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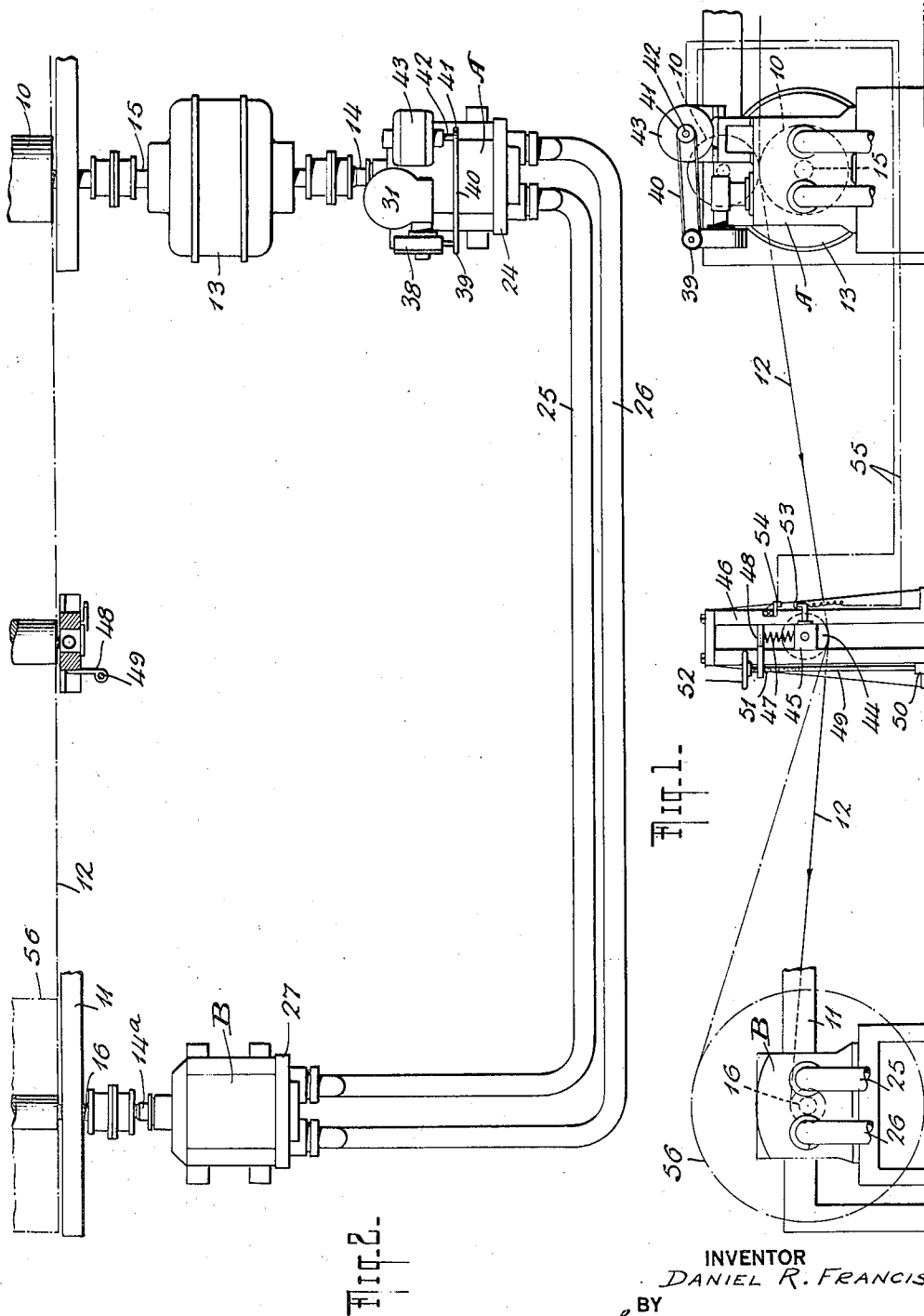
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AUTOMATICALLY CONTROLLED MECHANISMS FOR TRAVELING WEBS OF MATERIAL

