

Dec. 30, 1947.

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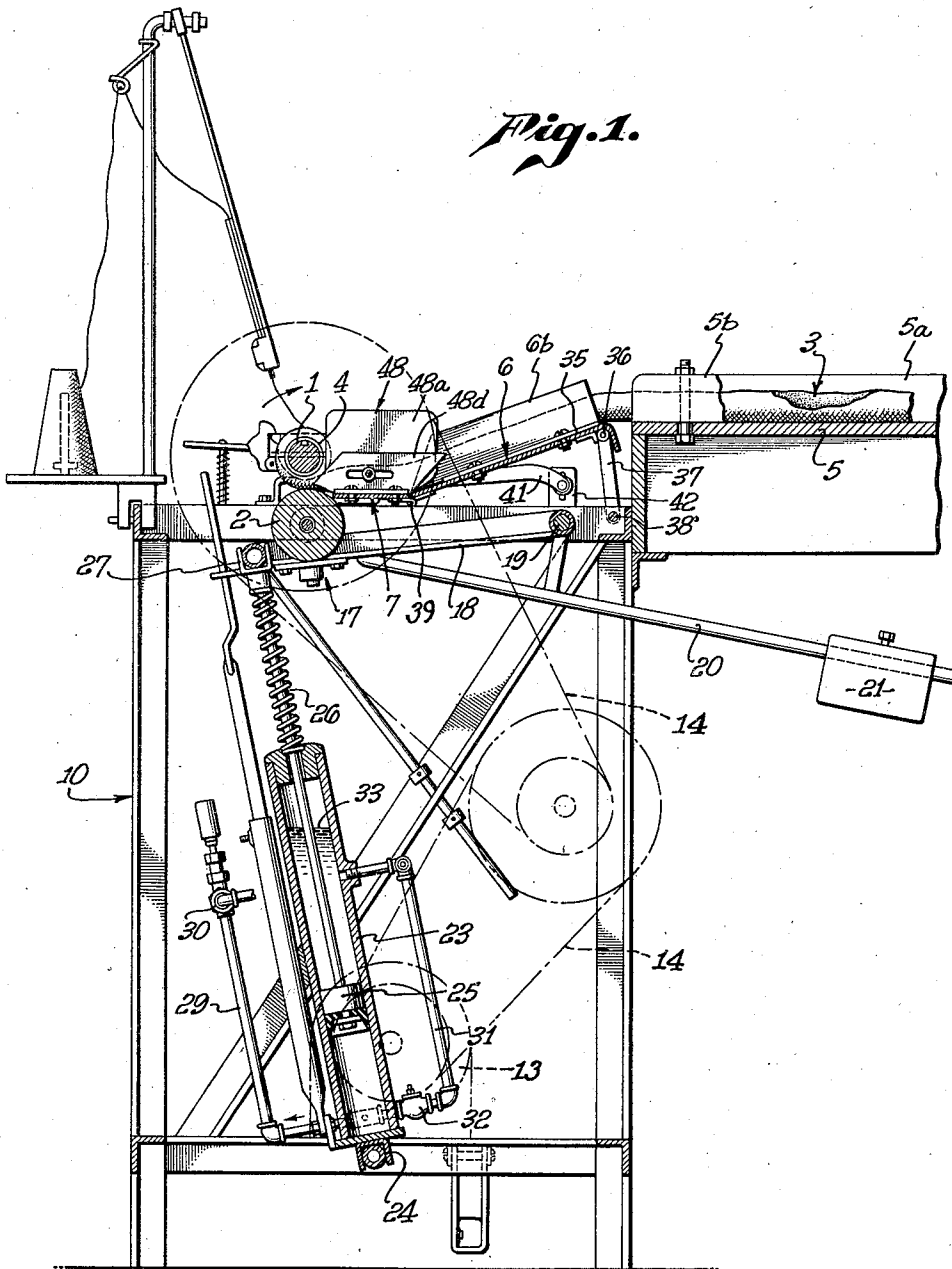
2,433,787

WINDING APPARATUS

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3 Sheets-Sheet 1

Fig. 1.



