AUTOMATIC STEERING APPARATUS

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This invention is directed to an improved guiding mechanism for automatically steering a tractor or engine driven plow or the like through the use of a suitable guide furrow, in order that the subsequent operation of the machine, particularly in its proper guiding function, will be automatically controlled.

The primary object of the present invention is the provision of means which will cooperate with an initially formed guide furrow and in such cooperation control, through suitable hydraulic and electric mechanism, the guiding of the machine in accordance with such guide furrow, whereby if a guide furrow is formed to define the outline of the particular field, the machine forming the subsequent furrows will be automatically caused to follow the guide furrow or subsequent furrows until the plowing or other treatment of the field is completed.

A further object of the invention is the provision of a guiding element which directly cooperates with the furrow and controls a switch designed to energize steering control mechanism and through such energization govern the steering of the vehicle or implement.

The invention is illustrated in the accompanying drawings, wherein:

Figure 1 is a perspective view of the invention showing the same in applied position for use.

Figure 2 is a perspective view of a steering knuckle illustrating particularly the means of attachment of the present invention.

Figure 3 is a perspective view of the steering gear illustrating particularly an electric motor drive.

Figure 4 is a more or less diagrammatic view with parts in plan, and parts in section, showing electric and hydraulic control means in accordance with the present invention, together with the guiding element.

Figure 5 is a diagrammatic view of an electric motor for steering control under the influence of the mechanism illustrated in Figure 1.

The invention as illustrated is directed to a bar 2 secured in any appropriate manner at its rear end to the knuckle or hinge 4a cooperating as usual with the front axle 2a of the tractor, the knuckle supporting the front wheel 3a, such wheel being the wheel nearest the furrow. The front end of the bar 2 projects forwardly of the tractor and in advance of the wheel is connected to a lateral member 3 having a bearing 4 in the form of a sleeve projecting above and below the member and at right angles thereto. A spindle 5 is supported in a bearing sleeve 4 for free rotary and vertical movement, a collar 6a adjustable through the medium of a set screw 6b being arranged on the spindle to limit the downward movement of the spindle in the sleeve bearing 4. The spindle 5 is yieldingly held at the downward limit of movement permitted by the collar 6a through the medium of a spring 6c arranged on the spindle below the member 3. The spring 6c limits the relative upward movement of the spindle and also functions as a buffer in such upward movement.

An arm 10 is, through the medium of a clamp plate 10a, adjustably secured near the upper end of the spindle. A plate 10a is secured to and depends from the upper end of the spindle, being formed with a plurality of openings for the adjustable reception of a hook to which the upper end of a coiled spring 11 is secured. The lower end of the coiled spring is connected to an extension of a yoke-like member forming a control guide 7, the arms of which are connected by a pivot pin 6 arranged to pass through the outturned lower end of the spindle 5. The control guide 7 is made up of a yoke member, on the free ends of the arms of which are slidably secured legs 8, the lower or free ends of which are outturned. The slideable relation of the legs 8 to the yoke member provides for the adjustment of the length of the control guide openings in the legs and in the arms of the yoke member being designed to be connected by a through pin to provide for adjustably connecting the legs to the arms of the yoke member.

The outturned free ends of the legs 8 constitute the ground engaging elements for initially inaugurating the steering operation of
the vehicle, and obviously these free terminals of the arms or legs are held in contact with the ground under a yielding pressure through the influence of the spring 11. As the control guide is turned in one direction or the other according to the direction of the wall of the furrow with which the control guide cooperates, spindle 5 is also turned, compelling a corresponding movement of the arm 10.

One end of the arm 10 remote from the spindle is provided with a fixed depending rod 12 on which is swingingly supported one end of a link 13. The opposite end of the link 13 is connected to a lever 15 pivotally supported at 16 on a box 18 secured on the arm 2. One end of the lever 15 carries a pin 17 operating through a slot in the box and engaging a switch arm 19 for the electrical control of the steering mechanism according to the movement of the lever 15 in response to the actuation of the spindle 5 through the medium of the guide control including the yoke 7 and the legs 8. The steering elements may be governed electrically or hydraulically, with the hydraulic mechanism electrically controlled.

With more particular reference to Figure 4, it will be noted that the switch lever 19 operates over a dielectric base 23 arranged in the box 18 and between contacts 21 and 22. The switch lever 19 is in circuit with a battery 24 through the medium of conductor 19c. The contact 21 is in circuit with a relay 25 and the armature controlled by this relay governs a circuit including a solenoid 26 having an electromagnet 27 and a movable armature 28.

The switch contact 22 is in circuit with the relay 24, the armature controlled by which governs a circuit including a solenoid 27 having an electromagnet 28 and an armature 29. A valve mechanism is arranged intermediate the solenoids 26 and 27 including a casing 30 having an exhaust port 31. Inlets 41 and 42 leading from a pump having inlet and outlet valves 44 and 45 and a piston 46 operated by a crank or other driver 47, the pump acting through a conventional pressure reservoir 143.

