FEEDING MECHANISM

Every feeding mechanism is the result of someone's effort to relieve the sewing machine operator from a specific task of material handling. Feeding devices are many and varied but their accomplishments can usually be classified in one or more of the following ten categories - - -

1. Supporting the material to be stitched (throat plates, needle plates, cloth plates, machine beds).
2. Holding material down, to prevent side-slipping or flagging (pressers).
3. Applying to correct pressure for positive feed without feed marking or other damage to fabric (pressure regulators).
4. Repeatedly moving material from one stitch position to next at regular intervals (feeds) without slippage.
5. Bringing two or more plies of material together in preparation for sewing (attachments).
6. Turning or folding the material (attachments).
7. Changing direction of feeding movement (reverse, zig-zag and vibrating feeds).
8. Varying the rate of feed motion (stitch regulators).
9. Clearing the sewing area of material already sewn (puller feeds, blowers, etc.).
10. Altering the setting or timing of any of these feeding components (regulators).

Basically the material to be stitched is handled and controlled during sewing by the presser foot, feed dog and throat plate. These three parts in a matched set are known as the FITTINGS of machine. Since the throat plate has already been discussed on page under "PRINCIPAL PARTS OF A SEWING MACHINE", only the other two parts will be treated here.

PRESSER FEET - - -

Primary function of the presser foot is to hold the material being stitched, with the required pressure against throat plate and feed dog, so that correct needle thread loop is formed, and so that feed dog carries the material forward through the machine the desired distance between needle perforations. Other functions of the presser foot are to serve as a margin guide, or to support auxiliary devices such as folders, cord guides, strip guides, and other material handling devices, or to produce special effects such as shirring, cording, or welting.

Presser feet are constructed in various ways to meet unusual conditions which might otherwise interfere with the correct functioning of foot. The shoe of the presser foot is sometimes hinged to the shank, where irregularities in thickness are to be passed over. In some cases a hinged shoe is fitted with a spring, to keep the toe of the shoe raised so that it will ride up onto extra thicknesses more easily. Shoe may also be hinged sideways, where conditions require it. Some feet are hinged both ways (at toe-end and heel-end) to provide a ball joint action for assuring even pressure over the entire surface of the feed dog, to prevent cutting of the material, and to enable feed motion to carry material forward in a straight line.

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Where the material is thicker on one side of the proposed line of stitching than on the other, a foot with the shoe in two parts supported on a rocker arm, is frequently used, so that each part of the shoe will exert the same amount of pressure on the material. Another type of foot has one part of the shoe fixed, while the other part can be moved against spring pressure, to compensate for unequal thickness. Certain types of work call for a foot with each part of shoe independently mounted on a spring pressure device. Extremely irregular surfaces may require a caterpillar or multiple hinged foot. Adhesive materials, which will not pass readily under any type of presser foot shoe, may require use of alternating pressers which consist of two independent presser bars and presser feet, and which "walk" over the surface by rising and lowering one after the other in time with the needle and the feed dog. On leather and many other materials a roller presser is used, to hold the material firmly at the needle, and to permit turning corners and sharp curves more readily. When attachments' or other auxiliary devices are used the foot is patterned accordingly, to operate in conjunction with them.

FEED DOGS - - -

All feed dogs are basically designed to move the material being stitched the desired distance between needle perforations. To accomplish this, a feed dog must be of suitable shape and size, and made with the correct type and arrangement of teeth on its upper surface.

Teeth of feed dog are usually cut at an angle so that they point in the direction of movement of material, minimizing the natural tendency of dog to draw material back as it returns to its starting position. Edges of teeth should protrude enough to engage material but not so sharp as to cut it. Size of teeth (that is, the number of teeth per inch) should be suited to the weave and thickness of the material. Arrangement of teeth in rows or connected areas should be determined by amount of feeding area required and nature of the work. Shape and size of feed dog surface should conform to shape and size of presser surface holding material against throat plate of machine.

