May 8, 1962 W. HIBBERT ETAL 3,033,000

CELLULOSE XANTHATE

Original Filed Sept. 13, 1955 3 Sheets-Sheet 1

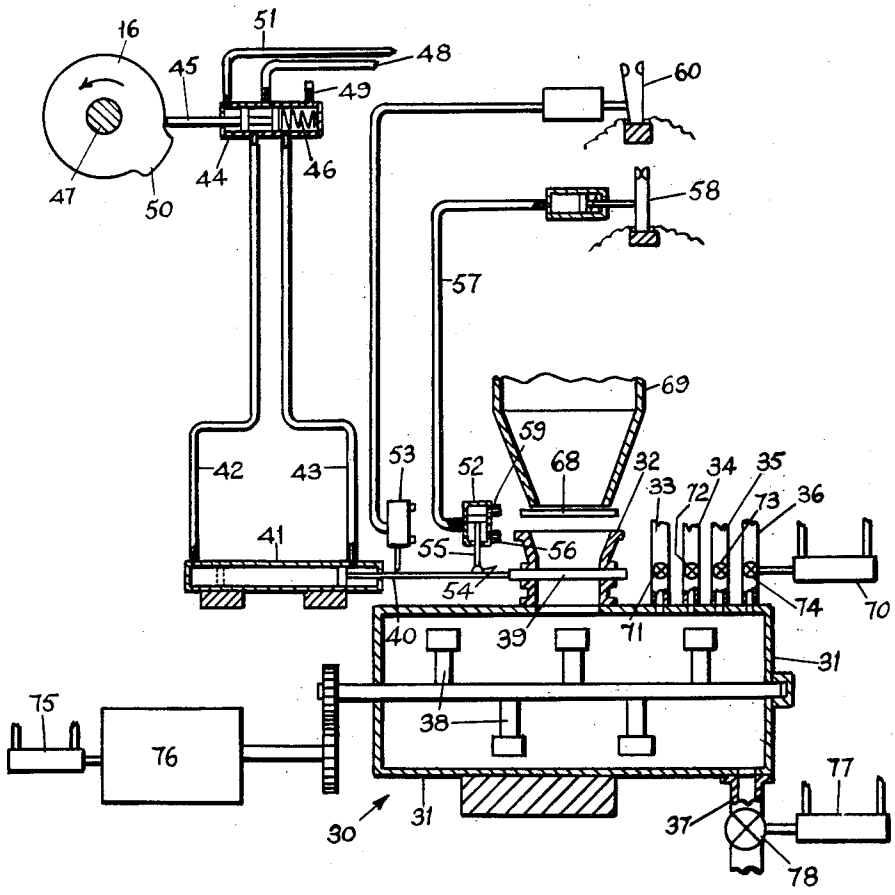


FIG. 1

INVENTORS:-
WILLIAM HIBBERT
JAMES BUNTING
by their Attorneys
Howson and Howson

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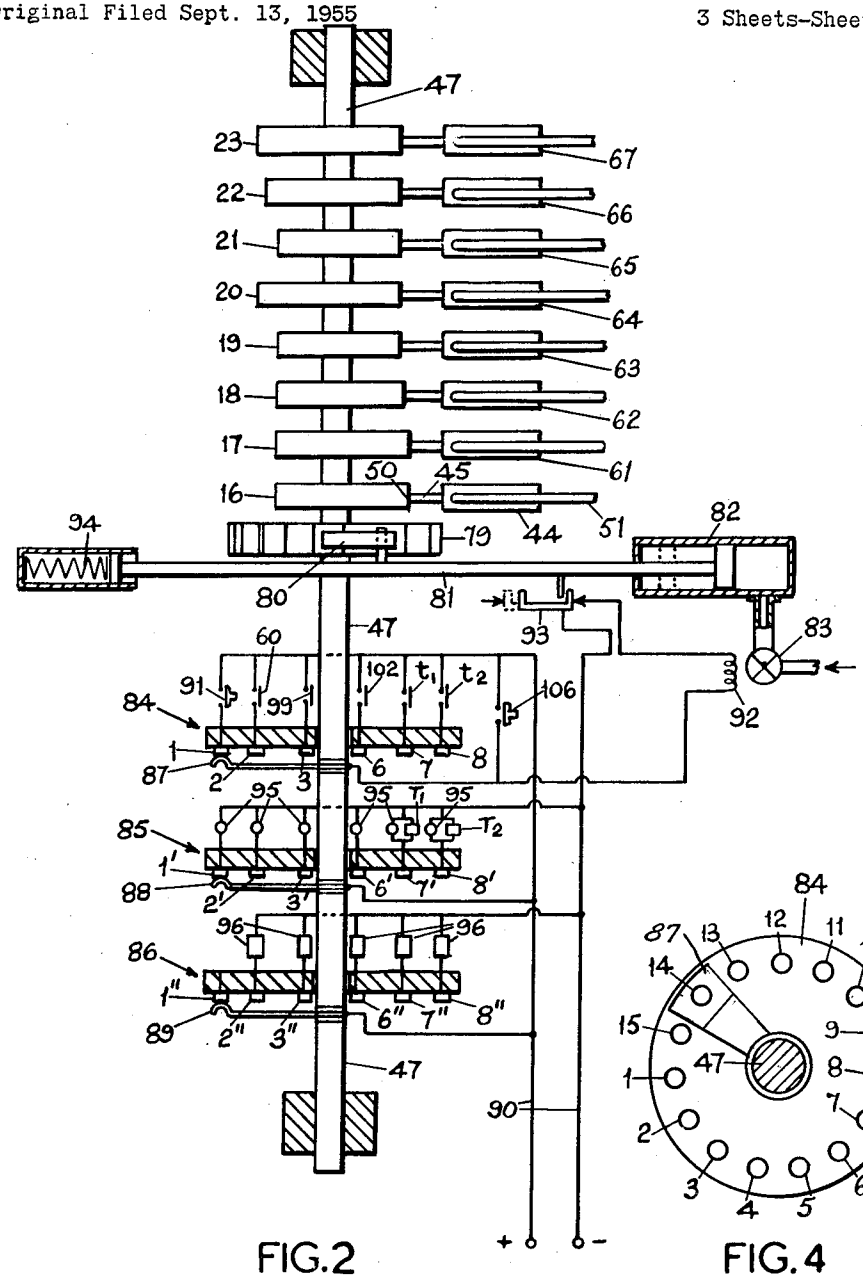


