This application is a division of application Serial No. 681,354 filed August 30, 1957 and now Patent No. 2,997,231.

This invention relates to tape feed mechanisms, and more particularly it relates to a tape feed mechanism having electromagnetic means operative in conjunction with a drive member to couple tape indexing means to said drive member.

Hereinafter electromagnetically operated tape feed mechanisms have employed electromagnets adapted when energized to magnetically drive the pawl means into a ratchet wheel to effect an incremental movement of a drum to which the ratchet wheel is secured whereby a tape driven by the drum is incrementally fed relative to a punching or reading station. The employment of electromagnets to perform such a power function requires that they be of considerable size and power whereby force sufficient to overcome the inertia of and to move the masses of the elements involved can be generated. Also the speed of operation in systems so constituted is limited by the pull-in time of the electromagnet.

This invention embodies a novel construction of tape feed mechanism which permits an electromagnet of minimum size and power to be utilized thereby to realize a very rapid and efficient electromechanical coupling of a drive source with a tape indexing mechanism. Efficient use of electrical power is realized by utilizing the power of a cyclic drive source to close and open the air gap between the electromagnet armature and pole piece. In accordance with the invention the cyclic drive source is coupled to the electromagnet armature by a link connected between the armature and a pawl rotatably mounted on but normally biased against rotation relative to the drive source. The construction of the cyclic drive source and associated elements is such that when the drive source is at one limit of its cycle, at which time the armature is adjacent its pole piece, the electromagnet is energized, the armature is restrained causing the pawl on the cyclic drive source to rotate and couple the drive source to a ratchet as the drive source moves toward the other limit of its cycle.

An object of the invention therefore is in the provision of a rapid and efficient tape feed mechanism.

Another object of the invention is to provide a tape feed mechanism wherein only the holding power of an electromagnet is utilized to couple a drive source to a tape indexing mechanism.

A still further object of the invention is in the provision of a high speed tape feed mechanism employing a pawl and ratchet construction wherein the pawl couples a cyclic drive to the ratchet and in combination with the drive moves the ratchet through an increment.

Another object of the invention is in the provision of a pawl and ratchet mechanism wherein the pawl is coupled to the ratchet mechanism by the action of a cyclic power source in conjunction with the holding power of an electromagnet.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIGURE 1 is a side view of a tape feed mechanism in accordance with the invention showing the position of the elements when the cyclic drive source is at one limit of its motion;

FIGURE 2 is a side view similar to FIGURE 1 showing the position of the elements when the cyclic drive source is at the other limit of its motion;

FIGURE 3 is a diagrammatic perspective view of the drive means; and

FIGURE 4 is a timing diagram explanatory of the operation of the tape feed mechanism.

Referring now to the drawings wherein an exemplary embodiment is illustrated there is shown in FIGURES 1 and 2 a tape feed mechanism generally designated by reference numeral 10 operable under control of a tape feed drive arm 11 and a tape feed electromagnet 12. As seen in FIGURE 3 the tape feed drive arm has a circular cutout 13 in its lower end adapted to receive a circular cam 14 to which is eccentrically secured a shaft 15. As the shaft 15 rotates through a 360° cycle the tape feed drive arm 11 is driven through an up and down motion as illustrated by curve 16 in FIGURE 4. The electromagnet 12 is provided with an armature 17 having one end pivotally mounted on the electromagnet frame 19 whereby the armature is movable toward and away from the pole piece 18 of the electromagnet. The tape feed mechanism comprises an actuator 20 rotatably mounted on the shaft 21 of a tape feed roll 22 which has a ratchet wheel 23 concentrically secured thereto. A pawl 24 is rotatably mounted intermediate its tail end 25 and its ratchet engaging end 26 to the actuator as at 27. The pawl is also articulated to the free end of armature 17 by a link 28. A pawl biasing spring 29 is connected between a stud 30 on the tail end of the pawl and a cooperating stud 31 on the actuator whereby stud 30 abuts edge 32 of the actuator under the action of spring 33 and pawl 24 is properly positioned relative to the ratchet wheel and biased against rotation relative to the actuator. The pawl is also provided with a projection 33 on its lower edge which is adapted to cooperate with a fixed stop 34 suitably secured to a frame member (not shown). The actuator 20 is provided with a stud 35 whereby it is rotatably connected to the tape feed drive arm 11 which as hereinafter stated is adapted to be driven through an up and down motion by the cam 14 and shaft 15. As shown in FIGURE 1 the normal position of the elements is such that the armature is in zero air gap position.

Referring to FIGURE 3 the shaft 15 which powers drive arm 11 is adapted to be coupled to a continuously rotating drive shaft 36 by a wrap spring clutch which, as is well known to the art, comprises a helical coupling spring 37 wrapped concentrically about the drive 36 and driven shaft 15. The ends of the spring 37 respectively are attached to a clutch control disk 38 rotatably mounted on shaft 36 and a clutch control disk 41 rotatably mounted on shaft 15. The normal diametral dimension of the spring is such that shafts 36 and 15 will be coupled thereby, with rotation of the shaft 36 serving to tighten the grip of the spring. The spring is normally disengaged by relatively rotatively displacing the control disks 38 and 41 in a direction which will expand the spring. The spring is held in disengaged condition by a fixed and a rotatably mounted interponent 42 and 43 respectively which cooperate with steps 44 on the periphery of the disks 38 and 41 whereby relative rotation of the disks under the action of the arm 11 which is expanded spring 37 is prevented. Interponent 43 comprises the armature of a clutch electromagnet, the energization of which pulls interponent 43 out of engagement with its associated step
on disk 41 whereupon the spring wraps and couples the shafts 36 and 15. As is understood in the art upon de-
energization of the clutch electromagnet during a cycle interponent 43 will re-engage the step on control disk 41
after the shaft 15 completes a 360° revolution thereby
to cause the spring to unwrap.

