May 13, 1958 R. BRADSHAW 2,834,808

RATIONAL SPEED SYNCHRONIZING SWITCH

Filed Aug. 20, 1948 4 Sheets-Sheet 1

FIG. 1.

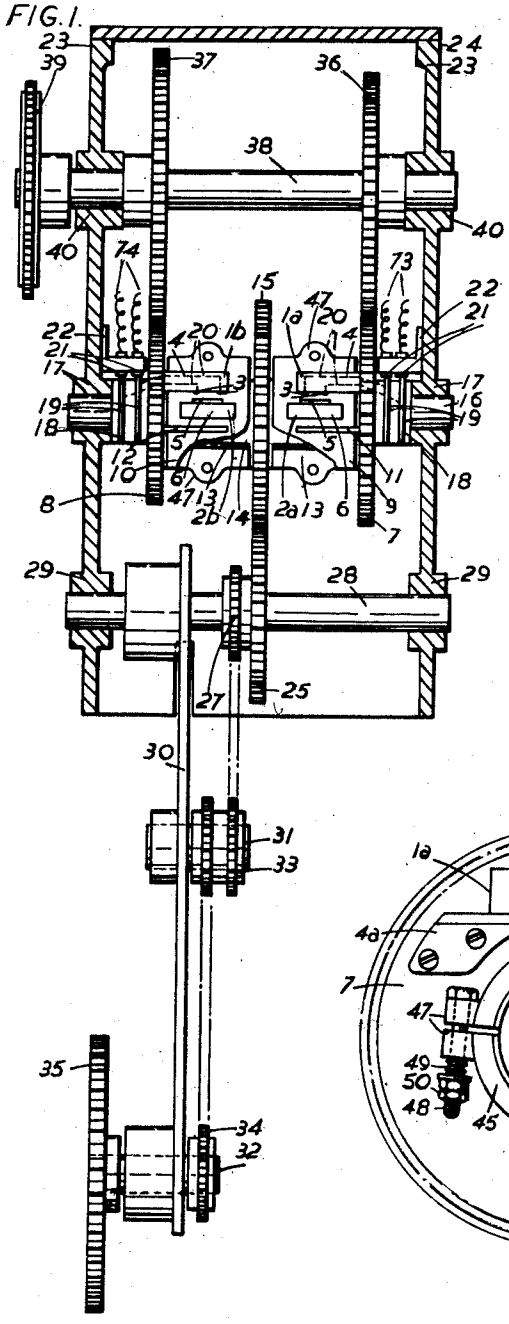
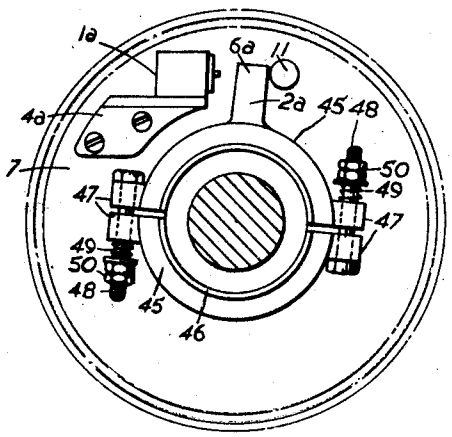


FIG. 2.



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RATIONAL SPEED SYNCHRONIZING SWITCH

