



Do It Yourself Switch Machines

And save a ton of dough!

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Malvern PA RPM 2008



What does a Switch Machine do?

- Move switch points back and forth
- Hold points in position
- Allow operator to change position
- Switch frog electrical polarity
- Work reliably



Commercial Options - Pros

- Commercial Options - Pros
- Pre-engineered, off-the-shelf solution
- readily available
- Install instructions
- Shared experience of others
- No need to re-invent the wheel



Commercial Options - Cons

- Often expensive per unit
- Limited selection of offerings
- Off-the-shelf may not meet your needs



Why make your own?

- **To save money!**
- Gain control over design, options
- Build to meet your needs
- Great learning experience
- It's fun!



Not covered here:

- Electrical / Electronic solutions
 - Not within reach of most modelers
- High quality, safe options already available
 - Ask after clinic about coming options :)



What is covered here:

- Trackside switch machines
- Under-table switch machines
- What parts make up a machine
- How they work together
- Design a machine by selected criteria
- Control options (Manual)

Caboose Ground Throws

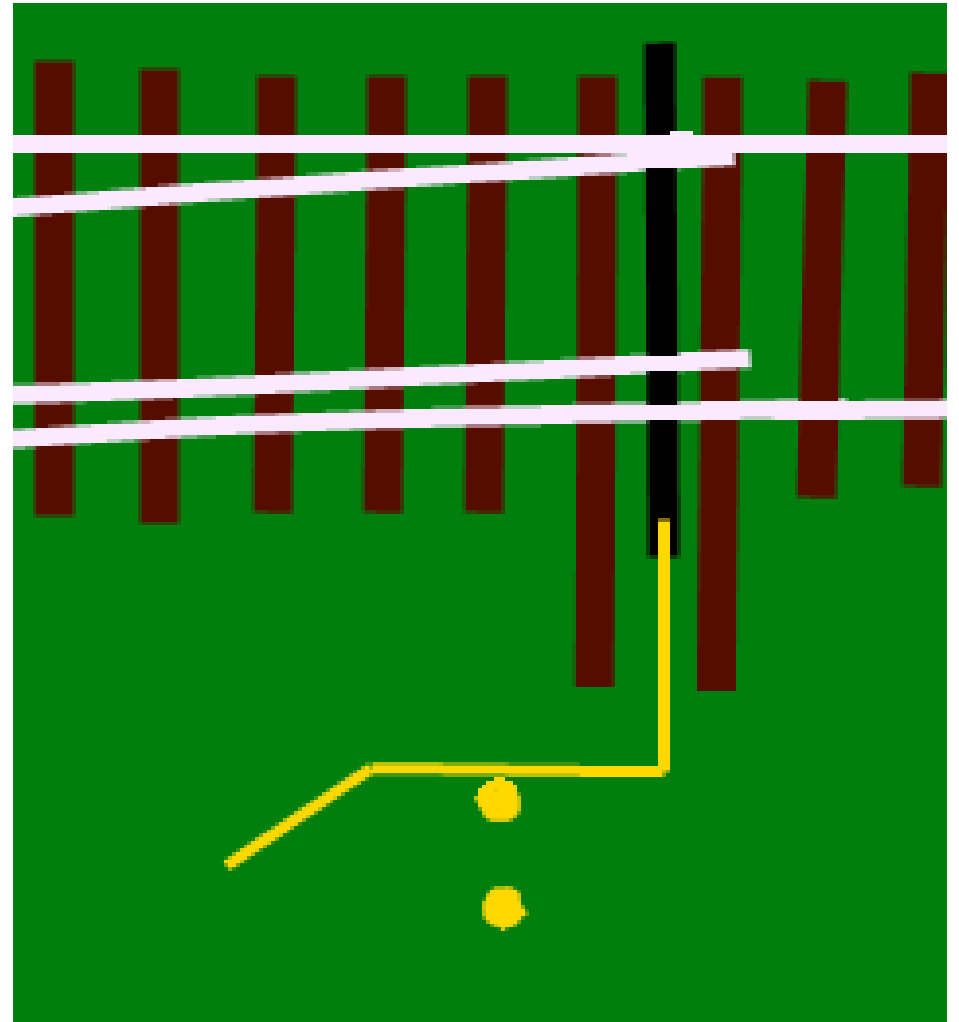
- Effective option at reasonable price
- Reliable, easy to install
- Power switching models much more expensive
- Look really bad in photos



Photo by Roger P. Hensley

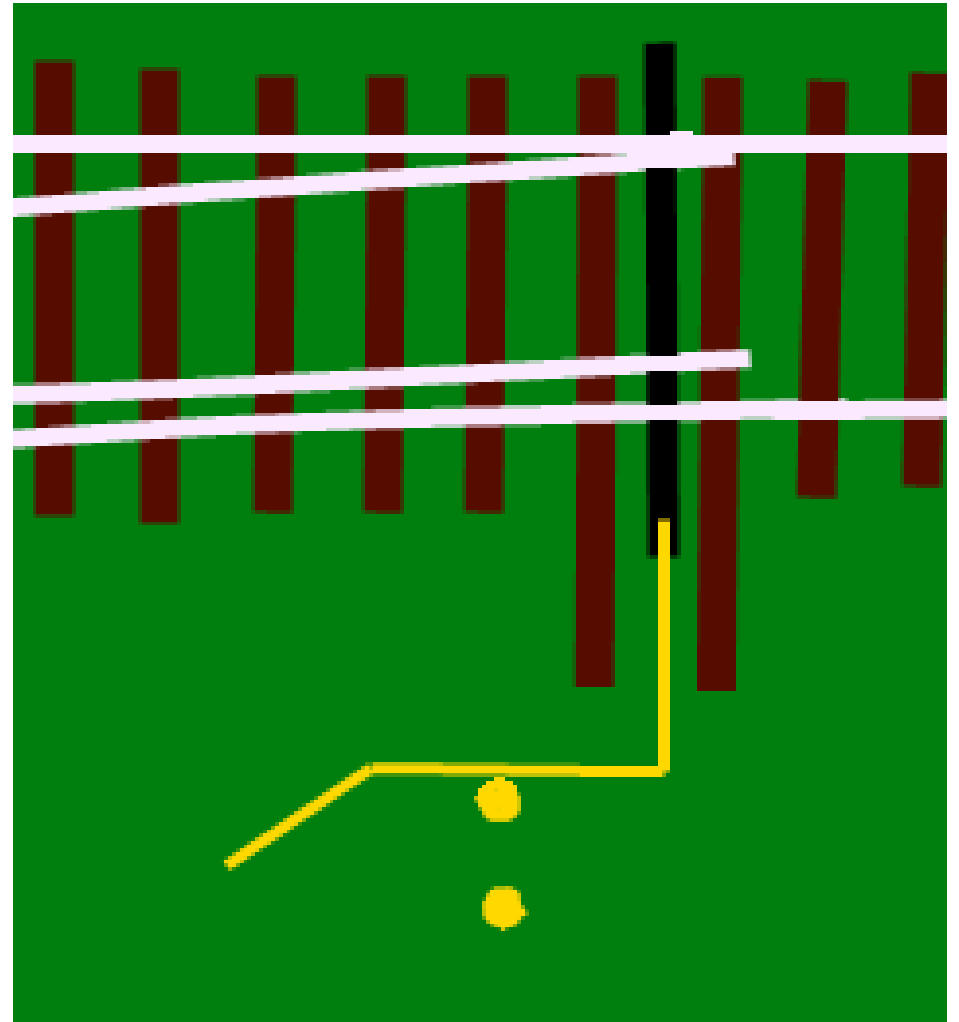
Simplest option - Nails and wire

- Simply two nails driven into layout next to points
- Wire 'hook' that connects to throw bar
- Hook goes on either side of nails to hold points
- Wire may be guided by staples



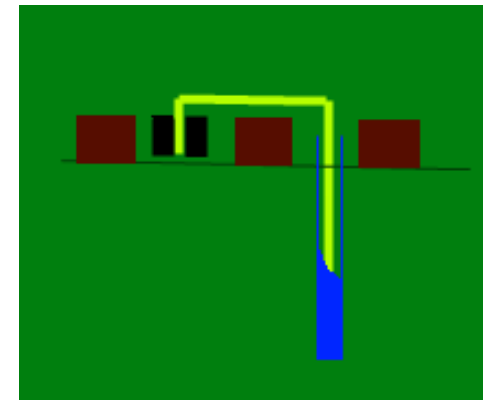
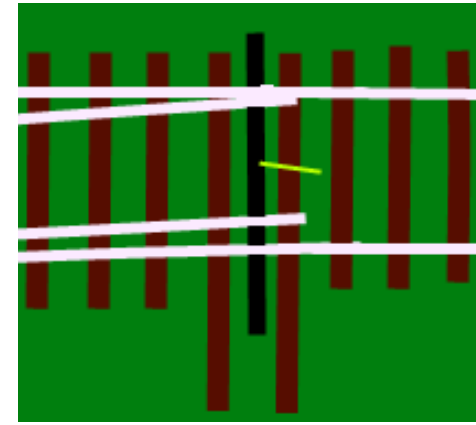
Simplest option - Nails and wire

- Looks pretty bad but really cheap
- Could power frog if wires hooked up to hook and nails
- Very low-tech but it works!



