# United States Patent

**Prescott**

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## [54] MOTOR OPERATED TAP CHANGER EMPLOYING CONTACT DRUM SWITCHES


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[52] **U.S. Cl.** .....**323/43.5 R**

[51] **Int. Cl.** .....**H02p 13/06,** G05f 1/14

[58] **Field of Search** .....323/43.5 R; 336/150; 318/54, 318/65, 280



[56] **References Cited**

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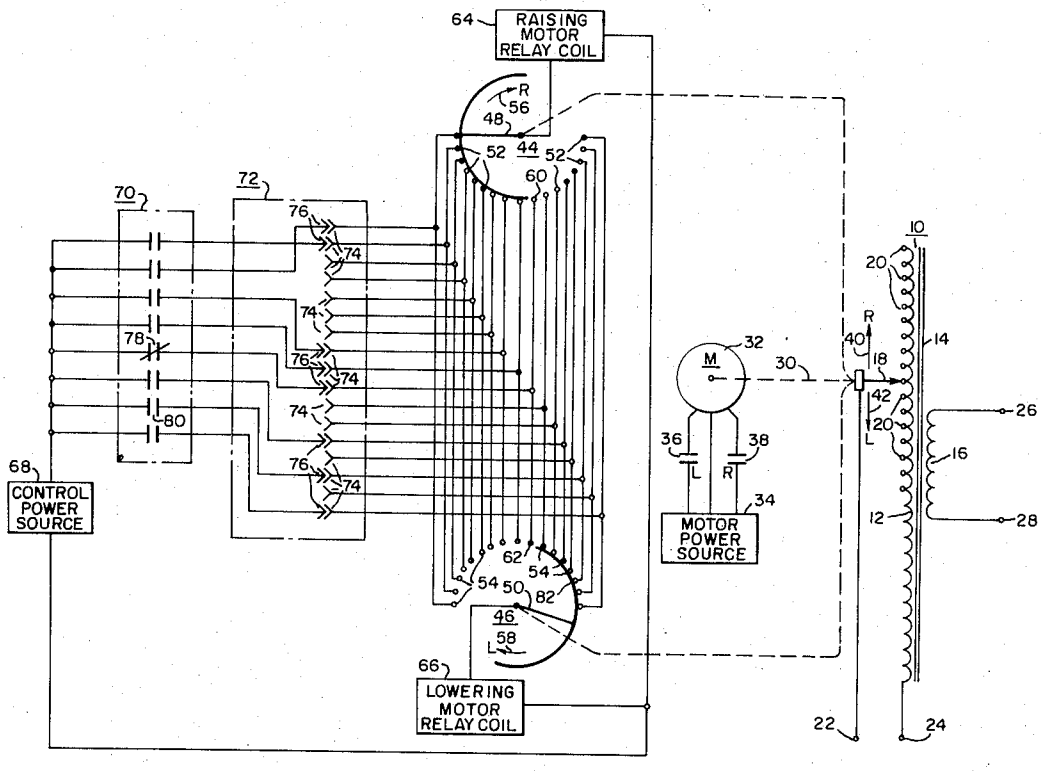
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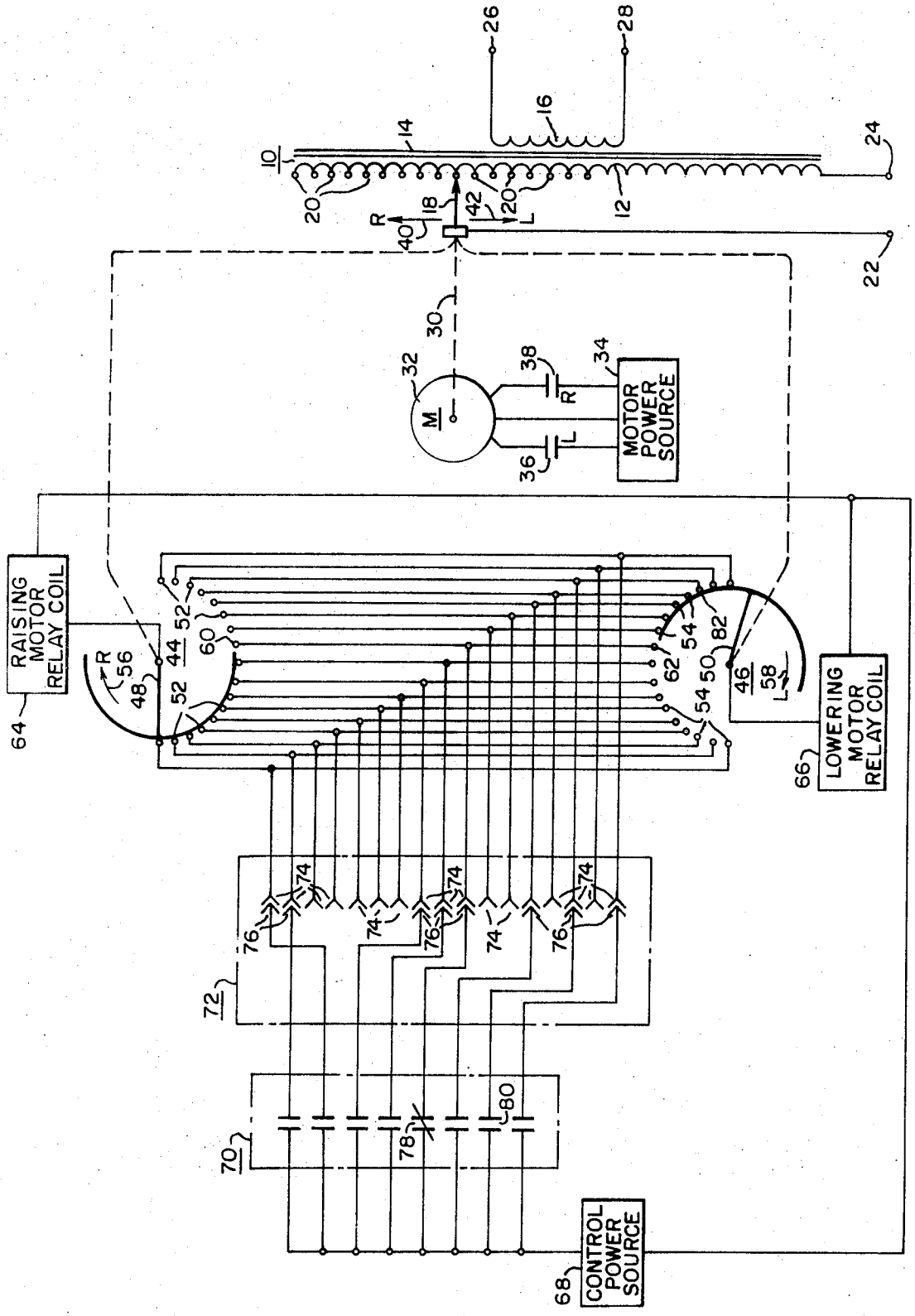


