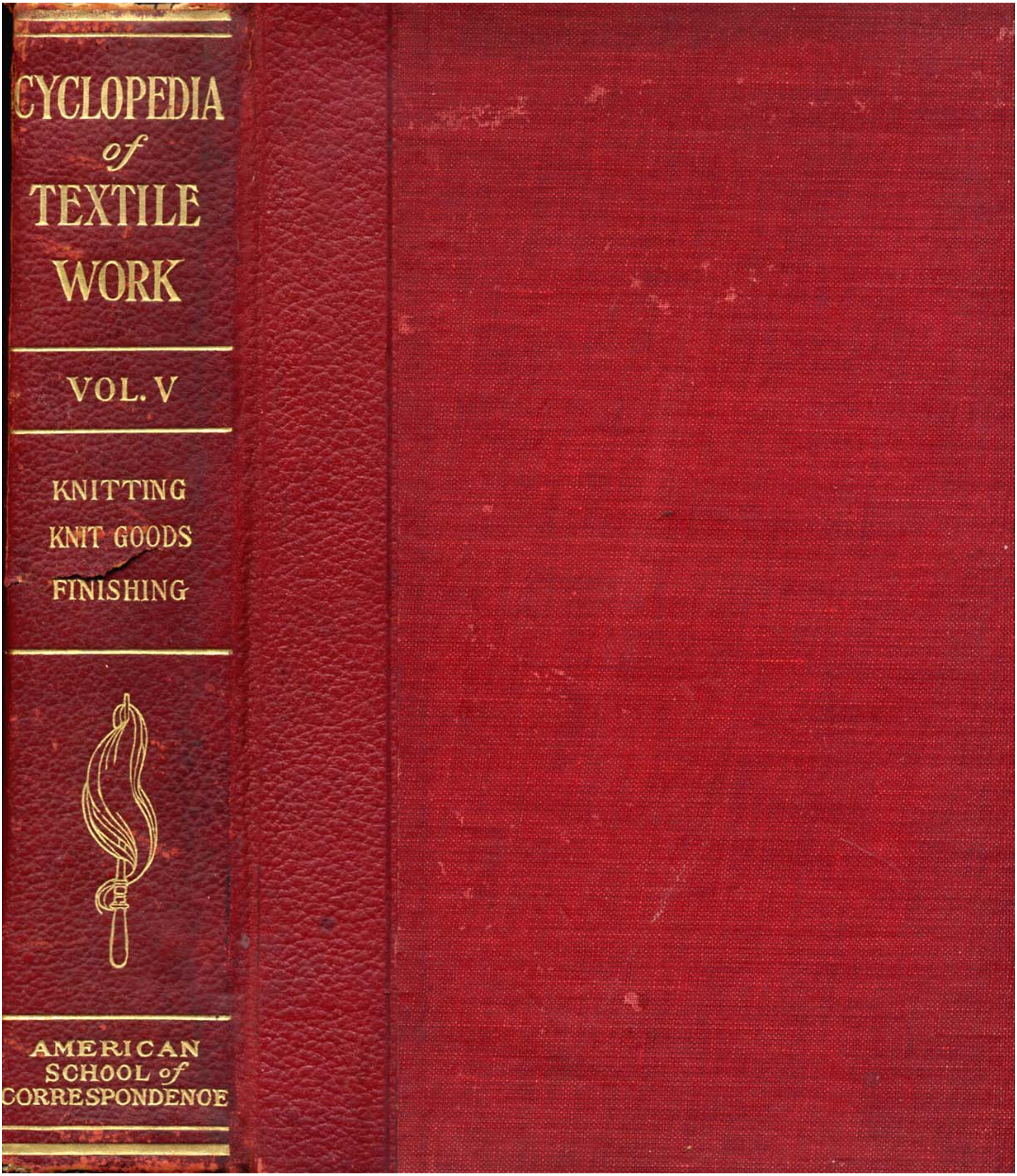
CYCLOPEDIA
of
TEXTILE
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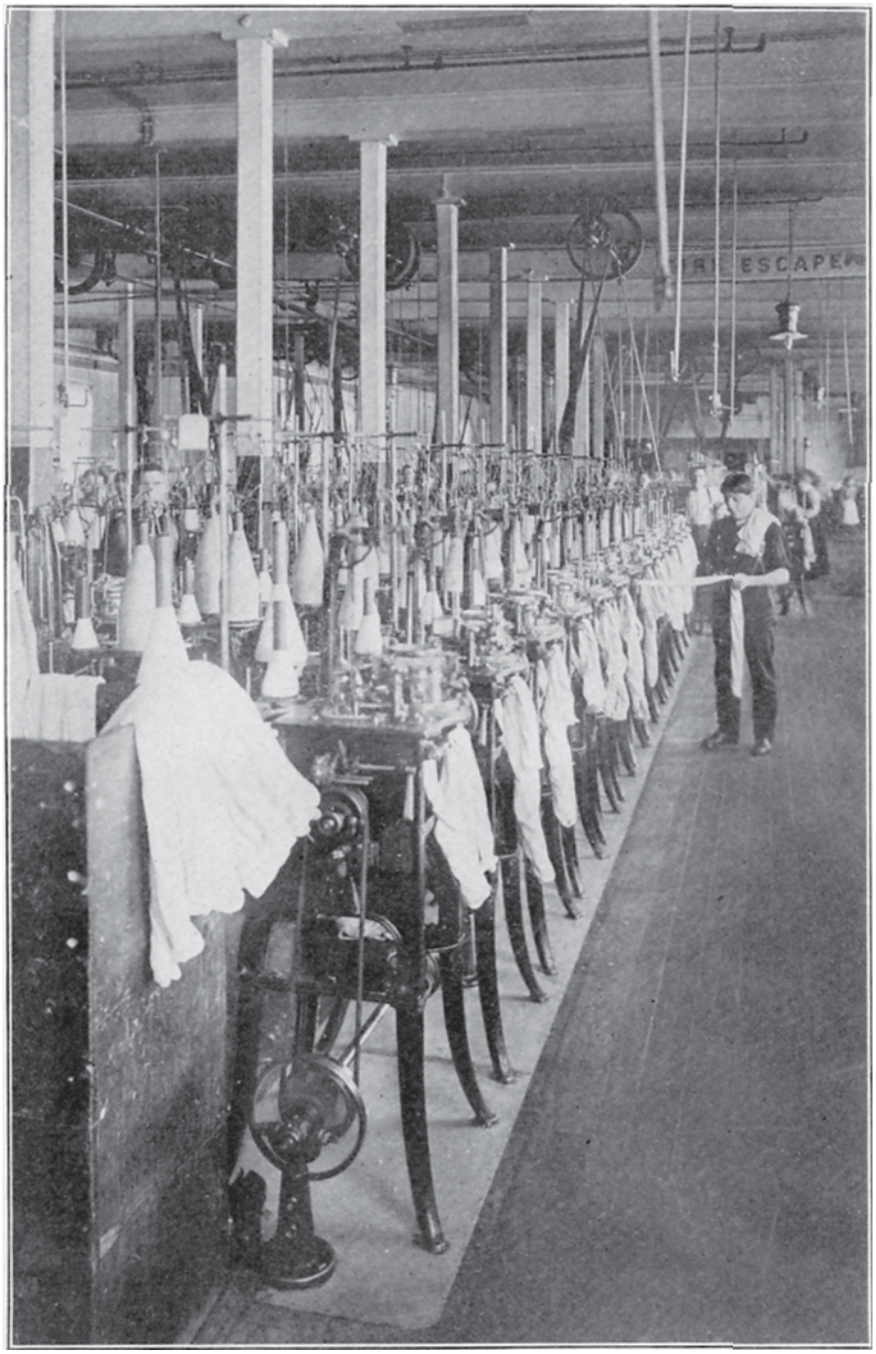
VOL. V
KNITTING
KNIT GOODS
FINISHING
AMERICAN
SCHOOL of
CORRESPONDENCE



HOSE KNITTING ROOM, AUTOMATIC SEAMLESS MACHINES
Lawrence Mfg. Co.

Cyclopedia
of
Textile Work

A General Reference Library

ON COTTON, WOOLEN AND WORSTED YARN MANUFACTURE, WEAVING, DESIGNING, CHEMISTRY AND DYEING, FINISHING, KNITTING, AND ALLIED SUBJECTS.

Prepared by a Corps of

TEXTILE EXPERTS AND LEADING MANUFACTURERS

Illustrated with over Two Thousand Engravings

SEVEN VOLUMES

CHICAGO
AMERICAN TECHNICAL SOCIETY
1907

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THE editors have freely consulted the standard technical literature of Europe and America in the preparation of these volumes and desire to express their indebtedness, particularly to the following eminent authorities, whose well known treatises should be in the library of every one connected with textile manufacturing.

Grateful acknowledgment is here made also for the invaluable co-operation of the foremost manufacturers of textile machinery, in making these volumes thoroughly representative of the best and latest practice in the design and construction of textile appliances; also for the valuable drawings and data, suggestions, criticisms, and other courtesies.

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Introductory Note

THE Cyclopedia of Textile Work is compiled from the most practical and comprehensive instruction papers of the American School of Correspondence. It is intended to furnish instruction to those who cannot take a correspondence course, in the same manner as the American School of Correspondence affords instruction to those who cannot attend a resident textile school.

The instruction papers forming the Cyclopedia have been prepared especially for home study by acknowledged authorities, and represent the most careful study of practical needs and conditions. Although primarily intended for correspondence study they are used as text-books by the Lowell Textile School, the Textile Department of the Clemson Agricultural College, the Textile Department of the North Carolina College of Agriculture and Mechanic Arts, the Mississippi Textile School, and for reference in the leading libraries and mills.

Years of experience in the mill, laboratory and class room have been required in the preparation of the various sections of the Cyclopedia. Each section has been tested by actual use for its practical value to the man who desires to know the latest and best practice from the card room to the finishing department.

Numerous examples for practice are inserted at intervals. These, with the test questions, help the reader to fix in mind the essential points, thus combining the advantages of a textbook with a reference work.

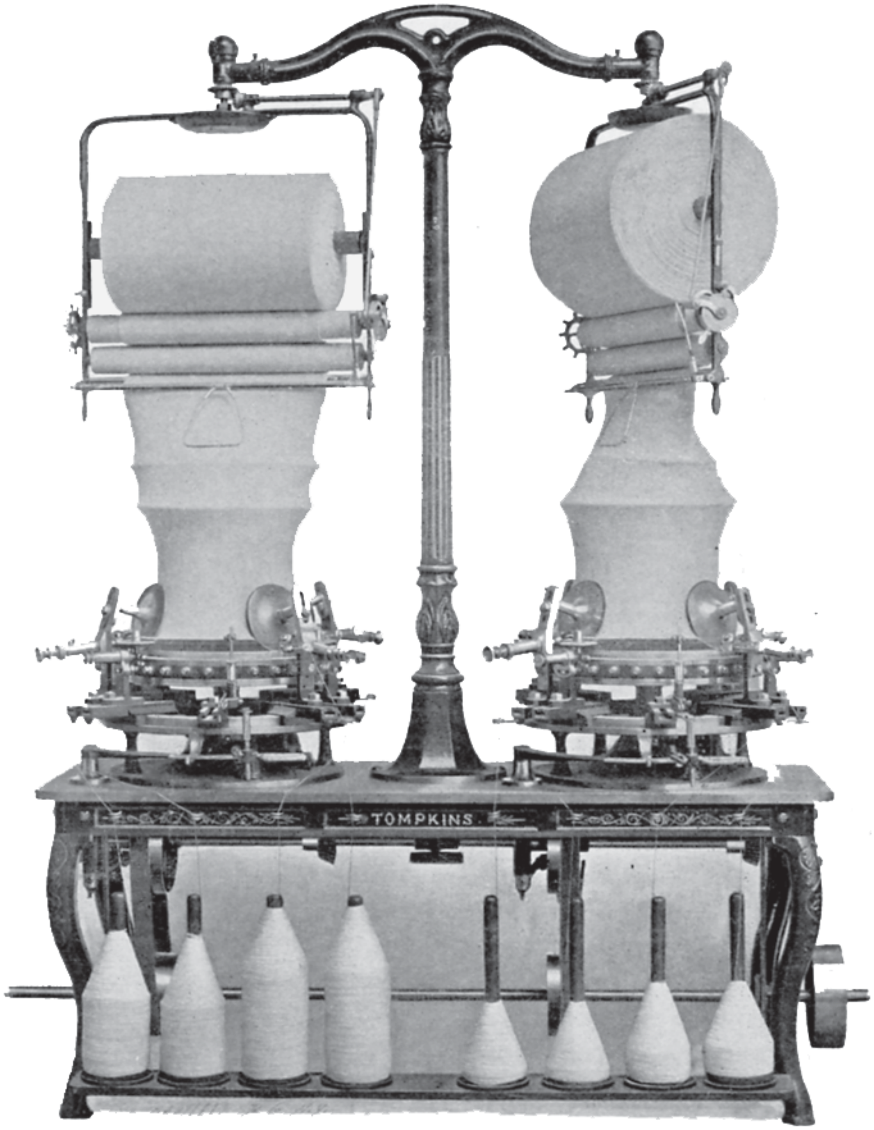
Grateful acknowledgment is due to the corps of authors and collaborators, who have prepared the many sections of this work. The hearty co-operation of these men — manufacturers and educators of wide practical experience and acknowledged ability — has alone made these volumes possible.

The Cyclopedia has been compiled with the idea of making it a work thoroughly technical, yet easily comprehended by the man who has but little time in which to acquaint himself with the fundamental branches of textile manufacturing. If, therefore, it should benefit any of the large number of workers who need, yet lack, technical training, the editors will feel that its mission has been accomplished.

Contents

VOLUME V.

* For Page numbers see foot of pages.



CIRCULAR SPRING-BEARD NEEDLE LOOP WHEEL MACHINE FOR MAKING PLAIN WEBBING
Tompkins Bros. Co.

KNITTING.

PART I.

CYLINDER SPRING NEEDLE KNITTING.

There are several kinds of knitted fabrics made in knitting mills, each kind requiring a radically different machine to produce it. What are commonly called *Flat Goods* are knit on Circular *Spring* Needle machines. *Ribbed Goods* are knit on Circular *Latch* Needle Machines. Shirt borders or rib tails, shirt cuffs or ribs, and drawer bottoms or ribs with selvedge edge, welt and slack course, are made on Straight Spring Needle Rib Machines, though some ribs for sleeves and drawer legs are made on small circular latch needle machines. Full Fashioned Underwear is made on Straight Spring Needle Machines provided with means for narrowing or shaping the garment to fit the body and limbs. The latest type is for knitting Ribbed Goods on a Circular Spring Needle Rib Machine. Hose is knit on Circular Latch Needle Machines generally, but of a different type than the machines for knitting Ribbed Underwear. Full Fashioned Hose is knit on Straight Spring Needle Machines with widening and narrowing devices for shaping the stocking, and Straight Latch Needle Machines.

It is evident from the above that knitting may be classified in a general way under three headings, viz :—

Flat Goods.

Ribbed Goods.

Hose or Stockings.

The first two classes include men's shirts and drawers, and ladies' vests and pants ; the third class including full length and half hose, full fashioned, shaped or cut, and seamless. A knitter should be well skilled in the art of knitting in all three classes to be competent to fill the best positions and obtain master's pay.

THE CONE WINDER.

The soft yarns, wool and mixtures and the backing yarns for cotton faced ribbed goods, are usually prepared, picked, carded and spun in the mill where they are knit up. Hard or cotton yarns are in most cases purchased in the market,— such yarns are used for ribbed goods, balbriggans, etc.,— but both kinds come to the knitter on jack bobbins or cops, and to facilitate the knitting are wound off on a much larger bobbin called a winder bobbin. The greatest care should be taken to have the yarn in the best possible condition on these bobbins. One of the most important factors in the production of knit goods is the proper presentation of the yarn to the knitting machine.

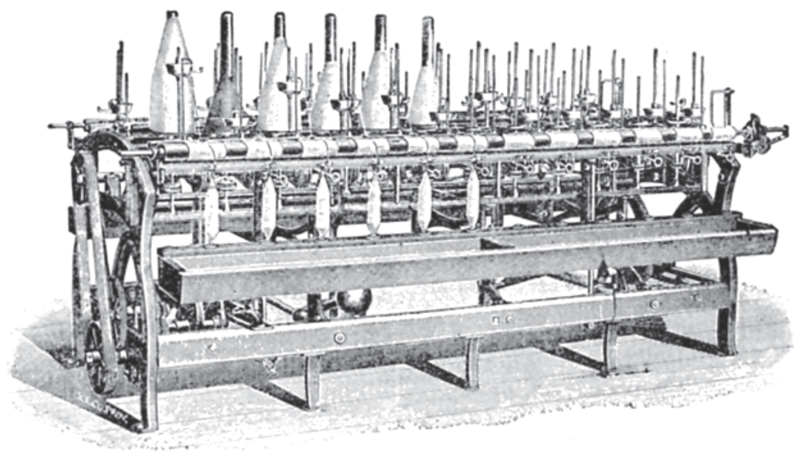


Fig. 1. Cone Winder.

Winding. When an end breaks down on a winder, the operator should not be allowed to flip the end on to the partly wound bobbin and let it go, because the result is almost sure to be a press-off when the yarn runs out on the knitting frame, especially when the knitting frame is not provided with automatic stops. The operator should be made to find the ends and tie them together in a small neat knot, and without forgetting to pull the ends through and break them off at the proper distance from the knot. If it is improperly or carelessly tied, leaving the ends in the knot, it leaves a loop and a larger knot, making a bunch in the yarn that will cause holes in the cloth and oftentimes break a number of needles — what the knitters call a "smash." If the knitter insists that the winders run the yarn through the scrapers on the winder, and tie every broken end properly, he will avoid many a hole in the cloth, break less needles and get a larger production of better fabric. The winding is the last handling of the yarn before it goes into the knitting needles and the real operation where the keenest inspection can be made. All the defects as seeds, sticks, knots, lumps, slugs, etc., that are removed in this process will materially affect the quality of the fabric, the production, and the cost of repairs, the three prime objects that must be kept in view to excel in the art of knitting.

Fig. 1 gives a comprehensive view of a Payne Cone Winder, winding from cop to knitting or winder bobbin; they are easily changed to wind from jack bobbin or skein. It is practically automatic, requiring but little attention from the operator except to replace the empty cops, tie the ends and remove the filled bobbins. As each spindle is independent and has its own stop motion, each bobbin is of course independent of the others and when filled may be stopped, taken off and another started in its place without stopping any of the other bobbins. This permits continuous winding.

The filling or building motion to each spindle adjusts itself to fine or coarse yarns without attention of the operator so that several different numbers of yarn can be wound on different bobbins at the same time if required. If the winder is kept in good order, the yarn will come off the bobbin when fed into the knitting machine with an almost constant tensión instead of coming off two or three turns at a time in which case it is liable to catch and make bad places in the cloth, break the yarn, break needles and cause other annoyances. The winder bobbins should be handled with care after being filled on the winder to preserve their initial shape and the lay of the yarn, and thereby ensure a free delivery of the yarn when delivered to the needles.

When this machine is set up it should be leveled and belted to run the receiving shaft 160 to 180 revolutions per minute. Particular pains must be taken to see that an uneven floor or other causes do not throw the machine out of alignment; if it does then it must be shimmed up until level its entire length. When the cone winder is taking more power to run it than seems necessary, it will be found in most every case to be out of alignment and immediate attention to putting it into line will usually remedy the difficulty. The machines vary in size from six to forty-eight spindles as required, and may be adjusted to wind a bobbin from four to six inches in diameter 17 inches high, leaving the top, cone-shaped, as observed in Fig. 2.

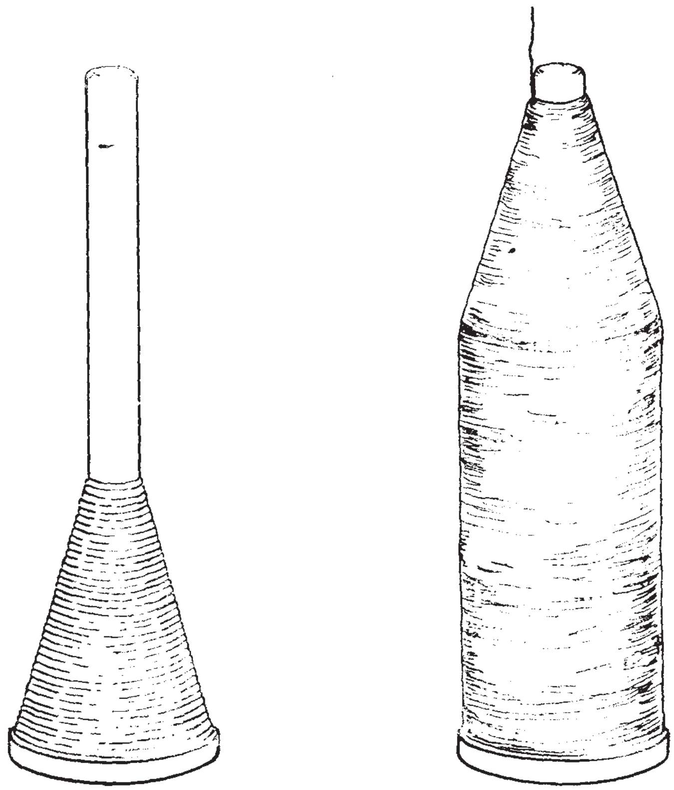


Fig. 2. Winder Bobbin, Empty and Filled.

The action of the cup attached to the filling or building motion controls the diameter of the bobbin, four to six inches as predetermined, or any size between. The building motion has a rise and fall corresponding to the height of the cone-shaped part of the empty bobbin and maintains that same rise and fall until the bobbin is filled. Tensions are so regulated that the yarn may be wound as tightly at the nose or small part of the bobbin as at the base or large part.

Spindle Drive. The top of the machine, between the rails that move up and down, is covered with light boarding; just beneath this covering is the receiving shaft extending the full length of the machine, on which are the band pulleys driving the spindles; each pulley has a double groove, as it drives a spindle on either side of the machine, transmitting with a round cotton banding, a separate band to each spindle, as in Fig. 3.