Filed Jan. 25, 1930

2 Sheets-Sheet 1



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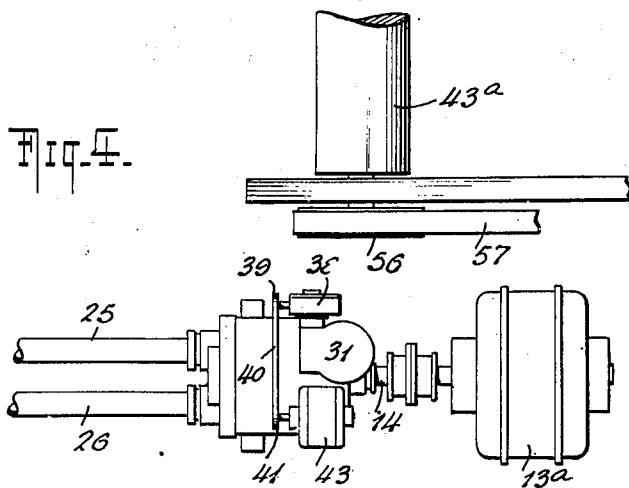
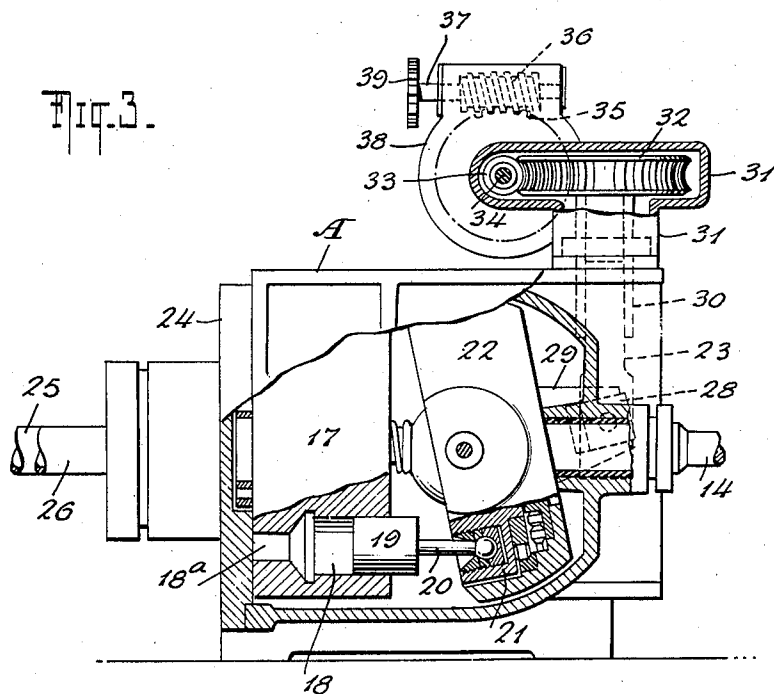
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2 Sheets-Sheet 2



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AUTOMATICALLY CONTROLLED MECHANISMS FOR TRAVELING WEBS OF MATERIAL

Application filed January 25, 1930. Serial No. 423,409.

The invention relates to those arts in which it is customary, in the manufacture of a product, to pass a web of material from one machine to another, or from one mechanical element to a co-operating. Because of the nature of the material it is oftentimes essential to prevent the development of undue tensional strains in the traveling web in order to avoid breakage thereof or other injury thereto; under such conditions it becomes necessary to control the operative speeds of the different machines or elements in a manner to provide a wide range of speed control and to cause the co-operating machines or mechanical elements to operate in properly timed relationship at all times. This problem of control is, in many instances, rendered more difficult because of the fact that during a given operative period a variable operating speed is developed or required in one or more of the units of a given installation. An example of the above is found in the paper making art, and more particularly in that step thereof in which the web of paper is passed from the calender rolls to the winding machine. The object of the invention is to provide an automatically controlled mechanism of simple construction whereby the different machines or elements will have the necessary speed range and be automatically and efficiently controlled in a manner to cause them to operate in properly timed relationship and so as to automatically produce any speed variations which may be required in one or more of the co-operating units. The invention contemplates more specifically the production of a simple and efficient mechanism whereby the operative speed of the winding machine for winding rolls of paper will be automatically varied relatively to the calender stack to provide for changes in the size of the roll being wound so as to avoid the development of undue and injurious strains in the traveling web of paper. The invention will be fully described hereinafter and the features of novelty will be pointed out in the claims.