FIG.2

FIG.4

INVENTORS:-
WILLIAM HIBBERT
JAMES BUNTING
by their Attorneys
Howson and Howson

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CELLULOSE XANTHATE

Original Filed Sept. 13, 1955 3 Sheets-Sheet 3

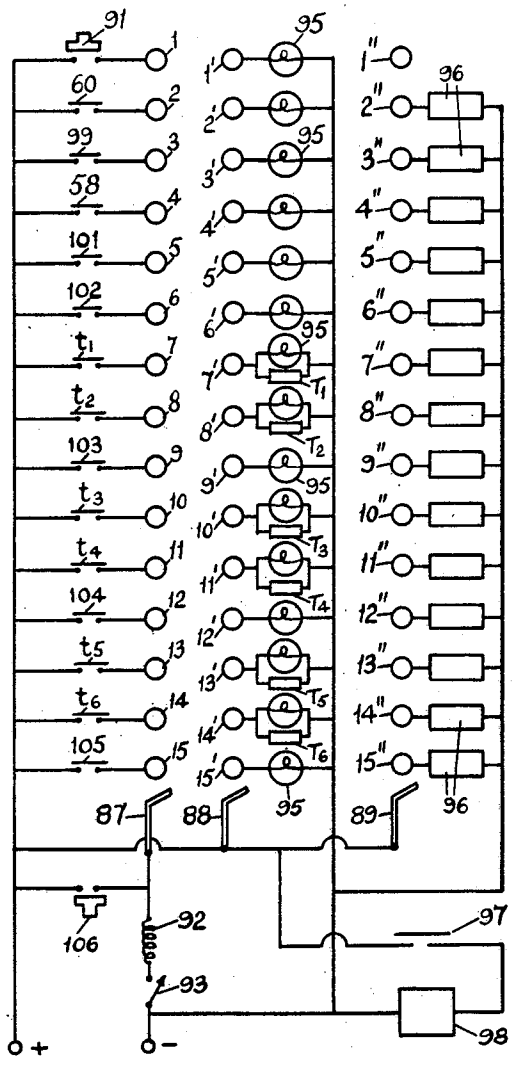


FIG. 5

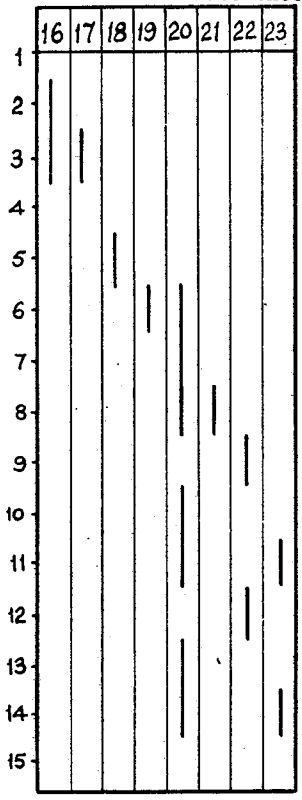


FIG. 6

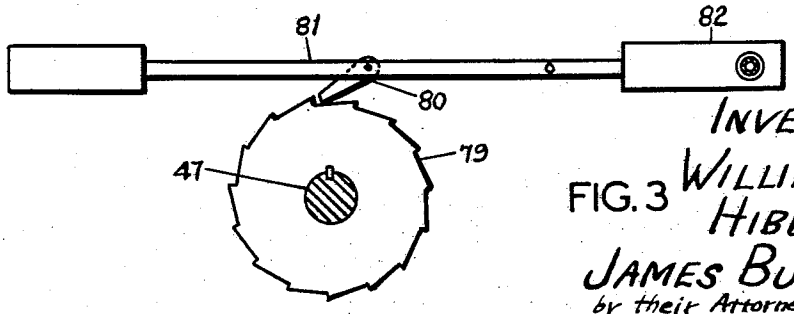


FIG. 3

INVENTORS:-
WILLIAM HIBBERT
JAMES BUNTING
by their Attorneys
Howson and Howson

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3,033,000

CELLULOSE XANTHATE

William Hibbert and James William Bunting, Coventry, England, assignors to Courtaulds Limited, London, England, a British company

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Claims priority, application Great Britain Sept. 20, 1954

3 Claims. (Cl. 60—97)

This invention relates to apparatus for the manufacture of cellulose xanthate.

In one method of manufacturing viscose by the so-called "wet churn" process, particles of alkali cellulose are charged into a churn fitted with paddles, the churn is sealed and evacuated, and a measured quantity of carbon disulphide is introduced. The paddles are rotated while the carbon disulphide reacts with the alkali cellulose to form cellulose xanthate. The churn is then vented, a measured quantity of aqueous sodium hydroxide solution is added and the cellulose xanthate is dispersed in the solution with agitation to form a slurry. Finally, the slurry is discharged from the churn and agitated to form viscose. The churn is rinsed with aqueous sodium hydroxide solution prior to receiving a fresh charge of alkali cellulose. In the so-called "dry churn" process, the freshly prepared solid cellulose xanthate is discharged from the churn and mixed with aqueous sodium hydroxide solution in a separate vessel.

