

June 26, 1923.

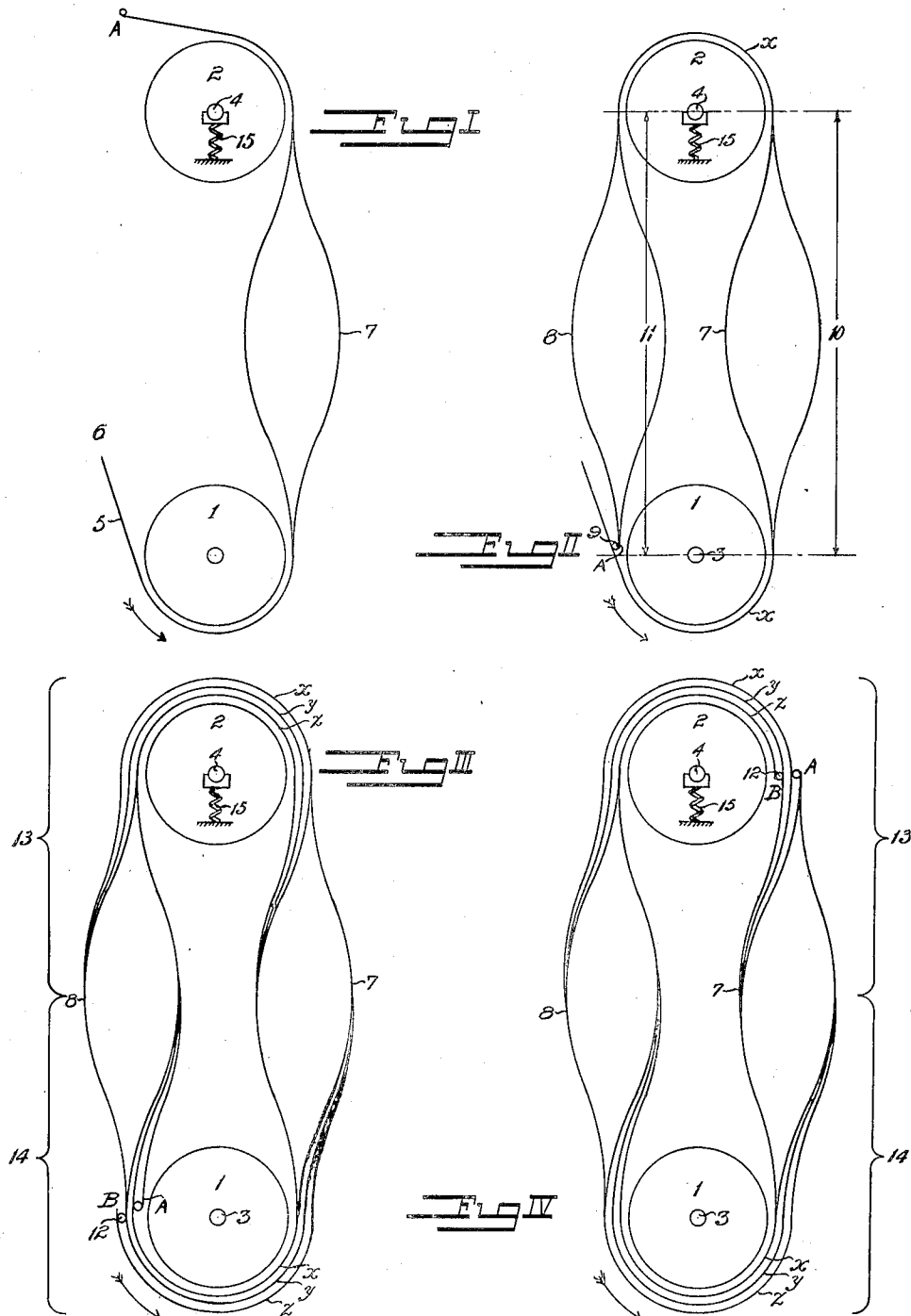
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A. G. PAVELY ET AL