Building Motion. At one end of the shaft is the receiving pulley; at the other end is another pulley also outside of the frame, for transmitting power to the building motion inside the lower part of the machine as in Figs. 4 and 5. In a bearing fastened to

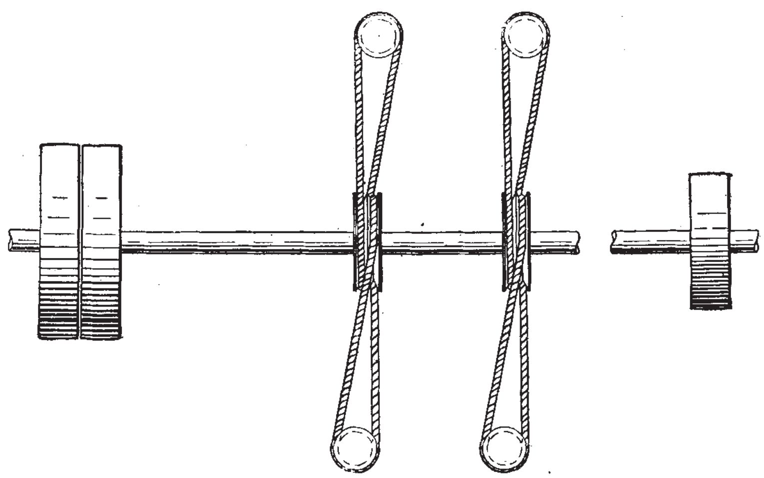


Fig. 3. Spindle Drive Showing Pulleys and Bands.

the end of the frame is a jackshaft on which, outside the end frame and close beside the belt pulley, is a pinion gear meshing into a wheel gear that drives, on its shaft inside the frame, an unusual arrangement of gears — double gears — so arranged that the teeth on one pair are just half the distance of one tooth ahead of the other pair. Such an arrangement serves to materially lessen the back-lash that must inevitably occur were but one pair of gears only employed. This system of gearing transmits motion to the heart cam shaft that gives the rise and fall to the building motion. The reversing at each end of the stroke is attended in similar mechanisms with more or less back-lash which in this machine is controlled by this double gear arrangement.

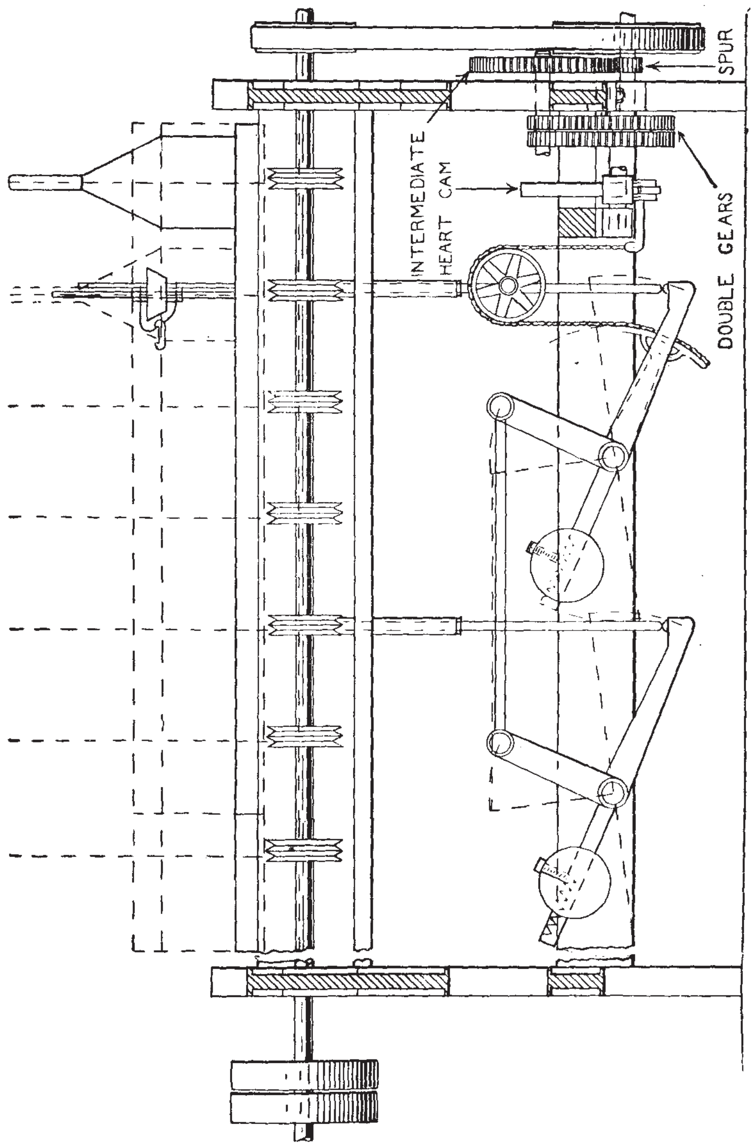


Fig. 4. Sectional View of Side Showing Building Motion.

The heart cam Fig. 6 has a long and short side, imparting to the building rail a slow rising movement, making a close wind on the bobbin and a quick falling movement which lays the yarn across the close wind and binds it in a manner best adapted for use on a knitting frame. The building rail, see Fig. 4, is connected with the heart cam in the following manner: By action of the cam, a lever on a rockshaft parallel to the cam shaft, with a cam roll near the vibrating end is made to transmit its motion by means of a chain belt attached to the above lever and running over an idler wheel to connect it with another rockshaft lever at right angles with the cam shaft. On this rockshaft another

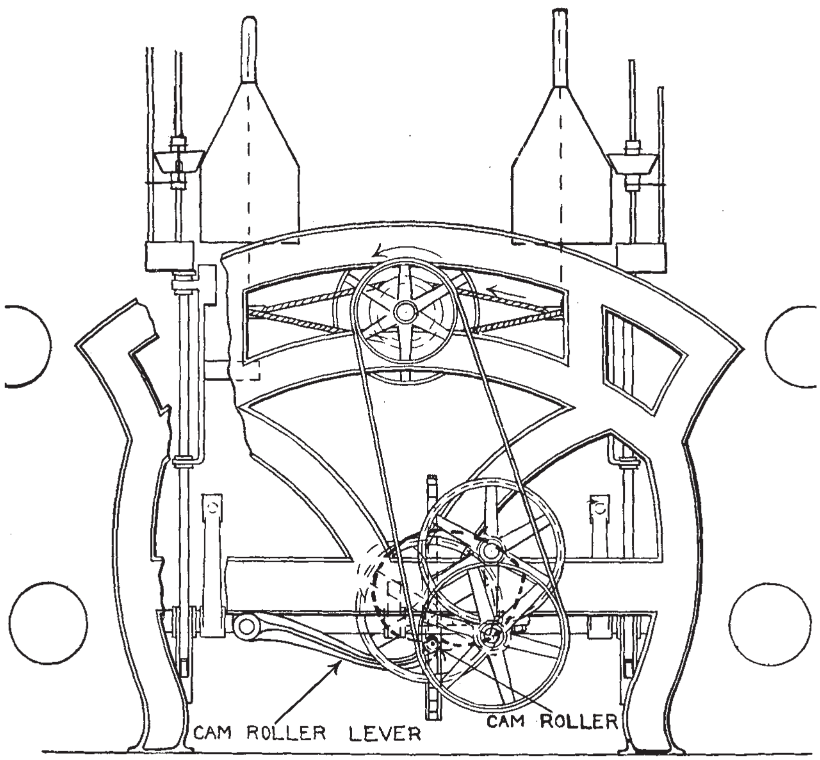


Fig. 5. End View of Cone Winder.

lever, connected by upright rods to the building rail, gives to it a rise and fall corresponding to the height of the cone-shaped portion of the winder bobbin. On a third lever of this rockshaft is a ball weight to equalize the motion, balance the weight of the cup rail or building rail, and thereby relieve the heart cam of excessive wear when lifting the rail. The upright rods to the building rail are near each end of the rail; the rockshaft with lifting rod lever and ball counterweight is consequently duplicated at the opposite end of the machine, the rockshaft being connected with rod and levers. The upright rods are not connected to the levers, but, having a broad heel, ride easily on a small roller wheel in the ends of the levers. This arrangement permits a free sweep of the levers with a minimum of friction.

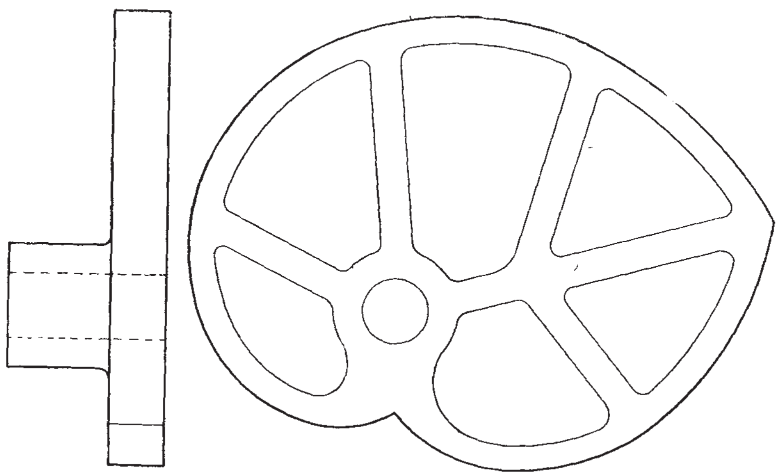
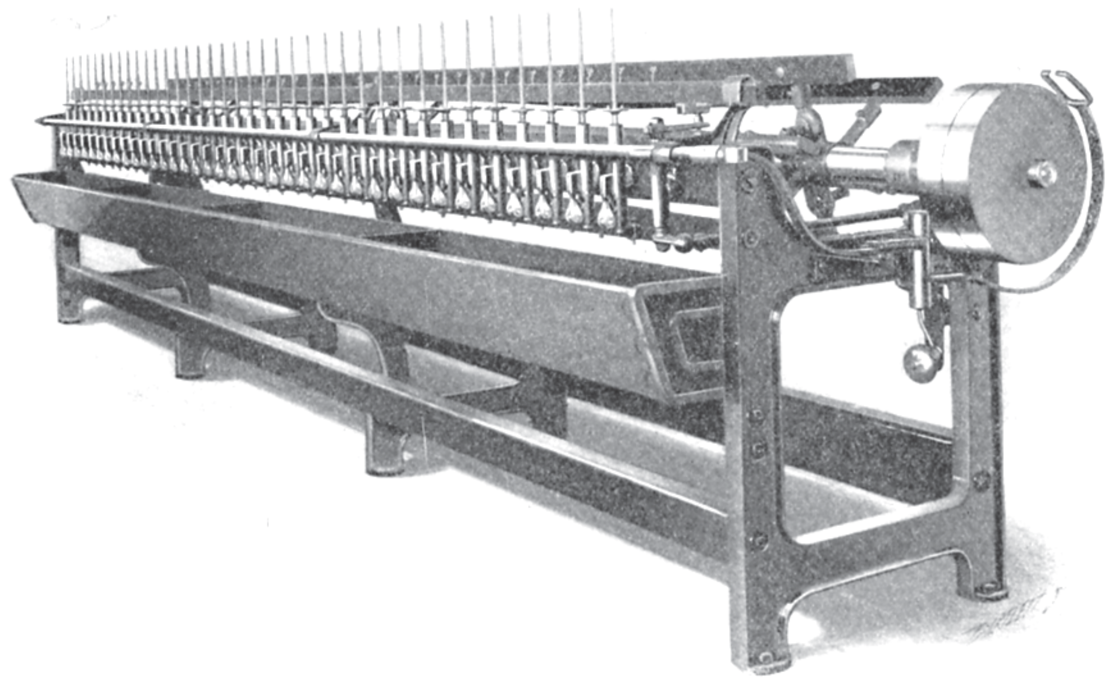


Fig. 6. Heart Cam.

The Spindles are properly stepped and run in oil with a cap closely fitted to the spindle and covering the step to keep out grit and lint. If the caps are kept in position the steps will last a long time. About eight inches above the step rail just beneath the board covering is the bolster rail with the spindle bearing. Just above the covering, fastened to the spindle with a taper bearing, is a flange on which the bobbin rides, held on by the spindle projecting up into the hole in the bobbin made for that purpose. On that part of the spindle between the step and the upper bearing is fastened the whorl for belting the spindle.

The jack bobbins or cops are placed in their position just under the cotton friction or cleaner rail. The yarn passes from the cop or jack bobbin through the inside curl of the double quirl guide wire, is wound two or three times around the wire as the ten-



REEL FOR WINDING YARN INTO SKEINS
Saco & Pettee Machine Shops

sion may require or the strength of the yarn permit; then through the outer curl, over the felt on the cotton friction rail, into the porcelain pot eye guide, through the scraper guide, up to the porcelain guide attached to the friction cup on the screw spindle; then thrown around the cloth covered part of the winder bobbin to which it clings and thereby gets its start. When the yarn has builded the bobbin to the required diameter at its base the yarn will rub against the cup, Fig. 7, move it around and up on the screw spindle; as the yarn guide is attached to the cup, the yarn is raised with it and consequently does not wind on the bobbin as far down on its next descent with the building rail when this operation is repeated. The cup, and the yarn with it, moves up gradually until the bobbin is full to the top of the spindle leaving the top in the shape of a cone just as it has builded it all the way up. It takes its form from the conical shape of the empty bobbin at its base, shown at Fig. 2, and is made to build in that manner because the yarn comes off the bobbin in the most approved manner for knitting machine purposes.

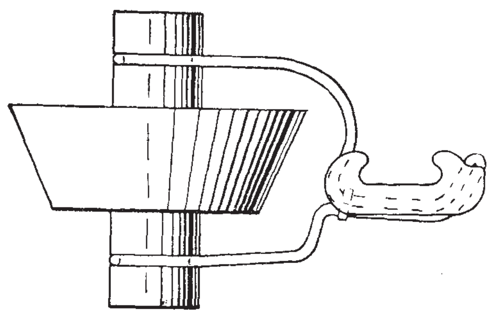


Fig. 7. Cup and Thread Guide.

The screw on which the cup moves is a ratch screw thread, flat on the upper side and V shaped on the lower; the cup is not tapped out but has a blade held in place by means of a spring, and meshing into the screw thread. This permits of the cup being raised with the thread or, in case of a bunch or large place on the bobbin, to slip up an extra tooth or be quickly raised out of harm's way in case of accident. When the bobbin is filled the cup is easily lowered to the starting point by a slight pressure of the thumb on a small lever on the blade while grasping the cup in the same hand.

Endwise Motion. The cotton friction, or cleaner-rail, has pieces of felt or flannel about three inches wide, attached to that part over which the yarn runs, to make friction, thereby increasing the tension and incidentally helping to cleanse the yarn. In order that the yarn may not run in one crease on the felt the rail is made to move slowly endwise back and forth, and to oscillate a little; the latter motion is imparted by the suitably connected rockshaft levers.

The mechanism for imparting the endwise motion, Fig. 8, is attached to the building rail on the receiving pulley end of the machine from which it gets its movement. The friction rail is supported at each end by trunnions on which it oscillates. These trunnions are made long to allow for the endwise movement in their bearings, with extra length on the end that carries the endwise mechanism. A ratchet wheel turning on the trunnion is

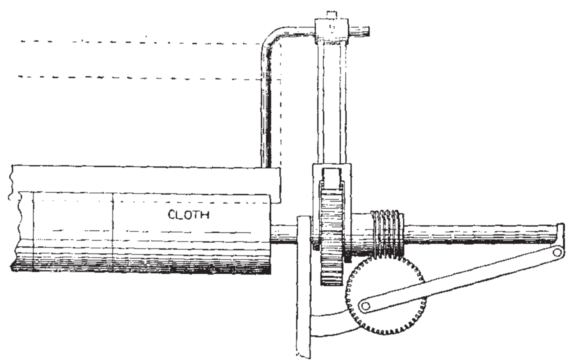


Fig. 8. Endwise Motion.

connected with the building rail and turns it with a worm gear running on the same trunnion. The worm causes to revolve a wheel gear to which is attached a rod connecting it with the cotton friction rail in a manner to impart to it a slow motion back and forth. These two motions prevent wearing the friction felts in only one place and thus assists in cleansing the yarn.

The Stop Motion is directly under that part of the bottom of the winder bobbin that projects over the flange, and is operated by pulling out the wire with a round eye that projects just beyond and below the rails beside and near the top of the cop (see Fig. 1). This action raises the winder bobbin from the flange and prevents it from revolving. Each bobbin has its own stop motion and consequently any bobbin may be stopped without stopping any of the others. As the building cup of each bobbin is also independent, one may be partially or almost filled and another just being started. The building cup also adjusts itself to fine or coarse yarns so that several numbers can be wound at the same time if required.

The Tension is regulated to draw loosest on woolen yarn at the largest part of the bobbin and to tighten gradually as the yarn nears the smallest part or nose, because the larger the diameter the faster the yarn travels and vice-versa. To help regulate this matter a rail, with a porcelain pot eye guide for each thread, between and nearly on a level with the cotton friction rail and the cup rail, is supported by connections with the ball lever rockshafts at such a point as to give a certain amount of rise to the pot-eye guide.

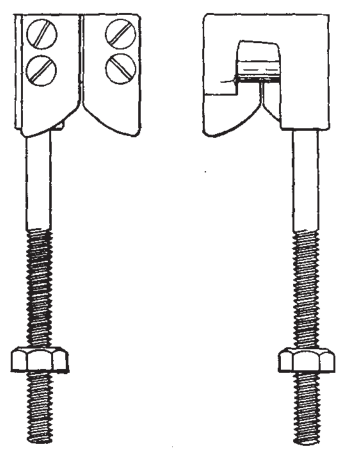


Fig. 9. Scraper Guide.

The Scraper Guide, Fig. 9 is stationary. It is a small casting having on the front side two blades, one adjustable. Between these blades the yarn passes, and as the slot between is adjusted to about the size of the yarn they act as a cleanser. If any foreign substance such as straws and seeds adhere to the yarn or lumpy places appear, the scraper helps to remove them. On the back of the scraper a porcelain guide is secured in the casting. When the yarn is being wound around the largest part of the bobbin the pot eye rail is at its lowest point; as the yarn builds higher on the bobbin the pot eye guide rail rises and gradually increases the tension by making a sharper angle between itself and the scraper guide, thereby increasing the friction on the yarn.

The Evans Friction Cone Drive is oftentimes applied to Winders to equalize the speed of winding, and by this means wind as fast at the small end or nose of the bobbin as at the large end or base. The cone drive is shown in Fig. 10 (Winder with Cone Drive). It has an automatic shipper X connected with the rockshaft arm of the building motion and so arranged that the bobbin runs at its lowest speed when tne yarn is being wound on its largest diameter and increases its speed in proportion to the decrease of its diameter, so that the yarn runs at the same speed and with more even tension. The leather friction band C is shipped from end to end of the cone A B by the auto-

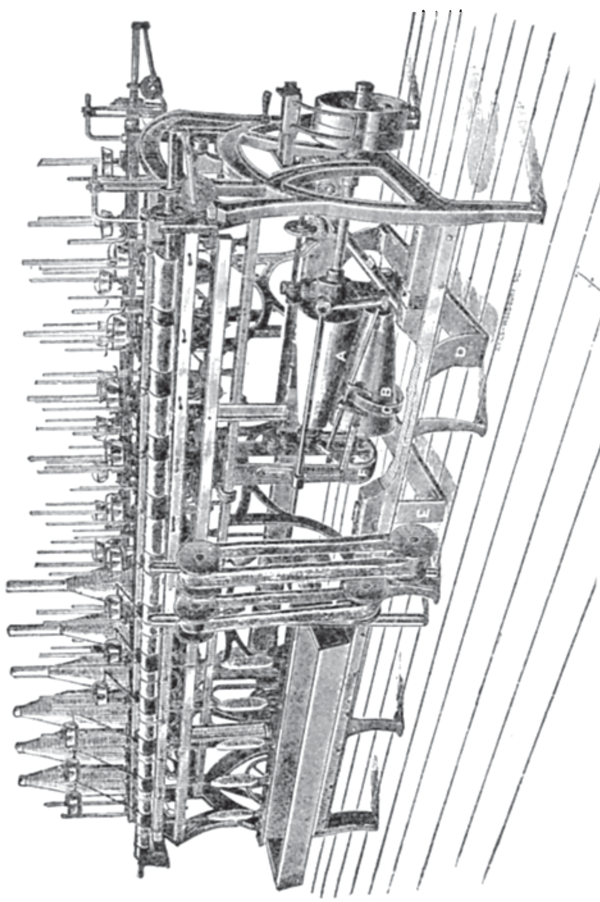
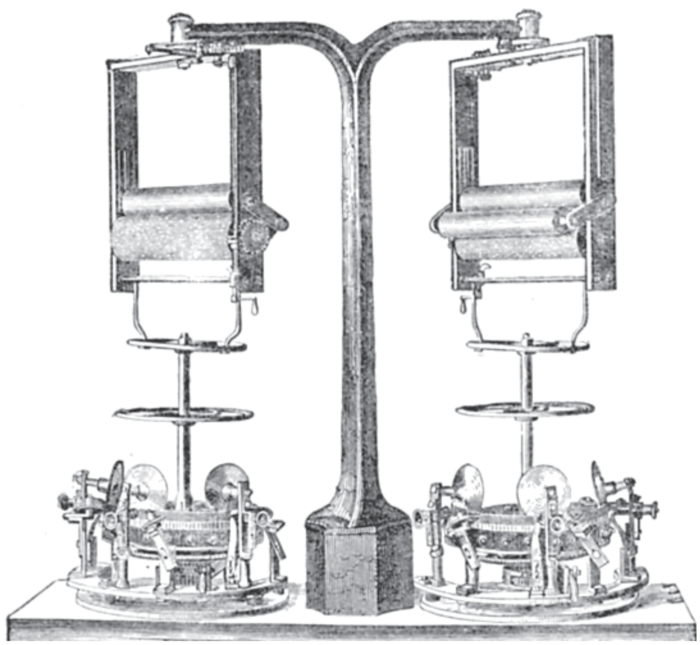


Fig. 10. Winder With Cone Drive.

matic shipper X. The cones should be carefully adjusted so that the pressure on the leather friction band, when the cones are at rest, is not so hard but what the band could be pulled through by hand, but not so loose that the friction is not sufficient to transmit the power. The cones may be forced together so hard that the leather friction band will not transmit the power it should with proper tension. Too much pressure will make the winder run hard and cause trouble with the winding and is entirely unnecessary. One edge of the leather friction band should not be allowed to stretch more than the other and will not if the cones are kept the same distance apart at each end. This distance may be adjusted by means of check nuts just beneath the bearings at each end of the shaft on the lower or driven cone. If the above directions are followed carefully the cone drive will help the winder to build a more evenly uniform bobbin and build it quicker with less breaking of the yarn in the twits.