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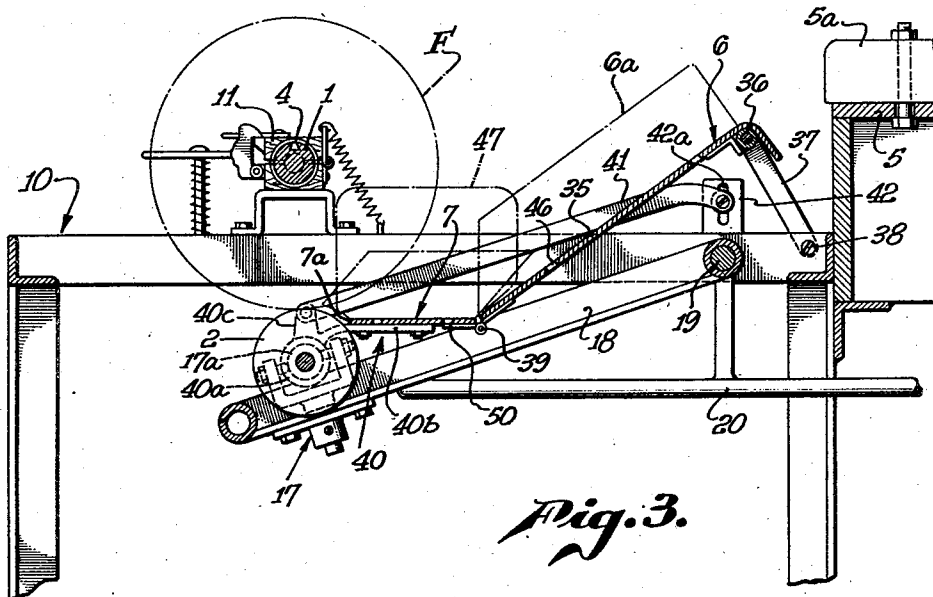


Fig. 3.

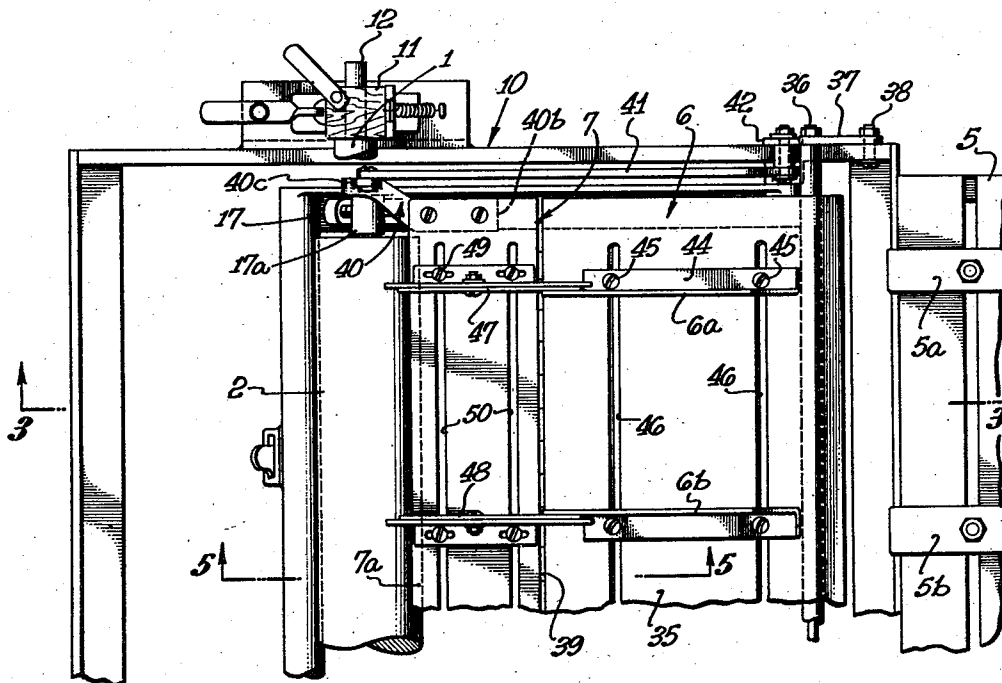


Fig. 2.