In the accompanying drawings, which illustrate an example of the invention without defining its limits, Fig. 1 is a fragmentary

elevation showing a paper machinery installation embodying the novel features; Fig. 2 is a fragmentary plan view thereof; Fig. 3 is a side elevation partly in section of a fluid pressure pump included in the installation, and Fig. 4 is a fragmentary plan view showing another arrangement of the invention.

For purposes of illustration and description the invention is shown in connection with paper machinery to automatically control the passage of the web of paper from the calender to the winding machine in a manner to avoid injury to the web in its travel from such calender to said winding machine; it will be understood that while the novel features are particularly adapted to such an installation, this is not to be construed as defining the limits of the invention.

As shown in the drawings the one machine or mechanical element is represented by the calender rolls 10 of a conventional paper calender, while the other machine or co-operating element is indicated by a paper winder 11 of customary type; in such an installation the web of paper 12 after traveling between the calender rolls 10 passes to the winder 11 on which it is wound in the form of a roll.

Experience has shown that it is of great importance that the drive of the paper winder 11, in order to provide rolls of paper of uniform density and with the desired hard centers, should have a speed range extending from the creeping speed necessary for threading-in the web up to the maximum speed, which should be high enough to allow the winder 11 to keep well in the lead of the paper machine 10. In addition to this it is desirable to provide for the varying peripheral speed of the roll of paper or its equivalent which results from the progressive increase in the diameter of said rolls as the winding proceeds, in order to avoid the development of excessive tensional strains in the traveling web which might cause breakage or other injury thereto. To adequately meet all of these requirements, and in accordance with the principles of the invention I employ an automatically controlled fluid pressure driving means comprising a

fluid pressure pump A arranged to deliver fluid under pressure to a fluid pressure motor B. The general construction of the pump A and motor B is similar, and may be of the type disclosed, for instance in Letters Patent of the United States granted to Harvey D. Williams on June 15, 1909, No. 925,148 and on November 8, 1912, No. 1,044,838.

In carrying out the present invention the pump A may be driven in any convenient manner as by means of a variable speed electric motor 13 preferably controlled by suitable limit switches and which may serve also to drive the calender rolls 10; in such case the motor 13 may be suitably connected directly to the shaft 14 of the pump A and to the shaft 15 of one of the calender rolls 10 as shown in Figs. 1 and 2. The fluid motor B is connected, in any suitable manner, to the shaft 16 of the winding machine, as illustrated also in Figs. 1 and 2.

As previously stated the fluid pressure pump A and the fluid pressure motor B may be of similar construction in that each comprises a rotating barrel 17 having a plurality of cylinders 18 bored therein in parallel alignment with the axis of the barrel; in the pump A the barrel 17 is carried by the driving shaft 14, while in the motor B the corresponding barrel is carried by the shaft 14^a, which is connected with the shaft 16 of the winder 11. Each cylinder 18 has mounted for reciprocation therein a plurality of pistons 19, provided with piston rods 20 connected with swash plates 21 whereby all of said pistons are reciprocated in the respective cylinders when the mechanism is in operation. The swash plates 21 are mounted for rotation within a tilting box 22 in any conventional manner, for instance, as shown in the patents above referred to. In the motor or B-end, the tilting box 22 is generally held at a fixed inclination, while in the pump or A-end, the angle of inclination of the tilting box 22 may be varied by means of a control shaft 23; with this arrangement the speed of rotation of the motor or B-end is varied by adjusting the control shaft 23, and thereby the inclination of the tilting box 22 of the pump or A-end. When the tilting box of the pump A is at right angles to the driving shaft 14 thereof, the pistons 19 will have no stroke and no fluid will be delivered by the pump, so that the speed gear occupies a neutral position. When, however, the tilting box 22 of the pump A is inclined to the shaft 14, fluid will be pumped by the motor in one or the other direction as the tilting box is tilted to one side or the other of its right angle or neutral position. As the pistons 19 of the pump A are caused to reciprocate, they suck or force oil through the cylinder ports 18^a which are adapted to register alternately, as the barrel 17 rotates, with arcuate ports formed in the end 24 of the pump casing, and connected by