COILING STRIP MATERIAL SUCH AS CINEMATOGRAH FILM

Filed March 14, 1922

3 Sheets-Sheet 1



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Fig. VII

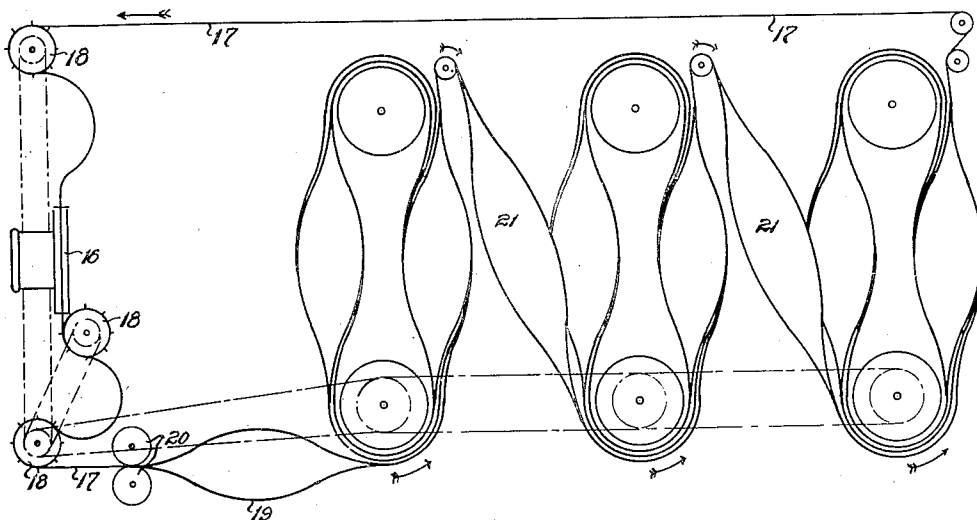
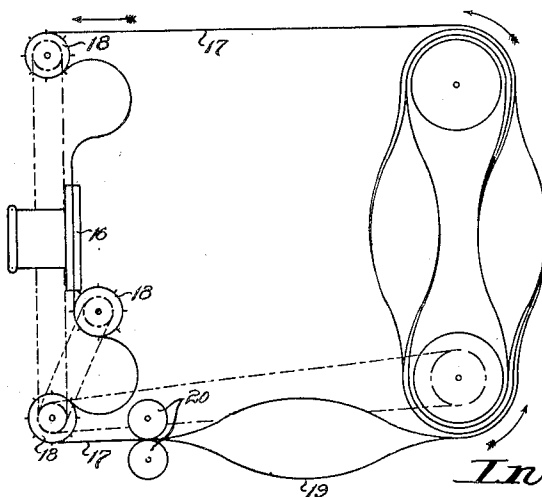