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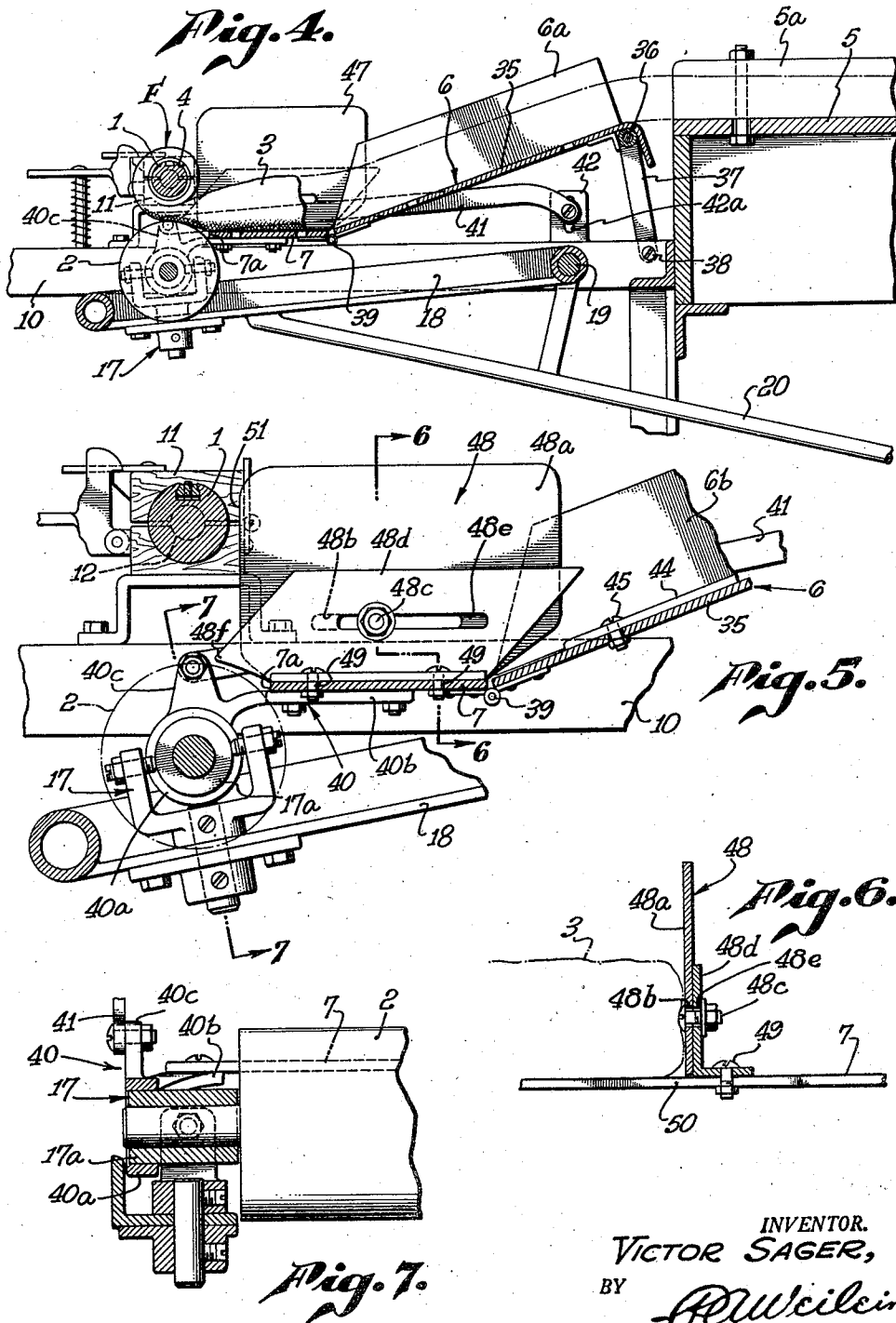
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WINDING APPARATUS

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3 Sheets-Sheet 3



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WINDING APPARATUS

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12 Claims. (Cl. 242—1)

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This invention relates generally to winding apparatus, and particularly to such apparatus used in producing spool type filter elements commonly employed in filtering devices for lubricating systems, Diesel fuel systems and the like.

In my copending application filed May 15, 1944, under Serial Number 535,590, and entitled "Apparatus for forming filter elements and the like," apparatus of the aforementioned type is disclosed. This application relates to improvements in such apparatus.

It is an object of this invention to provide such apparatus capable of producing a filter element of improved characteristics.

It is another object of this invention to provide such apparatus capable of winding filter elements of widely varying diameters, such apparatus being adapted to confine the ends of the filter element as it is wound, thus contributing to the uniformity of the finished element.

