

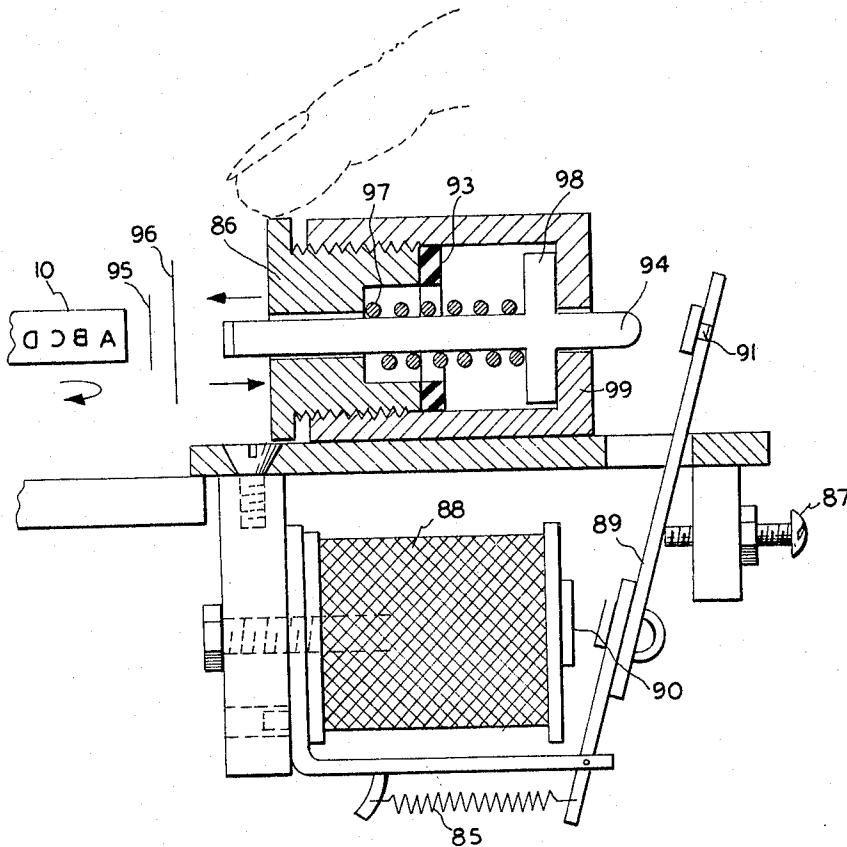
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HIGH SPEED IMPACT PRINT HAMMER ASSEMBLY WITH RESILIENT
ENERGY STORING MEANS 1204

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HIGH SPEED IMPACT PRINT HAMMER ASSEMBLY WITH RESILIENT ENERGY STORING MEANS

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Original application Aug. 11, 1964, Ser. No. 388,893, now
Patent No. 3,232,404, dated Feb. 1, 1966. Divided
and this application Oct. 5, 1965, Ser. No. 495,025
(Filed under Rule 45(c) and 35 U.S.C. 116)

2 Claims. (Cl. 101-93)

This is a division under Rule 45(c) of the copending ap-
plication, Serial No. 388,893, for "Keyboard Operated
Printer," filed Aug. 11, 1964, now Patent No. 3,232,404.
This invention relates to printing mechanisms and, more
particularly, it relates to impact type printers for striking
continuously rotating printwheels.

While prior art systems have been proposed for elec-
tronic controls to print from a continuously rotating type
wheel, such systems have involved complex timing means
to produce exact timing of contact by the printing ham-
mer in synchronization with the type characters presented
by the wheel to prevent jitter of type spacing within the
tolerances of the system parameters. The effect of the
speed of the type wheel, the coding and commutating de-
vices, the print hammer operating characteristics, the driv-
ing energy and resulting timing variations of the print
hammer with lubrication, voltage resistance, etc., all tend
to produce accumulative error of printing tolerances, thus
holding down printing speed attainable with printed char-
acters spaced within tolerances satisfying human visual
observation.