[57] **ABSTRACT**

Tap position selector device for controlling a motor operated tap changing mechanism. A selector switch is connected to two multiple contact drum switches. The drum switches are interconnected so that one drum switch conducts only when the selector switch requires that the tap position be raised and the other drum switch conducts only when the selector switch requires that the tap position be lowered. The movable contacts of both drum switches move with the tap changing mechanism.


**4 Claims, 1 Drawing Figure**




26
28
16
14
10
24
20
18
42
20
L
12
R
40
22
30
32
38
34
M
R
MOTOR POWER SOURCE
L
36
RAISING MOTOR RELAY COIL
64
R
56
48
44
52
52
60
54
82
62
54
50
46
58
L
LOWERING MOTOR RELAY COIL
66
74
74
74
74
74
76
76
76
72
70
78
80
CONTROL POWER SOURCE
68

# MOTOR OPERATED TAP CHANGER EMPLOYING CONTACT DRUM SWITCHES

## BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates, in general, to electrical inductive apparatus and, more particularly, to control circuitry for motor activated tap changers.

2. Description of the Prior Art

Changing taps on a tapped winding is usually accomplished with the aid of a set of fixed and movable contacts. The fixed contacts are connected to the tap leads of the tapped winding and the movable contacts are connected to the source or load which is being electrically connected to the tapped winding. In high power applications, especially in underload tap changers, the movable contacts are frequently moved by a mechanical means which is driven by an electric motor. The motor is operated manually by a tap position selector switch or automatically by means of computer or error detector devices.

The associated control circuitry required to energize the tap changing motor and deenergize it when the correct position is reached, according to the prior art, is relatively complex. The complexity of the position selector control circuitry increases as the number of tap positions increases. According to the prior art methods, a separate drum switch is required for each tap position. As the number of tap positions desired is increased to achieve greater regulation or input control, the economic feasibility and reliability of the control circuitry is substantially degraded. Therefore, it is desirable to provide a tap position selector device which readily permits multiple tap position selection without the need for an excessive number of drum switches.

It has also been characteristic of prior art tap control circuitry to require a complicated switching network to activate the control circuitry. It is desirable to provide a control circuit which can be activated by a single set of contacts for each tap position desired.

Certain tap changing applications require that only a portion of the taps be used during a particular period of time or during a certain type of operation. Welding applications frequently use different heat ranges for different work pieces. Thus, it is desirable to provide a control circuit which can readily select all the taps required during a particular operation or application while being versatile enough to select other tap positions for different operations with a minimum amount of circuit changes.

## SUMMARY OF THE INVENTION

This invention provides a new and improved position selector switching device for use with tap changing mechanisms. Only two drum switches are required regardless of the number of tap positions available. A selector switch, having a separate set of contacts for each tap position desired, is connected through a jack panel to the two drum switches. The jack panel is used to select the winding tap positions which will correspond to the desired position of the selector switch.

When a set of contacts on the selector switch are closed, a current flows through these contacts, through one of the drum switches and through a motor relay. If the selector switch contacts correspond to a higher tap position, the drum switch which is connected to the tap raising relay conducts. If the selector switch contacts correspond to a lower tap position, the drum switch which is connected to the tap lowering relay conducts. The movable contact assembly of the drum switches are mechanically connected to the tap changing contact drive mechanism. The motor will continue to run until the movable contact obtains a position where the switch does not conduct. The tap changer retains this position until the selector switch is changed.

## BRIEF DESCRIPTION OF THE DRAWING

Further advantages and uses of this invention will become more apparent when considered in view of the following detailed description and drawing, in which there is shown schematically a position selector circuit constructed according to this invention.



## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Throughout the following description similar reference characters refer to similar elements in all parts of the drawing.

Referring now to the drawing, there is shown tap changing apparatus constructed according to this invention. A transformer **10** which is associated with the tap changing apparatus includes a tapped winding **12**, a magnetic core **14** and a winding **16**. A movable tap contact assembly **18** electrically connects a tap terminal **20** to the terminal **22**. The terminals **22** and **24** and the terminals **26** and **28** may be connected either to a load circuit or to a power source. That is, the tapped winding **12** may be used to supply energy to the transformer **10** or supply energy from the transformer **10** to an external load.

The basic arrangement shown for discussion in the drawing would be used in no load tapping service. However, this invention is also applicable to load tap changers. The movable tap contact assembly **18** in load service may be attached to or synchronized with other movable contacts to prevent interrupting the winding current while changing taps.

