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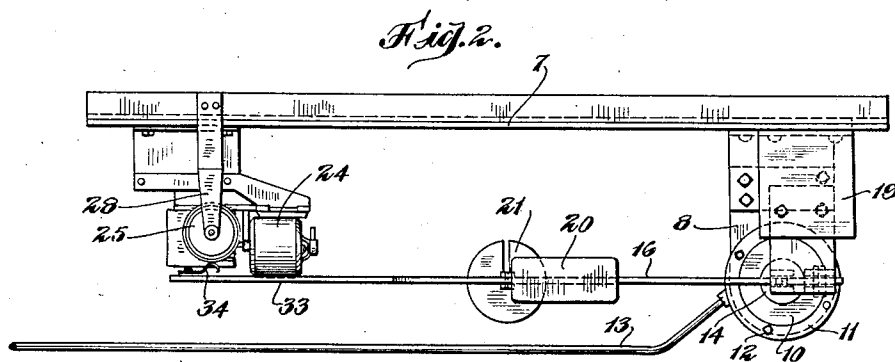
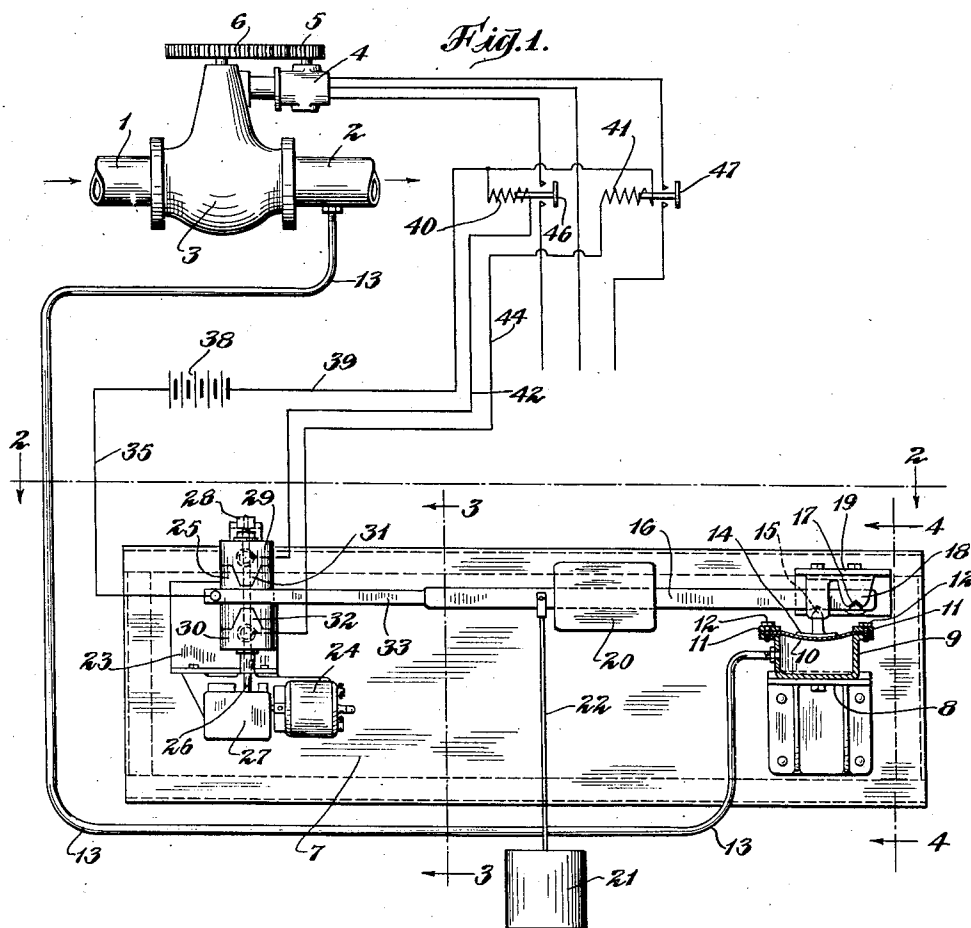
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REGULATING APPARATUS