Filed Aug. 20, 1948 4 Sheets-Sheet 2

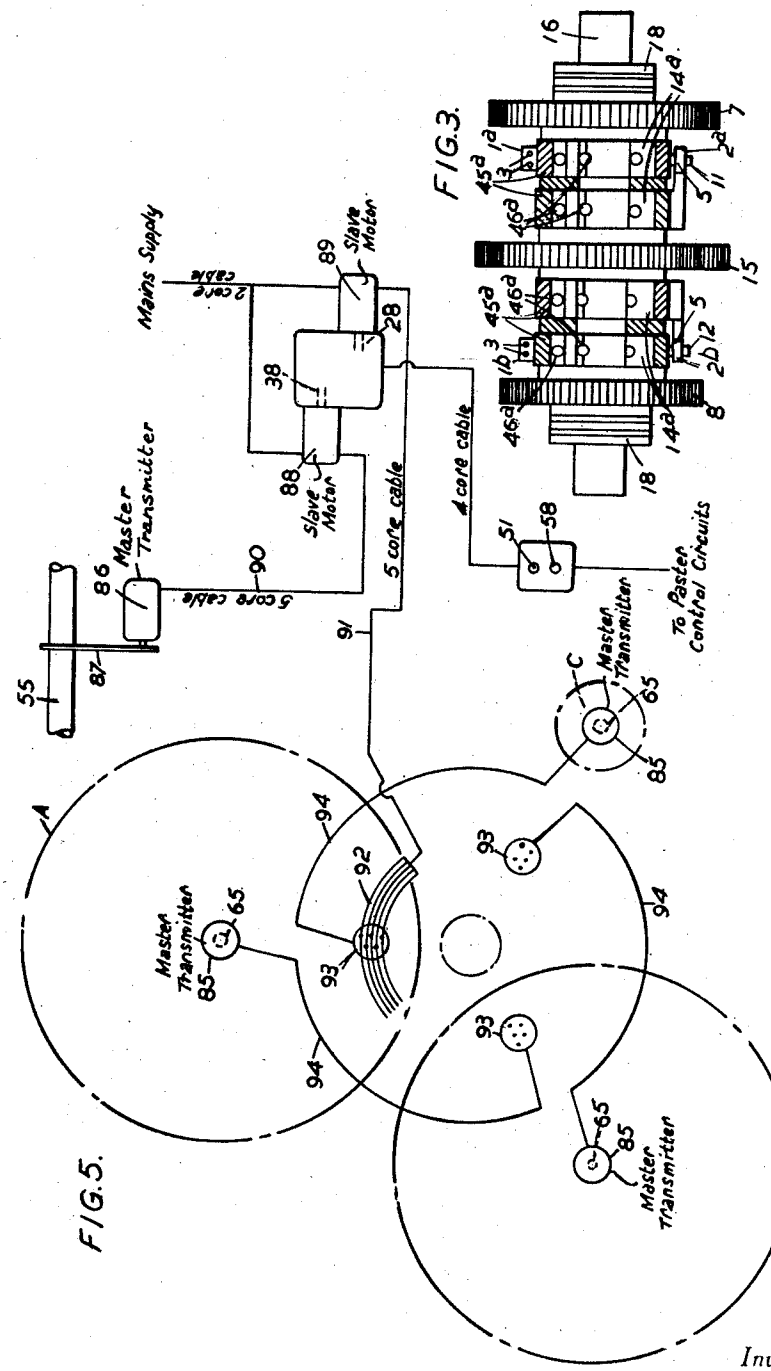


FIG. 3.

FIG. 5.

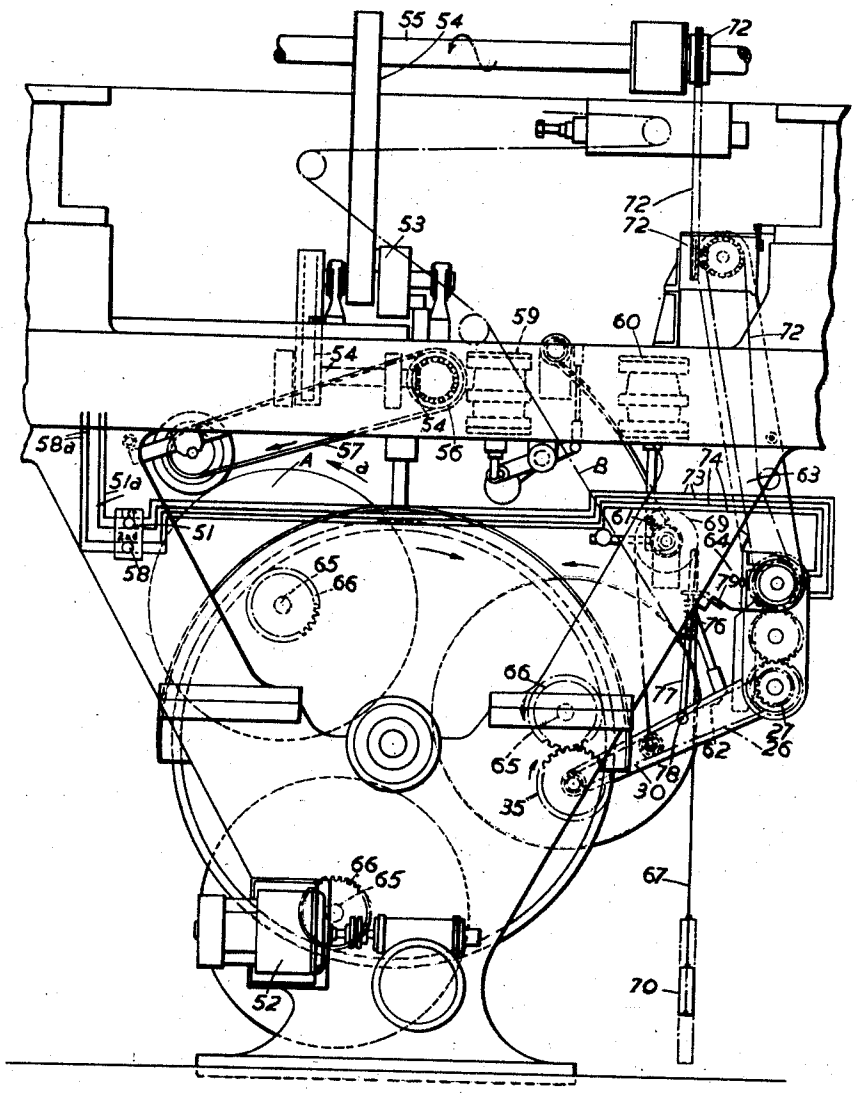
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RATIONAL SPEED SYNCHRONIZING SWITCH

Filed Aug. 20, 1948 4 Sheets-Sheet 3

FIG. 4.