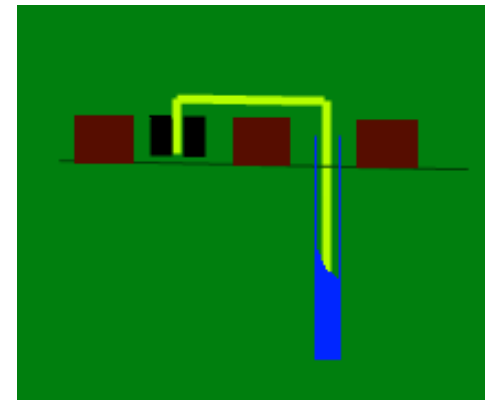
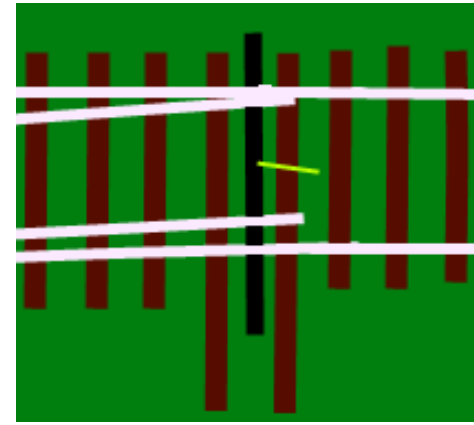
Finger spring

- Action similar to Peco and Micro-Engineering turnouts
- Stiff wire in "J" shape
- Installs in hole in roadbed, throw bar
- Compression on spring wire holds points of stock rails
- Spring compresses when moved across centerline



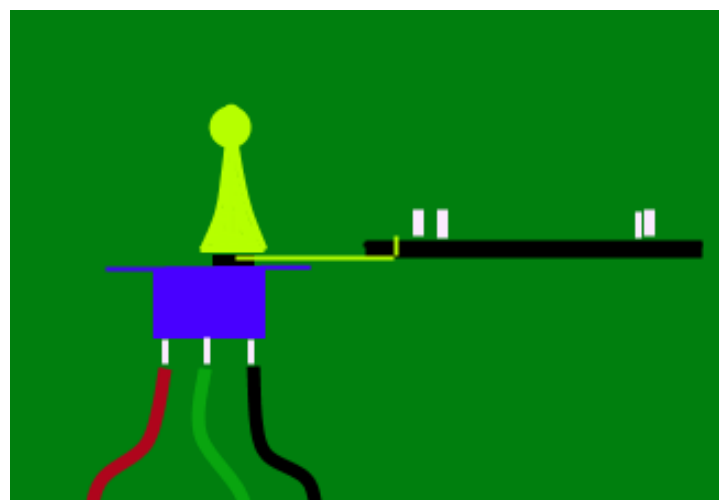
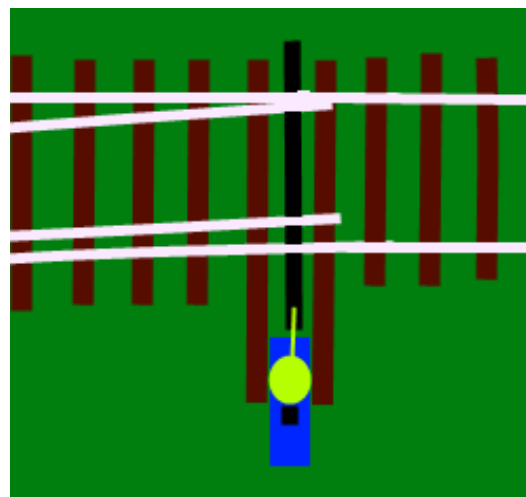
Finger spring

- Tricky to install, wear reduces effectiveness
- Difficult to adjust
- Bend in spring helps but looks really bad
- Also really cheap, easy to build



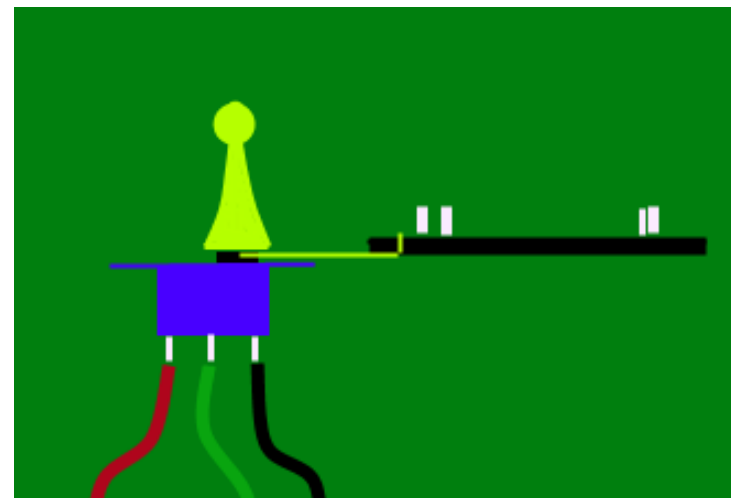
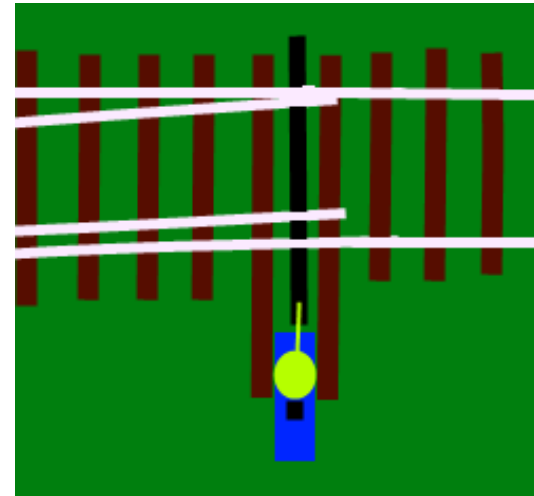
Slide Switch Switchstand

- First I know of in Australia, 1995
- Tony Koester using this on NKP third sub
- Small slide switch installs next to points
- small wire pushrod hooked up from throwbar to switch slider
- throwbar moves with slide switch



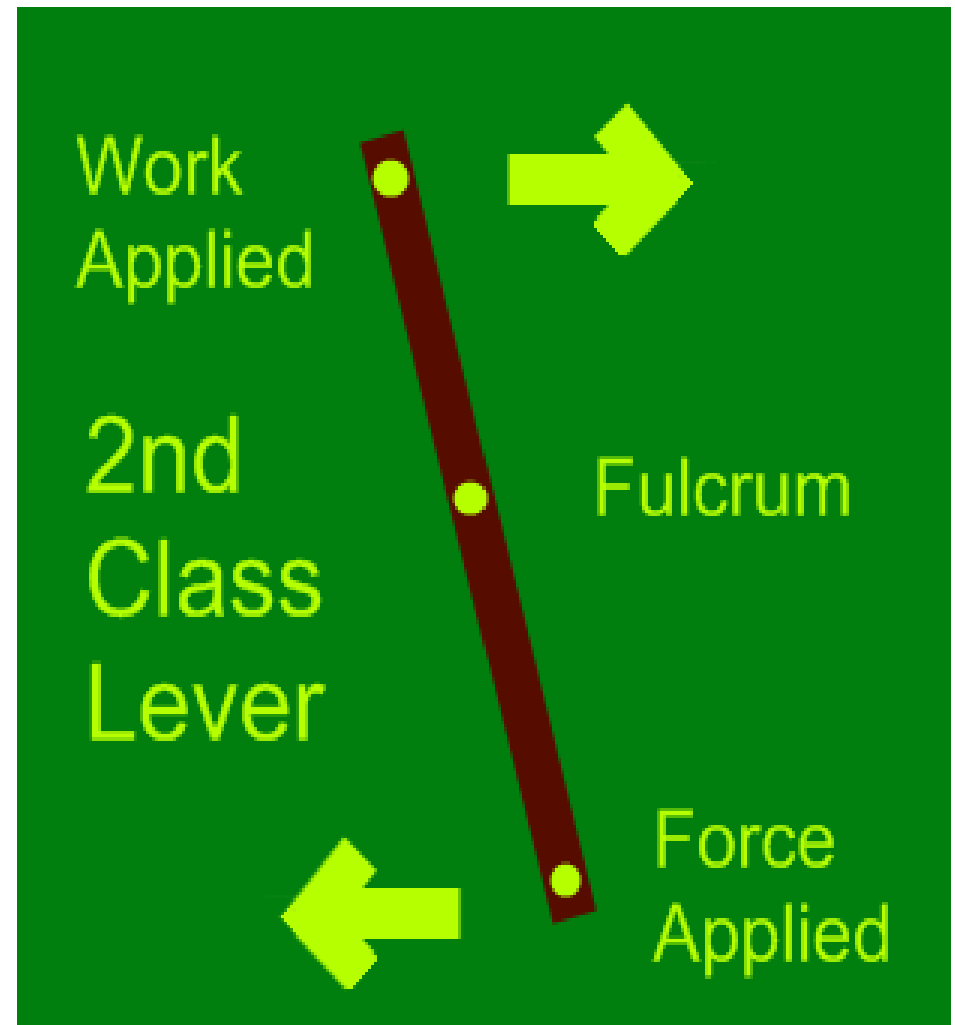
Slide Switch Switchstand

- Switch slider disguised by scale switchstand glued to top
- Frog power controlled by slide switch
- Moderately difficult install, tough to adjust after install
- Looks really good, operates pretty well