The operation of the tape feed mechanism will now
be explained, reference being directed to FIGURES 1, 2
and 4; FIGURE 4 showing the times of energization and
d-e-energization of the clutch and feed electromagnets
related to angular degrees of rotation of shaft 15 and the
tape feed drive arm motion over one cycle resulting from
rotation of shaft 15.

Energization of the tape feed and clutch electromagnets
may be effected in response to signals periodically or
aperiodically generated upon operation of a business ma-
chine. It is to be here noted that where signals are pe-
riodically generated at a constant rate the necessity for
intermittently coupling shaft 15 to a continuously driven
shaft 36 may be dispensed with and shaft 15 itself may
be continuously driven; the tape feed signals being del-
ivered to the electromagnet 12 in synchronism with the
motion of the new continuously rotating shaft 15.

As is apparent from FIGURE 4 the energization of
the clutch electromagnet at time \( t_0 \) results in a current
(curve 49) therethrough which is sufficiently built up to
pull its armature i.e. interponent 43 from engagement
with the clutch control disk 41 at time \( t_1 \) thereby permit-
ing the spring to unwind and couple shafts 36 and 15
whereby a cycle of the latter is started at time \( t_2 \). After
a cycle has started the clutch electromagnet may be
d-e-energized whereby the drive and driven shafts 36 and
15 respectively will be uncoupled at the end of a 360°
cycle. Since the tape feed electromagnet 12 is already
energized at time \( t_0 \) as illustrated by current curve 51,
on upward movement of the tape feed drive arm 11 and
rotation of the actuator 20 counterclockwise, the
pawl, rotatably mounted on the actuator 20 and linked
to the armature 17 is restrained by the energized electro-
magnet, and rotates relative to the actuator 20 under the
action of the drive arm 11. When the drive arm 11
reaches a position corresponding to 90° rotation of shaft
15 the pawl will have rotated into engagement with the
ratchet 23. Continued rotation of shaft 15 to 180°
moves the drive arm 11 further in the up direction as
shown by curve 52 thereby continuing the counterclock-
wise rotation of the actuator, causing the pawl 24 to lock
with and rotate the ratchet 23 one tooth. As is apparent,
after the pawl locks with the ratchet, and while the pawl
is rotating the ratchet, no further relative movement of
the pawl and actuator can occur whereby permit-
ing, during the 90–180° feed interval, the forcible with-
drawal of the armature 17 away from the pole piece
18, until the electromagnet 12 is de-energized; the latter
occurring when the drive arm reaches a position corre-
sponding to 156° as shown by curve 51. After 180° ro-
tation of shaft 15 the actuator 20 begins a clockwise ro-
tation due to the downward motion of arm 11. During
the 180° to 360° interval the pawl 24 is therefore dis-
engaged from the ratchet and returned to normal. As is
apparent from FIGURE 2 which shows the 180° posi-
tion of shaft 15 overtravel of the ratchet 23 due to its
inertia is prevented feed roll 34 which, when engaged
by the pawl projection 33, acts to increase the pressure
of the pawl tooth 26 on the ratchet 23.

It should be understood that the foregoing disclosure
relates to only a preferred embodiment of the invention
and that it is intended to cover all changes and modifi-
tions of the example of the invention herein chosen for
the purposes of the disclosure which do not constitute
departures from the spirit and scope of the invention.

The invention claimed is:

1. Ratchet indexing mechanism comprising drive
means, means oscillating said drive means between pre-
determined limits of motion, a pawl rotatably mounted
on said drive means, means normally biasing said pawl
against rotation relative to said drive means, control
means operative at one limit of motion of said drive
means to effect the rotation of said pawl relative to said
drive means as said drive means oscillates toward its
other limit of motion, and ratchet means engageable with
and driven by said rotated pawl.

2. A tape feed mechanism comprising a feed roll, a
ratchet concentrically mounted for movement with said
roll, cyclically operable means rotatably mounted on
said roll, cyclically operable means rotatably mounted
on said roll, cyclically operable means, means normally bias-
ing said pawl against rotation relative to said cyclically
operable means, an electromagnet and associated arma-
ture, link means for coupling said pawl and armature,
and means for driving said cyclically operable means be-
tween predetermined limits, said electromagnet being
adapted to be energized at the beginning of a cycle of
said cyclically operable means whereby as a cycle pro-
gresses said pawl is restrained by said armature and
caus ed to rotate relative to said cyclically operable means
into driving engagement with said ratchet.

3. A tape feed mechanism comprising a feed roll, a
ratchet concentrically mounted for movement with said
feed roll, cyclically operable means rotatably mounted
on the shaft of said feed roll, a pawl rotatably mounted
on said cyclically operable means, means normally bias-
ing said pawl against rotation relative to said cyclically
operable means, control means operative at one limit of
motion of said cyclically operable means to effect rota-
tion of said pawl relative to said cyclically operable
means as said cyclically operable means moves toward
its other limit of motion, ratchet means engageable with
and driven by said rotated pawl, and means operative in
association with said pawl for preventing inertial over-
travel of said ratchet and feed roll.

No references cited.