Feed dogs are designed in various surface patterns as the work may require. Teeth are also cut in various ways, to adapt them to unusual conditions. In some cases a saw tooth cut is used. In other cases a square cut may be more suitable. Pyramid shaped teeth and knurling are also used. The nature of the feed dog surface to be selected should be determined largely by the nature of the material to be moved by the feed dog.

FEED MOTIONS - - -

Designed to repeatedly advance material being stitched from one position to the next, to produce a series of stitches of equal length one after another, the basic feed motion actuates a feeding surface to engage the under surface of material, pressing it against the under surface of the presser foot, and mov-

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ing it forward a predetermined distance before releasing the material from pressure by dropping below the surface of the throat plate for the return stroke to starting point. The lifting and forward motions of the feeding surface are actuated by individual rockshafts usually driven from feed eccentrics by means of connecting rods.

FEED DRIVING MOTION is the forward movement of feeding device. In most machines this motion is adjustable.

FEED LIFTING MOTION or the rising movement of lower feed at beginning of forward stroke and the falling movement after the feeding is completed for each stitch is usually not adjustable but designed into the feed mechanism.

FEED THROW-OUT is a mechanism enabling operator to drop lower feed where it will not rise above throat plate - - - rendering feed inoperative. This is very convenient when darning or during embroidery or other "free stitching" operations.

CLAMP MOTION is the movement of material by means of a holding device above the throat plate.

LONGITUDINAL MOTION is any movement along cylinder bed or in line with the long dimension of flat bed of a sewing machine.

LATERAL MOTION is movement across cylinder bed or in line with short dimension of sewing machine.

S.P.I. is an abbreviation used to indicate stitches per inch or stitch length.

S.P.M. indicates number of stitches per minute, usually synonymous with SPEED of machine.

MAXIMUM SPEED is the highest speed at which a machine is capable of sewing. Maximum efficient speed is not only dependent upon capability of machine but also upon training of operator and the peculiarities of the sewing operation.

NEEDLE VIBRATING MOVEMENT is the motion of the needle bar sidewise during zig-zag stitching or lengthwise when needle is aiding the feeding of material.

This is accomplished by one of three basic devices - - -

1. GATE type needle bar, designed to swing between stitches in a horizontal arc, on two or more fixed points determined by a hinge or hinges on one side of needle bar frame.

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2. PENDULUM type needle bar, designed to swing between stitches in a vertical arc, from one fixed point on needle bar frame.
3. VERTICAL SLIDE type needle bar, designed to swing between stitches in a straight line. Actuated by eccentrics, pitman and slide device, needle bar rises and falls, within its holder, perpendicular to line of feed.

TRANSVERSE MOTION is movement across the normal line of feed.

CYCLE is a complete sewing operation performed by an automatic or a semi-automatic machine, such as a buttonhole or a tack.

FEEDS THAT ACT UPON THE UNDERSIDE OF THE MATERIAL - - -

DROP FEED, today, uses a four motion mechanism (first patented by Allen Wilson in 1855) to actuate a feed dog that alternately engages (forward motion) and disengages (backward motion) the underside of the material. This was the first important contribution in sewing machine design toward the principal of - - -

INTERMITTENT FEED: Any feed that moves the material only during a specific portion of the sewing cycle, (usually when the needle is out of the feeding area).

CONTINUOUS FEED machines require a vibrating or swinging needle bar in which the needle,after penetrating the material, enters an elongated needle hole in throat plate and moves along the feeding path to assist the feeding or to form the stitch during the feeding movement.

ROLLERS, WHEELS or BELTS are usually employed in continuous feed machines. They may also be used instead of drop feed in intermittent feed machines. When rollers or wheels are used below the material, the feed mechanism is called - - -

UNDER WHEEL FEED, (see glossary and index), a wheel which is in constant engagement with underside of the material.

VIBRATING FEED moves the material from side to side as well as in normal forward direction and is used in some zig-zag stitching, tacking, button sewing or buttonholing machines.