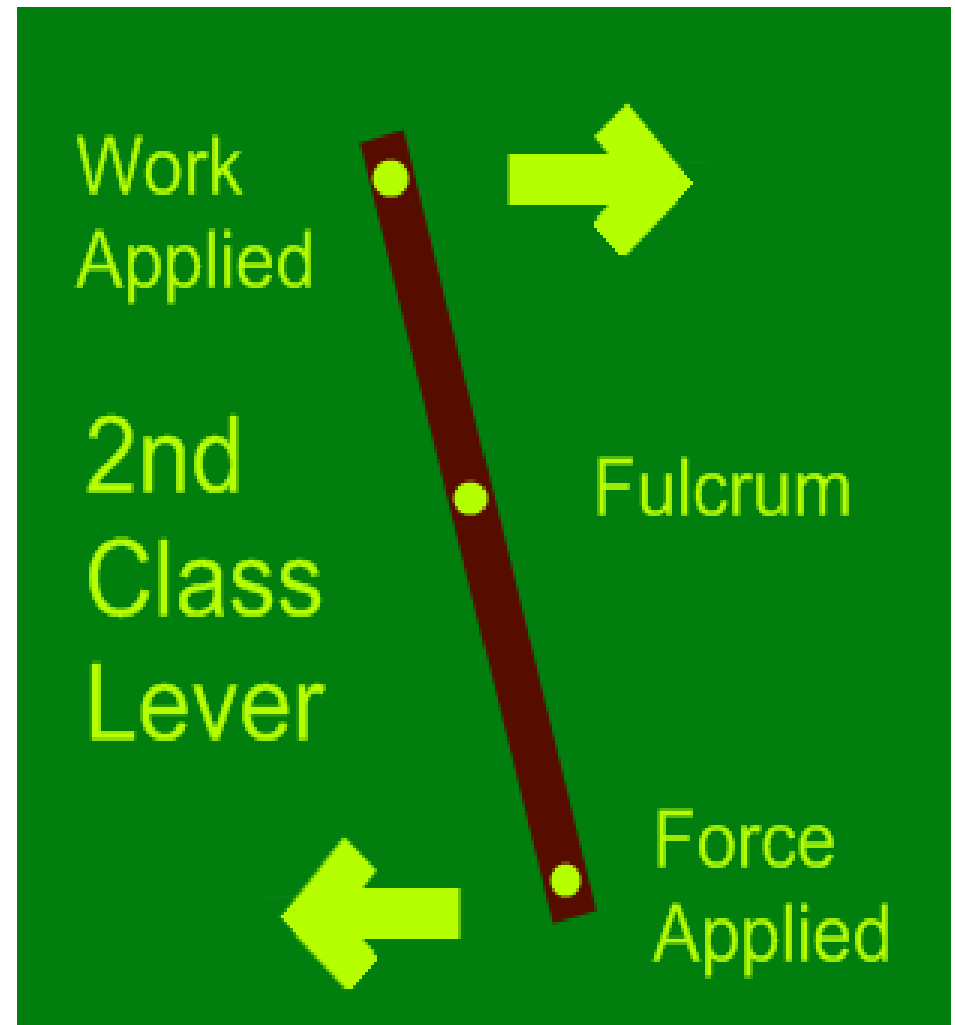
Under Table Options

- All designed using most of these features:
- LEVERS
- 2nd-class lever, 1 or more
- (like a seesaw, fulcrum at or near center, work applied to ends)
- Allows for small hole in benchwork beneath points



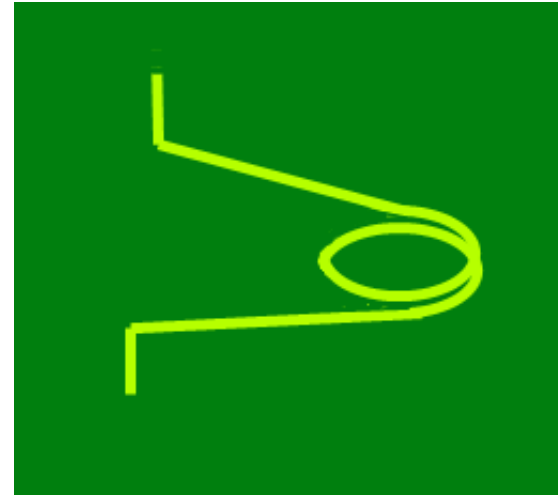
Under Table Options

- Tortoise, Blue Point machines use 2nd class levers
- Useful because fulcrum location helps keep hole in roadbed small
- Changing location of fulcrum changes force to distance inversely



Springs - Compression

- Compression spring like Mousetrap, Clothespin
- Force things together or apart
- Old twin-coil electric machines used compression spring to hold points after throw
- "Over-Center" type of spring, like finger throw we saw before
- Great for holding points to stock rails
- Easy to make yourself, inexpensive, reliable



Springs - Tension

- Tension springs like bedframe springs, rubber bands
- Can be used in many ways for turnout control
- Works with a variety of control methods
- String or cable tied to motion arm, pulled on by knob or lever



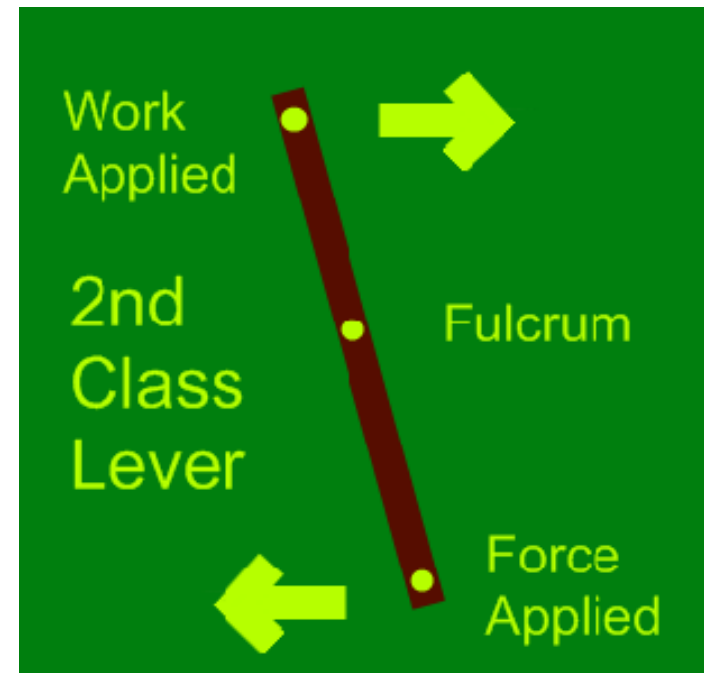


Springs

- Can be used in non-linear solutions
- Or used against a pushrod to force return against unconnected device
- Tension and compression springs can often be used in similar situations
- You decide which works better for given application

FULCRUM

- Adjustable fulcrum helps set good tension on points, throw distance
- Tortoise and Blue Point offer this option
- Fixed fulcrums work OK, best to discover "Sweet spot" thru experimentation before committing to design



Electrical Switch

- Often need method to switch frog polarity with points
- must be SPDT or DPDT
- Two methods - home-built or commercial
- Home built - any method to transfer power on change of position
- wipers, wires - Hump Yard Purveyance had good idea
- throw pin wired to frog, wires located to either side powered from bus



Electrical Switch

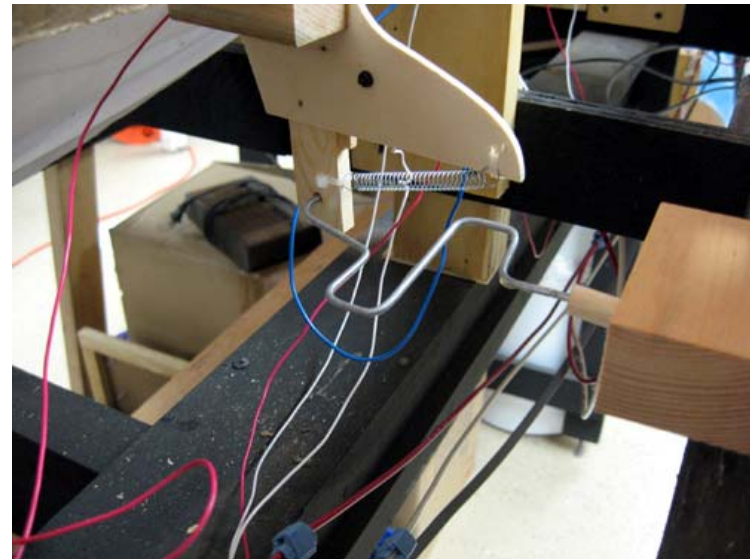
- Commercial switches - many good options, some not so good
- Slide Switches - seem like good idea but can be limiting
- Can restrict movement of motion arm if not carefully designed
- Detents seem like good idea, but incomplete throwing may cause dead frog

