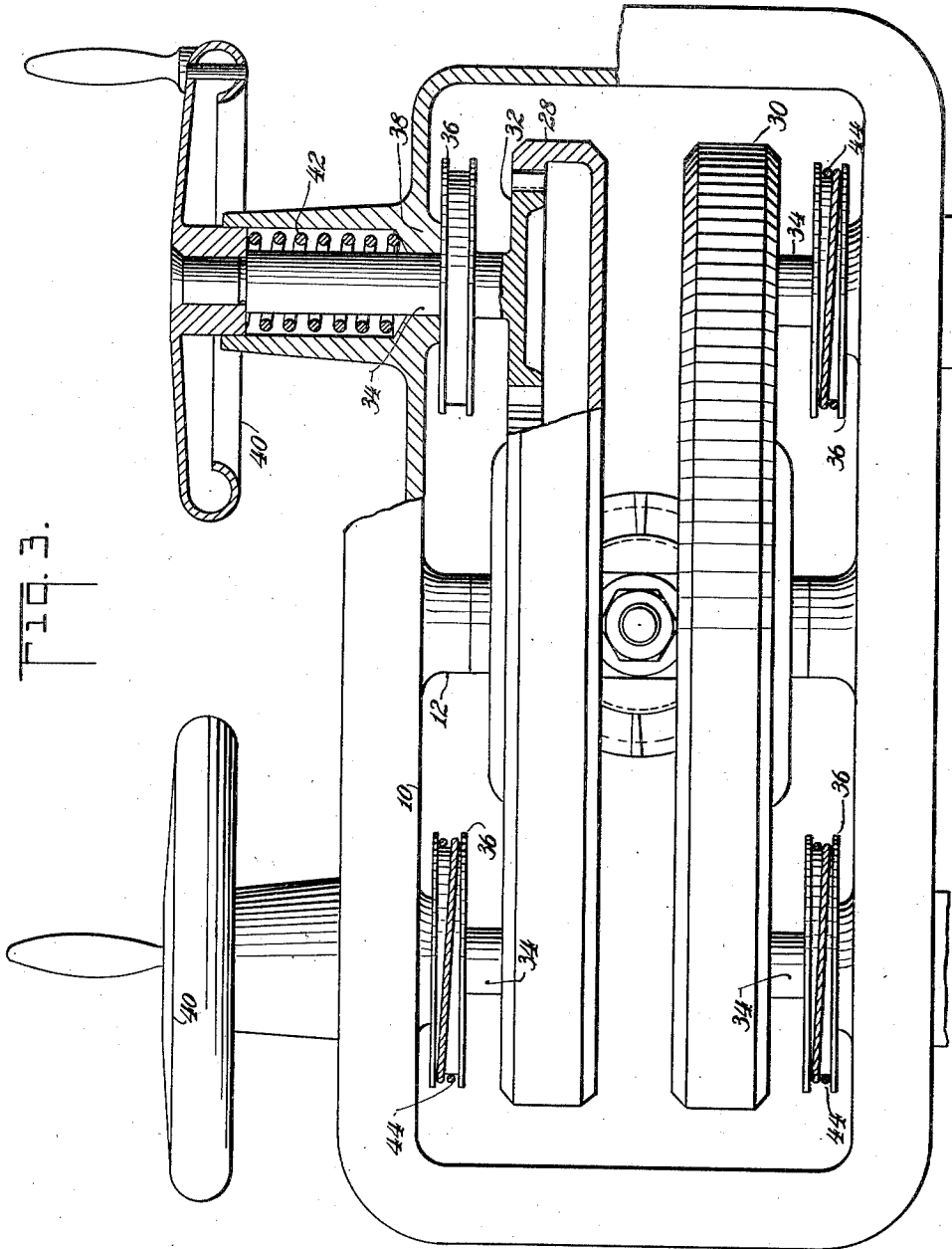
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MULTIPLE CONTROL