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RATIONAL SPEED SYNCHRONIZING SWITCH

Filed Aug. 20, 1948

4 Sheets-Sheet 4

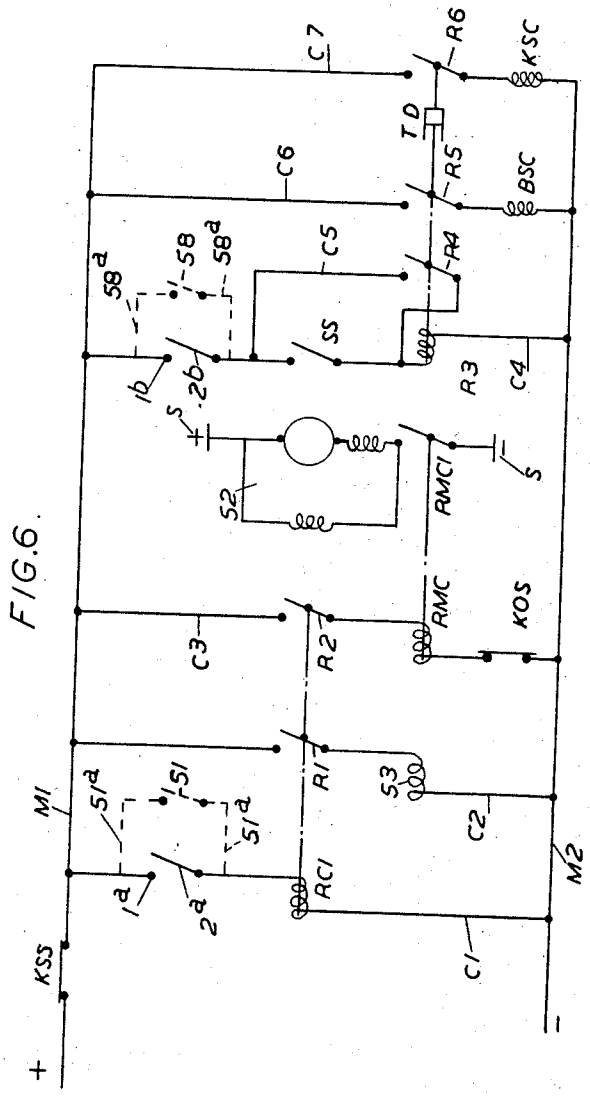


FIG. 6.

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2,834,808

RATIONAL SPEED SYNCHRONIZING SWITCH

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Application August 20, 1948, Serial No. 45,254

1 Claim. (Cl. 200—61.46)

One object of the present invention is the provision of a control device, for use in an electric circuit, adapted to effect a control operation in the circuit when two moving members attain predetermined relative rates of movement; and a further object of the invention is the provision of a control device, for use in electric circuits, adapted to effect control operations in sequence when two moving members attain predetermined relative rates of movement first of one order and then of a different order.

A still further object of the invention is the provision of a reel-joining mechanism associated with a printing press wherein the operation of joining the running web to the new web can be made to take place when the expiring reel has a predetermined degree of smallness. Still further objects of the invention are the provision of automatic reel-joining mechanisms, and the conversion of so-called semiautomatic reel joining mechanisms to fully automatic mechanisms, wherein the joining cycle is caused to commence when one predetermined degree of expiring reel smallness of diameter is attained, and the said cycle is completed when a further degree of expiring reel smallness is attained. An important advantage arising out of such applications of the invention is, therefore, economy of paper since guesswork on the part of an attendant is eliminated and the margin of safety necessary for ensuring that the running web shall not expire before a join is made can be cut down to fine limits.

The invention resides in the provision of a device for effecting a control operation in an electric circuit when two moving members attain predetermined relative rates of movement, comprising a first switch-part and a second switch-part complementary to each other and rotatable in the same circular path, means for connecting the first switch-part to one of said members in driven relation thereto and means for connecting the second switch-part to the other member in driven relation thereto to effect the travel of the switch-parts in the circular path, said switch-parts being arranged to effect the control operation when the second switch-part collides with the first switch-part upon the second switch-part being driven by its associated driving member faster than the first switch-part, and each of said means or one of them including a slipping or lost motion coupling permitting the two switch-parts to travel in the said path at the same rate even when the two members tend to drive the switch-parts at rates other than in the ratio of 1:1.