Electrical Switch

- Lever switches - Mount independent of motion arm but contact it to throw
- Can mount many places, use in different ways - Side, end, anywhere able to contact moving parts
- also problematic installation sometimes
- Can be rotated for fine adjustment after install
- Frog always powered, no dead position

PUSHRODS

- Connect switch machine to controlling device
- Make from sturdy wooden dowels or wire
- When possible include Z bend to cushion force
- Support long rods to prevent sagging, bending





CONTROLS

- Usually fascia-mount - knobs, handles
- Fancy or simple, attach with threads, epoxy, etc.
- Some unusual options - Barrel bolts, armstrong levers



How to design a switch machine

Criteria for selecting a design:

- On table / Under table
- Clearance
- Frog Power
- Actuation
- Construction and Materials
- Mounting
- Versatility
- Form follows function - answers to these questions help determine design

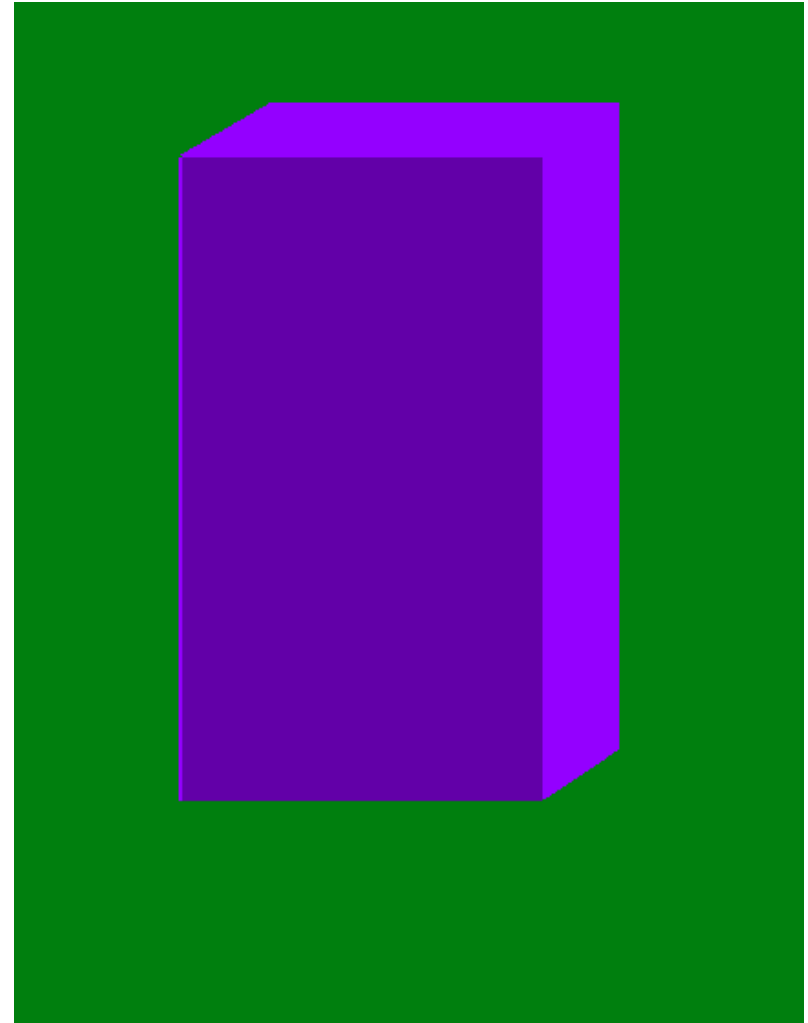


1st criteria - Below table

- Above table designs more obvious, fewer choices
- Select basic design of base and 2nd class lever motion arm

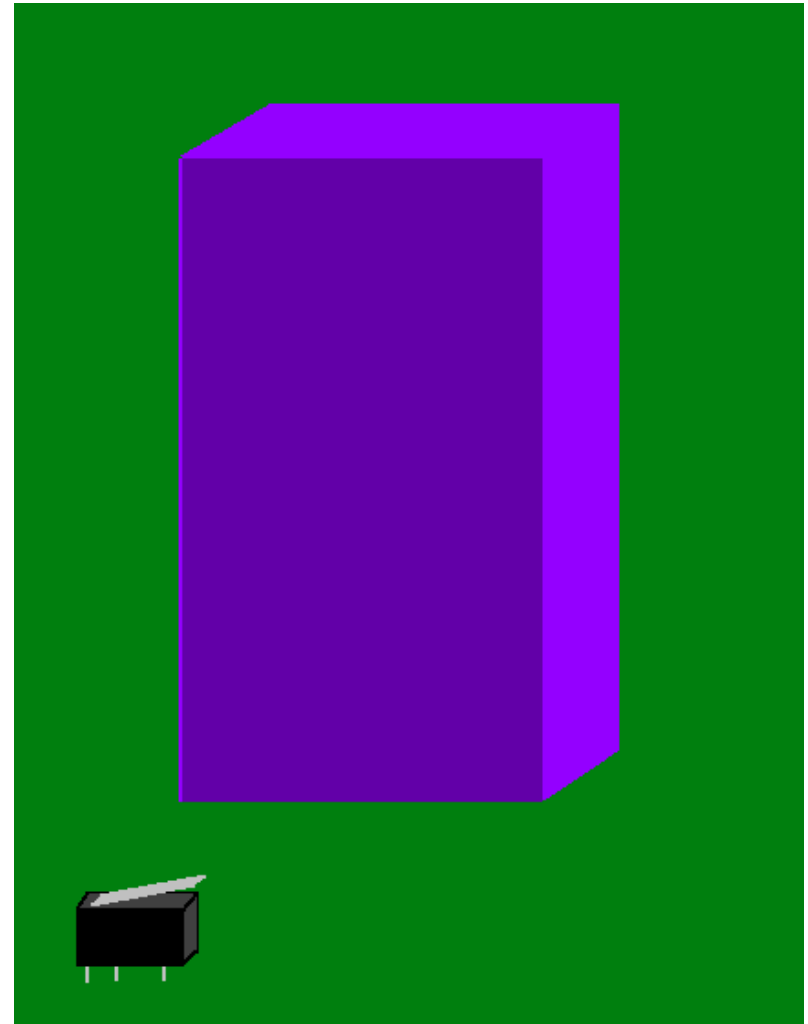
2nd criteria - Clearance issues

- No clearance issues
- This design not affected by sight lines, cramped benchwork
- Goal is always to design as small as possible, but without issues more vertical design options are open



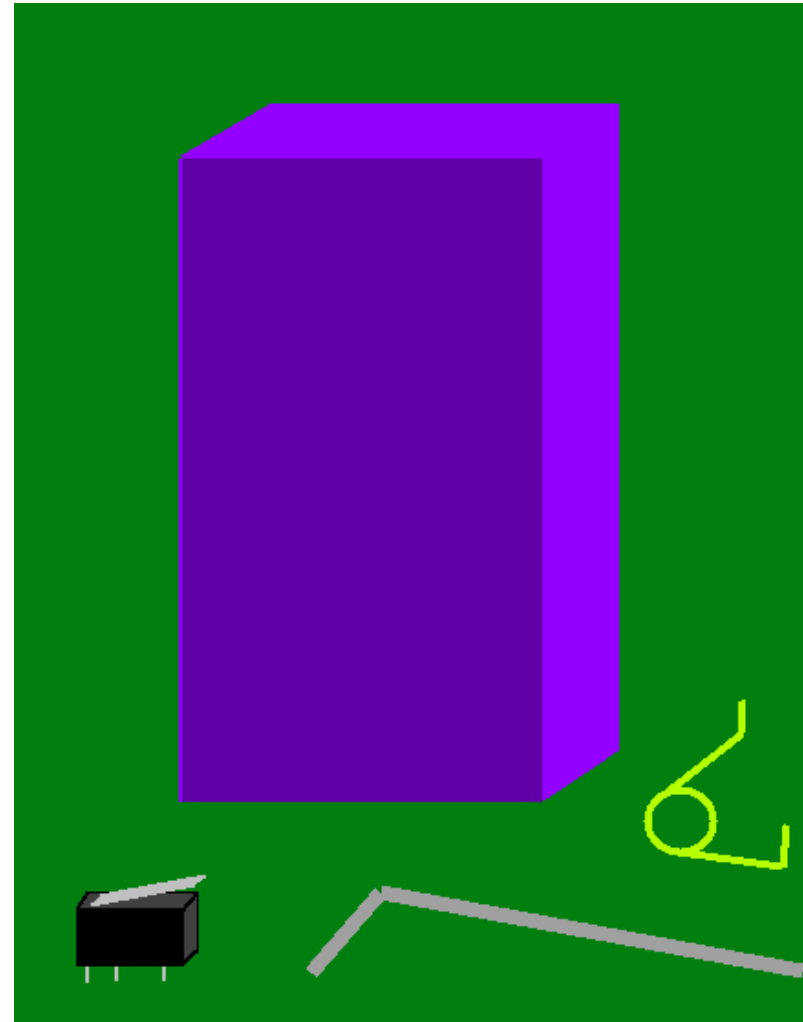
3rd Criteria - Frog Power

- Design will have to support powering turnout frog electrically
- commercial or home-made switch to be integrated