Arranged in the valve cylinder 33 is a valve rod 31 connected to the respective armatures 27 and 38 of the solenoids 26 and 37, and on the valve rod is arranged valves 32 and 35 controlling outlet pipes 48 and 49 leading from the valve cylinder and obviously, according to the solenoid actuated, placing a particular outlet pipe in communication with an inlet pipe from the pump, while at the same time the other outlet pipe is placed in communication with the exhaust 34. The outlet pipes 48 and 49 are so arranged that they may be placed in communication through the medium of a control valve 39, such outlet pipes, however, communicating directly with the respective ends of a power cylinder 51 within which is arranged a piston 52 connected to a piston rod 53.

Springs 29 and 36 are arranged between the respective armatures 27 and 38 and the ends of the valve cylinder 33 to assist in valve rod movement. A pressure adjustment chamber 144 is in communication with the pump cylinder and with a pressure equalizing cylinder 143. This pressure equalizing chamber has an exhaust pipe 145 and a release valve 146, the latter being connected through the medium of a spring 147 with a hand wheel controlled adjusting rod. The control of the valve 146 obviously controls pump pressure.

The piston rod 53 may be connected in any suitable manner for the actuation of the steering mechanism (not shown) so that in movement of the piston rod in one direction, steering of the tractor will follow in a predetermined direction, the opposite steering of the tractor being accomplished by the movement of the piston rod in the opposite direction. Thus, if the switch 19 is turned in one direction, the appropriate solenoid is energized and the armature thereof actuated and the valve rod moved with the valves to admit fluid pressure from the pump to one side or the other of the piston 52 and so automatically steer the vehicle. Of course, this steering operation is maintained as long as the circuit is maintained, so that the turning or steering movement is incident to the closing of the appropriate circuits and the latter directly governed by the guide control, as previously indicated.

The inlet pipes 41 and 42 from the pump communicate with a pipe 148 which terminates in a jet 149 in a pressure cylinder 150 provided with a manually controlled release valve 151. The release valve is operated by a lever 152 having a steering controlled lever 154 through an intermediate wire connection 153. The lever 154 is connected in any appropriate manner with the steering gear of the tractor so that the release valve is actuated only when the steering gear has moved to the extreme limit position in either direction. An auxiliary cylinder 155 is in communication with the cylinder 150 and has arranged therein a piston 156 through which is connected a piston rod 157, the piston being spring pressed in one direction by a spring 158. The ignition circuit of the tractor is controlled in the movement of the piston rod 157. When the steering gear of the tractor is turned to its extreme position, valve 151 is opened and the pressure in cylinder 150 thereby slowly reduced, the reduction, however, being greater than the increase of such pressure possible through the pressure in the jet 149. Therefore, if the steering gear remains at the extreme limit for a comparatively long time, the
pressure in cylinder 155 is so reduced that the spring 158 acts to move the piston 156 in a direction to cause the piston rod 157 to break the connection between the spaced 
points 159 of the ignition system, the operation being carried out by moving a bridging bar 159e through the medium of hook elements 160a on the piston rod 157 and on the bridging bar. The hook elements, of course, may be disconnected, if desired, manually to prevent any control of the ignition circuit or connected to provide for the automatic control of the ignition circuit to 
top the tractor when the latter has been 
deflected to one or the other steering limits 
for a long period. Thus the automatic 
ignition control will stop the tractor if the 
rear leaves the course of the guide furrow 
entirely, though obviously when extreme 
steering results from turning a sharp 
corner, the valve 151 will naturally be opened 
before the period is too short to permit a 
sufficient reduction of pressure in the cylin 
der to insure operation of the bridging bar 
to break the ignition circuit.

In Figure 5 is shown diagrammatically 
an electric motor adapted to be mounted 
upon or adjacent to the steering column of 
the tractor and to be connected thereto by 
the toothed wheels 160—161 (Figure 3) or 
by any other suitable means. This electrical 
apparatus includes a contact lever 19 in 
intermediate pivoted at 20 and opposite 
contacts 21 and 22, dielectric 23 and battery 
24 as before described. The motor is indi 
cated at 55, the poles thereof at 56, the 
armature at 57 and commutator at 58. Re 
lays are indicated at 59 and 60, the whole 
being wired so that the motor is operated 
by the battery current to correct the steering 
through any suitable gearing, such as the 
the toothed pinion 161 mounted upon the 
shaft of the motor and the spur wheel 160 
mounted upon the steering column of the 
tractor (Figure 3), immediately the con 
tact lever 19 makes contact with either of 
the contacts 21 or 22. In both Figures 4 
and 5, the wiring carrying the main current 
is shown in heavy lines, while the wiring 
carrying the small relay operating current 
is shown in fine lines.