It is another object of this invention to provide such apparatus especially adapted for winding large diameter filter elements.

It is another object of this invention to provide such apparatus employing a split apron for supporting the material to be wound, as it is fed to a movable pressure roller, said apron having a section adjacent the roller which is automatically adjusted with respect to the roller so as to be in proper feeding relation therewith for all positions of the roller.

This invention possesses many other advantages and has other objects which may be made more easily apparent from a consideration of one embodiment of the invention. For this purpose there is shown a form in the drawings accompanying and forming part of the present specification. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a longitudinal section through a machine, embodying the invention, showing a partly wound filter element in elevation;

Figure 2 is a plan view of part of the machine of Figure 1, on an enlarged scale, and without the filter element;

Figure 3 is a section, taken as indicated by line 3—3 of Figure 2;

Fig. 4 is a section similar to Figure 3, but

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showing the parts in a different operating position;

Figure 5 is a detail section on a further enlarged scale, taken as indicated by line 5—5 of Figure 2, but showing another operating position of the parts; and

Figures 6 and 7 are detail cross sections taken as indicated by the correspondingly numbered lines on Figure 5.

Referring to the drawings, an apparatus is shown which is quite similar to that disclosed in the aforementioned copending application. Thus, referring particularly to Figures 3, 4 and 5, a rotatable mandrel 1 is shown about which the filtering material is adapted to be wound to form the filtering element F, shown as partly formed in Figures 1 and 4. A pressure roll 2 is arranged to compress the filtering material as it is wound, the roll 2 being forced away from the mandrel 1 as the winding progresses and the diameter of the filtering element increases. As disclosed in said copending application, the filter element F is preferably formed of a continuous layer or pack 3 wrapped about a central tubular core 4 mounted on the mandrel 1 (see Figure 4). This layer or pack 3 may comprise fibrous material such as mixed shredded fibres of cotton, wool and sisal in suitable proportions confined within a porous wrapping 5 of muslin or other suitable material.

This filter pack 3 which is in the form of a long flexible strip is supported and guided on a platform 5 for movement toward the mandrel, the left hand end of the platform being shown in the drawing. The platform 5 terminates a short distance from the mandrel and pressure roll 1 and 2, the intervening space being bridged by an apron 6. The filter pack 3 is advanced along the table and apron, and fed between the mandrel 1 and pressure roll 2, whence the rotation of the mandrel 1 winds the pack 3. The apron 6 is inclined downwardly toward the pressure roll 2.

It will be clear that as the winding of the filter element progresses the diameter of the element will increase, and the pressure roll 2 will be forced away from the mandrel 1 by the increase in the distance of the outer surface of the element from the mandrel. It is quite essential to the production of a satisfactory filter element that the pack 3 be fed to the mandrel under proper conditions. Thus, the pack or layer 3 must be adequately supported as it leaves the apron 6 and passes to the mandrel and roll, particularly when starting to wind the

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element F. It is difficult to feed the layer 3 straight unless adequate support is provided. If the layer 3 is not started straight it will twist as it is wound, causing the wrapping to become wrinkled and producing an element of irregular shape and non-uniform diameter. Furthermore, the bottom of the layer 3 as it leaves the apron 6 should never be dragged past the edge of the apron, but should be lifted free of the apron.

Accordingly, means are provided so that the conditions under which the layer 3 is fed to the element F are substantially the same, regardless of the diameter of the element. For this purpose, a feed plate 7 is interposed between the end of the apron 6 and the point where the pack 3 is fed to the mandrel 1. The feed plate 7 is supported for angular movement about the pressure roll 2 and is arranged to have substantially the same inclination toward the roll 2 for all positions of the roll. In the present instance, the table 7 is shown as being about horizontal or having a zero inclination. However, this is only because a horizontal plate has been found particularly suitable for use with certain types of filter packs, and it might be desirable with other filter packs to variously incline the table 7 toward the roll 1, or even to incline it in the reverse direction. Such a change would require merely a slight alteration in the proportions of the parts.

In winding large filter elements, of for example 14" or more in diameter, it has been found that the pressure roll 2 sometimes has a tendency to distort the element out of round so that the exterior surfaces on the opposite sides of the element are forced outwardly. To prevent undue pressure from this cause on the advancing layer as it leaves the edge of the plate 7, the arrangement is such that the upper surface of the plate is always spaced vertically below the top of the roll 2 by a suitable distance. Furthermore, means are provided whereby this distance may be caused optionally to increase as the pressure roll 2 moves away from the mandrel 1.