Filed March 16, 1926

2 Sheets-Sheet 1



Inventor
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By his Attorneys
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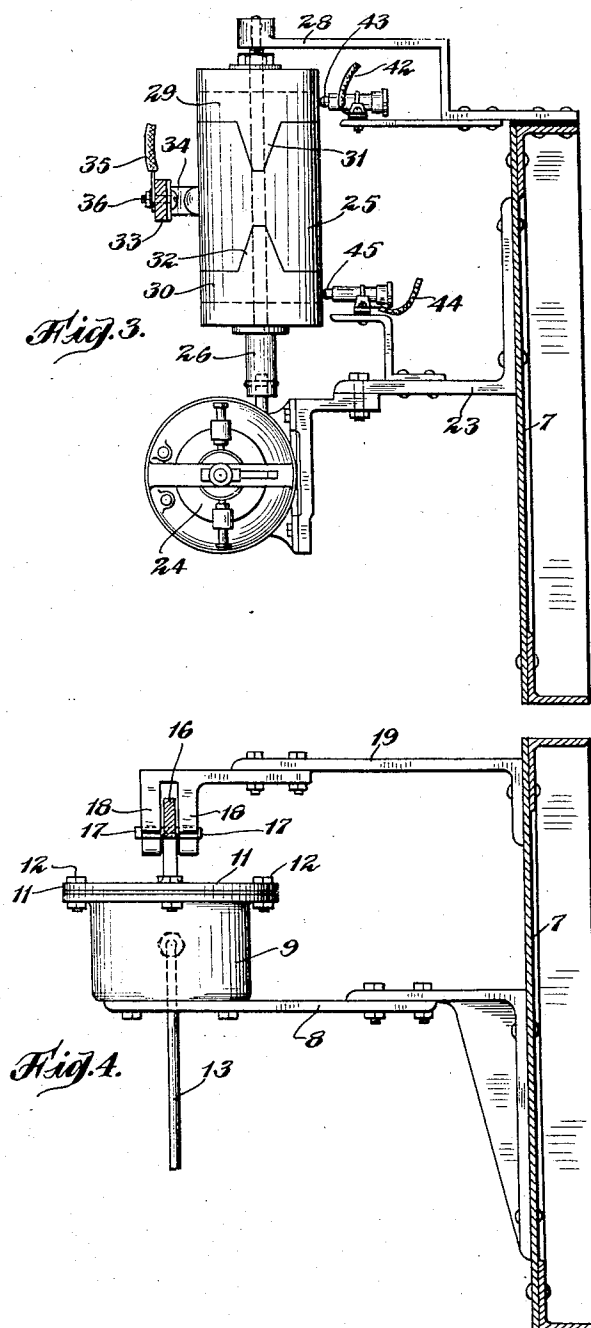
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UNITED STATES PATENT OFFICE

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REGULATING APPARATUS

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My invention relates to improvements in regulating arrangements and while the invention may be applied to the regulation of many different kinds of apparatus, it is particularly applicable to the regulation of steam pressure in a steam supply line and more particularly where the steam is supplied to the line at a high pressure and it is desired to deliver the steam therefrom at a substantially lower pressure.

The main object of the invention is to provide an arrangement of this class which will maintain the fluid pressure or other condition at the desired point or very close to a predetermined desired value or setting. A further object is to provide an apparatus or arrangement for this purpose which is not only simple and inexpensive in construction, but which is also particularly efficient in operation.

Further and more specific objects, features and advantages will more clearly appear from the detail description given below taken in connection with the accompanying drawings which form a part of this specification and which illustrate one form of the invention applied to the regulation of steam pressure.

Referring to the drawings, Fig. 1 is a view, largely diagrammatic, illustrating a preferred embodiment of my invention. Fig. 2 is a top plan view of a portion of the apparatus taken on the line 2—2 of Fig. 1. Fig. 3 is a transverse section of the same taken on the line 3—3 of Fig. 1, and Fig. 4 is a transverse section of the same taken on the line 4—4 of Fig. 1.

Referring to Fig. 1, 1, 2 represent a steam line or pipe, steam being supplied at high pressure to the section 1 and it being desired to maintain the steam in the section 2 at a substantially lower but substantially constant pressure. For this purpose there is interposed between the sections 1 and 2 a valve or pressure regulating device 3 adapted to control the admission of steam from the high pressure side to the low pressure side 2 in order to vary or maintain the pressure of the steam in the section 2. The steam may be supplied at high pressure directly to section 1

from the boilers and steam from section 2 may be utilized in the driving of engines or for any other purpose. As shown in Fig. 1, the valve or pressure regulating device 3 is adapted to be operated by an electric motor or electro-motive device 4 operating through gears 5 and 6.

7 represents a suitable panel or framework for carrying certain portions of the regulating apparatus. Arranged on the panel 7 is a bracket 8 carrying a circular steam chamber 9, the top of which is closed by a diaphragm 10 preferably composed of heavy rubberized fabric which is clamped at its periphery to the circumferential edge of the chamber 9 by means of clamping ring 11 and bolts 12 (see also Fig. 4). The chamber 9 is connected to the line section 2 by means of a steam line or pipe 13 so that steam may be admitted from the line 2 to the chamber 9 and the pressure of the steam in the chamber 9 will be the same as that in the section 2.