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4 Sheets-Sheet 2



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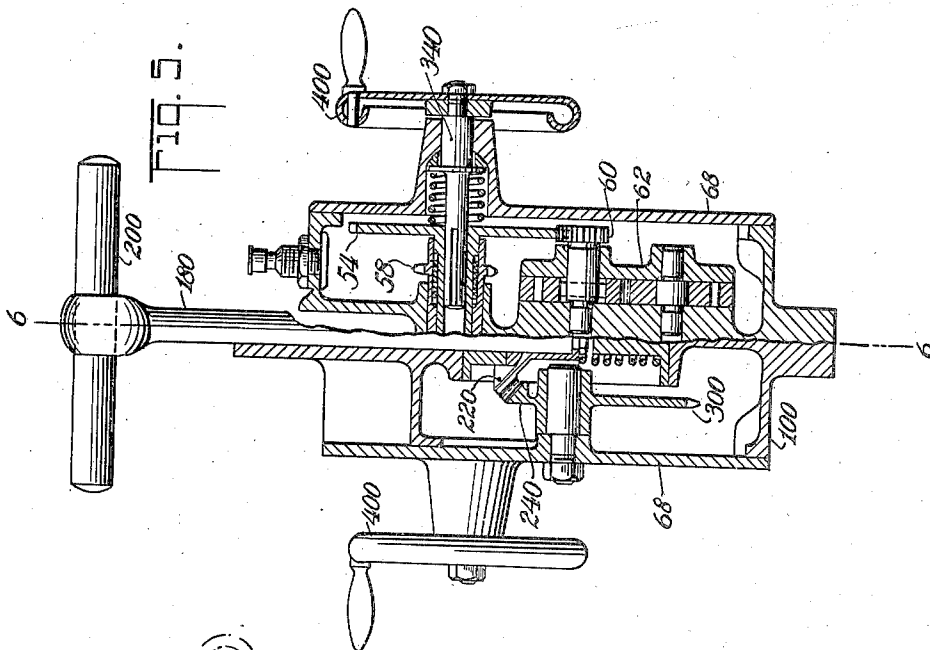
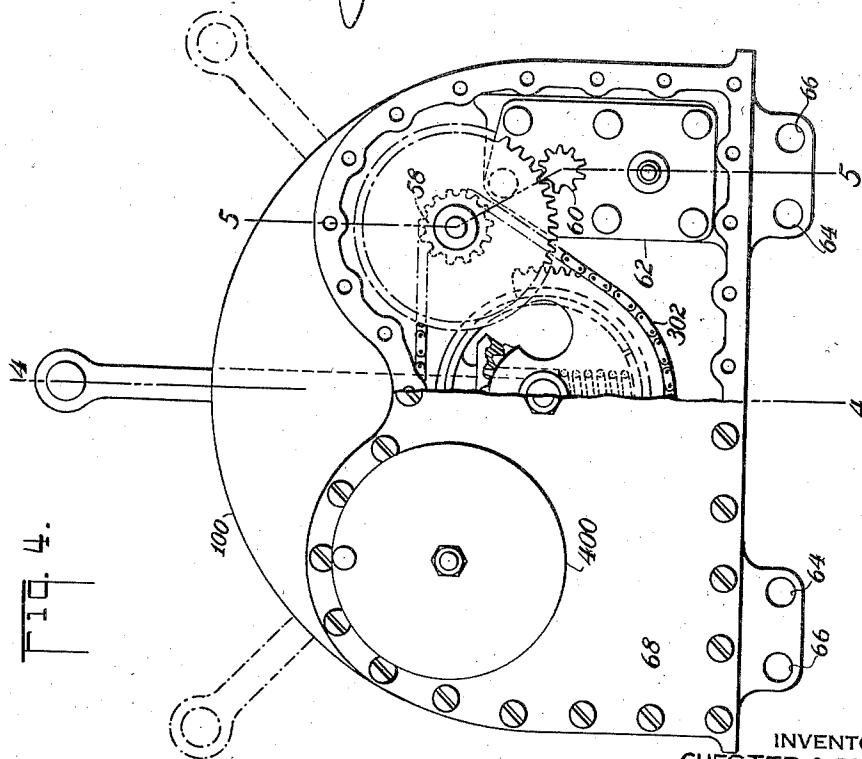
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MULTIPLE CONTROL