Referring in detail to the structure, the mandrel 1 is rotatably supported on a frame 10 by suitable bearings, one of which is shown at 11, engaging the reduced ends 12 of the mandrel, and is arranged to be driven in a clockwise direction in any desired way as by a motor 13 and a belt transmission 14, suitable control means (not shown) being provided (see Figure 1). As disclosed in said copending application, the mandrel 1 is arranged for vertical movement out of the bearing 11 to permit placement of a filter core 4 thereon and removal of the finished filter element F.

The pressure roll 2 is rotatably mounted, as by self aligning bearings 17, on a cradle frame 18 pivotally supported at 19 on the frame 10, to permit movement of the roll 2 toward and away from the mandrel 1. Means are provided for controlling the movement of the cradle frame 18 to cause the pressure roll 2 to exert pressure on the layer 3 as it is wound about the mandrel. For this purpose, an arm 20 is provided on the frame 18, carrying an adjustable weight 21 for urging the pressure roll 2 towards the mandrel 1. However, as discussed in the said copending application, it is preferred that such pressure be caused mainly by restricting the movement of the pressure roll 2 away from the mandrel 1 in response to increasing diameter of the element F as the winding progresses. For this purpose, 75

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mechanism including a hydraulic cylinder 23 is provided for supporting the free end of the cradle frame 18. The cylinder 23 is rockably mounted at its lower end 24 on the frame 10 and has a packed piston 25 slideable therein, a piston rod 26 extending upwardly from the piston to a swinging connection 27 on the cradle 18.

A bypass connection 29, controlled by a resiliently closed valve 30, connects the spaces above and below the piston. A return by-pass 31 controlled by a check valve 32 is also provided. The cylinder 23 is filled with a suitable liquid, such as light oil, to about the level indicated at 33. The arrangement is such that the liquid trapped below the piston 25 checks downward movement of the piston, the frame 18 and the pressure roll 2, to the rate allowed by escape of the liquid through the by-pass 29 and the valve 30 to the space above the piston. By adjusting the loading of the valve 30 in accordance with the characteristics of the layer 3 and the speed at which the layer is being wound, the pressure exerted by the roll 2 may be controlled. The piston 25 is movable freely in an upward direction, since the by-pass 31 and check valve 32 permit free return of the liquid to the space below the piston 25.

The apron 6 comprises a flat plate 35 with that edge which is adjacent the platform 5 pivotally supported at 36 on the upper end of struts or legs 37, pivoted at their lower ends 38 on the frame 10. The opposite edge of the plate 35 has the feed plate 7 hingedly connected thereto as by hinges 39. The feed plate 7 is supported for angular movement about the feed roll 2, and with its forward edge 7-a closely adjacent the surface of the roll 2, by a pair of bearing brackets, respectively adjacent the opposite ends of the plate 7, one of such brackets being indicated by the numeral 40. In this connection it is to be understood that the apron 6 including the feed plate 7, and the frame 18 are substantially symmetrical about the longitudinal center line of the apparatus. Thus, the means for supporting and positioning the feed plate now to be described, and as shown on one side of the apron, is duplicated at the other side. Thus, referring to Figure 2, that half of the apron etc., not shown is a substantial duplicate of that shown.

Each of the bearing brackets 40 includes a hollow hub or ring 40-a adapted to rotatably embrace a cylindrical sleeve or projection 17-a on the bearing 17 and which is coaxial with the roll 2. A horizontally extending support arm 40-b and an upwardly projecting control arm 40-c are formed integrally on the hub 40-a (see Figures 2, 5 and 7). A link 41 is pivotally connected at one end to the arm 40-c and at its other end to a lug 42 fixed on the frame 10. The arrangement is such that as the cradle frame 18 swings downwardly from the position shown in Figures 1 and 4, to the position shown in Figures 5 and 3, the link 41 swings the bracket 40 about the pressure roll 2 so that the feed plate 7 remains at a substantially constant inclination. Due to the hinged connection 39, the plate 35 is appropriately inclined about the pivots 36 and 38 as the feed plate 7 is moved. In this way, adequate support for the layer of filter material 3 at the start of the winding is assured, and due to the constant inclination of the plate 7, proper feeding of the material 3 to the filter element F as the winding proceeds is assured.