Seated upon the diaphragm 10 is a disc shaped member 14 carrying a knife edge 15 seated in a groove in a lever or beam 16 which has on either side thereof knife edges 17 seated in grooves in depending ears 18 carried by a bracket member 19 secured to frame 7. Thus the lever beam 16 is fulcrumed in the ears 18 about the knife edges 17 and is adapted to be moved up and down by the diaphragm 10 as the pressure of the fluid in chamber 9 varies. In order to regulate the pressure at which the beam 16 will be so moved, there is provided a sliding weight 20 slidable along the same and also a counter-weight 21 suspended therefrom by means of the link 22, the effect of which may be varied by adding more or less weight to the counter-weight.

At the other end of the frame 7 there is provided a bracket 23 to which is secured an electric motor 24 adapted to constantly rotate a contact cylinder 25, fixed to a shaft 26, through suitable reduction gearing in the casing 27 (see also Fig. 3). The upper end of the shaft 26 is journaled in a bracket 28.

The constantly rotating cylindrical contact member 25 is preferably made of insulating material but is provided on each end with

sheet metal contact members 29 and 30 respectively, these contact members extending entirely around the cylindrical member 25. At one point about the circumference of the member 25 the metal contact members 29 and 30 are provided with projecting portions 31 and 32 respectively, extending toward one another substantially parallel to the axis of rotation of the rotating member and preferably tapering toward their ends as illustrated in Figs. 1 and 3. Thus each rotating contact 29, and 30 has gaps between the projecting portions 31 and 32 respectively which vary in width in the direction of the axis of rotation of the contact member.

The beam or lever 16 is provided at its left-hand end as viewed in Fig. 1 with a switch arm 33 preferably made of insulating material and carrying a spring contact 34 to which electrical connection may be made to a conducting wire 35 by means of connecting screw 36.

When the beam 16 is in its normal position the contact 34 is adapted to lie between the contact portions 31 and 32 so that as the rotating switch contact member 25 rotates the contact spring 34 is out of contact with both of the contact portions 31 and 32. As shown in Fig. 1 the conducting wire 35 is connected to one pole of the battery or other source of E. M. F., 38 and the other pole of the battery is connected by wire conductor 39 to one terminal each of the electro-magnets 40 and 41. The other terminal of the magnet 40 is connected by wire 42 to a spring pressed contact 43 which constantly bears against the continuous band portion of the contact 29 of the rotating member 25. The other terminal of the electro-magnet 41 is connected by a wire 44 to a spring pressed contact 45 which makes constant contact with the continuous band portion of the contact 30 of the member 25.

In operation should the pressure of the fluid in the pipe 2 or other fluid holding means rise above the predetermined value, the same increase in pressure in the chamber 9 will cause the diaphragm 10 to lift the beam 16 about its fulcrum 17 and cause the contact 34 to move over the rotating contact member 25 in the direction of its axis of rotation and bring the spring contact 34 from its neutral position between the contacts 29 and 30 into contact with the portion 31 of the contact 29 as the contact member 25 revolves. This will close the circuit through the magnet 40 causing it to operate a relay switch 46 to close a circuit through the electro-motive device 4 which will operate the valve 3 to reduce the admission of steam or fluid from the section 1 to the section 2 and so tend to reduce the pressure of the steam in section 2. However, the circuit through the magnet 40 is only momentarily closed because with the continued rotation of the contact member 25, the

contact portion 31 will soon ride out of engagement with the contact-spring 34 and so open the circuit and thus open the switch 46 and stop the operation of the electro-motive device 4. I have found that with the apparatus shown in the drawings the same operates successfully if the contact cylinder 25 be rotated at a speed of about two revolutions per minute, so that the circuit is only maintained closed through contacts 31, 34 a few seconds at a time. If, however, the first momentary operation of the valve or pressure regulating device 3 has not reduced the pressure in the section 2 to the predetermined value for which the apparatus is set, the continued rotation of the contact member 25 will in a moment again bring the contact portion 31 into contact with the contact spring 34 and so again close the circuit through the magnet 40 and again cause the electro-responsive device 4 to further operate the valve or pressure regulating device 3 to further reduce the pressure in the section 2. Thus variations from a predetermined pressure in the steam or fluid in the section 2 will cause the pressure regulating device 3 to operate intermittently momentarily until the pressure in the section 2 (and likewise the pressure in the chamber 9) is returned substantially to the predetermined pressure or predetermined value setting for which the apparatus is set and without substantially changing said predetermined pressure setting or predetermined value setting, and the switch arm 33 is brought to a position where the spring contact 34 lies between contact portions 31 and 32 and no contact will be made therewith by a spring contact 34 as the member 25 revolves without materially changing said predetermined value setting.