It is known to carry out the churning operations automatically, step by step, under the control of a master clock. At predetermined intervals of time, the clock initiates the changes required to start a new step. In setting up the clock it is necessary to allow a minimum of time for each step to be completed before the next step is initiated and it is usual to allow a little margin over the minimum time required. The time cycle with this system of control therefore is usually longer than it need be.

The object of the present invention is to reduce the time lost in the automatic operation of a churn.

According to the present invention, in a process for the manufacture of cellulose xanthate from alkali cellulose in a series of steps carried out under automatic control, the start of each step is initiated by a signal indicating the completion of the previous step.

When the process is carried out in a wet churn, the cellulose xanthate is discharged as a slurry in aqueous sodium hydroxide solution. In the dry churn process, the cellulose xanthate is discharged as a solid.

The invention includes a controller for automatically controlling the manufacture of cellulose xanthate from alkali cellulose in a series of steps comprising a movable member for actuating pneumatic means for performing operations in each step, a driving mechanism for advancing the member a step at a time and a switching mechanism for actuating the driving mechanism on receipt of a signal indicating the completion of a step.

In a preferred form of the invention the completion of steps requiring physical movements are detected by pneumatic limit switches which operate electric switches in an electric circuit of the switching mechanism. Timing mechanism may be provided for timing other operations, such as xanthation of the alkali cellulose, when other means for detecting completion of the operation are not available. Electric switches in the switching mechanism are operated by the timing mechanisms.

Check timing units may be provided for each step to ensure that the time taken to perform the step does not exceed a predetermined period. Should the period be

exceeded, then an alarm is sounded to warn the operator that the apparatus is not functioning properly.

