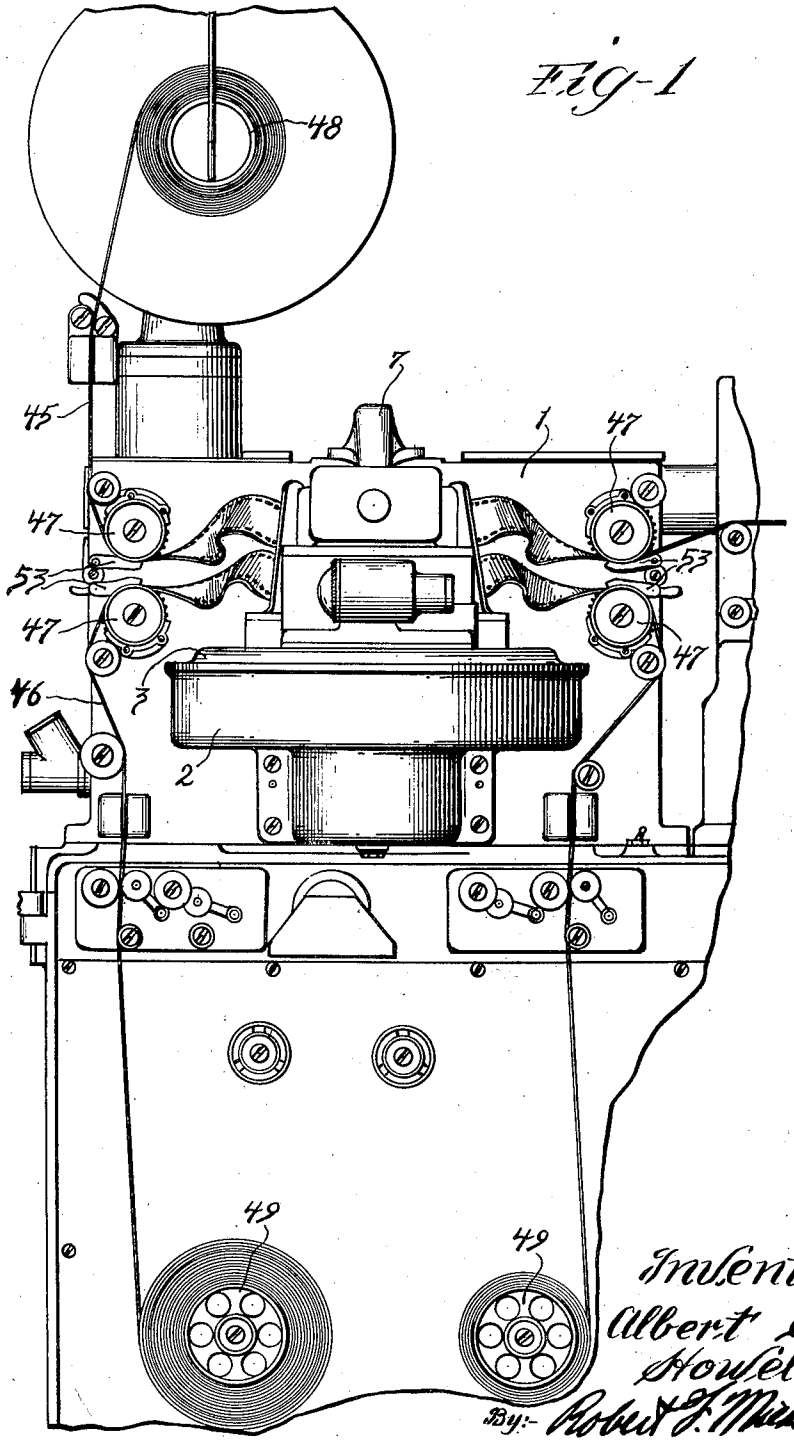
June 9, 1936. A. S. HOWELL 2,043,853

PHOTOGRAPHIC PRINTING MACHINE

Filed Sept. 28, 1933 6 Sheets-Sheet 1

Fig-1



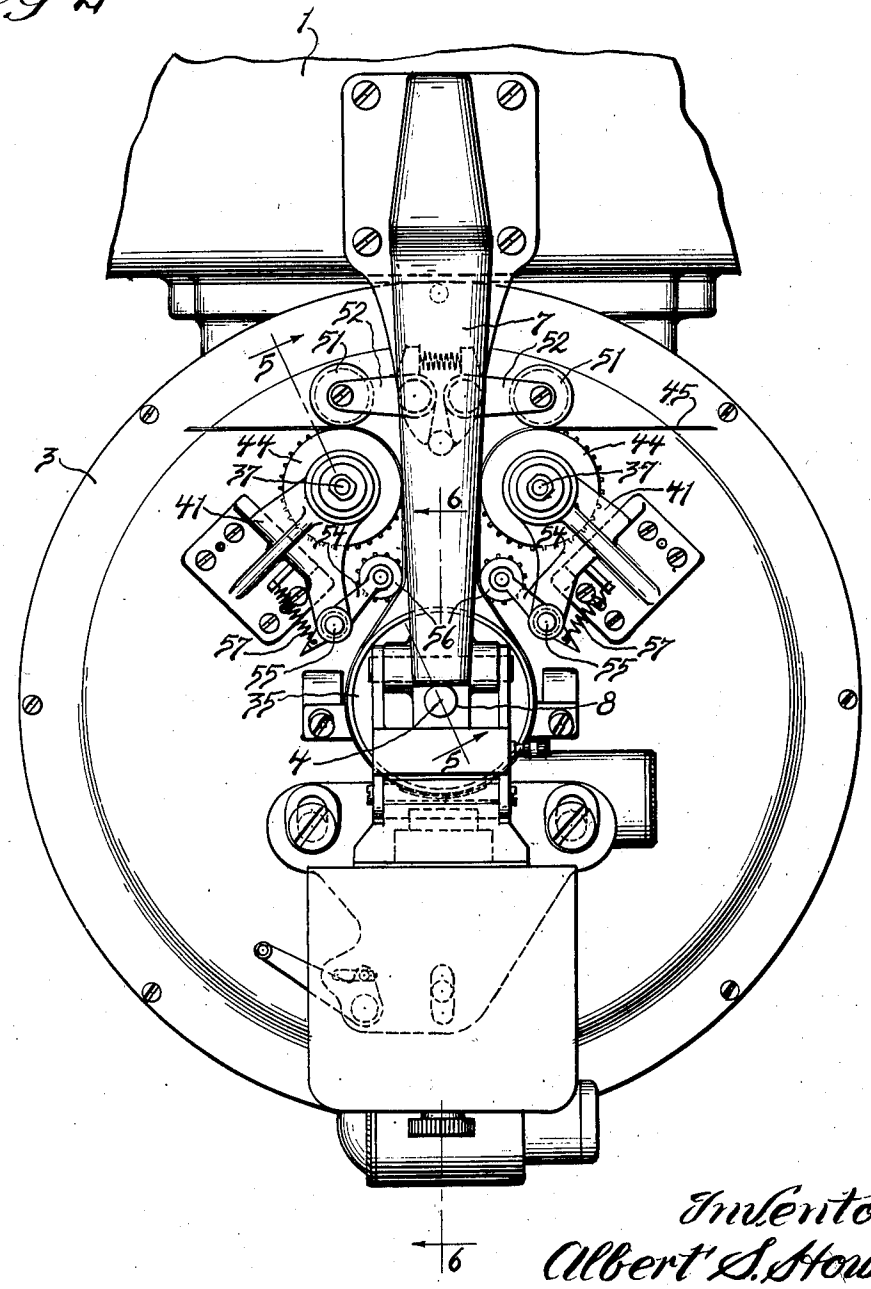
Inventor:
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PHOTOGRAPHIC PRINTING MACHINE

Filed Sept. 28, 1933 6 Sheets-Sheet 2

Fig-2



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PHOTOGRAPHIC PRINTING MACHINE