When the steering wheels of the tractor 
are deflected to either the right or the left, 
the movement is communicated to the con 
trol lever 7 and the switch lever 19 is oper 
ated. The lever by making contact com 
pletes a circuit and permits the current from 
the battery to energize the relative relay, 
thereby closing its contacts and energizing 
the electro-magnet of the relative solenoid, 
thereby attracting its armature and moving 
the pistons 32 and 35 along the cylinder 38. 
Obviously, when the piston 32, for example, is 
moved to the left by energization of the sole 
loid 37, the right inlet pipe 41 and transfer 
pipe 48 are placed in communication and 
pressure fluid from the pump cylinder 43 
enters the right hand side or end of the cylin 
der 51, forcing the piston 59 to the left and 
therewith any suitable gearing or sys 
tem of links and levers correcting the steer 
ing of the tractor.

It will also be obvious that when the pipes 
41 and 48 are in communication, the left 
transfer pipes 49 are in communication with 
the exhaust port 34, thereby permitting dis 
charge from the cylinder 51 of the fluid dis 
placed by the piston 52. The exhaust fluid 
may be returned to a supply vessel or tank 
(not shown) from which the pump cylin 
der receives or draws its supply. By means 
of the valve 60, the right and left transfer 
pipes 48 and 49 are placed in communication, 
and operation of the piston 52 neutralized. 
It will be obvious that the pressure in the 
reservoir 143 may be regulated by the valve 
146—147. Pressure in the cylinder 150 is 
increased under the control of the jet 149.

The present invention avoids the disadvan 
tages of a wheel which, for example, tends 
to continue on in a straight line when subjected 
to deviation, and it also avoids the compara 
tively slow movement of such arrangements 
and, further, avoids imposing any material 
resistance to movement of the guiding de 
vice by reason of connecting links or 
gear which themselves receive resistance 
from the steering wheels or gear of the tractor. 
The guiding device hereinafore described 
is very sensitive in its action and moves freely 
in the guide furrow. This is essential, parti 
cularly in sandy soil and the like and when 
using a shallow groove or guide furrow.

Further, the present invention does not at 
tempt to manipulate the steering wheels or 
gear of a tractor directly from the control 
guide device by links, gearing and the like, 
but employs the said device to manipulate or 
cause substantially an immediate operation 
of effective intermediate apparatus which 
possesses or develops sufficient power to at 
once correct the steering of the tractor with 
out conveying or imposing the burden to or 
upon the control guide. Such apparatus may 
be of an electric, hydraulic, pneumatic or like 
nature. By use of the present invention, a 
field may be completely ploughed without an 
atendant to or upon the tractor, and it is con 
sidered that this result is achieved by reason 
of the sensitivity of the control guide device 
which turns under very slight and almost im 
perceptible side draft or pressure, and also 
by the provision of such means as will at 
one release or apply to the steering gear of 
the tractor power sufficient to align the trac 
tor with the guide furrow very quickly.

I claim:

1. Improvements in or relating to auto 
matic steering apparatus for tractors drawing 
ploughs or the like, consisting in an hydraulic
device adapted to control and/or correct the steering gear of the tractor, means for electrically operating the hydraulic device, and a sensitive control guide device adapted to move along a guide furrow and adapted to operate the electrical means synchronously with deviating movement of the said control guide device in the said guide furrow.

2. Improvements in or relating to automatic steering apparatus for tractors drawing ploughs or the like, consisting in an hydraulic device adapted to control and/or correct the steering gear of the tractor means for electrically operating the hydraulic device, a sensitive control guide device adapted to move along a guide furrow and adapted to operate the electrical means synchronously with deviating movement of the said control guide device in the guide furrow, and means for stopping the tractor should it depart from the guide furrow line.

3. Improvements in or relating to automatic steering apparatus for tractors drawing ploughs or the like, consisting in a pump, an hydraulic device adapted to control and/or correct the steering gear of the tractor, means for electrically controlling the pressure supply from the pump to the hydraulic control means, a switch controlling the electrical means, and a sensitive control guide device adapted to move along a guide furrow and adapted to operate the switch synchronously with deviating movement of the said guide device in the guide furrow.

4. Improvements in or relating to automatic steering apparatus for tractors drawing ploughs or the like, consisting in a pump, an hydraulic device adapted to control and/or correct the steering gear of the tractor, means for electrically controlling the pressure supply from the pump to the hydraulic control means, means for varying the pressure of the hydraulic supply when the steering gear of the tractor is turned to its extreme position, means for stopping the tractor after a predetermined reduction of pressure has occurred, a switch controlling the electrical means, and a sensitive control guide device adapted to move along a guide furrow and adapted to operate the switch synchronously with deviating movement of the said guide device in the guide furrow.

In witness whereof I have signed this specification.

MAURICE GIBBONS EAGLE KNIGHT.