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4 Sheets-Sheet 3



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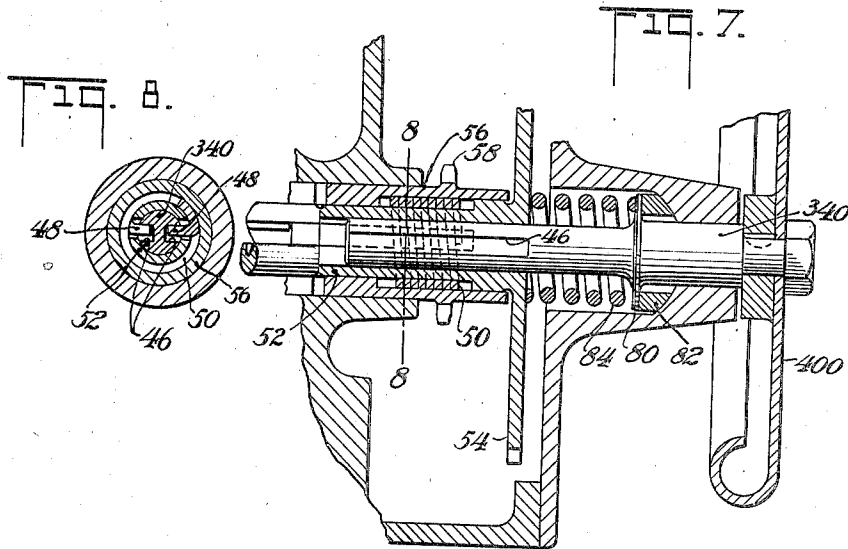
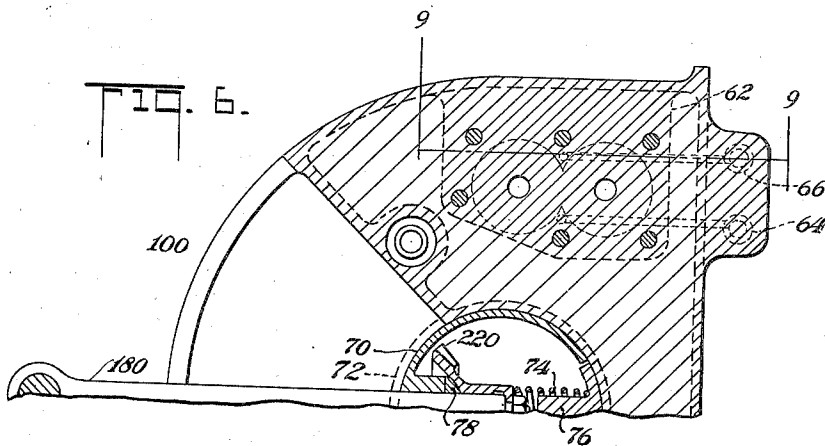
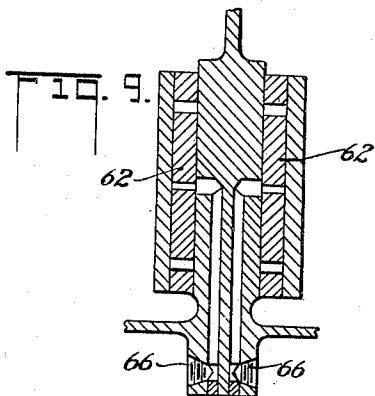
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MULTIPLE CONTROL

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UNITED STATES PATENT OFFICE

2,235,013

MULTIPLE CONTROL

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Application November 3, 1936, Serial No. 108,970

8 Claims. (Cl. 74—389)

This invention relates to multiple controls such as required, for example, in multiple engined aircraft. The specific embodiments of the drawings show an organization suited for installations having four engines which will usually be arranged as inboard and outboard engines on each wing.

Objects of the invention are to provide for a single-lever pilot's control, as for the engine throttle, whereby the power output of all the engines may be varied simultaneously and equally, or whereby certain of the engine throttles may be opened up more than others.

Another object of the invention is to provide simplified means whereby the engines may be synchronized accurately, and whereby any one engine may be operated independently of all the others, as for starting and warming up. Other objects of the invention will be obvious from, or will be pointed out, in the following description, with reference to the drawings, in which:

Fig. 1 is a side view of a simplified embodiment using cable type controls.