Filed Sept. 28, 1933 6 Sheets-Sheet 3

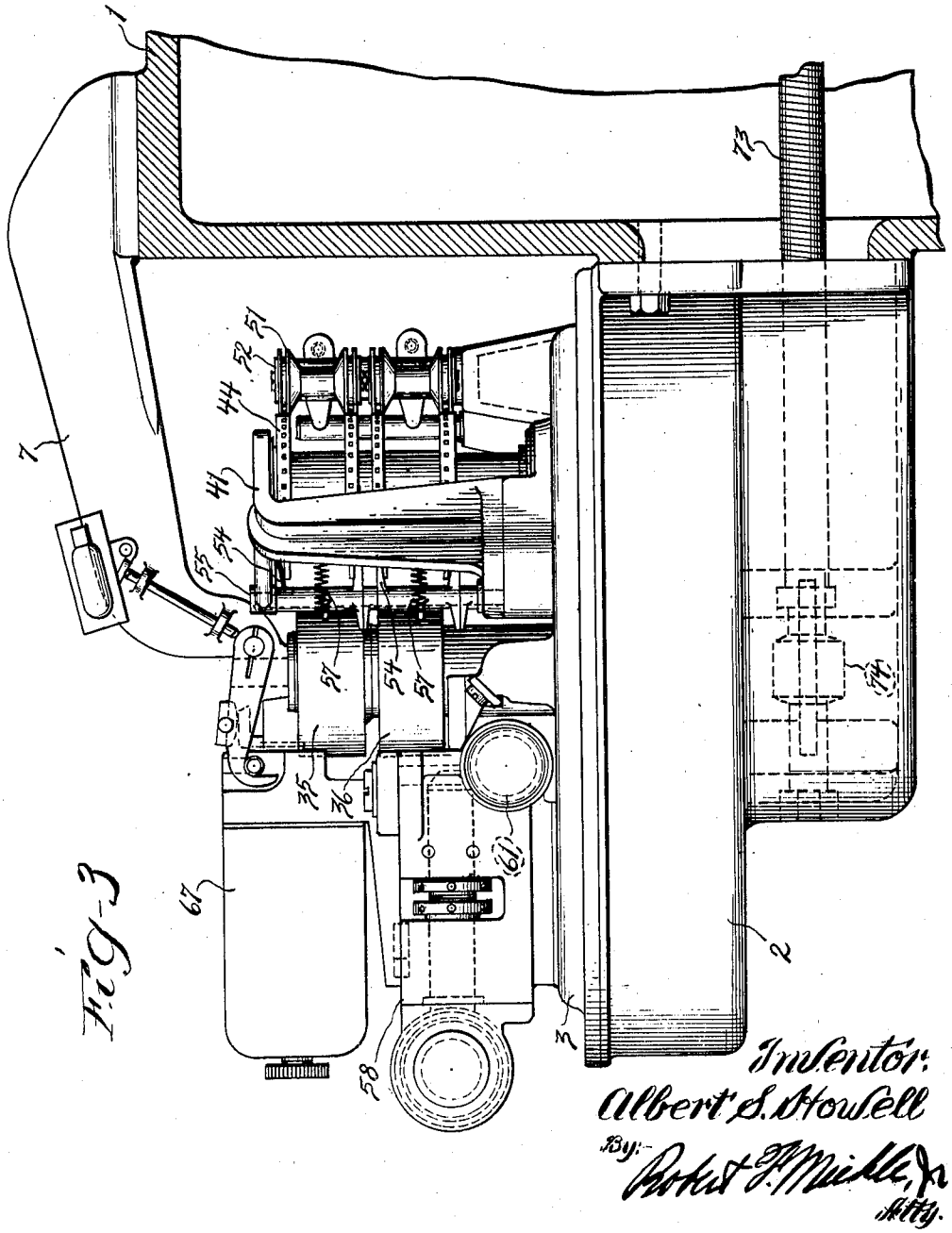


Fig. 3

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June 9, 1936. A. S. HOWELL 2,043,853

PHOTOGRAPHIC PRINTING MACHINE

Filed Sept. 28, 1933 6 Sheets-Sheet 4

Fig-4

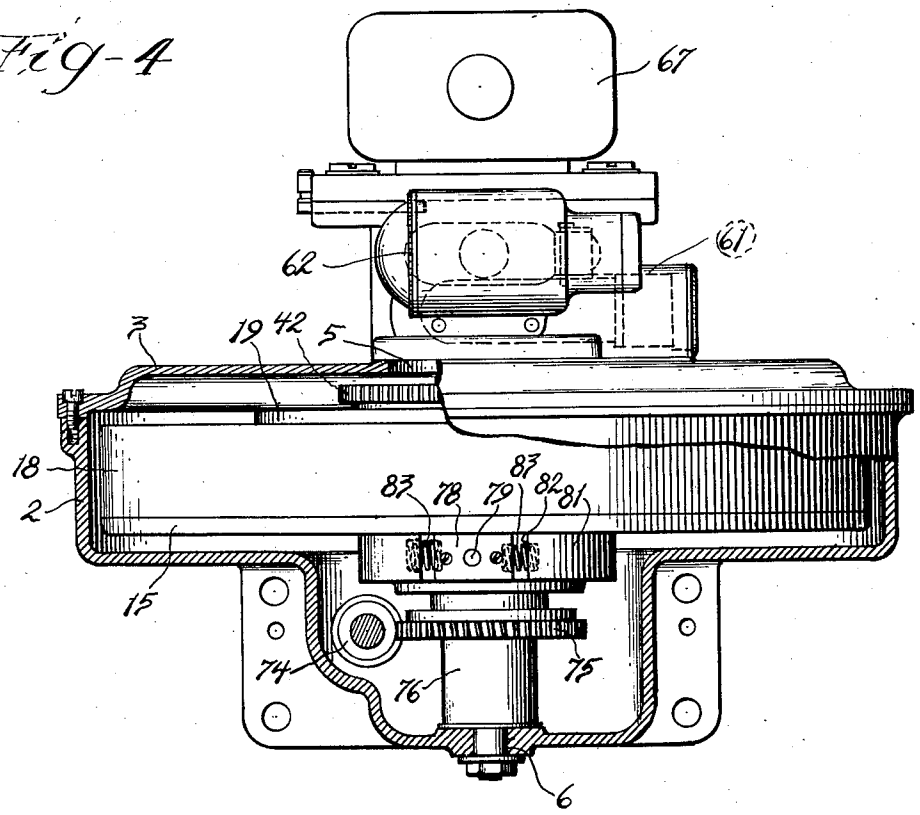
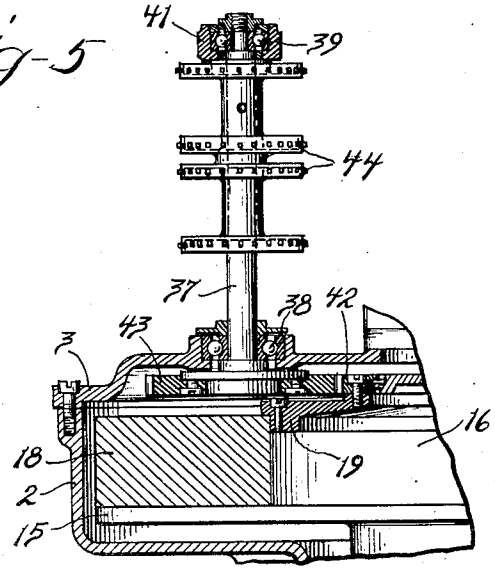