REVERSE FEED (see glossary and index) mechanisms enable operator to back tack or reverse the stitching at will.

DIFFERENTIAL DROP FEED has two feed dogs arranged in tandem which move different distances or at different speeds (differentially). Material can be gathered by adjusting the stroke of the feed dog ahead of the needle so that it is longer (or slower) than the stroke of the feed dog behind the needle. Conversely, material can be stretched by adjusting the stroke of the feed dog ahead of the needle so that it is shorter (or faster) than the stroke of the feed dog behind the needle. This device was invented by Isaac M. Singer in 1856.

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The term DIFFERENTIAL FEED used without qualifications in the description of a machine indicates that the feed can be adjusted to either gather or stretch material, or, if desired, it will feed the material without gathering or stretching, in which case both feed dogs are set so that their length of travel is the same and feed operates as a conventional drop feed.

If the machine has two feed dogs which move differently from one another but are actuated so that the feed dog in front of the needle always has a longer stroke than the feed dog behind the needle, the description of the machine should specify that it has Differential Feed for Gathering. Similarly if the feed dog in front of the needle always has a shorter stroke than the feed dog behind the needle the description of the machine should state Differential Feed for Stretching.

A FEED PLATE is a driven device mounted above the machine bed in place of the throat plate and used instead of a feed dog. It has the appearance of a needle plate with the addition of raised serrations about the feeding area to grip the material. Feed plate is driven along the bed or across the bed as required for particular operation.

FEEDS THAT ACT UPON THE UPPER SIDE OF MATERIAL - - -

In addition to the commonly known presser foot, discussed earlier, there are other lesser known upper feeding devices.

An UPPER FEED is one in which the feeding of the material is accomplished entirely by means of a mechanism consisting of a positively-driven feeding foot which alternately engages and disengages the upper side of the material.

A UNIVERSAL UPPER FEED is an upper feed mechanism that permits the feed motion of the feeding foot to be actuated at any time in any desired direction at will of operator.

ROLLER PRESSER may be used instead of presser foot to assist lower feed during sewing. A special roller presser called a WHEEL PRESSER, enables stitching around curves. This was the type of presser used on the original SINGER machine, invented in 1850.

UPPER WHEEL FEED is a feed having a wheel in constant engagement with the upper side of the material. The rotation of the feed wheel may be continuous or intermittent depending upon the movement of the needle bar.

A PULLER FEED consists of one or more rollers (at least one of which is driven) that feed or assist in feeding the material away from the needle and the machine. Puller feeds may be either continuous or intermittent and they are sometimes known as AUXILIARY FEEDS.

DARNING FOOT is a non-feeding foot, sometimes called a STRIPPER FOOT, designed only to prevent flagging by holding material down firmly upon throat plate.

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LIFTING (or HOLDING) FOOT is another non-feeding foot. It lifts during feeding movement of drop feed and descends with needle to hold down material firmly, until needle has risen above material again.

FEEDING FOOT is a presser foot sometimes toothed on its bottom surface. This foot moves with feed dog to aid in feeding movement.

COMPENSATING FOOT is a divided foot for simultaneously feeding two different thicknesses of material - - - usually designed so that heavier material actually forces other side of foot down upon lighter material. A YIELDING FOOT, however, is merely a divided foot that permits simultaneous feeding of two different thicknesses of material.

WALKING FOOT is a two part presser foot, driven from needle bar crank. Each part has its own presser bar and each operates independently of the other. When one part is down the other is raised, as the second descends the first one rises; giving the appearance of walking. Parts are not independently adjustable.

RUFFLERS operate on top plies of fabrics, automatically feeding a fixed amount of extra material under a presser foot or a top-gathering feed.

Many other ATTACHMENTS could be classified, in a broad sense, under feeding devices, except that they are not usually part of any sewing machine's basic design, nor are they necessary for the primary goal of all feeding mechanisms, which is to assist the stitch forming parts in sewing two plies of material, continuously and evenly.