means of pipes 25 and 26 with corresponding ports in the end 27 of the motor B. The construction and arrangement of the respective pump and motor ends 24 and 27 with the aforesaid ports may be identical with the disclosure of the patents hereinbefore mentioned. As shown in Fig. 3 the control shaft 23 is pivotally connected with a block 28 mounted in the work 29, which forms an integral part of, or is connected with, the tilting box 22 of the pump A. The control shaft 23 further is in threaded connection with an internally threaded sleeve 30 mounted for rotation, but held against axial displacement in a casing 31 and carrying at its upper end a worm gear 32, which also is enclosed in said casing 31. The worm gear 32 meshes with a worm pinion 33 also located in said casing 31 and carried by a shaft 34, which further has mounted thereon a worm gear 35 meshing with a second worm pinion 36 fixed upon an auxiliary shaft 37, said shaft 37, worm pinion 36 and worm gear 35 being enclosed in an auxiliary casing 28 forming part of or secured to the casing 31. The shaft 37 projects outwardly beyond the auxiliary casing 38 and has fixed thereon a sprocket wheel 39, which is connected by means of a sprocket chain 40 with a co-operating sprocket wheel 41 fastened upon the shaft 42 of an electric control motor 43 which, as shown in Figs. 1 and 2 may be suitably mounted upon the casing of the pump A.

At a point intermediate of the pump A and motor B, a tension roll 44 is arranged to rest and bear upon the web 12, said tension roll being journaled in blocks 45, which are vertically guided in upright guides 46, as shown in Fig. 1. For the purpose of adjustment the tension roll 44 may be provided with springs 47, bearing at one end against the blocks 45, and having their other ends in engagement with adjusting members 48 slidably mounted in the guides 46. The vertical adjustment of the adjusting members 48 is effected by means of adjusting screws 49, the lower end of which are rotatably mounted and held against axial movement in stationary bearings 50, and the upper portions of which are screw threaded as indicated at 51 for threaded engagement with the adjusting members 48. To facilitate the operation of the adjusting screws 49 and the tensional adjustments of the springs 47, the screws 49 may be provided at their upper ends with hand wheels 52 or their equivalent. One of the blocks 45 carries a contact 53 which partakes of the vertical movements of the tension roll, as will be hereinafter more fully brought out, and which co-operates with a stationary contact 54 fixed upon the contiguous guide 46. The contacts 53 and 54 constitute terminals of an electric circuit 55, which includes and leads to the electric control motor 43.

In practice the driving motor 13 actuates the calendering rolls 10 and at the same time operates the pump A which, in accordance with the setting of its swash plate 21, brings about an operation of the motor B which in turn through its shaft 14^a rotates the shaft 16 and consequently operates the winding machine 11. The web 12 after traveling between the calender rolls 10 passes to the winding machine 11 and is wound thereby upon a suitable spindle in the form of a roll 56. During the travel of the web 12 from the calender rolls 10 to the winding machine 11, the tension roll 44 will rest upon and be carried by said web as is clearly shown in Fig. 1; as the winding proceeds the web 12 is under a tension and the tension roll 44 is lifted thereby to a position in which the contact 53 is in engagement with the contact 54 to close the electric circuit 55 in which the control motor 43 is located. As long as this adjustment of the parts remains the control motor 43 will remain in operation with the result that the control shaft 23 is actuated to adjust the swash plate 21 of the pump A to progressively different angles of inclination which gradually approach the neutral position of the speed gear in which said swash plate 21 is at right angles to the driving shaft 14. Under such conditions, as the winding proceeds, the possibility exists that the tension in the traveling web 12 may be developed to a point which results in injury thereto.