Fig-5



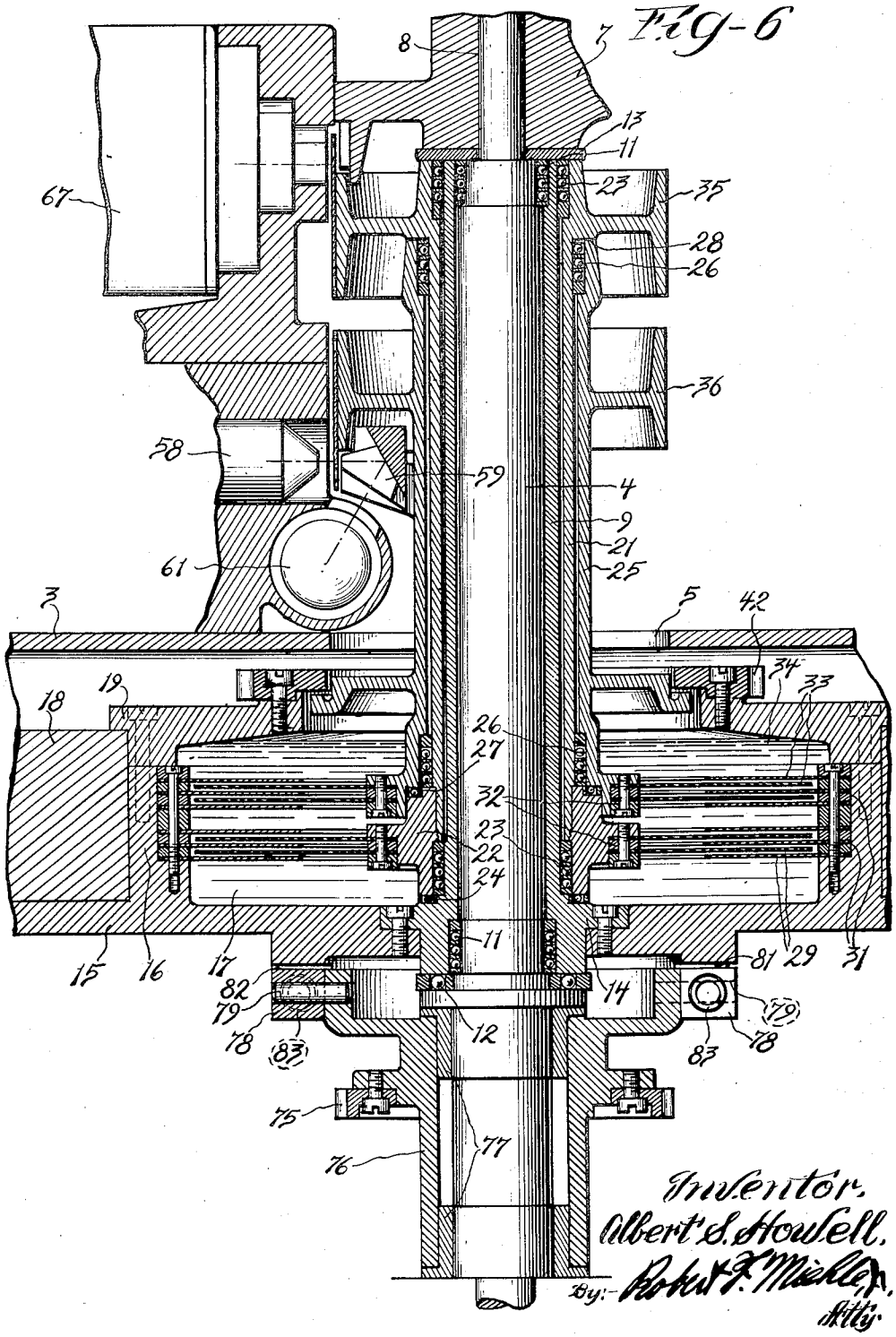
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PHOTOGRAPHIC PRINTING MACHINE