Old Type of Knitting Table.

KNITTING YARN TABLES AND CALCULATIONS.

The methods of designating the weight of mule spun yarn varies in different localities. The custom in the Cohoes Mills is to designate the yarn by the weight in grains of three threads from one draw of the jack; that is, after the jack has run back and drawn the roving off the spools, spun it and run to the furthermost point from the drawing roll, which is about 6 feet 3 inches, take three threads (from the spindle to the drawing rolls) break them off, and weigh them together. The weight in grains of these three threads, about $6\frac{1}{4}$ yards in length, is the "grain of the yarn." For instance, if these three threads weigh $11\frac{1}{2}$ grains, the yarn is classified as $11\frac{1}{2}$ grain yarn.

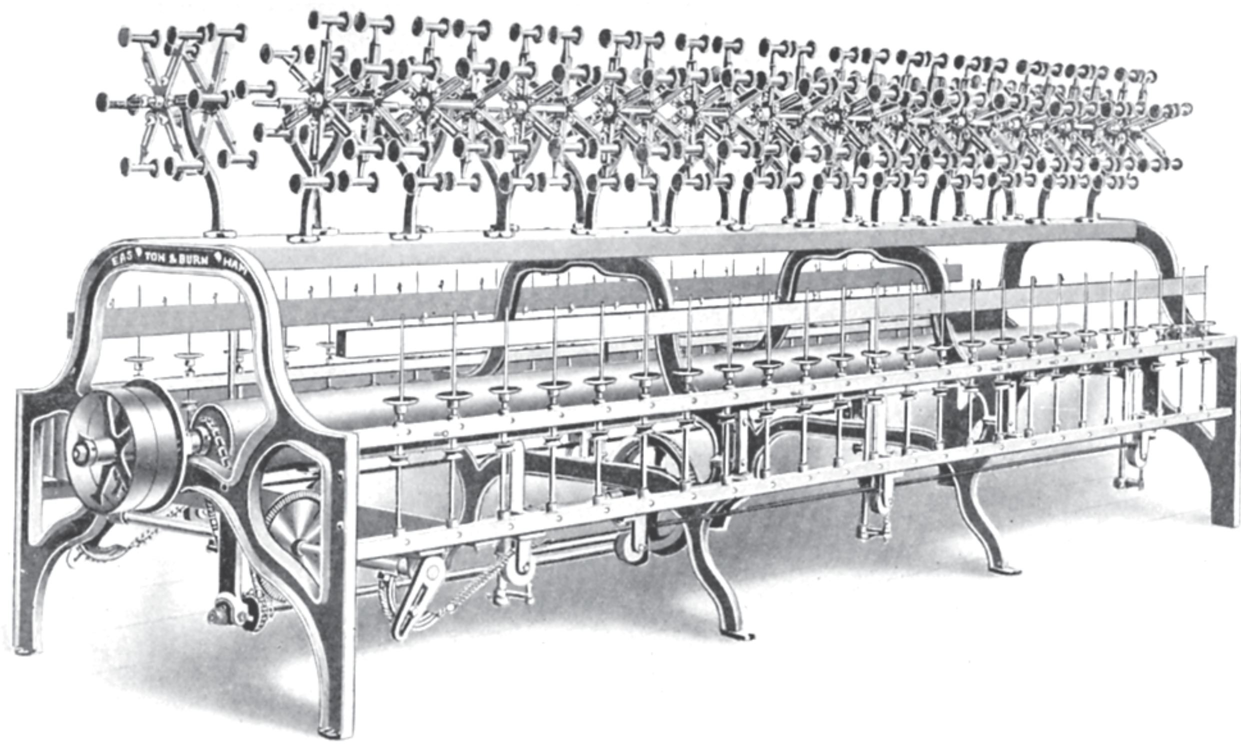
The Amsterdam method is to take 6 draws. This gives a closer weighing than the "three end" method but of course, the classification is twice as great. For instance, $11\frac{1}{2}$ grain yarn Cohoes standard is 23 grain yarn Amsterdam standard.

The weight of yarn suitable for any particular gauge is determined for a maximum by the weight that can be crowded between the needles without causing bad work, and for lesser weights by the weight of the fabric required. For instance, on an 18 gauge machine $9\frac{1}{4}$ grain (Cohoes standard) yarn is about as heavy as is advisable, and a (12 pound to the dozen) No. 40 shirt may be made with it. Less grain yarn may be used for lighter garments.

Appended is a table giving the size of yarn in grains for the commonly used gauges and the corresponding weight per dozen of No. 40 shirts.

Gauge.	Grains in six draws.	Grains in three draws.	Weight per doz. of No. 40 Shirts.
24	$9\frac{1}{2}$	$4\frac{3}{4}$	$8\frac{1}{4}$
22	11	$5\frac{1}{2}$	9
20	14	7	11
18	$18\frac{1}{2}$	$9\frac{1}{4}$	$11\frac{1}{2}$
16	$21\frac{1}{2}$	$10\frac{3}{4}$	12
14	23	$11\frac{1}{2}$	12
12	27	$13\frac{1}{2}$	12
10	30	15	$12\frac{1}{2}$

As there are various systems of numbering yarn used in different localities, the following comparative tables are given.



SKEIN WINDER EQUIPPED WITH SPIDER SWIFT
Easton & Burnham Machine Co.

COMPARATIVE YARN TABLES. EQUIVALENTS OF DIFFERENT YARN STANDARDS.

New Hampshire Standard, 50 yds. in grains.	Yds. per lb. (7,000 grains).	Yds. per ounce (437.5 grains).	Cohoes Standard, weight of 6¼ yds. in grains.	Cuts 300 yds. per lb. per No.	Runs 1600 yards per lb. per No.	Cotton, 840 yds. per lb. per No.	Worsted, 560 yds. per lb. per No.	New Hampshire Standard, 50 yds. in grains.	Yds. per lbs. (7000 grains.)	Yds. per ounce (437.5 grains).	Cohoes Standard, weight of 6¼ yds. in grains.	Cuts 300 yds. per lb. per No.	Runs 1600 yds. per lb. per No.	Cotton, 840 yds. per lb. per No.	Worsted, 560 yds. per lb. per No.
1166.67	300	18.75	145.83	1				35.35	9900	618.75	4.42	33			
625.	560	35.	78.13				1	34.72	10080	630.	4.34			12	18
583.33	600	37 5	72.92	2				34.31	10200	637.5	4.29	34			
416.66	840	52.5	52.08			1		33.33	10500	656.25	4.17	35		12½	18¾
388.89	900	56.25	48.61	3				32.89	10640	665.	4.11				19
312.5	1120	70.	39.06				2	32.41	10800	675.	4.05	36	6¾		
291.67	1200	75.	36.46	4				31.25	11200	700.	3.91		7		20
233.33	1500	93.75	29.17	5				29.76	11760	735.	3.72			14	21
218.75	1600	100.	27.34		1			29.16	12000	750.	3.65	40	7½		
208.33	1680	105.	26.04			2	3	28.41	12320	770.	3 55				22
194.44	1800	112.5	24.31	6				27.78	12600	787.5	3.47			15	22½
166.66	2100	131.25	20.83	7		2½	3¾	27.34	12800	800.	3.42		8		
156.25	2240	140.	19.53				4	26.04	13440	840.	3.26			16	24
145.83	2400	150.	18.23	8	1½			25.90	13500	843.75	3.24	45			
138.89	2520	157.5	17.36			3	4½	24.51	14280	892.5	3.06			17	25½
129.63	2700	168.75	16.20	9				24.31	14400	900.	3.04	48	9		
125.	2800	175.	15.63		1¾		5	24.04	14560	910.	3.01				26
116.66	3000	187.5	14.58	10				23.33	15000	937.5	2.92	50			
109.38	3200	200.	13.67		2			23.15	15120	945.	2.89			18	27
106.06	3300	206.25	13.26	11				22.44	15600	975.	2.81	52	9¾		
104.17	3360	210.	13.02			4	6	21.93	15960	997.5	2.74			19	28½
97.22	3600	225.	12.15	12	2¼			21.88	16000	1000.	2.74		10		
89.74	3900	243.75	11.22	13				21.21	16500	1031.25	2.65	55			
87.86	3920	245.	10.98				7	20.83	16800	1050.	2.60	56	10½	20	30
83.33	4200	262.5	10.42	14		5	7½	19.89	17600	1100.	2.49		11		
78.13	4480	280.	9.77				8	19.53	17920	1120.	2.44				32
77.77	4500	281.25	9.72	15				19.44	18000	1125.	2.43	60	11¼		
72.92	4800	300.	9.12	16	3			18.94	18480	1155.	2.37			22	33
69.44	5040	315.	8.68			6	9	18.38	19040	1190.	2.30				34
68.63	5100	318.75	8.58	17				18.23	19200	1200.	2.28		12		
64.82	5400	337.5	8.10	18				17.95	19500	1218.75	2.24	65			
62.50	5600	350.	7.81		3½		10	17.36	20160	1260.	2.17			24	36
61.40	5700	356.25	7.68	19				16.83	20800	1300.	2.10		13		
59.52	5880	367.5	7.44			7	10½	16.67	21000	1312.5	2.08	70		25	37½
58.33	6000	375.	7.29	20	3¾			16.45	21280	1330.	2.06				38
56.82	6160	385.	7.10				11	16.03	21840	1365.	2.00			26	39
55.56	6300	393.75	6.95	21		7½	11¼	15.63	22400	1400.	1.95		14		40
54.69	6400	400.	6.84		4			15.56	22500	1406.25	1.94	75			
53.03	6600	412.5	6.63	22				14.88	23520	1470.	1.86			28	42
52.08	6720	420.	6.51			8	12	14.58	24000	1500.	1.82	80	15		
50.72	6900	431.25	6.34	23				14.20	24640	1540.	1.78				44
48.61	7200	450.	6.08	24	4½			13.89	25200	1575.	1.74	84	15¾	30	45
48.08	7280	455.	6.01				13	13.73	25500	1593.75	1.72	85			
46.67	7500	468.75	5.83	25				13.67	25600	1600.	1.71		16		
46.30	7560	472.5	5.79			9		13.59	25760	1610.	1.70				46
44.85	7800	487.5	5.61	26				13.02	26880	1680.	1.63			32	48
44.64	7840	490.	5.58				14	12.97	27000	1687.5	1.62	90			
43.75	8000	500.	5.47		5			12.87	27200	1700.	1.61		17		
43.21	8100	506.25	5.40	27				12.28	28500	1781.25	1.54	95			
41.67	8400	525.	5.28	28	5¼	10	15	12.25	28560	1785.	1.53			34	51
40.23	8700	543.75	5.03	29				12.15	28800	1800.	2.77	98	18		
39.06	8960	560.	4.88				16	11.67	30000	1875.	1.46	100	18¾		
38.88	9000	562.5	4.86	30				11.57	30240	1890.	1.45			36	54
37.88	9240	577.5	4.74			11	16½	11.51	30400	1900.	1.44		19		
37.63	9300	581.25	4.70	31				10.96	31920	1995.	1.37			38	57
36.76	9520	595.	4.60				17	10.94	32000	2000.	1.37		20		
36.46	9600	600.	4.56	32	6			10.42	33600	2100.	1.30	112		40	60

Woolen Run System. Only the most delicate scales should be used for weighing yarn. Fig. 11 shows the kind of scale generally used for this work. The beam is graduated into 100 parts, indicating grains. Four weights, 100, 200, 400 and 800 grains, are furnished with the scale, and appended is a table giving the weights of fifty yards of many numbers of single woolen yarn, in grains. This table is obtained by the following calculation.

If 1,600 yards Single Woolen Yarn (called 1 Run) weigh 7,000 grains, (1 lb.) then one yard will weigh $\frac{1}{1600} \times 7000$ grains $= 4\frac{3}{8}$ grains, and 50 yards will weigh $50 \times 4\frac{3}{8}$ grains $=$ $218\frac{3}{4}$ grains. If 50 yards single Woolen 1 Run Yarn weigh $218\frac{3}{4}$ grains, 50 yards Single Woolen 2 Run Yarn will weigh $\frac{1}{2} \times 218\frac{3}{4}$ grains $= 109\frac{3}{8}$ grains and so on as per following table.

Weight in Grains, 50 Yards, Single Woolen Yarn in "Runs."

Run.	Grains.	Run.	Grains.
$\frac{1}{2}$	$437\frac{1}{2}$	$5\frac{1}{2}$	$39\frac{17}{22}$
$\frac{5}{8}$	350	$5\frac{3}{4}$	$38\frac{1}{23}$
$\frac{3}{4}$	$291\frac{2}{3}$	6	$36\frac{11}{24}$
$\frac{7}{8}$	250	$6\frac{1}{4}$	35
1	$218\frac{3}{4}$	$6\frac{1}{2}$	$35\frac{17}{36}$
$1\frac{1}{8}$	$194\frac{4}{9}$	$6\frac{3}{4}$	$32\frac{11}{27}$
$1\frac{1}{4}$	175	7	$31\frac{1}{4}$
$1\frac{3}{8}$	$159\frac{1}{11}$	$7\frac{1}{4}$	$30\frac{5}{29}$
$1\frac{1}{2}$	$145\frac{5}{6}$	$7\frac{1}{2}$	$29\frac{1}{6}$
$1\frac{5}{8}$	$134\frac{8}{13}$	$7\frac{3}{4}$	$28\frac{7}{31}$
$1\frac{3}{4}$	125	8	$27\frac{11}{32}$
$1\frac{7}{8}$	$116\frac{2}{3}$	$8\frac{1}{2}$	$25\frac{25}{34}$
2	$109\frac{3}{8}$	9	$24\frac{11}{36}$
$2\frac{1}{4}$	$97\frac{2}{9}$	$9\frac{1}{2}$	$23\frac{1}{38}$
$2\frac{1}{2}$	$87\frac{1}{2}$	10	$21\frac{7}{8}$
$2\frac{3}{4}$	$79\frac{6}{11}$	$10\frac{1}{2}$	$20\frac{35}{42}$
3	$72\frac{11}{12}$	11	$19\frac{39}{44}$
$3\frac{1}{4}$	$67\frac{4}{13}$	$11\frac{1}{2}$	$19\frac{1}{46}$
$3\frac{1}{2}$	$62\frac{1}{2}$	12	$18\frac{11}{48}$
$3\frac{3}{4}$	$58\frac{1}{3}$	$12\frac{1}{2}$	$17\frac{1}{2}$
4	$54\frac{11}{16}$	13	$16\frac{43}{52}$
$4\frac{1}{4}$	$51\frac{8}{17}$	$13\frac{1}{2}$	$16\frac{11}{54}$
$4\frac{1}{2}$	$48\frac{11}{18}$	14	$15\frac{5}{8}$
$4\frac{3}{4}$	$46\frac{1}{19}$	$14\frac{1}{2}$	$15\frac{5}{58}$
5	$43\frac{3}{4}$	15	$14\frac{7}{12}$
$5\frac{1}{4}$	$41\frac{2}{3}$		

Reel off 50 yards, and opposite its weight of grains in the table will be found its number or run of the yarn.

It often happens that it is necessary to ascertain the count from a small sample of yarn that measures but a few inches in length. This may be done by very carefully measuring the length of the yarn, and weighing it as accurately as possible. Then apply the following rule, viz.: Divide the weight by the length in inches and multiply the quotient by 1800. Refer to the table above for the count or Run.

Example: Suppose 30 inches of Single woolen yarn weigh 4.19 grains. Then $4.19 \div 30 = .1396 \times 1800 = 251.28$. Referring to the table we find that the sample is $\frac{7}{8}$ Run Yarn, a trifle heavy, as the Standard for $\frac{7}{8}$ Run Single Woolen Yarn is 250 grains for fifty yards.

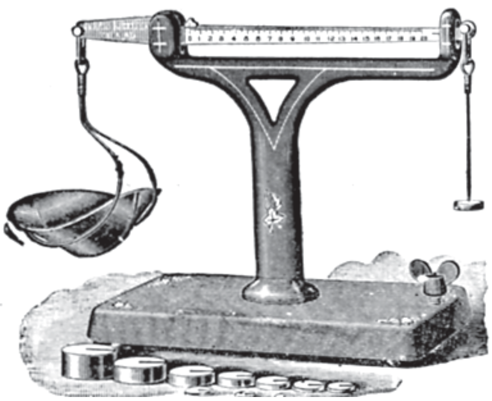


Fig. 11. Yarn Scales.

Again, suppose that we have 69 inches of Single woolen yarn that weigh 4.19 grains.

Then $4.19 \div 69 = .06072 \times 1800 = 109.29$.

Opposite this number in the table is the count, viz: 2 Run.

If the yarn is 2 Ply divide by 2.

" " " 3 " " " 3.

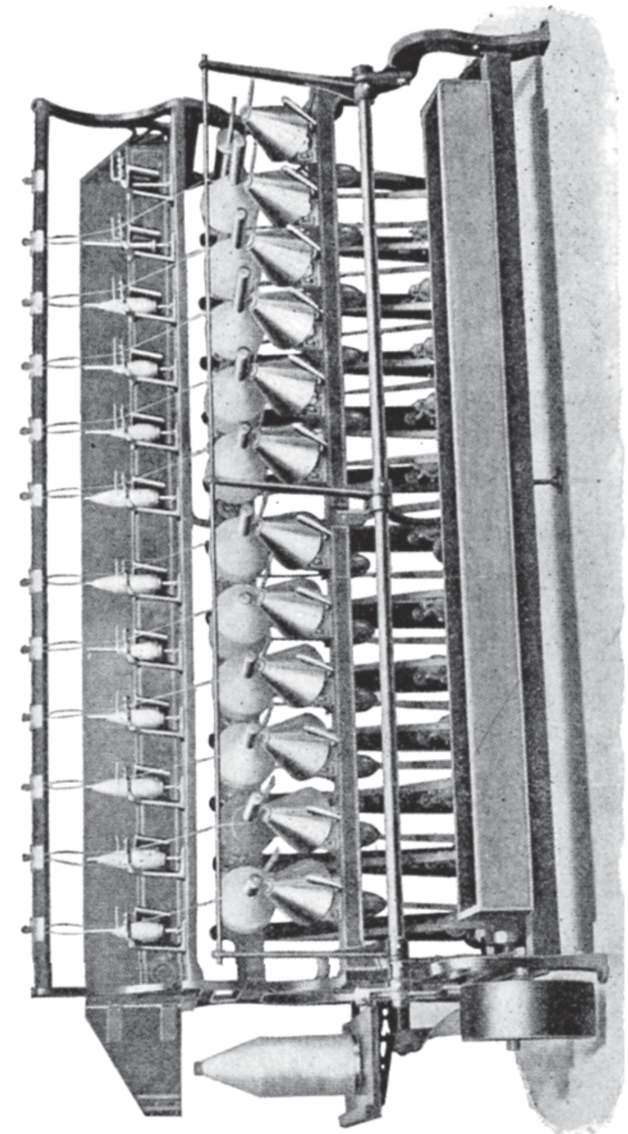
Again:—If 1,600 yards single woolen 1 Run Yarn weigh 7000 grains (1 lb.) then 1 yard will weigh $\frac{1}{1600} \times 7000 = 4\frac{3}{8}$ grains.

The number of yards weighing $4\frac{3}{8}$ grains is the same as the number of runs. For instance

1	yard	of	1	Run	Single	Woolen	Yarn	Weighs	$4\frac{3}{8}$	grains.
$1\frac{1}{4}$	"	"	$1\frac{1}{4}$	"	"	"	"	"	$4\frac{3}{8}$	"
$1\frac{1}{2}$	"	"	$1\frac{1}{2}$	"	"	"	"	"	$4\frac{3}{8}$	"
2	"	"	2	"	"	"	"	"	$4\frac{3}{8}$	"
$5\frac{1}{2}$	"	"	$5\frac{1}{2}$	"	"	"	"	"	$4\frac{3}{8}$	"
6	"	"	6	"	"	"	"	"	$4\frac{3}{8}$	"

And thus with all numbers between and so on.

Another way to find the number, or run, of woolen yarn is to reel or measure off and weigh any number of yards of the yarn (the greater number of yards the more accurate the result); multiply the number of yards by $4\frac{3}{8}$ and divide the product by the



Revolving Cone Winder.

weight of the yarn in grains; the quotient will be the number of runs per pound. For example: 9 yards weigh 5 grains, the $9 \times 4\frac{3}{8} = 39.375 \div 5 = 7\frac{7}{8}$ run, the count or number of the yarn. Or again, suppose 90 yards weigh 45 grains; $90 \times 4\frac{3}{8} = 393.75 \div 45 = 8\frac{3}{4}$ the number of run of the yarn.

Woolen cut System. If 300 yards Single Woolen 1 cut yarn weigh 7000 grains (1 lb. avoirdupois) then 1 yard will weigh $\frac{1}{300} \times 7000 = 23\frac{1}{3}$ grains and 50 yards will weigh $50 \times 23\frac{1}{3}$ grains $= 1{,}166\frac{2}{3}$ grains. Therefore, if 50 yards 1 cut Single Woolen Yarn weigh $1{,}166\frac{2}{3}$ grains, then 50 yards 2 cut will weigh one-half of $1{,}166\frac{2}{3}$ grains $= 583\frac{1}{3}$ grains.

Hence the following table:—

Weight in Grains 50 Yards any "Cut" Single Woolen Yarn.