It is therefore an object of the present invention to
provide improved impact printer means which operate at
high enough speeds to simplify system tolerances, and
eliminate jitter and accumulated timing errors.

While prior art systems have provided hammer mecha-
nisms which drive free-flying hammer pins into a con-
tinuously rotating typewheel, various problems have been
encountered which prevent satisfactory use of such
printers without complex auxiliary electronic or mechani-
cal timing controls to reduce jitter, smear, and timing
errors. Thus, in those systems providing mechanical cam
operation for driving print hammer pins, the speed of
impact of the hammer against the type is limited by
gradual acceleration of the driving means resulting in
smear and jitter at high typewheel speeds. Also, precise
electrical timing with electronic systems is difficult, being
dependent upon mechanical cycles and thus large timing
tolerances.

These deficiencies have, in part, been corrected by use
of electromagnetically controlled relay impact means for
operating the print hammer so that electronic timing de-
vices may be used to actuate the relay. However, relays
have significant inductance and very slow gradual closing
characteristics which can introduce long delays and un-
predictable tolerances into impact timing with resultant
jitter and bounce showing up in the print. Furthermore,
the inertia of the relay tends to hold the hammer in con-
tact with the print wheel introducing smear. In part this
has been corrected by introduction of free-flying pin ham-
mers which are projected by impact from a relay armature.
An example of such high speed printers is shown in Shep-
ard Patent 2,787,210, issued April 2, 1957. Even in these
devices, however, timing is critical and engineering design
must be confined to carefully relate relay and pin con-
figurations to a particular typewheel speed to prevent
smear.

An improved printing assembly is therefore provided
by the present invention producing less critical timing with

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simplified mechanical and electronic design requirements.
In essence, the print assembly provides an extremely high
speed flying-pin type hammer propelled from an electro-
magnetic relay armature in response to an electrical im-
pulse which can be timed to conform with external sys-
tem requirements. Not only is high impact speed provided
but also high return speed, so that contact with the type-
wheel takes place over very few microseconds, and thus
variations in print spacing, jitter and smear is essentially
eliminated. This results from a simple mechanical
bounce-back interposer external to the typewheel meet-
ing the free-flying pin at the moment it contacts the type-
wheel to forcibly return it. In this manner the return
force is made independent of the material in the type-
wheel, the speed of the wheel or the area of the character
being printed, etc., and is simply designed without signifi-
cant cost to produce optimum high speed return of the
hammer pin after striking the type with extremely high
force during a very short period of time, thereby not
necessitating any compromise in time of dwell to obtain
a favorable print characteristic, nor requiring a particular
type wheel elasticity, etc.

The construction of the print assembly thus afforded
by the invention is illustrated in the drawing by a sche-
matic representation of a printer assembly constructed
in accordance with the principles of this invention.

As shown in the drawing, the printer mechanism serves
to strike a continuously rotating type wheel 10 with a
print pin or hammer 94 to produce a printed character
on paper 96 from interspersed carbon paper 95. The
type wheel may rotate at speeds of from ten to thirty rev-
olutions per second to present alphanumeric type char-
acters typically each millisecond.

In order to produce substantially jitter-free print-
out and increased system tolerances in speed of the type-
wheel 10 and motion of the paper 95 and 96 with the
impact of a mechanically operated hammer, it is neces-
sary not only to strike the printwheel with the print ham-
mer at high impact speed, but also to retract the print
hammer quickly to avoid smear or bounce.

High impact speed is attained by using a free-flying
hammer pin 94, which has only a weak spring 97 for
holding it in rest or retracted position with yoke 98, which
defines the limitations of the pin stroke by resting at one
end against pin housing 99 to await impact by the elastic
driving member 91, which is a button of hardened steel
positioned upon relay armature 89. Accordingly, relay
coil 88 is energized by an electronic pulse to quickly close
armature 89 through the very small magnetic gap 90 to
drive the hammer pin 94 as it partially closes the gap to
rapidly drive it into the type wheel 10 at very high speed
in the same manner as a golf ball is driven from a tee,
rather than in a gradual contact as provided by cam
actuated hammers or those directly coupled for drive
by the relay armature. The rounded and hardened head
of pin 94 meets button 91 in almost pure elastic contact
to send almost all of the driving energy into the longi-
tudinal motion of the hammer pin 94, through its confined
stroke path provided by casing 99.