4th Criteria - Actuation

- Push-pull operation selected
- Will require spring to hold points in place to either side
- Over-Center compression spring is great choice
- Include method to connect pushrod to motion arm

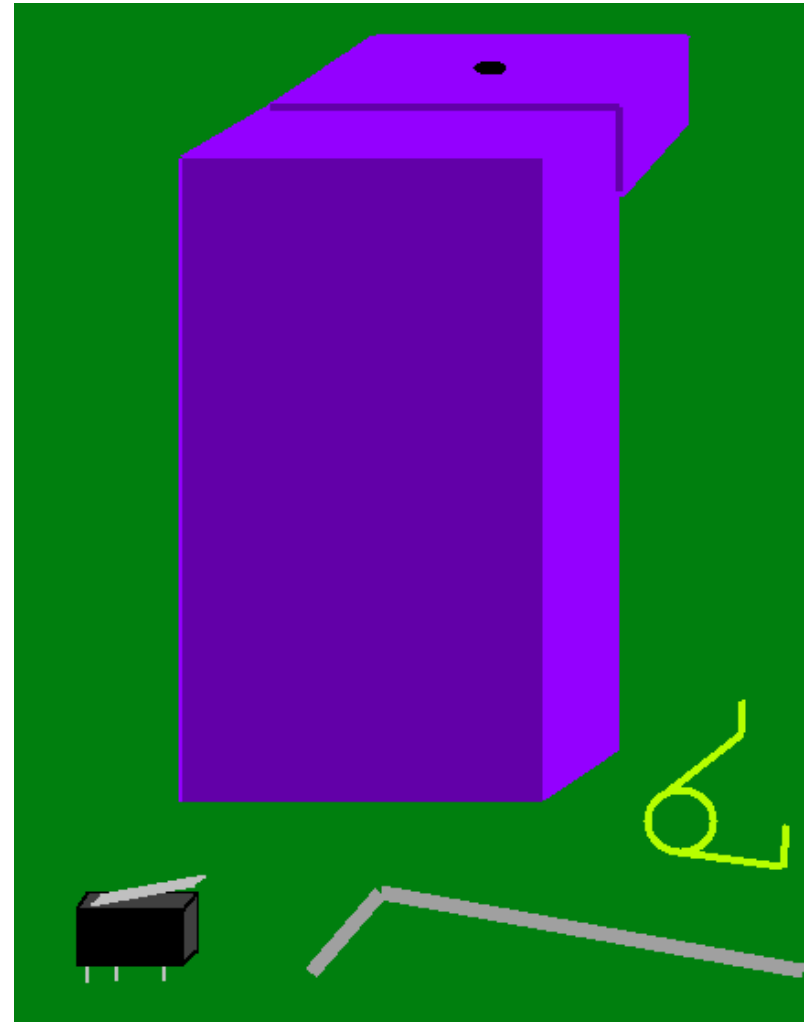



5th Criteria - Construction and materials

- Wood and Wire selected
- Metal and Plastic also good options
- Most modelers more familiar with woodworking
- Have basic tools and materials (saws, glue) for working wood

6th Criteria - Mounting

- Depends on (sub)roadbed materials
- Include mounting flange with screw hole





7th Criteria - Versatility

- Can machine be made to work in more than one way?
- Use push-pull or return spring actuation?
- Be mounted vertically or horizontally?
- Support different methods of powering frog?
- Allow adjustment before or after install?

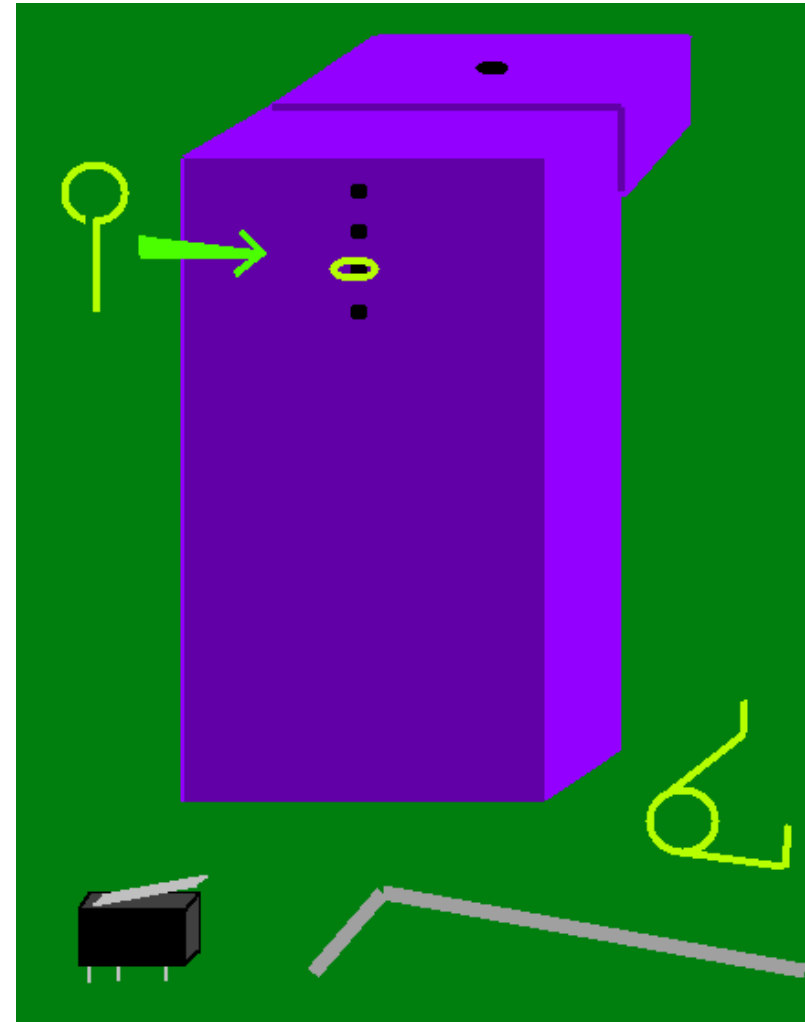


Selected Properties

- Under-table with no clearance issues
- Motion arm / throwing pin is 2nd class lever
- Push-pull operation
- Switch to power frog
- Made from wood and wire components
- Mounts vertically to (sub)roadbed

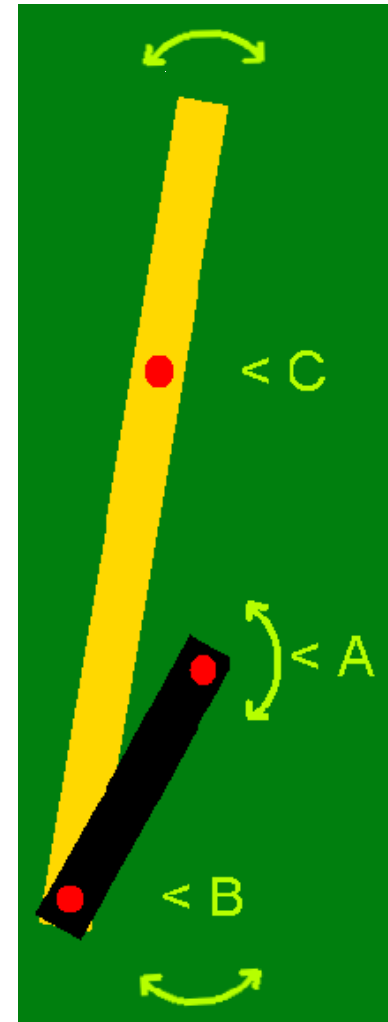
Base

- Mounting flange has to go on back, or it interferes with arm
- Single mounting point makes installation, adjustment easier
- Fulcrum for motion arm must be adjustable
- make fulcrum from small wire loop
- drill several holes in base near top to facilitate adjustment of fulcrum