50	yards	1-"Cut"	weigh	$1{,}166\frac{2}{3}$	grains	50	yards	20-"Cut"	weigh	$58\frac{1}{3}$	grains
50	"	2	"	$583\frac{1}{3}$	"	50	"	21	"	$55\frac{35}{63}$	"
50	"	3	"	$388\frac{8}{9}$	"	50	"	22	"	$53\frac{1}{33}$	"
50	"	4	"	$291\frac{2}{3}$	"	50	"	23	"	$50\frac{50}{69}$	"
50	"	5	"	$233\frac{1}{3}$	"	50	"	24	"	$48\frac{11}{18}$	"
50	"	6	"	$194\frac{4}{9}$	"	50	"	25	"	$46\frac{2}{3}$	"
50	"	7	"	$166\frac{2}{3}$	"	50	"	26	"	$44\frac{34}{39}$	"
50	"	8	"	$145\frac{5}{6}$	"	50	"	27	"	$43\frac{17}{81}$	"
50	"	9	"	$129\frac{17}{27}$	"	50	"	28	"	$41\frac{2}{3}$	"
50	"	10	"	$116\frac{2}{3}$	"	50	"	29	"	$40\frac{20}{87}$	"
50	"	11	"	$106\frac{2}{33}$	"	50	"	30	"	$38\frac{8}{9}$	"
50	"	12	"	$97\frac{2}{9}$	"	50	"	31	"	$37\frac{58}{93}$	"
50	"	13	"	$89\frac{29}{39}$	"	50	"	32	"	$36\frac{11}{24}$	"
50	"	14	"	$83\frac{1}{3}$	"	50	"	33	"	$35\frac{35}{99}$	"
50	"	15	"	$77\frac{7}{9}$	"	50	"	34	"	$34\frac{16}{51}$	"
50	"	16	"	$72\frac{11}{12}$	"	50	"	35	"	$33\frac{1}{3}$	"
50	"	17	"	$68\frac{32}{51}$	"	50	"	36	"	$32\frac{11}{27}$	"
50	"	18	"	$64\frac{22}{27}$	"	50	"	37	"	$31\frac{59}{111}$	"
50	"	19	"	$61\frac{23}{57}$	"	50	"	38	"	$30\frac{40}{57}$	"

Reel off 50 yards and opposite its weight in grains in the table will be found the cut.

For finding the cut of small samples the rule is the same as for the Run yarn, except that the above table must be used for finding the cut.

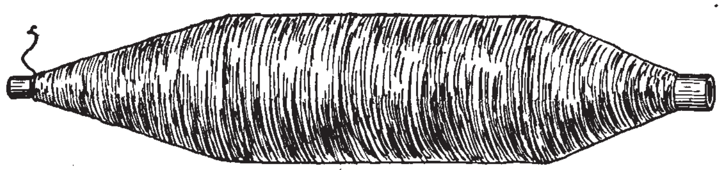
Example: Suppose 50 inches of single woolen yarn weigh 3.241 grains.

$$3.241 \div 50 = .06482 \times 1800 = 116.67$$

opposite that number in the table above, we find 10, which is the count or cut of the yarn.

The number of yards weighing 23⅓ grains is the same always as the number, or cut: thus —

1	yard	Single	Woolen	Yarn	1	Cut	weighs	23⅓ grains.
2	yards	"	"	"	2	"	"	23⅓ "
3	"	"	"	"	3	"	"	23⅔ "
10	"	"	"	"	10	"	"	23⅔ "
30	"	"	"	"	30	"	"	23⅔ "



French Spun Worsted; Cop Form.

The Yarn Reel used in connection with the yarn scales, is like the one shown in Fig. 12. This yarn reel is 54 inches or one and one-half yards in circumference. The dial is graduated into 120 parts, and indicates the number of yards reeled from each spindle. The yarn guides and spindles are so arranged that they are kept in line with each other while feeding yarn on to the reel. The extra length of the yarn guides is of use in increasing the friction on the yarn by making a half turn or more around them. In order to lay the yarn flat upon the reel, an automatic feed motion is provided, by means of which accurate and uniform measurement is secured. Following is a table for numbering cotton, linen, and worsted yarns.

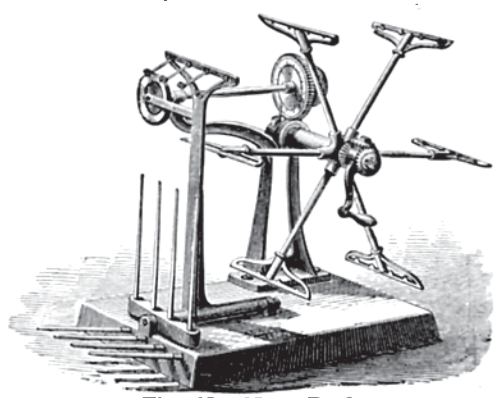
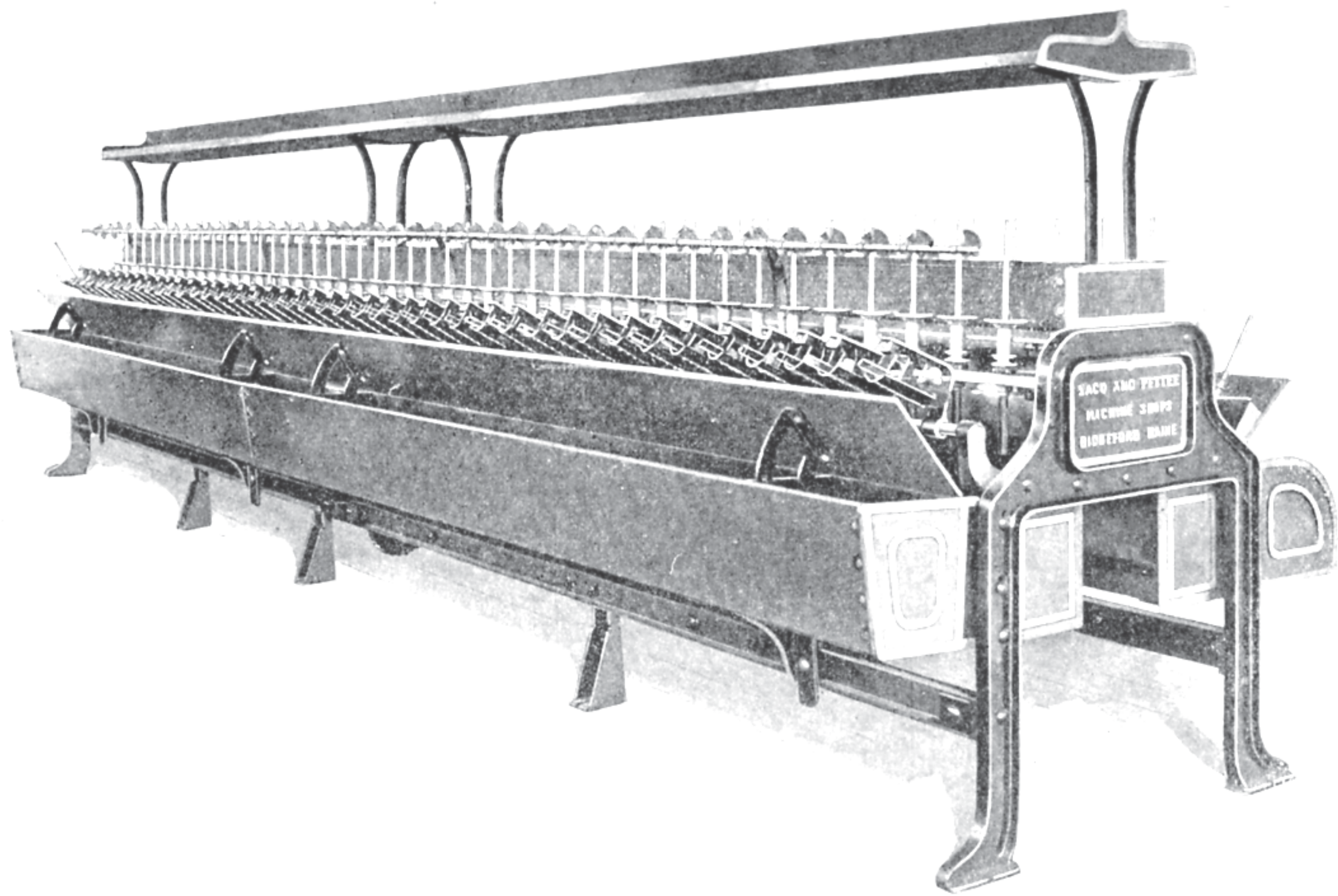


Fig. 12. Yarn Reel.



IMPROVED SPOOLER WITH CRADLE BOBBIN HOLDERS
Saco & Pettee Machine Shop

Table for Numbering Cotton, Linen and Worsted Yarns.

No.	Grains.	No.	Grains.	No.	Grains.	No.	Grains.	No.	Grains.
5	1400.	27	259.3	49	142.8	71	98.6	93	75.3
6	1166.6	28	250.	50	140.	72	97.2	94	74.5
7	1000.	29	241.5	51	137.3	73	95.9	95	73.7
8	875.	30	233.4	52	134.7	74	94.6	96	72.9
9	777.8	31	225.8	53	132.1	75	93.3	97	72.3
10	700.	32	218.8	54	129.7	76	92.1	98	71.4
11	636.4	33	212.2	55	127.3	77	90.9	99	70.7
12	583.3	34	206.	56	125.	78	89.7	100	70.
13	538.5	35	200.	57	122.8	79	88.6	105	66.7
14	500.	36	194.6	58	120.7	80	87.5	110	63.6
15	466.8	37	189.3	59	118.6	81	86.4	115	60.9
16	437.5	38	184.3	60	116.7	82	85.4	120	58.3
17	411.9	39	179.6	61	114.8	83	84.3	125	56.
18	389.	40	175.	62	112.9	84	83.3	130	53.8
19	368.5	41	170.8	63	111.1	85	82.4	135	51.8
20	350.	42	166.7	64	109.3	86	81.4	140	50.
21	333.3	43	162.8	65	107.7	87	80.4	145	48.3
22	318.3	44	159.2	66	106.1	88	79.5	150	46.7
23	304.6	45	155.6	67	104.4	89	78.6	155	45.2
24	292.8	46	152.2	68	102.9	90	77.8	160	43.8
25	280.	47	148.9	69	101.4	91	76.9	165	42.4
26	269.3	48	145.8	70	100.	92	79.1	170	41.2
								175	40.
								180	38.9
								185	37.8
								190	36.8
								195	35.9
								200	35.

To number cotton yarn: Reel 840 Yards, equal to one skein or hank, and opposite its weight of grains in the table, will be found its number.

To number linen yarn: Reel 300 yards, equal to one lea, and opposite its weight of grains in the table, will be found its number.

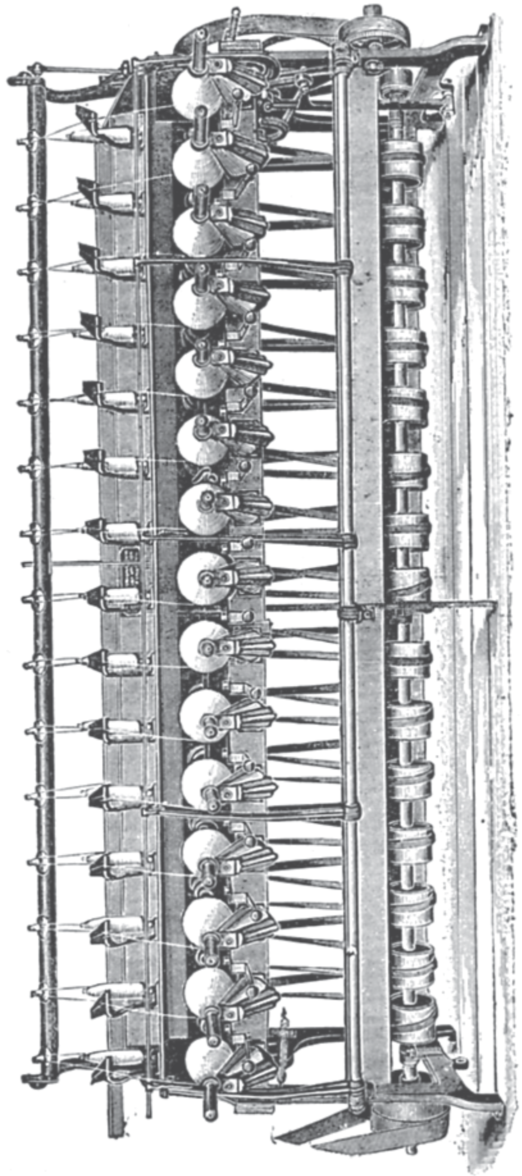
To number worsted yarn: Reel 560 yards, equal to one skein or hank, and opposite its weight of grains in the table, will be found its number.

Worsted Count System. 560 yards No. 1 Worsted Yarn weigh 7000 grains (1 lb.)

50 yards of No. 1 Worsted Yarn weigh 625 grains, from which the table on page 25 is calculated.

Reel off 50 yards, and opposite its weight of grains in the table will be found the count or No. of the yarn.

To find the count from a small sample of single worsted yarn: Divide the weight by the length in inches and multiply the quotient by 1800 (50 yards reduced to inches = 1800 inches). Find



Another Type of Cone Winder.

the number in the table on page 25 and opposite is the number designating the No. of the yarn.

Example : Suppose we have 52 inches of single worsted yarn weighing 6.02 grains: Then: 6.02 ÷ 52 = .1,157, this × 1800 = 208.33. Referring to the table we find that the size of this yarn is No. 3. Again ; — Suppose we have 152 inches weighing 1.056 grains, then 1.056 ÷ 152 = .006947 × 1800 = 12.505 ; therefore, by referring to the table we find that the count is No. 50.

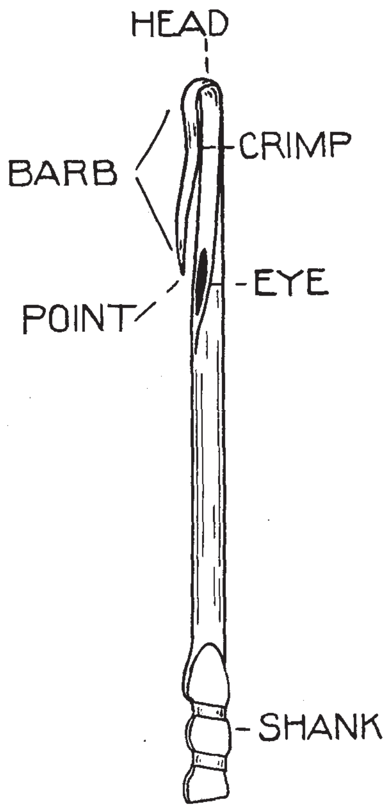
Weight in Grains 50 Yards. any No. Single Worsted Yarn.

No.	Grains.	No.	Grains.	No.	Grains.	No.	Grains.
1	625.	26	24.03	51	12.25	76	8.22
2	312.5	27	23.14	52	12.01	77	8.11
3	208.33	28	22.32	53	11.79	78	8.01
4	156.25	29	21.55	54	11.57	79	7.91
5	125.	30	20.83	55	11.36	80	7.81
6	104.16	31	20.16	56	11.16	81	7.71
7	89.28	32	19.53	57	10.96	82	7.62
8	78.12	33	18.93	58	10.77	83	7.53
9	69.44	34	17.38	59	10.59	84	7.44
10	62.50	35	17.85	60	10.41	85	7.35
11	56.81	36	17.36	61	10.24	86	7.26
12	52.08	37	16.89	62	10.08	87	7.18
13	48.07	38	16.44	63	9.92	88	7.10
14	44.64	39	16.03	64	9.76	89	7.02
15	41.66	40	15.62	65	9.61	90	6.94
16	39.06	41	15.24	66	9.46	91	6.86
17	36.76	42	14.88	67	9.32	92	6:79
18	34.72	43	14.53	68	9.19	93	6.72
19	32.89	44	14.20	69	9.05	94	6.64
20	31.25	45	13.88	70	8.92	95	6.57
21	29.76	46	13.58	71	8.80	96	6.51
22	28.40	47	13.29	72	8.68	97	6.44
23	27.17	48	13.02	73	8.56	98	6.37
24	26.04	49	12.75	74	8.44	99	6.31
25	25.	50	12.50	75	8.33	100	6.25

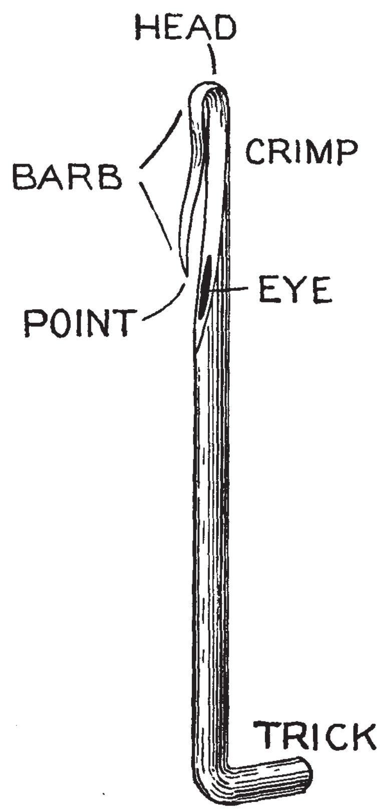
CYLINDER SPRING NEEDLE MACHINES.

There are different types of this style of machine, the principles being about the same but differing in construction. They may be classified as to method of holding the needles — the *Leaded Needle* and the *Trick Needle ;* as to the mode of driving the take-up — *Overhead Drive* and *Inside Drive ;* — and as to the kind of fabric made — *Flat*, *Backing* and *Rib.* The leaded needle machine is the oldest type and in most general use.

Fig. 13 shows the Tompkins two cylinder leaded spring needle machine. The most prominent feature brought out in this engraving, besides the general outlines, are the rolls of cloth showing the direction they take from the needles, the take-up for roll-ing up the cloth, the location of the winder bobbins and the feeds taking the yarn from the bobbins and feeding it to the needles. The needles are leaded in sections by placing in a mould specially made for the purpose which holds the needles securely in their proper position while the metal is run into it. The needles being in small sections or leads, two needles in a block, greatly facili-



Spring Needle (Unleaded) Actual Size.



Trick Needle.

tates the replacing of broken or worn needles as they are quickly and easily placed in position in the cylinder. It is a great mistake to neglect the needle moulds and leave them in the care of careless hands. If the moulds are abused and the needles made to go when they do not just fit, the cloth looks uneven and otherwise unsightly, the burs are difficult to set and smashes occur without any apparent reason.

The Needle Mould. Fig. 14, used in leading needles consists essentially of two side pieces, each having secured to its inner face a plate, and hinged by a bolt at one end. The side pieces form the sides of the mould and the adjacent edges of the plates form the

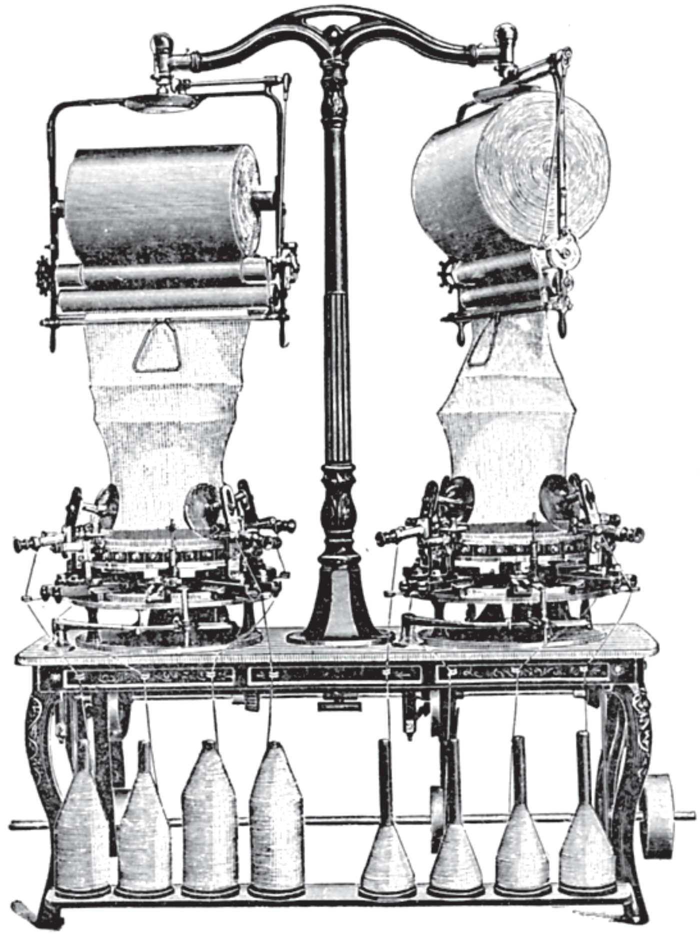


Fig. 13. Leaded Spring Needle Machine.

front and back faces of the mould. The sprue is drilled between the side pieces at the free ends, and the two needles, held heads outward by what is called a " trick " and grooves, project partially into the mould at the hinged end. A mixture of lead, antimony, and tin that fuses readily but is quite hard when solid is poured into the mould, which is then opened, the lead with the embedded needles is withdrawn, the sprue is cut off and the leaded needles are ready to be clamped in the cylinder. One advantage of leaded needles is that the needle being held in the mould by the head and middle portion stands true in the lead and consequently in the cylinder. An objection is the bother with the mould, lead and needle boy. Faulty moulds will produce altogether too much trouble and annoyance to be tolerated, and the knitter who neglects them will never excel in the art of knitting.