Furthermore, this movement of the plate 7 also maintains the edge or lip 7-a at a substantially constant distance below the top of the roll 2.

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Thus, the plate 7 is maintained clear of the surface of the element F even when the element is distorted out of round by the pressure roll 2, as previously mentioned. It may be desirable for this purpose to increase the distance of the lip 7-a of the feed plate 7 below the top of the roll 2 as the roll 2 moves away from the mandrel, particularly to such distance as required by a filter roll having a diameter of the order of 14" or more. Thus, correct feeding conditions are assured when the roll or element F is of small diameter, and adequate clearance for the surface of the element as the diameter increases is likewise assured. For this purpose, a slot 42-a is provided in the lug 42 to permit adjustment of the pivotal connection between the link 41 and the lug 42 with respect to the pivotal mounting 49 of the cradle frame 18. The link 41 may be so positioned in the slot 42-a that the feed plate 7 is maintained at the same inclination and with the lip 7-a at the same distance below the top of the roll 2, throughout the range of movement of the plate and roll; or the point of connection between the link 41 and the lug 42 may be positioned at a greater distance from the pivot 19, which will cause the feed plate 7 to rotate slightly in a clockwise direction about the roll 2, as the roll 2 moves away from the mandrel 1. This causes the lip 7-a to move downwardly with respect to the top of the roll 2. It will also alter the inclination of the plate 7 slightly, but this is of no consequence.

Means are provided for guiding the layer 3 as it is wound, to insure proper alignment of the successive convolutions of the element F, as well as preventing bulging of the ends thereof. Referring to Figure 2, a pair of longitudinally extending guide strips 5-a and 5-b are secured on the platform 5 for adjustment transversely thereof. The apron 6 is similarly provided with guides 6-a and 6-b which are aligned with the strips 5-a and 5-b respectively. These guides 6-a and 6-b may be formed conveniently of light metal plates, each with a portion bent to provide a foot 44 adapted to be secured to the apron 6 by a pair of bolts 45 passing through laterally extending slots 46 in the apron. By loosening these bolts 45, the guides 6-a and 6-b may be adjusted to agree with the strips 5-a and 5-b and accommodate layers 3 of different widths.

Guide means 47 and 48 are also provided on the plate 7. These guides 47 and 48 align respectively with the previously discussed guides 6-a and 6-b and serve to confine the edges of the layer 3 and the ends of the element F. The guides 47 and 48 are substantially identical, except that they are opposite hand, hence only one will be described, reference being had for this purpose to Figures 5 and 6. Therein the guide 48 is shown as comprising a flat plate 48-a, having a slot 48-b for accommodating a bolt 48-c, which adjustably secures the plate to the vertical leg of an angular support 48-d. This support 48-d is also provided with a slot 48-e for accommodating the bolt 48-c, thus increasing the range of adjustment of the plate 48-a. The angular support 48-d is adjustably secured to the feed plate 7 by a pair of bolts 49 passing through transversely extending slots 50 in the plate 7.

The angular support 48-d has a projecting tongue or point 48-f which is closely positioned above the roll 2 and which serves to guide the filter pack 3 practically until gripped by the roll

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2. This insures the accurate alignment of the successive layers on the element F and reduces bulging of the ends thereof under the influence of the pressure roll 2. The plate 48-a is made of sufficient height to engage a portion of the end of the element of substantially angular extent. Furthermore, since this plate 48-a has but slight movement toward and away from the mandrel 1, in response to movement of the pressure roll 2, the edge 51 of the plate is close to the mandrel 1 for all positions of the plate. This acts further to prevent bulging of the filter element as it is wound.

I claim:

1. In winding apparatus, including a rotatable work supporting mandrel and a pressure roll for exerting pressure against the work, and movable toward and away from said mandrel, means forming a work supporting surface over which the work is adapted to be fed between the mandrel and the pressure roll, and means maintaining said surface at a substantially constant inclination for all positions of the pressure roll.

2. In winding apparatus, including a work supporting mandrel and a pressure roll for exerting pressure against the work and movable toward and away from the mandrel, means forming a work supporting surface over which the work is adapted to be fed between said mandrel and said pressure roll, and means maintaining said surface in substantially constant spaced relationship with respect to that portion of the roll nearest the mandrel.