The movable tap contact assembly **18** may be a rotating arm having an arc of rotation such that the contacts **20** may be placed along the arc. The movable tap contact assembly **18** and the tap terminals **20** may also be aligned in linear relationship. The movable tap contact assembly **18** is attached by a drive mechanism **30** to a motor **32**. The drive mechanism may include a combination of gears to change the speed of the motor **32** to the desired speed for moving the movable tap contact assembly **18**. The motor **32** is powered by a motor power source **34** and controlled by a lowering relay contact **36** and a raising relay contact **38**. When the lowering relay contact **36** is closed and the raising relay contact **38** is opened, the motor **32** operates in a direction which lowers the movable tap contact assembly **18**, thus effectively decreasing the turns of the winding **12**. When the raising relay contact **38** is closed and the lowering relay contact **36** is opened, the motor **32** operates in a direction which raises the movable tap contact assembly **18**, thus effectively increasing the turns of the winding **12**. Arrows **40** and **42** respectively indicate the raising and lowering directions of the movable tap contact assembly **18**.

The multiple contact rotary drum switches **44** and **46** respectively include rotary or movable drum contacts **48** and **50** and fixed drum contacts **52** and **54**. The number of fixed drum contacts for each switch is dependent upon the number of tap positions desired for selection. As illustrated, each drum switch, **44** and **46**, includes **17** fixed drum contacts **52** and **54**, respectively, although this invention applies to drum switches having different numbers of fixed drum contacts. The drum switches **44** and **46** are arranged so that the fixed drum contacts **52** and **54**, respectively, are capable of contacting the movable drum contacts **48** and **50**, respectively. The movable drum contacts **48** and **50** are capable of contacting any number of the fixed drum contacts **52** and **54**, respectively, which are adjacent. That is, the movable drum contact may contact any one fixed drum contact or any number of adjacent fixed drum contacts up to the maximum number of fixed drum contacts on the switch.

The movable drum contacts **48** and **50** are connected with the drive mechanism **30** so that when the movable contact assembly **18** moves, the movable drum contacts **48** and **50** move also. The direction of movement of the movable drum contacts **48** and **50** is indicated by the arrows **56** and **58**, respectively. The movable drum contacts **48** and **50** move the same number of positions as the movable contact assembly **18**. For example, when the movable contact assembly **18** changes three tap positions, the movable drum contacts **48** and **50** change three positions of the fixed drum contacts **52** and **54**, respectively.

The fixed drum contacts **52** and **54** are interconnected as shown in the drawing. The movable drum contacts **48** and **50** are always positioned so that one pair of fixed drum contacts is not in contact with either of the movable drum contacts **48** and **50**. The fixed drum contacts **60** and **62** are shown with this relationship in the drawing. The movable drum contact **48** is electrically connected to a raising motor relay coil **64**, and the movable drum contact **50** is electrically connected to a lowering motor relay coil **66**. The coils **64** and **66** are connected, as shown, to a control power source **68**. The control power source may be of any type which is sufficient to activate the relay coils **64** and **66**.

A selector switch **70** and a jack panel **72** are connected as shown in the drawing. The jack panel **72** comprises jacks **74** and plugs **76**. The jacks **74** and the plugs **76** may be of any type which can be easily interchanged and are capable of safely handling the power level involved. The jack panel **72** may or may not be mounted physically close to the drum switches **44** and **46**. The purpose of the jack panel **72** is to allow convenient circuit changes of the selector control circuit to make it versatile and compatible with a wide range of tapping requirements. For example, one operation of the tap changer may require that the leads coming from the selector switch **70** be plugged into the jack panel **72** as shown in the drawing to obtain a specified relationship between the selector switch **70** position and the winding tap position. Another operation may require a different relationship, thus the plugs may be readily rearranged to provide the desired relationship. This situation exists in many types of high power industrial resistance welding applications. A particular piece being welded may require several different current settings while another piece may require other settings. The jack panel affords a relatively simple means for setting up the control circuit to furnish the desired taps.