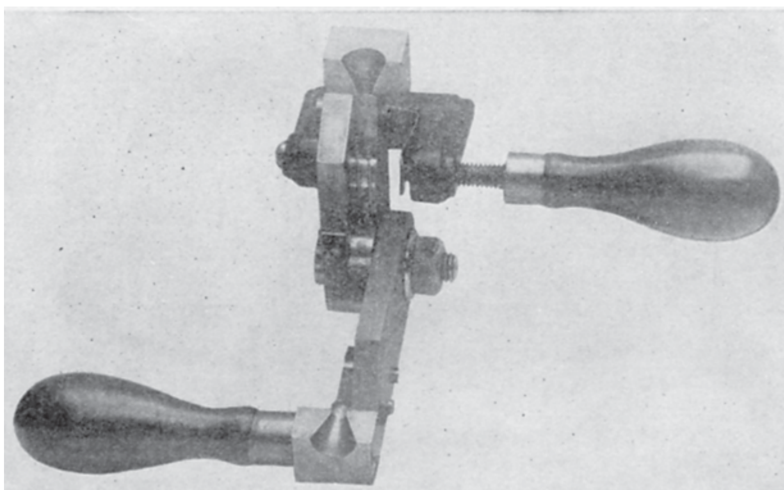
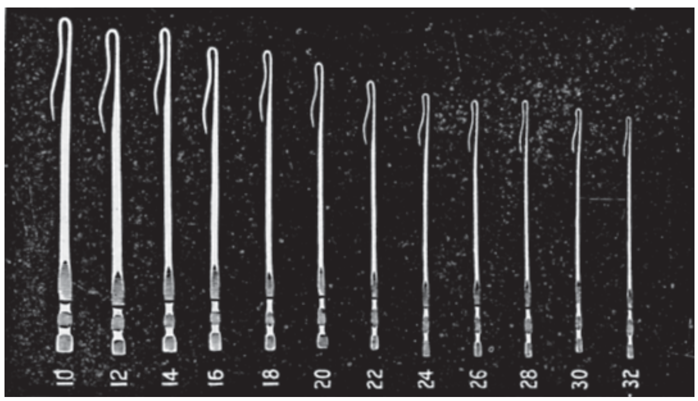


Fig. 14. Needle Mold.

Needles for backing work should be longer than for plain work, the object being to keep the sinker bur from picking up the backing. It also distributes the bending, caused by the backing bur, over a greater length of the needle and thereby prolongs the life of the needle.

The Gauge of a leaded needle cylinder can be changed by having a needle mould made for the gauge desired, or in a trick needle cylinder by having a new cylinder or trick-tops cut. The gauge determines the closeness of the wales of the cloth and the relative fineness of the fabric. The gauge is generally determined, in thé old way, by the number of leads contained in three inches of the circumference of the cylinder. As each lead contains two needles it is sometimes the custom or habit to call the gauge the number of needles in an inch and a half, and other times to call it half the number of needles in three inches; but it is not good practice, though equivalent thereto. In some localities the gauge is the number of needles to the inch, and yet again in other localities, the number of needles in two inches. The difference in measuring cylinders by different makers, and the difference in measuring leaded needle cylinders and trick needle



Spring Needles Unleaded.

cylinders, is mostly responsible for this lack of uniformity in designating the relative degree of fineness of the fabric. The knitter governs himself, in the gauge matter, according to the type of machine he encounters, and the locality he finds himself in.

If by the old way (viz: the number of leads in three inches), and twenty gauge is required, there should be forty needles in three inches measured on the circumference of the cylinder ($13\frac{1}{2}$ needles to the inch). Or if fourteen gauge is required, there should be twenty-eight needles in three inches on the circumference ($9\frac{1}{3}$ needles to the inch).

If it be a 14 inch cylinder, the circumference will measure 43.98 inches and if it be 20 gauge on the needle line, there would be 586 needles in the needle space around the cylinder. If it be a 22 inch cylinder, the circumference will measure 69.12 inches, and if it be a 22 gauge the needle space should contain 1014 needles.

The following table indicates sizes generally accepted: —

Gauge.	Needles to the Inch.	Stubbs Wire.	Size in Inches.
30	20	(24)	(.023 to)
		(23½)	(.0245)
		(23)	(.0255 to)
24	16	(22½)	(.0275)
22	14⅔	22	.029
20	13⅓	21	.0315
18	12	20	.0355
16	10⅔	19½	.039
14	9⅓	19	.0415

To reduce the old gauge to the number of needles to the inch; Multiply the gauge by $\frac{2}{3}$; because the gauge is the number of leads in three inches, and there are two needles in a lead.

To find the number of needles to the inch, the whole number of needles in the machine being given and the diameter: Multiply the diameter by 3.14 and divide the number of needles by the product. For example: Given a cylinder 22 inches in diameter containing 1014 needles, how many needles are there to the inch? $22 \times 3.14 = 69.08$. $1014 \div 69.08 = 14\frac{2}{3}$ needles to the inch, and $14\frac{2}{3}$ is $\frac{2}{3}$ of the gauge, or 22 gauge.

To find the number of needles required in the cylinder the number of needles to the inch as gauge being given, and the diameter of the cylinder: Multiply the diameter of the cylinder by 3.14 and multiply the product by the number of needles to the inch as gauge. For example: How many needles should there be in a cylinder 18 inches in diameter to knit 20 gauge cloth?

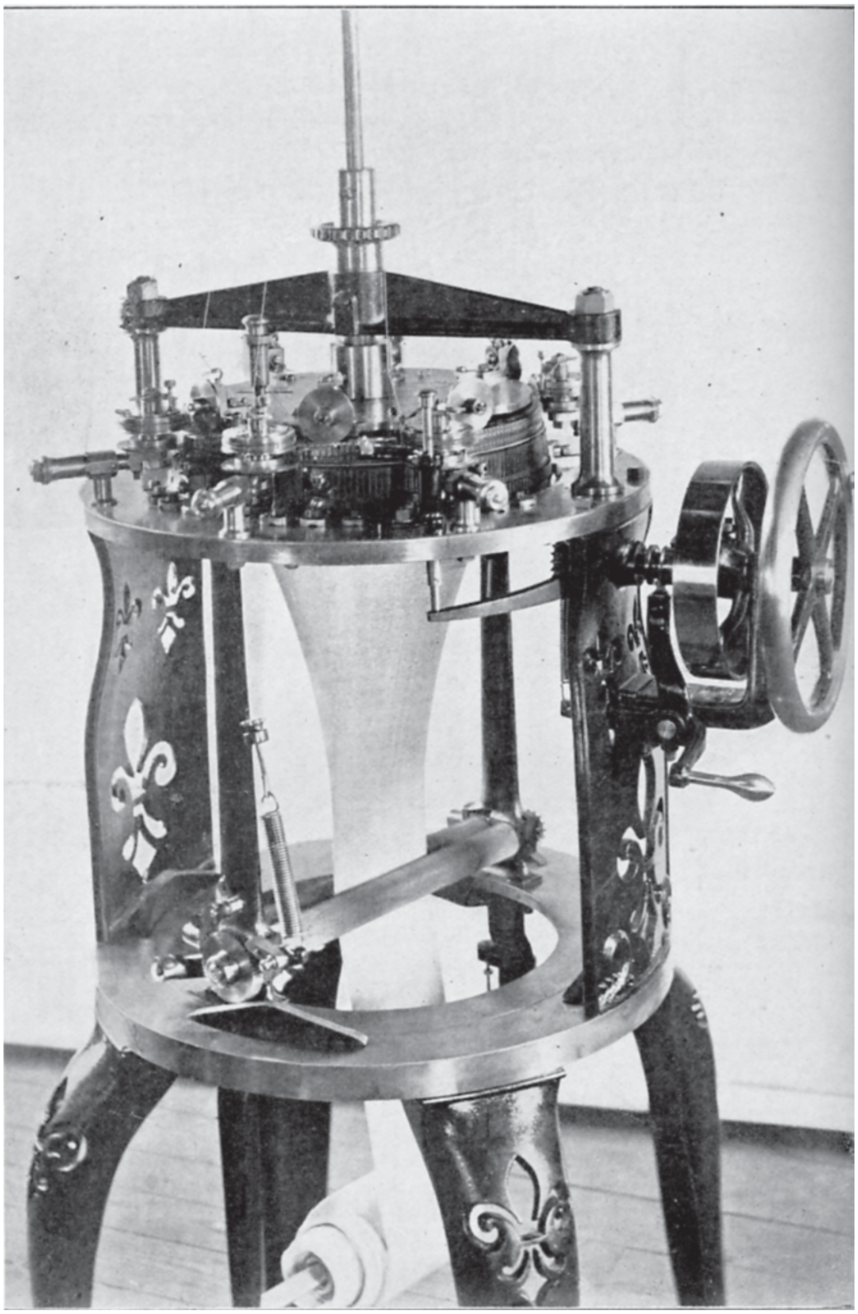
$18 \times 3.14 = 56.52 \times 13\frac{1}{3}$ ($\frac{2}{3}$ of the gauge 20 is $13\frac{1}{3}$ needles to the inch) $= 754$.

Following is a table giving circumferences of cylinders in inches from 6 to $35\frac{1}{2}$ inches in diameter:

Table of Circumferences of Cylinders in Inches and Feet.

Diameter of Cylinder. in Inches	Circumference of Cylinder in Inches.	Circumference of Cylinder in Feet.	Diameter of Cylinder in Inches.	Circumference of Cylinder in Inches.	Circumference of Cylinder in Feet.
6	18.85	1.57	24	75.40	6.28
6½	20.42	1.70	24½	76.97	6.41
7	21.99	1.83	25	78.54	6.55
7½	23 56	1.96	25½	80.11	6.68
8	25.13	2.09	26	81.68	6.81
8½	26 70	2.23	26½	83.25	6.94
9	28.27	2.36	27	84.82	7.07
9½	29.85	2.49	27½	86.39	7.20
10	31.42	2.62	28	87.97	7.33
10½	32 99	2.75	28½	89.54	7.46
11	34.56	2.88	29	91.11	7.59
11½	36.13	3.01	29½	92 68	7.72
12	37.70	3.14	30	94.25	7.85
12½	39.27	3.27	30½	95.82	7.99
13	40.84	3.40	31	97.39	8.12
13½	42.41	3.53	31½	98.96	8 25
14	43.98	3.67	32	100 53	8 38
14½	45.55	3.79	32½	102.10	8.51
15	47.12	3.93	33	103.67	8.64
15½	48.70	4.06	33½	105.24	8.77
16	50.27	4.19	34	106.21	8.90
16½	51.84	4.32	34½	108.39	9.03
17	53.41	4.45	35	109.96	9.16
17½	54.98	4.58	35½	111.53	9.29
18	56.55	4.71			
18½	58.12	4.84			
19	59.69	4.97			
19½	61.26	5.11			
20	62.83	5 24			
20½	64.40	5.37			
21	65.97	5.50			
21½	67.54	5.63			
22	69.12	5.76			
22½	70.69	5.89			
23	72.25	6.02			
23½	73.83	6.15			

The Method of Driving is with a belt attached to a pulley at the end of the table on the shaft, and at the bottom of the frame, that extends the length and projects at either end so that the receiving pulley may be driven from either end. On the shaft are two pulleys each driving a separate counter shaft — one for each cylinder — directly under the table. Each of these counters have a tight and loose pulley, for the cylinder is started and stopped with a shipper which is mounted on top of the table within easy reach of the operator, as is shown in detail in Fig. 15. On each counter is a bevel pinion that meshes with a bevel gear



SPRING NEEDLE RIB MACHINE EQUIPPED WITH STOP MOTION
Crane Mfg. Co.

driving the double pinion shown under the cylinder. The upper spur gear of the double pinion drives the cylinder and the lower half drives the center shaft — the vertical shaft shown in Fig. 16.

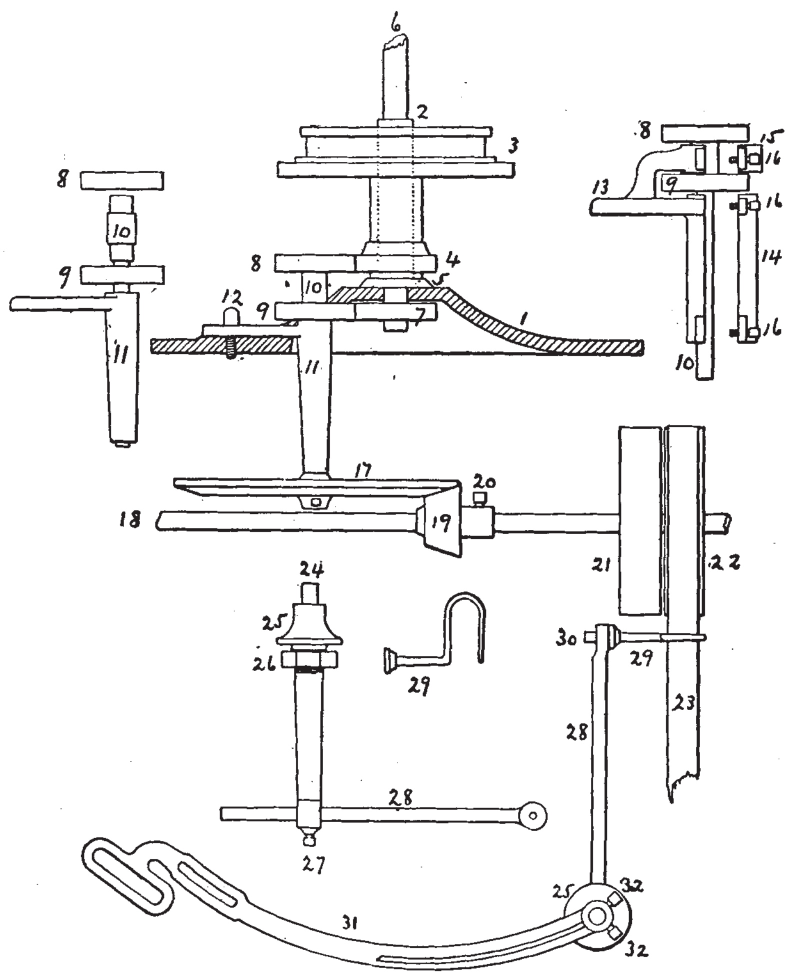


Fig. 15. Cylinder Drive.

The gear on the lower end of the vertical shaft is hidden by the bed plate, but is shown in detail in this illustration. This vertical shaft drives the take-up, revolves in the same direction as the cylinder and makes the same number of revolutions per minute.

The connections from the shipper to the cylinder and vertical shaft are shown in detail, and are thus explained: The shipper 31, is fastened to stud 24, which turns in sleeve 25, fastened to the guide 29, which throws the belt from tight to loose pulley or back at the will of the operator; the tight pulley drives the counter shaft 18, to which is fastened the bevel pinion 19, with set screw 20; bevel pinion 19, meshes with bevel gear 17, which drives shaft 10, at the upper end of which is fastened the double pinion 8 and 9, shaft 10, runs in sleeve or box 11, secured to the bed plate of the machine. Pinion 9, drives gear 7, which is fastened to vertical shaft 6, that drives the take-up; and pinion 8, drives gear 4, which drives the cylinder 3.

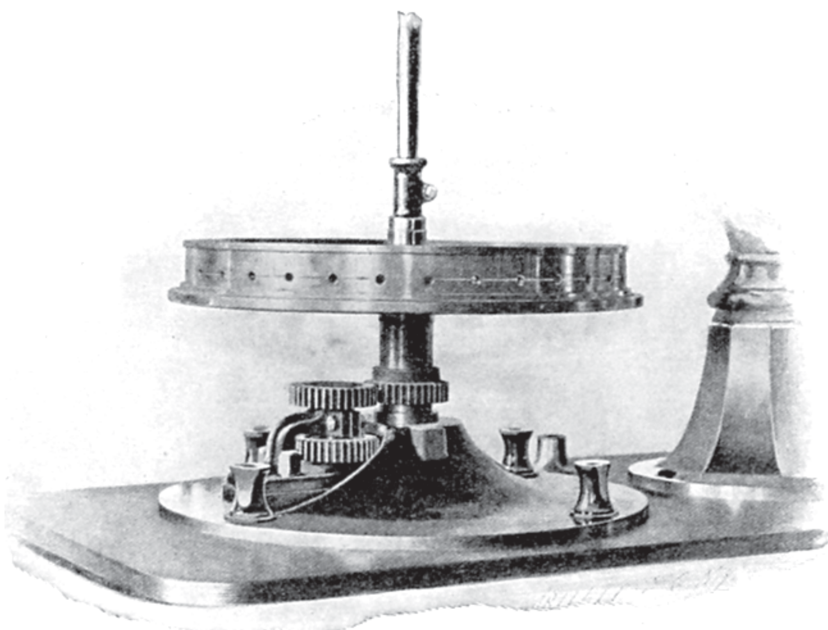


Fig. 16. Cylinder and Driving Gears.

The Cylinder. The cylinder is shown in detail in Figs. 16 and 17. The holes in the periphery of the cylinder are for the clamp screws to tighten the clamps that hold in place the leads containing the needles. The drawing on either side at the top of Fig. 15 show details of the double pinion and the bearing in which it runs.

The cylinder 1, is shown in two views—top and side; 2 is the spur gear which is fastened to the hub of the cylinder and drives it; 4 is the clamp for holding the leads; 6 the washer and 5 the clamp screw for tightening the clamps; 7 is an iron ring,

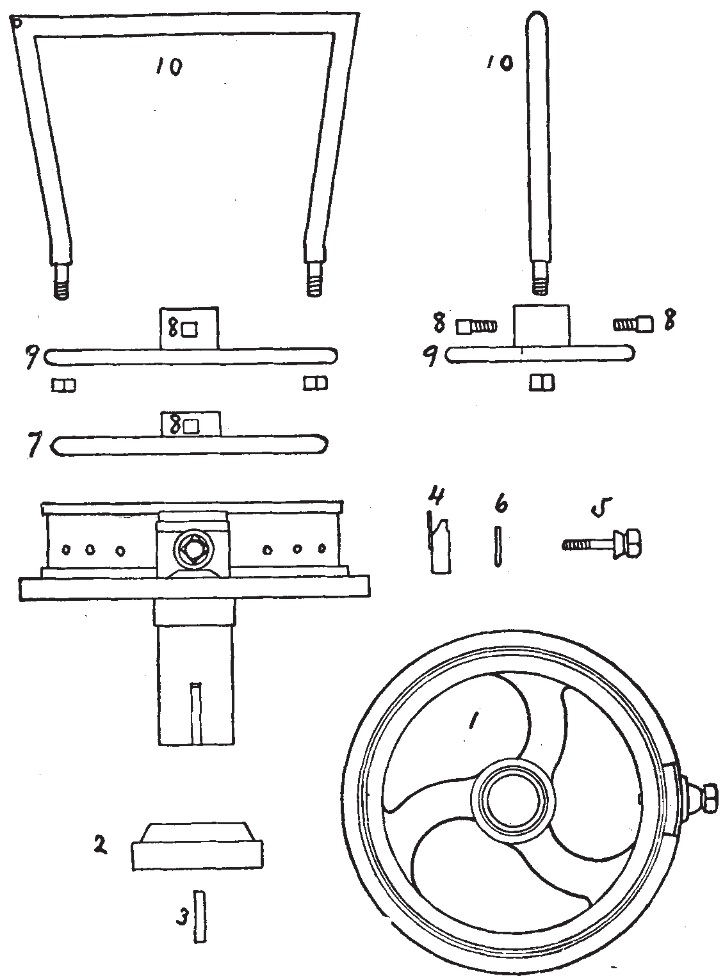
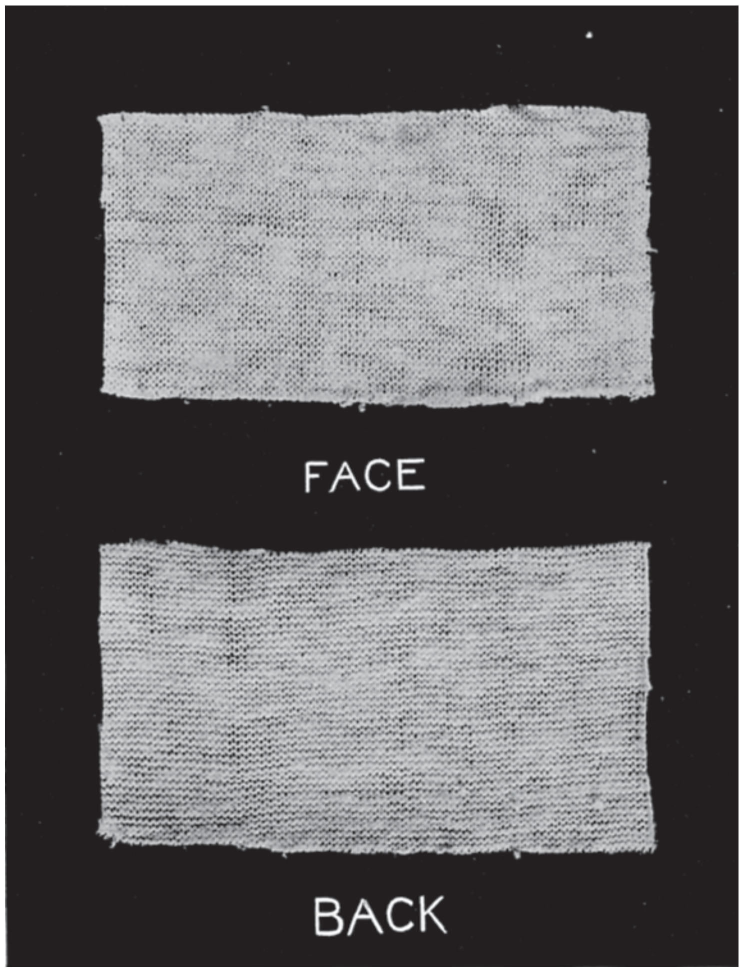


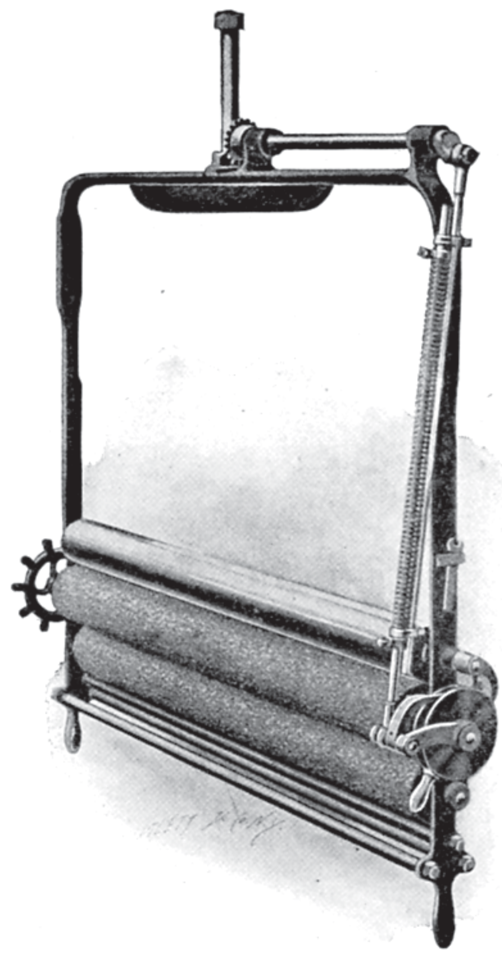
Fig. 17. Cylinder and Parts.

the bottom spreader, secured to the vertical shaft, and serves to keep the web in the cylindrical form in which it left the needles; 9 is an elliptical ring, the top spreader, also secured to the vertical shaft which serves to guide the web to the winding or take-up rolls and present it in better shape to be rolled up on the rolls. Bottom spreader 7, being the same shape as the cylinder equal-



Light Weight Cotton Fabric, 18 Gauge.

izes the tension of the cloth on the needles at all points round the cylinder, while the top spreader 9, shapes and guides the web to the take-up rollers so that it is rolled up with the circular rows of stitches or courses, in straight horizontal lines across the flattened fabric. To top spreader 9, is fastened the spreader bow 10, which is secured to the take-up and drives it. The drawing on the right and at the top of Fig. 17, is a side view of 9 and 10.