The invention also resides in the provision of a dual device for effecting a first control operation in an electric circuit when two moving members attain predetermined relative rates of movement and for subsequently effecting a further control operation in an electric circuit when the said members attain predetermined relative rates of movement of a different order, comprising a control device as set forth in the immediately preceding paragraph for effecting one of the control operations and a substantially corresponding device for effecting the other of the control operations, the means for connecting one of said switch-parts of one control device to its associated member including a drive transmission adapted to rotate it at a rate greater than that at which the same member rotates the corresponding swich-part of the other control device.

The complementary switch-parts may comprise, for example, a micro-switch of single-acting type or change-over type (forming one switch-part) and an actuating element therefor (forming the companion part) or a pair of contacts mounted in relatively insulated manner (forming one switch-part) and a contact bridge (forming the companion part).

It will be appreciated that except when the, or either pair of, complementary switch-parts are driven in the ratio of 1:1 by their respective driving members one switch-part of the or each pair tends to lag behind its companion switch-part, and unlimited independent travel of the said complementary parts is not possible because they lie in the same path. It is for this reason that devices according to the invention incorporate slipping couplings.

The invention further comprises paper reel mechanisms when provided with devices as above set forth, the moving members with which the control devices are associated being a moving part of a press on the one hand, for example the press shaft, and the reel-shaft of the expiring web reel on the other. Such mechanisms may be of the type wherein joining is effected manually, or of fully automatic type or of the type which, but for the control device, would be semi-automatic.

In all applications of the invention an increase of speed beyond a predetermined point of one moving member in relation to another, whether the relative increase result from an actual increase in the speed of one member or from the slowing down of the other, is utilised to effect the operation of a switch, and the many applications of such a control device will be apparent to those skilled in the art.

Examples of construction of control devices according to the invention and a reel joining mechanism according to the invention are shown in the accompanying drawings wherein.

Fig. 1 is a front elevation of a dual control device for effecting two control operations in sequence, the device being shown somewhat diagrammatically.

Fig. 2 is a side elevation showing details of a slipping clutch and two complementary switch-parts of modified form as compared with Fig. 1;

Fig. 3 is a somewhat diagrammatic front elevation of a modification applicable to Fig. 1;

Fig. 4 is a side elevation of a reel-joining mechanism incorporating the control device shown in Fig. 1;

Fig. 5 is a diagrammatic layout of a reel joining mechanism comprising the control device shown in Fig. 1 (or modified according to Figs. 2 or 3) wherein the driving means for the switch-parts of the control device comprises "Selsyn" equipment instead of the mechanical drive shown in Fig. 4, and

Fig. 6 is a diagram showing the electrical connections included in web-change mechanism incorporating the invention.

The device shown in Fig. 1 comprises two complementary switch-parts **1***a* and **2***a* and two complementary switch-parts **1***b* and **2***b*, the switch-parts **1***a* and **1***b* comprising contacts **3**, **3** borne by non-conducting carriers **4** and the switch-parts **2***a* and **2***b* comprising conducting plates **5** on carriers **6**, which plates bridge the contacts **3**, **3** of the companion switch-parts when in engagement with them.

The switch-parts **1***a* and **1***b* are mounted on the opposite sides of co-axial wheels **7** and **8**, and the switch-parts **2***a* and **2***b* are mounted on rotatable sleeves **9** and **10**, respectively, lying between the wheels and co-axial with them. It will be seen that the co-operating or complementary switch-parts lie opposite each other and, there-

fore, rotate in the same circular path; fingers 11 and 12 rigid with the wheels 7 and 8, respectively, lie at the other sides of the switch-parts and provide backstops which limit the degree of relative separation of the said parts 1*a* and 2*a*, 1*b* and 2*b* when the wheels and the sleeves 9 and 10 rotate.

The sleeves have friction linings 13 in slipping engagement with the peripheries of bosses 14 at the opposite sides of a centrally located wheel 15, which wheel, bosses and linings are co-axial with the wheels 7 and 8. The bosses, linings and sleeves, therefore, provide slipping or lost motion couplings which drivingly connect the wheel 15 to the switch-parts 2*a* and 2*b*.

A shaft 16 mounted in bearings 17 at its ends rotatably supports the wheel 15 and the wheels 7 and 8. Fixed to the bosses of the wheels 7 and 8 are non-conducting sleeves 18 carrying slip-rings 19. Each ring is connected to a contact 3 by a conductor 20, and brushes 21 rub against the rings. The brushes are mounted on brackets 22 fixed to the side walls 23 of the casing generally indicated by 24.