The selector switch **70** may or may not be positioned physically near the drum switches **44** and **46** or the tapped transformer **10**. The selector switch **70** is represented in the drawing by the eight sets of contacts, however, any number equal to or less than the number of tap positions available may be used. The contacts may be interlocked so that only one set can be closed simultaneously. The contacts may be connected to, or replaced by, computer or error detector outputs so that the tapping operation may be controlled automatically.

The drawing represents the state of the circuit after a tap change has been made. That is, the motor **32** is not running. If it is desired to change the tap position, a contact of the selector switch **70** corresponding to the tap position desired is closed. For example, when the contact **78** is opened and the contact **80** is closed, a current path exists through the jack panel **72**, the fixed drum contact **82**, the movable drum contact **50** and the lowering relay coil **66**. This closes the contacts **36** and energizes the motor **32**, thus the movable contact assembly **18** moves in a lowering direction. The movable drum contact **50** rotates in a clockwise direction and the movable drum contact **48** rotates in a counterclockwise direction. This rotation continues until the movable drum contact **50** does not contact the fixed drum contact **82**, at which time the current path is interrupted and the motor **32** is stopped. The tap changer retains this position until the selector switch **70** is changed by closing another set of contacts. The tap raising procedure is similar except that the direction of movement of the movable contacts is reversed.

I claim as my invention:



**1.** A position selector control device for tap changing apparatus comprising first and second rotary drum switches each having a rotary contact assembly and a plurality of fixed contacts, said rotary contact assemblies being connected to a motor which moves the tapping contacts so that one said rotary contact assembly rotates in a direction which increases the number of fixed contacts it touches while the other said rotary contact assembly rotates in a direction which decreases the number of fixed contacts it touches, and said fixed contacts of said first rotary drum switch being electrically connected to said fixed contacts of said second rotary drum switch at respective positions to form a plurality of fixed contact pairs, said rotary contact assemblies always being relatively positioned so that only one of said fixed contact pairs is not touched by either of said rotary contact assemblies.

**2.** The position selector control device for tap changing apparatus of claim **1** including a selector switch having a plurality of contact sets each being electrically connected to said fixed contact pairs of said rotary drum switches through patch panel means, said patch panel means allowing a quick change of the electrical connection of said selector switch contact sets from one of said fixed contact pairs to another of said fixed contact pairs.

**3.** A position selector control device for tap changing apparatus comprising a selector switch, first and second rotary drum switches, first and second motor relays, said selector switch having a plurality of contact sets which are electrically connected to said rotary drum switches, said first and second motor relays being electrically connected to said first and second rotary drum switches, means energizing said first motor relay to cause a motor to move the tapping contacts in one direction and means energizing said second motor relay to cause said motor to move the tapping contacts in the opposite direction, said rotary drum switches each having a rotary contact assembly which is connected to said motor so that closing a set of contacts of said selector switch causes one of said motor relays to energize until one of said rotary contact assemblies rotates to a position which deenergizes said motor relay.

**4.** Tap changing apparatus comprising a transformer having a tapped winding, a movable tapping contact for connecting an external circuit to said tapped winding, drive means including a motor for moving said tapping contacts, a selector switch having a plurality of contact sets, first and second rotary drum switches each having a rotary contact assembly and a plurality of fixed contacts, said rotary contact assemblies being connected to said motor so that when said motor is operating one said rotary contact assembly rotates in a direction which increases the number of fixed contacts it touches while the other said rotary contact assembly rotates in a direction which decreases the number of fixed contacts it touches, said fixed contacts of said first rotary drum switch being electrically connected to said fixed contacts of said second rotary drum switch at respective positions to form a plurality of fixed contact pairs, said rotary contact assemblies always being relatively positioned so that only one of said fixed contact pairs is not touched by either of said rotary contact assemblies, said contact sets of said selector switch each being electrically connected to said fixed contact pairs of said rotary drum switches through patch panel means, said patch panel means allowing a quick change of the electrical connection of said selector switch contact sets from one of said fixed contact pairs to another of said fixed contact pairs.

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