Elevation of Take-Up.

The Take-Up is an important adjunct to the knitting machine, whose function is to take away, or take-up, the web of cloth from the needles as fast as it is knitted, and maintain the proper degree of tension on the needles. To take it up too slowly would cause an accumulation of yarn in the needles; to take it up too fast would cause a severe strain on the needles. The effects of either would be broken needles, a smash, uneven cloth and possibly a pull off. The take-up which is shown in Fig. 18 consists of three rollers contained in a frame with connecting mechanism to turn them in the required manner. It is suspended to the cross-tree extending from the top of the central column of the machine (see Fig. 13) by the stationary stud 8, (Fig. 18,) and is driven by the spreader bow inside of the web and between the two rods at the

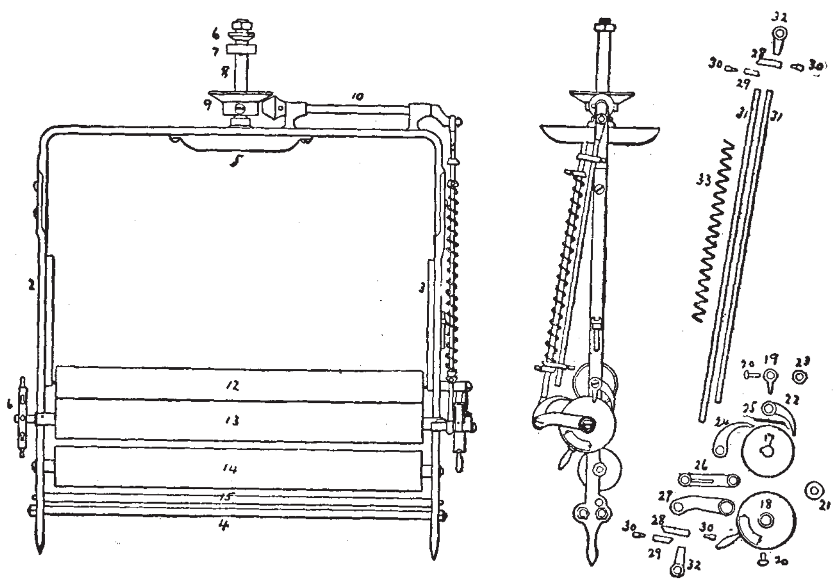
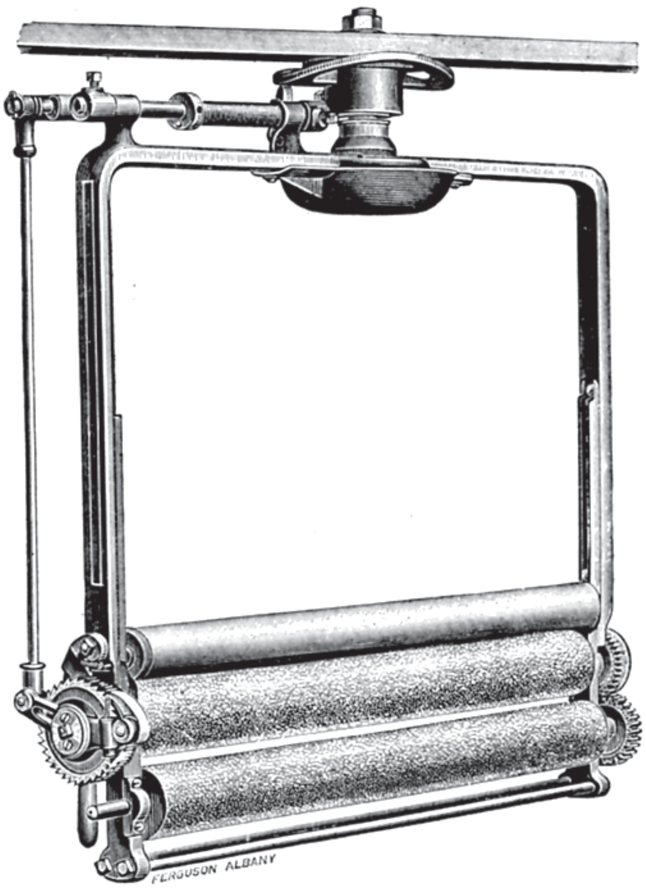


Fig. 18. Take-Up and Parts.

bottom of the frame. The spreader bow is supported and rotated by the vertical shaft. The weight of the take-up is supported by a hardened rounded steel collar (not shown in the cut) seated in a hardened steel cup, 5. This is sufficiently free to allow the take-up to move readily without leaving it too free to continue rotating after the stop motion has released the shipper. The bevel pinion 11, on top of the frame takes its motion from the standing gear 9, on the crosstree and by means of the crank 32, and spring connecting rod 33 and 31, reciprocates the dog 24, engaging the ratchet gear

17, on the end of the upper quartz covered roll 13. When the tension on the cloth is rightly adjusted the unnecessary take-up motion is absorbed by the spring and as the adjustment of this spring connecting rod device determines the degree of tension on



Take-Up, Outside Drive.

the cloth while being knitted, and is a most important factor in producing good cloth with a minimum of broken needles, detail drawing is given in this diagram.

The crank connection 32, is attached to the upper end of the connecting rod 31 ; on the other connecting rod 31, is a cylindrical spring 32. These two rods are held together at either end by connecting links 28, securely fastened to one of the rods, but allowing the other rod to move freely through the other holes in the links

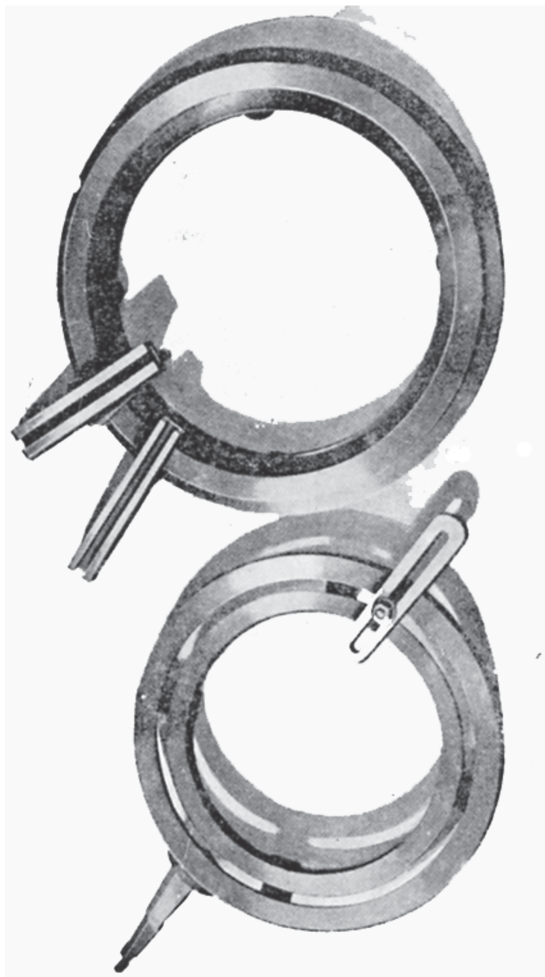


Fig. 19. Outside Circles.

when the crank actuated by bevel gear 11, on shaft 10, lifts the spring connecting rod mechanism. Spring 33, is so arranged between washer 29, fastened to the upper end of one of the rods 31, and link washer 28, fastened to the lower end of the other rod, that it makes a compensating connecting rod. The lower end of one of the rods 31, is connected by means of part 32, and link 26, and 27, to a mechanism arranged to contain and operate pawl 24, on a ratchet wheel 17, which being secured to quartz covered roll 13, draws up or takes up the web of cloth as fast as it is knit. It is then rolled up on the incumbent wooden roller 12, which turns by virtue of its own weight on roller 13. The draft roller 13, is held in position by the short pawl 22, engaging with the ratchet wheel 17, on the end of the roller.

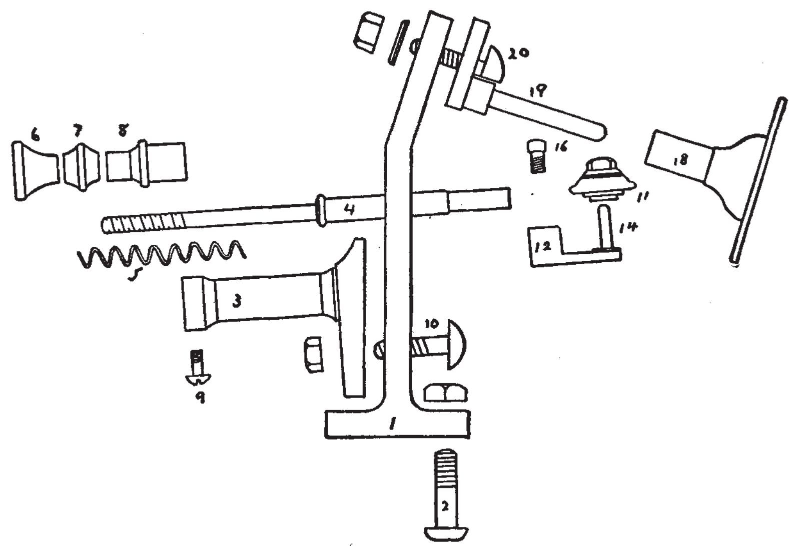


Fig. 20. Sinker Stand Parts.

When the tension on the cloth between the needles and the draft rollers will permit, the pawl 24, engages with ratchet wheel 17, causing the draft roll to move forward as far as is necessary to equalize the strain on the cloth. This tension is adjusted by means of spring 33. When the spring is at its full adjusted length the tension of the cloth is greater than the resisting force of the spring, but as more courses are knitted the tension of the cloth relaxes and the ratchet wheel yields to the pressure of the spring connecting rod turning the roll, taking up the slack cloth and maintaining the proper tension on the cloth between the needles and the rolls. In the meantime it will be remembered that the unnecessary take-up motion is absorbed by the spring. As the web is taken up it winds on the wooden roll 12, and when the roll is sufficiently large the cloth is cut and the roll removed by lifting out of the parallel ways on the inside of the frame. When it is desired to unwind the cloth, both dogs may be thrown out of gear by pushing up the handle attached to the gear cover.

Outside Circles. Fig. 19 shows two kinds of outside circles and links. The smaller of the two is called the slotted circle. The

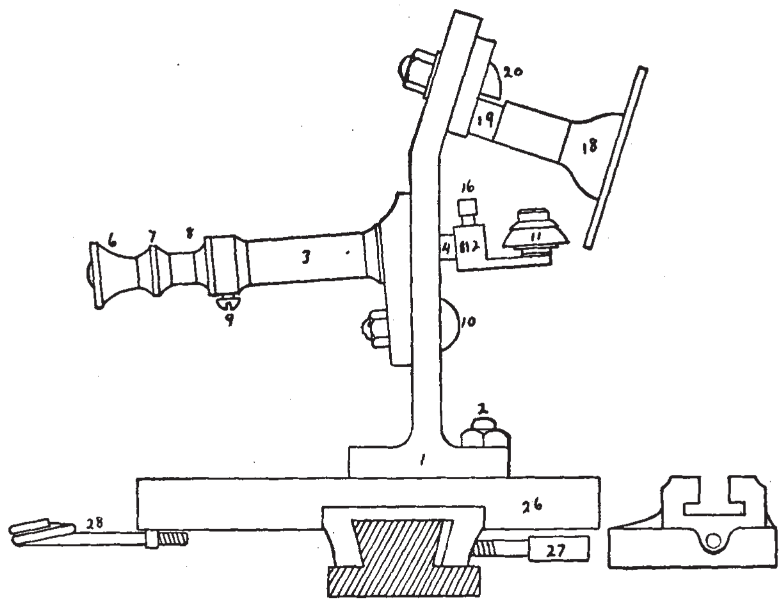


Fig. 20. Sinker Stand Assembled.

link on this circle is adjustable to almost any desired position. The larger one is called the dovetailed circle. A stand once set on this circle may be moved circumferentially without altering its adjustment. The links on this circle are always radial and cannot be moved in or out. The narrow link is generally used for plush work, the broader one for plain work. The circle is mounted on the projections rising from the bed plate, seen in Fig. 16, which brings it below the cylinder. The links bolted to this circle support the stands on which the outside burs and wheels run.

The Sinker Stand Fig 20, is a mechanical arrangement on the outside circle for supporting the sinker bur and the holding wheel. The sinker bur feeds the yarn up under the beards of the needles. The holding wheel is so arranged that it projects over and inside of the needles opposite the sinker bur and by means of the wide flange holds down the cloth to bring it in proper position and facilitate the action of the burs and needles so that new stitches may be formed.

The sinker stand 1, is secured to the links by the bolt 2. The tube 3, is secured to the stand 1, by means of bolt 10; tube 3, contains shaft 4, on which is spring 5. When the parts are assembled the spring 5, is confined between the shoulder on the shaft 4, and the collar 8, which is partially inserted in the tube 3, and secured thereto by set screw 9; the nut 6, is for locking nut 7, in its proper position. This arrangement is provided to give a yielding pressure to the shaft 4, which supports the bracket 12, with the stud 14, on which revolves the sinker bur 11. Bracket 12, is secured to the shaft 4, by screw 16. The shaft has a rotary adjustment, and is adjusted in and out by the nuts on the end of the shaft. When a bunch gets in under the bur, the shaft allows the bur to move back against the spring. After the bunch has passed the spring returns the bur to its position leaving the needles uninjured. At the top of the stand on the offset directly over the sinker bur, is supported the stud 19, which is secured to the stand with bolt 20, the holding down wheel 18, runs on stud 19.

The Presser Stand Fig. 21, supports the presser wheel, on the outside of the needles, which holds the beards of the needles down over the yarn while the lander bur (inside) raises the cloth and lands the stitches on the beards. The presser stand 1, is held in position on the link with bolt 2. The tube 3, is held in position on the stand with the screw 4. The shaft 5, is supported in tube 3, and the spring 6, is confined between the shoulder on the shaft and the end of tube, and is adjusted and set by means of lock nuts 7 and 8. At the inner end shaft 5, holds the presser wheel stud 13, with set screw 9. This stud is adjustable up and down and on it runs the presser wheel.

Inside Circles. Inside the cylinder and above it is the inside plate or ring, supported by four ribbed arms 1, Fig. 22, and secured to the cylinder stationary stud by set screw 2. On the ring are the gripes 3, which support the inside bur arms. The ring is dovetailed and each gripe is clamped to it by set screw 4, on the inner end.

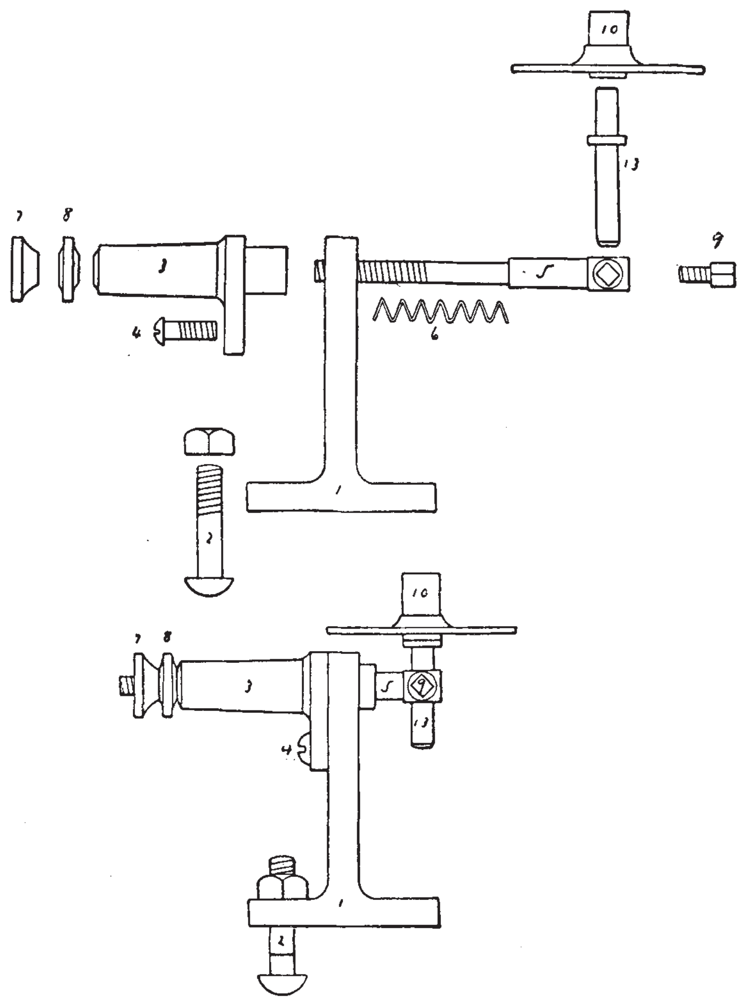


Fig. 21. Presser Stand Assembled and Parts.

When the screw is loosened the gripe may be moved circumferentially to any position without otherwise altering the position of the bur. The bur arm 11, may be rotated by loosening set screw

5 and allowing the holder 6, to be moved as desired. It can also be adjusted in and out with the use of set screw 10, and is capable of adjustment up and down by means of the right and left screw 9. On the end of bur arm 11, is the bur 12. When the web of cloth is on the machine the inside plate and inside burs are hidden from sight. The bottom stitches of the web are looped on the needles one loop to a needle.

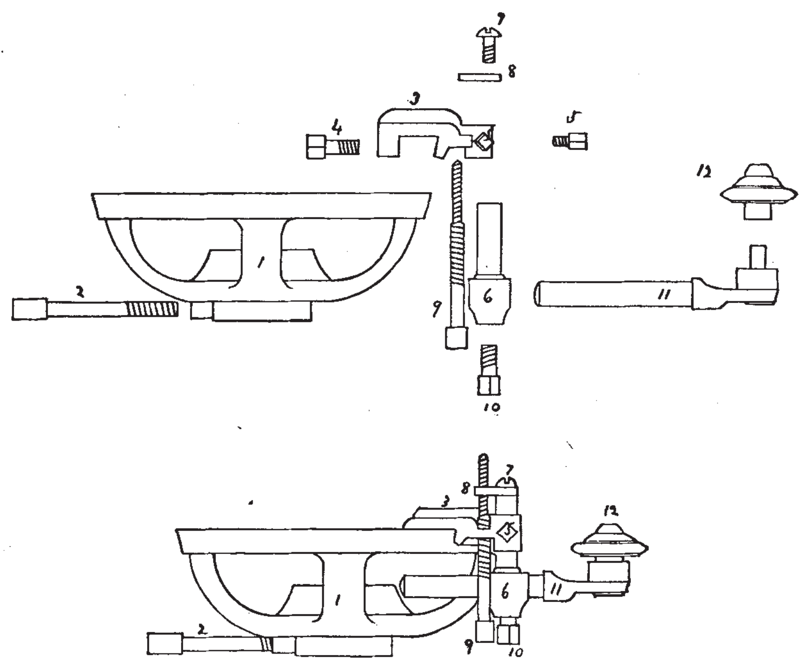
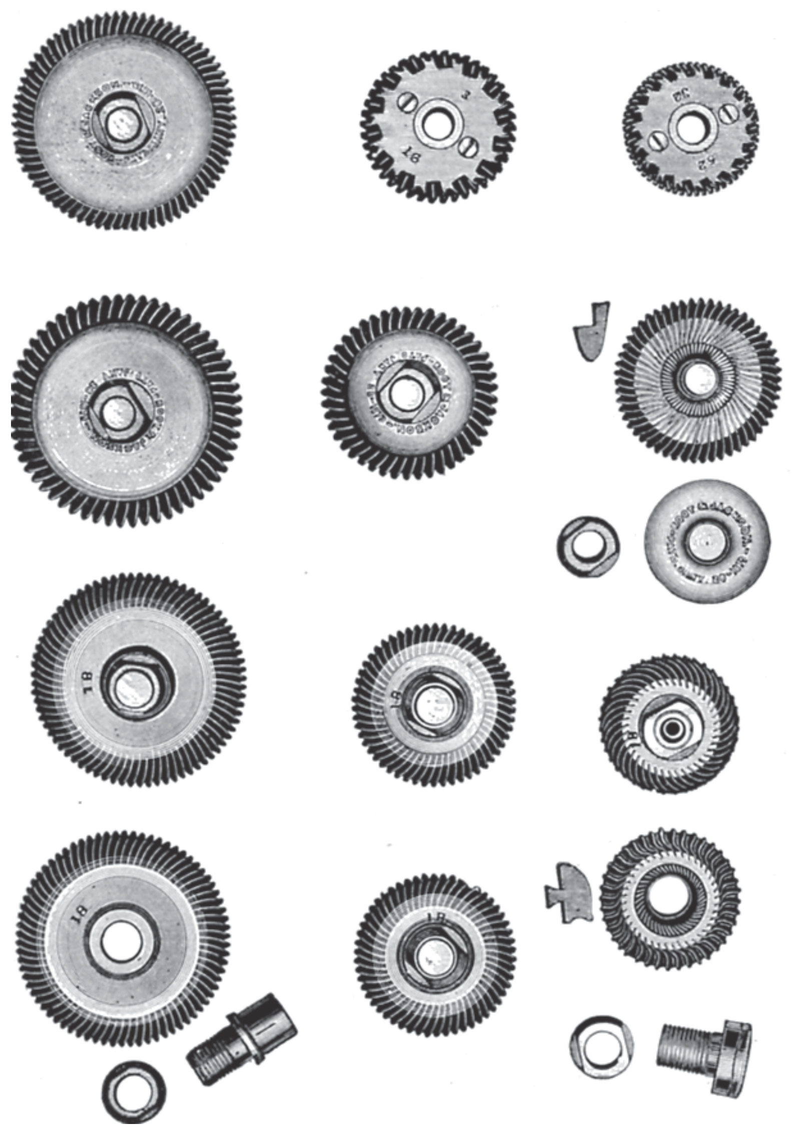


Fig. 22. Inside Circles Assembled and Parts.