An example of a specific apparatus in accordance with the present invention is illustrated in the accompanying drawing in which—

FIG. 1 is a diagrammatic elevation partly in section of a wet churn showing associated pneumatic control mechanisms,

FIG. 2 is a diagrammatic plan view, partly in section, of a controller,

FIG. 3 is a front elevation of part of FIG. 2,

FIG. 4 is a front elevation of a further part of FIG. 2,

FIG. 5 is a diagram of the electrical layout of FIG. 2, and

FIG. 6 is a diagram showing the relative movement of parts shown in FIG. 2 during a churning cycle.

In FIG. 1, a pneumatically operated wet-churn **30** comprises a fixed container **31** having an inlet **32** for charging the container **31** with alkali cellulose particles, a vacuum pipe **33**, a carbon disulphide inlet pipe **34**, a vent pipe **35**, a sodium hydroxide solution inlet pipe **36**, an outlet **37**, and stirring paddles **38**. The churn **30** is designed to effect the operation of forming cellulose xanthate from alkali cellulose in fourteen steps which will be described in detail below. The apparatus as shown in FIG. 1 is at the beginning of the cycle of operation.

In FIG. 1, the inlet **32** at the beginning of the cycle is sealed with a sliding door **39** attached by a rod **40** to a double-acting piston **41** connected by pipes **42**, **43** to a five-way changeover valve **44**. A piston rod **45** of the valve **44** is urged by a spring **46** against the periphery of a cam **16** mounted on a rotatable shaft **47**.

When the cam **16** is in the position shown, compressed air enters the valve **44** by way of a pipe **48** and passes through the pipe **42** to the piston **41** causing the rod **40** to hold the door **39** closed. The pipe **43** is vented to the atmosphere through the valve **44** and a vent pipe **49**.

When the cycle is initiated shaft **47** is turned; cam **16** is therefore also turned and a salient portion **50** on cam **16** pushes in the rod **45** of the valve **44**. Compressed air is thereby directed into the pipe **43** while the pipe **42** is vented to the atmosphere through the valve **44** and a vent pipe **51**. The piston **41** moves to the left with the result that the rod **40** opens the door **39**.

The position of the door **39** is detected by two three-way pneumatic valves **52**, **53** which are operated by a projection **54** on the rod **40**. When the door **39** is closed, the projection **54** pushes against a rod **55** of the valve **52** and compressed air passes from a supply pipe **56** through a connecting pipe **57** to a pressure operated electric switch **58** causing the latter to close an electric circuit. As the door **39** opens, the projection **54** releases the rod **55**, the connecting pipe **57** is vented through a vent pipe **59** and the switch **58** opens.

When the door **39** is fully open, the projection **54** operates the valve **53** in like manner to that described in respect of valve **52** and a pressure operated electric switch **60** closes.

FIG. 2 shows the apparatus used to effect the subsequent steps. In this figure, the cam **16** is mounted on the shaft **47** in a bank with seven further cams **17**, **18**, **19**, **20**, **21**, **22** and **23**, each of which operates in the same way as cam **16** one of seven five-way changeover valves **61**, **62**, **63**, **64**, **65**, **66** and **67**, each of which is similar to valve **44**.

Valve **61** operates a double acting piston (not shown) for opening and closing a hopper flap **68** on an alkali cellulose hopper **69** placed above the churn inlet **32** (FIG. 1).

Valves **62**, **63**, **65**, **66** each operate double acting pis-

tons 70 (one only of which is shown in FIG. 1) for opening and closing valves 71, 72, 73, 74 provided, respectively, in the pipes 33, 34, 35, 36.

Valve 64 operates a double acting piston 75 for opening and closing a switch (not shown) in a driving mechanism 76 for the paddles 38.

Valves 67 operate a double acting piston 77 for opening and closing a dump valve 78 (FIG. 1) in the outlet 37.

In each case, the pneumatic mechanism associated with the valves 61, 62, 63, 64, 65, 66 and 67 is similar to that described in respect of valve 44 for opening and closing the door 39.

The shaft 47 (FIGS. 2 and 3) is rotated stepwise by a ratchet wheel 79 and a pawl 80, the latter being mounted on a rod 81 operated by a pneumatic piston 82 having a valve 83 actuated by a solenoid 92. The ratchet wheel 79 has fifteen steps and the shaft 47 is rotated by one step for each thrust of the rod 81 from right to left.

Mounted about the shaft 47 are three stationary rotary switches 84, 85 and 86, each having fifteen studs 1 to 15, 1′ to 15′, 1″ to 15″ respectively (FIG. 4) which are wiped by brushes 87, 88, 89 fixed to the shaft 47.