Since the paper layers 95 and 96 are thin, the driving
range of the hammer pin 94 is small, and the magnetic
gap 90 in the relay need not be that thick to place the pin
94 in free-fly motion, operational speed is significantly in-
creased over normal large gap spacings which must move
the pin the entire distance into the paper by operation of
a square law factor associated with the gap spacing. In
other words, not only is the mechanical impact speed of
a free-flying pin increased in this embodiment, but also
the electrical operational speed is increased by reducing
the time it takes to signal the relay to impact the hammer
pin with its reduced length of stroke. It is also noted
that the armature 89 is light with little mechanical inertia

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as compared with that of a complete assembly including a hammer coupled to the armature, thus further contributing to high speed operation. Even spring 85 biasing the armature into its open position is light and need not seriously handicap operation speed since the mass of the armature is small. A typical operating speed of less than a half millisecond is thus provided in the relay as compared with an order of magnitude greater time with increased gap distances presenting greater electrical and mechanical inertia. Even greater improvement is produced over cases where the hammer and relay armature are integral.

Quick return of the hammer pin 94 from the flying typewheel 10 cannot be attained from weak spring 97 without significantly reducing free-fly speed of the hammer pin 94 and impact speed with the type wheel. Thus, a rubber or resilient plastic bumper member 93 is positioned to intercept the yoke 98 of the hammer pin 94 just as it strikes the print wheel to thereby produce a significant amount of return stroke energy. Because of the free-flying pin 94 configuration with rubber bumper 93 a complete print hammer stroke may be accomplished in the order of a few microseconds, thereby producing very high print speeds without jitter or smear from a continuously rotating wheel. This construction is simple, takes up essentially no extra space and does not confine the other engineering parameters of the system in any way by requiring optimum speeds or dimensions of the flying hammer pin 94, or the length of time armature 89 is in contact with hammer pin 94. Adjusting screw assembly 87 is provided for adjusting the magnetic gap 90 of the relay where desired to produce an optimized operation of each printer assembly. Similarly, screw assembly 86 can be used to precisely adjust the position of rubber bumper block 93 to account for mechanical variations in print assemblies.

Accordingly, a print hammer assembly is provided by this invention which works in combination to produce high speed jitter-free printing from a continuously rotating typewheel. Therefore, the features of the hammer assembly which combine to give the improved performance are defined with particularity in the appended claims which are believed to define the nature and scope of the invention.

What is claimed is:

1. A print assembly for impacting a continuously rotating typewheel comprising in combination,
 - a movable electromagnetic armature,
 - a relay for moving said armature responsive to electronic signals,

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a housing, said housing forming an enclosure having opposite end walls with apertures therein, means for relatively positioning one of said end walls, a movable hammer pin having an integral yoke member located within said enclosure,

said hammer pin having two stems, each of said stems projecting through an aperture in one of said opposite end walls, one stem opposite the relatively positionable end wall being positioned for intercepting and receiving the impact of said movable armature, an energy storing resilient bumper positioned upon the relatively positionable said end wall to intercept said yoke,

the movement of said hammer pin being confined by said yoke in a longitudinal stroke path defined by contact at two limiting positions at said resilient bumper and the other opposite end wall,

spring means positioned in said enclosure surrounding said pin for weakly biasing said yoke toward the one of said limiting positions away from said resilient bumper,

said means relatively positioning one of said end walls being adjusted to receive the impact of the pin yoke momentarily at one end of the stroke path to coincide with the pin striking said typewheel to print a character therefrom and quickly retract said pin from contact with said typewheel by means of energy stored in said bumper.

2. A print assembly as defined in claim 1 providing a very small magnetic gap between said armature and said relay, and with a spacing between the one of said stems receiving the armature impact and said armature to permit impact after the armature has partially closed said gap.

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