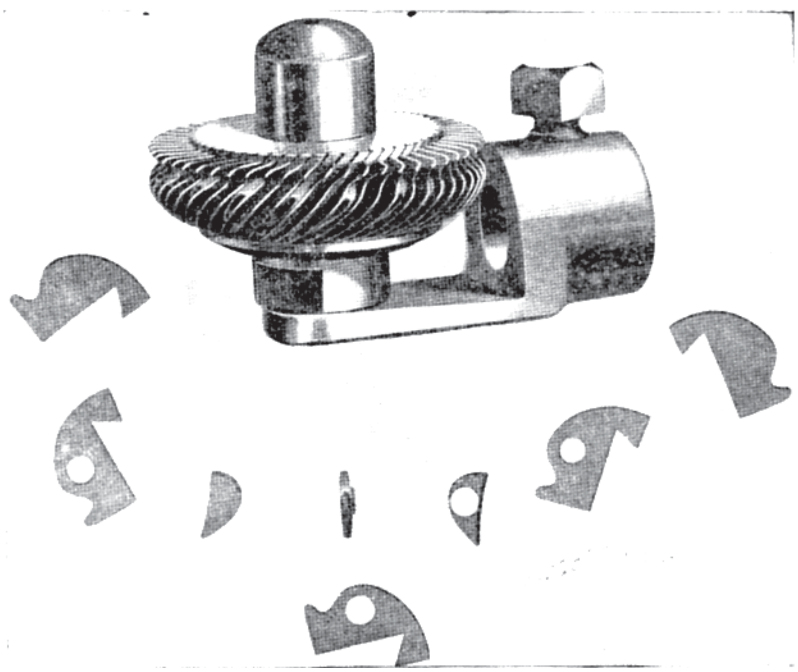
Burs. Burs are usually made with bronze bodies, though other metals and compositions are employed by different makers, or for that matter by the same makers. The blades are of steel; hardened and tempered in most instances, but often treated otherwise as the style of the bur seems to require, or the fancy of the maker or knitter dictates. The bushings are made of steel, are case-hardened and removable. The blades not only differ for the various functions they have to perform, but differ for the same



Burs and Parts.

employment according to the ideas of the designer, knitter or maker.

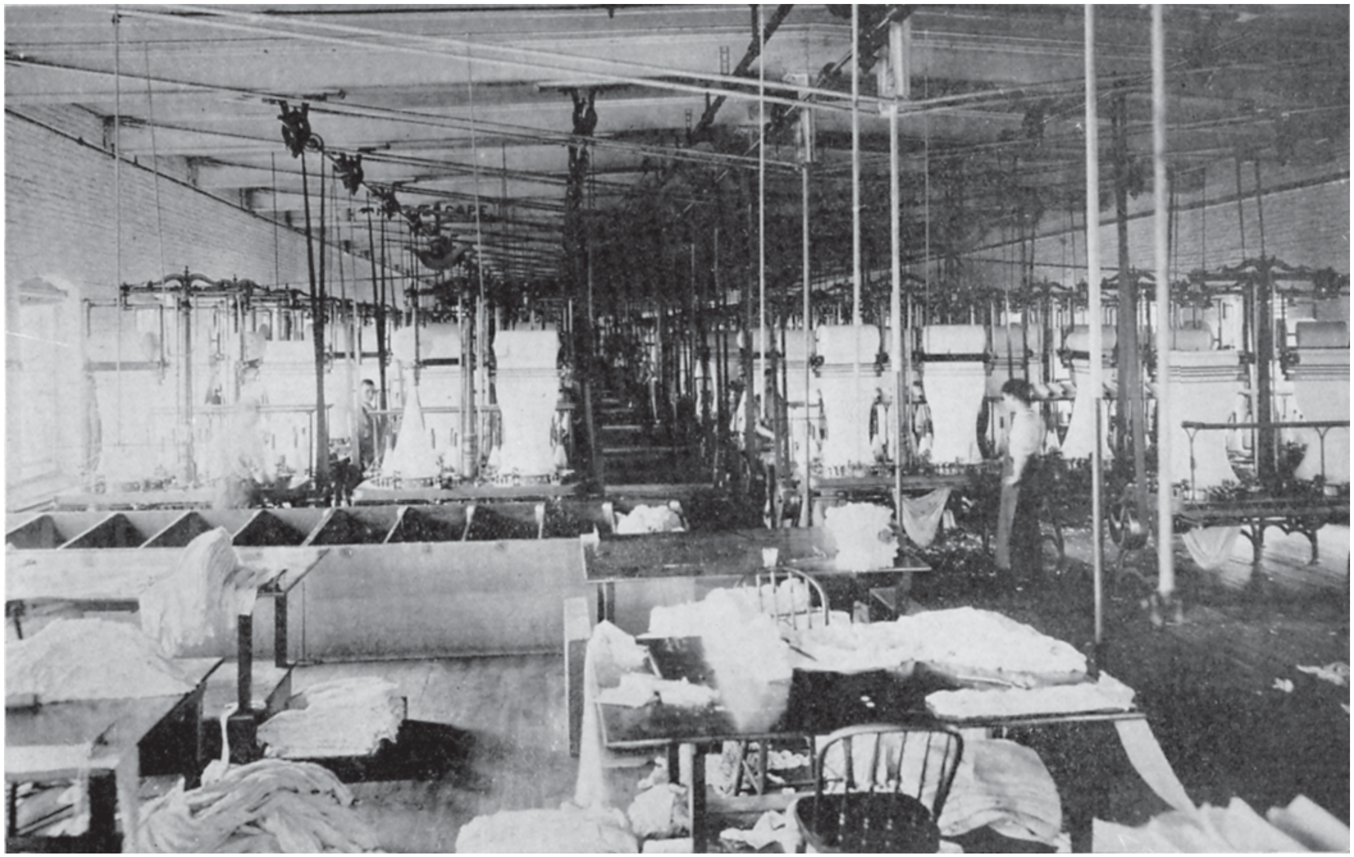
Inside Burs have either a self oiler, or the bur arms are provided with oilers that do not require replenishing for two or three days or more. This is very essential, for when the web is stretched from the needles to the take-up, the inside burs are only accessible in some machines after cutting the web, and difficult to get at in any machine. In some machines the cylinder is set high above the table to allow the knitter to reach up under inside to



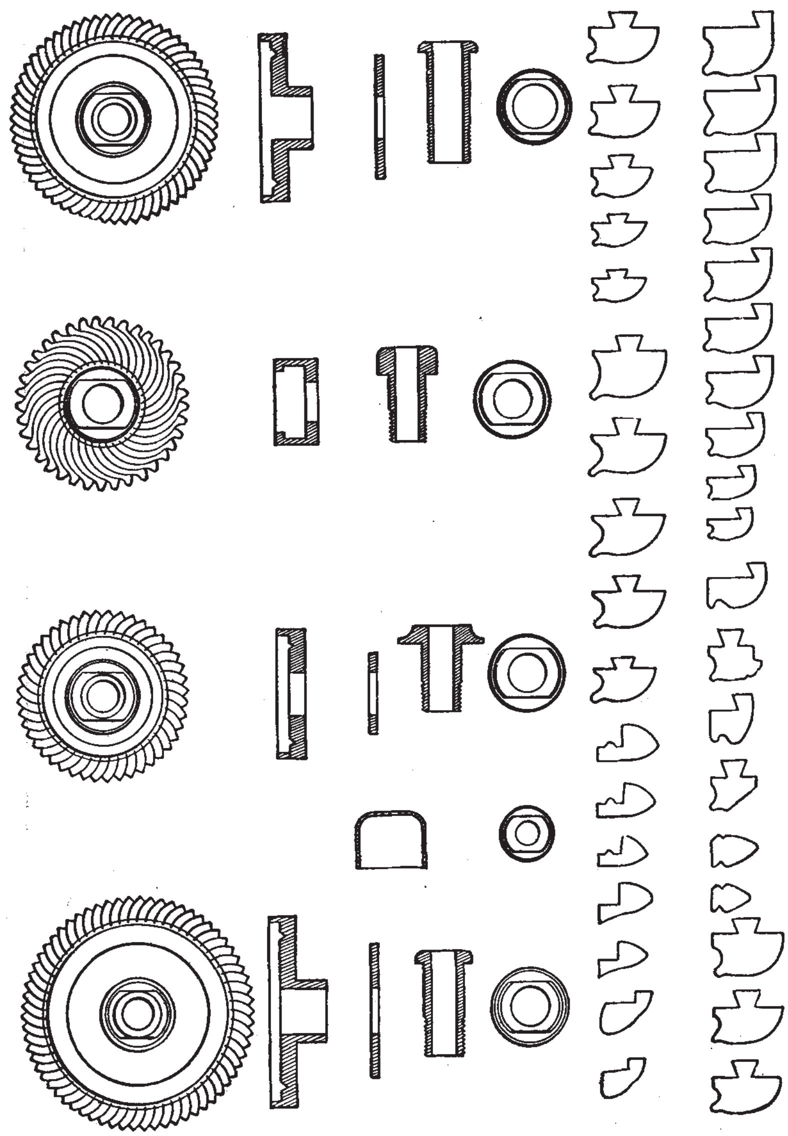
Backing Bur.

clean and adjust without cutting the web. In some machines the cylinder is close down to the table, but other advantages are gained by so doing.

The Feed Burs must correspond with the gauge of the needles, and in many cases permit of being changed to any desired gauge by removing the hub and putting in another of the gauge required. So, too in many cases can the blades be removed in case of wear



SECTION OF UNDERWEAR KNITTING ROOM
Lawrence Mfg. Company

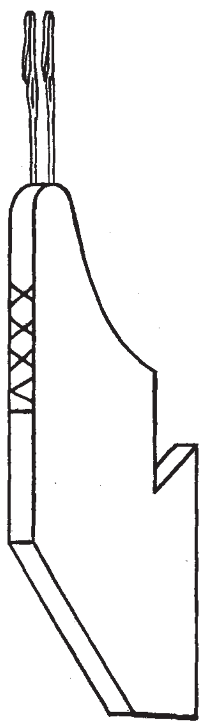


Burs and Bur Blades.

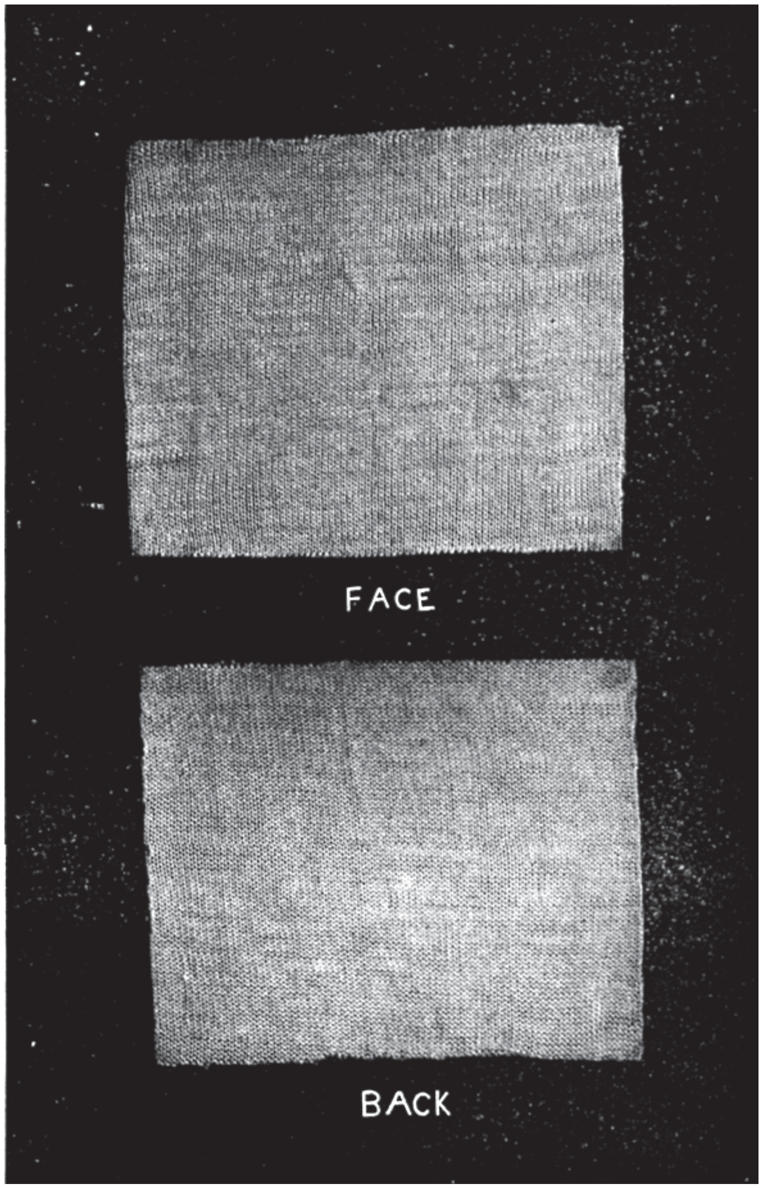
and replaced with new ones. In the landing and cast-off burs the wings can be replaced when necessary.

The burs push the yarn into and between the needles and in other ways manipulate it until it is cleared off the needles in a web. The blades strike the yarn quick and sharp blows and consequently are a considerable factor in determining the speed of running the machine.

The Backing Bur is for lacing among the needles a thread that appears mainly on the back of the web and is therefore called a backing yarn. This side of the cloth is napped to produce a pile or fleece fabric, or it may be left as it comes from the machine, as the fancy for a style suggests. Napping was done in former years on the knitting machine coincident with the knitting by severing the backing yarn and brushing out the loose ends to produce a pile or nap, but with the advent of the so called "fleece lined" underwear, napping machines were adapted to do that work, leaving the knitting machine to do its legitimate work. The usual way of lacing the yarn among the needles is to spring back alternate needles and lay the yarn in front of them and behind the others. This causes more severe strain on the needles than ordinary knitting. Another way of getting the yarn into the needles is to bend the yarn so that it may be placed alternately in front of and behind the needles. The style of bur to accomplish this object has a plate, to which in the press places, are hinged latches or sinkers which serve to hold back the yarn into the blade spaces in order to lay it in front of the needles. A stationary cam on the stand beneath the bur secures the opening of these latches to allow the yarn to enter the groove in the blades, and the contact of the needle pushes the latches and the yarn behind them into the spaces. On receding from the needles the latches open



One Lead, 36 Gauge, Actual Size.



36 Gauge Cloth (Spring Needle).

and release the yarn. This bur puts in a loose back and reduces the inward bend of the needles very considerably, though the friction slightly exceeds that of some other burs and slightly increases the side strain on the needles. A close study of the relations of the burs to the needles, and their action on the yarn will reveal

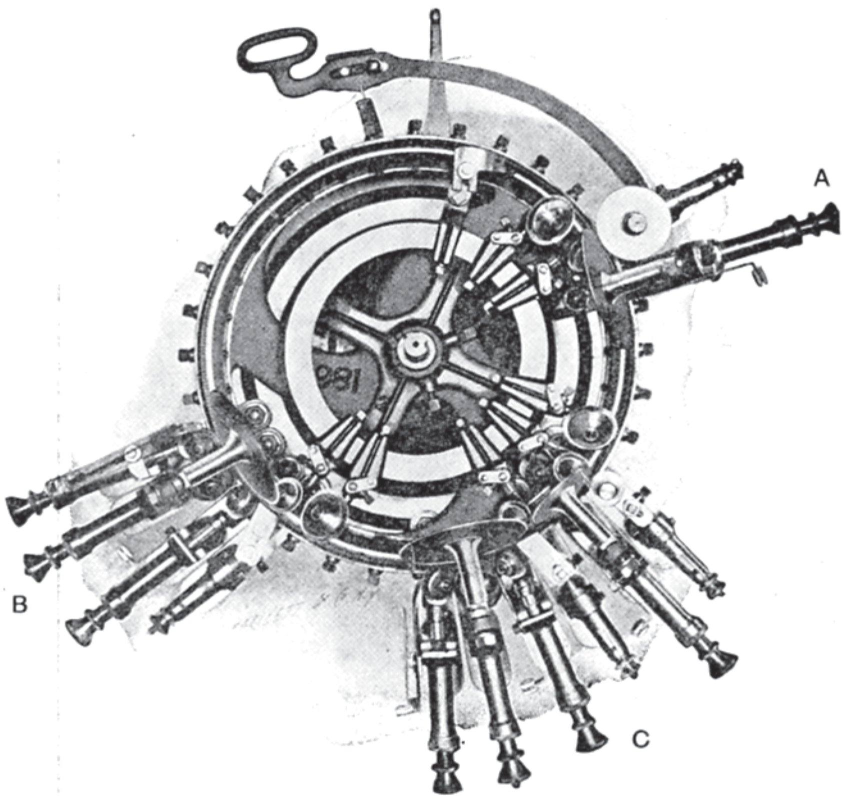


Fig. 23. Feeds.

much to the close observer and cannot fail to make the student a superior knitter.

Feeds. The large cylinder shown in the cut "Feeds" with the projecting collar screws is the needle cylinder. The direction in which this cylinder turns is counter-clockwise. Beside the cylinder and above it is the inside ring on which are the gripes. The center or vertical shaft is seen projecting up through the center.

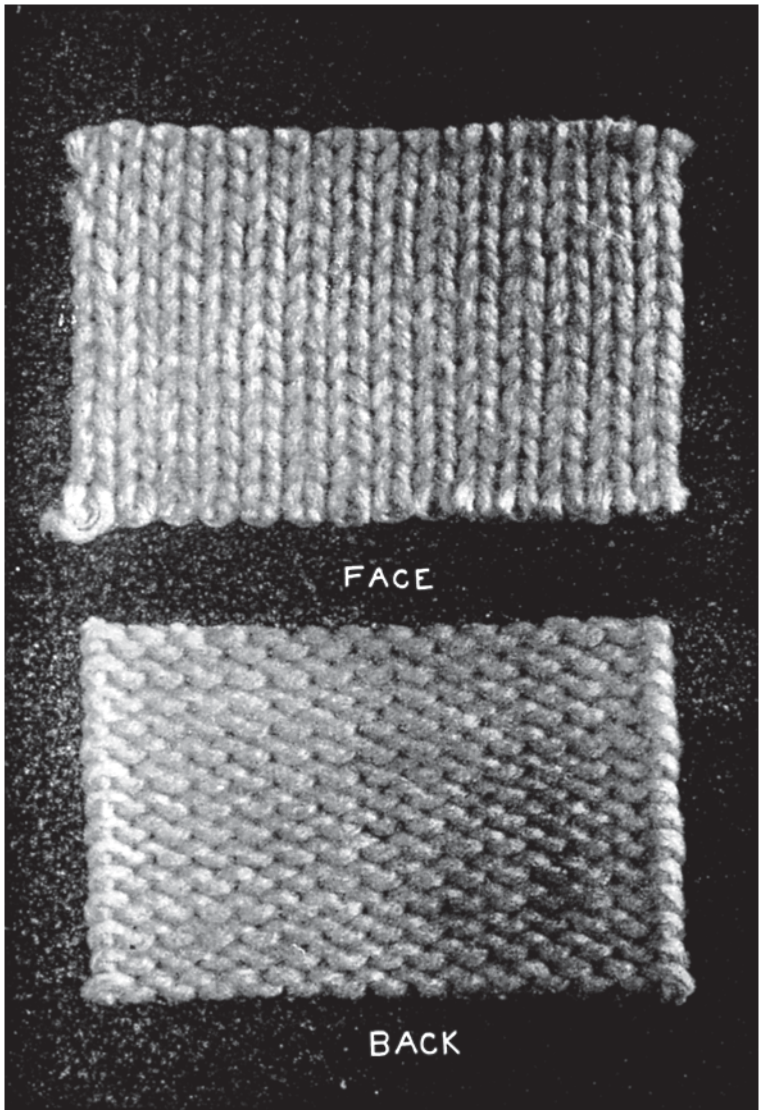
A Feed is a group of burs and wheels necessary to the formation of a complete stitch, whatever that stitch may be. Beginning at the right near the top of Fig. 23 and going counter-clockwise around the cylinder, the cut shows a plain feed A, a single plush feed B, and a double plush feed C. The plain feed makes the common knit stitch. Ordinary, or flat knitting is made with this feed. The plush feeds make what is called backing cloth; that is, a knit cloth with an extra thread looped into the back of the cloth. This thread when napped makes a fleece fabric. The face yarn is generally of cotton. The cloth is called single plush or double plush according as one or two face yarns are employed to make it. Almost anything that can be spun into yarn may be used for backing, such as goats hair, camels hair, etc. Plush cloth knit after such fashion is used for cloaks and overcoats, horse blankets, buffalo robes, etc., as well as underwear.

The Plain Feed, A, Fig. 23, a good illustration of which is shown on page 60, requires three burs, a holding-down wheel, and a presser wheel. The holding-down wheel is the largest of the group. Right under the hub of the holding-down wheel is the sinker bur; next comes the presser wheel on the outside of the needles and the lander bur on the inside of the needles; next the cast-off bur which raises the stitch off the needles. Sometimes when economy of space is desirable a single large inside bur is employed instead of two burs.