3. In winding apparatus including a work supporting mandrel and a pressure roll for exerting pressure against the work and movable toward and away from the mandrel, means forming a work supporting surface over which the work is adapted to be fed between said mandrel and said pressure roll, and mounted for angular adjustment about the pressure roll, and means for angularly adjusting said surface forming means in accordance with the movement of the pressure roll.

4. In winding apparatus including a work supporting mandrel and a pressure roll for exerting pressure on the work and movable toward and away from said mandrel, movably mounted surface forming means over which the work is adapted to be fed between the mandrel and the roll, spaced guide means carried by said means for engaging the edges of the work as it is fed and having portions respectively closely adjacent the mandrel for confining the work thereon, and means for moving said surface forming means in accordance with movement of said pressure roll to maintain said portions at a substantially constant distance from said mandrel for all positions of said surface.

5. In winding apparatus including a work supporting mandrel and a pressure roll for exerting pressure on the work, and a work supporting platform spaced from the mandrel, an apron over which the work is adapted to be fed from the platform to the mandrel, said apron being movable in accordance with the movement of said roll and having a relatively movable extension for feeding the work at a substantially constant angle.

6. In winding apparatus including a work supporting mandrel and a pressure roll for exerting pressure on the work, and a work supporting platform spaced from the mandrel, an apron over which the work is adapted to be fed from the platform to the mandrel, said apron being mov-

ably supported adjacent the table and having a relatively movable extension for feeding work to the pressure roll, and movably connected to the pressure roll, and means controlling the movement of said apron and said extension in accordance with the movement of the pressure roll.

7. In winding apparatus including a work supporting mandrel and a pressure roll for exerting pressure on the work, and a work supporting platform spaced from the mandrel, an apron over which the work is adapted to be fed from the platform to the mandrel, said apron being pivotally supported at that end adjacent the platform and having an extension at its other end for feeding work to the pressure roll, said extension being connected for angular movement about the pressure roll as well as pivotally connected to said apron, and means controlling the movement of said apron and said extension in accordance with the movement of the pressure roll.

8. In winding apparatus including a mandrel adapted to be rotated and about which work is to be wound and a pressure roll for creating pressure on the work and movable away from the mandrel as the winding progresses, means forming a surface for supporting the work as it is fed between the mandrel and the pressure roll, means pivotally supporting said surface forming means for angular movement about said roll, and means altering the angular position of said surface forming means in accordance with the position of said roll with respect to the mandrel.

9. In winding apparatus including a mandrel adapted to be rotated and about which work is to be wound and a pressure roll for creating pressure on the work and movable away from the mandrel as the winding progresses, means forming a surface for supporting the work as it is fed between the mandrel and the pressure roll, means pivotally supporting said surface forming means for angular movement about said roll, means altering the angular position of said surface forming means in accordance with the position of said roll with respect to the mandrel, and means for adjusting said angular position independently of the position of said roll.

10. In winding apparatus, a rotatable mandrel about which work is to be wound, a pressure roll cooperating with the mandrel for compressing the work on the mandrel and being forced away therefrom as the winding progresses, surface forming means for supporting the work as it is fed between the mandrel and the roll, laterally spaced guide means on said surface for the work, said means having extensions for guiding the work substantially to the point of pressure application by said roll.

11. In winding apparatus, a rotatable mandrel about which work is to be wound, a pressure roll cooperating with the mandrel for compressing the work on the mandrel and being forced away therefrom as the winding progresses, surface forming means for supporting the work as it is fed between the mandrel and the roll, laterally spaced guide means on said surface for the work, said means having extensions for guiding the work substantially to the point of pressure application by said roll, and means maintaining said extensions in substantially constant relation with said pressure roll for all positions of the roll.

12. In winding apparatus, a rotatable mandrel about which work is to be wound, a pressure roll cooperating with the mandrel for compressing the work on the mandrel and being forced away therefrom as the winding progresses, surface forming means for supporting the work as it is fed between the mandrel and the roll and terminating at a point adjacent the periphery of said roll and angularly spaced about the axis of said roll from a right line joining said axis and the axis of the mandrel in a direction opposite to that in which the roll rotates, and means for altering said angular spacing in response to movement of said roll away from the mandrel.

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