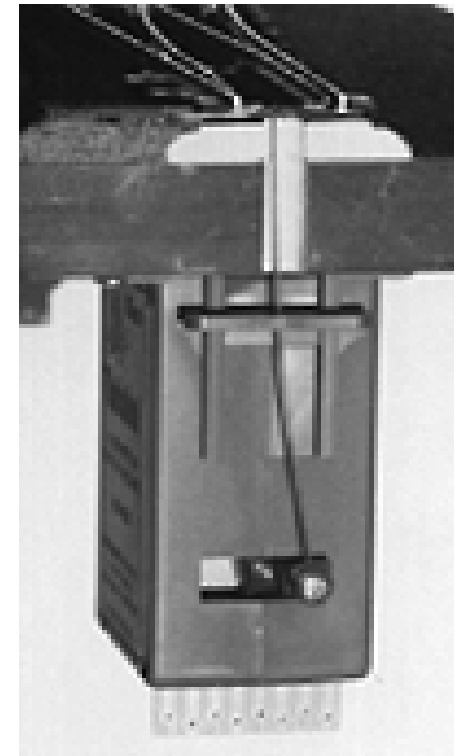
Levers

- Blue Point and Tortoise actually use two levers - actual throwing pin and shorter motion arm inside
- Motion arm will have fulcrum at high end
- connection for throwing pin near lower end



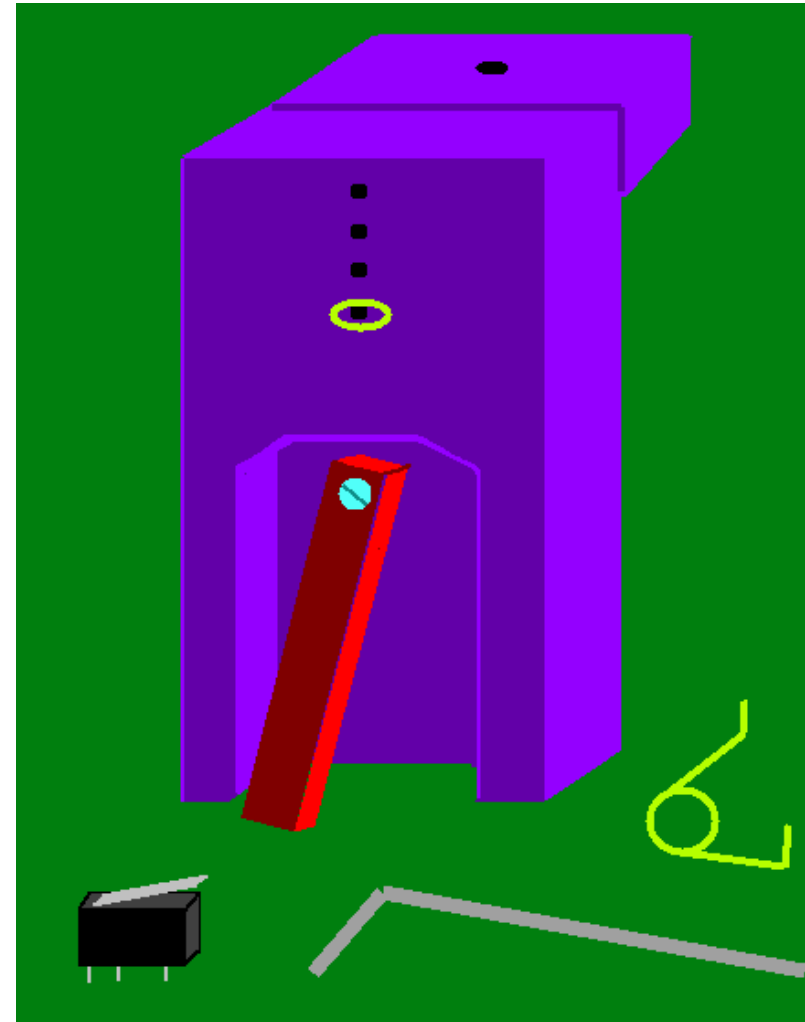
Levers

- Connection for pushrod at lower end and connection point for O-C spring near center
- Throwing pin will attach in hole with capture screw, like Tortoise
- Thread throw pin thru fulcrum loop



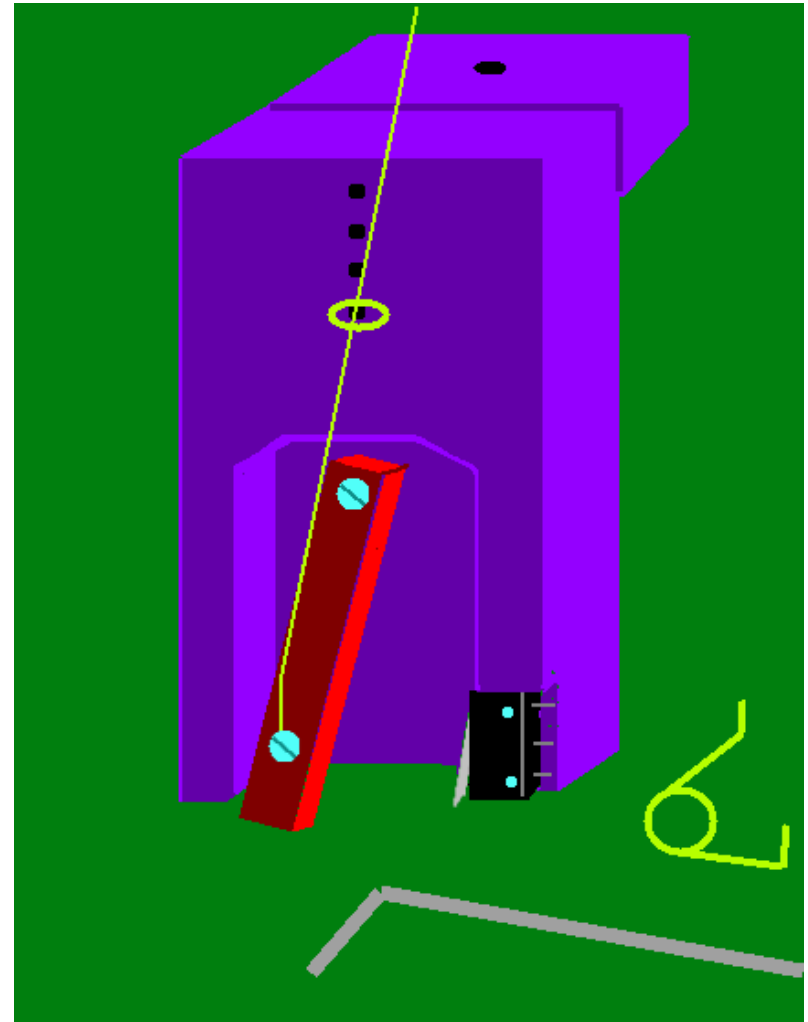
Design Process

- Problem - throwing arm mounts too high on base,
- needs to be recessed
- Redesign base to allow motion arm to be recessed into it
- Base can be built up from straight parts or milled with woodworking tools



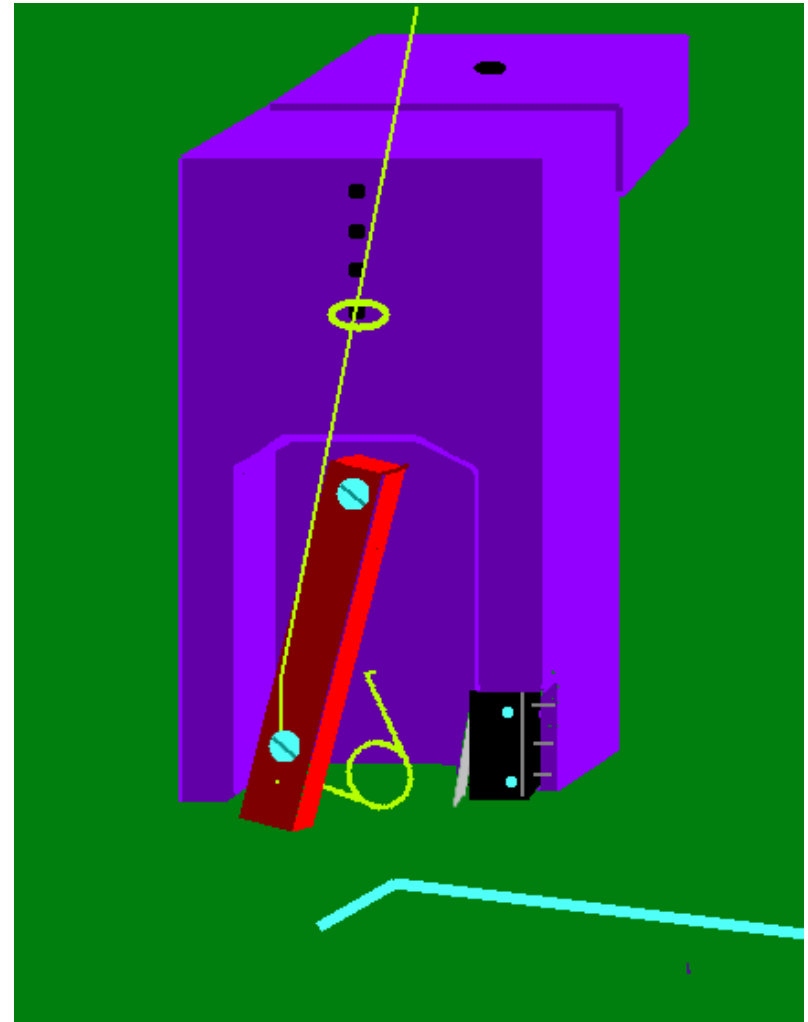
Design Process

- Recess give us a place to mount switch (lever) on one side,
- contacting motion arm - spring will ensure good contact
- Switch can be mounted either side, versatility plus