Fig. V



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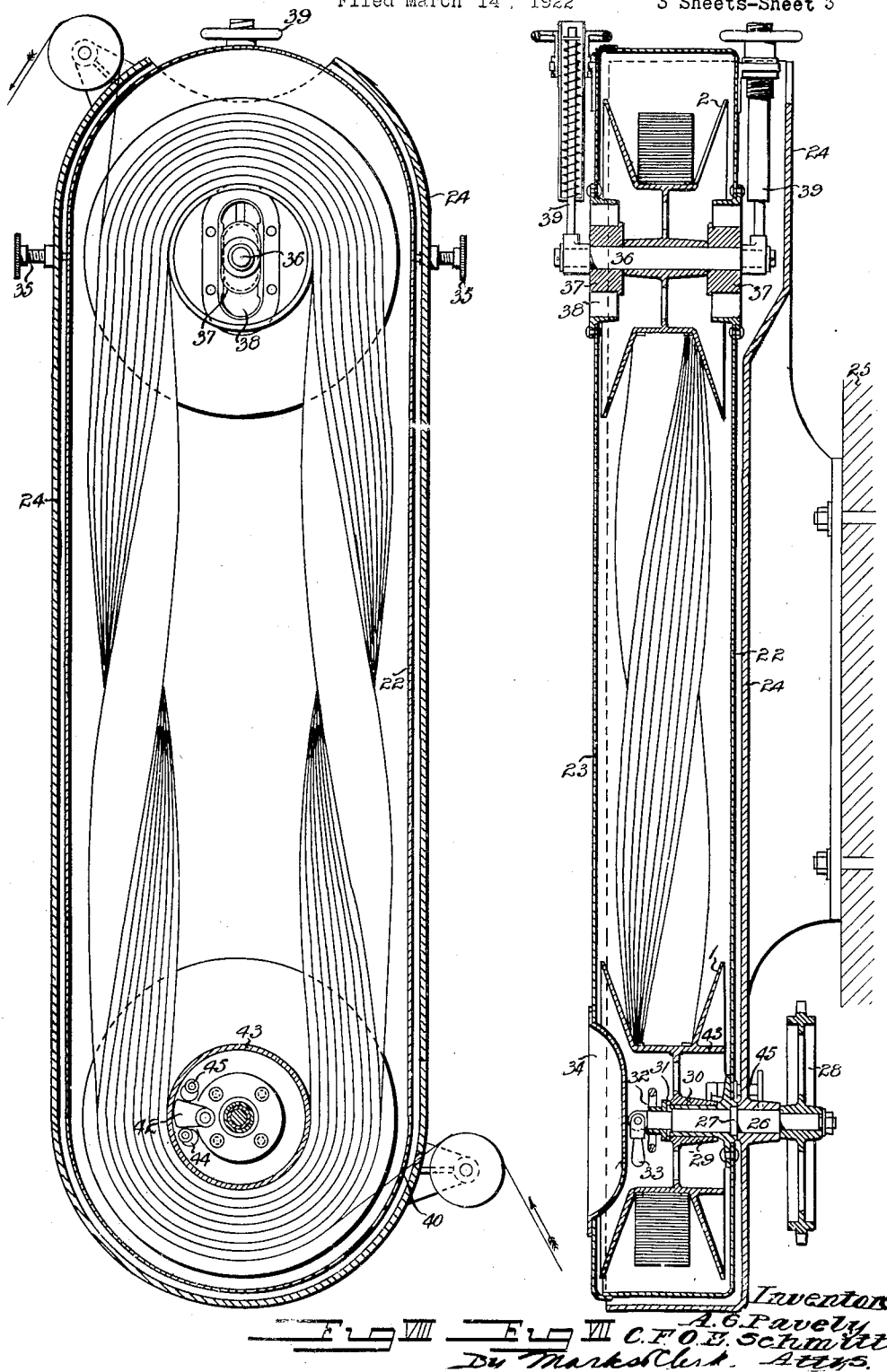
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UNITED STATES PATENT OFFICE.

ARTHUR GEORGE PAVELY AND CHARLES FRIEDRICH OSCAR EDUARD SCHMITT, OF
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COILING STRIP MATERIAL SUCH AS CINEMATOGRAPH FILM.

Application filed March 14, 1922. Serial No. 543,691.

To all whom it may concern:

Be it known that ARTHUR GEORGE PAVELY and CHARLES FRIEDRICH OSCAR EDUARD SCHMITT, British subjects, residing at 17 Harrison Street and Rand Club, Loveday Street, Johannesburg, Transvaal Province of the Union of South Africa, respectively, have invented certain new and useful Improvements in Coiling Strip Material Such as Cinematograph Film, of which the following is a specification.

The present invention has reference to coiling strip material and more particularly cinematograph film. The invention enables a considerable length of strip material to be wound in such a manner that at any time during winding the commencing end of the coil is accessible for withdrawal; and when the coil is completed both the commencing and final ends of the strip are equally available, and so that the strip may be unwound with equal facility from either end. The invention further provides for forming a coil as described in which all the convolutions are,—within small limits,—of the same length, whilst also each convolution remains unchanged at the length at which it is originally formed.

The invention consists primarily in coiling a number of superimposed convolutions of strip material in the form of a belt about two parallel and separated drums; each convolution of each span between the drums having a half twist in it.

The invention further consists in forming a coil (or a series of coils) as described in an endless strip, and circulating the strip as a whole whilst maintaining the form of the coil (or coils) unchanged.

Other features of the invention will appear from the following description.

The invention is illustrated in the accompanying drawings in which—

Figs. I to IV are diagrammatic views illustrating the formation of a coil.

Fig. V is a diagrammatic view of the coil in use with a cinematograph projector.

Fig. VI is a similar view showing a number of coils, arranged in series.

Figs. VII and VIII show the construction of the coil container.