Fig. 2 is a section of the line 2—2 of Fig. 1.

Fig. 3 is an inverted plan view, the right hand upper portion being in section on the line 3 of Fig. 2.

Fig. 4 is a side view of hydraulic control embodiment, the right hand half being shown with a cover plate removed.

Fig. 5 comprises, as to its left hand half, a section on the line 4—4 of Fig. 4, and as to its right hand portion, a section on the line 5—5 of Fig. 4.

Fig. 6 is a fragmentary section on the line 6—6 of Fig. 5.

Fig. 7 is a fragmentary enlarged section of a portion of Fig. 5.

Fig. 8 is a section on the line 8—8 of Fig. 7.

Fig. 9 is a fragmentary section on the line 9 of Fig. 6.

Referring first to Figures 1, 2 and 3, there is shown a housing 10 having central bearings 12 in which is mounted a cross shaft 14 having a boss 16 rotatably mounting the lower end of a pilot's control lever 18 equipped with a cross handle 20, the lever 18 being free to swing with shaft 14 and being rotatable on its own axis in the boss 16. The pilot's control lever 18 is equipped with a bevel gear 22 meshed with right and left hand bevel quadrants 24—26 formed integral with internal gears 28—30. Meshed with each of these internal gears are right and left hand pairs of pinions 32 integral with shafts 34 carrying cable drums 36 (Fig. 3). These shafts are supported in suitable bearings 38 and their projecting ends

carry control hand wheels 40 which are abutted by springs 42, whereby the pinions 32 are normally kept meshed with the gears 28—30. Cables 44 are wrapped around the drums 36 as shown. These are lead to the four separate engine controls (not shown) in the usual way. The operation of the embodiment just described is as follows:

When the operator swings the control lever 18 bodily, all of the shafts 34 and cables 44 are given equal and simultaneous control movement so that the cables 44 control all four engines in unison. Should the pilot rotate or twist the cross handle 20 about the longitudinal axis of the lever 18 the bevel gears 22, 24 and 26 will act differentially to advance the controls of the engines of one wing and retard those on the other side. By a combination of these two movements the pilot is able to open up the engines of the right and left hand wings simultaneously, but to different extent. By fine adjustment rotationally of the handle 20 he can also synchronize the right and left hand engines as pairs.

In order to operate any one engine individually, as required for starting, warming up, and individual synchronization, the pilot presses the appropriate hand wheel 40 inward against the spring 42, thus disengaging the associated pinion 32 and permitting individual operation of the engine concerned to any desired setting. As soon as the pilot releases the hand wheel 40, the control will be reconnected to the master control by the spring 42, remeshing the pinion 32. It will now be seen that the pilot not only has simultaneous control of all engines and differential control, as between the pairs of engines on respective wings, whereby he may operate them at equal or different powers by means of a single control handle, but that he may also at any time operate any individual engine, as for starting, or for fine adjustment with respect to the others.

The general operation of the hydraulic embodiment now to be described is the same as that already covered. The structural differences reside in the substitution of hydraulic controls, for the cable controls of the simplified embodiment just described. Also, disengagement of the individual controls in this hydraulic embodiment is obtained automatically by the two way coil clutches, instead of by axial demeshing of pinions 32. In Figs. 4 to 9 inclusive, parts having corresponding functions have been given reference numerals ten times those used in the embodiment of Figs. 1 to 3. In this case, accordingly, the bevel gear 220 of the control lever 180 meshes with bevel quad-

rants 240—260, formed integral with chain wheels 300. The individual shafts 340 are provided with key slots 46 (Figs. 7 and 8) which loosely engage inturned ends 48 of friction coils 50, in which
 5 coils are engaged hubs 52 of gears 54, the coils being themselves engaged in sleeves 56 integral with chain sprockets 58.