The studs 1 to 15 are each capable of being connected to the positive line of a pair of bus bars 90 carrying a direct current of 180 volts. For example, stud 1 is energized when a start button 91 is pressed. If the brush 87 is in contact with an energized stud, then a circuit is completed through the solenoid 92 of the valve 83, an isolating switch 93 and the negative line of the bus bars 90. The valve 83 opens, compressed air moves the rod 81 to the left against the action of a spring 94 and the pawl 80 engages the ratchet wheel 79 to turn the shaft 47 through one step. The brushes 87, 88 and 89 are then brought into contact with the next studs on the switches 84, 85 and 86.

To prevent the rod 81 from being held in its left hand position should the next stud 1 to 15 be energized, the isolating switch 93 isolates the solenoid 92 when the rod 81 has almost completed its movement to the left and reconnects the solenoid 92 to the circuit when the rod 81 has almost returned to its right hand position under the action of the spring 94.

The studs 1′ to 15′ are connected to the negative line of the bus bars 90 through annunciator lights 95, while the brush 88 is connected to the positive line. As the brush 88 wipes the studs 1′ to 15′ the corresponding light 95 is illuminated indicating to the operator the step reached by the apparatus.

The studs 2″ to 15″ are connected to the negative line of the bus bars 90 through check timing units 96. The stud 1″ is isolated. As the brush 89 makes contact with any one of the studs 2″ to 15″ the corresponding unit 96 is brought into action. Each unit 96 is set for a time a little in excess of that required for the particular processing operation to be completed during that step. Should the operation not be completed in that time, then the unit 96 closes a switch 97 (FIG. 5) which connects an alarm 98 across the bus bars 90 and so draws attention to the fault.

Each cam 16 to 23 has one or more salient portions 50 for operating the valves 44 and 61 to 67 so that each processing operation is carried out in its appointed order during the cycle. In FIG. 6 there are shown eight vertical columns, one for each of the cams 16 to 23, and fifteen vertical steps corresponding to the studs 1 to 15. The vertical lines in the columns indicated when the cams 16 to 23 are actuating their respective valves 44, 61 to 67 with reference to the position of the brush 87 on the studs 1 to 15.

A complete churning cycle takes place as follows:

A. With the light 95 associated with stud 1′ illuminated indicating that the brushes 87, 88, 89 are on studs 1, 1′ and 1″ respectively, the start button 91 is pressed. The shaft 47 is turned through one step by the pawl 80 engaging the ratchet wheel 79. The cam 16 causes the door 39 to open as described above and the closing of switch 60, indicating that the door 39 is fully open, energizes stud 2. If the door 39 does not open within the period set on the check timing unit 96 associated with stud 2″, then the alarm 98 warns the operator.

B. When the stud 2 is energized, the shaft 47 is turned through another step and cam 17 causes the hopper flap 68 to open and a charge of alkali cellulose then falls into the container 31. A switch 99 (FIG. 5), operated by pneumatic means (not shown) detecting that the hopper 69 is empty, then closes to energize stud 3.

C. The shaft 47 is turned through another step and cams 16, 17 simultaneously initiate the closure of the hopper flap 68 and the door 39. Stud 4 is energized by the closing of the switch 58 operated by pneumatic means as previously described (with reference to FIG. 1), when the door 39 is closed.

D. The shaft 47 turns until the brush 87 is on stud 5. During the movement, cam 18 causes the valve 71 in the vacuum pipe 33 to open and the container 31 is evacuated. Pneumatic means (not shown) closes a switch 101 associated with stud 5 when the vacuum is at a satisfactory level and stud 5 is energized.

E. Shaft 47 is turned until the brush 87 moves on to stud 6. On this movement cam 18 releases its associated valve 62 causing the valve 71 in the pipe 33 to close and the cams 19, 20 become operative causing the opening of valve 72 in the carbon disulphide pipe 34 and the rotation of the paddles 38 through the mechanism 76.

A switch 102 pneumatically operated by means (not shown) detecting when the full charge of carbon disulphide has entered the container 31, then closes to energize stud 6.

F. The shaft 47 turns until the brush 87 is in contact with stud 7, when cam 19 causes the closure of valve 72 and xanthation commences. The period of xanthation is timed by a timing mechanism T_1, arranged in parallel with the light 95 associated with stud 7′. It commences its timing operation when the brush 88 makes contact with stud 7′ and at the end of the predetermined period it closes a switch t_1, energizing stud 7.