Filed Sept. 28, 1933 6 Sheets-Sheet 5

Fig-6



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June 9, 1936. A. S. HOWELL 2,043,853

PHOTOGRAPHIC PRINTING MACHINE

Filed Sept. 28, 1933 6 Sheets-Sheet 6

Fig-7

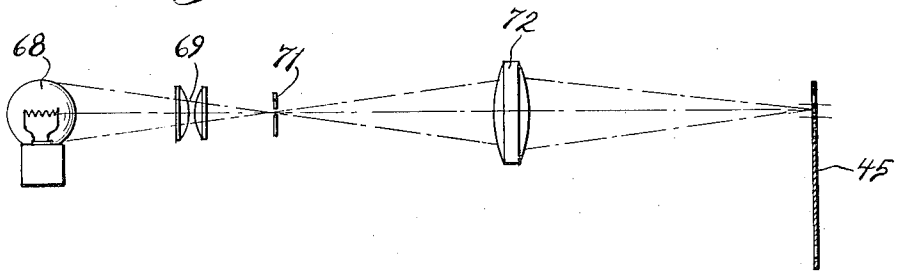


Fig-8

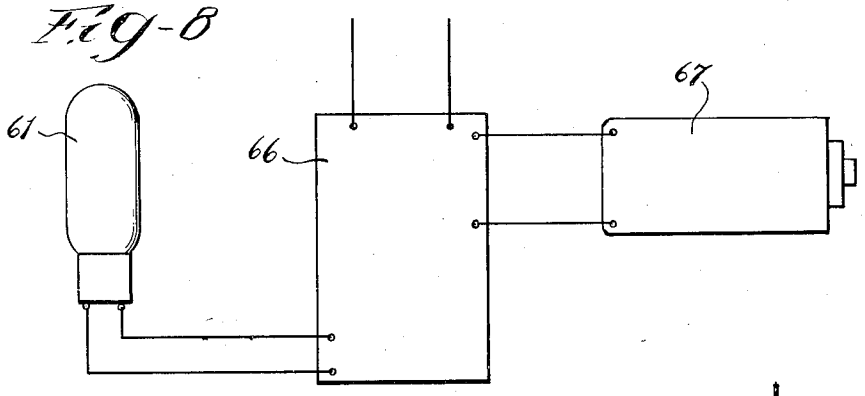
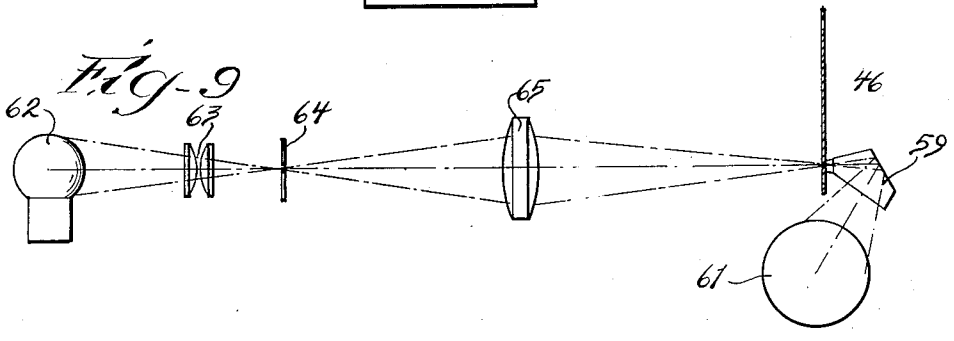


Fig-9



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Patented June 9, 1936

2,043,853

UNITED STATES PATENT OFFICE

2,043,853

PHOTOGRAPHIC PRINTING MACHINE

Albert S. Howell, Chicago, Ill., assignor to The Bell & Howell Company, Chicago, Ill., a corporation of Illinois

Application September 28, 1933, Serial No. 691,326

6 Claims. (Cl. 271—2.3)

My invention relates particularly to photographic printing machines for the printing of a photographic sound record on motion picture film although not limited to this use alone.

The main objects of the invention reside in the provision of a photographic printing machine which accommodates for length variation of the printing and sensitized photographic strips and which assures a uniform movement of the film at the printing station, particularly with a view toward the true and undistorted reproduction of sound records.