A triangular chain drive 302 connects each of the chain wheels 300 to the associated pair of
 10 sprockets 58 whereby all of the four gears 54 are rotated in unison when the handle 180 is swung. The coil clutch bands 50 are arranged to be self-locking when driving force is applied to the
 15 sprockets 58 so that the gears 54 are driven thereby in non-slipping relation. However, the effect of applying a driving force at any one of the hand wheels 400 is to unwind the associated coil band 50 from contact with the sleeve 56 of the associated sprocket 58 by the sides of the grooves
 20 46 engaging the coil ends 48 upon turning of shaft 340, so that the gear 54 may be advanced or retarded independently of the rest of the mechanism, but the parts are locked together for simultaneous movement, except when releasing
 25 torque is applied to one of these hand wheels 400.

The gears 54 are meshed with pinions 60 of conventional gear pumps indicated in general at 62, each of these four gear pumps having inlet and outlet connections 64—66 for connection, by suitable pipe lines (not shown) to hydraulic operating
 30 units at the individual engines.

The housing 100 comprises an oil reservoir, sealed by the cover plates 68, and by the arcuate sealing ring 70 (Fig. 6) which covers the slot 72
 35 required in the housing for the swing of the lever 180. This arcuate split sealing ring 70 is forced upwardly by the spring 74, engaging the arcuate abutment 76, this spring acting on the driving bevel gear 220 to keep it against a sealing ring
 40 78. The leakproof closure of the main housing 100 is completed by shoulders 80 on each of the control shafts 340, which shoulders engage sealing ring 82 under the action of springs 84.

In the two embodiments of the invention illustrated, in the one shown in Figs. 1 to 3, when any
 45 hand wheel 40 is pressed inwardly, its drum 36 is disconnected from the central drive so the hand wheel may be operated in either direction to rotate the drum for controlling the associated engine. In the embodiment of Figs. 4—9, no shift of
 50 a hand wheel 340 is needed. All driven means in the unit are clutched to the central control 200 for operation thereby, but, if any wheel 340 is turned individually, it drives its associated engine controls without respect to the central control 200 or other control wheels 340.
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While I have described my invention in detail in its present preferred embodiment, it will be obvious to those skilled in the art, after understanding my invention, that various changes and modifications may be made therein without departing from the spirit or scope thereof. I aim in the appended claims to cover all such modifications and changes.

What I claim is:

1. A four-way control including in combination, a pair of side bevel gears, a control gear differentially connecting said side gears, two pairs of control shafts geared to said respective side gears, and means for temporarily disconnecting said control shafts for individual operation. 5
2. A multiple control including in combination, two pairs of control shafts, gearing connecting said shafts in pairs, means for controlling said gears simultaneously and differentially, and means for the operation of any of said control shafts independently of said gearing. 10
3. A multiple control including in combination, two pairs of control shafts, gearing connecting said shafts in pairs, differential operating means engaging said gearing, and individual control means for a temporary disconnection of said shafts from said gearing for individual operation. 15
4. A multiple control including in combination, two pairs of control shafts, means connecting said shafts in pairs, differential gears for operating said means, and disengageable connections for the individual operation of any shaft. 20
5. A multiple control including in combination, two opposed groups of spaced control shafts, means drivably connecting the several shafts of each group movable in one sense to effect simultaneous operation, differential means connecting the groups for equal movement thereof and movable in another sense to effect differential movement thereof, and means to disconnect any one shaft for individual operation independently of the other shafts. 25
6. A multiple control including in combination, two pairs of control shafts, a single operating means for operating all said shafts in unison or pairs of shafts differentially, controlled members driven by respective shafts, and means for individually adjusting said members, said members being reversely movable independently of said shaft upon operation of said adjusting means. 30
7. In a control unit, a plurality of spaced shafts each adapted to be connected to mechanism to be controlled, a common control system having driving connections with said shafts for operating said shafts simultaneously, means for operating each shaft individually, and means responsive to the operation of each individual shaft operating means for disconnecting the driving connection between the respective shaft and said common control system. 35
8. In a control unit, a plurality of shafts to be driven, a common control system for said shafts including a sleeve embracing each shaft, and oppositely wrapped spring coils each keyed at one end to each shaft and bearing outwardly against the interior of said sleeve, said coils affording a two-way drive from each sleeve to its respective shaft but permitting individual shaft turning, due to unwrapping of one of the coils relative to the sleeve, to afford individual adjustment of each shaft with respect to its sleeve. 40

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