G. The shaft 47 turns through one step to bring the brush 87 on to stud 8. During this movement, cam 21 causes the valve 73 in the vent pipe 35 to open and the container 31 is vented to the atmosphere. After a timed period for venting determined by a timing mechanism T_2, arranged in parallel with the light 95 associated with stud 8′, a switch t_2 closes to energize stud 8.

H. The brush 87 is moved forward on to stud 9, when cam 21 initiates the closing of valve 73, cam 20 stops the rotation of the paddles 38 and cam 22 opens the valve 74 in the aqueous sodium hydroxide solution inlet pipe 36. When the correct quantity of sodium hydroxide solution has been admitted a switch 103, operated by pneumatic means (not shown), closes to energize stud 9.

I. The shaft 47 is turned through one step to bring the brush 87 on to stud 10, the valve 74 is closed through cam 22 and cam 20 again initiates the rotation of the paddles 38. The xanthated alkali cellulose is now formed into a slurry with the sodium hydroxide solution, and this period is timed by a timing-mechanism T_3 connected to stud 10′. On completion of the timed period, the mechanism T_3 closes a switch t_3 energizing stud 10.

J. Upon the turning of shaft 47 to bring the brush 87 on to stud 11, cam 23 initiates the opening of the dump valve 78 allowing the slurry of cellulose xanthate in the container 31 to pass out through the outlet 37. A timing mechanism T_4 set for the known dumping period closes a switch t_4 at the end of that period, so energizing stud 11.

K. The shaft 47 turns to bring the brush 87 on to stud 12 and cam 23 initiates the closing of the dump valve 78, cam 20 stops the rotation of the paddles 38 and the cam

22 opens valve 74 in the sodium hydroxide inlet pipe 36. A measured quantity of aqueous sodium hydroxide solution enters the container 31 for rinsing and a switch 104, operated pneumatically when all the solution has been delivered, closes to energize stud 12.

L. The brush 87 is brought on to stud 13 by turning of the shaft 47 and cam 22 initiates the closure of valve 74 while cam 20 again causes the paddles 38 to rotate. After a timed period measured by a timing mechanism T_5, a switch t_5 closes energizing stud 13.

M. The brush 87 moves on to stud 14 and at the same time cam 23 initiates the opening of the dump valve 78 to release the washing liquor. After a timed period, determined by a timing mechanism T_6, a switch t_6 is closed energizing stud 14.

N. On movement of the brush 87 on to stud 15, cam 23 causes the dump valve 78 to be closed and the paddles 38 are brought to rest through the action of the cam 20. A switch 105 operated pneumatically by the closure of the dump valve 78 is closed, so energizing stud 15. The churn 30 is now ready to start a further cycle and the shaft 47 is turned a final step to bring the brush 87 back on to stud 1.

All operations in the neighborhood of the churn 30 are carried out pneumatically to avoid any risk of an explosion due to sparks in the presence of the highly inflammable carbon disulphide which otherwise might occur if electrical systems were used.

Should it be necessary to advance the shaft 47 through a step irrespective of the control mechanism the rotary switch 84 may be overridden by a button 106.

This application is a continuation of the application Serial No. 534,102 filed September 13, 1955, now abandoned.

What is claimed is:

1. Apparatus for initiating in sequence a plurality of operations which characterize the functions of a viscose churn, said apparatus comprising a combination of a rotary member, a driving mechanism for rotating the rotary member step-wise, cams fixed to the rotary member for actuating mechanisms performing said mentioned operations, a contact brush attached to the rotary member, a plurality of stationary contacts each corresponding to a stationary position of the contact brush between the step-wise movements of said brush, a signalling mechanism adapted to send an electrical signal to a contact on the completion of an operation, and means in electrical communication with said contact brush to receive said electrical signal and rotate the rotary member via the driving mechanism.

2. A controller as claimed in claim 1, in which the signalling mechanism comprises pneumatic limit switches operated on completion of an operation and electrical switches in electrical series with the contacts adapted to be closed by operation of the pneumatic limit switches.

3. A controller as claimed in claim 2, having check timing units, a second contact brush attached to the rotary member for energizing said check timing units successively at the completion of each movement of the rotary member, and a warning indicator operated by a check timing unit should a predetermined period elapse before the rotary member advances.

References Cited in the file of this patent

UNITED STATES PATENTS

952,070	Cota	Mar. 15, 1910
1,799,113	Miedbrodt	Mar. 31, 1931
2,055,031	Hutchings	Sept. 22, 1936
2,277,640	Harrington	Mar. 24, 1942
2,327,524	Hibner et al.	Aug. 24, 1943
2,624,495	Vickers et al.	Jan. 6, 1953