In Fig. I 1 and 2 indicates two drums capable of rotation about their individual axes 3 and 4, which are parallel and spaced a

suitable distance apart. A length of film 5 coming from the direction 6 (e. g. from an ordinary spiral coil) is lapped about half the periphery of the drum 1 and taken across to drum 2, and at the same time given a half twist as indicated at 7. It is then lapped about half the drum 2, given a half twist at 8 and then the initial end A is secured to the oncoming film by means indicated by 9, thus forming about the drums an endless belt with a single convolution x , each span 10 and 11 of which is half twisted as shown in Fig. II. Upon the drums being then rotated in the direction shown by the arrows, further convolutions of film y , z are formed as indicated in Fig. III which shows three complete convolutions formed and the final end B of the film secured to the preceding convolution by the means 12. It may be remarked that the edge of the film is indicated in the drawings by a single line.

A characteristic feature of a belt with two half twists is that as the drums 1 and 2 are rotated, each face of the belt, during one complete circuit of the belt about the pulleys, is alternately on the inside and the outside of the belt. Thus in the position of Fig. III the end A of the belt is at the inside of the belt and the end B on the outside of the same; but by causing the belt to make a half circuit to the position indicated in Fig. IV, the end A comes to the outer face of the belt and the end B passes to the inner face.

It will be evident that a coil so formed can be unwound by releasing an end and suitably circulating the belt; and it will also be evident that in unwinding, either end may be made the commencing end by withdrawing from that portion of the belt circuit in which the desired end is outside. In the case of strips such as telegraph tapes and cinematograph film of which the order of movement is necessarily fixed, the unwinding would commence from the end A which was first wound on, and would take place from that half 13 of the belt which is separated by the twists 7, 8, from the half 14 of the belt at which the winding was begun.

Since the thickness of the additional convolutions y , z , becomes interposed between the original convolution x and the drum 2 as the coil increases from the single convolution coil of Fig. II to the multiple convolution coil of Fig. III, it is necessary, in order

to keep the original convolution (and each subsequent one), at its original length, for the drums to be able to approach one another. For this purpose the drum 2 is shown as yieldingly pressed away from the drum 1 by springs 15.

One important characteristic of a coil wound in the manner described, is that with a suitable relationship between the diameters of the drums 1, 2 and their distance apart, all the convolutions are sensibly of equal length. That this is true of the part of the coil which embraces the drums will be evident when it is considered that whatever the position of a convolution (e. g. x) when on one drum, say 1, it is symmetrically displaced with respect to the middle plane y of the thickness of the coil, when on the other drum 2. Thus if r equals the radius of the drums, T the thickness of the coil, and p the radial distance of the convolution from the drum 1, the length of its curved part about that drum will be $\pi(r+p)$. About the other drum 2, its length will be $\pi(r+T-p)$. Adding these expressings together gives a total length of the curved part of the convolution $=\pi(2r+T)$ which is constant for all the convolutions. Again were it not for the twist in the spans 10 and 11 the component strips of said spans would be the same length. The twist however causes the strips on either side of the middle strip to increase in length according to their distance from the middle strip. If the distance between the axes 3, 4, of the drums be L , the length of the middle strip of a coil as determined by the helical form of its edge would be

$$\sqrt{L^2 + \left(\pi \frac{W}{2}\right)^2}$$

where W equals the width of the strip. The length of any other strip which is n convolutions of t thickness each on either side of said middle strip would be

$$\sqrt{L^2 + \left\{ \pi \left(\frac{W^2}{2} + n^2 t^2 \right) \right\}}$$

Assuming 1000 feet of film of about the usual thickness to be wound on drums 2 inches in diameter and spaced 20 inches apart, there are about 235 convolutions giving a coil thickness of approximately 1.5 inches. The middle convolution would be 51.22 inches long and the outside convolution 51.50 inches long. That is to say the extreme difference of length between two convolutions would be .28 inch or roughly $\frac{1}{2}$ per cent; and the difference between two adjacent coils would not exceed .0024.

It will be seen that by withdrawing the ends of the film from the different halves of the coil and joining them to form a loop, the film may be circulated indefinitely through the loop and the coil. This arrangement

may conveniently be used in a camera, projector and the like, and is shown schematically in Fig. V. A coil as described having been formed on the drums, 1, 2, the end A of the film is withdrawn from the half 13 of the coil, passed through the projector gate 16 and joined to the end B projecting from the lower half of the coil, thus forming a loop 17. The film feed mechanism 18 is geared directly to the drum 1; and the film circulates through the loop 17 and the coil, which simply acts as a reservoir and does not change its form. As the loop 17 represents in effect a half convolution which has been withdrawn from the coil, it is necessary to form in it a half twist 19 which is separated from the driving sprocket by a pair of idler rollers 20. As shown by the numerical statement in the last paragraph, the total variation in the length of a convolution while it circulates through the coil need not exceed $\frac{1}{2}$ per cent so that rubbing of the convolutions against one another is negligible. The difference of length between the convolutions increases with the thickness of the coil and decreases with the length of the span between the drums. Accordingly to accommodate a lengthy film either the distance between the rollers 1, 2 may be increased, or as shown in Fig. VI a number of coils are arranged in series, the film circulating through them in succession. The film is half twisted at 21 between each pair of coils. It is not necessary that the several coils should be of the same dimensions, nor need they carry equal lengths of film.