Knitting machines are usually furnished with four feeds to a cylinder, but more feeds may be employed except on small sized cylinders. The production of a machine is proportioned to the number of feeds.

Single Plush Feed. Single plush is plain knitting with a yarn looped in each course of plain stitches. As it is usually made it is looped in one stitch, then skips two stitches on the back, and is then looped in another stitch and so on, thus making this yarn appear on the back of the cloth almost entirely. The single plush feed is essentially the same as the plain feed, except that a backing bur and a clearing bur are employed in addition to the burs used in the plain feed. The backing bur cannot carry the yarn down far enough on the needles, so the clearing bur is employed to assist it, just as the cast-off bur assists the lander.

The feed, shown in Fig. 23 nearly opposite the plain feed, is



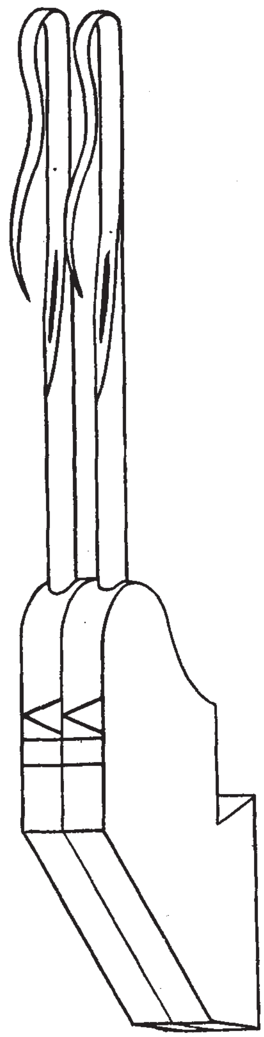
5-Gauge Sweater Cloth (Spring Needle) Composed of a Doubled 2 Ply French Spun Worsted.

a single plush feed B. Taking the burs and wheels in the order in which they properly come they are as follows:

1. Holding-down wheel.
2. Backing bur.
3. Clearing bur.
4. Sinker bur.
5. Presser.
6. Lander bur.
7. Cast-off bur.

As the holding-down wheel has to cover three burs instead of one — as in the plain feed — it should be larger than that required for a plain feed; on the other hand the large holding-down wheel will answer for a plain feed.

The backing bur and the clearing bur have to be held on to the stud by a nut, as shown in this cut, as the tendency of the work is to lift them off the stud. The backing yarn is fed into the bur by the guide shown. Sometimes the clearing bur is supported by a bracket secured to the backing stand. A flat presser is also shown, but either the large round presser shown in the plain feed or the small round presser shown in the double plush feed may be employed.



One Lead 7 Gauge
Actual Size.

A Double Plush Feed Fig. 23, C, may be made from a single plush feed by separating the single plush feed in the middle and inserting a sinker bur, presser and lander. It is then necessary to use another holding-down wheel on the original sinker stand; the added sinker puts in what is called the binding thread, and the presser and lander are to place it on the beards of the needles. As before stated the production of a machine is proportional to the number of feeds thereon, but it is not good practice to crowd in as many feeds as the space around the cylinder will permit. In such cases the only space at which needles may be removed and replaced is at the stop motion, and a smash located at any other

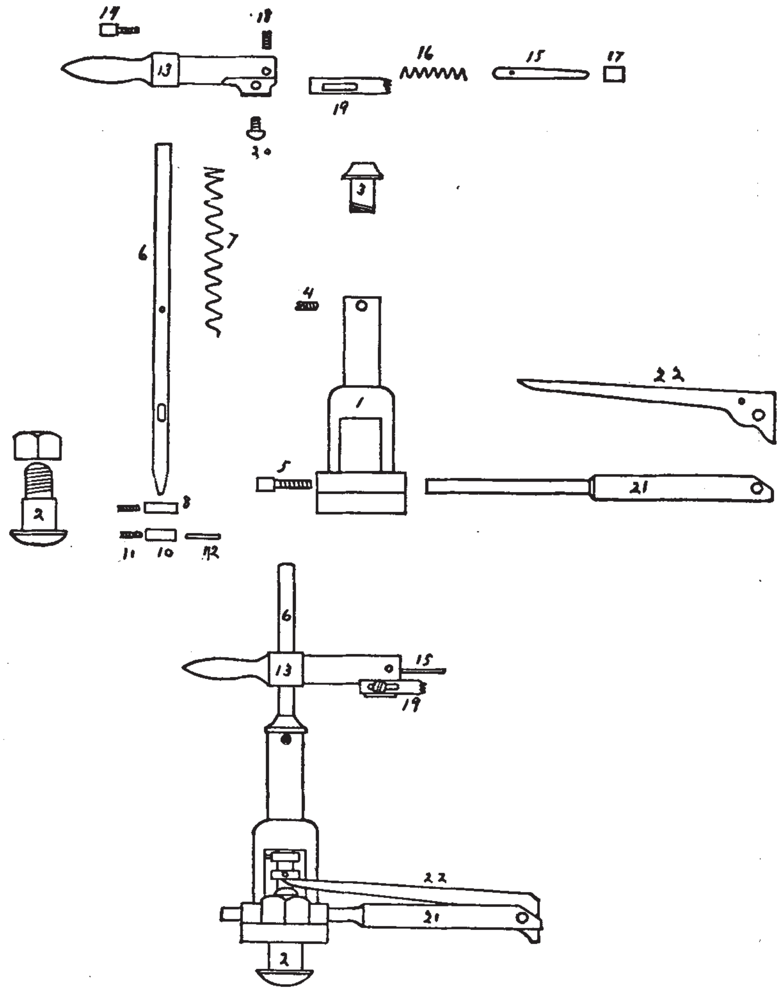


Fig. 24. Stop Motion Assembled and Parts.

place must be moved around to that point, thereby making a bad matter worse. Another objection against crowding in too many feeds to a cylinder is that more breaks, bunches, smashes, holes, etc., appear in proportion to the increased number of feeds, causing an increased number of stops. Every stop lessens production. A certain number of stops will soon offset the increased production of one of the feeds, therefore, it is a matter of judgment of how many feeds may be profitably employed — stops, quality of yarn and fabric being considered.

The Stop Motion is an arrangement for automatically stopping the cylinder when a hole in the web appears or an accumulation of yarn occurs in the needles, and aids very materially in preventing a lot of bad cloth and a good many needle smashes. On a two-cylinder frame each cylinder is driven with a separate belt, to each of which is applied a shipper for convenience in starting and stopping each cylinder and its take-up, separately. When these holes in the cloth or bunches of yarn in the needles appear, the stop motion is so arranged that the shipper is made to act on the belt, shifting it from the tight to the loose pulley and quickly stopping the cylinder. The stop motion is supported on a link secured to the outside circle in a like manner as the stands. Fig. 24 shows detail sketches of parts, and an assembled cut of the Holt stop motion. Number 1 is the stand secured to the link screw bolt 2. In this stand is inserted the bearing 3, which also provides a shoulder; between it and a pin through the round hole shown in the spindle 6, is confined a spiral spring. The handle-bar 13, after being adjusted to its proper position, is secured to the spindle 6, with its set screw 14. At the end of the handle-bar is inserted the finger or feeler 15, made very sensitive by action of spring 16, inside of the handle-bar directly behind the feeler or telltale. Just beneath the feeler and attached to the handle-bar by screw 20, is the part 19. When the sensitive finger 15, finds a hole in the web, or the feeler 19, encounters a bunch of yarn or fly in the needles, spindle 6, is rotated enough to disengage the lever 22, which is supported at the end of the adjustable shaft 21. The action of the lever 22, releases the shipper which by action of a spring is forced back, and by its connections shifts the belt, thereby stopping the cylinder. When the trouble is remedied the telltales 15 and 19, are thrown into position again with the handle on 13. the lever 22 adjusted and the cylinder is again ready to start.

Speed. Such a variety of circumstances are attendant in the process of knitting a fabric that no hard and fast rule for speed can be devised. Though exceedingly short, some interval of time is required for the easy and perfect formation of the stitch on the needle. Wool, mixtures and other soft yarns cannot be knitted with the needles running at the highest rate of speed, because they are likely to break before the stitch is formed. On the other hand the hard twisted yarns for balbriggans may be knit at the highest speed because they are strong, and capable of sustaining the strain and the quick, sharp blows of the blades of the burs pushing, and at high speed fairly striking, the yarn between the needles in sharp bends. Before the yarn reaches the needles it lies straight across the bur spaces from one blade to another. The needle entering the space presses the yarn back between the blades drawing it over the entering blade until the full depth of the stitch is obtained, while all the time, the yarn meets with the resistance caused by the blades meshing into the needles behind it. This is what is termed *stress* on the yarn. The face yarns employed in making plush are generally very strong, and on them comes the principal stress; but so many burs and wheels are employed on this sort of work that a smash at high speed would prove altogether too serious to take the chances of the fast running that the strength of such yarn would permit.

Common practice is to run a 20-inch cylinder between 40 and 65 turns a minute. This corresponds to a needle speed of from 210 to 340 feet per minute. The following table of speed represents some customary speeds:

		Gauge.	Revolutions.
Twenty inch cylinder	Wool, Mixtures	18	45
	Plush	24	60
	Balbriggan	24	66

Greater speed than this can, however, be attained when all or most of the conditions are favorable thereto. The machines are geared so that the needle speed is approximately constant for all sizes of cylinders; that is, if the machine is belted properly for a 20-inch cylinder it will be right for all other sizes of cylinders. It is also geared so that for one turn of the receiving shaft a 20-

inch cylinder makes .254 turns. In other words, the machine is geared about 4 to 1. Four turns of the receiving shaft to about one turn of the needle cylinder. The receiving shaft should run about 240 turns, which will make the cylinder run about 60 turns. A table of the gearing of the Tompkins leaded needle machine is appended.

Diameter of Cylinder in Inches.	Diameter of Change Pulley in Inches.	Turns of Cylinder to one turn of Receiving Shaft.	Diameter of Cylinder in Inches.	Diameter of Change Pulley in Inches.	Turns of Cylinder to one of Receiving Shaft.
9	13/	.428	17	9/	.302
10	13	.414	18	9	.286
11	12/	.398	19	8/	.270
12	12	.382	20	8	.254
13	11/	.366	21	7/	.239
14	11	.350	22	7	.223
15	10/	.334	23	6/	.207
16	10	.323	24	6	.191

TABLES OF SIZES FOR FLAT GOODS.

	Size.	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46
Men's Flat Shirts	Chest	...	...	...	...	...	...	...	...	...	34	36	38	40	42	43	46
	Length	...	...	...	...	...	...	...	...	...	29	30	31	32	33	24	35
	Sleeve	...	...	...	...	...	...	...	...	...	17	18	19	20	21	22	22
Men's Flat Drawers	Waist	...	...	...	...	...	...	28	30	32	34	36	38	40	42	44	..
	Inseam	...	...	...	...	...	...	27	28	29	29	29	30	30	30	31	..
	Body	...	...	...	...	...	...	13	14	15	15	15	16	16	16	17	..
Ladies' Flat Vests	Bust	...	...	...	...	...	...	...	30	32	34	36	38	40	..	..	..
	Length	...	...	...	...	...	...	...	30	31	32	33	34	35	..	..	..
	Sleeve	...	...	...	...	...	...	...	15	16	17	17	18	19	..	..	..
Boys' and Misses' Flat Vests	Width	16	18	20	22	24	26	28	30	32½	34	..	..	..	..	..	..
	Length	13	14½	16	18	20	22	24	26	27½	29	..	..	..	..	..	..
	Sleeve	7	8	9	10½	12	13	13½	14½	15½	17	..	..	..	..	..	..
Boys' Flat Drawers	Waist	...	...	...	..	24	26	28	30	32	..	..	..	..	..	..	..
	Inseam	...	...	...	...	18	21	24	25½	28	..	..	..	..	..	..	..
	Rise	...	...	...	...	10	11½	11½	12	14	..	..	..	..	..	..	..
	Back	...	...	...	..	11½	12½	13	14	15½	..	..	..	..	..	..	..
Boys' and Misses' Flat Pantalets	Waist	16	18	20	22	24	26	23	...	...	..	..	..	..	..	..	..
	Body Length	8½	9	10	11	12	13	13	...	...	..	..	..	..	..	..	..
	Inseam	9	10½	12½	14	16	17	18	...	...	..	..	..	..	..	..	..

TABLES FOR SELECTING CHILDREN'S UNDERWEAR, ACCORDING TO AGE.

SHIRTS.

Age.		Size.
6 months to 1 year	requires	16
1 year to 1½ years	"	18
1½ years to 2 years	"	20
2 " 4 "	"	22
4 " 6 "	"	24
6 " 8 "	"	26
8 " 10 "	"	28
10 " 12 "	"	30
12 " 13 "	"	32
31 " 14 "	"	34

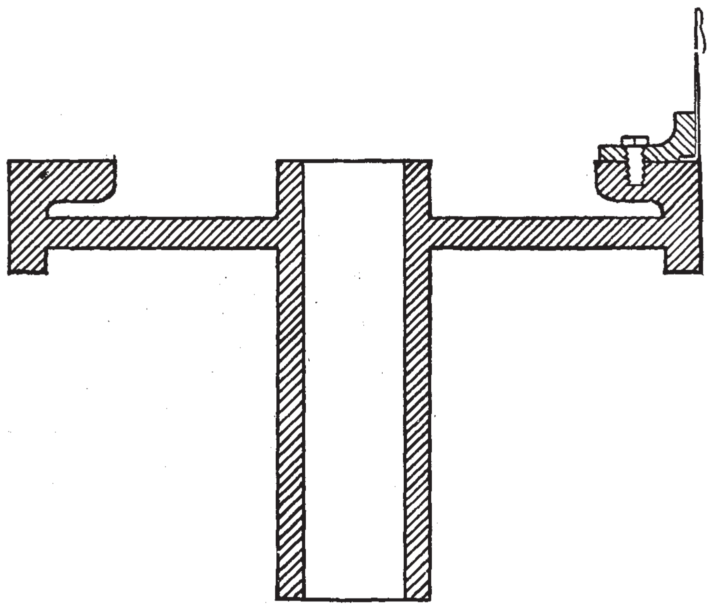
The cylinders are selected according to the sizes of the garments to be made. The following table is for spring woolen underwear weighing about six pounds to the dozen garments:

Size of Garment.	Size of Cylinder.	
	For Shirts.	For Drawers.
30		16
32		16
34	16	16
36	17	17
38	18	17
40	18	18
42	19	18
44	19	18
46	20	19
48	20	19

STARTING UP AND ADJUSTING.

Setting Trick Needles. Remove the needle plates. See that the tricks, both vertical and horizontal, are free from corrosion or dirt which would keep the needles from going into place; or from oil, which would work up onto the needle and streak the cloth. Place the needles in position, replacing the needle plates as each plate space is filled. Take care to place the plates so that the needle nearest each end of the plate is securely held. When all the needles are in position adjust a stiff wire pointer from the inside plate or heart to the needle line and plyer the needles so that they stand horizontally, and so that all just touch the end of the pointer when the cylinder is revolved.

Setting Leaded Needles. Remove the needle plates and see that the verge (the part where the leads bear) is free from corrosion, gum and oil. Lay the leaded needles out alongside on a board in rows, having the beards uppermost. Put one plate in position but leave the screw loose. Pick up as many leaded needles as the plate will cover, place them between the verge and the plate, rather low down, and then press gently on the cap. They should rise easily into line. Screw the cap down gently and then square the end leads with a small square placed on the ledge of the cylinder (the part which supports the plate). Tighten the screws enough to keep the leads from tipping. Replace the next plate; place the needles as before, pressing them against the preceding lot so that no spaces are left between the leads. Square the exposed end of this lot of needles. Repeat this around the cylinder. The last plate cannot be squared but the first lot will keep them from tipping. If a space is left, it may be necessary, in order to fill it, to cast a lead with one needle and file the superfluous lead away. If the space is less than half a lead, loosen all the plates slightly and begin tightening on the side opposite,

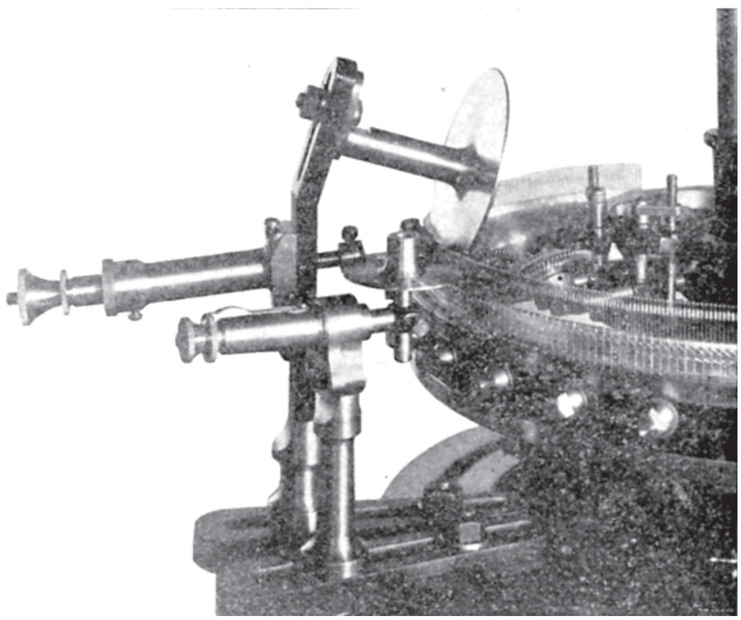


Method of Setting Trick Needle.

tapping them gently and approaching the space from both sides. This should close the space. Very little plyering should be necessary.

Bur and Wheel Adjustment. The functions of the burs and accessories in forming the stitch should be thoroughly understood before attempting to set the machine. Briefly, they are these: As the needles revolve, the cloth wheel or cam presses the old stitches (looped onto the needles to start with) down to the lowest exposed portion of the needle, and holds them there while the sinker bur runs the yarn up under the beards of the needles and while the presser which follows the sinker closes the beards at the presser, the cloth wheel or cam releases the old stitches gradually, allowing the lander to land them on the points of the beards. The cast-off follows the lander and casts the old stitches clear of the needles.

Setting the Burs. Divide the needle line into as many parts as there are to be feeds — four is the conventional number



Plain Feed, and Inside Cylinder.

— leaving room on the front of the machine for the stop motion. These divisions may be marked by setting the cast-offs, provisionally, placing the first one just before the stop motion; i.e., so that the needles when in motion reach the cast-off before they do the stop motion. When the needle line has thus been divided, finish the setting of the first cast-off. The wings should reach from below the beards of the needles, but not to the base, up a little above the heads of the needles, and should run with no back lash. If the bur has back lash (is loose) tip it forward, thus binding it slightly. The ideal position is that in which the bur is tight enough to cast off the stitch evenly without interfering with the needles, and yet not so tight as to put unnecessary stress on the needles, thus working them in the leads or tricks. Occasionai slugs in the yarn must be taken into account in this consideration, as slugs are more difficult to cast off than the ordinary yarn. The bur should come far enough through the needles to even the new stitches in the heads of the needles as the old stitches are cast off, yet not so far as to put undue stress on the stitches, thus breaking them and making holes.

Lander. The lander is set just ahead of the cast-off. The blades should reach as low as possible without striking the cylinder or leads, and should carry up far enough to land the stitches a little above the points of the beards. It should be loose enough in the needles to run without working the needles, but not so loose that the entering blade will strike the approaching needle, thus cutting the yarn or bending the needle. It is good practice to leave enough space between the lander and cast-off to permit taking the cast-off from the stud in order to clean or repair it.

Cloth Wheel. The cloth wheel or cam is set just ahead of the lander so that the old stitches will be held down until the lander raises them. It should carry the old stitches down to the base of the needle, but without putting undue strain either on the cloth or on the needles at the front edge of the wheel or cam.

Sinker. The sinker bur is set in the needle space covered by the cloth wheel, far enough from the front of the wheel to make sure that the old stitches will be carried down before the sinker is reached and far enough from the back edge of the cloth wheel to leave room between the sinker and the lander for the presser. The sinker should be set with the upper part of the entering blade inclined toward the head of the approaching needle; that is to say, if the needles are moving from left to right, the bur should be tipped from right to left, and vice-versa. The extent to which the bur should be tipped is dependent on the following considerations: In the first place the sinker blade is generally a deep blade, and but little tip is possible without interfering with the needles, which, of course, should be avoided.

Again, the yarn is looped under the beards by the blades of the sinker and in this process the blades have to crowd the yarn between the needles, and a considerable amount of force is required to do this. The force is supplied by the needles to the bur and in doing so the needles bend a little, allowing the bur blades to fall slightly behind their normal position and making interference likely from this cause. Now, the position of the bur to be sought is that in which the yarn will be surely placed under the beards, looped to the required depth, and carried well up in the heads of the needles, with the least stress on the yarn and on the needles and without interference with the needles. If the bur is tipped too much, it works the needles excessively and is likely to cut the yarn. If not tipped sufficiently, it interferes with the needles and picks off the beards.

Presser. The presser should be set to hold the beards closed as the stitches are being raised over them. This space is just a little ahead of the center of the lander. Space must be left between the presser and the lander blades to allow the rising stitches free passage, otherwise, they will be cut. When hard twisted or wiry yarn is used the flat presser is frequently used and is made long enough to cover all the beards between the sinker and the lander, thus keeping the yarn from dropping out of the needles until caught by the old stitches.

This completes the setting of one plain feed. The other feeds are set in the same manner. Before starting the machine all bearings should be lubricated and oil cups filled.

Starting Up. To start the machine take a tube of knit fabric, preferably of about the width of the fabric to be made, and of the same or finer gauge, pass it over the take-up rollers so that it will be rolled up when the take-up is in action, throw out the ratchet so that the fabric may be drawn down, and draw it down over the spreaders so that by stretching it a little it will reach the needles. Then throw in the ratchets in order that the fabric will not descend further. Select the needle space that is freest from obstructions, generally the stop motion space, and press the fabric near its edge down over the needles until the beards catch and hold it from coming off. Begin putting the fabric on near a sinker bur and continue in the direction opposite to the direction of rotation.

Threading. When the available needle space is filled, take