Should the apparatus be started with the valve 3 in wide open position such that the pressure in the section 2 is very considerably greater than that for which the apparatus is set, the beam 16 may be elevated to such an extent as to bring the spring contact 34 into engagement with the upper and continuous band portion of the contact 29 and when in this position the circuit through magnet 40 will not be intermittently broken as member 25 revolves but the switch 46 will be maintained closed and the electro-motive device 4 will operate the valve or regulating device 3 continuously until the pressure in the section 2 and chamber 9 is brought more closely to the predetermined pressure for which the apparatus is set, whereupon the beam 16 will drop until the switch arm 33 brings the contact 34 to such a position that it will only make intermittent contact with the contact 31 as the contact cylinder 25 revolves. Thus I have provided means whereby certain variations from a predetermined value setting in a certain condition will cause the regulating means 3 to operate intermittently until said

condition is returned substantially to said predetermined value setting and also whereby larger departures from said predetermined value, will cause said regulating means to operate constantly in a direction tending to return said condition toward said predetermined value setting.

Thus I have provided an arrangement by which the motor 4 and valve may be given a relatively small movement in a given time when the variations from the predetermined pressure are relatively small, and a relatively large movement in the same given time when the variations from the predetermined pressure are relatively large; or by reason of the circumferential contacts 29 and 30 extending substantially entirely around the periphery of the member 25 at its ends and by reason of the tapering projections on the rotating contacts, the motor 4 is energized intermittently and with the periods of energization relatively short as compared with the periods of non-energization when the departures from the predetermined pressure are relatively small, and the periods of energization are larger when the departures from said predetermined value are larger, and the motor is energized substantially continuously when the departures from said predetermined value are still larger.

Likewise if the pressure in the section 2 (and consequently also in the chamber 9) should drop below the predetermined value for which the apparatus is set, the beam 16 will lower the switch arm 32 so that contact 34 will be brought into intermittent momentary engagement with the contact portion 32 and thus cause the intermittent closing of the circuit through the magnet 41 and a corresponding intermittent operation of the relay switch 47 which will cause an intermittent operation of the electro-motive device 4 to intermittently momentarily operate the regulating means 3 in the opposite direction to increase the pressure of the steam in the section 2. Likewise should the departure from the predetermined pressure of the fluid in section 2 be so great as to cause the switch contact 34 to be brought into engagement with the continuous band portion of contact 30, the regulating device 3 will be continuously or constantly operated until the pressure of the fluid in the section 2 is brought within certain smaller variations from the predetermined pressure, when the contact 34 will come only into engagement with the contact portion 32 and so cause an intermittent operation of the regulating device 3 until the pressure in the section 2 is returned substantially to the predetermined pressure for which the apparatus is set.

By reason of the intermittent operation of the regulating device as the pressure is brought back nearly to the predetermined value for which the apparatus is set, substan-

tial hunting of the regulating means is prevented. If the circuits were maintained closed until the pressure in section 2 had been brought back to the predetermined value for which the apparatus is set, then the lag in the apparatus or momentum of the electro-motive device 4 and regulating device 3 would tend to cause these devices to carry the regulation too far and produce a hunting action; thereby in effect, setting up variations in the pressure of the steam or fluid in the section 2. However, by discontinuing momentarily the operation of the regulating device 3 before the pressure has been brought back to the predetermined value for which the apparatus is set, the action of the regulating apparatus is in effect, dampened as the desired pressure is approached and the apparatus thereby made more efficient.

While I have described my improvements in great detail and with respect to one preferred embodiment thereof, I do not desire to be limited to such details or embodiment since many changes and modifications may be made and the invention embodied in widely different forms of apparatus without departing from the spirit and scope thereof in its broader aspects. Hence I desire to cover all modifications, forms and embodiments coming within the language or scope of any one or more of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. A fluid pressure regulating arrangement having in combination with means holding a fluid under pressure, means for varying the pressure of the fluid in said holding means, means whereby certain variations in the pressure of the fluid in said holding means from a predetermined value, will cause said regulating means to operate intermittently until the pressure of the fluid in said holding means is returned substantially to said predetermined value and whereby larger departures in the pressure of the fluid in said holding means from said predetermined value will cause said regulating means to operate constantly until the pressure of the fluid in said holding means is brought within said first mentioned certain variations.