With these objects in view my invention consists in certain features of novelty in the construction, combination, and arrangement of parts by which the said objects and certain other objects, hereinafter appearing, are effected, all as fully described with reference to the accompanying drawings and more particularly pointed out in the appended claims.

In the said drawings—

Figure 1 is a partial front elevation of a photographic film strip printing machine embodying my invention;

Figure 2 is a partial top plan view of the same;

Figure 3 is a partial side elevation of the same with a part broken away and shown in section;

Figure 4 is a partial front elevation of the same with parts broken away and shown in section;

Figure 5 is a partial section taken on the line 5—5 of Figure 2;

Figure 6 is a partial section taken on the line 6—6 of Figure 2; and

Figures 7, 8 and 9 are diagrammatic views of the electro optical translating device embodied in the machine.

Like characters of reference indicate like parts in the several views.

Referring to the drawings, 1 designates a main frame, and secured on the front of the main frame is a housing 2 of generally circular form in a horizontal plane and open at the top and provided with a cover 3 secured thereon and closing the top thereof. See Figures 1, 2 ar i 3.

A vertical arbor 4 is disposed centrally of the housing 2 and, projecting downwardly thereinto through a relatively large central opening 5 in the cover 3, has its lower end secured on the bottom of the housing, as designated at 6 in Figure 4 and has its upper end, disposed considerably above the housing, mounted on the forwardly projecting end of an arm 7 secured on the top of the main frame 1, as designated at 8. See Figures 2, 3 and 6.

A hollow shaft 9 is engaged over the arbor 4 and is mounted for rotation thereon by means of radial ball bearings 11, a downward thrust ball bearing 12 and a plain upward thrust bearing comprising a bearing washer 13 encircling the arbor 4 and arranged between the arm 7 and the upper end of the shaft 9. See Figure 6.

The lower end of the shaft 9 is enlarged and flanged, as designated at 14, and a flywheel part 15, disposed within the housing 2, is provided with a shouldered axial opening engaged on the enlarged and flanged portion 14 of the shaft 9 and is secured therewith. The flywheel part 15 is provided with an intermediate concentric upwardly projecting circular flange 16 which forms an axial recess or chamber 17 closed at the bottom and open at the top.

An annular member 18 of heavy material, such as lead, is engaged over the flange 16 and is clamped downwardly upon the peripheral portion of the part 15 by means of an annular member 19 secured downwardly on the top of the flange 16, thus completing the assembled flywheel provided with the axial recess or chamber 17 above described.

A hollow shaft 21 having its lower end secured in a bored hub member 22 is engaged over the shaft 9 and is mounted for rotation with respect thereto by means of radial ball bearings 23 and a downward thrust ball bearing 24, the washer 13 forming an upward thrust bearing therefor.

A hollow shaft 25 is engaged over the shaft 21 and is mounted for rotation with respect thereto by means of radial ball bearings 26 and a downward thrust ball bearing 27, upward thrust being taken care of by means of the upper end of the shaft 25 engaging a downwardly facing shoulder 28 on the shaft 21.

The shafts 21 and 25 are thus disposed and mounted for independent rotation coaxially of each other and of the flywheel and project downwardly into the flywheel recess 17 through the opening 5 of the housing cover 3 and the top opening of the recess 17.

A set of adjacently spaced annular plates 29 are disposed within the flywheel recess 17 and are disposed in planes of rotation of the flywheel and shafts 21 and 25 and are alternately fixed with the flywheel flange 16, as designated at 31, and with the hub member 22 of the shaft 21, as designated at 32.

Another set of adjacently spaced annular plates 33 are disposed within the flywheel recess 17 and are disposed in planes of rotation of the flywheel and shafts 21 and 25 and alternately fixed with the flywheel flange 16, as also designated at 31,

and with the lower end of the shaft 25, as also designated at 32.

The plates 29 and 33 cooperate with liquid, indicated at 34 and preferably oil of the desired viscosity, contained in the flywheel recess 17 to form independent liquid drag or frictional slip drives between the flywheel and shafts 21 and 25.

Formed on the upper end of the shaft 21 is a film drum 35, and formed on the upper portion of the shaft 25 is a second film drum 36, which drums are driven independently from the flywheel through the liquid drag drives above described. See Figures 2, 3 and 6.

Spaced shafts 37 are disposed parallel to the axis of the drums 35 and 36 and project downwardly through openings in the housing cover 3 and are mounted for rotation by means of lower bearings 38 on the housing cover 3 and upper bearings 39 on brackets 41 secured on and extending upwardly from the housing cover. See Figures 2, 3 and 5. The shafts 37 are positively driven from the flywheel by means of a ring gear 42 secured downwardly on the annular member 19 and meshing with gears 43 secured on the lower ends of the shafts 37.