FEEDS THAT COMBINE TO ACT ON TOP AND ON UNDERSIDE OF MATERIAL - - -

ALTERNATING FEED, or ALTERNATING PRESSERS are terms used for the compound foot mechanism, usually actuated from an eccentric on arm shaft and operating in conjunction with lower feed. Consisting of feeding foot and lifting foot, these pressers are so arranged that they press down alternately upon the work, each at its moment of pressure exerting a fulcrum upon which the other is raised. The feeding foot and needle are in contact with the material during the feeding movement. The lifting foot decends and holds the material, firmly, until the feeding foot and needle return to the start of the next feed motion.

SPRING RETURN FEEDING FOOT is an alternating presser in which feeding motion of feeding foot is imparted to it by motion of feed dog on underside of material. At end of feeding stroke, feeding foot lifts and is returned by spring action to its starting position.

POSITIVE DRIVEN FEEDING FOOT is an alternating presser in which feeding foot is actuated by its own mechanism, throughout feeding cycle.

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INDEPENDENT UPPER AND UNDER FEED uses a feeding foot operating in conjunction with a drop feed. Feeding foot is usually assisted by a stripper foot. The lengths of stroke of the feeding foot and drop feed are independently adjustable so that they may either feed faster or slower or synchronically. On some machines the feeding foot or the feed dog, or both, may be adjusted so that it either feeds or remains stationary, in which case the description of the machine will so state.

TOP-DRIVEN GRIPPER FEED consists of a feed dog, above the material, driven by a linkage actuated by a countershaft which in turn is driven from an adjustable eccentric on arm shaft. Eccentric on arm shaft is independently adjustable to obtain optimum relationship between top and bottom feeding mechanisms.

NEEDLE FEED is a vibrating needle bar mechanism that moves needle in material, along line of feed to assist presser foot in feeding the material. This type of feed is often used without any lower feed mechanism, otherwise it is known as - - -

COMPOUND FEED: a needle feed designed to move in unison with drop feed. The needle hole is usually in the feed dog, except in a few cases on compound feed trimming machines, where narrow trimming margin makes it necessary to put a narrow, elongated needle hole in the throat plate. The needles pass through the material into the feed dog and assist in feeding the material. A change in the length of stitch does not disturb the relative positions or movements of the needle and feed dog.

UNISON FEED consists of a vibrating needle bar, a feeding foot, a lifting foot and a bi-motion feed plate which vibrates flush with surface of throat plate. Vibration of all feeding parts is always on line of stitching. The needle descends through the material and needle hole in feed plate at same time that feeding foot contacts material. All move together along line of stitching. Lifting foot then contacts material holding it firmly while needle and feeding foot rise and feed plate returns to start of next stitch.

Moving the stitch regulator adjusts the throw of the needle, feeding foot and feed plate without disturbing their relative positions.

UPPER AND UNDER FEED is used to designate machines in which the feeding is accomplished by means of a drop feed operating in unison with a feeding foot. The feeding foot may be either positively driven or of the spring return type as described, but cannot be adjusted to feed faster or slower than the under feed. It may be possible, (if so stated in the description) to suspend the feed motion of either the drop feed or the feeding foot, in which case the machine then becomes either an Upper or an Under Feed machine as the case may be.

UPPER AND UNDER WHEEL FEED is a feed having two wheels in constant engagement with the material, one on the upper side of the material and the other on the under side of the material. The two wheels may rotate either

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continuously or intermittently and their rates of rotation may be either synchronized or independently adjustable.

RECIPROCAL FEED consists of a two motion feed in combination with a presser foot and a LIFTING THROAT PLATE. Feed Dog does not rise or fall but moves forward and backward in the same horizontal plane. Material is fed one stitch length during each forward movement. Throat plate lifts the material above the grip of the feed dog teeth during the return movement of the feed and then drops to permit forward movement of feed dog to feed the material again beneath the presser foot.