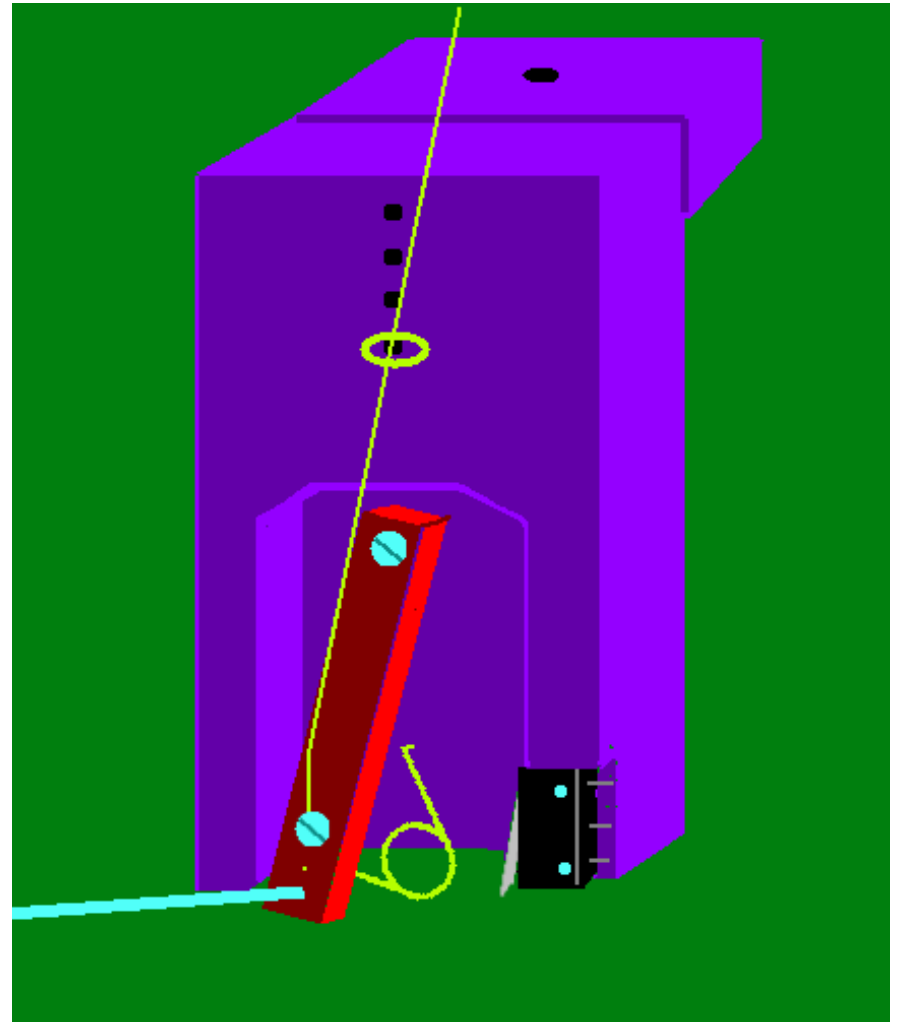
Design Process

- O-C spring mounts near bottom edge of base (centered)
- and on motion arm near end (centered)
- Farther mounted from fulcrum provides more spring travel, force
- Make several loops in spring, more even force for travel distance



Design Complete!

- Basic design of Blue Point clone is complete!
- Added versatility -
- Remount mounting flange, can be used horizontally as well
- need to include extra fulcrum at (sub) roadbed base but will work fine





Versatility

- Throw distance, point pressure, force req'd to throw all adjustable by making a few simple design changes
- YOU have complete control of parameters
- YOU choose how your machine works!
- Change size, components, forces for different scales, actuation styles
- Experimentation improves design



You take it from here

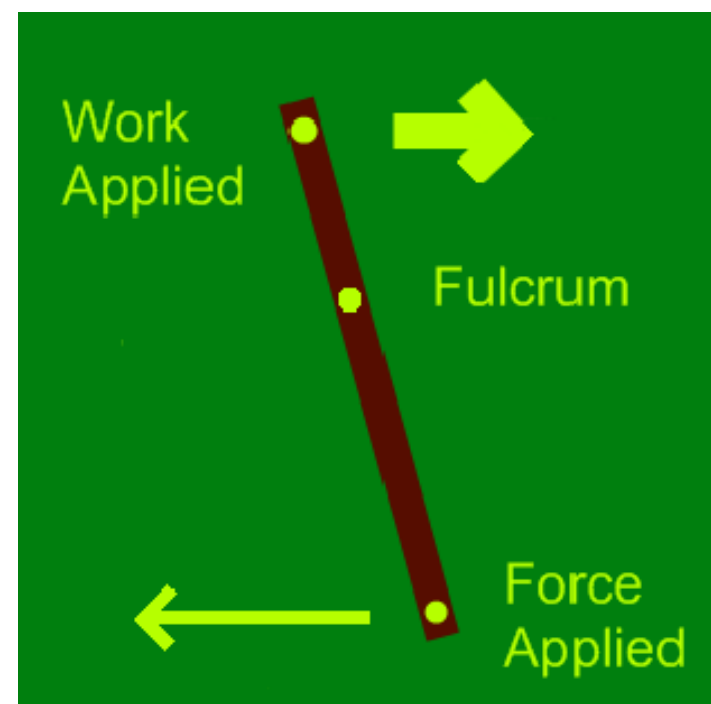
- This is not necessarily the ideal design
- may be good for selected criteria, others could be better!
- Could be tuned for your personal needs, variations
- Or a different design altogether

Other options to consider

- Control styles
- Direct connection pushrod
- fixed to machine, push-pull action
- Return spring on pushrod
- forces pushrod back towards disconnected device
- Tension spring and string or cable
- Pulls on string, connected to lever or knob
- spring pulls string back when actuator relaxed

Other options to consider

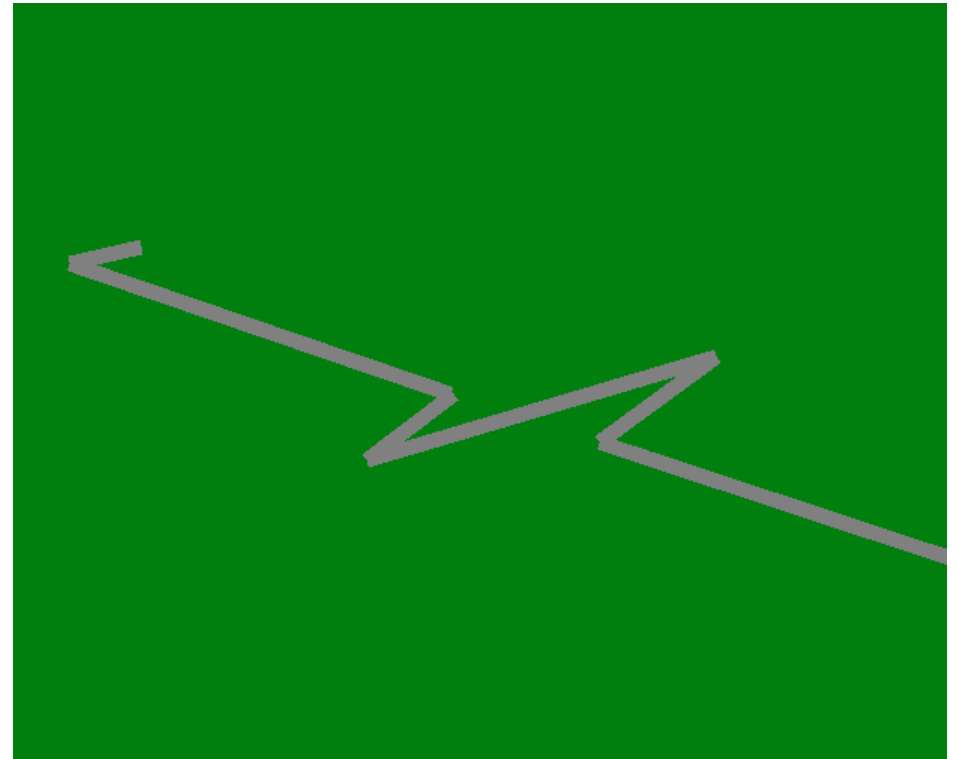
- Strengthen / weaken force - change fulcrum points of levers
- Inverse proportion - distance moved / force applied
- Better for shorter distance applications