The wheel 15 may be connected to the moving member previously referred to in any suitable manner. In the example shown the driving means comprises a toothed wheel 25 in mesh with the toothed wheel 15 and chain gearing generally indicated by 26. The finally driven chain wheel 27 of the said gearing is rigid with the wheel 25; and these two wheels are borne by a shaft 28 mounted in bearings 29. An arm 30 swingably borne by the shaft 28 carries the spindles 31 and 32 respectively, of the chain wheels 33 and 34 of the said gearing. A driving spur wheel 35 for the chain wheel 34 of the gearing is fixed to the spindle 32 of the said chain wheel. When the wheel 35 is driven the drive is transmitted to the wheel 15.

The wheels 7 and 8 are connected to the other moving member by a drive-transmitting means so arranged that the two wheels are driven at different rates by the said members. In the example shown the drive transmitting means comprises two toothed wheels 36 and 37 fixed to a shaft 38, which shaft is driven by a chain wheel 39 adapted to be coupled to the moving member. Wheel 36 meshes with the wheel 7 and wheel 37 meshes with the wheel 8, but the ratio of the wheels 36—7 is lower than that of the wheels 7—8. Hence the wheels 7 and 8 are always driven at different speeds irrespectively of the speed of the member driving the wheel 39.

The shaft 38 is mounted in bearings 40 and these bearings and the bearings 17 and 29 are in the side walls 23 of the casing 24. The casing is open at the bottom to permit the arm 30 to project therefrom.

The device operates as follows, it being assumed that normally the wheels 7 and 8 are driven faster than the wheel 25 and the direction of rotation is such that the contacts 3, 3 tend further to separate from the plates 5.

Whilst the higher speed of the wheels 7 and 8 is maintained switch-parts 1*a* and 1*b* are held away from their respective parts 2*a* and 2*b* since the said parts 2*a* and 2*b* tend to lag behind them. The degree of separation is limited, however, by the backstops 11 and 12, which drive the elements 2*a* and 2*b* at the same rate as the parts 1*a* and 1*b* are driven; and such driving is possible because the slipping couplings permit the switch-parts 2*a* and 2*b* to travel at a greater rate than the wheel 25.

Upon the wheel 25 accelerating sufficiently, or upon the wheel 39 slowing down sufficiently, first the rate of rotation of the wheel 25 becomes greater than that of the switch-part 1*a* and then the rate of rotation of the said wheel becomes greater than that of the switch-part 1*b*. As a result the wheel 25 is able, through the slipping couplings, to drive first the switch-part 2*a* and then the switch-part 2*b* both faster than the switch-parts 1*a* and 2*b*. This causes the plate 5 of switch-part 2*a* to overtake the contacts 3 of switch-part 1*a*, thereby closing the switch to effect the first control operation, and subsequently the plate 5 of the switch-part 2*b* overtakes the contacts of the switch-part 1*b*, thereby closing the switch 1*b*, 2*b* to effect the subsequent control operation; and immediately the switch-parts 2*a* and 2*b* overtake their complementary parts the couplings slip to permit the switch-parts 1*a* and 2*a* to rotate together and the switch-parts 1*b* and 2*b* to rotate together at the respective rates of the wheels 7 and 8. It will be evident that the backstops 11 and 12, by limiting the degree of separation of the complementary parts, ensures that switching operations occur quickly once the parts 2*a* and 2*b* become driven faster than the parts 1*a* and 1*b*.

If desired the wheel 15 may normally be driven faster than the wheels 7 and 8, in which case the direction of rotation of the switch-parts is clockwise as viewed in Fig. 2, and when the relative speeds of the members to which the wheel 25 and the wheel 39 are respectively connected are such that control operations are required to be performed by the switches, the first control operation will be effected by the switch-parts 1*b* and 2*b*.

The sleeves 9 and 10 are preferably constructed in the form of companion half-cylinders provided with means for urging them into contact with the peripheries of their respective bosses 14. Such a form of construction of sleeve is shown in Fig. 2. The half-cylinders are indicated by 45 and the friction lining, which is applied to the inner peripheries of the half cylinders, is indicated by 46. The longitudinal edges of the elements 45 have centrally located, outwardly extending lugs 47 on them in which are holes for the passage therethrough of bolts 48. Springs 49 between nuts 50 on the bolts and the adjacent lugs urge the half-cylinders towards each other and, therefore, cause the linings to grip the boss 14 with a force determined by the extent to which the springs are compressed.

The switches (formed by the complementary switch-parts) may be of any suitable kind. For example, in Fig. 2 the switch-part 1*a* is a press button switch and the complementary switch-part 2*a* is a radial arm 6*a* comparable with the element 6, Fig. 1. The switch is preferably a microswitch, it is mounted on the wheel 7 by means of a bracket 4*a*. The backstop is indicated by 11, as in Fig. 1.