2. A fluid pressure regulating apparatus having in combination, means for regulating the admission of fluid under pressure, and means responsive to variations in pressure from a predetermined pressure setting for causing said fluid admission regulating means to operate intermittently until the pressure is returned substantially to said predetermined pressure setting, said last mentioned means including electro-responsive means for controlling the operation of said fluid admission regulating means, and a switch device for controlling said electro-responsive means, said switch device having a continuously rotating member with a contact thereon compris-

ing a substantially continuous contact extending circumferentially around the same and a contact extending therefrom parallel with the axis of rotation of said rotating member, and a contact member moved into and out of contact with said contacts responsive to said variations in pressure.

3. A fluid pressure regulating arrangement having in combination, means for regulating the admission of fluid under pressure, and means responsive to variations in pressure from a predetermined pressure setting for causing said fluid admission regulating means to operate until the pressure is returned substantially to said predetermined pressure setting, said last mentioned means controlling said first mentioned means to cause the latter to operate substantially continuously when the variations from the predetermined pressure are relatively large and to operate only intermittently and for intervals which are relatively short as compared with the intervals of non-operation when the variations from the predetermined pressure are relatively small.

4. Regulating apparatus having in combination regulating means for varying a certain condition, means whereby relatively small variations from a predetermined value setting in said condition will cause said regulating means to operate intermittently until the said condition is returned substantially to said predetermined value setting and whereby larger departures from said predetermined value setting will cause said regulating means to operate substantially continuously in a direction tending to return said condition toward said predetermined value setting.

5. Regulating apparatus having in combination regulating means for varying a certain condition, means whereby relatively small variations from a predetermined value setting in said conditions will cause said regulating means to operate intermittently until said condition is returned substantially to said predetermined value setting, the length of each intermittent operation being relatively small as compared with the length of the intervals between intermittent operations, and means whereby larger departures from said predetermined value setting will cause said regulating means to operate substantially continuously in a direction tending to return said condition toward said predetermined value setting.

6. Regulating apparatus having in combination, means for regulating the admission of a fluid under pressure, an electric motor for operating the same and switching means controlling the energization of said motor responsive to variations in fluid pressure from a predetermined pressure setting, and whereby the motor is energized substantially con-

tinuously when the variations from the predetermined pressure are relatively large and the motor is operated only intermittently and for intervals which are relatively short as compared with the intervals of non-energization when the variations are relatively small.

7. Regulating apparatus having in combination, means for regulating the pressure of fluid, an electric motor for operating the same, a switch for energizing said motor, means controlling said switch responsive to variations in the pressure of said fluid from a predetermined value, said switch acting to energize said motor intermittently and with the periods of energization relatively short as compared with the periods of non-energization when the departures from said predetermined pressure are relatively small, and with periods of energization longer when the departures from said predetermined value are larger, and said switch acting to energize said motor substantially continuously when the departures from said predetermined pressure are still larger.

8. Regulating apparatus having in combination regulating means for varying a certain condition, means whereby variations from a predetermined value setting in said condition will cause said regulating means to operate until said condition is returned substantially to said predetermined value setting, said regulating means having a fixed framework, a member rotating about a single axis which is fixed with respect to said framework, said rotating member having two electric contacts thereon, spaced from one another to form a neutral position therebetween, an electrical contact member pivotally mounted with respect to said fixed framework and adapted to swing from said neutral position to make electrical contact with either of said contacts on the rotating member, the contacts on said rotating member each extending substantially entirely around said rotating member and each having a projection extending therefrom parallel with the axis of said rotating member and with which the pivotally mounted contact is adapted to make contact before it makes contact with the portion which extends substantially entirely around the rotating member, as the pivotally mounted contact swings from said neutral position.

9. Regulating apparatus having in combination regulating means for varying a certain condition, means whereby variations from a predetermined value setting in said condition will cause said regulating means to operate until said condition is returned substantially to said predetermined value setting, said regulating means having a rotating contact member having a contact thereon extending substantially entirely around said rotating member, an electric contact member adapted to swing over said rotating member axially

thereof to make contact with said first contact, said first contact having a projection extending therefrom and with which the second contact member is adapted to make contact before it makes contact with the portion which extends substantially entirely around the rotating member, said projection tapering outwardly away from the other portion thereof, whereby as the second mentioned contact swings over the rotating member, a circuit through said contacts is closed intermittently, at first for short periods of time, then for longer periods of time and finally substantially constantly.

In testimony whereof I have signed my name to this specification.

JAMES NELSON HELPBRINGER.