To overcome this objection, the control motor 43 is set for high speed when the roll 56 on the winding machine 11 is small in diameter, and the gearing between said motor 43 and the control shaft 23 of the pump A is so arranged that the motor B and with it the roll 56 will slow down just a little bit faster than is necessary to keep the traveling web 12 in a taut condition. As the aforesaid adjustment of the swash plate 21 takes place this excess slowing down of the motor B and roll 56 will cause the web 12 to become slightly slack in that part thereof which lies between the calender 10 and the winding machine 11. Because of this slack in the web 12 the tension roll 44 will drop and cause the contact 53 to move downwardly out of engagement with the contact 54 whereby the electric circuit 55 is broken and the control motor 43 is stopped. Further adjustment of the swash plate 21 is accordingly arrested, and the motor B and with it the roll 56 consequently rotate at a constant speed at this stage. Under such conditions the gradually increasing diameter of the roll 56 tends to increase the tension in the traveling web 12 and to again render it taut so that the tension roll 44 is again raised to return the contact 53 into engagement with the contact 54; the circuit 55 is thus again closed and the

control motor 43 again started whereupon the above described steps are repeated.

In the preferred arrangement the contact 54 is not a positively located contact, that is, the contact 53 makes contact with the contact 54 between certain limits which should correspond to a web tension varying between the minimum and maximum allowable; these limits are determined by properly setting the spring 48, the tension of which may be varied for different grades and weights of the web.

From the above it will be clear that the speed of the winding machine 11 relatively to that of the calender stack will be automatically varied to provide for changes in the diameter and size of the roll being wound, and in a manner to prevent the development of any undue tensional strains in the web 12, which might cause breakage thereof or other injury thereto. The control is absolutely automatic and is governed by the web 12 itself, and at the same time is of maximum efficiency and consequently results in a proper operative co-ordination of the winding machine and calendering rolls throughout all stages of a given winding operation. The production consequently may be carried out at high speed, while losses due to shut downs because of breakage or other injury in and to the web 12 are reduced to a minimum and in fact in most cases, completely avoided. With the arrangement shown in Figs. 1 and 2 the pump A is driven at the same speed as the calender rolls, and is started coincidentally therewith and operates at all times in synchronism with said calender rolls; if for any reason the operation of the calender rolls is discontinued, the pump A will also be stopped simultaneously therewith, and consequently the operation of the winding machine will also be arrested at once.

In the form shown in Fig. 4 the calender rolls 43^a are driven independently of the pump A, for instance by means of a pulley 56 and belt 57; in other words, the pump A is not connected with the calender driving means, but is operated independently thereof by its own electric motor 13^a or equivalent means. Otherwise the arrangement and operation of the form shown in Fig. 4 may be the same as that shown in Figs. 1, 2 and 3, the advantages recited hereinbefore being inherent also in the form last described.

While the mechanism illustrated and described is adapted particularly to the paper making art, it is in no sense limited thereto, and may be effectively utilized in other ways in which a web of material travels from one mechanism to another. In other words, it is to be understood that the invention is not limited in its application to machines of the construction herein disclosed, or to machines for calendering and winding paper, but that said invention may be applied to any ma-

chines for successively operating on or handling webs of material.

Various changes in the specific forms shown and described may be made within the scope of the claims without departing from the spirit of the invention.

I claim:—

1. The combination with a machine from which a web of material is fed and a winding machine for receiving said web from said first machine and winding it in a roll, of a fluid pressure motor for driving said winding machine, a fluid pressure pump for operating said fluid pressure motor, electrically controlled means for adjusting said fluid pressure pump to vary the driven speed of said fluid pressure motor, and means governed by said web for automatically controlling the operation of said electrically controlled means to maintain the driven speed of said fluid pressure motor in properly timed relationship with the operative speed of said first machine to compensate for variations in the size of the roll being wound.

2. The combination with a machine from which a web of material is fed and a winding machine for receiving said web from said first machine and winding it in a roll, of a fluid pressure motor for driving said winding machine, a fluid pressure pump for operating said fluid pressure motor, an electric control motor for adjusting said fluid pressure pump to vary the driven speed of said fluid pressure motor, an electric circuit including said control motor, a pair of co-operating contacts constituting terminals of said electric circuit, at least one of said contacts being movable, and means governed by said web for moving said contacts into and out of engagement with each other whereby said electric circuit is periodically closed and opened and said control motor is controlled to maintain the driven speed of said fluid pressure motor in properly timed relationship with the operative speed of said first machine to compensate for variations in the size of the roll being wound.