Other options to consider

Pushrods

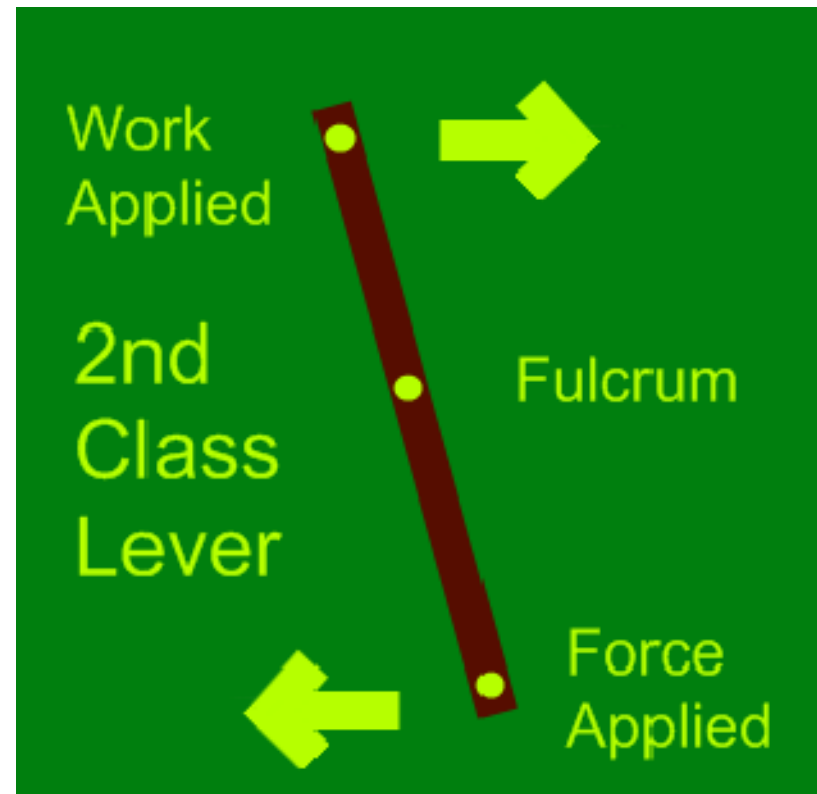
- Use sturdy wire or dowels for strength
- Support long runs at intervals
- Keep direction of motion consistent
- Include Z bend to ease forces on machine at end



Other options to consider

Bellcranks

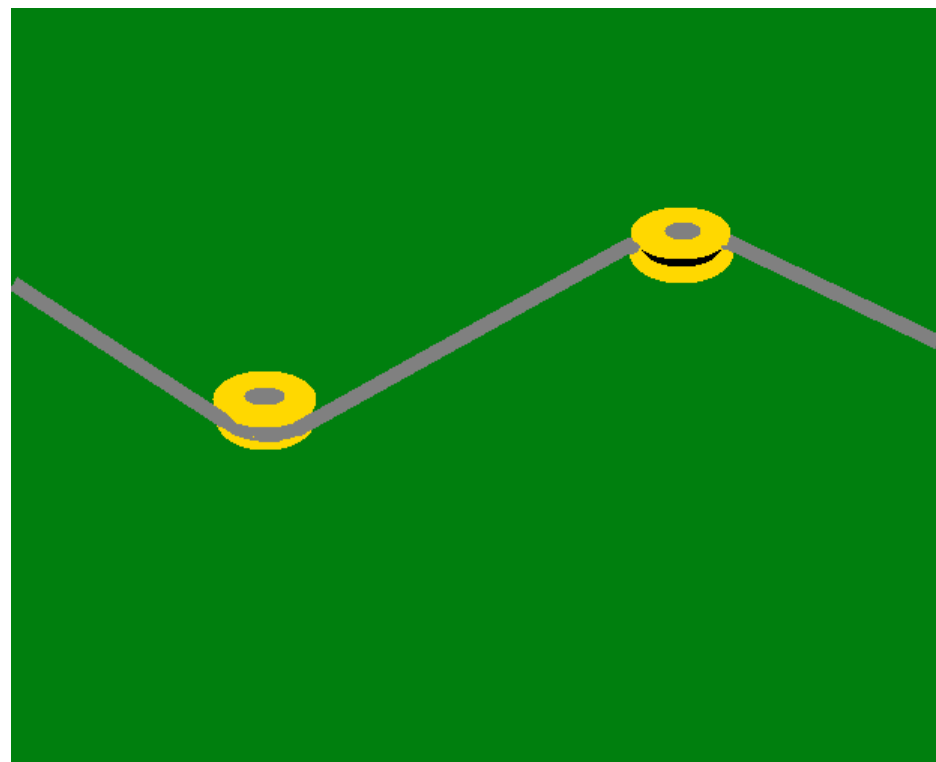
- Used with pushrods to change direction of force
- Straight bellcrank reverses direction
- Angled bellcrank redirects motion to side
- Fulcrum can be changed to increase / decrease force or travel
- Can be used to split effort between devices



Other options to consider

Linkages - Cables, strings

- Small pulleys ideal for changing direction of force
- Use block & tackle methods to change force
- (usually only works for changing long motion to short)
- Easier to change elevations, reach farther distances



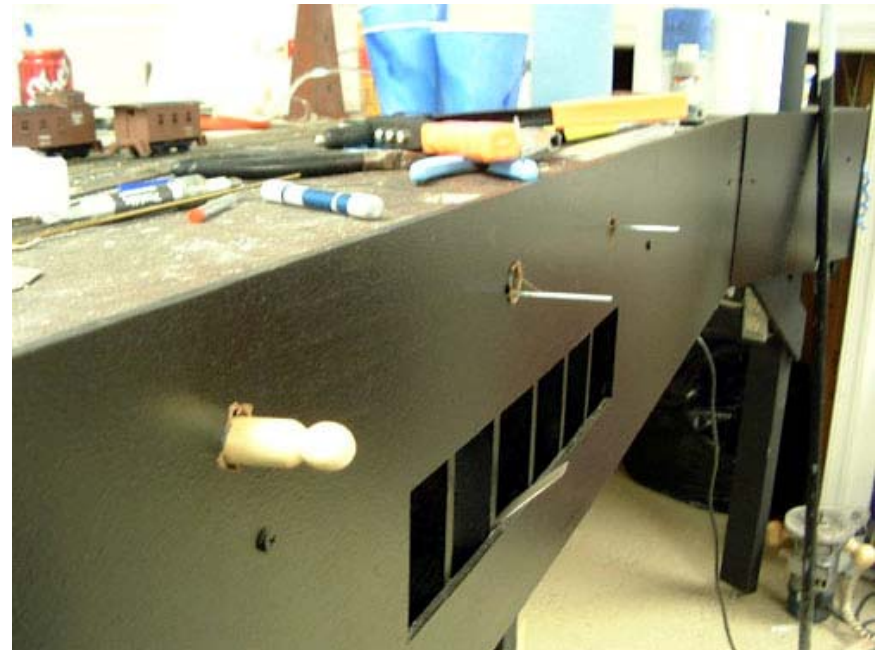
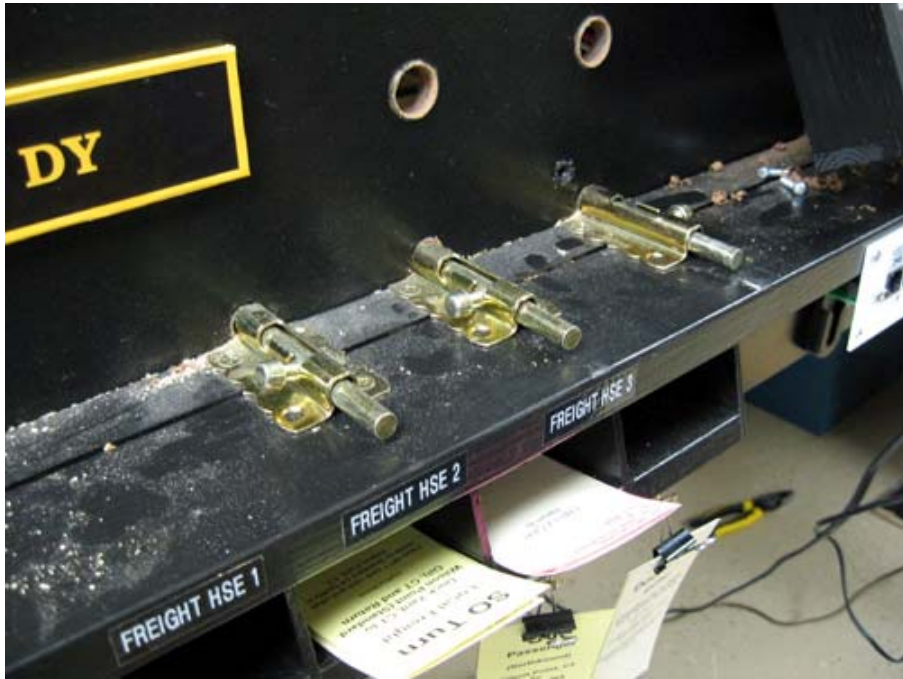


Controls

All kinds of options available to you

- Knobs and levers
- Hump Yard Purveyance
- Wood balls
- Clothespins
- You name it

Switch Controls



Switch Controls



Switch Controls





Open Floor

- What issues do you have with switch machines?
- How have you modified or innovated with design or installation of switch machines?
- What do you need a machine to do that isn't handled by commercial options?



The End

- Contact Information:
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Thank you for attending!