The slipping or lost motion couplings shown in Figs. 1 and 2 may be replaced by another form of lost-motion couplings, e. g., unidirectional couplings, between the switch-parts 2*a* and 2*b* and the wheel 15 and between the switch-parts 1*a* and 1*b* and their respective driving wheels 7 and 8 so that any switch-part may overrun its associated driving means when its complementary switch-part is running faster than its said associated driving means tends to drive it. Such an arrangement is shown in Fig. 3.

In Fig. 3 the unidirectional couplings, of which there are four, are of the multi-lobe cam and ball type, the multi-lobe cams being indicated by 14*a*, the balls by 46*a* and the surrounding sleeves, between which and the cams the balls jam in certain circumstances (in known manner), by 45*a*. Two of the multi lobe cams are rigid with the wheel 15 and the third and fourth cams are rigid with the wheels 7 and 8, respectively. The sleeves surrounding the cams rigid with the wheel 15 are provided with switch-parts 2*a* and 2*b*, respectively, and the sleeves surrounding the cams rigid with the wheels 7 and 8, respectively, carry the switch-parts 1*a* and 1*b*.

When the switch-parts 1*a* and 1*b* are driven faster than the wheel 15 tends to drive the switch-parts 2*a* and 2*b*, the said parts 2*a* and 2*b* trail round with the said parts 1*a* and 1*b* because the switch-parts 2*a* and 2*b*, driven by the backstops 11 and 12, are able to overrun their respective cams; and when the switch-parts 2*a* and 2*b* are driven faster than the wheels 7 and 8 tend to drive the switch-parts 1*a* and 1*b* the said switch-parts 1*a* and 1*b* are pushed round by the said parts 2*a* and 2*b*, after collision, because these last mentioned parts are able to overrun their respective cams. It will thus be

evident that the operation of the arrangement shown in Fig. 3 is comparable with that of the arrangement shown in Fig. 1. It will also be evident that instead of the switch-parts **1***a* and **1***b* being driven through unidirectional couplings between them and their respective wheels **7** and **8**, unidirectional couplings may be located between the wheels **36** and **37** (Fig. 1), which mesh with the wheels **7** and **8**, and the shaft **38**.

The control device described with reference to the drawings is a dual control device in that two control operations are performed in sequence by the complementary switch-parts. The device may, however, be constructed as a single control device by the use, principally, of two complementary switch-parts, a wheel as **7** and a wheel as **15** associated with a slipping clutch.

The driving gear comprising the elements mounted on the swinging arm **30**, Fig. 1 may be replaced by any equivalent gearing. The said gearing has been described in association with the control device shown in Fig. 1 for convenience in describing the said device in the reel joining mechanism shown in Fig. 4.

The said mechanism, without the control device and without the drive transmitting means for operating the said device is known, said mechanism being of semi-automatic type.

In the semi-automatic mechanism operation of the first press-button **51** brings about energization of the motor **52**, to effect a partial rotation of the reel stand, and energization of a magnetic clutch **53** to cause a drive transmission, generally indicated by **54**, to transmit a drive from the press shaft **55** to the pulleys **56**. The partial rotation of the stand brings the periphery of the replacement reel A into contact with the belts **57**; the drive transmitted to the pulleys **56** causes the belts to rotate the said reel in the direction of the arrow *a*, the peripheral speed of the reel being substantially equal to the linear speed of the running web B. The leading end of the web forming the new reel is covered with paste before the button **51** is pressed.

When the attendant considers that joining should be effected he operates the second press-button, **58**. This brings about energization of the solenoids **59** and **60** in rapid succession. Energization of the solenoid **59** causes dabbing brushes **61** to deflect the running web B into contact with the periphery of the replacement reel, so that the running web picks up the replacement web by the pasted, leading end of the latter and the two webs are drawn into the press; and energization of the solenoid **60** causes slitting knives **62** to sever the web B from its stub.

Operation of the said semi-automatic mechanism will now be further described with reference to the wiring diagram shown in Fig. 6.

When the first switch **51** is closed, the relay RC1 is energized from mains M1 and M2 by way of the switch and conductor C1, the relay closing contacts R1 and R2. The first contact R1 energizes the coil of the magnetic clutch **53** by way of conductor C2 and the clutch completes the transmission of the drive from the press-shaft **55** (Fig. 4) to the speed-up belts **57** which acting on the periphery of the reel A cause the reel to be rotated with a periphery speed equal to the linear speed of the running web B, as previously stated. At the same time the second contact R2 energizes the reel-stand rotation motor contactor RMC1 through operating coil RMC, current being supplied to the coil RMC by way of conductor C3 and a normally closed switch KOS. The operation of the rotation motor contactor RMC1 causes the reel-stand rotation motor **52**, which is fed from a separate power supply S, to be energized. The rotation of the reel-stand brings the new reel A towards the running web B and the reel-stand opens the switch KOS, which switch is a knock-off switch in the path of the rotating reel-stand so positioned that is is opened to de-energize the relay RMC and, therefore, open the rotation motor contactor RMC1 when the new reel is in the correct relative position to the running web, i. e. within ½" to 1".