CUP FEED is a type of feed used on machines in which the needle operates in a horizontal plane. Feeding is usually accomplished by two wheels or discs rotating intermittently in a horizontal plane. One or both of these discs may be driven, the material passing between their edges. However, feeding may be accomplished instead by a single disc operating against a suitable presser surface.

STITCH REGULATORS or FEED REGULATORS are devices to assist operator in setting feed driving mechanism for length of stitch (distance between needle perforations), or, as in the case of a variable cam stack, to actuate needle vibrating mechanism as well as feed driver.

There are various devices that make these changes possible, namely -

1. CONSTANT-BREADTH (HEART-SHAPED or TRI-LOBE) CAM WITH ADJUSTABLE LEVERAGE - - - consists of a cam fixed upon arm shaft with a fork connection riding upon it as a follower to actuate the feed. This type is used most often on family type sewing machines. Operator increases stitch length by moving an adjustable lever so that fulcrum point of fork connection moves away from center of cam and decreases stitch length by moving lever so that fulcrum point moves toward cam center.

2. NON-ADJUSTABLE ECCENTRIC WITH ADJUSTABLE LEVERAGE - - - consists of a feed eccentric fixed upon arm shaft with a closed (or open) end of a connection rod riding upon it. Operator increases stitch length by moving adjustable lever so that fulcrum point of connection rod moves away from center of eccentric and decreases stitch length by moving lever so that fulcrum point moves toward eccentric center.

3. SPIRAL GROOVE AND PIN TYPE - - - Actuator consists of an eccentric with a spiral groove and a slide, with pin affixed, that rides in groove. Since position of pin determines action of feed, stitch length is changed by moving eccentric so that pin is farther away or closer to center of eccentric.

4. ECCENTRIC WITHIN AN ECCENTRIC - - - has one eccentric within another and a ratchet wheel or friction device (to hold desired stitch length position, when set). Operator changes stitch length by releasing ratchet wheel, or friction part, and moving one eccentric so that its functional surface is closer to or farther away from center of other eccentric.

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5. SCREW TYPE - - - consists of an eccentric, an adjusting screw and a worm. Worm, when turned, varies the off-center position of feed driving eccentric. Requires screwdriver adjustment. Used mostly on chainstitch machines, where stitch length is changed only infrequently.

6. SPINDLE TYPE - - - consists of an adjustable spindle in the balance wheel end of the arm shaft. Spindle, when turned, varies the off-center position of feed driving eccentric, producing more or less pitman motion of feed rockshaft, to increase or decrease the feed travel of the feed dog, back and forth.

7. REPLACEABLE (NON-ADJUSTABLE) ECCENTRICS OR GEARS - - - where easily identifiable eccentrics or gears can be interchanged on feed driving shaft to change the stitch length.

8. GEAR SHIFT - - - using a set of different size gears, each of which has a recognized stitch length function, and a means to shift feed driver to gear that will produce desired stitch length.

9. VARIABLE CAM STACK - - - using a set of cams of various shapes and sizes, each having a recognized pattern of feed driving and needle bar vibrating functions designed into it, and a means to shift feed driver and needle bar vibrator to cam that will produce desired stitch pattern.

PRESSER BAR is a simple but very important part of the feeding system of a sewing machine. Using either a coiled or a flat spring with an adjustable turn screw upon it, the presser bar should exert just enough force to the presser to hold the material down upon the sewing platform without permitting any abrasion of the fabric.

SUMMARY:

Only the simplest and most basic functions of machine sewing have been discussed up to this point.

Driving mechanisms, lubrication, methods of trimming and other more complex aspects of machine design will be treated as they are found on specific machines under our observation farther on in this manual.

However, the reader now should have a firm grasp of the fundamentals of sewing machine design. The application of this knowledge to the areas of lockstitch machines and chainstitch machines will then conclude our study.

Whenever the meaning of some term is obscure, the reader should make full use of the alphabetical glossary at the rear of this book.

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