Fixed on the shafts 37 are double sprockets 44 disposed for feeding perforated film strips to and from the drums 35 and 36, in the present case a positive or sensitized motion picture film strip 45 to and from the upper drum 35 and a negative or record bearing motion picture film strip 46 to and from the lower drum 36.

The film strips 45 and 46 are fed to and from the sprockets 44 by horizontally disposed constant feed sprockets 47 which are driven in synchronism with the sprockets 44 by mechanism not shown, the film strips being somewhat loose between the sprockets 44 and 47 and making a right angle twist therebetween. See Figure 1. The positive film 45 is fed from and wound on spools, one of which is shown at 48, and the negative film 46 is fed from and wound on spools 49 in a usual manner. The film strips are retained in perforation engaged relation with the sprockets 44 by means of rollers 51 carried on pivoted arms 52 yieldably urged into film retaining position, see Figure 2, and the film strips are similarly retained in perforation engaged relation with the sprockets 47 by means of retaining members 53, see Figure 1.

Two pairs of arms 54 are pivotally mounted as designated at 55, one pair in coaxial relation on each bracket 41, on axes parallel to the axes of the sprockets 44 and of the drums 35 and 36. See Figures 2 and 3. Each arm is pivotally movable independently of its mate, and these arms carry toothed rollers 56 at their free ends which are engageable with the film strips between the sprockets 44 and the drums 35 and 36. Each arm 54 is yieldably urged independently, by a spring 57, in the direction against the corresponding portion of one of the film strips to tension the same, both portions of a film strip between its drum and the sprockets 44 being thus tensioned and the strip tensioned about its drum, it being observed that each film strip is tensioned independently of the other.

The printing from the negative film strip 46 upon the positive film strip 45 takes place at the drums 35 and 36 and, as shown, is effected in the following manner.

The negative strip 46 extends beyond the lower edge of the drum 36 sufficiently to expose both faces of this strip at the sound record bearing portion thereof, and the positive strip 45 extends beyond the upper edge of the drum 35 sufficiently to expose both faces of this strip at the portion thereof upon which the sound record is printed. See Figure 6.

An exciter lamp device of uniform intensity, generally indicated at 58, projects light in the form of a transverse line upon the exterior of the negative film strip 46 on the drum 36 at the sound record bearing portion thereof, and this light passing through the film is varied in intensity by the sound record and is reflected by a prism 59, arranged within the film strip 46 on the drum 36, to a light sensitive cell 61 capable of modulating an electrical current corresponding with the intensity of the light to which the cell is subjected. See Figures 3, 6 and 9.

The exciter lamp device consists of an electric lamp 62, a condenser 63, a fixed light slot member 64, and a lens 65 for projecting the slot image upon the negative film strip. See Figure 9.

The cell 61 is connected in circuit with a suitable amplifier 66, see Figure 8, which is in turn connected in circuit with a suitable device, such as an Erpe type magnetic light valve, generally designated at 67, for projecting an exposing light upon the exterior of the positive film strip 45 at the sound record portion thereof, which exposing light is modulated in accordance with the sound record on the negative film for the reproduction thereof upon the positive film.

The light valve 67 consists, see Figure 7, of an electric lamp 68 of uniform intensity, a condenser 69, a variable light slot device 71 which is varied magnetically in correspondence with the current modulated by the cell 61 in a manner unnecessary to be described, and a lens 72 for projecting the varied slot image upon the positive film.

The film strips are, of course, fed at a uniform speed during the printing operation.

The flywheel, hereinbefore described, is driven in the following manner. A flexible shaft 73 leads from the main frame 1, where it is driven, into the housing 2 below the flywheel and has a spiral pinion gear 74 fixed on the outer end thereof. See Figures 3 and 4. The pinion 74 meshes with a spiral ring gear 75 secured on a bored driving member 76 which is disposed within the housing 2 below the flywheel and is mounted for rotation, as designated at 77, see Figures 4 and 6, on the lower portion of the arbor 4. The upper portion of the member 76 is enlarged, and two diametrically opposite blocks 78 are mounted on the periphery of the upper portion thereof by means of studs 79.

The flywheel part 15 is provided with a concentric downwardly projecting cylindrical flange 81 which is provided with diametrically opposite slots 82 in which the blocks 78 are disposed, the slots having greater extents than the blocks so that there is angular play between the flywheel and the driving member 76. Helical compression springs 83 are disposed between opposite ends of each block 78 and the corresponding side of the respective slot and are under opposing tension to provide a resilient drive between the driving member 76 and the flywheel.

As the flywheel is thus driven, variations in the drive thereof are absorbed, the arrangement being such that the flywheel has a relatively low vibration period.