When the press button switch **58** is closed there is established the first stage in the operation of a relay R3. In series with the press button switch **58** is a switch SS which is supported by one of the spindles on which the new reel is supported and one contact of which rotates with the reel so that the switch SS makes close contact once in every revolution of the reel, the moment of making contact being pre-set in relation to the position of the paste on the new reel: thus after the switch **58** has been closed, the circuit of the relay R3 is completed, by way of conductor C4 by the subsequent closing of the spindle switch SS. Energization of the said relay R3 causes contacts R4, R5 and R6 to close. The contact R4 establishes a circuit C5 in parallel with the contact SS and maintains the relay R3 energized when the contact SS opens at each revolution of the reel. The contact R5 energizes the solenoid coil BSC of the brush solenoid **59** (Fig. 4), by way of conductor C6, and this solenoid actuates the brushes **61** to deflect the web B onto the new reel A to effect the join with the previously pasted leading edge of this reel. The contact R6 which is actuated from its relay R3 through a time delay mechanism TD closes a short predetermined time after contact R5 and energizes the coil KSC of the knife solenoid **60** (Fig. 4) by way of conductor C7, and this solenoid actuates the knives **62** (Fig. 4) which sever the running web B from the expiring reel to complete the joining process.

A switch KSS is fitted to the knife solenoid and is arranged to operate when the solenoid completes its full stroke and after the knives have severed the old web. This switch KSS opens the feed to the whole of the control system described above and so re-sets the complete circuit for its next operation.

When a control device according to the invention, such as the control device described with reference to Fig. 1 is incorporated in the mechanism the complementary switch-parts **1***a*—**2***a* and **1***b*—**2***b* effect the operations previously effected by the press buttons **51** and **58** (hence the press buttons have been indicated in dotted line in Fig. 6), and these operations they perform automatically because the moving members with which the switch-parts are associated are a moving part of the press and the shaft of the expiring reel, respectively. Moreover, the driving means connecting the switch-parts **1***a* and **1***b* to their moving member, and the driving means connecting the switch-parts **2***a* and **2***b* to their moving member, have ratio such that two complementary switch-parts do not collide until the expiring reel has a predetermined degree of smallness and the other two complementary switch-parts do not collide until the said reel has a lower, predetermined degree of smallness.

The said device is shown in Fig. 4 mounted on part of the reel stand structure **63** by means of a bracket **64**. Each reel-shaft **65** is provided with a spur wheel **66** adapted to engage with the spur wheel **35** as the reels with which they are associated attain the feeding position, the arm **30** being yieldingly held in position to locate the wheel **35** in the path of the wheel **66** of the feeding reel-shaft by the cable **67**. One end of the cable is attached to the arm at **68**, it passes over a pulley **69** above the arm, said pulley being mounted on the structure **63**, and is weighted at **70**. The spur wheel **39** of the device is connected with the press shaft **55** by chain gearing and bevel gearing generally indicated by **72**. Thus, when the press is running the complementary switch-parts rotate, all in the same direction.

The conductors associated with the switch-parts **1***a*, **2***a* and **1***b*, **2***b*, respectively, are indicated at **73** and **74**. Each conductor is shown in series with the leads **51***a*

and **58***a* of the press buttons but the press buttons may, of course, be dispensed with.

The drive transmission ratio from the shaft **65** to the bosses **14** is so chosen that the bosses lag behind the wheels **7** and **8** until operations equivalent to the operations performed by the press buttons **51** and **58** are necessary, it being appreciated that the rate of rotation of the reel-shaft increases as the feeding reel decreases in diameter. Now, as the diameter of the expiring reel is a factor determining the rate of rotation of the bosses **14**, and the ratio of the drive transmission for the bosses to the drive transmission for the switch-part **1***a*, and to the drive transmission for the switch-part **1***b*, can be readily predetermined, the reel diameters at which a joining cycle is made to commence and end can be readily predetermined by a suitable selection of these ratios. In practice, therefore, the diameter at which web-deflection and slitting operations are effected can be made quite small without fear of these operations being left too late. And, if the mechanism be of the type where the speed of the press is reduced at the beginning of the joining cycle, the time at which the press speed is reduced may be delayed to a minimum safe point in advance of the joining and slitting operations in order to keep to a minimum the duration of the period of speed reduction, thereby enabling the attendant to keep the output of the press up to a high value.