When the film is to be exhibited once and then removed from the projector, its ends, after being passed through the projector, are temporarily clipped together and sufficient dead film is provided to enable the picture to be shown without the clip coming into contact with the gate 16. They may be thus secured by adhesive tape.

For a continuous exhibition the ends of the film are connected together by cement so that the joint can pass through the gate 16.

A device for holding and operating a coil as described is shown in Figs. VII and VIII. 22 indicates a box within which the coil is mounted and which is also used for transporting the coil. Said box is provided with a cover 23 which may be removed to facilitate the first formation of the coil in the box. The box is supported in a frame 24 which may be permanently attached to a part 25 such as a projecting machine.

The spindle 26 for the drum 1 is permanently mounted for rotation in the frame 24 and is retained by the collar 27 and the sprocket wheel 28 by which the drum 1 is rotated. The box 22 is supported in the frame by means of a sleeve 29 fixed in the box and slipped over said spindle. The hub 30 of the drum 1 rotates on the outside of

said sleeve and is formed at the end with a clutch member 31. A second clutch member 32 rotating with the spindle 26 can be engaged with the member 31 or disengaged therefrom. A snap lever 33 holds said clutch member 32 so engaged and also locks the box on the spindle 26. A small door 34 in the box cover permits access to said parts.

The upper end of the box is held in the frame 24 by the set screws 35. The spindle 36 of the drum 2 is carried in bearings 37 sliding in slots 38. At each end of the spindle 36 is an adjustable spring tension device 39 which pulls the drum 2 upwards, but allows it to move downwards as the coil is formed. Film passes into the box at 40 and leaves at the upper left hand end of said box.

42 is a gravity friction pawl which normally engages with a flange 43 of the drum 1 to prevent the same from rotating backwards. A cam 44 rotatable from outside the box is fitted for holding said pawl 42 out of action in case it is necessary at any time to reverse the rotation of the drum; and a second similar cam 45 enables the pawl to be locked to secure the coil for transportation.

In operating with a coil as described it may be in some cases desirable to wind it wholly off one pair of drums and rewind it onto another pair. It is of interest to note that in such case with a coil of the dimensions above referred to, the linear speed of the film is, within small limits, constant in regard to the rotational speed of the drums.

We claim:

1. A strip coil composed of a number of superimposed convolutions each of which has two half twists formed in it.

2. A strip coil composed of a number of superimposed convolutions individually formed with two half twists.

3. A strip coil composed of a number of superimposed strip convolutions parallel

with one another throughout and of substantially equal length.

4. A strip coil composed of a number of strip convolutions in which the individual convolutions are, in opposite halves of the coil, symmetrically displaced with respect to the midplane of the thickness of the coil.

5. A strip coil formed as a belt lapped about two parallel and separated drums, the spans between the drums being formed with a half twist.

6. The method which consists in winding a strip beltwise about two parallel drums and half twisting each span, and then winding on further similar convolutions.

7. The method which consists in winding a strip beltwise on two parallel drums, half twisting each span, winding on further similar convolutions, withdrawing the ends of the strip from opposite halves of the belt, uniting said ends to form a loop and circulating the strip through the belt and the loop.

8. The method which consists in employing a strip coil composed of a number of superimposed convolutions individually formed with two half twists, withdrawing the ends of the films separately from the halves of the coil separated by said twists, joining said ends to form a loop and circulating the strip through the coil and the loop.

9. The method which consists in forming a single strip into a series of coils each convolution of which is formed with two half twists, joining the ends of the strip to form a loop and circulating the strip through the coils and the loop.

In testimony whereof we affix our signatures.

ARTHUR GEORGE PAVELY.

CHARLES FRIEDRICH OSCAR EDUARD SCHMITT.