3. The combination with a machine from which a web of material is fed and a winding machine for receiving said web from said first machine and winding it in a roll, of a fluid pressure motor for driving said winding machine, a fluid pressure pump for operating said fluid pressure motor, an electric control motor for adjusting said fluid pressure pump to vary the driven speed of said fluid pressure motor, an electric circuit including said control motor, a stationary contact constituting one terminal of said electric circuit, a movable contact constituting the other terminal of said electric circuit, and a tension roll carrying said movable contact and resting upon said web, said tension roll being movable by said web as a result of tensional changes therein

to shift said movable contact into and out of engagement with said fixed contact whereby said electric circuit is periodically closed and opened and said control motor is controlled to maintain the driven speed of said fluid pressure motor in properly timed relationship with the operative speed of said first machine to compensate for variations in the size of the roll being wound.

4. The combination with a machine from which a web of paper is fed and a winding machine for receiving said web of paper from said first machine and winding it in a roll, of a fluid pressure motor for driving said winding machine, a fluid pressure pump for operating said fluid pressure motor, a variable speed driving motor operatively connected with said first machine and fluid pressure pump, an electric control motor for adjusting said fluid pressure pump to vary the driven speed of said fluid pressure motor, an electric circuit including said control motor, upright guide means, a stationary contact on said guide means constituting one terminal of said circuit, a movable contact constituting the other terminal of said circuit, and a tension roll resting upon said web of paper and vertically movable on said guide means, said tension roll carrying said movable contact and being movable by said web as a result of tensional changes therein to shift said movable contact into and out of engagement with said stationary contact whereby said electric circuit is periodically closed and opened and said control motor is controlled to maintain the driven speed of said fluid pressure motor in properly timed relationship with the operative speed of said first machine to compensate for variations in the size of the roll being wound.

5. The combination with a machine from which a web of paper is fed and a winding machine for receiving said web of paper from said first machine and winding it in a roll, of a fluid pressure motor for driving said winding machine, a fluid pressure pump for operating said fluid pressure motor, a variable speed driving motor independently connected with said fluid pressure pump for operating said pump independently of said first machine, an electric control motor for adjusting said fluid pressure pump to vary the driven speed of said fluid pressure motor, an electric circuit including said control motor, upright guide means, a stationary contact on said guide means constituting one terminal of said circuit, a movable contact constituting the other terminal of said circuit, and a tension roll resting upon said web of paper and vertically movable on said guide means, said tension roll carrying said movable contact and being movable by said web as a result of tensional changes therein to shift said movable contact into and out of engagement with said stationary contact

whereby said electric circuit is periodically closed and opened and said control motor is controlled to maintain the driven speed of said fluid pressure motor in properly timed relationship with the operative speed of said first machine to compensate for variations in the size of the roll being wound.

6. The combination with a machine from which a web of material is fed and a winding machine for receiving said web from said first machine and winding it in a roll, of a fluid pressure motor for driving said winding machine, a fluid pressure pump for operating said fluid pressure motor, and including an adjustable swash plate for varying the speed of said fluid pressure motor and a control shaft for adjusting said swash plate, an electric control motor, an electric circuit including said control motor, a pair of co-operating contacts constituting terminals of said electric circuit, a tension roll resting upon said web and carrying one of said contacts, said last named contact being maintained in engagement with the co-operating contact when said web is taut whereby said electric circuit is closed and said control motor is operated to adjust said swash plate to progressively reduce the speed of said fluid pressure motor as the size of the roll being wound increases, and gearing connecting said electric control motor with said control shaft and arranged to create an excess slowing down of said fluid pressure motor to provide slack in said web and drop said tension roll to separate said contacts and arrest the operation of said electric control motor whereby the maximum tension developed in said web as the roll increases in size is predetermined.

In testimony whereof I have hereunto set my hand.

DANIEL ROBERT FRANCIS.

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