Inasmuch as, the sprockets 44 and the drums 35 and 36 are driven from the flywheel a uniform drive of the film strips is effected at the printing station and the independent liquid drag

drives between the flywheel and the drums **35** and **36** accommodate for length variation of the strips and particularly with reference to the negative strip, the tensioning rollers **56** maintaining the film at the proper tension about the drums **35** and **36**, and the negative drum **36** being preferably slightly smaller than the positive drum **35** in view of the natural shrinkage of the negative film in processing.

Having thus described my invention, I do not wish to be limited to the precise details described as changes may be readily made without departing from the spirit of my invention, but having thus described my invention, I claim as new and desire to secure by Letters Patent the following.

I claim:

1. In a photographic printing machine the combination of two independently rotatable drums about which photographic printing and sensitized strips are respectively trained, a rotatable flywheel, a rotatable primary driver, a resilient drive connection between said flywheel and primary driver, a liquid drag driving connection between each of said drums and said flywheel, constant feed sprocket means positively driven from said flywheel for feeding said strips to and from said drums, and tensioning means yieldably urged against both portions of the strips between said drums and sprocket means and adapted to independently tension the strips.

2. In a photographic printing machine the combination of a rotatable driven flywheel provided with an axial recess open at one side thereof, a rotatable shaft disposed coaxial with said flywheel and projecting into said recess through the open side thereof, a rotatable drum about which a photographic strip is trained and disposed outwardly beyond the open side of said flywheel and rotatably fixed with said shaft, and adjacently spaced plates within said recess and alternately fixed with said flywheel and shaft and disposed in planes of rotation thereof and cooperating with liquid in said recess to form a liquid drag drive between said flywheel and shaft.

3. In a photographic printing machine the combination of a rotatable driven flywheel provided with an axial recess open at one side thereof, a rotatable shaft disposed coaxial with said flywheel and projecting into said recess through the open side thereof, a rotatable drum about which a photographic strip is trained and disposed outwardly beyond the open side of said flywheel and rotatably fixed with said shaft, adjacently spaced plates within said recess and alternately fixed with said flywheel and shaft and disposed in planes of rotation thereof and cooperating with liquid in said recess to form a liquid drag drive between said flywheel and shaft, strip feeding means associated with said drum, and means for driving said strip feeding means including a gear fixed on said flywheel.

4. In a photographic printing machine the combination of a rotatable driven flywheel disposed on a vertical axis and provided with an axial recess closed at the bottom and open at the top, a rotatable shaft disposed coaxial with said flywheel and projecting downwardly into said recess, a rotatable drum about which a photographic strip is trained and disposed above said flywheel and rotatably fixed with said shaft, adjacently spaced plates within said recess and alternately fixed with said flywheel and shaft and disposed in planes of rotation thereof and cooperating with liquid in said recess to form a liquid drag drive between said flywheel and shaft, strip feeding means associated with said drum, means for driving said strip feeding means including a gear on the upper side of said flywheel, a rotatable primary drive member disposed below said flywheel in coaxial relation therewith, and a resilient drive connection between said primary drive member and said flywheel.

5. In a photographic printing machine the combination of a rotatable driven flywheel provided with an axial recess open at one side thereof, a rotatable shaft disposed centrally of said flywheel and projecting into said recess through the open side thereof, a second and hollow rotatable shaft engaged over said first mentioned shaft and rotatable independently thereof and projecting into said recess, two rotatable drums about which photographic printing and sensitized strips are respectively trained and disposed outwardly beyond the open side of said flywheel and rotatably fixed one with each of said shafts, and two sets of adjacently spaced plates within said recess and the plates of each set being alternately fixed with said flywheel and a respective shaft, said sets of plates being disposed in planes of rotation of said flywheel and shafts and cooperating with liquid in said recess to form independent liquid drag drives between said shafts and said flywheel.

6. In a photographic printing machine the combination of a rotatable driven flywheel disposed on a vertical axis and provided with an axial recess closed at the bottom and open at the top, a rotatable shaft disposed coaxial with said flywheel and projecting downwardly into said recess, a second and hollow shaft engaged over said first mentioned shaft in coaxial relation therewith and rotatable independently thereof and projecting downwardly into said recess, two rotatable drums about which photographic printing and sensitized strips are respectively trained and disposed above said flywheel and rotatably fixed one with each of said shafts, two sets of adjacently spaced plates within said recess and the plates of each set being alternately fixed with said flywheel and a respective shaft, said sets of plates being disposed in planes of rotation of said flywheel and shafts and cooperating with liquid in said recess to form independent liquid drag drives between said shafts and flywheel, constant feed sprocket means associated with said drums, means for driving said sprocket means from said flywheel including a gear on the top of said flywheel, a rotatable primary driver below said flywheel in coaxial relation therewith, and a resilient drive connection between said flywheel and primary driver.

ALBERT S. HOWELL.