When the reel stand is rotated to bring the stub of the spent reel to the removal and replacement position the wheel **66** of the spent reel is able to push the wheel **35** downwards and sidewards as this latter wheel is borne by the swingable arm **30**. When the wheel **66** clears the wheel **35** the wheel **35** and the arm swing upwards, in readiness for the said wheel to engage the succeeding wheel **35**, owing to the action of the weight **70**. The upward swing is, however, cushioned by a spring **76** surrounding a rod **77**, said rod being pivoted to the arm at **78** and being slidable in a bracket **79** fixed to the structure **63**.

The mechanism shown in Fig. 4 is thus a fully automatic mechanism. A fully automatic mechanism of any known type may incorporate a dual control device for commencing and ending a joining cycle, as will be evident to those skilled in the art.

Another application of the invention is to a paper-web feeding mechanism wherein joining up is effected by hand. A control device comprising two complementary switch-parts, as distinct from two pairs of such parts, may have one part rotated by the press and the other by the reel-shaft, the arrangement being such that the complementary switch-parts effect a control operation in an electric circuit resulting in the press being slowed to "inching" speed, to permit of joining, only when the reel reaches a predetermined degree of smallness.

The drive connection between one moving member and its associated switch-part or switch-parts and the drive connection between the other moving member and the switch-part or switch-parts associated therewith may, as previously stated, be of any suitable kind. They may be either mechanical, (for example, as shown in the drawings) or electrical. The electrical drive when used preferably comprises "Selsyn" equipment as shown in Fig. 5.

In Fig. 5 each reel-shaft directly drives a master "Selsyn" unit **85** and the press shaft **55** drives a master "Selsyn" unit **86** through a chain gear **87**. A "slave" unit **88** drives the shaft **38** which, in Fig. 1, is driven by the wheel **39** whilst a second "slave" unit, **89**, drives the shaft **28**, Fig. 1. The master unit **86** is electrically connected to the slave unit **88** by a 5-core cable **90** whilst the phases of the slave unit **89** are connected by a 5-core cable **91**

to the respective bars of a group of contact bars **92**, said bars being of arcuate form fixed to the reel stand frame and having their centre in the axis of rotation of the reel-stand spider. The phases of the units **85** are connected to the respective plungers of 5-plunger boxes **93** by means of 5-core cables **94**, said plunger boxes being so located that the plungers associated with the unit **85** driven by the feeding reel C (the reel from which the web B is running) wipe over the respective bars **92** and, therefore, connect the said unit **85** to the unit **89** throughout approximately 90°, this angle being substantially that through which the reel stand is rotated during a joining cycle. It will be evident that the plunger boxes successively contact with the bars as their associated reels come into the joining and feeding position. The four-core cable **95** is made up of conductors corresponding to **73** and **74**, Figs. 1 and 4.

Normally the "Selsyn" units **86**, **88** will drive the shaft **38** at such a rate that the switch-parts **1***a* and **1***b* will keep ahead of the switch-parts **2***a* and **2***b*, the unit **85** of the feeding reel and the unit **89** driving the shaft **28** at such a rate that the wheel **15** will be slower than the rates of rotation of the wheels **7** and **8**.

As the diameter of the feeding reel decreases the rate of rotation of its shaft and, therefore, the rate of rotation of the units **85** and **89** will increase until switch-part **2***a* overtakes switch-part **1***a*. This produces an operation equivalent to the manual operation of press-button **51**. Thereafter switch-part **2***b* overtakes switch-part **1***b* and produces an operation equivalent to the manual operation of the press-button **58**. The joining cycle is thus commenced and completed—as will be evident having regard to the description already given in connection with Fig. 3.

What I claim is:

A dual device for effecting a first control operation in an electric circuit according to a first predetermined order of speed of rotation of a first rotary member in relation to the speed of rotation of a second rotary member and for subsequently effecting a further control operation in an electric circuit when the said members attain a predetermined relative rate of rotation of a different order from the first, comprising a first control device and a second control device, each of said control devices comprising a switch, said switch including a first switch-part and a second switch-part complementary to said first switch-part, means to support said first switch-part to rotate in a circular path and means to support said second switch-part to rotate in the same circular path as said first switch-part, a first drive-transmitting means for connecting each of said first switch-parts to said first rotary member in driven relation thereto to effect the travel of said first switch-parts in their respective circular paths, a second drive-transmitting means for connecting each of said second switch-parts of said second rotary member in driven relation thereto to effect the travel of said second switch-parts in their respective circular paths, said second drive-transmitting means including coupling means responsive to a change of predetermined degree in the rate of relative rotation of said members to move said second switch-parts into cooperative relation to their respective first switch-parts.

References Cited in the file of this patent

UNITED STATES PATENTS

1,311,135	Olds	July 22, 1919
1,650,786	Burnett	Nov. 29, 1927
2,071,440	Tomlin et al.	Feb. 23, 1937

FOREIGN PATENTS

89,635	Sweden	July 6, 1937
666,142	Germany	Oct. 13, 1938